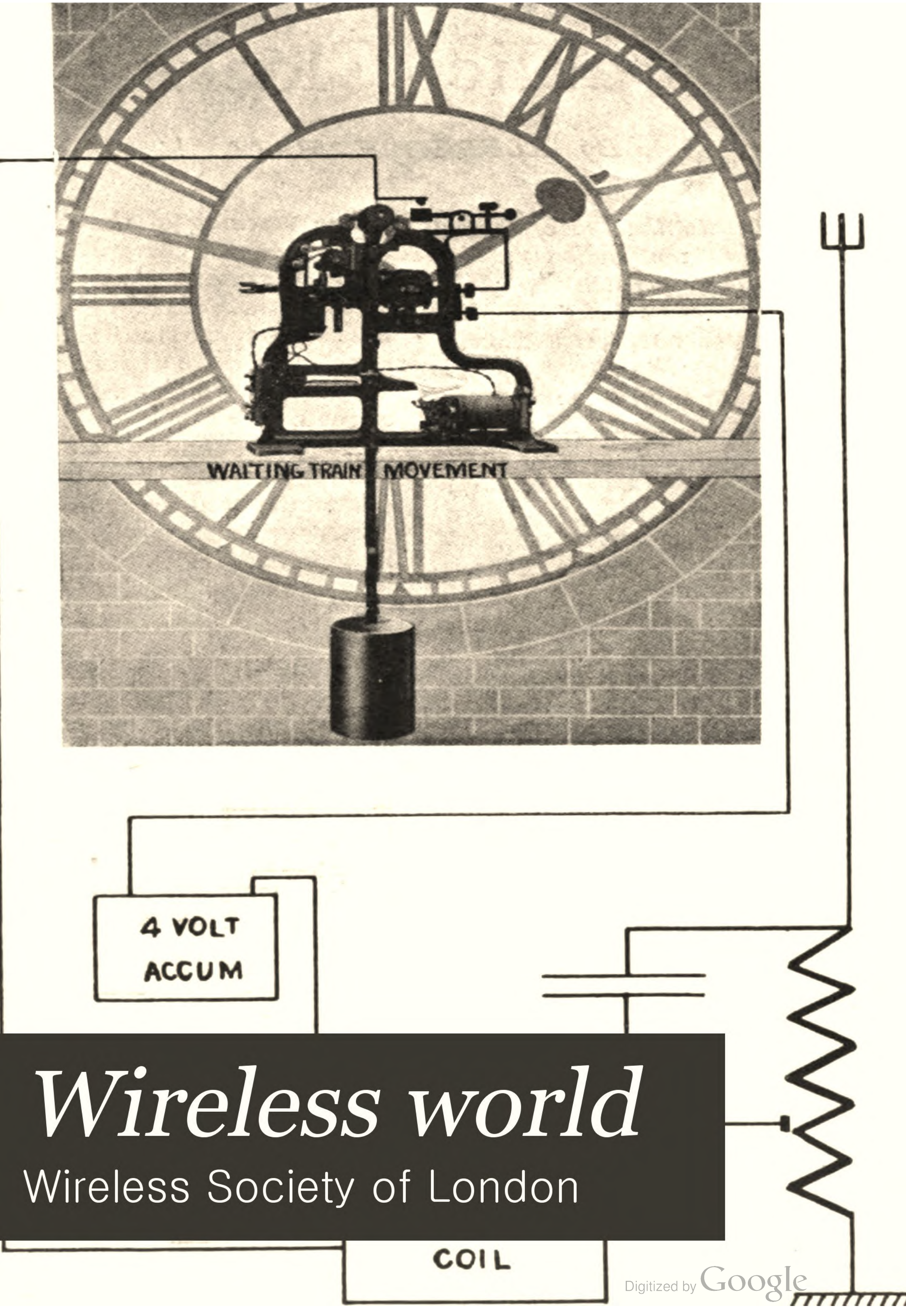
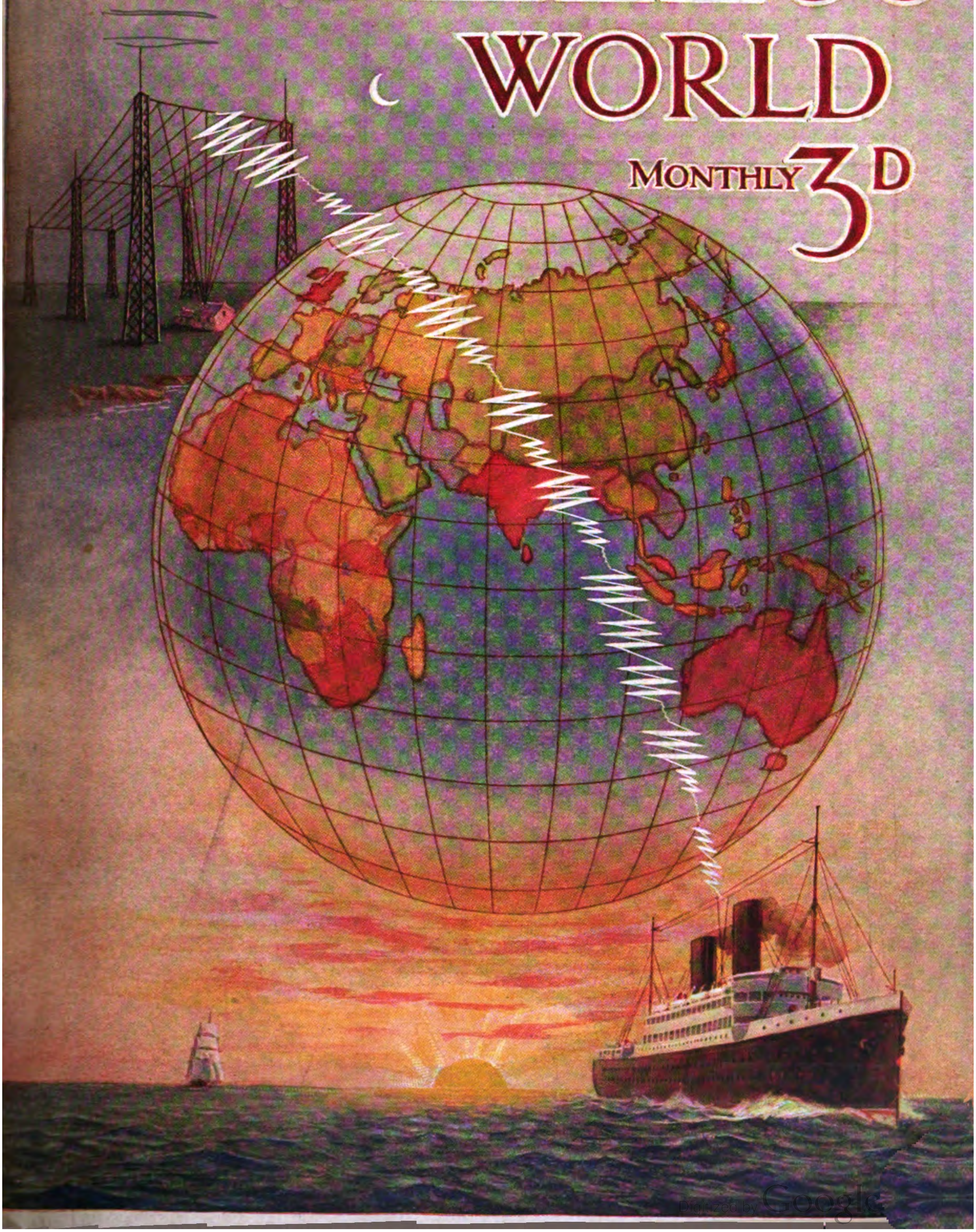
Wireless world

Wireless Society of London



WIRELESS WORLD

MONTHLY 3D



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THE WIRELESS WORLD

Vol. 3.—No. 25. (New Series) April, 1915. Subscription 5/0 per annum post free. Price 3d. Post Free 5d.

OUR NEW VOLUME

"We look before and after and sigh for what is not."

THE March issue finished our second volume, and to-day we start our third. The air is heavy with the thunderclouds of war, and our wireless messages are frequently "jammed" by the electrical storms of an atmosphere surcharged with the magnetic waves of military disturbances. But we take heart, and, attuning our receivers aright, we listen eagerly for the musical notes of the message we are all hoping to receive: the message of "Peace on earth; goodwill towards men."

We have had occasion frequently to remind our readers of the fact that wireless telegraphy has entered into almost every phase of the present war. Some of the points in connection therewith have appeared in our "Wireless Telegraphy in the War" pages, and we feel certain that they have proved of interest to our readers. We hope to continue these items, but we can assure our friends that when the muzzling orders, necessarily imposed under present conditions, are removed we shall have the opportunity of letting them know a great deal more than is now either desirable or possible.

Such an occasion as the present, when we thank old friends for past appreciation, and look forward to an ever-increasing circle of new ones, naturally lends itself to an admixture of apparently irreconcilable sentiments—those of regret and hope. The regret is for our past shortcomings, the hope for the better realisation of our good intentions. Amongst the former may be reckoned our failure to hold our intended examinations promised for May. Our announcement on page 52 with regard thereto will, however, show that our failure was due to circumstances beyond our control. The examinations will certainly be held, and the time of forced abstention from experimental work would be wisely used by prospective candidates for the study of theory, and preparation for the forthcoming test.

With regard to the future, our intention is not to make any violent changes, but to improve our magazine along its well-established lines, at the same time so selecting and enhancing the quality of our matter as to deserve the increased approbation for which we hope. The success of every performance depends as much upon the audience as upon the performers. Radiation and refraction must continue constantly at work between them if the result is to show improvement. All our readers can help us by friendly criticism, and we appeal to them to favour us with that help. We have to tender our very hearty thanks to many of the most eminent men in the wireless world for assistance freely bestowed in the past, and trust that we may hope to continue to receive it in the future.

Mr. W. DUDDELL, F.R.S.

Personalities in the Wireless World

W. DUDDELL, F.R.S.

ONCE only in the history of the Institution of Electrical Engineers has the much-coveted office of President been held by the same person for two consecutive years. This was in 1912–14, when Mr. Wm. Duddell, F.R.S., was unanimously invited to take and retain the lead.

Mr. Duddell, who was born in London in 1872, was originally trained as a mechanical engineer. Studying at the Central Technical College, London, under Professor Ayrton, and taking both the engineering and physics courses, he secured within three years a Whitworth Exhibition. In 1897 he obtained the Whitworth Scholarship, and following this distinction, returned to the Central College to resume the experimental work which he had previously started there. This research, based on certain phenomena associated with arc lamps, was largely inspired by Professor and Mrs. Ayrton and others who were engaged upon arc-lamp problems at the time. The particular line of investigation conducted by Mr. Duddell was, however, his own suggestion, and so excellent were the results that it was made the foundation of further highly productive research. The musical arc and the oscillograph, and other lesser-known instruments with which Mr. Duddell's name is associated were the result of this series of experiments.

The "Duddell" oscillograph is an instrument used for recording variations of electric currents and voltages when these variations are of relatively high frequency. It has proved of great value in generating stations, and is used widely by telephone companies in the investigation of sounds.

Mr. Duddell's interest in wireless transmission dates from the earliest days of his experimental work. He approached Sir John Gavey, and obtained facilities, first at Bushy Park and then across the Irish Channel, for determining the law connecting distance and the strength of received signals. This law has since been confirmed and extended by Dr. Austin, of the Imperial Standards Committee, over distances far greater than were at first available.

In 1904 Mr. Duddell was the honorary secretary to the delegates to the International Electrical Congress at St. Louis. In 1907 he was elected President of the Röntgen Society, and in 1908, Vice-President of the Physical Society. The same year he acted as one of the secretaries to the International Conference on Electrical Units and Standards.

In 1912 the Government recognised Mr. Duddell's position in the world of wireless by appointing him a member of the technical committee instituted to consider the question of long-distance wireless telegraphy. Their faith in his ability has since been demonstrated by his appointment as Consulting Engineer to the Post Office in connection with the Imperial wireless contract. It is interesting to know that Mr. Duddell holds the opinion that wireless has a greater scope than is at present appreciated. He believes it will create for itself an entirely new and extensive traffic.

Shortly before the outbreak of war (in April last to be precise) Mr. Duddell presided in Brussels over the International Commission to aid wireless research. The programme then drafted was much hindered by subsequent events, but great as may have been the disappointment experienced by the subject of our sketch, we feel certain that it was compensated for to some extent by the prominent part he was able to play, as President of the I.E.E., in raising conjointly with two other professional institutions a corps of engineers for the Royal Naval Division.

Mr. Duddell is yet young. His brilliant career to date suggests that he may play an important part in carrying Great Britain to an unquestioned first position in electrical science.

Resonance Phenomena in the Low Frequency Circuit

By H. E. HALLBORG.

PART I.

IT is the purpose of this paper to outline briefly the principal low frequency circuit characteristics common to all radio transmitters using alternators and transformers for charging the condensers of the radio frequency circuit. By low frequency we mean frequencies of the order of from 60 to 500 cycles as commonly used.

The transformer is one of the important units of all radio stations, except the arc or reflector alternator type. A practical study, therefore, of the phenomena occurring in the alternator transformer circuit cannot fail to be of interest to us all. In this circuit are to be found some of the most perplexing experiences of the experimenter and of the engineer. Strangely enough, many engineers who calculate freely decrements, coupling co-efficients, and other radio frequency circuit combinations entirely overlook the fact that the low frequency circuit combinations are equally numerous and their proportioning equally important. Possibly more cases of inefficiency in wireless transmitters generally are due to improper alternator transformer circuit adjustments than to any other one cause. To sum up briefly, in the wireless circuit resonance plays the master rôle, from generator slip-rings to aerial.

In attempting this paper the writer realises that the subject has had much mathematical treatment, and that many empirical expressions covering particular phases and conditions of circuits have been derived. Unfortunately, much of this work has been presented in a way not to appeal to the average engineer. It is the writer's hope to so cover the subject that it may have more practical application than heretofore. The expressions and circuit relations given are for the most part fundamentals, or easily derived. The methods of taking these resonance observations were devised by the writer, and the curves shown are nearly all actual graphs of measurements on circuits of various types and sizes.

Resonance readings in the alternator-transformer circuit can be obtained by several methods. Since we can readily make quantitative measurements of the variation of current and voltage, two methods immediately present themselves. The first is a method which we shall call the *primary ampère method*, and the second a method which we shall term the *secondary voltage method*.

The *primary ampère method* consists simply of plotting relations between current in the generator circuit, and step by step capacity loading in the high tension circuit. It is evident, since the circuit constants on the high and low tension sides of a transformer bear a definite relation to each other, that if the point of resonance in the primary circuit is determined the constants of the entire circuit may be closely calculated. The only equipment necessary for obtaining this data is an ammeter, a frequency meter, and a widely adjustable field rheostat. The connections for taking measurements by the *primary ampère method* are shown in Fig. 1.

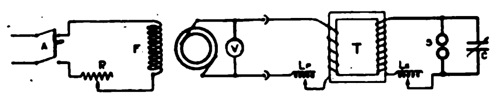


Fig. 1.

Here F represents the alternator field and R a resistance inserted in this field of such a value, determined by trial, that the primary ammeter A has less than full scale deflection when the point of resonance is reached. T represents the transformer, and L_p and L_s series connected primary and secondary inductances. These are not essential to making the measurements, but are shown to cover general conditions. C is the condenser which is to be varied in known steps.

A plot may be made between any of the variables, capacity, frequency, or ampères. The most practical method is to hold constant frequency, and to determine the relation between primary current and the capacity loading. When the exact value of C, at which maximum current obtains, is found, the value of the effective inductance of the secondary circuit is calculated by the well-known relation :

$$L_2 = \frac{10^6}{4\pi^2 f^2 C} \text{ Henrys.}$$

C is given in MF.

This value of L_2 is especially useful from the point of view of the designer, since the maximum secondary current value may be obtained from it by the relation :

$$I_2 = \frac{E}{2\pi f L_2}$$

E is the potential applied to the condensers determined by the usual power relation.

Several curves taken by the *primary ampère method* are subsequently shown. In making this measurement with a closed core transformer error may be introduced by the low magnetic density of the iron. Ordinarily this error is not large, since high-resistance silicon steel cores are now almost universally used. With open core transformers the error is negligible, since the saturation characteristic is a straight line. Slight error may also be introduced by low-saturation effect in the generator, but this has not been found to be appreciable.

The *secondary voltage method* consists of determining the relation between generator open circuit volts and the discharge voltage of a calibrated ball or sphere gap connected in parallel with the secondary condenser. The connections are somewhat similar to the primary method, and the apparatus required is no more elaborate. The connections are shown in Fig. 2.

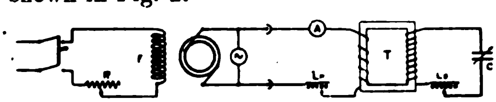


Fig. 2.

Here A represents the alternator field switch, and R an alternator field rheostat capable of varying its excitation through a wide range. V is a voltmeter connected to read the alternator open circuit volts, and S is a calibrated discharge gap adjusted to break down at a point which will not endanger the transformer insulation. C is the capacity load as before.

The process of taking readings consists of varying C by known steps, and finding the alternator excitation which just discharges S when field switch A is closed. The point of resonance is found by noting the condenser setting C which discharges S at the lowest alternator excitation. The order of resonance effect is found by dividing the known sparking voltage of S, which remains fixed, by the voltage, V, required to discharge it. A curve may be plotted from these values showing the secondary voltage obtainable for any applied constant primary voltage as the value of C is varied. While open to criticism due to transient effect, this method gives information regarding the secondary potential under conditions that make static voltmeters unavailable. Curves taken by this method are shown below.

By reference to the vector diagrams of the ideal transformer, as given in most textbooks, we obtain three important relations between primary capacity, inductance, and resistance, and their equivalent values when transferred to the secondary of the transformer. These relations are useful enough in conjunction with transformer resonance to be here stated. They are :

$$C_1 = (\text{Ratio}^2)\, C_2$$
$$L_2 = (\text{Ratio}^2)\, L_1$$
$$R_2 = (\text{Ratio}^2)\, R_1$$

Given a transformer ratio of, say, 10, these expressions may be interpreted as follows : The total capacity inserted in the primary to have the equivalent effect of a capacity C_2 inserted in the secondary is $100 \times C_2$. Similarly, an inductance L_1 inserted in the primary has an equivalent effect of $100 \times L_1$ inserted in the secondary. Likewise a resistance R_1 inserted in the primary has a secondary equivalent effect of $100 \times R_1$. The curves presented are evidence enough of the importance of these relations in connection with low-frequency resonance. The writer has made several predeterminations of resonance characteristics in fair agreement with later measurement by transferring circuit constants by this means. For the predetermination of primary current the fundamental formula was used—namely:

$$I = \frac{E}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}}$$

The values of ωL and $\frac{1}{\omega C}$, where L and C are the total circuit inductance and capacity respectively referred back to the primary by the relations above shown, were obtained on both sides of the resonance value and plotted. Similarly, the equivalent value of R was obtained. In finding an equivalent primary value of R in this formula a difficulty is experienced in determining a proper value of the total secondary resistance of the condenser circuit. This resistance is a function of the applied frequency, the number of condensers connected, and their manner of connection. Tests made at the Naval Radio-Telegraphic Laboratory in Washington indicate that this resistance for a single plate-glass condenser of 0·002 mf. is of the order of 50,000 ohms at 60 cycles. This figure agrees quite well with values obtained by the writer.

A most useful and practical method of getting at the low-frequency characteristics of a wireless set is by measurement of the per cent. reactance of the transformer, the alternator, and other circuit inductances. This method consists of observing the voltage drop at the terminals of each inductance in question — alternator, transformer, etc.—when rated full-load current is flowing. The per cent. reactance is the percentage voltage drop on each unit in terms of the rated voltage. For instance, if a 500-volt generator has a synchronous impedance of 10 ohms at normal frequency, and if the rated full-load current is 10 ampères, the impedance volts of the machine is 10 × 10, or 100 volts, and its per cent. reactance is 100/500, or 20 per cent. Similarly, two or more reactances connected in circuit are added arithmetically to obtain the *per cent. total circuit reactance*. This is the reactance value having direct bearing on the resonance characteristic. From it may be obtained the total primary inductance value, L_1, as well as the total secondary inductance value, L_2, as follows:

$$L_1 = \text{per cent. total circuit reactance} \times \frac{\text{normal primary volts}}{2\pi f \times \text{normal primary current.}}$$

$$L_2 = \text{per cent. total circuit reactance} \times \frac{\text{normal secondary volts}}{2\pi f \times \text{normal secondary current.}}$$

Having these inductance values, the capacity required for resonance is easily computed from the formula:

$$C = \frac{10^6}{4\pi^2 f^2 L} \text{ microfarads.}$$

The capacity value is usually fixed by considerations other than transformer resonance, and the problem is one of adjusting the circuits properly for the specified capacity values. A few experimentally determined facts tend to simplify this adjustment. Nearly all spark transmitters operate most efficiently when the natural frequency of the alternator-transformer circuit—*i.e.*, $F = \frac{1}{2\pi\sqrt{LC}}$—is lower than the impressed circuit frequency, f, of the alternator. The exact percentage difference between F and f varies with the type of spark gap used. The writer has found that a value of inductance 30 per cent. greater than the resonating value is a proper value for synchronous rotating gap types, and for quenched gaps a value 40 per cent. in excess of the value to give transformer-alternator resonance. The natural frequency of the circuit, therefore, must be 12 per cent. to 15 per cent. lower than the impressed frequency, f. In some cases it is necessary to detune to the extent of 20 per cent. or more; but wide detuning always results in loss of efficiency. In the case of quenched gaps the choice usually lies between a clear note with lower efficiency and a medium note with higher efficiency. The value of L for quenched spark sets, as above given as 40 per cent. over the resonance value, is a mean between the limits just mentioned.

The transformers for the American Marconi high-power stations were successfully adjusted by the methods above outlined. No condensers were required for test purposes, and the available test frequency was only 60 cycles, whereas the rated frequencies of the several equipments covered a wide range. All of these transformers are of the closed core, oil-cooled type. The aggregate capacity of 300 kw. per station is obtained by paralleling four 75-kw. units and supplying one spare unit. The complete breakdown of the transformer equipment is thereby made quite remote.

A transformer of the closed core type, with alternate primary and secondary windings, lends itself well to wide reactance variation. The design is not unlike the tub arc lighting transformer. The difference between the two lies in the fact that the flux leakage of the tub type is a function of the load, while the leakage of the wireless transformer is fixed, and made sufficient to suppress arcing and excess wattless current upon spark discharge. With this type the required leakage is obtained by proper separation of the primary and secondary coils. The exact amount of leakage in the transformer is apportioned as controlled by the total circuit inductance found necessary, and is high or low as the condition may be.

In the case of the transformers for the Marconi high-power stations it was necessary to adjust precisely the reactance of each unit to ensure proper division of the load when four units were operated normally in parallel. When similar adjustment of all the units for one station had been made, actual reactance readings on one unit were found to suffice, since the combined inductance value for normal operation could be obtained by dividing the single unit value by the number of units it was desired to operate in parallel. Actual measurement on four units in parallel checked this assumption exactly. The problem of reactance adjustment in a circuit consisting of alternator, several transformers in parallel, and a series of secondary loading coils is to determine the combined transformer inductance which, with the alternator and the secondary loading coils, gives a total secondary circuit inductance 30 per cent. in excess of the inductance calculated for resonance with the specified capacity.

(*Part II will be published in our May issue.*)

The Heavyside Layer

Some further Correspondence

THE correspondence on this subject, which we summarised on pages 763–764 of our March issue, is still being continued in the *Electrician*. Dr. Eccles replies to Mr. Murdoch in the following terms:

"It is asked why layers of ionised air, if present in the atmosphere, will sometimes reflect, at other times refract, electric waves, according to theory. The answer is that it is all a matter of gradient of ionisation. If the concentration of ions increases very slowly as distance from the earth increases, then there is a gradual bending of the rays, which is called 'refraction' for short; if, on the contrary, there are no ions at low levels, and then at some high level a rapid gradient of ionic concentration, the rays travel in straight lines till they meet the sharply-marked boundary of the ionised layer, when they experience the rather sudden downward bending which is called, for short, 'reflection.' The first phenomenon appears to occur in an atmosphere ionised by sunlight, the second at night, when the ionisation must be due to a different cause and is apparently permanent. Such evidence as geophysics afford for the existence of this permanent layer, which I have named the heaviside layer, has been collected and published by me already.

"In case an analogy may clear matters I may remind readers that the visibility of the sun or a star after it is really below the horizon is due to refraction in layers of air of varying density. On the other hand, the mirages formed by layers of air over tropical deserts are sometimes due to reflection at the sharply-marked interface between hot and cold air. Excellent examples of the refraction of electric waves have been adduced by Prof. Fleming in his recent Physical Society Paper, discussing the effects of the gradual diminution of the electric inductivity of the atmosphere with increase of height.

"Mr. J. E. Taylor, in amazing sentences, speaks of enormous atmospheric conductivities being assumed in discussions of the effect of atmospheric ionisation on the propagation of electric waves. Although air may be given as great a conductivity as sea water, such an extreme degree of ionisation is not demanded in the hypotheses which I have originated. In the 'Proceedings' of the Royal Society, June 5th, 1912, I have given formulæ for calculating the ionic concentrations demanded, and there are numerical examples in plain language. For instance, it is shown that the number of ions of molecular size required for bending the trajectories of electric waves of 6,000 metres length to the curvature of the earth is about 16,000 per cubic centimetre. This involves a conductivity about a million times smaller than that of sea water."

"Mr. W. H. F. Murdoch compliments Dr. Eccles on the letter quoted above and characterises it as a very good defence of the 'Heavyside' layer. He proceeds to discuss Dr. Eccles' letter as follows: 'He admits that the layer is not ionised by sunlight at night,' and that 'it must be due to a different cause,' as I pointed out by arithmetical calculation. It seems to me it is another case of a 'generalisation killed by fact,' and I doubt whether Lord Kelvin's twenty-one coefficients (*vide* Baltimore Lectures) could possibly fit the Maxwellian equations into the 'watertight compartments' now demanded by wireless telegraphists.

"However, the first step is to get rid of superfluous assumptions of which the Heaviside layer seems one. Dr. Marchant in last week's issue postulates another set of conditions in addition to it!

"With regard to Mr. Taylor's contention I do not agree, as Dr. Eccles has proved a high conductivity unnecessary. But some people seem to imagine the earth is surrounded by a concentric sphere having the conductivity of copper!

"Neither do I think too much attention should be paid to the views of Arrhenius and Schuster as to what is occurring in the upper atmosphere—nobody knows; and it is better to admit the fact than to pile one postulate on the top of another."

"Mr. J. E. Taylor expresses gratification at finding that Dr. Eccles supports his contention that there is no justification in fact for the assumption of a layer of heavily ionosed air having a conductivity at all comparable with that of sea water. He goes on to say 'If the whole atmosphere were electrically luminous day and night, conductivity of that order might be expected.' In view of the explanation he now gives I do not see the bearing of his remark (in your issue of January 22nd) as to the possibility of rarefied air under certain conditions possessing conductivity of the order of sea water. As to my amazing 'sentences,' I must urge that we live in amazing times.

"I have not, as yet, raised Dr. Eccles' own special theory as an issue; but it does not appeal strongly to me on account of the following considerations, among others:

"1. The conductivity necessary to produce the required refraction would, apparently, have a serious attenuating effect on the waves, due to absorption. This, it seems to me, is a similar problem to that of depth of penetration of waves of high frequency currents into conducting or semi-conducting media.

"2. Dr. Eccles' theory apparently involves recourse to the reflection hypothesis for the explanation of night ranges. It would be interesting to have his calculations as to the ratio of reflected to incident wave energy at the boundary of a layer of reasonably ionised (but non-luminous) air, even assuming the most abrupt transition possible at the boundary of the layer. I imagine the ratio would be almost a negligible quantity.

"3. What justification is there in fact for the assumption of anything but a gradual transition in degree of ionisation as height above the ground is increased?"

A CORRECTION

We have to call our readers' attention to the fact that in our March issue, page 784, in recording the death of General Thys, the date of his decease was printed as February 18th, instead of February 10th.

Digest of Wireless Literature

ABSTRACTS OF IMPORTANT ORIGINAL ARTICLES DEALING WITH WIRELESS TELEGRAPHY AND COMMUNICATIONS READ BEFORE SCIENTIFIC SOCIETIES.

RADIO FREQUENCY AMMETERS.

In the February, 1915, number of *Modern Mechanics* is an interesting article by Mr. A. S. Blatterman on the subject of Radio Frequency Ammeters.

In the article it is pointed out that successful high-frequency ammeters utilise the thermal effect of the current; the way in which the heat production is measured by expansion, calorimetric effect, resistance, or thermal E.M.F. does not affect the accuracy.

In a high-frequency circuit the current in the conductor is not constant throughout the circuit, since the electrostatic capacity between different parts of the circuit causes an appreciable part of the current to be shunted as a capacity current through the dielectric. Thus in an ammeter a capacity current will pass between the terminals to which the heating elements are connected, as a capacity current through the insulating material used, and similar currents may pass to the framework. When the active element of a hot-wire ammeter is shunted by another wire the readings of the instrument will change with the frequency. The self and mutual inductance of the parts, often supposed to be negligible, are the cause of most of the errors in commercial instruments.

Mr. Blatterman shows that for an ammeter to read correctly on all frequencies the shunt which is required when a single wire will not carry the current must always be made part of the instrument itself, and not external thereto. One method for doing so is as follows. A number of wires all of the same cross-section and resistance may be fixed to heavy terminal blocks, but only one of the wires takes part in the indications of the instrument. These wires must be fine to reduce the " skin effect " to a minimum.

A numerical example is worked out of the relative currents carried by a measuring wire of No. 30 gauge Therlo (an alloy of copper, manganese, and aluminium) and a shunt of No. 8 copper wire.

For a wave-length of 900 metres the ratios of current $\frac{I_m}{I_s} = \cdot553$

for 300 metres $\frac{I_m}{I_s} = \cdot2695$

and for direct current $\frac{I_m}{I_s} = \cdot000224$

from which it follows that the correction factor for the shunt is:

2·81 for 300 metres.
4·71 ,, 900 ,,
4460 ,, direct current.

An ammeter constructed on this principle must therefore be calibrated on the wave-length it is to be used for, and every change in wave-length requires a fresh calibration.

The indications of the instrument can be made to depend on the actual linear expansion of the measuring wire or on the sag produced by this expansion in a wire stretched between supports.

The expansion due to changes in temperature of the atmosphere must be compensated just as in ordinary hot-wire ammeters.

ATMOSPHERIC DISTURBANCES.

Mr. E. O. Walker writes a letter to the February 26th issue of the *Electrician*, on the subject of Radiotelegraphy and Atmospheric Disturbances, prompted by Professor Marchant's recent interesting paper fully reported in our March number, on pages 748–754. He says that " the strongest disturbances noticeable when a telephone is used as the receiver are characterised at the commencement by a sound like that of a distant waterfall, and this is followed by a succession of splutters or small explosions. The most potent effects are produced when snow is falling. Strong disturbances have been observed in a yellow fog in London; and when the air is still there is not absolute freedom from interference. On a bright morning, when the sky is clear and the sun shining, disturbances of a similar character have been noticed from sunrise for three hours before rain fell, the wind being south-west. It would appear in this last case as if a mass of electrically-charged vapour drifted for many miles in front of the approaching rainstorm. But it is not only that a south-west wind occasions this phenomenon, but in a minor degree it is observable when the wind is coming from any other quarter. Again, when rain is actually falling the electrical discharges are present more often than not. The early morning before sunrise is a quiet time, but from sunrise to 11 o'clock at night there is little actual freedom from interference. Within the limits of observation it may perhaps be said that from 9 a.m. to 10 a.m. and 8 p.m. to 9 p.m. are the least disturbed hours of an otherwise 'splutter-full' day." He concludes his observation with the statement that, in order to rule out the class of disturbances referred to, it is necessary to provide a certain margin of power for transmission, and a certain coarseness for receipt of signals.

INSTITUTION OF ELECTRICAL ENGINEERS.

The following is an abstract of the discussion on the "Applications of Electrical Engineering to Warfare," which took place in the Students' Section of the Institution of Electrical Engineers on March 3rd, as announced in our last number.

Section (*a*), "Communications," was opened by Mr. P. R. Coursey: Communications are the nerves of an army, while rapidity is an essential element of modern warfare. Fire and flashlight signalling has long ceased to be utilised as a means of official communication, and the applications of electrical engineering have enabled great strides to be made towards the ideals of speed and secrecy. The Boer War furnishes us with the first example of the use of the electric telegraph for military purposes, although it had not then the reliability that is now regarded as essential. The heliograph was also largely used in that war and foreshadowed the uses of wireless for war purposes, especially for such a type of campaign. In the Russo-Japanese War we find the telegraph and also the telephone fulfilling very important functions, while the same war has also a further interest as being the first time when wireless telegraphy, as we now know it, took a part in any communications. In the present war electrical means of communication are naturally being employed to an enormous extent by all the nations involved. Five main types of electrical apparatus for communication purposes are being employed by the conflicting armies: (*a*) wireless telegraph; (*b*) Wheatstone automatic telegraph; (*c*) Morse sounders; (*d*) vibrator telegraph; (*e*) field telephone; the last two being generally combined into one apparatus.

Mr. Coursey then continued with brief descriptions and illustrations of the most general types of military apparatus, and compared their uses and relative advantages.

Mr. Smith-Rose referred to the difficulties of reception of wireless messages on aeroplanes on account of the noise of the engine, and asked for details of means employed to minimise interference from this cause.

Mr. Emtage suggested that it might be possible to detect the approach of Zeppelins and submarines by picking up their ignition sparks by wireless receivers, and also described the pneumatic headpiece "shock-absorbers" worn by airmen, which at the same time serves to deaden the noises due to the engine and facilitated wireless reception.

Mr. Killingback asked how the wireless aerials were arranged on submarines.

Mr. Wellings referred to the possibility of the "tapping" of messages by spies, and asked for information as to which means of communication it was easiest to "tap."

Mr. Rashis enquired as to the working of the various systems employed and the differences between them.

Mr. Heslop spoke about the relative weights of different forms of masts for aerials, and the times required for erection.

The Chairman (Mr. Duddell) contrasted the modern means of communication with those employed in wars a hundred years ago and more, and referred to the old semaphores used for communications overland, and to the introduction of the electric telegraph.

Mr. Coursey replied to the various points raised in the discussion.

Section (*b*), "The Firing of Mines and Explosives," was opened by Mr. S. Killingback, who said that the advantages of electrical means for firing mines may be briefly summarised as: (*a*) convenience; (*b*) greater reliability; (*c*) remote control; (*d*) simultaneous firing of several charges. Mines and explosives may be fired either by accumulators or by the portable hand operated service dynamo. The standard types of electric fuses and detonators require a current of about 0·8 amp. for fusing.

In the discussion which followed Mr. Emtage asked why platinum-iridium wires were employed in the standard service fuses, and also expressed an opinion that Tri-nitro-toluene was superseding guncotton and gunpowder in the fuses.

Mr. Heslop referred to the fact that electrical firing of mines was not employed in the Russo-Japanese War, and that the chief field for electrical firing of mines was for harbour protection, as reliable connections and cables could then be laid. The ordinary time fuses are generally satisfactory in other cases.

The Chairman (Mr. Duddell) referred to the exploder captured from the Boers (which was of German make even at that time) that was now preserved in the Institution Library.

Mr. Killingback made a short reply to the chief points raised in the discussion.

KEITH LECTURES.

The fourth and concluding lecture of the series of Keith Lectures, under the auspices of the Royal Scottish Society of Arts, was delivered on February 22nd in the Society's Hall, 117 George Street, Edinburgh, by Mr. J. Erskine-Murray, D.Sc., F.R.S.E., M.I.E.E. The subject of the lectures was "Electric waves and the principles of wireless telegraphy and telephony." Mr. James R. Milne, vice-president, presided over a large attendance.

Dr. Erskine-Murray, in his concluding lecture of the course, gave an explanation of the way in which signals were received, and a description of the methods of wireless telephony. In regard to the former, the lecturer remarked that as the difference between wire and wireless telegraphy consisted in the use of high frequency alternating currents in place of unidirectional currents, the reception of signals necessarily involved the conv rsion of these into slower electrical motions, such as might be either recorded by some type of galvanometer or rendered audible in the telephone. In certain cases, such as the steering of torpedoes or the control of beacon lights, the motions required were even slower than those of telegraphy. In the case of the Roseneath beacon of the Northern Lights Commissioners, the resonance of two pendulums had been introduced in order that the lighting up of the beacon might depend only on the proper signals, and might not occur by accident through the arrival of an ordinary ship's message. It was shown that the discovery of the coherer by Lodge and Branly had rendered wireless telegraphy practicable owing to the fact that the high frequency current received, though of extremely short duration, left a semi-permanent record of its passage in the reduction of the resistance of the coherer, a record which lasted sufficiently long for a local battery current to actuate a recorder. The methods of action of modern detectors, including the magnetic, the crystalline, the tone wheel, and the heterodyne, were explained in detail. Descriptions were also given of the various types of relays and magnifiers which were used in conjunction with detectors for the making of permanent records of wireless signals. The lecturer then turned to the subject of wireless telephony, showing how the radiated current must in this case correspond exactly in its variations of strength to the waves of air pressure constituting the sound which it was desired to transmit. It was necessary, therefore, that the alternate current radiated must be continuous, and that the control must be a gradual one, and not merely a complete make and break as in telegraphy. To attain this a variable contact, whose resistance varied in proportion to the pressure between the electrodes, was used, such an instrument being called a microphone. It was known that the microphone might either be connected in series with the aerial wire, thus varying the actual high frequency current, and, therefore, the power radiated, or might be put in the supply circuit to the arc or in the exciting circuit of the high frequency dynamo, if one were used. Other methods suitable to short distance transmission were described, and it was mentioned that the greatest distance over which speech had so far been transmitted without wires was between Italy and Tripoli—that was to say, about 600 miles. Experimental demonstrations showing the forms of the sound waves constituting different vowels and consonants, and a method by which the voice might be made to control the current in an arc, were given. In conclusion, the lecturer indicated various directions in which the energy of electric waves might be applied other than to the transmission of intelligence.

The Chairman, in proposing a vote of thanks at the conclusion, said the lecturer was one of the pioneers in connection with wireless telegraphy. His lectures had been not only full and comprehensive, but also authoritative, in that he had the happy art of wearing his learning lightly and of explaining the very difficult and recondite parts of the subject by means of simple and convincing experiments. (Applause). In the name of the Society, he tendered Dr. Erskine-Murray a hearty and appreciable vote of thanks for his brilliant course of lectures. (Applause.)

BIRMINGHAM UNIVERSITY.

Dr. Wall, a distinguished member of the professional staff at Birmingham University, lectured for nearly two hours to an interested, enthusiastic, and appreciative audience at the Technical School on Tuesday, March 9th. As a matter of fact, the Government's ban on wireless installations robbed the proceedings of some of its interest from a spectacular point of view, but what was lacking in the matter of demonstrations was compensated for in the wealth of information which the lecturer was able to impart. Mr. E. A. Allcut, M.Sc., presided, and spoke appreciatingly of Dr. Wall's kindness.

The lecturer outlined the history of signalling and incidentally referred to the use of the heliograph during the South African War; as early as the eleventh century there was a system of heliograph. He showed how electric waves were intimately connected with light. Of the complicated and advanced subject, Dr. Wall had much to say of the work of Marconi and of Sir Oliver Lodge. Of the latter's experiments in receiving apparatus he demonstrated that the message was received in the form of a musical note which was exceedingly easy to detect, and easy to tell when a signal was coming from any particular station.

The installations on board ship were described and the way in which the signal was given, by the significant "click" that a message was being sent. This development of the Marconi system was shown to be one of the most romantic incidents in modern history. The station giving communication between Clifden and the United States and the station at Poldhu in Cornwall were referred to. In 1896 Marconi patented the horizontal aerial; the importance of that was explained by the fact that messages could be sent in a given direction with greater success. The earth contact for one of the aerial wires proved to be an immense advantage in signalling over long distances, but the reason was not yet capable of explanation.

The Chairman referred to several important points in the lecture. For instance, the connection between light and the electric wave was of interest to all. The secret of cold light had not yet been penetrated. When they thought of the millions of tons of coal that were wasted in producing heat which was not wanted in connection with lighting they saw the importance of the subject. Speaking of the mechanical appliances which the lecturer had used in the demonstrations, he said that many of the experiments made in the laboratories had been laughed at by so-called practical men who had regarded them as playthings for scientists. But it seemed that a very large part of the science—the practical science—of wireless telegraphy had been built up on the use of "scientific toys."

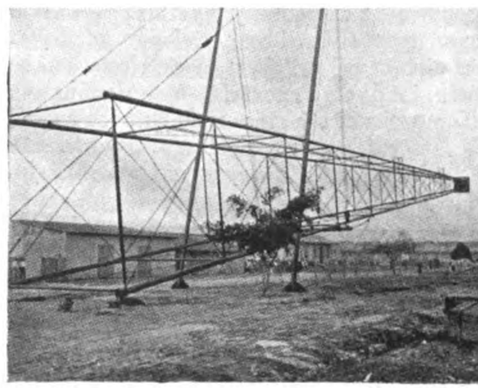
Mr. Guest proposed the vote of thanks to Dr. Wall. He said how indebted all must be for the knowledge gained from such an interesting lecture.—Mr. Adams, seconding, said that reference had been made to the horizontal aerial.

Dr. Wall mentioned that scientific experiments had been impossible because the Government had commandeered the University installation. There was no question of getting permission; there was no apparatus to be had. Further, it was inadvisable to make experiments at this juncture. Having replied to a number of points raised, he said that it was a pleasurable duty to have done something to interest students in the wonders of wireless telegraphy.

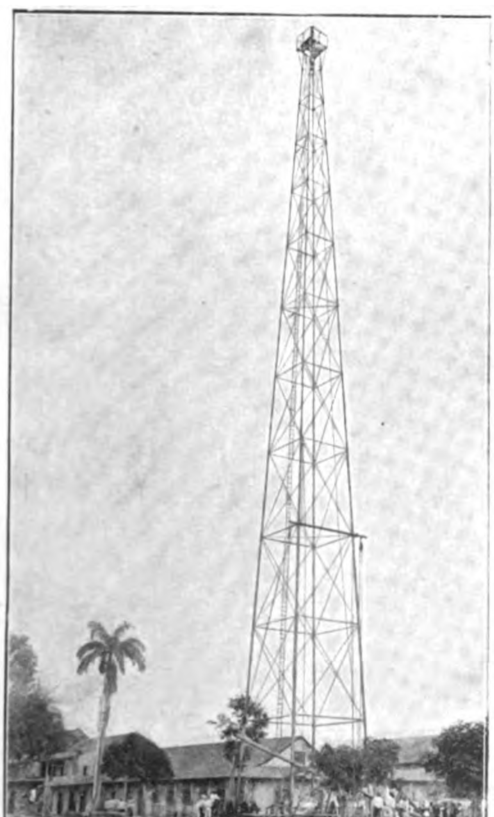
Trinidad Station

A Description and the Official Report of Successful Working.

THE Colonial Office Report No. 819 Trinidad and Tobago, which constitutes the latest report issued for these British Colonies, makes the gratifying statement that the new 5-kw Marconi Wireless Station at Port of Spain, established some little time ago, has been, since its installation, in continuous working, and "has proved to be very satisfactory." Communication has been frequently held at night up to a range of 1,500 miles, while during the day it is always possible to communicate with the Curacao Station, some 500 miles to the west. Another station has been erected at Toco (near Pointe Galera) on the north-east coast, which will enable earlier information of the movements of shipping to be communicated to Port of Spain.



Aerial in course of erection.



Trinidad Aerial.

The installation possesses a guaranteed daylight range of 350 nautical miles, which is largely exceeded under favourable conditions. During the night the wave-length is 600 m. to 2,000 m., the aerial being of the standard T type. The towers are 200 feet high and 550 feet apart. The alternator for the wireless installation is driven by a direct current motor which takes its supply from a Tudor battery, this latter being charged from a dynamo driven by a Gardner oil engine. Mr. A. G. Bell, Director of Public Works at Port of Spain, superintended the erection of the towers and the wireless plant. The towers, as will be observed from our illustrations, belong to the tubular type, in which the contractors (Messrs. Stewarts & Lloyds) make a speciality. It may be interesting to note that the second tower was erected in the extraordinarily short space of two hours. One of the advantages of this design consists in its being possible to build these tubular structures in long unsupported lengths, thus reducing to a minimum the number of parts, and simplifying the process of erection. Our second figure will show that its great strength renders possible the putting together of the structure horizontally. Subsequently it can be raised to the vertical position by means of long tubular derricks and winches. It is not usual to fit with guy ropes towers of this construction less than 200 feet high. Where this height is exceeded some slight modifications are introduced, which enable suitable arrangement to be made for this method of support. The island of Trinidad occupies a highly important position amongst the Caribbean Colonies of Great Britain, standing as it does close to the main land of Venezuela, and dominating the mouths of the great river Orinoco as well safest strategical entrance to the ean Sea for the ships of Great Britain. The climate is one of the most tropical of the British West India Islands. The vegetation, fertilised in highly nutritious soil, furnished with an ample supply of moisture, and growing under a hot sun, is characterised by gorgeous luxuriance. Next to Jamaica, Trinidad ranks as the largest British island in this part of the world. Its exports are already considerable, and yearly increase in volume and value; the increase, for instance, of 1913 over 1912 (the latest statistics available) amounted to £1,019,131. Port of Spain, the capital of the Island, stands on the site of an old Indian village about two miles from the mouth of the Caroni River, and contains a population of about 55.000. Our illustrations will serve to give some idea of the nature of the scenery in this favoured climate. The prints depicting the masts during erection and in their final position we owe to the courtesy of the *Electrician* and to that of Messrs. Stewarts & Lloyds.

A Corner of the Botanical Gardens, Trinidad.

Proposed Wireless Control of Public Clocks

By ALFRED E. BALL.

WE are indebted to the "Horological Journal" for the following interesting paper, written by Mr. Alfred E. Ball, which we reprint in full. The article deals with the novel suggestion of using "wireless" for regulating public clocks, and we feel sure that it will appeal to many of our readers, some of whom may have turned their own thoughts in this direction, and may like to give us their views on the subject.

Radiographic waves have proved of great service to the science and practice of horology in the distribution of time over extensive areas, its most striking service in this direction being perhaps the exact determination of longitude of observatories and equivalent land stations.

Radiographic waves will doubtless, in course of time, be pressed into the service of the horologist in many ways, and one of the most useful forms will, in the writer's opinion, be the wireless control, or rather supervision, of public clocks. The synchronisation of public clocks is a question we have always before us. The writer proposes and advocates, as a solution of the question, a system of wireless supervision.

The scheme advocated, and which has been put to a practical test by the writer, consists briefly in fitting each of the main public clocks of a town with a small wireless transmitting set, which would be operated periodically by the clock at definite times, and the installing of an official wireless receiving station at which the various clocks would be checked daily. By means of this system each public clock would report its time-keeping, and on any clock having an error greater than a certain small predetermined value, steps should be taken at once to have it corrected.

The working of the scheme would be as follows :—

It is assumed that it is desired to place eight of the principal clocks of a town under wireless supervision, and these clocks have been fitted with the automatic transmitting apparatus which will be hereinafter described.

At the sound of an "Attention" bell (arranged to ring shortly before 10 a.m.) the person deputed to "listen in" at the wireless receiving station, which we will assume is installed at the Town Hall, takes his place at the receiving instrument, and takes the

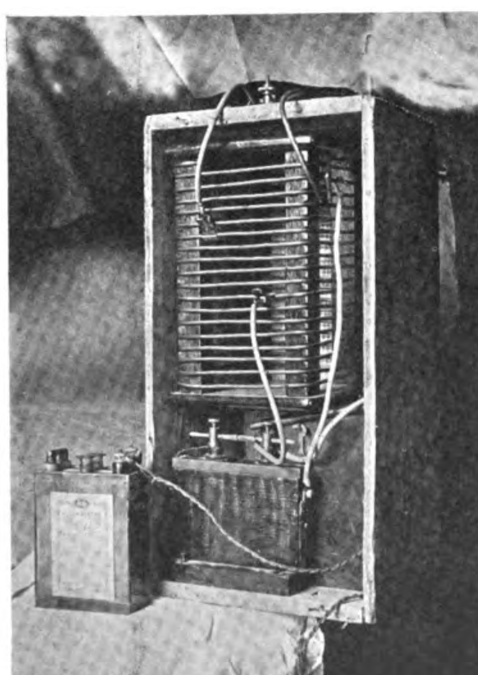


Fig. 1.

10 o'clock Paris time signal, from which he checks a standard clock, which should be provided with a seconds hand. instrument to a position suitable for the reception of a 50 metre wave-length which would be marked on the coil, and he then

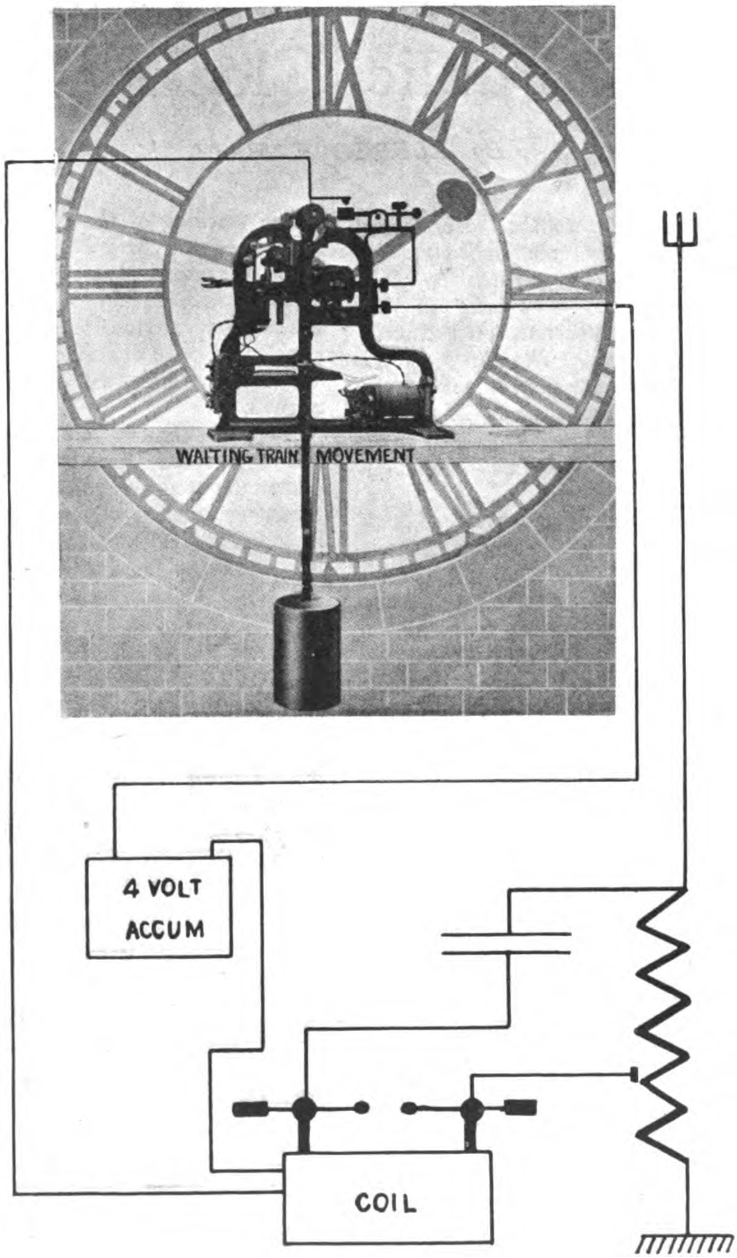


Fig. 2.

The error of the standard clock is duly noted in the "clock rate book." He then moves the tuning slides of his receiving "listens in" for clock No. 1, which has been arranged to send its signal at 10.1 a.m. As soon as he has moved his slides to the required position, he hears clock No. 1 sending a series of short "buzzes" which continue for approximately a whole minute, and terminate precisely when No. 1 clock shows 10 hours 1 minute a.m. By keeping his eye on the seconds hand of his Standard clock while listening, he is able to note the error of clock No. 1 to a second, and this error is duly noted in the rate book in a space provided against the number of the clock.

No. 2 clock does not commence sending its signal until 10 hours 1 minute 40 seconds. The longer time has been given to clock No. 1 to give the operator ample time to tune in sharply and so get good signals. At 10 hours 2 minutes by No. 2 clock it signals its time by its last "buzz," and its error is also noted in the rate book.

No. 3 clock is next listened for, and so on, with the remaining five clocks, the entire process occupying eight minutes, or, including the taking of the Paris time-signal, eleven minutes.

Means would be provided to enable the different clocks to be identified. The intervals of 40 seconds between the signals should be sufficient to prevent overlapping, as no public clock should have such an error. The signals would be repeated by the clocks again at 11.1 a.m., so that the times may be confirmed if desired, and could be repeated again at say 3 p.m., so that supervision may be exercised twice daily.

It is usual to associate "matters wireless" with tall and unsightly aerials and with expensive instruments requiring considerable electrical power where "sending" or transmitting is concerned. The writer has proved that, for the purpose in view, the aerial may be quite unobtrusive, the apparatus simple and inexpensive and the power small.

Fig. 1 is a photograph of the transmitting apparatus employed by the writer. This is a simple affair, and is contained in a box measuring 1 ft. 8 in. by 1 ft. by 8 in., and is operated by a small 4 volt ignition accumulator which would last one month or longer with one charge.

Each turret clock to be supervised would require the following :—

(*a*) A transmitting apparatus as shown in Fig 1.

(*b*) Contacts fitted to the clock movement to *break* contact at a certain definite prearranged time.

(*c*) An aerial which may be of an unobtrusive pattern.

(*d*) An "earth" connection, which may be the lightning conductor or a water pipe.

The connections of the apparatus to the contacts mentioned and to the aerial and "earth" are shown diagrammatically in Fig. 2, and, incidentally, the movement shown is an electric "waiting-train" movement, now largely used for turret clocks, and of which the writer is co-patentee with the makers—Gent & Co., Ltd., of Leicester. In this figure the aerial is represented by the usual "pitchfork-like" device, but in practice need only be a single wire. The aerial used by the writer in his experiments passed into the tower between the louvres at one end, and was secured to an insulator *inside* the tower, while at the other end an ebonite block was used, with the result that no insulators were visible to attract attention to the wire, and it passed unnoticed up to the time of its removal on the outbreak of the war. The length of the aerial was 40 ft. approximately.

The separate "buzzes" are obtained by means of a contact operated by the pendulum at each swing, and the sudden cessation of the "buzzes" is produced by a contact in series therewith, which is broken by a small lever falling off a cam fixed to, say, the centre wheel. In the case of a "waiting-train" movement, the spring which makes contact with the pendulum may be a fixed one, and may contact idly when not in operation, because the "interference" could not affect the timekeeping, but in the case of a mechanical movement this spring may be lifted out of the way by a cam when not in use, or brought into action by an electromagnet only when required.

In the case of striking turret clocks the lifting cams (or pins), or the lifting lever, could be utilised for making the necessary contacts, the last "buzz" in this instance indicating the last blow of the hour struck.

In addition to other means the clock would be recognised by its rate of striking. In checking the time of such clocks from the last blow, allowance would be made for its striking rate, thus if the intervals were 3 seconds, the clocks' actual time would be 27 seconds in advance of the last "buzz."

This method of "contacting" ensures that the striking is in order, as well as that the clock is to time, but it is obvious that not more than one—or at the most—two clocks could be checked on the "striking" at the same hour.

The amount of "latitude" which would be given to the clocks would depend somewhat on their capabilities. A town which desires to be "well-timed" should decide that should any of its supervised clocks signal an error of more than 10 seconds, its custodian should be instructed to correct it forthwith.

With regard to attention and maintenance, this would consist chiefly in exchanging the accumulator once per month for one fully charged. As, however, in the case of mechanical clocks, weekly visitations are necessary for the purpose of winding, it should be an easy matter for the winder to perform this office. The use of the mains would render this operation unnecessary, or the use of good dry cells would make this attention less frequent.

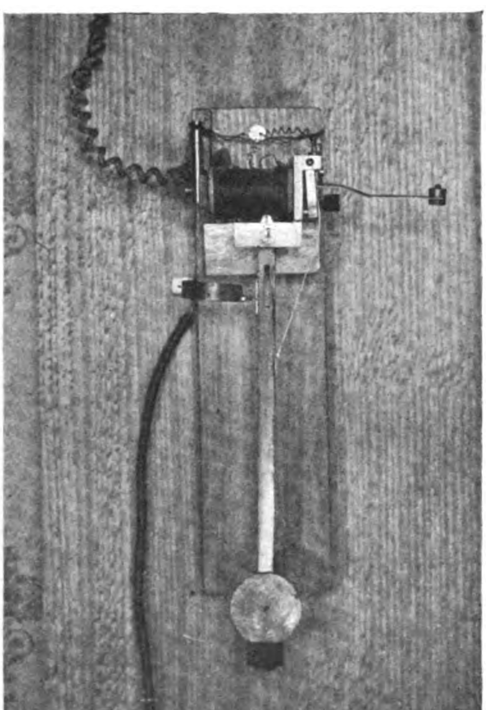


Fig. 3.

With regard to the transmitting set (shown in Fig. 1) this would be in practice completely enclosed in a dust-tight box, and as the only moving part would be the contact-breaker of the coil, little or no attention would be needed. In the event of the contact-breaker being out of adjustment this would be indicated at the receiving station. The contacts to the clockwork could be of a robust character, and could therefore be trusted to look after themselves.

Fig. 3 shows an instrument the writer has made to enable a system of impulse clocks to signal its time-keeping to the receiving station, and therefore be supervised.

This instrument consists essentially of a short and light pendulum which is arranged to operate after the manner of a slow ringing electric bell. One dry cell operates it, and its circuit is closed at pre-arranged times by contacts fitted to one of the impulse clocks in the circuit. The clock employed by the writer for the purpose was one made by his firm for ringing bells in a factory for the starting and stopping of work. The contact is closed for half a minute, and, in vibrating, the pendulum runs full tilt into contact with a spring at the end of each swing, thereby closing the circuit of the induction coil and producing a series of timed "buzzes" at the receiving station. It is obvious that by using pendulums of varying periodicities, different clock installations could be readily identified.

Fig. 4 shows diagrammatically the connections employed, which are self-explanatory. The relay shown at R is necessary to break the primary circuit of the induction coil precisely at the end of the half minute, and so terminate the "buzzes," because the pendulum, by its inertia, continues to swing and so touch the contact spring after the clock contact has broken.

Identification of individual turret clocks could be secured in many ways. First, the varying pendulum lengths could be taken advantage of when pendulum contacts are used, turret clock pendulums varying from 1 second beat up to 2 seconds or more in steps of $\frac{1}{4}$ second, and so the frequency of the "buzzes" heard would enable the clock to be identified should it be considerably out of position on the schedule. Also, in the case of "striking" contacts, the frequency of the "blows," or rather "buzzes," would be a means of identification. Coupled with the foregoing features a variation in the character of the note can be employed, and, for the sake of simplicity, this should be brought about by variations in the design of the spark-gap and contact-breaker rather than the employment of rotating gaps.

The object of advocating the employment of the short wave-length of 50 metres and small aerials is to ensure that the large commercial stations be not interfered with. Interruption or "jamming" would be possible from local amateurs with untuned apparatus, but, as amateurs usually only display their activity at night, trouble would not be experienced on this score.

The writer's wireless apparatus (including the apparatus described and illustrated) has all been dismantled at the request of the Postmaster-General since the outbreak of the war, and it is not known to him definitely what time signals are now, or will be, sent, but he has read that one of the powerful stations (which shall be nameless), has now ceased to send out time-signals.

With the scheme of wireless supervision advocated by the writer it is recommended that a Greenwich time signal, or the Post Office time signal, be installed at the official receiving station in place of, or supplementary to, a wireless time signal.

Fig. 5 shows the receiving station used by the writer.

It may be mentioned that it would not be necessary for the operator to know the Morse code (to be seen on the wall in the photograph), as he would not require to use it in connection with the scheme proposed. The "spare" receiver seen enables a second person to "listen in" also.

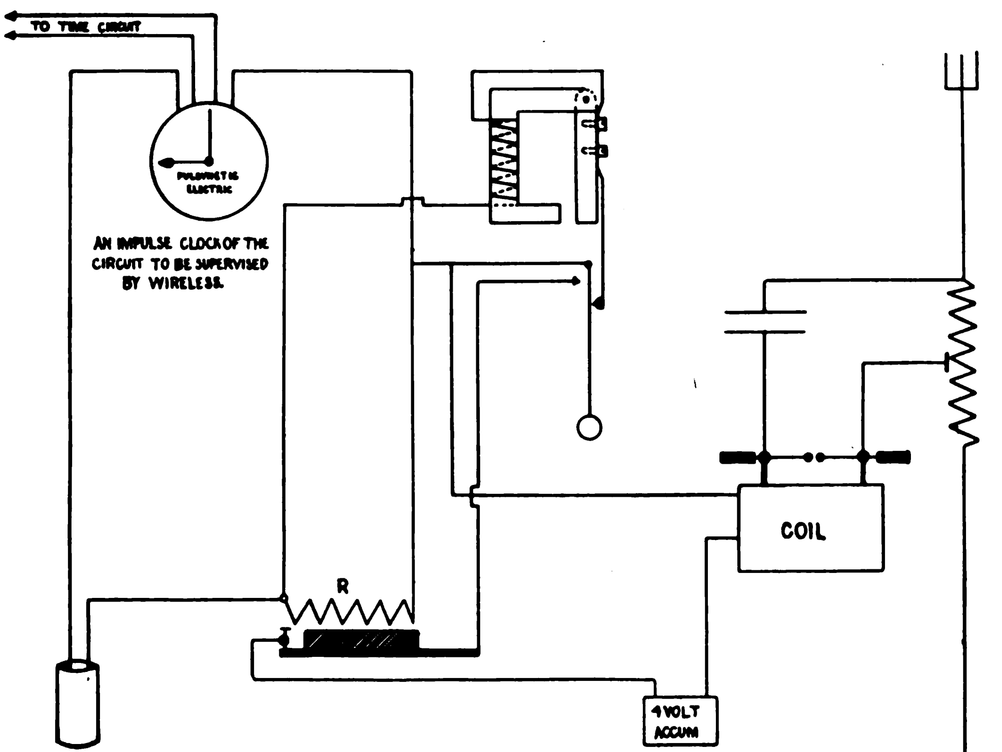


Fig. 4.—Wireless Supervision of an Impulse Clock System.

Before wireless supervision could be adopted it would be necessary to get the permission of, and a licence from, the Postmaster-General, who would stipulate the maximum wave-length which would be permitted, and also the maximum power to be employed. The requirements of this scheme,

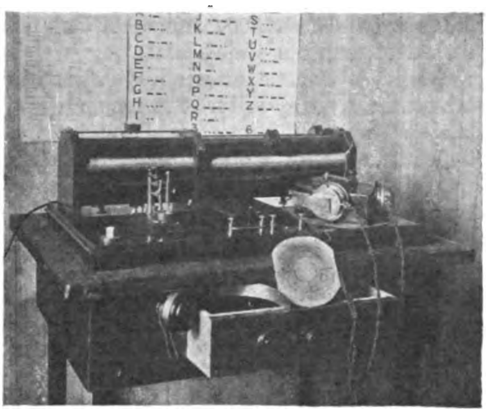


Fig. 5.

however, are below the limits usually stipulated.

An argument against the adoption of this scheme would be that in the event of another European war, the scheme would be put out of operation by the suspension of the licence during hostilities. The writer ventures to assert that it will be a " long, long " time before Europe will be again brought under the spell of war.

WIRELESS IN NAVAL WARFARE.

SOME excellent articles on Wireless in connection with warfare in general have recently been appearing in *The Glasgow Herald* from the pen of Mr. Charles R. Gibson, F.R.S.E. We extract some paragraphs which have special reference to the use of radiotelegraphy by the Fleet.

" It is on sea that wireless telegraphy has an unrivalled sphere. Communication may be made between ships far distant from each other, or from ship to shore or shore to ship. Submarines and torpedo boats carry small installations capable of sending messages over a range of about 25 miles. Larger ships have more powerful apparatus, capable of sending messages to a distance of several hundred miles. And even when a ship is at a greater distance than its wireless can transmit it can send word to some ship nearer land, which ship can in turn transmit the message to land.

" Ships in the Fleet are furnished with a wireless apparatus, so that they can communicate with each other and with the shore. Each large vessel has a special duty assigned to it; it is held responsible for keeping up communication with a shore station, with a cruiser squadron, or with a flotilla of destroyers. One ship in the Fleet must always be in touch with the Admiralty, because all foreign news concerning the enemy ships goes to the Admiralty, and thence to the Admiral of the Fleet, who directs the ships accordingly.

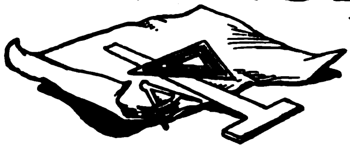
" When the battleships are steaming along a number of light cruisers spread out several miles in front, and each reports to a particular battleship. The cruisers are accompanied by destroyers, and there are sometimes as many as thirty ships on the look-out, each ship being equipped with wireless apparatus. When the battleships receive the messages from the advance guard they convey the intelligence to the Admiral of the Fleet on board his flagship. This retransmission over a short distance is generally done by means of a semaphore, or by Morse lamp signals. The Admiral's order to attack is sent out by wireless, and the light cruisers fall in behind the battleships.

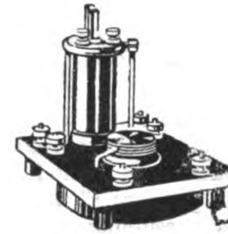
" That the presence of wireless apparatus on board a man-of-war is considered of much value is evident from the way in which the Germans handled our old cruiser *Halcyon*, which was protecting the fishing at Lowestoft when the enemy appeared on November 3rd with the intention of raiding the British coasts. As soon as the enemy sighted the *Halcyon* they made her wireless mast their first target. They did not fire a shot at her hull until they had first destroyed her wireless rigging. But the operator had succeeded in sending out a warning of the raid, and when the enemy fled he was able to repair his wireless aerial.

" According to the home-letter of a humorous Jack Tar, the North Sea Fleet once became so impatient waiting on the German Navy to come out from their place of safety that the British Admiral sent the German Admiral a wireless message saying, ' It's a fine day for a sail, sir,' but he wouldn't come.

" The British Fleet in the North Sea is not cut off from the daily happenings in the world, for each night the Marconi station at Poldhu (Cornwall) transmits to ships at sea a summary of the day's events. Some ships of the Grand Fleet print a ' daily sheet ' of such wireless news."

The ENGINEERS Note Book





[Under this heading we propose to publish each month communications from our readers dealing with general engineering matters of various kinds in their application to wireless telegraphy, and we would welcome criticisms, remarks and questions relating to the matter published under this heading. We do not hold ourselves responsible for the opinions and statements of our contributors.]

Four-cycle Oil Engines.

WE have already mentioned in former articles that constant care in the maintenance of these engines is essential to success in their use; and it may not be out of place to enter more fully into the matter of general management.

Fuel.

The ordinary oil engine is intended for use with those grades of petroleum known as kerosine or paraffin, having a specific gravity of about 0·82 or 0·825 and a flashpoint varying from 80° to 100° (close test). The higher the specific gravity the greater will be the heat required on the burners for keeping the vapourisers at correct temperature. The oil used should not be too rich in tarry constituents. A surplus of tar in the fuel will render the lamp passages and valve stems liable to be "gummed" up much more quickly, and thus necessitate more frequent cleaning. It is hardly necessary to say that the oil should be perfectly free from all foreign matter (dirt, etc.).

Pressure Fuel Feed.

Oil engines are often constructed to operate by either pressure or gravity fuel feed, the pressure feed giving a steady and continuous flow to the burners and feeders so long as the engine is in motion. The equipment consists of a reservoir capable of holding a small quantity of fuel, and arranged so as to prevent the liquid rising above the level of one-third of its height. For preliminary use a filling plug is placed at the side, and a small air pump is fitted for supplying the initial pressure while heating up the engine vaporisers. Both the valve communicating with this reservoir and the fuel pump on the engine should be closed while "warming up"; but when the engine is started the valve should be immediately opened, thereby allowing a fresh charge of fuel to take the place of the supply in consumption. As the general principle of this pressure feed is that of an air chamber, the liquid will never rise above the level it attained when the pump starting working, unless the attendant allows a certain quantity of air to escape. In the event of an engine standing by with the lamps burning for some considerable time, it would be prudent to make sure that the oil is at an adequate level. This is most readily effected by slightly loosening the filling plug and allowing a minute leakage of air, watching the pressure gauge at the same time to prevent the supply falling below the requirements. As soon as oil commences to ooze from the filling plug the latter should be tightened down, as the oil has then reached its normal level, and will remain so as long as the engine is running. The fuel pump is of a capacity far in excess of that necessary for the combined service of vaporisers and burners, and to relieve this surplus an automatic by-pass valve, controlled by the air pressure acting upon a little piston, is arranged at the side. This piston valve is spring loaded; it is adjusted externally, and the pressure can be regulated to any required degree even while the engine is running. No regulation of this should be necessary after the adjustment most suitable to local conditions and the fuel in use has been secured. Generally speaking, the engines are tested at about 3½ lb., but they will work at pressures varying from 2 to 4 lbs. per square inch. The instruction book will give the pressure at which the test was made; and, assuming that the specific gravity of the fuel is somewhat similar to that used on test, little or no alteration will be necessary under normal conditions. In very cold climates a higher pressure will be required in order to keep the vaporisers hot; in hot climates rather less, as the surrounding temperature will keep the fuel many degrees warmer, and in consequence the lamps will not have so much work to do. It should be remembered that any variation in the working pressure of a pressure feed service will necessitate a corresponding alteration in the size of the opening on the fuel feeders; a higher pressure requiring less opening, and *vice versa.*

Assuming that an accident has damaged any portion of the pressure feed outfit, and it is essential to maintain the engine in running condition, a temporary feed can be arranged by gravity; any suitable receptacle being mounted at a height sufficient to give rather more head than that obtained by the air pressure. Roughly speaking, there will be about ½-lb. pressure for every foot in height. It should be noted that a burner arranged for a pressure feed does not give quite such good results with a gravity feed; and a slight stuctural difference exists, the pressure feed burner having a brass finger in the vertical passage, whereas for gravity this is replaced by a gauze wick. It will be seen that the repair to the pressure service should be effected as quickly as possible as the engine will undoubtedly require more attention when running on the make-shift service. The maintenance of heat on the vaporisers is of the utmost importance if easy running is to be attained; therefore, if the engine has to run persistently on a light load, the attendant may need to increase the pressure at which the burners are working, and possibly slightly reduce the air supply to the vaporisers. The most ready indication of these requirements will be difficulty in maintaining even running, and a persistent tendency to cough; and there may be a show of moist oil round the joint of the vaporiser cover and the electrodes. Such a condition is a sure sign of insufficient heating, and must be corrected if sweet running is to be maintained.

Gravity Fuel Feed.

This subject has been partially covered by the above remarks; but if an engine is intended for use with gravity feed, arrangements are usually made to adapt the burners and vaporisers to work at a head of about 3 feet or 4 feet. That is to say, the bottom of the fuel tank should be at least 3 feet or 4 feet above the burners; and for obvious reasons the fuel tank should not be more than 1 foot in depth, the level of the fuel being maintained approximately even, otherwise the variation in pressure may cause a marked difference in the heat of the vaporisers, or may give rise to trouble in the burners.

Burners.

When operating correctly the flame is blue with possibly the merest trace of yellow in the centre. It is quite clean, and similar in appearance and condition to that obtained with an ordinary gas Bunsen burner. As the burners are of the self-vaporising regenerative type they should be correctly heated and started, or there will be difficulty in getting them into condition. Cleanliness, internally as well as externally, is most necessary to success. Even the grid at the end of the mixing chamber where the flame burns will need occasional attention, as there is a tendency for corrosion to take place round the holes, thereby impairing the quantity of air and vapour which can pass. For the same reason, if a nipple be allowed to remain too long in use, it may become either too large from constant use of the pricker, or too small from persistent corrosion around the orifice. A word of warning may not be unseemly; never, under any circumstances, tighten up brass screws on a burner while it is hot as at certain temperatures brass is so rotten that damage is almost inevitable, and stripped threads or possibly permanent leakages may result.

Administrative Notes

Argentina.

THE *Boletin Oficial* (Buenos Aires) of December 10th publishes the text of the Regulations, drawn up by the Argentine Ministry of Marine, for the working of the wireless telegraph service of the Republic, which for administrative purposes in this connection is divided into two zones—viz.: (1) The maritime zone, comprising all the stations working in territorial waters and on navigable rivers, as well as those on land installed within a distance of 100 kilometres of the coast and the shores of the River Plate and 50 kilometres of the banks of the other navigable rivers; and (2) the land zone, comprising all other stations.

The maritime zone will be under the jurisdiction of the Ministry of Marine and the land zone under the Ministry of the Interior. No wireless telegraph station may be installed in the Republic without previous authorisation being obtained from the Ministry in whose jurisdiction it is desired to erect the station.

Articles 35 and 46 of the Regulations deal with wireless telegraph installations on merchant vessels. Merchant vessels carrying fifty or more persons on board must, unless they are specially exempted, be provided from the time they are put in commission with radio-telegraph installations. A similar obligation is in force for all vessels entering or leaving national ports. The equipment is at all times to have a minimum transmitting power of 200 kilometres (124 miles) in the case of river vessels, and 500 kilometres (310 miles) in the case of seagoing vessels.

The full text of the above-mentioned Regulations (in Spanish) may be consulted by the United Kingdom shippers interested at the Commercial Intelligence Branch of the Board of Trade, 73 Basinghall Street, London, E.C.

Brazil.

We are notified that the Brazilian coast station at Fernando Noronha has been closed.

The Brazilian Government wishes to notify that they have decided to allow through their coast stations exchange of official telegrams, and also telegrams in clear language between the vessels and their passengers, on the one side, and the agents of the shipping companies on the other side, on condition that the telegrams of this latter class have no other object than the private interest of the companies and passengers.

China.

The coast wireless telegraph stations at Woosung and Canton, completed for working last summer, have now started regular service; similar stations at Foochow and Hankow are expected to be completed within the next few months. The stations are all of the same construction, each being provided with two masts of a height of 200 ft., giving them a range of 700 nautical miles by day and at least 1,300 nautical miles at night.

Italy.

With reference to the Ancona station, the opening of which has already been announced, the Italian Administration notifies that this station will use, for public correspondence, only wave-lengths of 300 and 600 metres, and not 1,200 metres, as previously advised.

Japan.

Advice has been received from the Japanese Telegraph Administration to the effect that the coast stations at Choshi, Fukkikaku, and Dairenwan, will transmit messages to ships at sea regarding typhoons reported by the Central Meteorological Office at Tokio. No charges will be made for these messages, except in cases where ships have requested that such advices be specially transmitted to them.

When in the vicinity of these coast stations, operators should endeavour to receive these special typhoon reports when signalled broadcast, and deliver them to the commander against the usual messenger receipts.

North Atlantic Ocean.

The Admiralty Hydrographer notifies that for the purpose of carrying on the ice observations and ice patrol service provided for by the International Convention for the Safety of Life at Sea, the U.S. coastguard cutter *Seneca* left New York on February 15th, to proceed to the Grand Banks of Newfoundland.

During the period of ice observations the *Seneca* will be the only vessel employed on this duty; but when the ice has moved southward so as to make a constant patrol necessary, an additional vessel will be detailed for that purpose.

The experience of previous years has shown that a continuous ice patrol should be established about April 1st annually, and continued throughout the season of dangerous ice conditions.

WIRELESS WARNINGS.

Upon getting in touch with the ice the *Seneca* will send a report daily to the Branch Hydrographic Office, New York City, at 4 a.m., 75th meridian time, addressed "Hydrographic, New York." An endeavour will be made to communicate direct with coast wireless telegraph stations, but should the *Seneca* be unable to communicate with any of these stations the message will be relayed through any vessel within reach.

The ice information will be given in as plain and concise a form as practicable, and will state the following:

(*a*) Ice (berg or field).
(*b*) Date.
(*c*) Time (75th meridian).
(*d*) Latitude.
(*e*) Longitude.
(*f*) Other data as may be necessary.

While on this duty the patrol vessel will endeavour by means of daily wireless messages to keep ships at sea advised of the limits of the ice fields, etc.

The *Seneca's* call letters are NRE, and she uses wave-lengths of 300, 600, and 750 metres.

Pacific.

We have been advised that on and from February 1st, 1915, the ship tax on vessels equipped by the Marconi Wireless Telegraph Company of America, trading in the North and South American service on the Pacific coast will be increased from two cents (2c.) to four cents (4c.) per word, and the coastal rate of the Pacific coast stations for the same service will be increased from three cents (3c.) to six cents (6c.) per word.

Panama.

We learn that, in an Anglo-American agreement just concluded, arrangements have been made to obviate certain confusion which has been experienced in the working of radio-telegrams in the neighbourhood of the Panama Canal. This would appear to have arisen through the simultaneous sending of American and British naval and commercial messages. Certain hours of the day are allotted, under this agreement, to the uninterrupted operation of messages from warships, whilst the rest of the twenty-four hours is utilised by shore stations without naval interruption. The following special circular has been issued by the Marconi Wireless Telegraph Company of America concerning the use of wireless telegraphy in connection with the Panama Canal route:

(1) As soon as radio communication can be established with the canal, vessels should report their names, nationality, length, draft, tonnage, whether or not they desire to pass through the canal, require coal, provisions, supplies, repairs, to go alongside of a wharf, the use of tugs, probable time of arrival, length of stay in port, or any other matters of importance or interest. If this information has been previously communicated, through agents or otherwise, to the captain of the port, it will not be necessary to report by radio; but the probable time of arrival should always be sent.

(2) Control of radio-communication is entirely in the hands of the radio shore stations. No vessel will be allowed to interfere in the slightest degree with the canal radio stations; upon an order being received by a vessel at any time while within the waters under the control of the canal to discontinue using radio, even if in the midst of transmission of a message, she shall immediately comply.

(3) Upon a ship's arriving within the 15-mile limit, and until leaving the 15-mile limit of the canal zone, she shall transmit only with low power, not exceeding $\frac{1}{2}$ kw.

(4) Messages to stations will be sent only to the Colon Station (NAX) when in Gatun locks and to northward thereof, and only to Balboa Station (NPJ) when in Miraflores locks and to southward thereof; between these two points ships may work to either station, preferably to the nearer one; the high-power station (Darien) at Radiol will not handle commercial work, and will not be called for canal business except in case of emergency.

(5) All messages between ships in the canal zone and ships at sea must be forwarded through the nearer shore station.

(6) Messages from ships in the Caribbean Sea for ships in the Pacific waters, or *vice versa*, shall be routed through the canal zone shore stations.

(7) All vessels fitted with radio, after leaving the terminal harbour to pass through the canal, shall keep an operator on watch until the further terminal harbour has been reached; this applies to the time when they are anchored in Gatun Lake, while passing through the locks, or moored to the lock walls, or to any of the wharves in the canal proper, as well as when they are under way. Messages relating to the ship's movements and the canal business shall take precedence over all commercial messages.

8. Pilots on vessels passing through the canal shall have the right to use a vessel's radio freely for the transaction of the canal business.

9. Under the direction of the pilots vessels will from time to time report their progress through the canal; accidents to machinery, propellers, steering gear, equipment or anything else that may delay them or require assistance; any sickness or casualties that require medical attendance from canal officials, or any other matter of importance that may arise.

10. No radio tolls, either coast station or forwarding, will be imposed against ships on radiograms transmitted by ships on canal business. There will be no charge made against the Panama Canal by canal zone land lines or radio stations for the transmission of radiograms to ships on canal business.

11. No vessel will be allowed to communicate with any lock or signal station while in transit through the canal, except through the pilot; all messages of any kind must be sent through him. This does not apply to vessels moored at the terminals at Cristobal or Balboa, before entering or having passed through the canal, which may wish to communicate through the terminal stations.

On wireless telegrams received in relation to canal business from the canal zone radio stations, the "ship tax" of the receiving ships shall be charged against the sending radio coast station.

A SUGGESTED SUBSTITUTE FOR A "BUZZER."

A recent number of the *English Mechanic* contains a rather amusing letter, referring to the Postmaster-General's notice concerning wireless apparatus. Mr. Howard J. Duncan, who writes the letter, states that it "may interest some of our wireless amateurs to know that a fair substitute for a 'buzzer' may be made by slipping the point of a dinner knife under a dinner plate till it reaches near the centre, and then operating the handle of the knife in the same manner as a Morse key. In this way it is possible to practise Morse without offending the Postmaster-General or infringing the Defence of the Realm Act." We note that Mr. Duncan does not consider this quite equal to the regular "buzzer," and only recommends it as a "stop-gap."

MISCONCEPTION OF WIRELESS POSSIBILITIES.

Mr. Charles R. Gibson has been contributing long articles recently to the *Glasgow Herald* on the present use of wireless by the belligerents, and in the course of one of them tells an amusing story which, according to the writer, was repeated to him with portentous seriousness as an incident of the greatest gravity which had recently come under the narrator's personal observation:

"Two German workmen had been arrested as spies, and there had been discovered, hidden beneath the hearthstone of the kitchen in their two-roomed tenement house, a complete wireless installation capable of transmitting messages to Berlin."

Mr. Gibson comments that it is possible to send wireless messages as far as from here to Berlin, but not with apparatus that can be stowed away beneath a kitchen hearthstone, or even contained in a large room.

NOTES OF THE MONTH

WE have received the following particulars of the departure of the S.Y. *Aurora* from Sydney.

"A full month behind the time originally "fixed for her departure from Sydney, the "*Aurora* left on December 14th for Hobart, "*en route* to the Antarctic, where she is to "remain for upwards of a year, not returning "to Australia till March, 1916. It is "expected that the vessel will reach her "destination about the second week in "January, and Captain Mackintosh and his "staff will at once begin the preparations "necessary for the safety of Sir Ernest "Shackleton's main party, which left "Buenos Ayres over two months ago for "the Weddell Sea, on the opposite side of "the Antarctic Continent, and which will "cross overland from there to Ross Sea "on the Australian side. Mr. T. F. Knox "received the following wireless message "from Captain Mackintosh, leader of the "expedition, last night: *Accept our first* "*wireless greeting. To all kind friends* "*adieux. We won't forget Sydney.*"

* * *

The Union Steamship Company's Tasmanian Mail Steamer *Loongana*, trading between Melbourne and Launceston, has just been equipped with a complete wireless telegraph set by the Amalgamated Wireless of Australasia, Limited. The equipment is of the latest type, and the engineering design of the apparatus is the result of long experience in the particular requirements of apparatus for shipboard use. The *Loongana* can keep in touch with the Melbourne Radio station all the way between that city and Launceston. Included in the equipment is a special emergency plant, which is designed to enable communication to be maintained independently of the ship's dynamo. In case of accident the wireless plant could be operated as long as the wireless cabin (which is on the uppermost deck) remains intact. This principle of providing such emergency equipments was inaugurated by Marconi's Wireless Telegraph Company fully ten years ago, and its immense value in saving lives was first demonstrated when the ss. *Republic* went down off Nantucket Lightship in 1909, and the operator was able to maintain communication with several land stations and liners even while his ship was waterlogged and sinking. The system of the Marconi Company has been endorsed by the International Radiotelegraph Convention and by the Governments of the United Kingdom, Australia, Canada, New Zealand, and many others by making compulsory regulations for the use of this emergency plant on all vessels equipped for radiotelegraphy.

In view of the special trade in which the *Loongana* is employed and the short distance between her terminal ports, arrangements have been completed for a reduced charge for radiotelegrams to and from the *Loongana*. Messages sent by passengers on the *Loongana* to any address in Australia will be charged only threepence per word, the same rate obtaining for messages handed in at any telegraph office in Australia addressed to the ship. Only the actual number of words has to be paid for, as there is no minimum charge per message. The ordinary charge for wireless messages to and from ships registered in Australia or New Zealand was recently reduced to sixpence per word.

* * *

In his annual report Secretary Daniels, of the United States Navy, dwells upon several interesting phases of wireless telegraphy. He states that the navy department has opened twenty-five stations to commercial business and that every ship of the navy is herself a commercial station, as all private messages handled are paid for by the senders. He points out that 300 jewellers throughout the country have installed wireless apparatus in order to receive the time signals sent out from the Arlington station, near Washington, and that the number may be expected to grow to 3,000, according to information received.

Referring to the radio compass now under construction at the Fire Island station, near New York Harbour, he says: "This device is intended to send out radio signals of such a character that a vessel in a fog may get a close approximation of her bearing, or compass direction, from the station. By means of observations taken five or ten miles apart it should be possible for the vessel to determine her actual position with fair accuracy. This is the first installation of this type to be made in this country; but a second installation of different type, though answering the same purpose, is projected for the station at Cape Cod. The signals sent out by the radio compass at Fire Island will necessarily be limited as to range, but the Cape Cod installation will allow of a ship calling the station in the usual manner from any distance within the ship's ordinary range and receiving a definite reply as to her bearing from the station. In the case of Fire Island the ship will determine her bearing from the character of the signals continuously emitted; for Cape Cod the station determines the bearing of the ship from her calling signal and sends the information back. If these installations prove as successful as anticipated, the radio operators of ships will become an important part of the navigating force."

* * *

We have received an interesting communication from the wireless operators on board the R.M.S.P. *Demerara* relating to the reception of signals at unusually long distances. They write: "At 11.10 p.m. on February 18th, while south of St. Vincent (Cape Verde Islands), we heard Land's End station (600 metre wave) a distance of 2,400 miles. At 11.45 p.m. the Paris time-signal was received. At 1.20 a.m. on the following morning (19th), just 2 hours 10 minutes after hearing Lands End, we heard Cape Race sending ice reports, signals very good, distance 2,600 miles. An hour later we heard Norddeich (Germany), distance 2,660 miles, signals remarkably clear. On the 20th, when just south of Teneriffe, we heard Fernando Po (Gulf of Guinea), distance 2,040 miles.

* * *

The *Montreal Star* recently published some thrilling experiences in the Antarctic of Sir Douglas Mawson, the Australian explorer, who recently arrived in New York on the Cunarder *Orduña*. We understand that Sir Douglas intends shortly lecturing before the American Geographical Society on his experiences in the Antarctic during 1912 and 1913. In the preliminary remarks made to the newspaper reported, Sir Douglas claims to have discovered "the place where storms are spawned." According to this explorer, the breeding place of South American hurricanes can be shown to be Amelieland. It must be, indeed, the home of Boreas, for we learn that the wind there blows *on an average* fifty miles an hour, whilst during the trip Sir Douglas and his companions registered it as high as 220 miles on their wind gauge!

Swiftly, however, as the storm may travel, it is easily out-distanced by wireless "waves," and the exploring party discovered that it was possible for them to transmit news of the forthcoming arrival of hurricanes to the Australian coast at least *forty-eight hours in advance.* The immense utility of such a warning can scarcely be exaggerated.

* * *

An account of "savage" wireless appeared in a recent number of the *Northern Daily Mail.* It is not uninteresting as showing the primitive use of the "musical note" which plays an important part in differentiating between the haphazard sounds produced by electrical disturbances in the atmosphere and those deliberately promulgated for the purposes of the transmission of messages. In the Juamara region of the Amazon the natives use a crude system of wireless telegraphy, which, it is claimed, has been in operation for thousands of years. The transmitter found by an explorer was a hollowed trunk of a tree suspended from a horizontal pole stretched between two stumps. Inside, the transmitter had been arranged much like a violin, and it was explained that when the instrument was struck smartly with a small rubber hammer a vibration was created that carried for miles over the hills.

Doings of Operators

STAFF notes constitute the central feature of the February issue of the *Marconi Service Magazine*, and, amongst them, one stands out unmistakably as full of thrilling interest. It describes how M. L. Burgin and A. L. Cresse, first and second operators respectively of the s.s. *Camino*, distinguished themselves by heroic discharge of duty under circumstances of extreme peril.

Off the Newfoundland coast the *Camino* became helpless in a severe storm, 150 miles south-east of Sable Island and 220 miles from Halifax. So severe was the weather encountered that the wireless cabin was torn from its lashings, and the unhappy operators were reduced to assembling the apparatus together in a corner and continuing, under constant buffetings of wind and rain, to flash their signals. Despite these terrible hardships, they were able to obtain and maintain constant touch with coast and ship station. Through their agency the Canadian Government steamer *Lady Laurier* and other vessels were called to the assistance of the *Camino*, and one of the rescuers took her in tow. So fearful, however, were the waves that the hawser parted, and the *Camino* fell back into the trough of the sea. Eventually she succeeded in carrying her crew of thirty and her single passenger safely into port. The circumstances reflect the greatest credit upon the devotion to duty of these young men.

Two further examples of similar conduct occurred in recent days, one on the *Hanalei*, wrecked near San Francisco, in a storm, and the other on the *Chester*, whose rescued crew were brought to New York on February 9th by the *Philadelphia*. In the former instance the solitary operator, after his radio-equipment had been disabled by the breaking seas, although lashed to the mast, devised means of signalling to the life-savers on shore. He effected this through the agency of an electric light at the mast-head, presumably using the Morse Code by flashes. He kept the rescuers informed as to how the life lines were falling, and, by his signals, enabled them at last to "find the range" for their rockets.

In the latter instance the *Philadelphia*, in mid-ocean, sighted the *Chester*, a tank steamer with a captain and crew of 32 men. Mr. Jones, the wireless operator on the *Philadelphia*, attempted to get into communication by wireless, but failed, owing to the fact that the *Chester* had had her apparatus swept away. Here, again, the operator was able to signal, through the Morse Code, by means of lamps, and learned the state of affairs on board the *Chester*. They were about as bad as they could be; the ship was on fire, and had it not been for the resourcefulness of the operators on the respective steamers there is little doubt that all on board the *Chester* would have perished.

* * *

Thrilling stories of rescue were told by survivors of the lost British auxiliary cruiser *Bayano*, which met her doom off Corsewall Point, Wigtownshire, and, according to the Admiralty's statement, was probably sunk by an enemy's torpedo. The loss of life is estimated at no less than 190, only twenty-six of her ship's company having been rescued.

While all the crew of the lost cruiser were heroes, the bravery of the captain, who was last seen on the bridge engulfed by the swirling waters, and of the *two wireless operators*, who were still flashing the "S.O.S." signal as the ship went down, stands out in vivid colours.

"Captain Carr behaved with great bravery," said one survivor. "As I left he shook me by the hand and said 'Good-bye.' He had no thought for himself, but every thought for his men. To one man who offered him a lifebelt he said, "Good lad, save yourself.'"

One survivor stated he was below in his hammock when the ship was torpedoed. Two-thirds of the crew were in bed at the time and the other third on watch. All were wakened by the explosion, many being thrown from their hammocks. The explosion seemed to blow in the bottom of the vessel amidships, and volumes of water poured in. All made for the deck, which was awash, and in about three minutes the ship sank bow first. They had enough rafts and boats, but not enough time to use them all.

All the twenty survivors of the auxiliary cruiser *Bayano* who were landed at Ayr were suffering severely from exposure, while four were, in addition, so badly injured by the explosion that they had to be taken to hospital.

* * *

The record of wireless achievements in the way of rescue afforded to ships in distress is now becoming as long as it is honourable. We believe, however, that the following account, reprinted from the *Dundee Advertiser*, chronicling the part played by radiotelegraphy in bringing assistance to a Dundee steamer recently arrived, is worth calling to the attention of our readers :—

"The passage from Calcutta had been an uneventful one, but when the *City of Lincoln* entered the dreaded bay a furious storm burst. The ship at first withstood the shock well, but unfortunately the rudder post broke under the strain, and left the steamer at the mercy of wind and waves. The position was extremely precarious. Huge waves swept the decks, carrying away parts of the steamer's equipment, and strewing the passages with ropes and deck fittings; while at one time the peril became so acute that many of the lascars who form part of the ship's company leapt to the rigging and climbed the masts for safety. Meanwhile the wireless operator of the *City of Lincoln* was sending out calls for assistance. Three of his messages were answered, but the responding vessels were unable to afford immediate help. A fourth call was sent out at five o'clock in the morning, and the operator informed the anxious crew that the steamer *Raphael*, of Liverpool, had replied, and was steaming to their assistance. Working strenuously, the engineers temporarily repaired the damage, and at seven o'clock the hearts of the men were cheered by the arrival of the *Raphael*. Tow wires were expeditiously run out, but at the first strain one of these gave. Fortunately it was found that the *City of Lincoln* could proceed under her own steam, and she was taken into a small repair port in the north of Spain, where the broken rudder post was securely clamped. The storm had abated before this operation was finished, and she concluded her passage in safety."

SIGNOR MARCONI A SENATOR.

In the Senate on March 17th Signor Guglielmo Marconi was introduced to the House as a new Senator with the customary formalities. He was received with long and enthusiastic applause, in which the public in the gallery joined.

TRANSATLANTIC WIRELESS.

We understand from the Copenhagen correspondent of the Exchange Telegraph Company that a commercial movement is on foot to establish direct wireless communication between Sweden and New York. Representations have been made to the Swedish Postmaster-General, who considers the scheme to be favourable, although he does not see any possibility of acting just now because of the uncertainty of the time it will take to erect a high-power station on Swedish soil. It is considered probable that Sweden will decide to use Marconi's new high-power station in Norway, which was specially built for communication with America. All Danish wireless schemes have been dropped.

PATENT INTELLIGENCE.

275. January 7th.—WESTERN ELECTRIC Co., LTD. (Western Electric Co., U.S.A.). Electric wave amplifying apparatus. (*Complete.*)

433. January 11th.—CHAS. H. PARKER. Adjustable stand or holder for crystals used as detectors of electric signals in Wireless Telegraphy and Telephony. (*Provisional.*)

519. January 12th.—LUCIEN ROUZET. Polyphase generator for high-frequency currents with polyphase tuned spark-gap. (*Complete.*) (Convention date, France, January 12th, 1914.) (*Open to Public Inspection.*)

1402. January 28th.—EDWARD C. RUSSELL. Wireless apparatus. (*Provisional.*)

2076. February 9th.—CHAS. TUCKFIELD and W. G. DE FORGES GARLAND. Wireless aerial elevator. (*Provisional.*)

2565. February 17th.—JOHN PERRY and SIDNEY G. BROWN. Wireless Telegraphy and Telephony. (*Provisional.*)

2821. February 22nd.—RICHARD CARTWRIGHT and HAROLD J. BULL.—Means for increasing the oscillations in frequency of electric currents. (*Provisional.*)

3507. March 4th.—MARCONI'S WIRELESS TELEGRAPH Co., LTD., and RAYMOND D. BANGAY. Means for receiving signals by sound. (*Provisional.*)

3546. March 5th.—J. J. DENTON and ANDREW G. MACCULLOCH. Wireless control for operating machinery. (*Provisional.*)

3950. March 12th.—LEE DE FOREST and CHARLES V. LOGWOOD. Wireless receiving systems. (Convention date, United States, March 12th, 1914.) (*Complete.*)

3954. March 12th.—NAAMLOOZE VENNOOTSCHAP DE NEDERLANDSCHE THERMOTELEPHOON MAATSCHAPPIJ. Wireless Telegraphy or Telephony. (Convention date, Germany, February 5th, 1915.) (*Complete.*)

4017. March 13th.—AXEL UNO SÄRNMARK. Devices for Wireless Telegraphy and Telephony. (Convention date, Sweden, March 13th, 1914.) (*Complete.*)

CARTOON OF THE MONTH.

A German Submarine Crew Working on a Higher Aerial.

New Applications for Wireless.

No. 1.—The Case of the Empress Music-Hall.

By W. B. COLE.

A FOGGY evening in January, about 8.30 p.m. Two men are walking along the Strand in the direction of the West End. The pockets of their overcoats bulge considerably, and render it hard for them to thread their way along the pavement without collision.

"The first house clears out at 8.45," says the elder of the two, "and if we are quick we shall be quite ready for our little 'turn' in case our prey come on early in the programme."

These are not music-hall artists *en route* to fulfil an engagement, but simply two wireless enthusiasts with a theory to prove that night.

Clifford, the elder, is an old hand in wireless work, about thirty years of age, clean-shaven, fair, and rather tall. His companion is considerably younger, short and dark, and the proud possessor of a smile that wins all hearts, especially those of the ladies. He has only been in the wireless world about two years, and the two had met and worked together some months before on a large battleship wireless installation in the north of England.

A fortnight before, they had come together again in London, and had made up their minds to carry out an idea of Clifford's without delay. Now, after some days of preparation, they are on their way to put it to the test.

. . . . .

Outside the Empress Music-Hall, near Leicester Square, huge posters announce as a great attraction that the world-famed Signor and Madame Zanani would give that night their celebrated thought-reading entertainment; that anyone in the audience might hand to Signor Zanani any article, when his wife, blindfolded on the stage, would immediately give the name of it.

A quarter of an hour later our friends are divesting themselves of their overcoats in a side box.

"I think we shall have time now before the curtain goes up," says Clifford, as he places a heap of queer-looking articles in the corner.

His colleague, having now taken his coat off, looks more like a living advertisement of Michelin tyres than a rational being: for his body is wound round with indiarubber-covered wire of a thickness equal to an ordinary finger.

"'Oh, I prithee, turn me not round, my stomach is not constant,'" quotes our wireless "Stephano" as his friend starts unwinding him by the easiest process of forcing him round.

"We must be quick," replies Clifford. "Weston will be here in a few minutes."

Then follow a few minutes of intense activity. Supported by the hat hooks that Holland had brought, the two men fix the rubber-covered cable round the box until there are four complete turns.

"It's fortunate for us they haven't altogether abolished gas yet," says Clifford, as he screws a clamp on to the lead pipe of the jet. "This will make an excellent *earth*. Now, Holland, old man, you connect this end to the discharger while I join up the cells, and we shall have our first spark in a minute."

The box now constitutes a regular amateur wireless station. In the corner stand five dry cells connected to a small ignition coil, while on a chair is placed a little operating key. The big coil of wire hanging round the box above their heads is connected to one discharger terminal, while the other terminal of the discharger is joined by a length of thick wire to the clamp on the gas bracket. A pair of telephone receivers and a little box containing various coils, handles and switches form the receiver. This completes the essential outfit, bewildering to anyone not acquainted with "wireless mysteries."

"Just mind yourself, old chap," exclaims Clifford, "while I try the spark"; and, as he speaks, he presses the small operating key.

A tiny crackling white spark flashes out between two small knobs, seen through the little glass window of the discharger box.

"O.K. and quite a good tone, and not too noisy to give the show away."

No sooner have the young engineers made their first test when there is a knock at the door, and the programme girl enters.

"Programme, sir?"

"Oh yes, thanks. I say—er—er—don't say anything of what you see here," says Clifford as the girl utters an exclamation of surprise. "We are not Suffragists, and there is not going to be any trouble." So saying, he slips something into her hand.

The girl promises and withdraws quite pleased.

"Good!" says Holland. "First possible opposition overcome by the usual means. I wish your friend would hurry up."

The orchestra by now has tuned up and are preparing to settle down to the night's business, when "May I come in?" says a voice.

"At last!" exclaims Clifford. "Come in; be careful where you tread. This is my friend Holland, co-worker and affectionately known as the 'damboy.' This is Mr. Weston, of the *Daily Thunderer*."

The men shake hands.

Mr. Weston, a special correspondent of the *Daily Thunderer* and a friend of Clifford's, is a tall, alert-looking man of about forty years of age, with iron-grey hair.

"Well, gentlemen," says Weston, looking round the box with an amused and semi-critical smile, for he had dabbled a little in wireless himself, "I hope I shall have the satisfaction of congratulating you at the end of the performance."

Meantime the house has been filling rapidly and the orchestra playing the overture. This soon ends, and No. 5 shows on the illuminated indicating board. This is the turn for which our friends have so carefully prepared.

The curtain rises and shows Signor Zanani standing beside his wife in the middle of the stage. When the applause subsides he advances, and after a few preliminary remarks concerning the nature of their performance, he turns to his wife, who seats herself in a large, comfortable chair. Taking a large white handkerchief from her, he wraps it securely round her eyes and down over her nose, and Madame arranges it slightly over a corner of her mouth. Signor Zanani then turns the chair round so that his wife sits with her back to the audience.

An attendant places a small plank on the stage, extending from the footlights to the chair of the conductor, and Signor Zanani, crossing this, descends into the orchestra stalls and asks members of the audience to hand him any article they may have handy.

Many are immediately passed over. Taking a ring from a lady, he looks up at it for about five seconds.

"What is this?" he says, looking towards the stage.

Immediately come the reply, "A ring."

"And this?"—holding up a knife he has just taken from a gentleman.

Again the correct answer comes from the stage. Great applause greets this success.

"Now for our little turn," says Clifford in a whisper. "Give me any word you like, Weston, the shorter the better. You are supposed to be investigating this theory for your paper."

"All right," whispers back the correspondent. "Send 'pen.'"

Clifford's hand slides along to the operating key. "Dr-drrr-drrr-dr (pause) dr (pause) drrr-dr," crackles the spark in the discharger.

"What is this?" the thought-reader is saying down below, holding out a brooch.

A pause ensues. The conspirators lean forward, tense with excitement.

"A pen," come the words distinctly from the stage.

The men in the box jump.

"Done it, by Jove!" whispers Clifford—"first time!"

"A slight mistake on my part," says Signor Zanani, who is now right under our friends' box. "I will try again."

Holland has meanwhile put on the telephone headgear and is now busily writing on a paper pad. "Look here," he whispers.

His friends crowd over him. On the paper is written "p-k-t."

"And this?" the performer says, holding up a little object for the audience to see.

"Packet," comes the reply at once.

"Ain't that good enough proof for you, Weston?" says Clifford.

Again Holland busies himself with his fountain pen.

"C-g-t-s," spells out Weston, looking over his friend's shoulder.

"Packet of what?" inquires Signor Zanani.

"Of cigarettes," says his wife.

"Quite right," replies the performer; "and thank you, sir," handing back the cigarettes to the owner.

"It's jolly smart sending," says Holland; "he sent the word before he asked her what it was."

"Give me one word more, Weston," Clifford says.

"Send 'key,' then," replies he.

Again the tiny spark crackles out the dots and dashes of the Morse code.

"Key," answers Madame in response to the usual inquiry.

Signor Zanani by this time appears distinctly upset. "That is not quite right," he says; "and I should like to say here, in explanation of this apparent failure, that such accidents occasionally occur on a disturbing day. Objects which are associated with one another are often impressed on my mind, and so are conveyed to the mind of my wife, who is so much attuned to me. In that case Madame receives that word instead of the right one. For example, I am holding a watch in my hand, and my wife in this peculiar way receives the word 'key,' or the impression of a key. By the way, this watch has a key attached to it. The two,

you see, ladies and gentlemen, are intimately associated."

"Ingenious old chap, isn't he ?" whispers Weston, "and on such a short notice too."

"I will increase the power and keep the key down for half a minute," says Clifford, "and let us see what will happen."

He kneels down in the corner and connects three more cells into the circuit. "Go ahead, Holland"; and Holland presses the key at the same moment that Signor Zanani is taking further articles from the audience.

"What is this now ?" he says.

There is no reply from the stage. Signor Zanani looks expectantly, but still there is no reply.

"Switch off!" says Clifford quickly, as the lady rises from her seat and clings to the edge of her chair.

Signor Zanani dashes up the plank and runs towards his wife, at the same time with impatient gestures indicating that the curtain should be dropped.

"There is no harm done," says Clifford, as Weston and Holland look a little uncomfortable. "Zanani will come forward in a minute and tell us that all is right."

The curtain had dropped rather clumsily, and so suddenly have the above events taken place that the audience are taken unawares. Now a buzz of conversation runs through the house.

A few seconds elapse. The curtains part and Signor Zanani steps forward and makes the following announcement:

"Ladies and gentlemen, I sincerely regret having to end our performance abruptly owing to the sudden illness of my wife, although I am glad to say that she is suffering from nothing more serious than a fainting fit. I trust you will excuse us for to-night, and we shall hope to be with you to-morrow. We thank you heartily for your appreciation."

"Excellent English and well delivered for a foreigner," says Weston, smiling. "I wonder if he is really a 'Signor'? Perhaps it pays better."

The "Signor" now retires, bowing his acknowledgments; but ere he disappears behind the curtain he glances swiftly but suspiciously along the rows of boxes.

"He guesses there is a jamming station somewhere up here," says Holland. "I think we ought to dismantle the gear, as he might get the manager to come round on an inspection on some pretence or other."

In four minutes everything is packed away in their overcoats, Weston taking his share. They are not a moment too soon, for in the next box can be heard the voice of the manager making an excuse for his intrusion.

"I will ring for drinks," says Clifford, reaching out and pressing the electric button. "Open the door, Holland, and call out for the waiter."

Holland steps out of the door just as the manager comes out of the adjacent box.

"Good evening, gentlemen," says he, advancing towards their door. "I am the manager, and I am sorry the last turn ended so abruptly. I am just running round to a few of the boxes to explain that all is well."

"Oh, come in, by all means," says Clifford. "Sit down. Will you have a drink ?" as the waiter appears at the door.

"No, thanks, really," replies the manager; "I have too much to do before the next two turns. Kindly excuse me," and he hurries out.

"He is gone," remarks Holland, with a smile. "I think we ought to cut too, for I saw the business manager enquiring very earnestly of the programme girl. I gave her a wink, but he may have some idea of questioning us, and there may be some liability for disturbing a show."

"Come to my club and have supper," says Weston, "there are lots of little things that are not quite clear to me, and I must know them before I write my article."

. . . . .

An hour later the three have finished a delightful little supper in a private room at Weston's club, situated in one of those quiet squares not far off Fleet Street. They have been sipping their coffee and liqueurs for the last five minutes while Weston has been filling several small sheets with shorthand notes.

"Now I am ready," he says, turning to Clifford, "to put you into the witness box. I can understand Zanani's transmitting arrangements more or less. No doubt for an aerial he had something like ours, only wrapped round his body."

"Yes," interrupts Clifford, "but ours

was earthed to the gas jet and sparked plain aerial fashion. I think his aerial was more likely in two parts—one wound round his body and the other part round his leg or legs, but both adjusted to the same wave-length."

"And he sparked it in the middle?" enquires Weston.

"Yes," replies Clifford, "from a small coil like ours, but well silenced. It is possible," he continues, "that he had a similar aerial to ours, and for an earth he might have had metallic soles in his shoes. His wife then would have the same arrangement."

"That's quite clear and straightforward," says Weston, making a few notes; "but how did he send? I particularly noticed he did not have his hands in his pockets on a hidden key."

"That," replies Clifford, "could be done in many ways, but the best method I can think of is that he used his big toe. Wait a moment," he continues, as Weston starts laughing. "If you have comfortable boots, you will find there is plenty of room to move your big toe considerably. It would only need practice and a specially designed contact plate for anyone to be able to send quite ten words a minute; and you remember he abbreviated his words. 'P-k-t' meant 'packet,' was one example; 'C-g-t-s' for cigarettes, another."

"That's excellent," laughs Weston, "but here is the hardest nut to crack. How did Madame receive, for she had no telephones? I'll swear to that, for I was watching her carefully through the glasses when Zanani was bandaging her eyes, and she was not secreting any instrument inside them."

"I think I have the explanation of that too," says Clifford. "Did you notice that one corner of her mouth was covered with the handkerchief? In fact she arranged that herself."

"Now you mention it, I *do* remember noticing it," answers Weston.

"And," continues Clifford, "I feel sure the receiver was in her mouth. She had a similar aerial to that of her husband, but with a jigger in the middle, with the secondary wound for some kind of oscillation rectifier, probably a crystal or combination of crystals. The direct current produced was taken to the receiver in her mouth by two wires. They were probably flesh-coloured and there from the beginning; but the actual receiver is the smartest thing of the lot. Any elementary book on electricity will give you the various known methods of detecting electric current, and when all are considered there is only one, in my opinion, that could be used in this case, and that is the physiological one. The lady felt the messages, or rather tasted them. One of the first experiments I ever did in electricity was at school. In the first chapter of our class book on electricity it describes a simple experiment of putting a copper coin under the tongue and a silver one on top. Nothing happens until they touch, when a coppery taste is noticed. 'That,' says the book, 'is due to the electric current passing through the tongue.' Now, applying that idea to our lady, let us assume she possesses false teeth."

"Ah, ha!" chuckles Weston. "I understand. I will finish the tale. Two wires from the rectifier enter her mouth and are attached to her dental plates."

"Just so," said Clifford; "it is the old experiment reversed. Current is supplied to the plates from an outside source, and the plates need not be dissimilar in material in this case, I suppose. It may be the lady receives the messages in a series of neuralgic pains or spasms. But I am not sure it was all done that way," says Clifford, "although it seems to me the most probable.

Would you care to join us next Saturday evening, say, first for dinner at seven-thirty at Frascati's?"

"Rather!" cries the correspondent. "A thousand thanks for the chance. Shall I want my revolver?"

"Yes, you might bring it," says Clifford, "it is sometimes a good argument; and you might also bring with you two forks and a spoon."

Well, anyway, I think we've done a pretty good night's work and thrown an unexpected bombshell into the Zanani camp. Now, Weston, Holland and I have been experimenting on similar lines with another physiological receiver, and I have something rather more serious to propose. This time it may be dangerous, and will most certainly prove exciting.

"WIRELESS WORLD" INDEX AND BINDING CASES.

The Index to Volume I. of THE WIRELESS WORLD is now ready, and will be sent free of charge to any reader requiring a copy, provided a penny stamp is sent with the application to cover cost of postage.

Cloth cases for binding the first volume of THE WIRELESS WORLD have also been prepared, and these are on sale at 1s. each (postage 3d. extra). A limited number of bound copies of Volume II. of THE WIRELESS WORLD are available, price 4s. 6d. net each copy (postage 6d. extra).

Applications for binding cases and copies of bound volumes should be sent with full remittance to the Wireless Press, Ltd., Marconi House, Strand, London, W.C.

A WIRE WINDING "PEN."

By P. J. PARMITER.

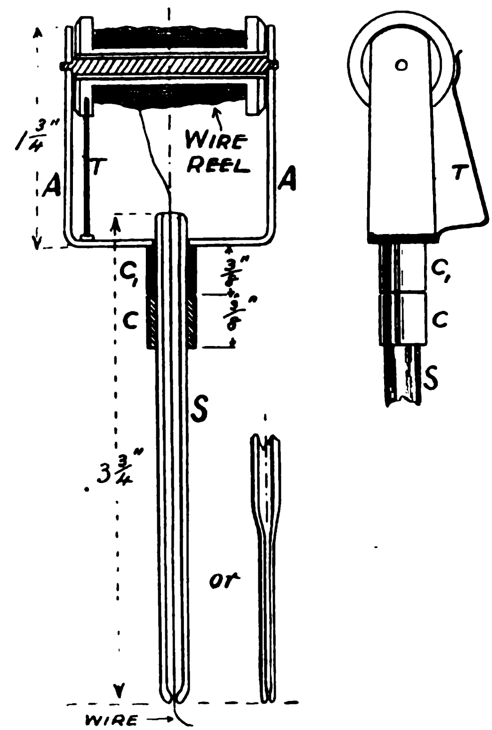
IT often happens that the wireless experimenter is faced with the problem of having to wind a given quantity of fine wire around two or more mandrels having a limited space between them. For this purpose the wire "pen" may prove useful. As can be seen from the dimensioned sketch, it consists of a glass stem, S, having one fixed and one loose brass collar (C C_1 respectively). To the loose collar is soldered a strip of stiff brass about ½ inch wide, bent twice at right angles, and having a hole through which the glass stem can freely pass. Two smaller holes take the short axle on which the reel of wire can turn easily—for which object it may be bushed with a short length of brass or glass tubing.

The length of the arms, A A, should not be less than their distance apart.

The glass stem may be purchased at a chemist's for 1d.; its ends are rounded off by heating in a Bunsen flame (turning the tube meanwhile), the lower end being heated until only a fair-sized pinhole remains.

The opposed edges of the brass collars should be quite smooth, so that the upper one can turn easily. The lower one, C, is fixed to the glass by Canada balsam, which, by the way, is about the best substance to use for small "brass to glass" jobs.

The use of the device is self-explanatory, the points which make for its efficiency being free movement of the reel and correct



height of the arms, A A; it will then be found of service in small jobs with wires of No. 36 and under. A feeble spring, T, may be added if so desired, as it will assist in keeping the wire taut.

WIRELESS CONTROL SHIP.

According to the *Journal Télégraphique*, the United States Government has equipped a vessel with apparatus for quickly measuring wave-lengths; it will cruise in the Atlantic, and will ascertain whether wireless stations conform to the rules relating to the wave-lengths that they must use. It has been noticed during the past year that the regulations are often neglected. The control ship will also take steps to prevent the emission of alarm signals in cases that are not urgent, as has often happened.

The Amateur Handyman

A COMPACT WIRELESS RECEIVING SET.

By J. STANLEY.

In the following article I hope to have succeeded in explaining and giving ample instructions to enable any amateur to construct a wireless receiving set similar to the one I have made, and which will pick up the weakest amateur signals, and also the largest commercial stations.

The set is enclosed in a box 12 in. by 12 in. by 10 in., which contains everything necessary—viz., a loose coupled inductance, 3 variable condensers, made up of 26 separate condensers, 4 detectors, potentiometer, battery, and 'phones. The whole is worked from the top board by means of switches, thus giving the maximum of variations with the minimum of trouble and time.

To commence work.—First construct a strawboard tube with wood ends, 10 in. long and 5 in. diameter, well shellac over all, and when dry mark the length out into 12 equal spaces, as in fig. 1. Then sub-mark the first

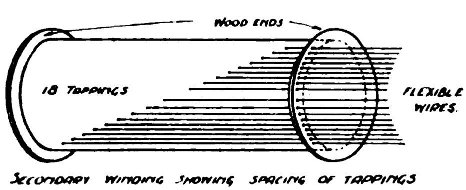


Fig. 1.

of the 12 spaces into 6 equal parts, and begin winding very closely and evenly as much No. 38 S.W.G.D.C.C. wire as it will take, leaving a small twisted loop about ¾ in. at each mark on the tube, which, when finished, should have 18 tappings, including both ends, well shellac, and let dry. Then bare the ends of tappings for about ½ in., twist, and solder to each one a length of about 18 in. of single flexible wire to allow of connections to studs. It is best to strip off the cotton covering on the flexible, leaving only the rubber insulation, and, where the wires are soldered, it is essential to insulate well from each other by means of a small piece of rubber tube. This done, shellac over all again and let thoroughly dry, when it can be

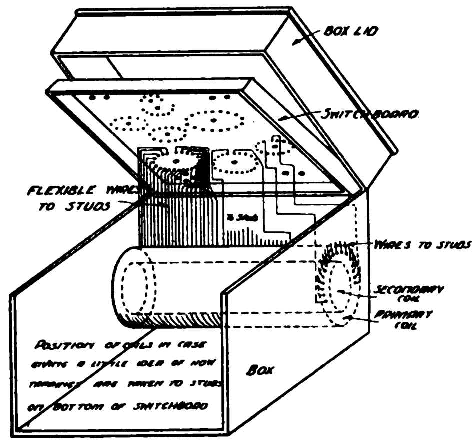


Fig. 2.

handled without fear of injuring the windings. This will complete the secondary winding.

Next prepare 2 hardwood circles 6 in. diameter, drill 18 holes ⅛ in. apart and ¼ in. from the edge in one of the pieces, and screw to the ends of the secondary coil, taking care to get the holes on top on the right-hand side of coil, that is the finishing end, then thread the flexible wires through the holes already made (see fig. 1), bunch together and tie up, in order to protect them while winding the primary, which is made as follows:

Obtain another piece of strawboard, 11 in. wide and 20 in. long, tack on to the edges of the 6 in. wood circles, and so form another tube with the secondary coil inside, leaving only the 18 tappings outside through the holes, shellac well and dry, and commence winding on No. 28 S.W.G.D.C.C. wire, leaving a twisted loop every second turn, up to 51 complete turns, which will mean 26 tappings, then mark out the remaining space on coil into 24 equal widths and finish winding, leaving a loop at every mark, making another 25 tappings — in all 51 tappings—shellac well, and dry, when it can be mounted in box, which can be made of any hardwood suitably prepared, about ⅜ in. to ½ in. thick.

Coils may be secured by screws to the sides of box, care being taken not to let it touch either the bottom or back (see fig. 2). Obtain a piece of ebonite, 12 in. square and about ⅛ in. or 3/16 in. thick, cut to fit inside the top of box flush with the top edges, then mark out circles for studs, switches, and terminals (positions and numbers of which can be seen on photograph of switchboard), drill all holes, and screw on ½ in. by 1 in. frame, all round the bottom edge of the ebonite sheet, which, by so doing, will be strengthened and kept flat, then fix the board by means of hinges to back of box, as in fig. 2.

The detectors are made as follows: Obtain or make 4 pieces of angle brass, about 2 in. by ⅜ in., drill hole on the top and bottom,

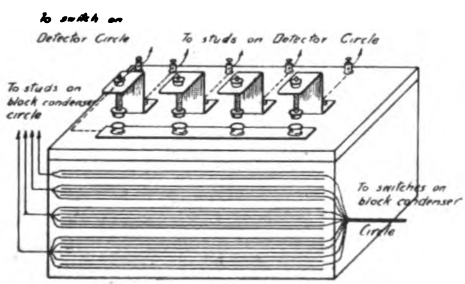


Fig. 3.

and screw on to a hardwood base 4 in. by 3 in. (as in fig. 3), about ½ in. from the back edge and equal distance apart, then obtain 8 ½-in. brass screw caps from any gasfitter's, and drill a hole in 4 of them centrally, solder an ⅛-in. brass thread about 1½ in. long in them, then place a brass spring on, put into angle brass and screw a small terminal on top. The other 4 caps can be soldered on a brass strip equally apart, and connections taken to terminals on back of base, as in fig. 3, which will enable detectors to be easily detached.

The crystals are put in a piece of tinfoil and screwed in cups, which will hold them very tightly, thus doing away with the need of soldering them in, which I think spoils their sensitivity. The block condenser is really 4 condensers of different capacity, being 3 plates 4 in. by 2 in., 5 plates, 7 plates, and 9 plates respectively, connections taken to studs and switches on board, which will allow of any one condenser to be used, or almost any value from the smallest up to the full capacity of the two largest, to suit any phones. They are made in the usual way, interleaved with mica or waxed sheets, and connected as in fig. 3.

The other 22 condensers, 11 each for the primary and secondary circuits, are made up of thin zinc (obtained from an export match case) in the usual way, and consist of No. 1, 3 plates 1 in. square; No. 2, 3 plates 1¼ in. square; No. 3, 3 plates 1½ in. square; No. 4, 3 plates 1¾ in. square; No. 5, 3 plates 2 in. square; No. 6, 3 plates 2½ in. square; No. 7, 3 plates 3 in. square; No. 8, 3 plates 3½ in. square; No. 9, 3 plates 4 in. square; No. 10, 5 plates 4 in. square; and No. 11, 7 plates 4 in. square. Solder on flexible wires, long enough to reach the studs, and number them as you go on so that you get them to the proper studs, assemble, and box up, connections to be made as in fig. 4—viz., No. 1 condenser to the second stud on primary circle, and so on. Make another set exactly the same for the secondary circuit, and repeat the connections to the secondary circle.

The potentiometer is very simple, being a length of high-resistance wire wound on a wood roller with wood ends, and 12 tappings being soldered on, one on every second turn, and the 2 ends to terminals on top.

An insulated double switch will be required for the secondary studs, to enable the user to pick out any one or number of sections, and by turning the contacts round towards the last stud (keeping them the same distance apart) you vary the distance of that particular section or sections in relation to the primary, thus varying the

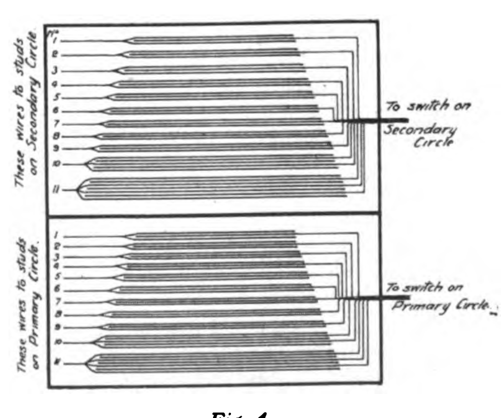


Fig. 4.

coupling. The small change-over switch is used for placing the primary condensers either in series or parallel.

The double switches (not insulated from each other) on the block condenser studs will enable you to use any one condenser, or almost any value up to the full capacity of the two largest.

The contact switches and studs can be bought of almost any electrical dealers, or can be turned up in the lathe, and are very simple to make. Six switches and about a gross of studs are required; the other two small switches can be made out of any scrap you may have to hand. You will also require six good-size terminals, two each for battery and 'phones, and one each for aerial and earth.

When all parts are made and assembled, the connections are made as follows: Connect up the flexible wires from the primary coil, the first wire to the first stud on the primary circle of studs, and so on up to the last wire of the small sections, then the first wire of the larger sections on to bottom of switch on primary circle, the second wire to the second stud on large primary circle of studs, and so on up to the last, leaving the first stud dead, then on to switch of large primary circle a wire straight to the terminal, E, then the first wire of secondary on to the first stud of secondary circle, and so on up to the last. The connections of condensers are, first wire to second stud on condenser circles, and so on, and the bunched wires to the switches, thus by using the switch you can pick out any one condenser, making them variable.

The potentiometer is connected in the same way, as are also the block condensors and detectors, and all other connections are to be seen in the diagram.

The lid of the box can now be made and hinged on and the whole box then finished to suit the maker's taste.

The aerial is 30 ft. high by 38 ft. long, two-wire spreader type using No. 20 S.W.G. bare copper with a lead to instruments of about 20 ft., the water pipe being the earth. 'Phones used are 3,000 ohm resistance, being bought secondhand, and the results obtained are all that one can desire, Paris and the Admiralty being read with the 'phones lying on the bench, and, as to tuning, either station can be tuned out at will, when both are sending together.

WAVES

Thoughts inspired by a Lecture given by Dr. Erskine-Murray before the London Wireless Society.

> "No rock so hard but that a little wave
> May beat admission in a thousand years."

IT seems a little strange that an abstruse subject like wave motion should be demonstrable by such homely analogies as were used to illustrate Dr. Erskine-Murray's lecture on "Waves" before the London Wireless Society last month. The royal and only road to a lucid understanding of wave-motions is to visualise them by studying the simple analogies which are always more or less readily available. Dr. Murray showed clearly how fascinating such a study might be made.

What he said and did has been referred to in another place (see page 41). Our purpose here is rather to refer to what the lecturer seemed merely to hint at. His suggestions regarding the psychological effects of wave-motions on individuals must have set many of his audience thinking along quite original lines. He cited the soothing effect of the wave-motion called waltzing and the thrill imparted by the "roll" of the kettle or side-drum.

The lecturer's references to, and illustrations of, the complicated wave-forms involved in speech and music were especially interesting in view of the developments now taking place in radio-telephony. Although the sound waves of speech and music are periodic motions of the air, it is on the ether waves that their complicated forms have to be impressed for transmission in radio-telephony. Radio-telegraphy employs only groups of comparatively simple waves.

We have, perhaps, all some more or less complicated wave-forms as peculiar to ourselves as our thumb-prints. Would not such a theory account for the very peculiar effect some musical airs have on individuals? For instance, Handel's Largo and some of Grieg's works have a deeply emotional effect on certain persons.

One might conclude that Adelaide Proctor, when she wrote the "Lost Chord," had a sub-consciousness of this phenomenon. The words "came from the soul of the organ and entered into mine" may well have a scientific explanation. The same underlying idea or principle may unconsciously have inspired the writer of the frivolous song in *The Chinese Honeymoon* about someone's favourite "twiddley bit."

The writer was once on a ship the captain of which was, very properly, a strict disciplinarian and the wireless operator a good pianist with certain other qualities. The operator had studied the musical susceptibilities of the captain and other officers, and would sometimes make them the unconscious subjects of much fun by improvising music which included the "twiddley bits" by which each were respectively most affected. On occasion he would succeed in warding off trouble with the same persons by similar means.

Many commonplace periodic motions which have never been suspected of a scientific explanation occur to one. We do not rock the baby's cot for nothing, nor is it from caprice that the baby is most soothed by a periodic motion of a particular frequency.

It may be that some day what is now regarded as a cranky theory will become an exact science, and one would like to know what Dr. Erskine-Murray thinks of the possibility.

AN AUSTRALIAN INCIDENT

Hospitality Repaid by Treachery.

IN our last number we devoted considerable space and prominence to emphasising the necessity for wireless amateurs placing themselves unreservedly in the hands of the British authorities with regard to their apparatus. We trust that our appeal, grounded on patriotism as well as self-interest, will have been effective. Our attention has recently been called to a paragraph in this connection which was cabled over from Australia. At Melbourne, as recently as an early date in March, the military authorities seized a wireless plant at the residence of an employee of the Western Electric Company named Bleeck. The man was of German parentage, in constant touch with his relatives in the Fatherland, to which country he was in the habit of paying frequent visits. The fact that this discovery only occurred eight months after the war had been in operation points to the necessity for continuous and unceasing vigilance.

Waves and Wave-emotions.

Among the Wireless Societies

Notes on Meetings and Future Arrangements.

Wireless Society of London.—Dr. J. Erskine-Murray, F.R.S.E., gave a most interesting lecture at the meeting of the Wireless Society of London on Tuesday, March 9th, on "Waves." The lecturer did not go into any of the properties of electrical waves nor their functions in wireless telegraphy, but gave a discourse on the subject of waves in general, and merely hinted here and there the analogy between waves produced mechanically and electric waves. The various simple experiments demonstrated the lecturer's points without the aid of mathematics of any kind. Waves, explained Dr. Erskine-Murray, are enormous in number and enormously important. There are sea waves, sand waves, light waves, heat waves, electric waves; all of them periodic motions. There were cases where the periodic beat of a steam engine in a factory got into time with the natural spring of the floors, and if that went on for any length of time the building would inevitably come down; indeed, that had actually happened, owing to the superposition of the slight impulses of the engine on to the natural vibration of the building itself. This showed, he said, how important it was thoroughly to understand waves. A first and most important property of waves, especially in wireless, was to understand that they can cross each other at any angle whatsoever without in the least disturbing each other. This was demonstrated in an interesting way by ripples on water. Dr. Erskine-Murray said this explained why any number of sending stations near one another do not interfere with each other. The water experiment, projected on the screen, showed the waves distinctly crossing each other without the least interference. The motion of wind on water was next considered, and the fact that the formation of waves is a to and fro motion was explained. The same was true, said the lecturer, of electric waves. It was not a mass of electricity rushing along, but a to and fro motion, a motion transverse to the direction of the waves. Finally, consideration was given to the effect of one vibrating body on another. This was demonstrated by springs of different sizes and by weighted rods. When motion was transferred from one to the other, the vibratory motion went on until all the energy has been used up in friction. In the same way, the discharge of an electric spark did not cause the motion of the electric wave to come to an end. Further experiments illustrated mechanically the effect of an oscillatory circuit, and showed how the energy was first transmitted from the primary to the secondary and back again from the secondary to the primary. The last experiment was with oscillators operated by water waves, the object being to show how a vibrator picks out its own set of waves, corresponding to tuning in wireless telegraphy.

* * *

Bristol Wireless Association. — A special meeting of the above Association was held at 8 p.m. on Saturday, February 13th, at 141, Redland Road. Those present included Mr. A. C. Davis, who acted as deputy chairman in the absence of Rev. W. P. Rigby, also Messrs. Davis (Junr.), Duggan, Eason, Elkins, Parsons, White, Fawcett and Noble. After considerable discussion it was decided not to join the Model Engineers' Society this year, but, should occasion arise, the matter would be further discussed at the next annual general meeting of the Society of Model Engineers, and terms of amalgamation would be agreed upon. Mr. Davis consented to read and explain the first instructional article in THE WIRELESS WORLD at the next meeting. Messrs. Léfebure, Duggan, Parsons and White were elected members of the Association.

* * *

Institute of Radio-Engineers.—At the annual meeting of the Institute, held at Columbia University on January 6th, the election of the following officers for 1915 was announced: president, John Stone Stone; vice-president, Dr. Geo. W. Pierce; treasurer Warren F. Hubley; secretary, David Sarnoff; managers, Dr. L. W. Austin, John Hays Hammond (Junr.), Robert H. Marriott, Guy Hill, Geo. S. Davis and Roy A. Weagant. Dr. Alfred N. Goldsmith continues as editor of publications, and three additional managers from the New York membership are to be appointed by the Board of Direction.

The Institute held its regular meeting at Columbia University, New York, on February 3rd.

Mr. John Stone Stone delivered a presidential address and a paper on "The Effect of the Spark on the Oscillations of an Electrical Circuit." The paper described the theory of oscillating circuits having sources of both linear and logarithmic decrements within themselves. Among those who discussed the paper was Professor Zenneck, of Germany.

The reading of the paper on "Wooden Lattice Masts," by Cyril F. Elwell, chief engineer of the Universal Radio Syndicate (Poulsen System), of England, which was postponed at the previous meeting of the Institute, followed Mr. Stone's paper.

Mr. Elwell's paper gave in detail the design, construction and guying of lattice masts.

* * *

Liverpool Wireless Association.—Meetings of the above association will be held at Creamery Café, 56 Whitechapel, on April 1st, 15th, and 29th. Free classes are held in "Electricity and Magnetism" and "Ordinary and Wireless Telegraphy."

* * *

Stoke-on-Trent Wireless Club.—We are informed by the secretary of the above club that, owing to the fact that the late secretary, Mr. Frank Gamment, has joined the Royal Navy as Electrical Artificer, and to other reasons connected with the war, it has been decided to temporarily suspend the business of the club.

* * *

Barnsley Amateur Wireless Association.—The above association held their annual meeting on March 3rd. The following officers were elected for the ensuing year: chairman, Mr. E. Harding; treasurer, Mr. J. A. Carr; secretary, Mr. G. W. Wigglesworth. During February the usual Morse practice took place and also the study of the theory of "wireless." The hon. secretary, in writing of the latter, says: "I "should like to remark how much we "are benefiting by the study of theory. "Many old ideas on the subject have been "exploded, and we find the more we learn "the more there is to learn."

WAR NOTES.

By Our Irresponsible Expert.

Extract from German Wireless Handbook: "Operators on Zeppelins, when getting into communication with land stations, must send in their "TR" the following information: distance, bearing, course, speed, and number of bombs."

"The following abbreviations may also be used:—

"*Question.* QVA? Have you killed any children? ANSWER. QVA7. I have dropped bombs on seven children.

"*Question.* QVB? How many cabbage patches have you injured? ANSWER. QVB3. I have injured three cabbage beds and one brussel-sprout.

* * *

KINDNESS OF BRITISH TOMMIES.

On several occasions recently our soldiers have helped the German aeroplane operators to get a good earth. Strange to say, the operators when picked up have shown very little gratitude.

* * *

German wireless will in future be known as the Telefunking System.

* * *

GREAT WAR CONUNDRUM.

How often is Poldhu? ANSWER: Every Nauen then. (Copyright in civilised Europe and also in Germany.)

* * *

Another rumoured Defence of the Realm case. Three months for a man for possessing a Morse Key and a Noah's Arc.

Wireless Telegraphy in the War

A resumé of the work which is being accomplished both on land and sea

THE paragraph from *Indian Engineering* reprinted in our issue for March, on page 789, has brought us a letter from the Netherlands Legation in London, as well as several letters from correspondents of Dutch nationality.

The Netherlands Minister informs us, by order of his Government, that the article from *Indian Engineering* about the Dutch wireless station at Sabang is contrary to truth, and states that the radio-telegraphic station at Sabang, Poelve Weh, is not a German station, nor is it served by German telegraphists. The establishment was installed originally by a German company (Telefunken), but the station belongs to the Netherlands Government, and since the opening for the public—September 8th, 1911—it has been served exclusively by Netherlands Indian officials who all are Netherlands subjects.

As is the case with all the other Government stations, the most scrupulous care is taken at Sabang that not a single telegram is sent which should be contrary to the strict neutrality which the Netherlands have declared to maintain. The most explicit instructions in the matter have been given.

Our private correspondents also have made very clear the careful precautions taken to prevent the possibility of any abuse, in the enemy's interests, of the facilities of wireless in the Dutch colonies.

We are pleased to take this opportunity of saying that the goodwill and sense of fair play manifested by Hollanders is as much appreciated by the wireless world as by all sections of the British community, both at home and abroad.

* * *

The thrilling account of the Falkland Islands engagement which we were able to print on pages 766–8 of our March issue has not unnaturally attracted considerable attention from the daily Press, and has brought many congratulations direct to this office. War is a great teacher of geography, and it is quite likely that, until this British naval victory occurred off its rocky coasts, a large number of newspaper readers would have been puzzled to give even a general indication of the whereabouts of this interesting British colony in the South Atlantic. It is instructive to note that the Falkland Islands group was first sighted by the British explorer Davis, in 1592, and received its present name, about one hundred years later, from another British navigator, Captain Strong. Twice occupied by France (1764 and 1770), it was purchased, in the eighteenth century, by Spain, who, immediately after spending her money, was compelled to surrender her claim by an ultimatum from the British Government. Between 1833 and 1852 it was utilised as a British penal colony, but this state of affairs came to an end at the latter date. Our illustration on page 44 will give some idea of the rugged nature of its coasts, and we cannot help wondering whether this resemblance to "Caledonia, stern and wild" accounts for the fact that the greater number of the settlers are Scotch. Our picture on page 45 depicts the outlying portion of Port Stanley, the wireless station, situated on Cape Pembroke, about two miles off. This was opened for public service on November 1st, 1913, and the night range thereof extends to about one thousand miles. A full description thereof will be found, under the title "An Outpost of Empire," on pages 81–84 of our May, 1914, number.

* * *

Reverting to the account of the naval engagement from the pen of Mr. W. D. Lacey, the wireless operator of the Falkland Islands station, we are not surprised to find that the imaginations of a large number of people have been fired by the incident, first recorded in this account, of the "Nelson touch" of Admiral Sturdee, with which he followed up the example of the "England expects" message which preceded the victory at Trafalgar. The fleet under the command of our modern hero signalled as they passed into the engagement the wireless message "God save the King." We have since had this interesting item supplemented, through a source of irreproachable reliability, by a few further details. It appears that the British admiral proceeded to his task with all the calm composure of his race. When the approach of the German squadron was first announced his ships were engaged in coaling. He ordered work to cease, and issued instructions that every man should have a bath and his dinner before proceeding to "business." In the meantime the vessels steamed towards their enemies at half speed, and it was not until the seamen had been thoroughly refreshed that the men-of-war, in turn, were put in fighting trim. Then followed the order to steam at full speed for the engagement with their foes. The deliberation of the whole procedure indicates the absolute confidence of the British Commander in his arrangements. Incidentally, we may remark, it was ascertained from some of the prisoners taken that, when first the German Admiral heard that the British ships advancing to meet him bore the unmistakable appearance of battle cruisers of the first line, he absolutely refused to believe his men's report, so effectually had been kept the secret of their despatch and arrival.

* * *

An interesting article, which has been followed up by correspondence, appeared recently in the columns of our esteemed London evening contemporary the *Globe*, dealing with the subject of the danger of the misuse of wireless telegraphy in the interests of the enemy. Of course, the more powerful the machine one possesses the more efficacious it is for misuse as well as use. But, on the whole, considering the fact that wireless telegraphy has practically entered into every phase of the present struggle, the amount of misuse has been extremely small.

The well-known author Mr. William Le Queux, one of the *Globe's* correspondents, narrates the steps taken by the authorities in consequence of a report by himself, and suggests further surveillance of German spies in England. The following letter, from Professor A. A. Campbell Swinton, appears to "put the matter in a nut-shell." We have pleasure in reprinting it:

"As President of the Wireless Society of "London, Hatton Garden, and acquainted "with the facts, I should like to be allowed "to say that most of the statements made "by your anonymous medical corre-"spondent are untrue, and others are "altogether misleading. For instance, it is "contrary to the fact that any German, "naturalised or otherwise, has ever been an "official of the Wireless Society, which, "moreover, is well known and includes "among its members the majority of the "most eminent exponents of wireless tele-"graphy in the country.

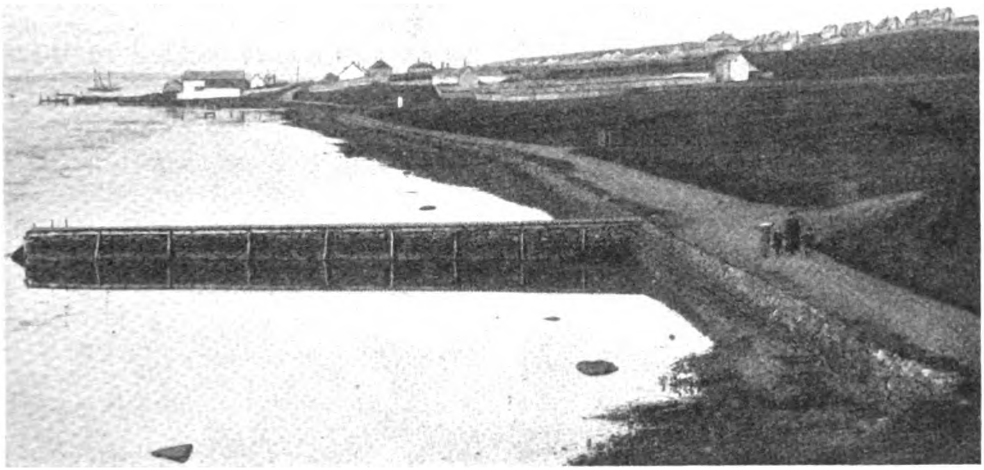
"It is also entirely incorrect to suggest, "as does your correspondent, that the "authorities have been supine as regards "illicit wireless telegraphy since the breaking "out of the war. On the contrary, I am in "a position to know that they have been "most active, while it is also within my "knowledge that they have most carefully "considered all aspects of the question "from time to time.

"I hope that the above is enough to "show how "little value "should be "attached to "your corre-"spondent's "alarmist "state-"ments."

* * *

On pp. 62 to 64 will be found some interesting particulars relating to the

The Rocky Coast of the Falkland Islands.



A Corner of Port Stanley Harbour.

fitting of wireless apparatus on air craft. The arrangement of wireless apparatus under such conditions presented, as may be easily imagined, considerable difficulties. These, however, have been largely overcome, as the following report from the General Headquarters of the British Expeditionary Force will testify :—

"The programme arranged for us began with a visit to the aviation park, within a short motor-car ride of the town. At this point the air patrol service is centred and controlled. A record is kept of every flight and its success or non-success, that is, whether information was obtained and proved to be correct, carefully tabulated for reference. Every aeroplane is tended by two mechanics, one for the engine and one for the planes and frame. The result of all this care is the gratifyingly small proportion of accidents among the Army airmen.

"A walk across muddy fields brings one to the quarters of the wireless aeroplane section. This section, divided into flights of four machines each, consists of *aeroplanes fitted with wireless telegraphic apparatus capable of transmitting signals to the receiving station at the aviation park.* It has been found possible, as the result of a wireless signal from the air, for the artillery to locate and hit a moving target before it could reach shelter."

* * *

Cousin Jonathan always likes to claim that he has the "biggest thing on earth." One of his recent achievements in the military line is a portable field station, which, employing only a 2 kw. generating set and an equipment capable of erection in ten minutes, finds no difficulty in transmitting eight hundred miles under favourable conditions. Exactly how this is done we are not told, but the Signal Corps Laboratory has been kind enough lately to allow the publication of just sufficient technical details (reproduced in the February *Wireless Age*) to arouse at once our wonder and our appetite for more.

* * *

WS. are the call letters of this station. They do not figure in the Government lists, but are stated to be unmistakable when in competition with the ordinary traffic. The station which was completed about five months ago, was built, with the exception of the motor which carries it, entirely in the workshops of the Signal Corps Laboratory at Washington.

The prime source of power is the 30 h.p. motor which hauls the van. This operates a 2 kw. Diehl generator with an output giving 110 volts at 500 cycles, which current is stepped up to 22,000 volts by a 2 kw. open-core transformer and discharged through the quenched gap mounted on the switchboard between the two seats. The normal radiation of the set is stated to be 16½ amperes.

American Army New Field Apparatus.

The arrangement of the plant, which may be checked on the illustration above showing the interior view of the operating car, is such that the switchboard and the instruments governing the primary current figure on the left side of the car whilst the receiving set is on the right-hand side. All the instruments likely to be affected by vibration are mounted on springs. Amongst those on the primary switchboard that are so safeguarded are a voltmeter, ammeter, frequency meter, wattmeter, field rheostat and primary relay.

A moulded mica condenser, edgewise-wound helices and loading coils are all mounted behind the switchboard and controlled by substantial handles. In the centre of the board is a hot-wire meter. The receiving set consists of a "doughnut" tuner, two variable condensers, two very simple detectors, which are stated to work to perfection, a pair of 5,000-ohm phones and the necessary switches. The crystals used are galena, cerusite, and a new substance known as "silicite."

The aerial, which is the outcome of prolonged experiments under service conditions, is of the umbrella type. It is supported when in use for average work upon a 85-ft. mast built of sections and has been erected in ten and a half minutes. For long distance work the mast is raised to 110 ft. The earthing arrangements, as improved by experiment, consist of insulated wires radiating out in all directions from a central socket into which each wire plugs. The extreme end of each wire is firmly fastened into moist ground. In actual operation the telegraphist, after receiving his call, signals to a private to start up the motor which drives the generator. He then throws the change-over switch, and directly his meters show the plant to be running satisfactorily he starts sending. When the message is despatched the motor is stopped. The operators are proud of the fact that, although the car is violently shaken when the generator is running, the detector invariably remains in adjustment. The detectors are shunted with a 5 mf. condenser when sending.

* * *

How far the most recent portable sets employed in the British Army can compete with this American "marvel" we may not speculate at this juncture. When war is over perhaps we may say things. In the meantime it is interesting to note that the application of wireless to Army purposes has so stirred the imagination of the public as to receive prominence in the Press. Half a page of pictures, for instance, appeared in the *Daily Call* on March 8th illustrating the work of the "wireless detachment" in the signalling section of the Westmoreland and Cumberland Yeomanry. Two pictures dealing with the same corps are reproduced in this issue (pp. 47 and 48).

Whilst it would be indiscreet to enter into details regarding this apparatus, reference to the Westmoreland and Cumberland Yeomanry's appliances is appropriate, for we believe that this regiment was the first cavalry unit to equip itself with a really efficient series of wireless sets at its own expense. We do not know what has happened since the outbreak of war, but we believe we are right in stating that up to August last the wireless sets owned and worked by these smart North Countrymen were regarded by the War Office as in the nature of a hobby and therefore not entitled to subsidy.

As officers and men have made the present set a common hobby, it may be taken for granted that every improvement within the limits of their ingenuity has been applied to it.

* * *

During a recent visit to the Front under official guidance a party of British journalists were shown the wireless and other stations employed in the rapid and secret transmission of messages. What they saw may be recounted at the end of the war or at some time earlier when the existing situation has changed, but it may not be out of place to recall the types of station employed by the armies of the world up to two summers ago. Generally speaking, they were of Marconi pattern and could be classified as long-range stations, intermediate-range stations, cavalry stations, landing stations—the two latter being modifications of the intermediate stations and short-range stations of extreme mobility.

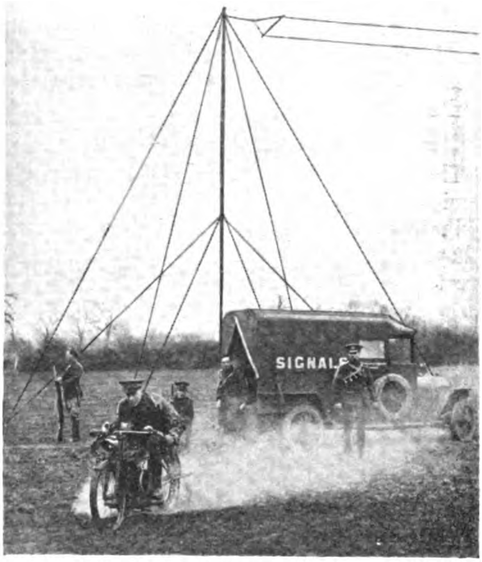
The largest of these had a range of about 200 miles and took eight men about ten minutes to erect. The prime mover was an eight horse-power specially air-cooled engine. The antennæ consisted of two woven wires about 500 feet long supported by two masts 70 feet high. The earth connection consisted of four strips of phosphor-bronze wire netting, each of about 90 square feet, laid on the surface of the ground. For the erection of the mast a derrick was employed. All the refinements invented for long-range work could be used with these stations, as weight within reasonable limits played no very important part.

* * *

The intermediate stations, although having a wider range of utility, lacked many of the refinements associated with the larger sets. They could be worked by fewer men, erected and dismantled in shorter periods of time, and be employed in most expeditionary works. The prime mover was a twin-cylinder engine of about 2½ h.p., the aerial 350 feet of wire supported on 30-ft. masts. When arranged for pack transport the engine and dynamo were mounted on either side of a rigid pack-saddle frame. By ingenious design no animal was given a load exceeding 200 lbs. This means that the whole equipment could be transported at a gallop if necessary. If required for landing purposes the apparatus was distributed so as to be divisible into loads of 75 lbs. weight. The range of these stations was usually about 50 miles, although with 70-ft. masts an increase up to 100 miles was possible.

The short-range stations, of which the "knapsack" variety was a type, were

British Yeomanry Field Equipment.



British Portable Aerial.

designed in loads of between 20 and 30 lbs. They could be carried by four men and worked effectively over 10 miles. An umbrella form of antenna was employed and primary batteries or accumulators used as the source of energy. Landing stations of the intermediate range variety are known to be included amongst the equipment of the Turkish Army.

* * *

The method of securing secrecy most strongly advocated by the Marconi Wireless Telegraph Company was that of changing the wavelength of the transmitter at frequent pre-determined intervals. This was made possible by the use of a change-tune switch capable of use with both transmitter and receiver. By careful pre-arrangement almost any variant of wavelengths could be secured, and if practised with sufficient frequency tapping became a physical impossibility.

* * *

As matters stand at present, there is scarcely any operation which is conducted without the use of wireless; even when our battleships are engaged in shelling the land forts of the decrepit Turkish Empire we read in our daily papers, quite as a matter of course, that the operations are directed by wireless from aeroplanes.

* * *

Some of us who take part in those informal Parliaments held daily in our "regular" railway compartments as we travel to town are not unfamiliar with the phrase "wireless lies," often uttered in a tone which appears to pour contempt not so much upon the "lies" as upon the medium from which they come. Now, nothing could possibly be further from the truth. *Wireless never lies.* What happens is that a great many unscrupulous people use this unique truth-teller for their own base purposes. A very good story has been told of Mr. Gladstone in connection with another branch of applied science. Mr. Gladstone once, in the House of Commons, laid down, with all the sententiousness natural to him, "photography cannot lie." Of course, in essence he was perfectly correct. Rays of light are correctly and *truthfully* reproduced by the sensitised plates, just as words are correctly and truthfully transmitted by the "waves" of radio-telegraphy. But one of the wags in the House of Commons proved the lying use to which photography might be put by producing, within twenty-four hours of Mr. Gladstone's pronouncement, a "faked" photograph of the G.O.M. showing the rt. hon. gentleman emerging from a Temple of Bacchus, within the purlieus of Seven Dials, in a state of jocund inebriety!

* * *

In the same way, use has been made by Teutonic manipulators of wireless telegraphy. If their statements were founded on fact, German siege guns would be almost within battering distance of the Statue of Liberty in the West and of Tokio in the East. Let us, however, remind our critical readers that this is not the fault of "wireless." The serious part about the situation is that, had it not been for German appreciation of the potentialities of radio-telegraphy, and their provision, accordingly, of high-power stations, the Central European coalition would, at this moment, be entirely cut off from the rest of the world, both in the matter of intelligence and power of commercial communications. But that, as the poet says, "is another story."

QUESTIONS AND ANSWERS

Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study to the Editor,* THE WIRELESS WORLD, *Marconi House, Strand, London, W.C. Such questions must be accompanied by the name and address of the writer, otherwise they will remain unanswered.

E. G. O. (Tollington Park, London) is going to make a receiver, and wants to know how big his condensers and inductances should be.

Answer.—You seem to be rather muddled about the functions of the inductances and condensers. The maximum distance from which signals can be received depends not only on the efficiency of the receiving station, but on the efficiency of the transmitting station; its power and other factors and the weather conditions, bright sunshine, and darkness also play their parts. Every time you alter the number of turns in your aerial-tuning inductance you alter the wave-length and make signals stronger or weaker, according to whether you were in or out of tune before the alteration was made. The same with the condensers, whether aerial or detector. The aerial condenser should be of fairly large capacity, say, ·01 mfd., and in the Instructional Article for December, 1914, you will find a formula which will give you good ground to work on. Your aerial might be very conveniently a twin wire of the lengths you state, with the wires 6 feet apart. In the February Instructional article you will find a method of arriving at the values of the wave-length, capacity, and inductance of the aerial, but for your convenience we have worked yours out. Your values are natural wave-length 322 metres, capacity ·000634 mfd., inductance 45 mbys. Further in this article you will find instruction in the determination of the value of the necessary inductance to increase the wave-length of your station to the value you desire. There is also some information on the calculation of the inductance of a coil. You would do well to read carefully the articles mentioned, and also the answer to G. P. (Widnes) in the February WIRELESS WORLD. For your detector circuit you require a condenser of, say, ·0004 mfd. maximum capacity. Having settled the wave-length you wish to receive, you can find the inductance from $\lambda = 1885\sqrt{LC}$, and then calculate the number of turns to put on your coil. A better way to arrange your circuits is shown in the reply to C. F. (Watford, Ontario), in the March issue. This shows the arrangement of potentiometer and cells. The water pipe should make a good earth.

J. W. (West Bridgford, Nottingham) asks questions about coefficients of coupling and the measurement of same.

Answer.—In the article you mention, it is stated that the formula given is not exact, but a close approximation. Dr. Fleming, in his book *The Principles of Electric Wave Telegraphy and Telephony*, gives the following formula:—

$$K = \frac{\lambda_1^2 - \lambda_2^2}{\lambda_1^2 + \lambda_2^2}$$

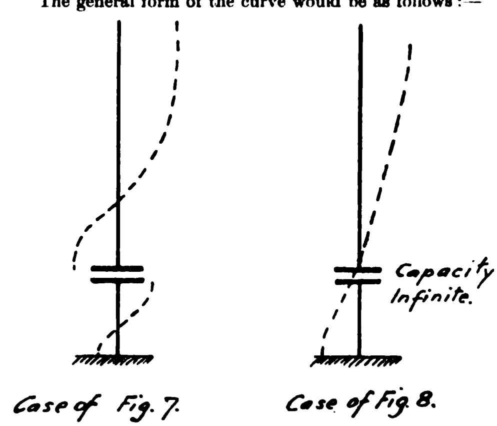
Where λ_1 is the longer wave emitted

λ_2 is the shorter wave emitted

K is the coefficient of coupling, and this coefficient is a fraction. It is necessary to multiply by 100 to give a percentage. Dr. Fleming also gives $2\ \lambda_0^2 = \lambda_1^2 + \lambda_2^2$. Where λ_0 is the wave-length to which both circuits are tuned separately. Taking the ship set as an example, if the primary jigger circuit and the secondary or aerial circuit are both tuned separately to a wave-length of λ_0, and then these two circuits are closely coupled together, two waves will be emitted λ_1 and λ_2. If now a wave-meter be applied, it will be found that there are two distinct points at which the instrument tunes. These two points being the position on the wave-meter for λ_1 and λ_2. Substituting these values in the above equation and working out we have the value of K. It is wrong to suppose that the true wave-length is the mean of the two wave-lengths measured by the wave-meter. You will find in the article you mention some information of this description. If two circuits were fully coupled, the two resultant waves would be so far apart that one would be sensibly zero, and the only wave-length left would be $\sqrt{2}$ times the wave-length to which the two circuits were tuned separately. Taking the second formula $2\ \lambda_0^2 = \lambda_1^2 + \lambda_2^2$: let λ_2 be vanishingly small, then $2\ \lambda_0^2 = \lambda_1^2$ and $\lambda_1 = \sqrt{2}\ \lambda_0$. It will be seen from this formula that the square of the tuned wave-length equals the mean of the sum of the squares of the resultant wave-lengths. For your other query the best way of obtaining first-hand information is to write to some of the schools and ask for their prospectus.

"BOULANGE" enquires as to what form the voltage-distribution curve would take for the aerials illustrated in Figs. 7 and 8 of the instructional article for the July, 1914, number, when the condensers at the base of the aerial are connected to earth by long wires.

The general form of the curve would be as follows:—



The positions of the nodes would depend on the relative lengths of aerial and earth wires and the capacity of the condenser.

"EXPERIMENTER" (Calcutta) is interested in telemechanics, and wants to use a coherer as a means to operate other apparatus. He evidently wants to arrange things so that one signal causes his remote apparatus to start working, and another signal causes some change in the working, or, perhaps, stops it. He also describes a coherer he made from a piece of glass tube with brass plugs and iron filings, but he says that this is extremely insensitive, and wants to make a more sensitive one

Answer.—Other people have adapted coherers to work as you suggest, and have taken out patents for their ideas, but altogether it is a rather complicated scheme, and too big to be handled in these columns. In the Marconi Company's fog-signalling apparatus there is an extremely ingenious idea, the great feature being that whilst signals sent at any irregular periods, such as ordinary Morse signals, will not affect the receiver, special signals sent at a certain frequency cause relays to operate and shut switches, and other signals sent at another frequency again work the relays and cause the switches to open. This apparatus was described in THE WIRELESS WORLD for June, 1914, and there was another article in the July number dealing with telemechanical problems. The study of these articles will, perhaps, give you an idea of the lines to work on, and it is always possible to get Patent Specifications describing previous ideas. Your coherer is, perhaps, rather roughly made and could be very well exchanged for a Marconi one. This doubtless would be much more sensitive than a home-made one.

A. J. A. (St. Albans, Herts) asks if he can use a coherer and bell instead of a telephone in his circuit; he also sends a sketch of his coherer.

Answer.—The coherer you propose to use is a form of one known as the Italian Navy coherer; but why use a coherer at all? To do such a thing for ordinary reception is certainly a step backwards. The first wireless stations were fitted with coherers, but as time went on these things gave place to more sensitive apparatus, and to-day the crystal and telephone combination holds its own in most cases against all comers. If you do use the carbon-mercury coherer in the manner you suggest, you will find it as well to use a very light vibratory apparatus, such as a high note buzzer, but we do not think you will get any satisfaction from your set, as the coherer you show easily gets out of order, is very liable to jamming, and you will not be able to distinguish one station from another by their respective notes. You will also find that you want a much higher voltage to work your buzzer in this manner than if you were working a buzzer in the ordinary way. Look up some of the back numbers of THE WIRELESS WORLD, and you will see advertisements for telephones which will be suitable in every way for your work.

THE APPLICATION OF WIRELESS TELEGRAPHY TO SMALL CRAFT.

THE problem of the equipment of small vessels with wireless telegraphy is one which has been receiving considerable attention from experts recently.

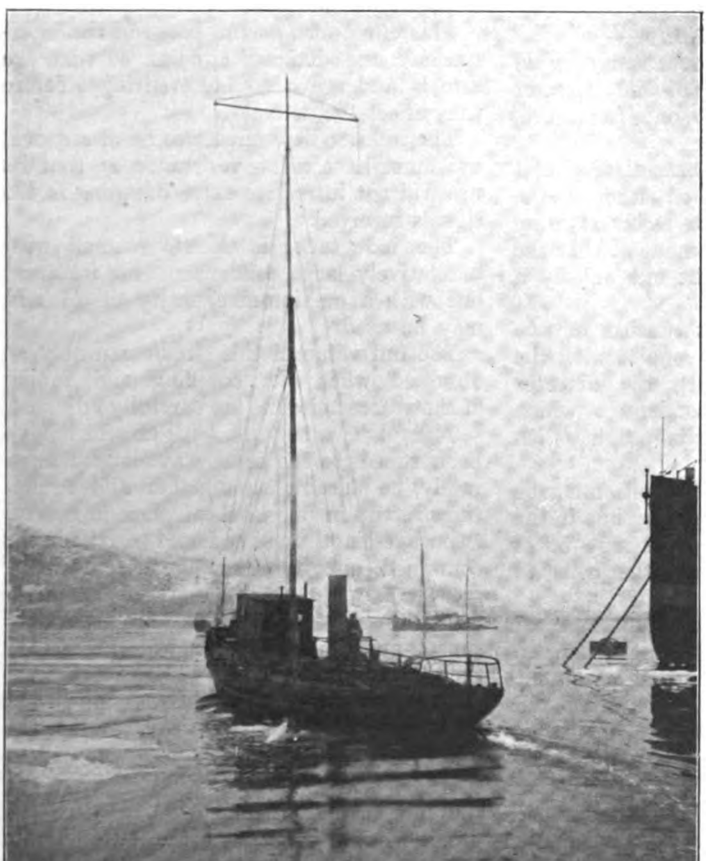
The main difficulty which confronts the designer of apparatus for this purpose is the restricted space available for carrying the antennæ wires. As is well known, a considerable length of aerial is required to obtain the utmost efficiency, and where the maximum aerial span has to be brought within the limits of a small vessel having, say, a total length of only 36 feet, the efficiency of the wireless equipment is seriously reduced. The same problem, of course, arises in the design of wireless apparatus for aeroplanes, where the length of the aerial wires must be brought within the limits of the maximum length of the machine from the front of the upper plane to the tip of the tail.

No doubt there have been many private experimenters who have fitted small power wireless sets of their own design to private motor boats and sailing boats, but, so far, the application of wireless to such small craft has not extended very far in commercial use. The reason for this may perhaps be traced to the fact that small craft would seldom have cause to employ wireless telegraphy, since their business would not usually require that they should be capable of inter-communication, or of communication with a base.

Not long ago, however, a new channel was opened up for the use of wireless on small craft. This was in the equipment of the motor lifeboats of the s.s. *Aquitania* with wireless apparatus. The equipment of this type of vessel was the result of a recommendation made by the Committee for the Safety of Life at Sea, and the object in view was to enable the motor lifeboats to keep in touch with one another in the event of disaster or mishap to the mother ship, and also to enable them to signal for assistance to passing vessels. The apparatus fitted to these lifeboats was designed by the Marconi Company and is capable of receiving on wave-lengths up to 600 metres and will transmit on a 300 metre wave-length. A description of this apparatus was given in the issue of June last of this magazine.

Three years ago a ½-kw. Marconi set was fitted to a Swedish motor boat attached to a fleet of fishing vessels. The motor-boat was able to communicate with the coast station at Gothenburg when the fishing fleet was thirty miles out at sea. This example forms a striking illustration of the adaptability of wireless to small vessels of this description.

From the foregoing remarks regarding the reliability of the service of wireless telegraphy when applied to small craft, it would seem that a new and important use might be made of small motor-boats fitted with wireless telegraphy and capable of travelling at a high speed. Such craft it would seem, might be used to advantage for the purpose of patrolling a coast in time of war on the look-out for any signs of hostile submarines or of the approach of raiding warships. Many vessels of this type could be built in the same time and at the same cost as one torpedo boat or torpedo boat destroyer, and, owing to the small size of the vessels, they would run but little risk of being torpedoed by hostile submarines, and would be able to communicate instantly with any ship or coast wireless station within a radius of, say, fifty miles, should any hostile craft be sighted. For the purpose of repelling submarine attacks these small craft might also be armed with a small quick-firing gun.



Swedish Motor-Boat fitted with Wireless.

SIGNAL SERVICE 1st LONDON DIVISIONAL ENGINEERS.

MAJOR GORDON RENNARD, R.E. (T.), has written to us asking us to draw attention in our columns to the following notice regarding the Third Signal Company of the Royal Engineers (Territorial Force), which is about to be raised. We have very much pleasure in acceding to his request.

"A third Signal Company will shortly be raised. Applications are required for enlistment from young, well-educated electrical engineers or electrical engineering students. Applicants should possess a practical working knowledge of some branch of the electrical industry, or have studied at some technical institute.

"The work of the Company being of a highly technical nature, the experience gained after some months' service renders a man more qualified for appointments in civil life.

"Most of the men are mounted, but those unable to ride will be taught.

"The pay and allowances are at the special Royal Engineer rates, with separation allowance to dependants.

"Applications for enlistment should be made, in the first place in writing, to the Recruiting Officer, c/o O.C. 2/1 London Divisional Signal Company, 10 Victoria Park Square, Bethnal Green, E."

INSTRUCTION IN WIRELESS TELEGRAPHY

(Second Course)

(IX.) The Receiving Circuit.

[The dislocation of our arrangements, due to the war, has prevented us from completing, in our last Volume, the second course of Instructional Articles. These are being continued in the third Volume, and we hope to arrange for the Examination (full particulars of which are given on page 333 of our issue of August, 1914) to be held in the early autumn of this year. The present is the ninth of the second series of articles, which will deal chiefly with the application of the principles of wireless telegraphy. Those who have not studied the first series are advised to obtain a copy of *The Elementary Principles of Wireless Telegraphy*, which is now published, price one shilling net, and to master its contents before taking up the second course of instruction.]

THE descriptions of the four types of receivers, printed on pages 801 to 805 of our March issue, were not affixed to the figures.

They should be read as follows :—

Fig. 1 is that of Receiver, type 3.
Fig. 2 is that of Receiver, type 4.
Fig. 3 is that of Receiver, type 1.
Fig. 4 is that of Receiver, type 2.

748. The fifth class of receivers consists of those in which the aerial and detecter circuits are coupled by one (or more) intermediate circuits.

The presence of this intermediate circuit does not alter the design of either of the other two circuits ; in fact, receivers using this arrangement are often made so that the intermediate circuit may be cut out by a switch if desired.

The intermediate circuit consists of two inductances, one of which couples with the aerial and the other with the detecter circuit, with a tuning condenser, which may be either in series or in parallel with the two coils.

In the latter case the two coils must be of exactly the same inductance, but if the condenser be in series the coils may be of different dimensions to suit the coils to which they are linked.

When in parallel the total inductance of the circuit will be half that of one coil, so that to design an intermediate circuit to receive a given wave-length with the coils in parallel each coil must have twice the value of inductance required by the formula $\lambda_m = 1885 \sqrt{LC}$.

When in series the total inductance is the sum of that of the separate coils, and hence they are made so that this sum gives the calculated value for the wave-length.

The object of the intermediate circuit is to increase the selectivity of the receiver for the signals required. This circuit being tuned to the same wave-length as that of the signals, the current in the aerial circuit produced by the signals gives a larger current in the intermediate circuit than would equal currents in the aerial which are of different wave-lengths.

This effect also occurs between the intermediate and detecter circuits, so that the signals undergo a double " sifting " before they affect the detecter.

The intermediate circuit to be of any real use must have a low resistance, so that its use will not introduce extra damping in the signals received.

The inductance is therefore small with a relatively large condenser ; for instance, one with a maximum capacity of ·01 mfd may be used.

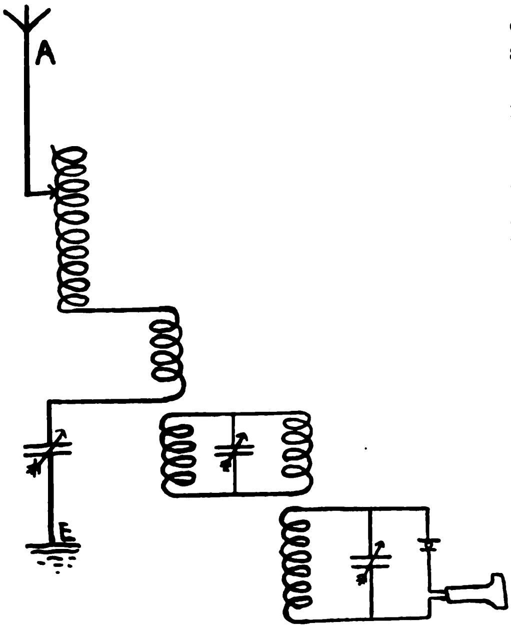
The full value of this circuit can only be obtained when the coupling and tuning of the various circuits are carefully adjusted.

749. If two circuits, both of which have been tuned to the same wave-length separately, be placed close together and oscillations set up in one of them, then in general two wave-lengths will be found to exist in the combined circuit. One of these will be greater and the other less than the wave-length to which the circuits were separately tuned, and this difference will increase as the two circuits are brought close together.

They are said to be tightly coupled, and if λ_1 and λ_2 be the two wave-lengths, the ratio $\dfrac{\lambda_1^2 - \lambda_2^2}{\lambda_1^2 + \lambda_2^2}$ is termed the co-efficient of coupling between them.

The coupling between the two circuits may be either electromagnetic or electrostatic, or both.

If the two circuits be coupled electromagnetically, then the coefficient of coupling for any arrangement can be calculated from the mutual inductance between the circuits for the given relative positions of their inductances and the value of self-inductance of these coils.



Receiver—Type 5.

The ratio $\frac{M}{\sqrt{L_1 L_2}}$ where M = mutual inductance between the circuits L_1 and L_2 = self-inductances of the whole of the coils associated with each circuit, is the co-efficient of coupling between the two circuits.

If the circuits be coupled electrostatically the co-efficient of coupling is $\frac{\sqrt{C_1 C_2}}{K}$ where K = mutual capacity between the circuits, and C_1 and C_2 the capacities of the two circuits. Receivers using pure electrostatic coupling are almost unknown, although various transmitting circuits employing electrostatic coupling have been designed.

Most receivers which are designed for electromagnetic coupling have a certain amount of electrostatic coupling as well; since two coils of wire placed close together will form the two plates of a condenser just as two metal cylinders will, and the circuits are coupled by this mutual capacity.

If, as in some receivers, the primary coil slides right inside the secondary, the electrostatic coupling between the circuits may be quite large.

750. When the two circuits are coupled both electromagnetically and electrostatically the coefficient of coupling between them depends on whether the two couplings are so as to assist or oppose each other.

In an article in THE WIRELESS WORLD for July, 1914, Mr. Pletts has worked out the coupling for such a case, and shows that if *m* be the electromagnetic and *s* the electrostatic coupling between the circuits, *k*, the coefficient of coupling between them which corresponds to that given by the two wave-lengths is $k = \pm \frac{m \pm s}{1 \pm ms}$.

It is also shown in the article that, from this equation, if either the electrostatic or electromagnetic coupling be tight, then, however loose the other may be, the resultant will be tight, and if neither be tight then the resultant will not be tight.

It is useful, therefore, to be able to calculate the maximum and minimum coupling which will be given by any receiver. For pure electromagnetic coupling we must know the total inductances of the two circuits—*i.e.*, not merely of the two coils by which they are coupled but of all the coils in the circuits. In most cases the inductance of the aerial and any straight leading-in wires is relatively small, and if so may be neglected.

The inductances may be worked out by the formulas already given.

We also require the mutual inductance between the circuits. This can be calculated from the dimensions and distance apart of the two coupling coils. It is not possible to give a formula, since the best one to use depends on whether the coils are close together, or far apart, etc. In a subsequent article we hope to give a table or curve by which the calculations may be facilitated.

It is important, however, to design a receiver so that the coupling can be made loose if required, since the ability to tune-out interfering signals depends largely on a proper adjustment of the coupling—a point which is often overlooked.

There is no reason why the whole of the aerial tuning inductance should not be used to couple to the detecter inductance provided it can be placed at a sufficient distance away to ensure weak coupling. For a compact receiver, however, it is usually better to use a separate coupling coil with an inductance such that it gives a good degree of coupling when the receiving circuits are tuned to the longest wave-length which is to be received.

A coupling of 10 per cent—*i.e.*, for which $\frac{M}{\sqrt{L_1L_2}} = 0{\cdot}1$, is quite strong enough for most purposes.

Receivers which do not permit a variation in coupling, such as those of Class II., cannot give such good all-round results as those which allow of an adjustment.

751. It is important to note that an idle coil of wire may reduce the strength of signals in a circuit near which it may be placed. As mentioned above, every coil has a distributed capacity which forms with it a circuit in which alternating current can flow. If the natural wave-length of the coil be near that of the circuit the amount of energy which it can absorb from it depends on the coupling between them. If the coils have a large mutual inductance the energy absorbed will be great.

In order for a receiver to be able to receive both long and short waves it is necessary to divide the secondary inductance into several sections, since, as has been pointed out above, it is not possible to use a very large capacity in the tuning condenser for the purpose. There are several methods by which this may be done :

(1) The inductance can be wound in a single continuous winding on a tube with tappings made at suitable intervals brought out to terminals or switch contacts.

(2) The winding can be in several distinct sections, separated by spaces, on the same tube, which are put in series for long waves by special switches.

(3) The coils can be wound on separate formers, which are either each sufficient for a special wave range or may be connected in series with leads.

This last method provides that the idle coils have no influence on the working ones, but it is not possible to make quick changes from one wave-range to another, which is sometimes desirable.

The first method allows change of wave-length to be quickly carried out, but the coupling between idle and active coils is as strong as possible. It should, therefore, not be adopted where the natural wave of the idle coil is as great as any to be received on the lower ranges. In this connection the fact that the natural wave is a harmonic of the other is nearly as detrimental as if it is the same. This method of connection will, in practice, be found to be unsuitable for coils of large inductance.

The second method is a compromise between the others, and by skilful adjustment of the inductance and mutual inductance values an efficient receiver may be constructed on this principle, with the advantage that it can quickly be set to any wave-length. It is to be noted that although mutual inductance is detrimental when it allows energy to be absorbed by idle coils, it is advantageous in that by combining two coils to form an inductance the value of inductance obtained is L_1+L_2+M, where L_1 and L_2 are the self-inductances of the coils, and M the mutual inductance between them. This means that L_2 has less resistance and costs less for wire than if its value was simply added to that of L_1, as it would be if they were connected at right angles to one another.

752. The principal parts of the receiver have now been dealt with. Before proceeding to consider the actual detecter and such instruments as the telephones, etc., used in connection with it, we will first touch upon one or two minor points connected with the receiver and then proceed to some calculations of the various circuits.

It is well known that there exists a difference of potential between the surface of the earth and the atmosphere at different levels above it. The gradient of this potential difference varies from time to time and becomes very great at times, as when a thunderstorm is approaching.

Due to this potential difference a current will flow in any conducting body, such as an aerial, which runs from the earth to any considerable height in the atmosphere.

This current is unidirectional and will not affect the detecter if the latter be associated with a coupled secondary circuit.

If the detecter circuit be direct-coupled to the aerial some of this current may flow through the detecter, and this, as will be shown in the article on detecters, may modify its sensitivity.

A detecter, such as a thermogalvanometer, placed directly in the aerial circuit will, of course, indicate the total current flowing through it, which includes this "static" current.

If, however, we are using a condenser in series with the aerial this unidirectional current will be checked and the condenser will be charged to a voltage which will vary from time to time, but which in general will be considerable and may easily reach a value sufficient to puncture the thin dielectric sheets of which the condenser is often constructed. To prevent this a coil with a very large inductance is connected in shunt with the condenser. The coil may be wound with fine wire, since the resistance (within reasonable limits) is not of importance, merely reducing the steady current flowing, but its inductance must be several times larger than that of any other part of the circuit, so that the oscillations due to the signals will pass through the condenser and not through the inductive winding.

This coil is usually called a static coil, as its function is to prevent a "static" charge accumulating in the condenser.

If the potential gradient varies rapidly, as often happens, the inductance will not be sufficient to protect the condenser, since it offers an obstruction to sudden variations in the current passing through it.

For this reason, and also to protect the condenser from strong "atmospherics," a spark gap should be connected to the two plates of the condenser.

It is advisable to connect another spark-gap across the aerial and earth terminals of the receiver to protect the inductance and condenser as a whole against strong atmospheric disturbances.

When the secondary coil is of large inductance it is as well to protect this circuit by a spark-gap across the condenser in the same way.

Care must be taken to keep all these gaps clean, as the smallest particle of dirt between them or even a film of moisture will weaken or cut off signals in a manner which will puzzle the careless experimenter.

We will next consider some calculations of various parts of the circuits which make up a receiving instrument.

PANAMA-PACIFIC EXHIBITION

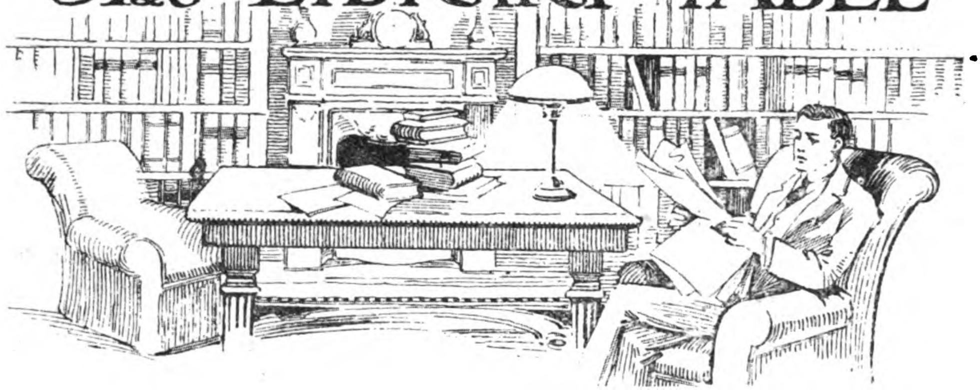
Formal Opening Ceremony Performed by Wireless from Washington.

WE can most of us remember writing copy-book maxims at school. One of the favourite exercises of our writing master laid it down that "Peace hath her victories no less renowned than war." It is owing to present circumstances, and the world-wide character of military operations, that we are continually referring to instances of the utility of radio-telegraphy in *warfare*. It is pleasant to turn for a moment to the more peaceful side of our existence and call attention to an occasion of a notable triumph of peace and wireless telegraphy. The commencement of working the Panama Canal has been fitly followed up by the opening of the Panama-Pacific Exhibition. President Wilson, with his numerous engagements, might have found it difficult to go down to the Isthmus in order to perform the opening ceremony; so wireless came to the rescue. At three o'clock, Washington time, on February 20th, the President of the United States closed a key, which sent a wireless signal, operating automatically, through the antennæ on the Tower of Jewels, in the exhibition grounds, and throwing open the Exhibition to the public. At the instant it was received the doors swung open, and the Mayor of San Francisco, heading a delegation of citizens, entered the Exhibition, the fountains began playing, and the wheels of the machinery turned. In sending the signal which officially opened the Exhibition, the President used a telegraph key studded with gold nuggets, which was used by President Taft in opening the Alaska-Yukon Exhibition. Several distinguished government officials were present at the ceremony.

. . . .

The Exhibition Company, the various States and nations and the concessionaires, have vested approximately $80,000,000 in buildings and work done. Including the value of the exhibits, it is estimated the Exhibition represents an investment of $300,000,000 or more.

The LIBRARY TABLE



AIRCRAFT IN WAR. By J. M. Spaight, LL.D. London : Macmillan & Co.

Dr. J. M. Spaight in his *Aircraft in War*, a book evidently written before the cataclysm of August last, insists, as Major Baden-Powell insisted ten years ago, that the advent of mechanical flight requires a modification of the Legal Code and even of International Laws. Dr. Spaight has anticipated this development by sketching out a code for aircraft in war, and by placing this code alongside similar proposals by eminent legal authorities in other countries. We can only hope that the time is quite near at hand when affairs of so international a character can be discussed in a manner that is fitting.

The volume, it may be emphasised, has points of direct appeal to the student of "wireless." Dr. Spaight is particularly well informed in all matters relating to the progress of aviation, and, as might be expected under the circumstances, makes allusion to the use of wireless upon aircraft. In advocating the sequestration of private enemy aircraft in a belligerent's territory at the outbreak of war, he points out that every aircraft that can fly can be employed in war to some useful purpose, such, for instance, as the transmission of information by wireless telegraphy. In support of his argument he points out that wireless installations shown at the Paris Exhibition of 1913 and Olympia, 1914, were said to have a range of 120 and 110 miles respectively "Seaplanes had actually sent wireless messages over 100 miles, and land aeroplanes over 50."

In suggesting regulations for controlling the use (by belligerent military aircraft) of wireless telegraphy stations erected on neutral territory, Dr. Spaight holds that the provisions of Articles 3, 8 and 9 of the Hague Convention on the Rights and Duties of Neutral Powers and Persons in Land War, and of Article 5 of the Hague Convention on the Rights and Duties of Neutral Powers in Maritime War, are applicable. For the information of any who may be interested, these articles were reproduced upon page 450 of the last volume of THE WIRELESS WORLD.

Leaving the "wireless interest," some excuse may be offered for reproducing Dr. Spaight's views on the possibility of an aerial bombardment of London. The author points out that history produces cases in which undefended cities have been grievously damaged by shells directed against Government stores therein. "International Law," he says, "enjoins the respect for the lives and property of pacific citizens in war time, but it recognises that non-combatants may have to suffer when they or their property are unlucky enough to be near a scene of operations or military stores and plant which the enemy has a clear right to destroy." "Still," he adds, "when all is said, to bombard a city like London from the air would undoubtedly be an extreme and unprecedented act of belligerency."

How strangely prophetic! London has not yet been bombarded, but since this book was written bombs have fallen on the peaceful villages of Norfolk and the fortified places of Kent.

The Wireless Transmission of Photographs.

By MARCUS J. MARTIN.

ARTICLE I.

IN THE WIRELESS WORLD, Vol. 2, Nos. 22, 23, 24, the manner in which photographs and drawings are prepared and transmitted by the aid of "wireless" has been fully explained, and in this series of articles the several available methods of receiving, and the driving and synchronising of the two stations, will be dealt with. Before, however, going on to describe the various methods of receiving, the following points in connection with the transmitting apparatus will be first considered.

It was assumed in Article 3 (WIRELESS WORLD, No. 24) that the number of contacts made by the stylus is 5,000 per minute, and in working at this speed the first difficulty is encountered in the use of the two relays. The relay R is lightly built and capable of working at a fairly high speed, but R^1 is a heavier pattern, and consequently works at a slightly lower rate. This relay must necessarily be heavier as more substantial contacts are needed in order to pass the heavy current taken by the spark coil. Relays sensitive and accurate enough to work at this speed will in all probability be beyond the reach of the majority of workers, but there are several types of relays on the market, very reasonable in price, that will answer very well for experimental work, although the speed of working will, no doubt, be slower.

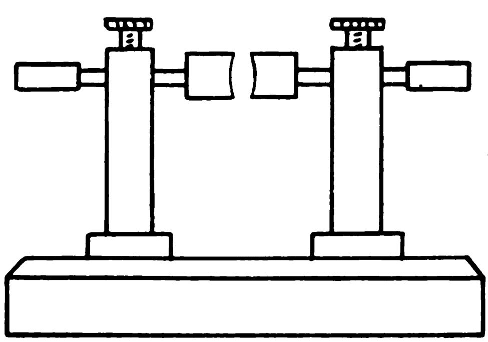


Fig. 17.

For the best results the duration of the wave-trains sent out should be of the same duration as the contact made by R, and therefore equal to the time taken by the stylus to trace over a conducting strip; but if the duration of the contact made by R is t, then that made by R^1 and consequently the duration of the groups of wave-trains would be $t-v$, where v equals the extra time required by R^1 to complete its local circuit. The difference in time made by the two relays, although very slight, will be found to affect the quality of the received pictures. Renewing the platinum contacts is also a great expense, as they are soon burnt out where a heavy current is passed.

If the distance experimented over is short so that the power taken by the coil is not very heavy, one relay will be sufficient, providing the contacts are massive enough to carry the current safely. It is useless to expect any of the ordinary relays in general use to work satisfactorily at such a high speed, and in order to compensate for this we must either increase the time of transmission or, as already suggested, make use of a coarser line screen in preparing the photographs. For reasons already explained all points of make and break should be shunted by a condenser. The effective working speed of an ordinary type of relay may be anything from 1,000 to 2,500 per minute, depending upon accuracy of design and construction.

In the wireless transmission of photographs it is absolutely essential to use some form of rotary spark gap, as where sparks are passed in rapid succession the ordinary type of gap is worse than useless. When a spark passes between the electrodes of an ordinary spark gap, Fig. 17, we find that for a fraction of a second after the first spark has passed the normally high resistance of the gap has been lowered to less than 1 ohm. If the column of hot gas which constitutes the spark is not instantly dispersed but remains between the electrodes, it will provide an easy path for any further discharges, and if sparks are passed at all rapidly, what was at first a disruptive and oscillatory discharge will degenerate into a hot, non-oscillatory arc.*

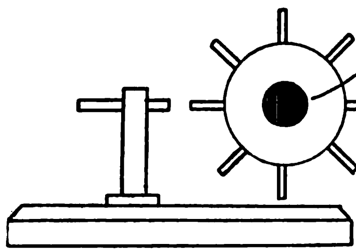


Fig. 18.

Two forms of rotating spark gaps are shown in Figs. 18 and 19, and are known as "synchronous" and "non-synchronous" gaps respectively. In the synchronous gap the cog wheel is mounted upon the shaft of the alternator, and a cog comes opposite the fixed electrode when the maximum of potential is reached in the condenser, thus ensuring a discharge at every alternation of current. With this type of gap a spark of pure tone is obtained, which is of great value where the signals are received by means of a telephone, but where the signals are to be mechanically recorded the tone of the spark is of little consequence. In a non-synchronous gap a separate motor is used for driving the toothed wheel, and can either be mounted on the motor shaft or driven by means of a band, there being no regard given to synchronism with the alternator. The fixed electrode is best made long enough to cover about two of the teeth, as this ensures regular sparking and a uniform sparking distance ; the spark length is double the length of the spark gap. The toothed wheel should revolve at a high speed, anything from 5,000 to 8,000 revolutions per minute, or even more being required. The shaft of the toothed wheel is preferably mounted in ball bearings.

* In wireless telegraphy "arcing" is principally caused by the continuation of the energy supply after the aerial has been charged to a potential sufficient to break down the insulation of the gap.

Owing to the large number of sparks that are required per minute in order to transmit a photograph at even an ordinary speed it is necessary that the contact breaker be capable of working at a very high speed indeed. The best break to use is what is known as a "mercury jet" interrupter, the frequency of the interruptions being in some cases as high as 70,000 per second. No description of these breaks will be given as the working of them is generally well understood.

In some cases an alternator is used in place of the battery, B, Fig. 16, and when this is done the break, N, can be dispensed with. In larger stations the coil, H, is replaced with a special transformer.

The writer has designed an improved relay which will respond to currents lasting only $\frac{1}{100}$th part of a second, and capable of dealing with rather large currents in the local circuit. This relay has not yet been tried, but if it is successful the two relays, R and R^1, can be dispensed with, and the result will be more effective and accurate transmission.

The connections for a complete experimental station, transmitting and receiving apparatus combined, is given in Fig. 19*a*. The terminals, W, W, are for connecting to the photo-telegraphic receiving apparatus.

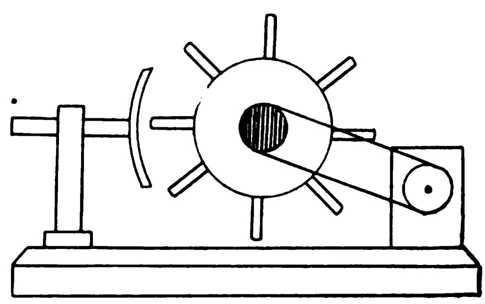


Fig. 19.

Q is a double-pole two-way switch, for throwing either the transmitting or receiving apparatus in circuit.

There is another system of transmitting devised by Prof. Korn, which employs an entirely new method from the foregoing. By using the apparatus just described the waves generated are what are known as "damped waves," and by using these damped waves, tuning, which is so essential to good commercial working, can be made to

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reach a fairly high degree of efficiency. With "undamped" waves it is claimed that tuning can reach an efficiency of 2 per cent. (This means that the receiving station will only respond to signals having a wave-length between 382 and 408 metres if the normal wave-length is 400 metres.)

The question of damped *versus* undamped waves is a somewhat burning one, and no attempt will be made here to deal with the merits or demerits of the claims made for the respective systems. A series of articles describing the production of undamped waves and their efficiency in working compared with damped waves will be found in the WIRELESS WORLD, Nos. 3 and 4, 1913, and are well worth reading by anyone interested in the subject.

A diagramatic representation of the apparatus as arranged by Prof. Korn is given in Fig. 20. The undamped or "continuous" waves ar generated by means of a high-frequency alternator, or Poulsen arc. In Fig. 20, X is the generator, F, inductance, C, condenser. The aerial inductance, T, is connected to the aerial, A, and earth, E. By this means the waves are tuned to a certain period. A metal print similar to that already described is wrapped round the drum, D, of the machine. When the stylus traces over an insulating strip the waves generated are in tune with the receiving station, but when it traces over a conducting strip a portion of the inductance, T, is short-circuited. the period of the oscillations is altered, and the two stations are thrown out of tune.

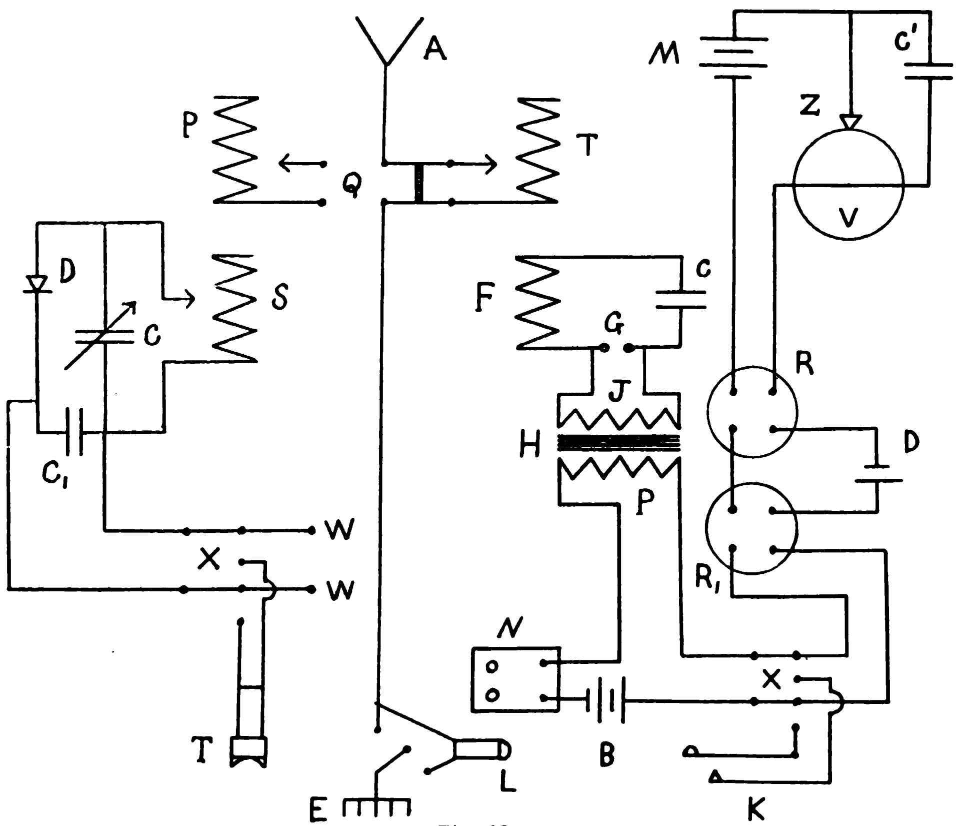

Fig. 19a.

The receiving station is provided with an aperiodic circuit, which consists of an inductance, F, condenser, C, and a detector, E. A string galvanometer (to be described in Article 2) and an inductance, B, are connected in parallel with the condenser, C. The purpose of the inductance, B, is to let only currents of one certain direction pass through the galvanometer so that it can only be deflected to one side. The manner in which the string galvanometer is arranged to reproduce the transmitted picture is shown in Fig. 27.

The connections adopted by the Poulsen Company for photographically receiving

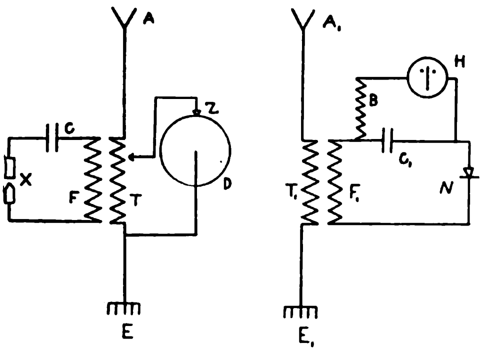

Fig. 20.

wireless messages are shown in Fig. 21, a string galvanometer of the Einthoven type being used.

The two self-induction coils, S and S^1, are in circuit with the detector, D, and the galvanometer, G. The condenser, C^1, prevents the continuous current produced by the detector from flowing through the high-frequency circuit. P is the primary of the aerial inductance, and F the secondary.

The method of transmitting adopted by Prof. Korn appears to be a simple and reliable arrangement, provided that an equally reliable method of producing the undamped waves can be found. Owing to the absence of mechanical inertia it should be capable of working at a good speed, while the absence of a number of delicate pieces of apparatus, all requiring careful adjustment, add greatly to its reliability. In any spark system with a properly designed aerial, a coil taking 10 amperes is capable of transmitting signals over a distance of 30 to 50 miles, but where the number of interruptions per second required is very high, as in radio-photography, it must be remembered that a much higher voltage is needed to drive the requisite amount of current through the primary winding of the coil than would be the case if the interruptions were slower. It is possible to use platinum contacts for the relays for currents up to 10 amperes, but for heavier currents than this some arrangement whereby contact is made with mercury will be found more economical and reliable.

In the transmitter already described and given in Fig. 16, the best results would be obtained by finding the speed at which the relay, R^1, works best and regulating the number of contacts made by the stylus accordingly.

The method employed by De 'Bernochi (*see* Article 1) of varying the intensity of a beam of light by passing it through a photographic film, which in turn alters the resistance of a selenium cell, has been very successfully employed in at least one system of photo-telegraphy. Its application has also been suggested for wireless transmission, and although with any system using continuous waves this would not be very difficult, it could hardly be adopted to work with the ordinary spark systems. The apparatus for receiving from this type of transmitter would on the other hand necessarily be more elaborate than the methods of receiving, which will be described in the next article, and so far as the writer's experience goes, experiments along these lines would not prove very profitable, as simplicity is the key-note of success in any radio-photographic system.

There can be no doubt that a system of radio-photography, if fairly reliable and capable of working over a distance of, say, 30 miles would be of great military use for transmitting maps and written matter, with a great saving of time, and even life. Written matter could be transmitted with even greater safety than messages which are sent

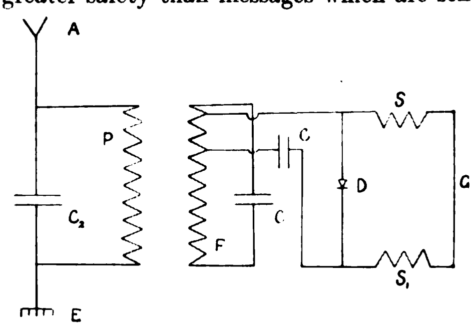

Fig. 21.

in the ordinary way in Morse code as the signals received in the receiver of a hostile installation would be but a meaningless jumble of sound, and even were they possessed of radio-photographic apparatus, the received message would be unintelligible unless they knew the exact speed at which the machines were running and could synchronise accurately.

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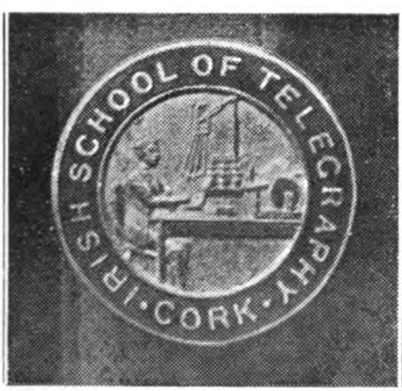

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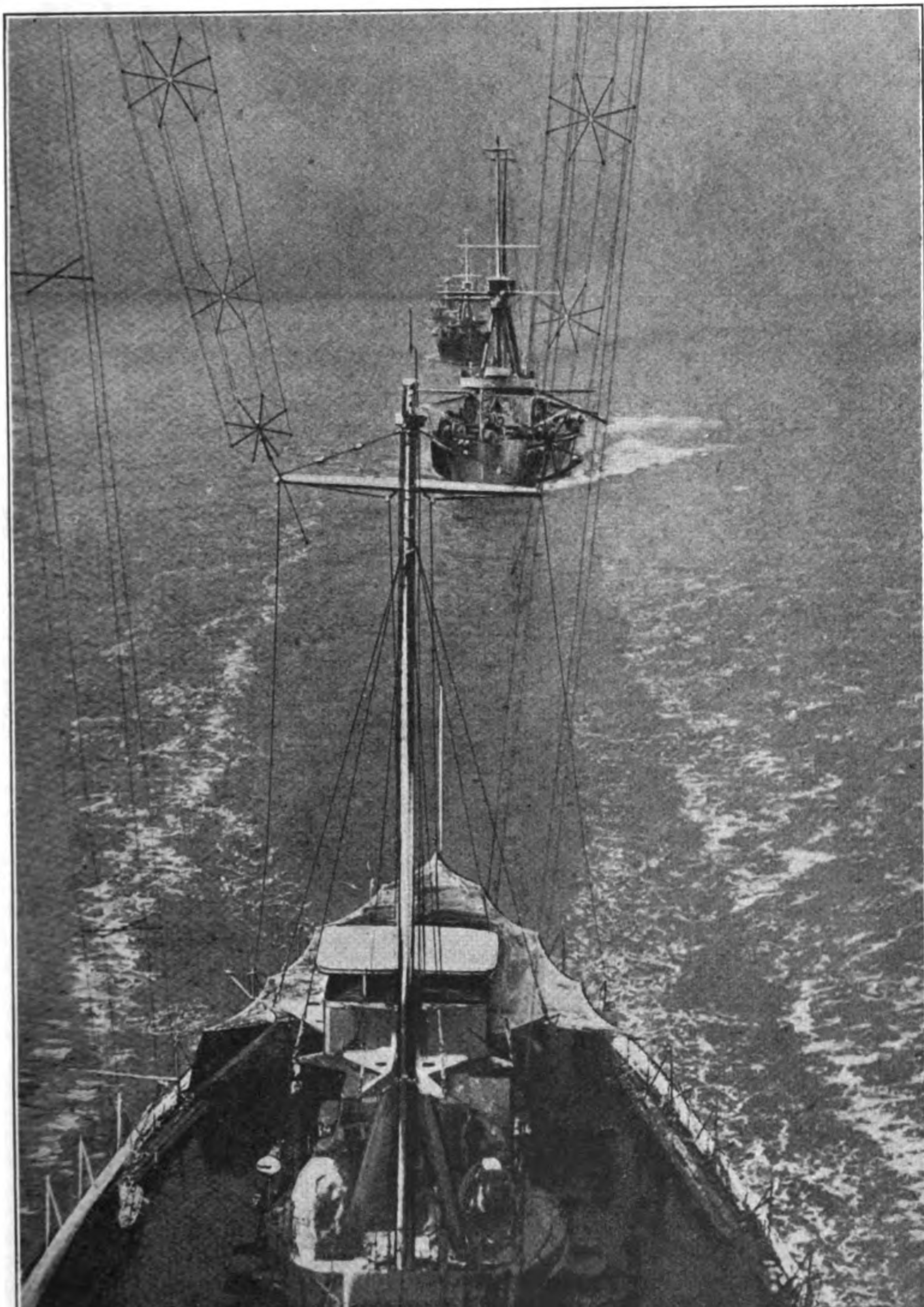

Our illustration shows the adverse circumstances under which much of our naval work is conducted. The snow which can be seen at the back of the battle cruisers, and the general wintry character of the weather conditions, will bring home to our warm firesides some of the hardships encountered by "Jack afloat."

WIRELESS IN ACTION

Some Illustrated Notes.

CONDITIONS still prevail which naturally prohibit any detailed reference to the part being played by wireless in the cause of the Allies. It is a certain fact, however, that many of the most thrilling incidents in this the world's greatest melodrama have had their origin or success determined by a wireless whisper.

It may be safely stated that at the outbreak of war the development of the military side of wireless telegraphy had far surpassed anything that might be classed as common knowledge. Commander C. F. Loring, R.N., Inspector of Wireless Telegraphy to the Post Office, writing on Wireless Telegraphy in the Navy in the *Naval Annual* of 1914, concluded his record of naval progress with an outline of the improvements introduced in 1909. "Subsequent to 1909," he says, "I am unable to point to any notable improvements or radical changes of general interest, as all later developments are still considered as confidential. Some idea, however, of the increasing importance attached by the Admiralty to this means of communication may be gathered from the fact that on board the *Vernon* alone there are now about twenty officers whose duties are appropriated solely to wireless telegraphy as compared with the three or four who were employed in the school in 1904, whilst the number of trained operators in the Fleet in 1912 stood at over 1,100. Similarly it is of interest to note that at the end of the year 1900 there were forty-two ships and eight shore stations equipped with wireless telegraphy in the Navy, and at the end of the year 1913 these figures have increased to 435 and thirty respectively."

The use of wireless on submarines was pretty general before the war broke out, no difficulty being experienced by these craft in maintaining communication between their parent ships or shore stations when quite a distance away. This intercommunication naturally ceased when the submarine dived and her antennæ were wholly or partly submerged.

WATERSPOUT AERIALS.

One of the problems therefore connected with the use of wireless on these craft has been the rapid re-establishment of wireless communication after a dive. How far this has been solved we are not permitted to say, but reports in the foreign technical Press suggest that useful results have been obtained elsewhere by the aid of jets of salt water pumped vertically into the air. These novel antennæ are insulated from the sea by passing through a spiral tubing forming the coupling coil. Needless to say the waves set up on such aerials must be considerably damped and must have a limited radius of utility.

Two recent numbers of THE WIRELESS WORLD—the issues for November, 1914, and January, 1915, respectively—have contained details relating to wireless in military aviation. The former contained some general remarks upon the range of airships, and the latter specific statistics regarding the equipment in 1913 of the old Zeppelin *Viktoria Luise* and the purpose of the ring of wireless stations built at frequent intervals around the German frontier. Naturally the Germans, like ourselves, have kept all recent progress in military wireless strictly secret, but we are able this month to supplement our previous notes by a very interesting illustration. This is an authentic photograph taken in one of the great German aerodromes, showing in some detail the arrangements of the aerials on a Parseval airship. Although little has been written in the English Press about the German Parseval airships, possibly because they lack the magnitude of the Zeppelin and therefore do not make so great an appeal to the imagination, it is the Parseval and not the Zeppelin type of ship that has found the greatest favour amongst our aeronautical experts of this country. The recent "Warning" notices which have been freely displayed throughout the country show that we possess a Parseval very similar in general outline to the German prototype.

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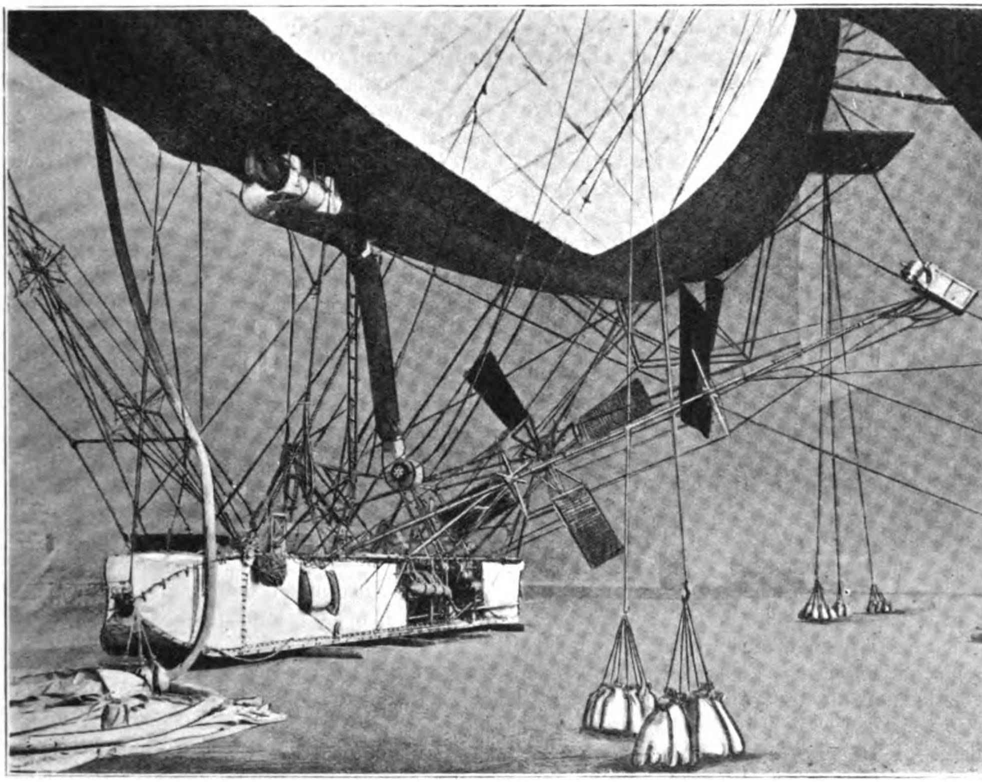


Car and Wireless Equipment of a Parseval Airship

The Parseval airship, it may be explained, is one of the non-rigid class. Unlike the Zeppelin, it does not rely for its lifting power upon a series of balloonets arranged within a stiff metal framework, but maintains its dirigibility by means of the gas pressure upon the envelope. The car, which is relatively small, is suspended below the gas bag. The great advantage to be gained from this type of airship is the ease with which it may be deflated and transported to an operating base, to perform, if needs be, a continuance throughout the night of the work conducted by aeroplanes during daylight. The Parseval type of non-rigid airship has a propeller built up of fabric, a method of construction found to be particularly suitable for war-craft.

Unlike the Zeppelin the German Parseval appears to dispense with the trailing aerial and rely instead upon star-shaped antennæ stretched out at right angles to the car on bamboo or composite poles. These can be raised and lowered at will, and although they may not give the Parseval as great a range of intercommunication as the Zeppelin they do permit of one important feature, the ability to cruise at night at relatively low altitudes. The Germans discovered quite early in their research that an airship cruising low down with the general haze and cloud forming a background is safer from observation, on average nights, than one flying high up.

The application of wireless to airships gave more instant success from a military point of view than the similar application to aeroplanes. Apart from the greater range afforded by the airship equipment, there was (at any rate for a considerable period) this great advantage. An airship by stopping its engines allowed the receipt of messages from the land stations. If an aeroplane stopped its engine it came hurriedly to earth. The aeroplane, therefore, before the advent of the sound-proof helmet was restricted to the despatch of signals.

Details of a typical French wireless equipment for aeroplanes appeared in a recent article in *Flight*. These equipments are apparently made in two sizes, one weighing 35 kilogrammes giving an effective daylight range of 100 kilometres, and another weighing 48 kilogrammes giving an effective radius of 200 kilometres.

The generator for the smaller set consists of a Bethenod magneto alternator having an output of 350 watts, low tension, and giving a spark frequency of 800 sparks per second. This alternator has no commutator.

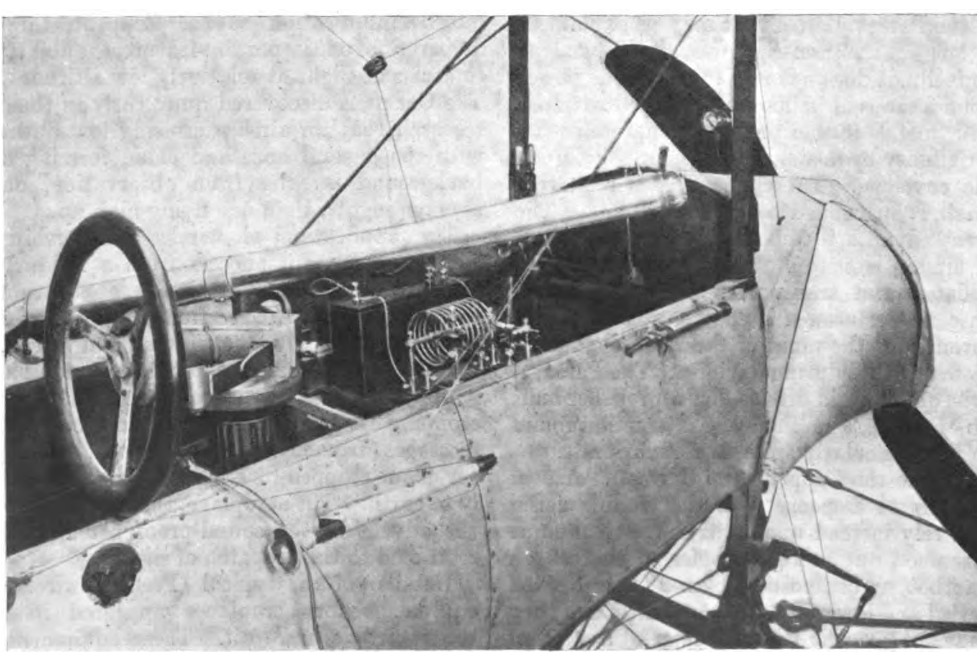
The aerial employed in connection with this plant consists of a bronze cable about 1 mm. in diameter, ballasted at its extremity by means of a weight in the form of a spindle. This aerial trails in the air and assumes almost an horizontal position when the machine is in full flight. By means of brush contacts on the spindle of the winding reel the cable can be wound or unwound without interrupting the operation of the apparatus. An alternation in wave-lengths can thereby be easily effected. The " earth " connection in this case is replaced by an electrical capacity, all the metallic parts of the machine being connected together electrically.

The generator for the larger set, which alone weighs 19 kilogrammes, has a normal output of 750 watts, and like its smaller fellow is driven from the aeroplane engine. The musical note which is obtainable with this generator can be varied from a low octave sound to a shrill whistle.

The oscillating circuits are arranged to give a wave-length of 400 metres. They consist of a condenser having a capacity of 100th microfarad and a spark gap. This gap in the smaller set is of the point and plate type, but in the larger set of a tube and a plate fitted with a ventilating apparatus.

For use upon seaplanes, where messages have to be sent whilst the machine is resting on the water, and the propelling machinery motionless, important alterations are made in the equipment. In the first place the trailing aerial is supplemented by one capable of being attached to a folding box kite. In the second place the generators are driven by independent petrol motors, one of 1 B.H.P. in the case of the smaller set, and of 3 B.H.P. for the larger set. Where an auxiliary motor cannot be used accumulators are carried, giving an output of 50 watts and a transmitting radius of 80 kilometres in the daytime.

The receiving sets for use with the above are stated to be fitted with crystal and electrolytic detectors and very sensitive, loud-speaking telephones. The 'phones can be conveniently fixed to the aviator's helmets and so render possible the reception of signals when the engine is running.



Wireless Fittings on a French Breguet Machine.

COMPANY NOTICES

THE report of the Marconi Wireless Telegraph Company of Canada for the year ended January 31st, 1914, states that the business done under contract with the Canadian and Newfoundland Governments has satisfactorily expanded, but the ship traffic receipts were seriously interfered with through the destruction of the operating house at the Cape Race Station by fire. In the circumstances the increase in gross profit from $60 to $7,200 is a very creditable performance. Interest charges amount to $24,500, as against $19,000, and the net deficit is therefore $17,300, as compared with $18,900. In 1912-13 the loss was written off organisation expenses account, leaving only $2,000 at the credit of that fund, which now serves to reduce the present deficit to $15,300, the latter amount going forward for subsequent liquidation.

* * *

The text of the report referred to above reads as follows:

"The report of the Marconi Wireless Telegraph Company of Canada, Ltd., for the year ended January 31st, 1914, states that the contract with the Canadian Government for the operation of the coast station on the Great Lakes has now been completed by the addition of new stations at Port Burwell, Toronto and Kingston. The operation of these stations has now been placed on a satisfactory basis, and this section of the company's business should henceforth produce a steadily increasing revenue. The company was also successful in securing the contract for the construction of these stations. Under agreement with the Newfoundland and Canadian Governments the company now operates the following stations: 10 small stations in Newfoundland and Labrador, 22 stations on the eastern coast of Canada, 8 stations on the Great Lakes of Canada. The Newfoundland stations are subsidised to the amount of $4,630 per annum, and the Canadian stations $89,200 per annum. According to the latest Government return covering steamships of Canadian register, there were 93 vessels at date equipped with wireless telegraphy, of which no less than 90 vessels are equipped with the Marconi system. The policy of systematically improving the contract for steamship operation is being successfully carried out. With the completion of the duplex system the Louisburg Transatlantic receiving station has been brought into operation, in addition to the installation for high speed transmissions at Glace Bay. To provide for additional traffic with these improved facilities a special business campaign was inaugurated, which has so far yielded gratifying results, and which should materially improve the future Transatlantic traffic. This policy will be continued until the full capacity of the circuit is reached. As a result of the destruction of the operating house by fire on May 5th the Cape Race station suffered severely during the year. Prompt measures were taken to re-establish a temporary station, which was in operation within two days, but owing to the isolation of Cape Race it was not until September 30th that a full commercial service could be resumed. Improved equipment has now been installed, adding to the capacity of the station. The necessity for increasing the height of the masts has been strongly urged on the Government, and action has subsequently been taken for such construction, which will be completed before the end of the current year. Thus equipped, Cape Race will be the most important coast station on the North Atlantic Ocean, and the increase in earnings that can be expected is indicated by the results already apparent since the installation of the improved plant. Owing to this unfortunate occurrence the ship traffic receipts show only a small increase over the previous year. Transatlantic traffic shows improved receipts for the year, and the revenue from the operation of the Marconi system on steamers and sales of apparatus shows decided progress. Important legislation covering equipment of Canadian steamers with wireless telegraphy has been enacted during the year. This law became operative on January 1st, 1914, and since the close of the past fiscal year a number of contracts have been made with shipowners covering vessels affected by the Act. Work on the contract with the Department of Railways and Canals for the construction of stations at Le Pas and Port Nelson has been pushed forward and will be completed during the current year. Owing to exceptional difficulties encountered by the Government through lack of terminal and transportation facilities, the company was unavoidably delayed in completing its portion of the work, but will not thereby be subjected to any financial loss. Owing to the isolation of the localities these difficulties had been anticipated. Communication between the two stations was established in February, which was a source of gratification to the Government."

Personal.

In the "Wireless Telegraphy in the War," of our March number, on page 791, we had the pleasure of giving an extract from a letter written by Mr. Charles E. Gould, wireless operator on H.M.S. *Good Hope*. We below reproduce his photograph, by the courtesy and kind permission of his father, Mr. Thomas Gould, of Sonning-on-Thames, Berkshire.

Mr. H. T. Clarke, a Marconi operator, writing from the usual address of "Somewhere in France," says:—"I am going on quite well and keeping very fit at present. I have been in France with my regiment since last September and have been right up in the firing line ever since, so I consider myself very lucky so far. We are now working seven days in the trenches and seven days out; when we are out of the trenches we go about three miles from the firing line to billets in a large town here (I am unable to give you names of places or my address), and usually get a hot bath and a general clean up all round. It seems very strange, but one night we are about 300 yards from the German trenches and the next night having a walk around the town and enter a restaurant and call for a cup of coffee as if nothing was on at all. I may say that the majority of the inhabitants are still in this town, and they are occasionally shelled by the heavy guns of the Germans, but all the notice that they take is to shrug their shoulders and say 'Allemande.' The weather is brightening up considerably here now, as it has been awful throughout the winter, especially in the trenches, sometimes over knee-deep in mud and water. There is one consolation that when we have been in a fix that way the Germans have been the same, and probably worse. We are now out for a rest, and go back into the trenches Sunday evening next. The reason for going in at dark is because the German trenches are only 400 yards from us, and they (the Germans) would make it jolly hot for us if they got to know that we were relieving. Hope the weather will keep getting finer, and then most probably we shall be able to do something more definite. Could write you a lot more, but the Censor would no doubt blue pencil it; so will close, hoping to be with the Company again very soon.

Mr. Charles E. Gould.

Mr. W. MacKilligan.

In connection with the sinking of the Royal Mail Steam Packet's steamer *Potaro* by the *Kronprinz Wilhelm* in the South Atlantic, and whose crew was landed at Buenos Aires, we are informed that the wireless operator of the former was Mr. William MacKilligan, of Aberdeen, whose photograph we reproduce above.

Jack Durrell Green, aged 16 years, son of Mr. James Green, of Wivenhoe, has been successful in winning the first prize in a Marconi wireless examination, which takes place annually in the Navy. Green is now serving on H.M.S. *Agamemnon*.

A Sad Loss.

The following announcement appears in one of our American contemporaries:—

"Archie Thomas, aged twenty-one years, wireless operator at the leper colony at Penikese Island, Buzzard's Bay, Mass., and himself a leper, died of pneumonia recently. The colony is thus deprived of an important means of communication with the outside world."

There is a world of tragedy contained in the brief announcement reprinted above.

WIRELESS TIME SIGNALS.

Practical Notes on their use at Sydney, N.S.W

WE have been favoured with the following article from Mr. F. Basil Cooke, F.R.A.S., of the Observatory at Sydney, New South Wales. The communication was inspired by the article in THE WIRELESS WORLD for November, 1914, on "Wireless Time Signals," and may be read in connection therewith. It indicates the practical use of wireless made at the Sydney Observatory.

* * *

I think it universally known that the Commonwealth has at last undertaken the completion of the trans-continental railway which will connect Perth through Adelaide to Melbourne, and then from Melbourne through Sydney to Brisbane. This will make a complete chain of railway linking all the five capitals.

The line is complete from Brisbane to Adelaide, but there is no rail from Adelaide to Perth, and it is this last link that is now in the making.

In this gigantic undertaking it is absolutely essential that certain places along the proposed track should be located with precision.

In fixing the position of a place it is essential that we have two factors—namely, latitude and longitude. The latitude can easily be determined by a theodolite by any skilled surveyor.

The determination of longitude, however, is an entirely different proposition, as it is a purely relative function of time. The longitude is directly determined by a comparison of the time at any given instant between the unknown place and some known place, preferably an observatory.

The usual method of procedure is as follows:

Let us denote the unknown place by X and the known observatory by Y. Firstly, some star is selected for observation, and the exact time taken by the clock at X when the star is exactly on the meridian. The same evening the exact time is taken at Y when that star is on the meridian. Now it takes a certain time for the star to pass from the meridian at X to meridian at Y, and this difference of time is the difference in longitude between X and Y.

The most important part of the whole procedure is the comparison of clock X with clock Y. This has in the past been done by cable or land telegraphic line, which has, however, always introduced an unknown factor. The time of transmission and armature times have played an important part in this factoı.

Once more wireless has shown us a way out of our difficulty, and has made it possible to eliminate the unknown error, and also made it possible to determine the longitude of places not already connected by metal circuits.

The method used is practically the same as that described in your article using the method of coincidences. The particular work we have just been interested in was the determination of Port Agusta, which is the survey base of the trans-continental railway.

With respect to the main difficulty mentioned in your article—*i.e.*, the hearing of the ticks from the controlling and controlled clocks—I should like to state that we have been fortunate enough to absolutely eliminate this very serious trouble in the following manner: around every pair of contacts we have shunted a wet condenser; the consequence is that there is absolutely no sparking at any of the contacts, and therefore there are no oscillating currents set up. I should like to add that all these shunts are home made and are absolutely effective. They act beneficially in two ways: firstly, they eliminate the wireless trouble; and, secondly, they save a great deal of trouble with the contacts. Whereas formerly we were constantly having to clean and true up our contacts, now we need scarcely ever touch them. These shunts, for the description of which I am indebted to the Eastern Extension Telegraphic Co., are of simple construction, and consist of two pieces of aluminium wire immersed in a 10 per cent. solution of ammonium sulphate, the whole being enclosed in a small gallipot and hermetically sealed.

Unfortunately I am not able at present

to furnish any figures in connection with our recent work with Port Agusta, but I have reason to believe that the wireless results will turn out to be equally satisfactory with those obtained at the same time with the land line, although this is our first attempt at that kind of work. There seems to be no doubt that in the future all longitude determinations will be carried out by means of wireless; and, also, this method opens up a vast field of very important work to be done in the southern hemisphere—such, for example, as correctly charting the South Sea islands, etc.

As for hearing the ticks from our own clock, instead of using an induction coil and connecting the phones to the terminals of the secondary, we have inductively coupled the primary (carrying the current from the clock) to the secondary of the jigger. This seems to me to be more satisfactory, because in the former case the incoming ticks from the distant station have a very good chance of leaking across the secondary of the coil rather than all going through the phones; further, our own arrangement enables us to more easily cut our signals down to the same audibility as the incoming signals.

In conclusion, I should like to state that all our instruments were made at the observatory, and are capable of very fine work. In the work referred to we received the clock beats from Melbourne and Adelaide. In addition, we have heard Perth (2,200 miles across land), and have no difficulty in hearing Brisbane, Hobart, New Zealand, Numea, etc. The aerial is a four-strand T aerial 90 ft. high at one end and 70 ft. at the other. Its length is 90 ft.

Trade Notes.

Perhaps one of the most important requisites of the Drawing Office, and also one of the most costly, is tracing cloth. The original tracing cloth was invented in 1859 by Mr. F. G. Spilsbury, and since that date improvements have been made until manufacturers were able to produce the material which for many years has been regarded as almost the perfected article. The price of the tracing cloth was, however, still high owing to the cost of production and the fact that the material was manufactured only by a very few firms, and consequently the market price could be controlled in favour of the producers.

Just recently it has been brought to our notice that an English competitor has come forward who has produced tracing cloths equal in every respect to those manufactured by other English houses and infinitely superior to any foreign production. Moreover, the new cloth has several distinct advantages over other makes. We would particularly emphasise the fact that the new tracing cloths are specially prepared for use without chalk. In addition to embodying to a high degree of perfection all the essential features of first-grade articles, the new material is sold at a figure about 10 per cent. below other cloths of similar quality.

This new tracing cloth, which is manufactured under the brand of "R.C.," may be obtained from B. J. Hall & Co., Ltd., of Chalfont House, Westminster.

We have been asked to notify to friends of Messrs. Harvey's, the uniform tailors who supply so many of our gallant soldiers and sailors, that their address has been changed to 17, London Street, right opposite to Fenchurch Street Station.

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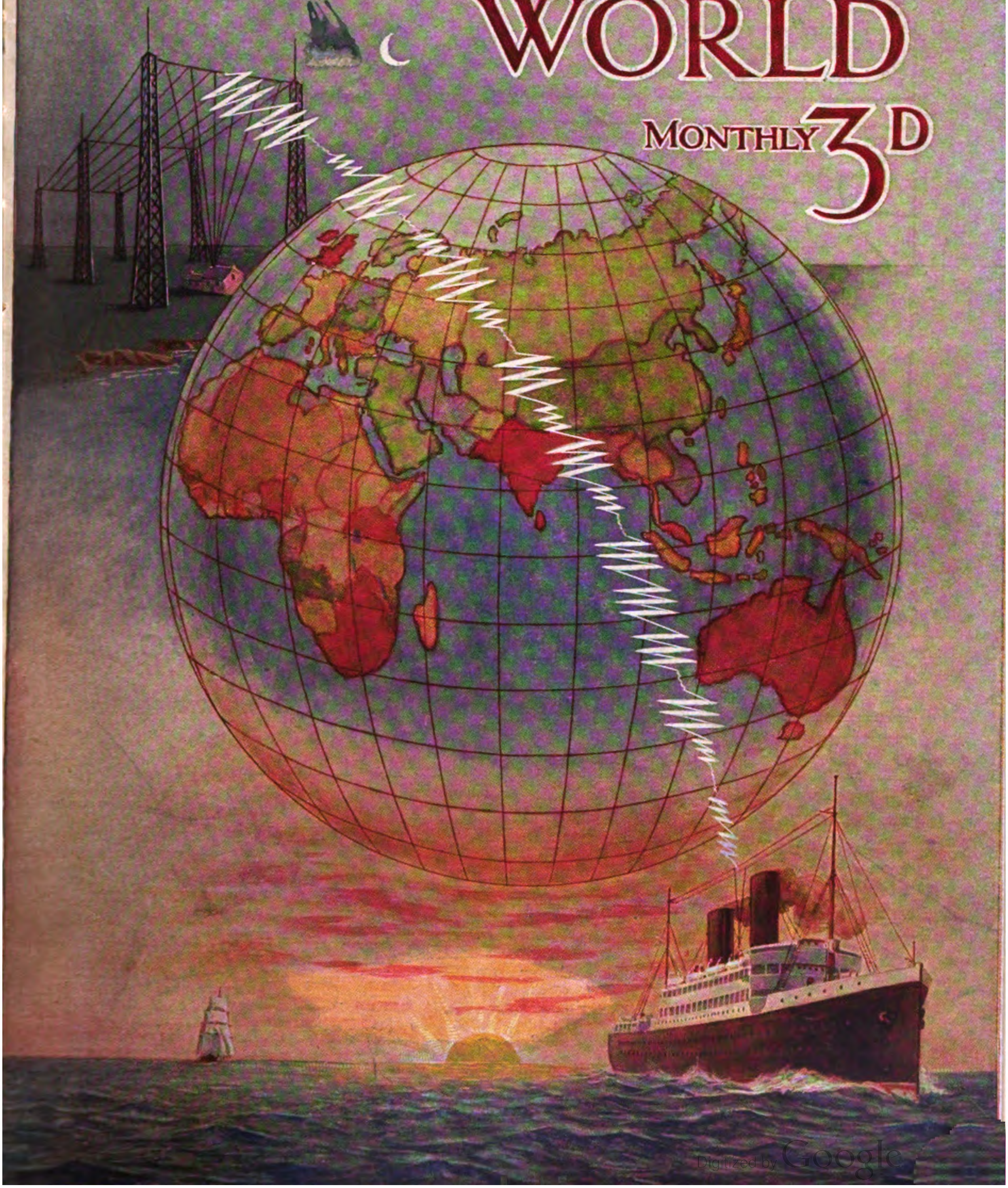
WIRELESS WORLD

MONTHLY 3D



THE WIRELESS WORLD

Vol. 3.—No. 26. (New Series) May, 1915. Subscription 5/0 per annum post free. Price 3d. Post Free 5d.

UBIQUITY

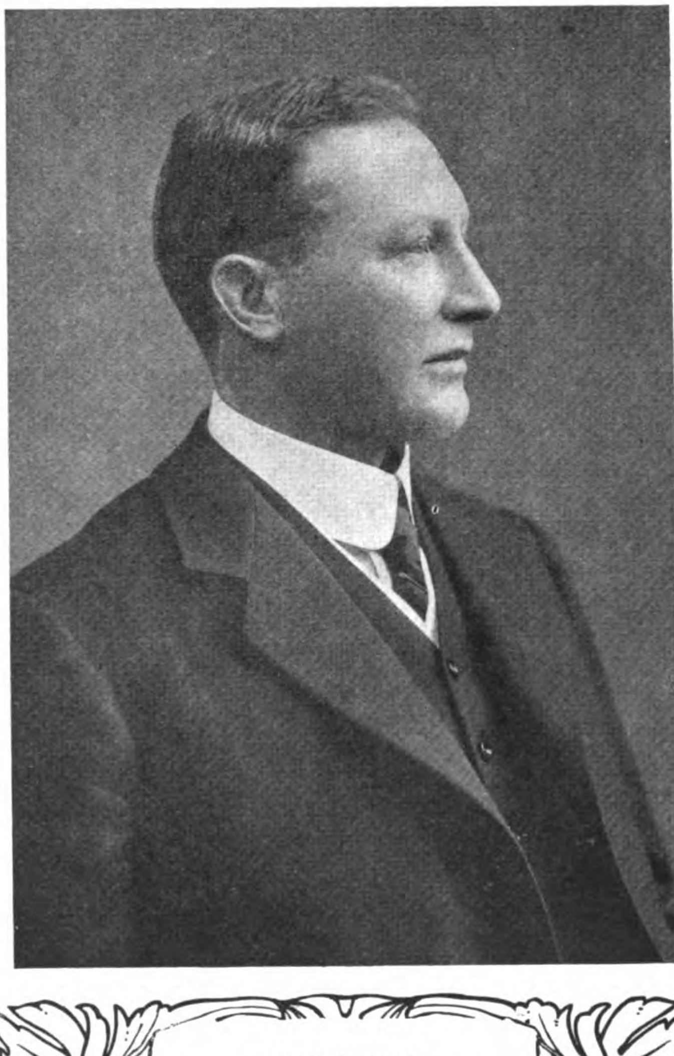
The Birthright of Wireless Telegraphy.

TO be "Jack of all trades" continues to be popularly associated with the traditional corollary of being "master of none." Because "wireless" can fulfil extraordinary functions it is occasionally assumed by superficial observers to be less capable of performing ordinary service. Because it alone can summon aid to ships in distress, or put aviators, whilst in full flight, into connection with earth, it sometimes appears to be adjudged less capable of performing the task of conveying press and business messages to and fro across the Atlantic. Of course, there are thousands of people perfectly well aware of its powers in the sphere of such everyday, prosaic, business transactions. This fact is emphasised by the opening of the new Fenchurch Street Office, which, after all, is but a response to a real demand for the facilities it offers. But, had it not been for the idea which links wireless with the romance of the (hitherto) impossible, it is quite within the bounds of probability that that demand would have become long since too insistent to have been denied, and would, ere now, have forced the Marconi Company to supply the City with the cheap facilities for long-distance telegraphic communication, at length brought to the door of business men located in the city of London.

At such a time as this, when the thoughts of the whole world are directed to war, the fact that looms largest in the attention of the general public is that wireless telegraphy is daily proving its utility as a means of establishing communication with ships at sea, both naval and mercantile, with aeroplanes and aircraft, with submarines, and on the battlefield. The public imagination has been fired by the revelation of what it can do in regions hitherto untouched, somewhat to the exclusion of recognition of its utility in familiar fields.

Many parts of the globe still remain in a somewhat savage or undeveloped state, awaiting the benefits which "wireless" brings in its train. We refer here not merely to outlying parts of His Majesty's Empire and to those portions of "the dark continent" of Africa still mainly "tenanted" by savages, swamps and jungles, but to countries like some of the Central States of South America, whose development has been retarded by lack of the means of communication which wireless is now opening out to them. Only the other day the ruler of the Republic of Ecuador, in his annual presidential address, laid emphatic stress upon the beneficial results of the new long-distance station erected within their boundaries.

In fact, it is immaterial whether we look at the manifold activities of the civilised world or let our vision range geographically over the various parts of the globe: whether we confine our attention to the earth or extend it to the air or to the sea—we still feel that a stage has been reached in the development of wireless telegraphy which justifies our contention that ubiquity forms its most striking characteristic.



COMMANDER
F. G. LORING, R.N.

Personalities in the Wireless World

COMMANDER F. G. LORING, R.N., M.I.E.E.

THE name of Commander Loring is so well known to all who are interested in wireless telegraphy that a few notes in connection with his life and work are certain to be a welcome addition to the biographical library of wireless celebrities published month by month in our pages.

Commander Frederick George Loring, R.N., M.I.E.E., Inspector of Wireless Telegraphy at the General Post Office, has had a distinguished and varied career, and is still a man in the prime of life, having been born on March 11th, 1869. He is the eldest son of the late Admiral Sir William Loring, K.C.B. Following in his distinguished father's, footsteps he entered the Navy at the age of 13, and served in various parts of the world, notably in Australian and Pacific waters.

In 1891 Lieutenant Loring was appointed to the Royal Yacht—a service which carried with it special promotion on its termination—and two years later was serving on board H.M.S. *Victoria* when she was rammed and sunk on June 22nd, 1893, by H.M.S. *Camperdown* off the coast of Tripoli. This disaster occurred during the middle of a fine afternoon, and the *Victoria* went down in less than 15 minutes, carrying with her many lives, among whom was the Commander-in-Chief of the Mediterranean Fleet, Vice-Admiral Sir George Tryon. Lieutenant Loring was instrumental in saving two lives on this occasion, and for his gallantry was awarded the Bronze Medal of the Royal Humane Society. With regard to the sinking of the *Victoria*, it is a strange fact that when she was re-commissioned at Malta, a few months before the catastrophe, the Maltese, who are a very superstitious race, were loath to serve on her, and many Maltese bandsmen and servants of the first commission positively refused to re-engage for the second commission, despite the fact that the *Victoria* was the Flagship of the Mediterranean Squadron.

Disaster was freely prophesied for the ship, and many persons were reported to have received warnings in dreams concerning her. But strangest of all is the fact that on the very day the *Victoria* was sunk rumours were rife in Malta that a very serious accident had befallen the ship, long before any information could possibly have reached the island in those pre-wireless days.

In 1894 Lieutenant Loring was selected to undergo two years' special training in electrical engineering in order to qualify as a Torpedo Officer, and on the completion of this period he received an appointment on the Staff of H.M.S. *Defiance* (Captain H. B. Jackson). Here he first came into touch with wireless telegraphy, and was a witness of Captain H. B. Jackson's early attempts in this direction.

One of the first ships to be fitted with a permanent installation of "wireless" was H.M.S. *Alexandra*, to which ship Commander Loring was appointed in 1900.

In 1902 he was offered the appointment of Officer-in-charge of Naval Shore Wireless Telegraph Stations, which he accepted, and since that date has been exclusively employed on radio-telegraphic duties.

Being offered his present important post as Inspector of "Wireless Telegraphy" at the General Post Office in 1908, Commander Loring retired from the Navy after receiving the thanks of the Admiralty for his valuable services in the cause of radio-telegraphy.

During the tenure of his present office Commander Loring has twice served as delegate at important "Wireless" Conferences—viz., as Admiralty Delegate at the International Conference of Wireless Telegraphy held in Berlin in 1906, and as Post Office Delegate at the International Conference in London in 1912. In addition to this, Commander Loring served as Adviser to the Board of Trade in matters connected with "wireless" at the "Safety of Life at Sea" Convention of 1914, at the termination of which he received the special thanks of Lord Buxton for his eminent services.

Resonance Phenomena in the Low Frequency Circuit

By H. E. HALLBORG

PART II

FIG. 3 is an outline of a method used by the writer of charting a low-frequency circuit, and thereby obtaining a complete graphical record of its inductance characteristics. It shows the relation between total secondary inductance as ordinates, and series connected inductances, primary and secondary, as abscissa. The three curves shown give, respectively, the value of the alternator inductance referred to the secondary, the value of alternator and transformer referred to the secondary, and the value of alternator, transformer and secondary loading coils referred to the secondary. Any condition of the circuit is at once available. When the iron is worked at moderate densities, as in the units above mentioned, it was found that the curves are quite straight lines, and only a few readings were necessary to locate the entire curve. With this data at hand, the value of condenser for resonance, the point of best operation, and even the general shape of the resonance curve can be closely approximated.

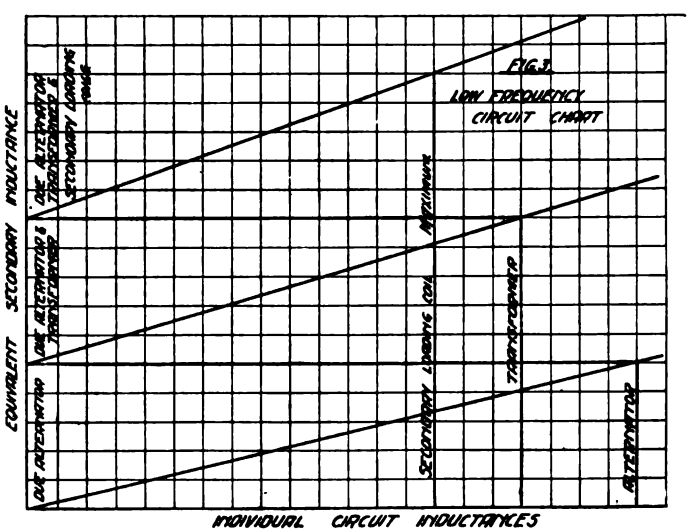


Fig. 3.

Fig. 4, taken by the *primary ampère method*, shows the actual tuning curves of the 300-kw. alternator-transformer circuit at New Brunswick for various settings of the secondary loading coils. It will be noted that as the circuit is stiffened by adding loading coils the primary current amplitude falls, and the resonance effect is sharpened. The decrease in primary current amplitude is probably partly due to added resistance as coils are inserted, and to the large increase in resistance due to the smaller number of condensers required as the inductance is increased, as previously pointed out. The stars indicate actual operating points at different wave-lengths. Since these operating points fall quite within the middle ranges of the loading coils, it is evident that it is possible to make factory adjustments as above outlined, with a high degree of accuracy.

Fig. 5 is an application of the *primary ampère method* and the *secondary voltage method* to a 2-kw., 500-cycle, 110/18,000 volt open core transformer designed for a

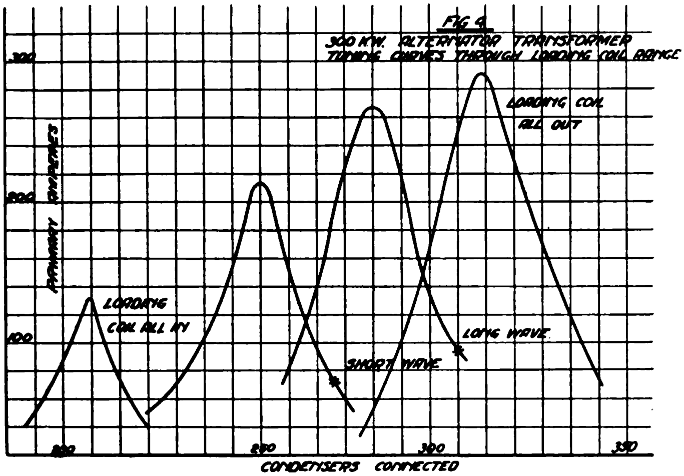


Fig. 4.

nator frequency. The variation of primary voltage and current with frequency changes is also shown. These curves are quite similar, as is to be expected, since they are linked together by the relation $E = 2\pi fLI_1$ where $2\pi fL$ is the generator impedance, and I_1 the current flowing.

Fig. 6 is of interest since it demonstrates quite conclusively that alternator synchronous impedance has an effect on resonance similar to any inserted inductance of equivalent value, and must be considered as such. Curve A is the resonance condition when no reactance is inserted in series with a transformer and a 2-kw., 500-cycle alternator of 0·5-ohm synchronous impedance. Curve B results from connecting a reactance of 3 ohms in this alternator-transformer circuit. Curve C is the result obtained by using the same transformer with another alternator whose synchronous impedance is 3·4 ohms, or roughly the sum of the impedances of curve B.

synchronous rotary spark set. It will be noted that the point of resonance taken by the two methods does not occur at the same condenser value; but that the *secondary voltage method* gives an inductance value somewhat less than the value obtained by the *primary voltage method*. From the alternator-transformer constants of this particular circuit—namely, 3·4 ohms synchronous impedance, and 2·8 ohms transformer impedance—we deduce for the equivalent secondary inductance by the Ratio² transformation the value 19·7 Henrys. The value of capacity for resonance should therefore be 0·0051 mf. However, the curves show this inductance to be about 30 per cent. greater than the figure deduced by the Ratio² method. For a loosely coupled transformer, such as the one under consideration, Seibt deduced the expression $L_2 = \frac{1}{\omega^2 C(1 - K^2)}$ for the value of secondary inductance for resonance with capacity, C, and coupling factor, K, equal to 0·7. Solving for K from the data above given, we get a value about 0·5. This figure is more nearly in conformity with the writer's experience and results on open core units. With closed core transformers, K is unity, or at least nearly enough so for all practical purposes. The operating point for best results is shown by a star. The natural frequency of the circuit corresponding is 407 cycles, or 18 per cent. below the alter-

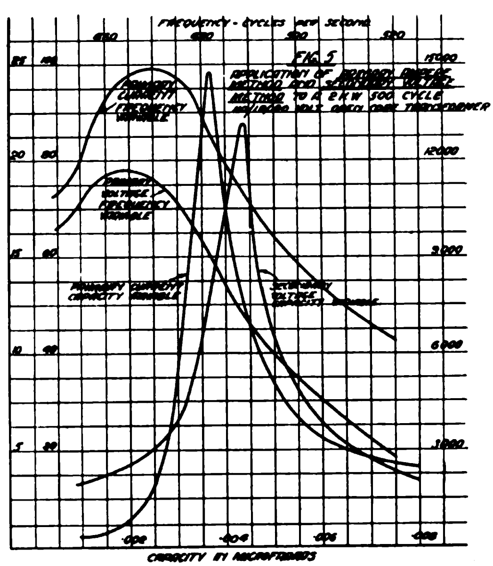


Fig. 5.

Fig. 7 illustrates the effect on resonance of adding resistance in series with the secondary circuit of a 7·5-kw. open core transformer. The resistances inserted were carbon rods of 700 ohms each. The curves become rapidly flatter as the resistance, or damping, is increased. The amount to completely wipe out resonance is approximately such that the rated output is all consumed in the resistance. Resistance has no effect on the resonance curve other than broadening the tuning, so to speak.

Fig. 8 shows the effect of resistance inserted in the primary of a 2-kw., 500-cycle, 110/18,000 volt transformer circuit. These curves are striking examples of the correctness of the deduction that inserting a resistance R_1 in the primary circuit has an equivalent secondary effect of $\text{Ratio}^2 \times R_1$. Resonance is wiped out surprisingly fast. In this experiment the point of resonance moved slightly to the left in the direction of increased inductance, since the rheostat used was slightly inductive. The curves were made by the *secondary voltage method*.

Fig. 9 represents the conditions found to occur in a 5-kw., 500-cycle, 110/12,500 volt open core transformer tested by the *secondary voltage method* when a step-by-step primary inductance was inserted. Secondary voltage rise becomes sharper, and its

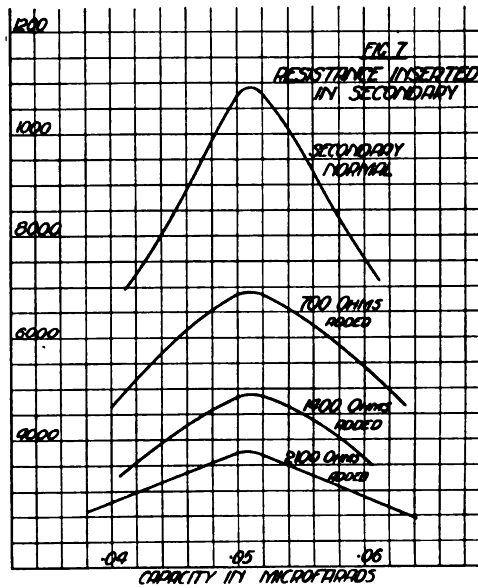


Fig. 7.

amplitude greater as more primary inductance is inserted. We have noted in Fig. 4 that the primary current falls off with increased inductance; hence the secondary current must likewise drop. If the secondary voltage is to be considered as resulting simply by the building up of voltage across inductance of the secondary by the relation $E_2 = 2\pi f L_2 I_2$, it is evident that a condition such as here shown can only result when the secondary inductance increase is more rapid than the secondary current decrease. This is probably the case with open core transformers having liberal copper and a relatively weak coefficient of coupling.

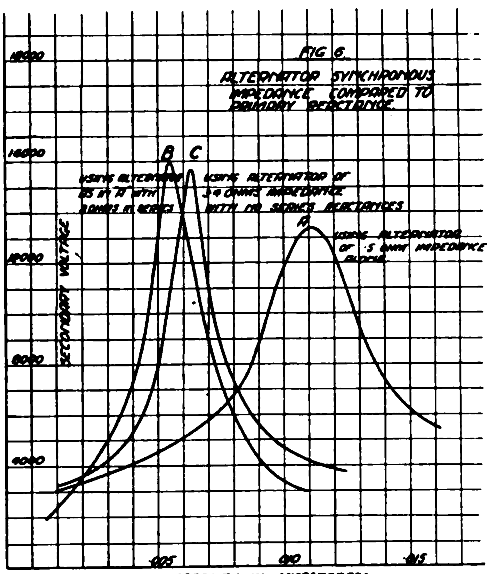


Fig. 6.

Fig. 10 demonstrates the desirability of detuning the alternator-transformer circuit of a quenched spark transmitter with respect to the alternator frequency. The natural frequency of this circuit is seen to be 450 cycles, or 50 cycles lower than the alternator. This setting represents the working point nearest resonance with this particular set for a perfectly clear note. It was also the most efficient operating point. A detuning of 100 cycles or 20 per cent. is nearer the average condition.

Fig. 11 shows a simultaneous set of primary voltage and primary current readings for one of the settings made on the

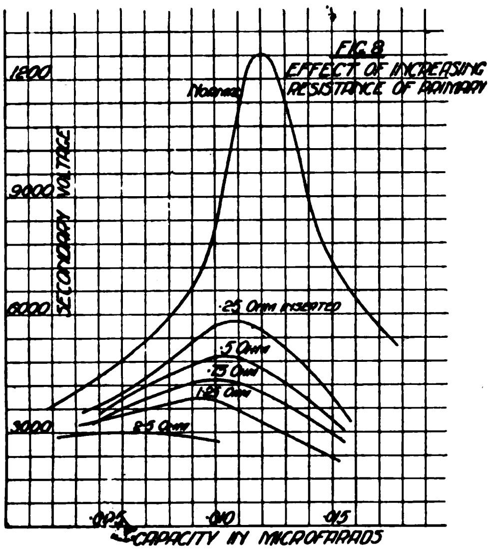


Fig. 8.

300-kw. set at New Brunswick, and shown in Fig. 4. The primary voltage curve checks quite closely with the voltage calculated from the simple relation $E_1 = 2\pi f L_1 I_1$, or is merely the product of alternator synchronous impedance and the current flowing. A few calculated points are shown by circles.

Fig. 12 is a record of the simultaneous primary and secondary currents of the 300-kw. set at New Brunswick during a resonance setting as above. These curves were taken to determine the extent of the variation of transformer ratio during resonance. The two curves are plotted against the same ordinates by multiplying the secondary current by the winding ratio, and plotting primary ampères direct. It is apparent that no wide change of ratio occurs.

Some vital facts may be gleaned from the data presented in regard to the design of transformers for this class of work. Quite evidently, low resistance values in both primary and secondary are desirable. Further, it has been demonstrated that the total circuit inductance is the value of prime importance from the point of view of resonance. We have also noted that this circuit inductance may be made up of a number of separate small inductances, or concentrated in the alternator and transformer alone. For a particular specified capacity value in the oscillating circuit the most efficient arrangement is that in which the total inductance is made up in the alternator and transformer only. Both copper and iron losses are thereby reduced; but the arrangement lacks flexibility if a wide range of capacity is to be used. Usually this is not the case. Flexibility, if desired, is most easily obtained by means of primary variable reactance, or, better still, from the point of view of efficiency, by varying the mutual inductance of the transformer, thereby regulating its flux leakage.

The choice between open and closed core transformers for wireless work has long been a point in dispute. The open core transformer has the advantage of simplicity. It has also the inherent high leakage charac-

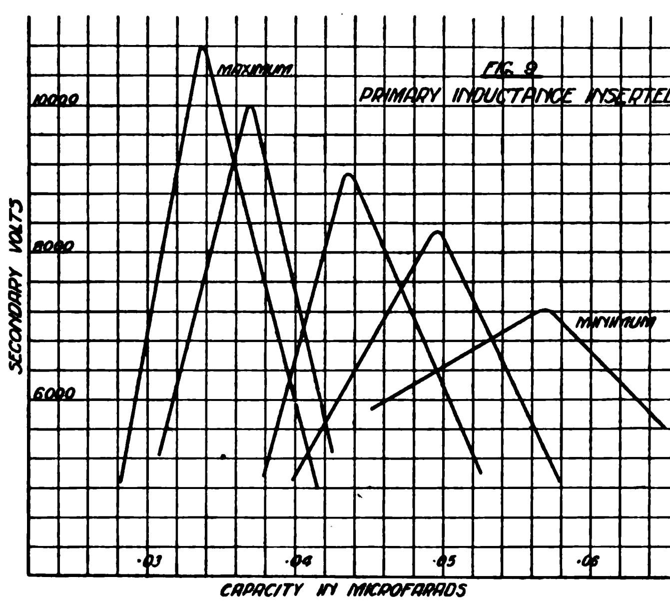


Fig. 9.

teristic sometimes so desirable. It requires more iron and wire for a given output than the closed core unit. Assuming the same magnetic flux density in a similar unit of each type, the copper loss in the closed core unit will be less, since less wire is needed; and for the same reason its iron loss is lower, since the volume of iron is less, although the flux densities are the same. The closed

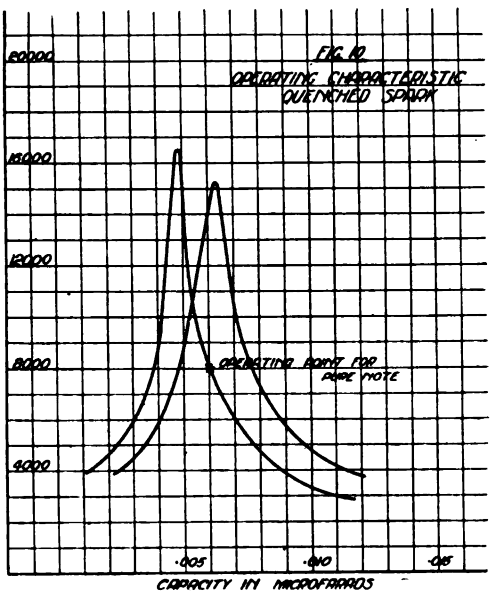


Fig. 10.

core unit, therefore, is more efficient. A considerable saving in space in favour of the closed core type also results. This saving, as we have just noted, is effected in both core and coils. High leakage may be obtained in the closed core type by careful disposition of the windings without resort to magnetic shunts or other devices. It is apparent for these reasons that the closed core transformer is the more economical type both electrically and mechanically.

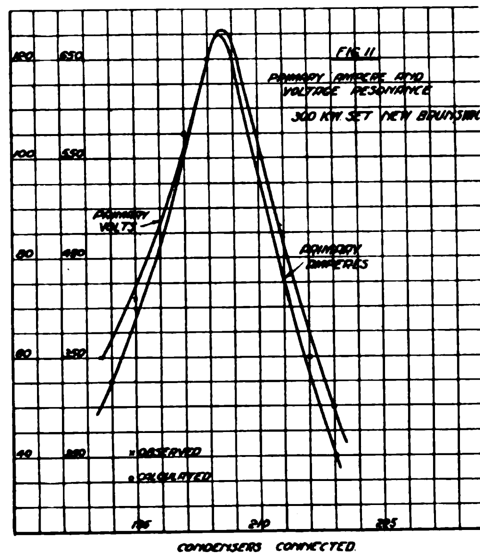


Fig. 11.

[Presented before the Institute of Radio Engineers on the evening of November 4th, 1914, Columbia University, New York.]

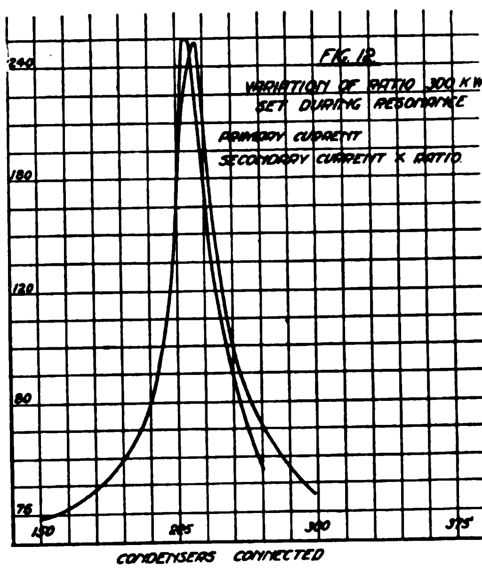


Fig. 12.

Digest of Wireless Literature

ABSTRACTS OF IMPORTANT ORIGINAL ARTICLES DEALING WITH WIRELESS TELEGRAPHY AND COMMUNICATIONS READ BEFORE SCIENTIFIC SOCIETIES.

THE INSTITUTE OF ELECTRICAL ENGINEERS.

The following is an abstract of a paper on "Some Experiments on the Induction Generator," read before the Students' Section of the above Institution by Mr. W. H. Date, B.Sc.(Eng.), on March 17th :—

The author begins by mentioning how little is known about induction generators; this fact causing him to write the present paper.

First consider what constitutes an induction generator. An ordinary polyphase induction motor whose rotor is mechanically driven above synchronism is capable of acting as a generator provided its stator terminals are connected to a polyphase generator which supplies the exciting current necessary to maintain the rotating field. Hence an induction generator is not self-exciting. Apart from this difference, the performances of induction and shunt-wound continuous current machines are very similar: each develops a torque which increases very nearly in proportion to the decrease of speed from no-load speed, and each, if driven at a higher speed than this, is capable of acting as a generator.

It may be mentioned that the property of an induction motor of acting as a generator at speeds above synchronism is used on some railways to return power to the line on a down gradient, thus providing an economical method of braking.

The author suggests that this method of regenerative braking might also be advantageously employed on comparatively slight gradients if a pole-changing switch be provided for increasing the number of poles. The effect of this would be at once to decrease the speed of the rotating field, with the result that the machine would commence to generate and pump current back into the line at a much lower speed of the rotor.

Mention may be made of the following interesting experiment. An induction generator driven by a shunt-wound motor was connected to a three-phase generator driven by a d.c. motor. The supply was then cut off from this motor, which, however, still continued to revolve, being driven by the three-phase generator, now acting as a synchronous motor, on power supplied by the induction generator. The same thing occurs if the three-phase generator is replaced by a rotary converter and the d.c. supply is cut off.

The importance of these experiments must be obvious to all station engineers who have to deal with alternators running in parallel. The disastrous effect that may overtake the plant if any one of the generators should be suddenly deprived of its excitation is entirely avoided if the machines be fitted with the amortisseur circuits, thereby converting them into induction generators when required. Further, there is no danger nor waiting when synchronising.

A modified form of the Hopkinson test can be carried out if one pulley is made smaller than the other, so that the machines run at different speeds.

The author then discusses the phase relations of the various currents, and constructs vector diagrams.

Then follows a description of tests made on a 1 h.p. 3 ph. 60 cycle 60 volt motor, running at 1,650 revs. per minute. The machine was run both as a generator and as a motor, the change from one to the other being made gradually, by increasing the power supplied to the driving motor. With reference to the well-known Heyland diagram, it was found that the readings for the motor and generator gave a practically complete circle. Similar results were obtained from a single-phase machine.

In conclusion, the scope and advantage of the asynchronous generator based on the results obtained from the experiments will be summarised as far as possible. First and foremost, perhaps, we have seen that in a system supplied by induction generators the troubles of hunting and synchronising cease to exist. Every station engineer is aware of the dangers of hunting and synchronising with synchronous generators; with the induction generator it becomes exceedingly simple to parallel a machine on to the busbars. In consequence the switchboard controlling a set of induction generators would present none of the complications met with in a station of synchronous generators.

From a mechanical standpoint also there appear to be some rather striking advantages. The rotor of the induction generator would be squirrel cage, thus doing away with slip rings, and as such could be built to stand higher centrifugal stresses than in the case of the revolving field. Further, an accurate balance of the rotor could be obtained far more easily than is the case at present, since the distribution of material in the rotor would be symmetrical. It is evident then that the induction generator is especially suitable for turbine speeds.

With the machine in parallel with a synchronous motor, we have seen that the voltage, frequency, and power factor are all capable of easy regulation, and that the generator will stand a heavy overload.

The author puts forward the suggestion that a station equipped with these machines driven by turbines and running in parallel with high-speed synchronous motors would be cheaper to instal, and would possess the above advantages over a station employing synchronous generators.

TRANSMISSION BY DAMPED AND CONTINUOUS OSCILLATIONS.

In the *Bulletin* of the Bureau of Standards, Vol. II., No. 1, there is an interesting note by L. W. Austin on wave-lengths and transmission by damped and continuous oscillations. The testing of the recently erected high-power United States naval radiotelegraphic station at Arlington, Va., has given another opportunity for carrying out experiments on the relation between the currents in sending and receiving antennas at varying distances, and at the same time for investigating the relative advantages of transmission by means of damped and continuous oscillations. At present the observations on the transmission of different wavelengths over great distances are too meagre in number to settle the question of the relation between the attenuation of the signals and the wave-length. It is certain, however, that the attenuation even over sea-water is very much decreased as the wave-length is increased. The comparisons made of the efficiency of arc and spark transmission have indicated that for distances of the order of 3,700 kms. or more continuous oscillations are on an average superior. The evidence is not complete enough to prove that this superiority always exists. It is apparently connected in some way with the reinforcement of the signals from the upper layers of the atmosphere, and is subject to the vagaries of this portion of the received energy. The indications seem to be that the superiority of the continuous oscillations is greater in winter than in summer.

MEASUREMENT OF HIGH FREQUENCY ALTERNATING CURRENT.

In a paper read before the Royal Society, Messrs. A. Campbell and D. W. Dye describe some important investigations on the measurement of alternating currents of high frequency, and give some simple practical methods of obtaining precision. The authors commence by referring to the importance, both from a scientific and practical point of view, of accuracy in such measurements, and point out that whilst by the methods at present in use it is comparatively easy to measure currents of the order of 0·1 ampère, many difficulties present themselves when we have to deal with currents of 1 to 50 or 100 ampères.

Dealing firstly with thermal instruments, the paper states that the most common method of measuring a high-frequency current is to pass it through a conductor and observe the rise in temperature of this as shown by its expansion or change of resistance, or by means of one or more thermojunctions in contact with it or near it. The last method, that of a heater and separate thermopile, was investigated by one of the authors many years ago, and was used later to measure the voltages induced in small search coils by alternating magnetic fields. The separate heater system was used by Mr. Duddell in his beautiful application of Mr. Boy's radiomicrometer to current measurement; and his thermo-galvanometer still represents the high-water mark in efficiency. Whilst, however, the self-contained thermo-junction and moving coil no doubt give the highest efficiency, the use of a thermopile connected to a separate galvanometer has several advantages, especially in laboratories where economy of instruments has to be considered.

The authors next describe the thermopiles they used, mentioning that the most frequently used couples were either iron-constantan or magnanin-constantan. The iron-constantan couple has two strong points in its favour: it gives a voltage almost exactly proportional to its temperature, and the temperature coefficient of its voltage sensitivity is very small. On the other hand, the high thermal conductivity of the iron is not desirable and its magnetic properties may give trouble.

Some interesting particulars are also given of the behaviour of a separate heater and thermopile immersed in oil. It has been found that several important factors have to be taken into consideration in connection with the thermal expansibility, the viscosity, and other properties of the liquid. Current transformers are next dealt with, and a description of air-core transformers suitable for use in measuring large alternating currents is given. The authors next give the methods used and the results obtained in testing air core transformers, each transformer being tested at a number of frequencies.

There is a very general belief that the use of iron in high-frequency measuring instruments is almost impossible, since hysteresis and eddy current effects become so pronounced when the magnetic cycle is repeated at such frequent intervals. In the case of current transformers, however, this is quite a mistake, for most excellent results can be obtained by the introduction of iron cores, and it is not even necessary to use specially thin iron sheet or wire in making these.

In dealing with general conclusions the authors state that it is evident from their experiments that properly designed air-core transformers, when used with due care in conjunction with thermal ammeters, afford a simple means of measuring currents of the order of 1 to 50 ampères with good accuracy at frequencies from 50,000 up to 2,000,000 cycles per second. Iron-core transformers, which have some advantages in ease of construction, can also be designed to fulfil the same purpose and to give very satisfactory results.

LEEDS ASSOCIATION OF ENGINEERS.

At a recent meeting of the above Association, Mr. H. F. Yardley read an interesting paper on Wireless Telegraphy, before an appreciative audience. Mr. Yardley commenced by outlining the history of wireless telegraphy from the time that Faraday made his initial experiments with induction, and next dealt in simple language with the subject of waves and wave-motion. He went on to compare the waves of light with those used in wireless telegraphy, showing that the main difference was one of wave-length, the waves in wireless being about a million or more times longer than those of light. Mr. Yardley then informed his audience of the different methods of producing the electric waves, starting from the experiments of Heinrich Hertz and running through the early and later experiments of Marconi. A description was then given of the Marconi, Poulsen and Telefunken systems, the lecturer explaining the differences in construction of apparatus, etc., by which these systems are distinguished. Some mention was also made of the Marconi transatlantic station at Clifden.

Details of the apparatus were described in clear and simple language, the connection between the various parts being dealt with in an interesting manner. Finally the lecturer made reference to practical working and the difficulties which present themselves to the operator and experimenter.

At the conclusion of the lecture Mr. Rainforth, the president, remarked that Mr. Yardley had dealt with a very complicated subject in a very simple manner, and various members asked questions, to which the lecturer gave reply. On the proposition of the Vice-President, a hearty vote of thanks was passed to Mr. Yardley for his interesting and very instructive paper.

WIRELESS AND THE MERCURY VAPOUR ARC.

In the March number of *Modern Mechanics*, Mr. Robert G. Skerrett writes concerning the work of Dr. Peter Cooper Hewitt and the Mercury Vapour Arc in its relation to wireless telegraphy. The article is entitled "A New System of Radio Communication," but perusal of it shows that the novelty lies only in a mercury vapour arc being utilised as a generator of oscillations and a specially modified form as a receiver. Dr. Hewitt, in the course of an interview, stated that he had discovered that "there are nearly forty things going on inside the tube of a mercury vapour arc," although in the beginning he thought there were only three. Some of the comparisons alleged to have been made by Dr. Hewitt between the "spark-gap" oscillators and the mercury vapour arc call for some comment. As an example we quote the following :—

"The spark-gap oscillators are costly affairs: the big rotor for this work weighing five tons in one of the Transatlantic plants. It is built well-nigh as carefully as a watch and, to carry the comparison further, is pretty nearly as delicate. Constant heavy work is apt to derange it. Mechanically the Poulsen arc is much simpler, but the difficulty lies in the fact that the carbons between which the flame is made burn out rather quickly and are expensive to replace. . . . I have found that I can get from a mercury vapour arc oscillator, weighing not more than two pounds, an uninterrupted flow of Hertzian waves that will reach as far as those generated by the sparking machine in which the rotor weighs quite 10,000 pounds."

We presume the rotor referred to is the rotary spark discharger of a very large wireless plant. A plant sufficiently large to require such a heavy disc would be capable of radiating some hundreds of kilowatts. A mercury vapour tube weighing only two pounds and which can utilise even one hundred kilowatts must be a remarkable invention!

Again, we cannot agree with the statement that the Poulsen arc apparatus is mechanically simpler in a large plant. Further, the difficulty lies in many directions other than that of the carbons burning away and being expensive to replace.

At the conclusion of the article it is stated that in the mercury arc transmitter and the mercury arc receiver Dr. Hewitt has the essentials of a successful long-distance system of wireless telephony.

OBITUARY.

DEATH OF AN EMINENT TELEGRAPH EXPERT.

We regret to have to record the death of Sir John Cameron Lamb, formerly Second Secretary of the Post Office, which took place on March 30th at his residence in Hampstead. Sir John (then Mr. Lamb) entered the Post Office in 1864, and was one of a group of young men who eventually took a large share in the development of the service as it exists to-day. In 1870 he was selected with others to assist in negotiations for the acquisition of the Inland Telegraphs, which up to that date had been entirely in the hands of private companies. In 1888 he carried out most of the arrangements in connection with the introduction of sixpenny telegrams. As a result of the growth of the telegraph business between England and the Continent, and the necessity of cheapening the rates to meet commercial requirements, it became increasingly apparent that the public interest demanded that cables connecting this country with France, Holland, Belgium and Germany should be owned by the respective States, and in 1884, and again in 1888, Mr. Lamb attended conferences with the officials of the various telegraph administrations concerned, and negotiated agreements for the joint acquisition and working of the cables. Mr. Lamb took part in three international telegraph conferences—in 1890 in Paris, in 1896 at Buda Pesth, and in 1903 in London. He was appointed Third Secretary of the Post Office in 1896, and in the following year became Second Secretary. Mr. Lamb was the Senior British delegate at the first International Conference on Wireless Telegraphy, held in Berlin in 1903. From 1892 to 1897 he served as a member of the Royal Commission appointed to consider the establishment of electrical communication with lighthouses and lightships. He received the C.M.G. in 1890, the C.B. in 1895, and had the honour of knighthood conferred on him when he retired from the Post Office in 1905, after more than forty years' service.

Palma—the capital of the Island of Majorca.

LIFE ON THE SÓLLER STATION.

A narrative of everyday experiences in the Majorca *(Balearic Islands)*.

By E. BLAKE.

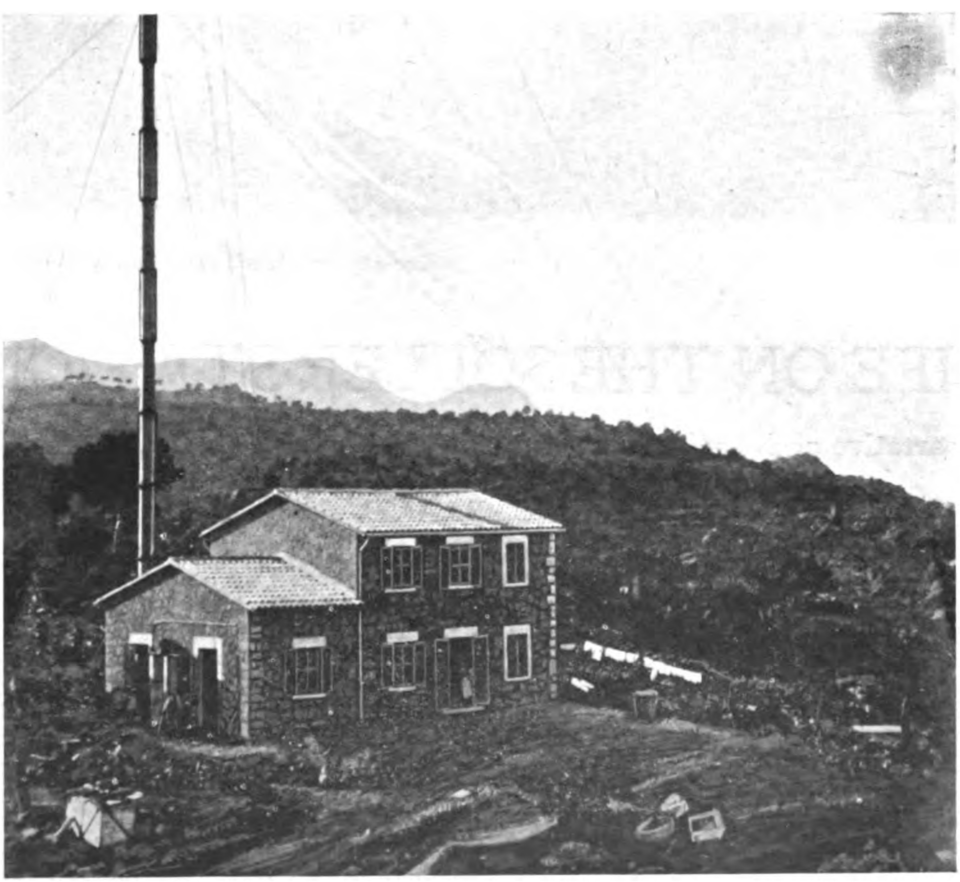
IN these days of Cook's tours it is surprising that there should be in the Mediterranean, only two and a-half days' travel from Charing Cross, an island about which the majority of English people know practically nothing; an island populated by a proud, intelligent, and historic race with a grammar and literature of its own; a people which has given soldiers and statesmen to Spain, which possesses railways, telephones, and telegraphs (not to mention the wireless station), and which is a strenuous and enthusiastic imitator of the English in the matters of boxing, "bridge," tennis, and five o'clock tea. I refer to Majorca and the Mallorquines. The average Briton would probably stoutly deny his ignorance of Spain, but confess to haziness in regard to the Balearic Islands. Madrid? Oh, bullfights—and all that! Seville? Marmalade oranges! Barcelona? Why, of course, that is where the nuts come from! Spain generally? Guitars, daggers hidden in señoritas' garters, bombs, onions, and King Alfonso! But Majorca! Was there not an Admiral

Byng who was shot? . . . no, that was Minorca. . . .

Here is an island of mountain torrents and mountains clothed wellnigh to their summits with olive-gardens; of rich valleys where the date, the fig, the orange, lemon, and grape flourish prolifically with a minimum of human labour; an island where the air is like wine and fragrant with the scent of almond and orange blossom. To reach this great orchard you follow the ordinary route through Paris and Port Bou to Barcelona, travelling thence by mail steamer to Palma, the capital of Majorca. From Palma an hour's journey by rail through the heart of a mountain-range brings you to Sóller, a town of semi-tropical beauty, set in the hollow of the hills. Three miles from here is the sapphire-coloured sea lapping the little fishing village of El Puerto de Sóller, and a coast which by reason of its magnificence is the despair of artists.

The wireless station is situated on the top of Punta Grossa, a rock some 700 ft. high, overlooking Sóller Bay, and at the time of which I write we three British operators lived there together with a cook, a labourer, and a mule. When I left the staff had been augmented by two dogs, several generations of cats who held no very narrow views on the subject of consanguinity, a stud of guinea-pigs and one lonely hen. The labourer also had a private snail-farm which supplied him with breakfasts when the hen forgot her duty. Our only neighbours were the two lighthouse-keepers who tended the penny-farthing oil-lamp which was supposed to be a guide to mariners.

It must be admi ted that when the glamour



Wireless Station at Sóller, showing base of Sectional Steel Mast.

El Puerto de Sóller.

of the scenery began to lose its power and we wearied of tramping over the rough volcanic rock which was the chief geological feature of the district, we were rather at a loss for spare-time occupations. At times we had bad attacks of bottle-shooting with pistols, and a herd of half-wild pigs which often invaded our domains with disastrous results to our earth-wires, gave us sport, for we stoned them relentlessly. In El Puerto was an antediluvian motor-boat which we coaxed into a semblance of activity and in this we sometimes went clanking round the coast, listening to the irregular explosions of the motor as one might to the heart-beats of a dying man, wondering which would be the last. The bathing was splendid, and possible during about eight months of the year, commencing from February. There lived in the bay a healthy breed of small octopuses, but we had the luck to escape meeting any of these. The only fishing which seemed to pay for the trouble was of the "seine-net" variety, and of shooting there was none worth the name. Still, for the artist, the photographer (oh, yes! *you* are an artist also) and the archaeologist the island is a veritable Tom Tiddler's ground, though with regard to photography one has to take one's chance with the local chemist. He is really an alchemist.

There are plenty of mountains, but the inducement to climb them is small, for Spanish sunshine and, maybe, a breath of the sirocco straight from Algeria incline one more to indolence and the sucking of oranges than to stepping heavenward with a blistered nose for reward. We did actually scale the highest peak, some 6,000 ft. high, accompanied by mules and guides, and everyone agreed that the drinks were the best part of the expedition.

In winter our amusements were very few, for the island receives its yearly supply of rain during the first quarter. The town of Sóller afforded us nothing in the way of diversions. The inhabitants are people of simple tastes and retire early. Their clubs, *fiestas*, which are holidays brightened by mild flirting with fans, cheap sweets and a brass band, and gambling constitute their chief pleasures. We used to sit in our little living-room and quarrel as only exiled Britons can, discuss all questions of Time and Eternity, and indulge in an enthralling card-game called *siete y media*, by the playing of which for half a day one might win or lose twopence-halfpenny. As a more serious employment, apart from official duty, one could sit in the springless cart behind Juanina the mule, and partly wobble, partly bump, down into Sóller for the mails. The zig-zag path down the cliff was just about as wide as the cart and was stayed with boulders. On the right hand the cliff mostly rose up sheer and on the left it dropped sheer. There was a two-foot mud wall (*adóbe*), mostly broken down, along the left-hand edge of the path (going downward) and the joy of the ride lay in the fact that Juanina had for many years been employed in walking blind-folded round a water-distributor. Mules thus engaged proceed counter-clockwise, so that by long habit Juanina had an irresistible, incurable bias towards the left. Thus her

Sóller—set in the hollow of the hills.

helm was in a permanent state of hard-a-starboard, and only a concentrated mind working in sympathy with an unslacking pull on the right-hand rein saved one from driving off into space.

Britons like to live as Britons wherever they are, and we at first found serious differences existing between Mallorquin fare and that to which we were accustomed. We hankered after the fleshpots, and all we could get was lean, mountain-fed mutton. For six months we ate dry bread until a local trader was induced to import butter —at 2s. 6d. a pound. Save as an occasional medicine, tea is not used in those rural parts, but by perseverance we got it, at 5s. a pound. Fruit and vegetables are plentiful and extraordinarily cheap. Tomatoes grow in the open fields in rows like potatoes in England, and one often sees loaded grape-vines forming the hedges of a public lane. Fig-trees flourish rooted in the crevices of bare rock, and it is as inconceivable that they should find nourishment there as it is that the gnarled, dead-looking trunks, some of them centuries old, which cover the hillsides should be olive trees capable of bearing, sometimes, a double yearly crop of fruit.

The less said about the tobacco the better; the Government supplies it. It is said that the Mallorquins are inveterate smugglers, and I do not blame them, for even hardened smokers draw the line somewhere.

I said that the people are a historic race. Tacitus it is, I believe, who mentions the slingers of the Balearic Islands, who as

The Path was stayed with boulders.

mercenaries in the ancient wars took only women and wine as payment. Slinging is to this day an accomplishment of which the peasants are proud. When the Moors overran Spain, including Majorca, they were distinctly unpopular with the people of Sóller, who on more than one occasion kicked them out of the district. One great battle was fought in Sóller bay, when the Moors, who arrived in ships, were met with fusillades of cannon-balls and "pot-legs" from the entire village. A landing was effected, but the Sóllerenses were "all over them," and the heads of the raiding expedition were captured and executed in the market-place. The old cannon still lie behind El Puerto. Every three years there is a special holiday in honour of the event and the battle is re-enacted in costume. Even the various sailing strategies of the Moors are carefully imitated by those who constitute the invading force, and the young bloods have a glorious debauch of gunpowder, finishing with a first-class rough-and-tumble as the "Moors" leap ashore. One of these celebrations took place during my stay there, and while I was carefully focussing the pirate king the tide of battle rolled over me, and the subsequent appearance of my negatives was sketchy and nebulous. Their value to the daily illustrated Press would be enormous, for they can be used to illustrate such subjects as "Foggy Weather in the Vosges," and "Wurtemburgers looking for bread-cards during an earthquake."

The Mallorquines speak an obvious mixture of Spanish, French and Italian, very similar to the Catalan tongue. The question of which has the *pukka* language and which a dialect is still an acute one between the people of the island and the inhabitants of Cataluña, and from time to time evokes some pretty wit in the newspapers. The people are a healthy, happy, and contented lot, not overburdened with education or ambition. They are great lovers of their country and fully alive to its marvellous beauties, and as long as the various crops do well and there is a bullfight now and then, all is well indeed.

Not even in Sóller, which thinks Barcelona is the hub of the world, can one escape the ubiquitous boy-scout, who is there with his bare knees, broomstick, and badges, endeavouring to burnish the glory of Spain.

To give the reader an idea of what life is like in the sleepy village of El Puerto de Sóller, I conclude with a summary of a typical week, in which for obvious reasons I clothe fact with fancy.

Monday.—Oldest inhabitant appears with brand new seat to his trousers. The knife-grinder receives a telegram; mass-meeting outside his house and local paper comments favourably, incidentally dragging in the glory of Spain. Three babies arrive—two Pedros and a Maria.

Tuesday. — Local policeman observed cleaning his rifle; Revolutionary Club at once denounces Government. Narizroja, the tavern-keeper, lays in a new cask of wine and a bottle of Benedictine; receives gold medal from local Chamber of Commerce and newspaper alludes to new spirit of enterprise animating noble bosoms of sons of glorious Spain. Three babies arrive; two Dolores and a José.

Wednesday.—Local policeman leans up against an entirely different post; Conservative Club thereupon passes vote of lack of confidence in Government. Revolutionary Club buys cartridges. Four babies arrive—two Pedros, a Dolores, and a Maria.

Thursday.—Exciting day. Two pieces of paper blow past and a dog goes off at a tangent. This being too much for nerves of oldest inhabitant, he runs amuck. Two babies arrive—José and Catalina.

Friday.—A priest pulls a boy's ear; powder play by Revolutionary Club. Three members of same arrested several times in rapid succession by Mayor in name of: (1) God and the King; (2) his honour; (3) his duty to Spain; (4) the memory of the immortal Cervantes. Liberal Club, frantic with joy, stands Mayor much vermouth. He makes a speech on patriotism, the Cuban question, the glory of Spain, and the new by-law concerning goats' milk; bursts into tears and gives his sword away to the billiard-marker. Two babies arrive—Pedro and Maria.

Saturday.—Commandante of Marine puts on collar and officially looks at the weather. All political clubs censure Government, but policeman now being up against his usual post has quietening effect, and only one man is shot. Mayor discovers that brand new seat to oldest inhabitant's trousers corresponds to the missing portion of one of his (the Mayor's) potato-sacks.

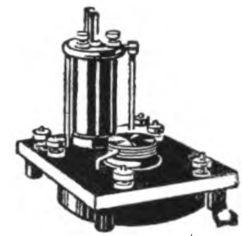
Among the Olives.

Oldest inhabitant swears by the imperishable lustre of the glory of Spain and the finger-bones of Raymond Lully * that he has seen no sack. Not the Mayor's sack. And even if it *were* the Mayor's sack, what of it? He would spit upon the Mayor's shadow. Thus! Pah! Pork! Son of a ——a Magdalene! To accuse him, Don Manuel Alfalfa y Algarroba, whose parents were gentlefolks and took baths! Ay, Dios mio! señores, was ever a Spanish caballero thus unjustly . . . Is led off to bed. Four babies arrive—two Josés, one Antonio, and a Marietta.

Sunday.—Profound peace. Priests drift about like fat bumble-bees. Commandante of Marine puts on collar and milks his mother-in-law's goat. Oldest inhabitant tells Revolutionary Club once again his great story entitled "How I drew gore from a sergeant of carabineros in '39." Revolutionary Club goes out *en masse* and darkly regards local policeman from beneath beetled brows. Man accidentally shot in Conservative Club simply because he mentioned to knife-grinder that he would give five pesetas for a sight of his (the knife-grinder's) heart and liver. All babies baptised, including three Saturday night stop-press editions—Pedro, Catalina, and Aldebaran.

* Raymond Lully was a Majorcan soldier of fortune turned monk. His cell is one of the show places of the island.

The ENGINEERS Note Book



[Under this heading we propose to publish each month communications from our readers dealing with genera engineering matters of various kinds in their application to wireless telegraphy, and we would welcome criticisms, remarks and questions relating to the matter published under this heading. We do not hold ourselves responsible for the opinions and statements of our contributors.]

Starting by Hand.

ENGINES up to about 50 B.H.P. which are fitted with an efficient compression release and hand-turning gear are easily started by one man of average strength, but a hint may not be out of place—viz., that something more than getting the engine round is essential for easy and expeditious starting. It is assumed that careful looking round and oiling, as per instruction book, will always be part of the routine when starting up, so that the engine may be in a proper condition, then after placing the compression release lever in the starting position, the attendant should commence slowly pulling the engine round, preferably starting from a position when the handle is being pulled towards him rather than pushed away. At the second revolution, when the inertia of the moving parts has been overcome, special effort should be made not only to increase the speed to a maximum, but to overcome the compression and ensure a good spark from the magneto. If the engine does not respond to this treatment, take a rest, and again examine matters to see that the vaporisers are correctly heated and the fuel-feed valves acting, etc., and then proceed as before. Continual turning round is absolutely unnecessary and futile, besides being very tiring, and is never likely to get the engine to work. It is just for this reason that occasionally one hears of a man pulling an engine round for a long time with no result, and then asking someone who is fresh to have a turn, and it starts immediately. Knack, coupled with intelligence, is really of far more value than brute force. It should be noted that the method of starting up an oil engine is quite different from that usually adopted for starting up a petrol engine, which is suddenly jerked over the compression.

Starting by Compressed Air.

As the frictional resistance of the larger engines would be too much for one man to conveniently overcome and attain a sufficient speed for getting under way, it is usual to fit a compressed air equipment which operates as follows:—A suitable service of pipes is led from a shut-off valve to distributing valves operated from the camshaft, and it should here be noted that the compressed air is only used for the purpose of turning the engine round, in exactly the same manner as the hand turning above described, therefore no attempt should be made to start against a load, and the compression release should be used so that no energy may be wasted in overcoming the high compression; in fact, unless the compression release is used, there is every possibility of back firing, which would defeat the end in view. Certain marks will be found on the rim of the flywheel and the gears which drive the lay shafts of the engines. By hand barring the engine has to be brought into such a position that these marks are in a line, thereby placing the cranks in the best position for making the most of the compressed air. After priming the vaporisers, and seeing that everything is in order, the compressed air valve should be turned on sharply, and immediately the engine is heard to take up its ignition, this valve should be closed and the half-compression lever put into the working position.

A word or two on keeping the air receiver well charged may be advisable, and to that end it is a good practice to always start the air compressor and re-charge the air receiver previous to putting the engine upon her working load. There should be a stop valve on the receiver as well as one on the engine, and, when properly charged, both should be closed to prevent leakage. In case a joint is suspected of leakage, a drop of oil or thick soapy water smeared round will instantly reveal its position by the gradual formation of a bubble, and it should be remembered that the minutest leak in the air service is sufficient to rapidly lose all pressure from the receiver. The little air compressor itself should receive careful attention from time to time; it should be kept thoroughly clean, well lubricated, and the valves in perfect order.

Various Engines.

The above remarks apply to almost all types or fuels, but for suction gas outfits it is specially necessary to make sure gas is delivered right up to the engine before attempting to turn on any compressed air for starting, as otherwise the receiver would be exhausted before the service pipes had been sucked clear of air.

Suction Gas Plants.

Another word of warning on the subject of Suction Gas Plants is that the gas itself is exceedingly poisonous, and therefore the generating house and engine room should be both thoroughly and efficiently ventilated, and a card hung up in each place showing the symptoms and remedies for gas poisoning. One of the most important is fresh air, but with any ordinary care no danger need be anticipated; it is only the careless or inexperienced who are likely to be affected.

We have pleasure in reproducing below a letter which we have received from a reader of THE WIRELESS WORLD concerning the "Engineer's Note-book" for March. The letter has been submitted to the writer of the Notes in question, and his reply is appended. We welcome such criticisms as these, as they add considerably to the interest of the articles.

"*The Editor*, THE WIRELESS WORLD.

"SIR,—Allow me first of all to express my appreciation of the excellence of the current number of THE WIRELESS WORLD. You invite criticism of the 'Engineer's Note-book.' While agreeing with the first part of the section 'Engine Maintenance,' which is excellent, I may be allowed a word or two on the last part *re* bearings.

"The method suggested of slacking back the cap nut is hardly a good one, I think, because if first of all you tighten the nut on the cap with the fingers the bearing is loose, and tightening the outside lock-nut on it will make it also slightly more loose and throw the strain of the bearing on the cap and bolts, instead of the solid block of a good bearing.

"May I suggest a better way is to fit a thin paper liner the shape of the cap, and over the bolts, and then to tighten up the bearing, tight, and try the fit of the pin, but no engineer, fitter or erector worthy of the name would leave a bearing needing to be further fitted by either method, which is at best a makeshift.—Yours faithfully,

"W. E. DENSLOW."

The writer of "Notes on Internal Combustion Engines" has much pleasure in replying to the criticism of adjustment of bearing, and much appreciates the kindly spirit in which it was proffered. He is perhaps the better able to make his defence, having been trained in the practice of marine steam engines, and therefore can appreciate the origin of the comments on our methods—which it must be distinctly understood apply *solely* to internal combustion engines.

Your correspondent's method is perfectly correct as applying to bearings taking their thrust and pull evenly as in steam, but with internal combustion engines the bearing only receives working thrust, and there is no "pull" whatever; in fact, the caps only serve the purpose of preventing the journal jumping away from its bearing. Even on the non-working stroke there is the "compression" which keeps the bearing and journal in contact, and on many multi-cylinder engines it is common practice to only have bottom bearing between cranks and a cap to each end bearing.

Another feature is that instead of a comparatively even applied turning effort, as in steam, the impulse of an internal combustion engnie is more of the nature of a blow, which in a new engine has a gradually hardening effect on the white metal lining and may necessitate adjustment far more frequently than with steam, and this adjustment must always be of the nature of a micrometer adjustment: hence the method adopted. It would obviously be impossible to be continually renewing or refitting linen strips between cover and housing.

In conclusion, we would say that the method has been perfectly successful on a very large number of engines, and may add, moreover, that it is accepted as perfectly good practice by the Admiralty, War Office, and other Government Departments at home and by the Consulting Engineers for the India Office, Crown Agents for the Colonies, and many foreign governments and private firms of high standing, when it is applied to internal combustion engines.

One slight correction is necessary—viz., we recommend bringing the surfaces in contact *first* by tightening with a spanner, then adjusting finger tight, and then tightening back on to the lock-nut, which does give just the correct clearance without unnecessary slackness.

IN LIGHTER VEIN.

Our irresponsible expert sends us the following announcement:—

BERLIN, February 31st.—It is rumoured that a new company has been formed to acquire the apparatus on interned German ships. The title is to be "The Benighted Wireless Company."

From over the sea comes an account of an invention by a scientist in the United States. He possesses an electric dog, which follows him about and is controlled by means of a selenium cell and an electric light. We, ourselves, in the editorial offices have an electric cat, which follows us about and is controlled by a piece of cat's meat. Its electrolytic is milk.

WIRELESS POETRY.

"LIGHT from an inside source" is shown, with regard to an operator's life, in a recent issue of the *Marconi Service Magazine* (San Francisco). We give below three verses extracted from a poem headed "This is the Life."

Said Billy McGee,
Who worked in a shop,
"What's to hinder me
From becoming an Op.
And ditching this grind
For a job at sea?
And I've a mind
To quit, by gee"—
And so he did.

Then Billy McGee
To Marconi went
And off to sea
Was shortly sent
On the *Flee Maru*,
Of the Muggins line,
With uniform new
And buttons "ashine"—
And so was he.

And Billy McGee,
Most all the trip
With pail on knee
And pale of lip,
Sighed for the shop,
But sighed in vain,
For seas will slop
And stomachs will strain—
And so did Bill's.

"WIRELESS WORLD" INDEX AND BINDING CASES.

The Index to Volume II. of THE WIRELESS WORLD is now ready, and will be sent free of charge to any reader requiring a copy, provided a penny stamp is sent with the application to cover cost of postage.

Cloth cases for binding the first volume of THE WIRELESS WORLD have also been prepared, and these are on sale at 1s. each (postage 3d. extra). A limited number of bound copies of Volume II. of THE WIRELESS WORLD are available, price 4s. 6d net each copy (postage 6d. extra).

Applications for binding cases and copies of bound volumes should be sent with full remittance to the Wireless Press, Ltd., Marconi House, Strand, London, W.C.

Administrative Notes

United Kingdom.

We are informed that from March 18th, 1915, the Seaforth Wireless Station will be closed to commercial service.

* * *

United States.

The Bureau of Navigation has issued the following note on the subject of wave-lengths and interference in the official "Radio Service Bulletin":

With the opening of many high-power stations during the last two years the Bureau has received complaints of interference, particularly on the longer wave-lengths. Heretofore, in the issuing of licences, in very few instances have wave-lengths requested by commercial companies been refused. However, some consideration now must be given to the distribution of wave-lengths, especially among high-power stations. The Act of August 13th, 1912, to regulate radio communication, was designed to execute, on behalf of the United States, the International Radiotelegraph Convention, and thus to promote the orderly exchange of radiotelegrams. Section 2 of the Act empowers the Secretary of Commerce to specify the wave-length or wave-lengths which may be used by commercial stations, and hereafter particular attention will be given to this matter, and in most cases only one or two wave-lengths above 1,600 metres will be authorised for high-power stations. The attention of those concerned is particularly invited to the London Radiotelegraph Convention service regulations, Article 35, paragraph 2, concerning the use of the 1,800-meter wave-length. Applicants desiring the use of additional wave-lengths must submit with Form 761 a detailed statement of the purpose for which additional wave-lengths are desired, and such statement will be considered with regard to wave-lengths assigned to other stations.

A request for several wave-lengths for the purpose of passing from one wave-length to another to avoid interference will not be considered.

* * *

Antarctic.

The steam yacht *Aurora* of the Imperial Antarctic Expedition will probably winter in Macmurdo Sound in the Ross Sea, and remain there until the early part of 1917. Steamers of the New Zealand Shipping Company, Shaw Saville, and other lines, which run direct from New Zealand to South America, pass within 2,000 miles of the steam yacht *Aurora's* proposed base. Operators on these steamers may on occasion be able to establish communication with the *Aurora*, and deal with any traffic that the ship may have to dispose of.

* * *

Panama.

An arrangement as to the operation of wireless telegraphy at Panama Canal has been made between Sir Cecil Spring-Rice, the British Ambassador, and officials of the United States State and Navy Departments, under which certain hours of the day will be set aside for the uninterrupted use of the air by warships, and during the remainder of the time the shore stations will handle their messages without interference from the British naval operators.

* * *

Ratification of International Convention.

The British Government has notified the International Bureau at Berne that the Radiotelegraphic Convention of London, together with the final Protocol and Service Regulations, has been ratified by Greece, Morocco, and Brazil, dating from July 24th, 1914, November 2nd, 1914, December 18th, 1914, respectively. It is also notified that Guatemala, Panama, and Colombia have agreed to the Convention of London from July 10th, 1914, July 14th, 1914, and August 25th, 1914, respectively.

Wireless Telegraphy in the War

A résumé of the work which is being accomplished both on land and sea.

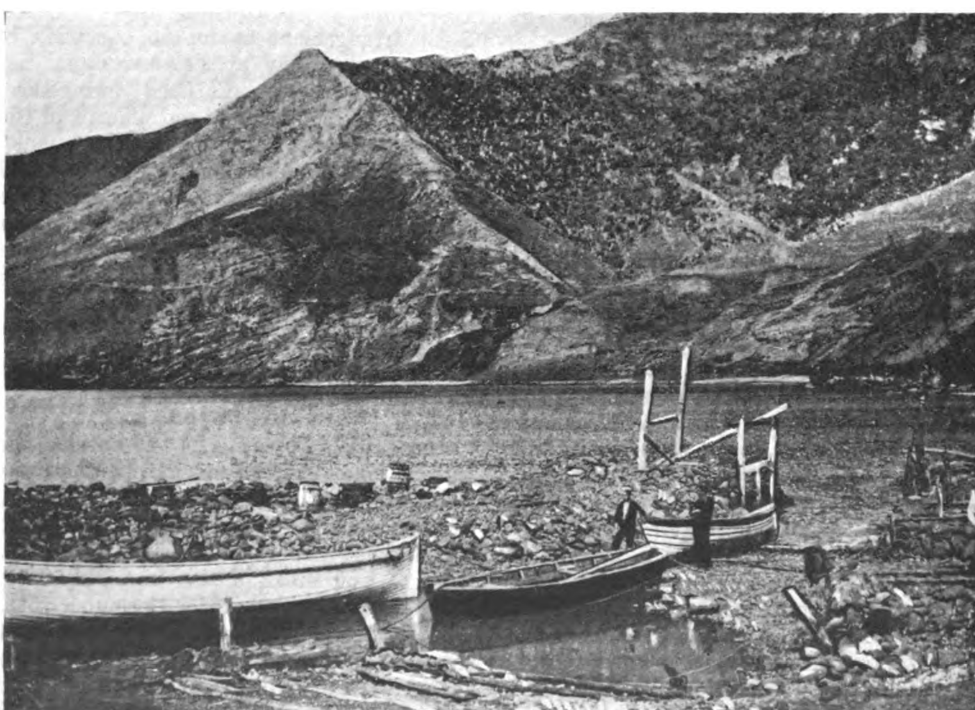
WE reproduce below an excellent view of Cumberland Bay, in Juan Fernandez, the spot in the "Robinson Crusoe Island" where, guided by wireless, the three British cruisers—*Kent*, *Glasgow*, and *Orama*—discovered and destroyed the German "commerce destroyer" *Dresden*. The island was discovered in 1563 by the Spaniard whose name it bears, and was, for five years, the solitary abode of Alexander Selkirk, a Scotch buccaneer, whose story is supposed to have suggested Daniel Defoe's famous novel referred to above.

We drew attention in our April issue to the imaginative fictions which our enemy circulates all day long and every day by wireless, and so good an opportunity as the sinking of the *Dresden* did not fail to draw from them a characteristic piece of fiction. Juan Fernandez belongs to the Republic of Chile, whose relations with Great Britain have been most cordial, both before and since the war. The clumsy German attempt to create friction between Englishmen and Chilians over this incident fell remarkably flat.

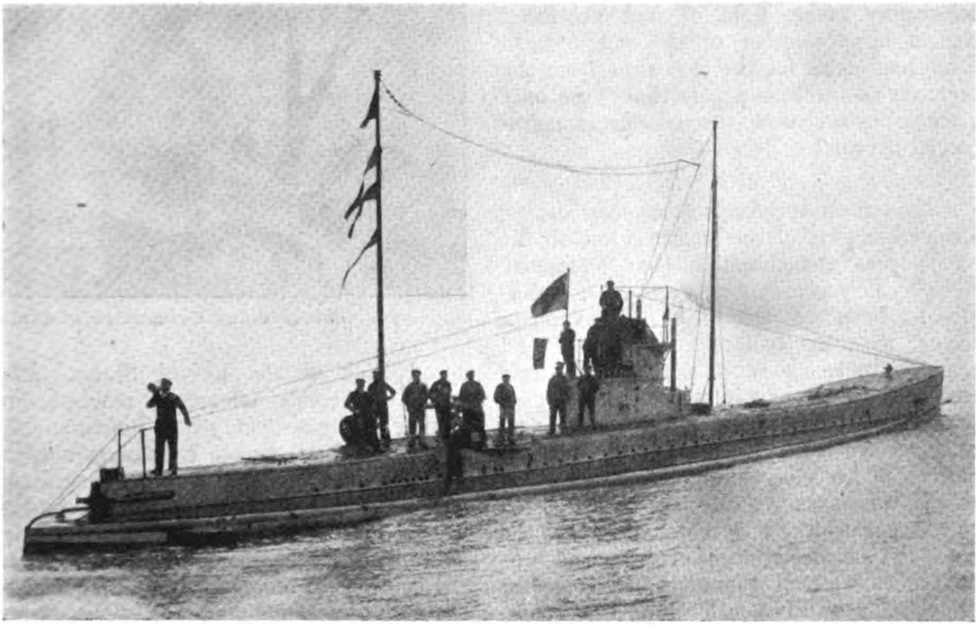
* * *

Our evening contemporary, the *Globe*, in a recent issue printed, in one of their leaderettes, some remarks from which we extract the following:

"For once we find ourselves in complete "agreement with a correspondent in the "*Westminster Gazette* in his protest against "the adulation which 'Eye-Witness' so "frequently bestows upon the enemy.



Cumberland Bay, Juan Fernandez.



German Submarine Craft, showing Antennae

" Nothing, it seems to us, could be better
" calculated to improve German morale
" than these acknowledgments of German
" bravery and skill. If the authorities re-
" sponsible for the dissemination of news in
" England would let us have the German
" *wireless uncensored* the end they have in
" view would be much more speedily and
" safely attained. There can be no question
" here of betraying secrets to the enemy. A
" little more common sense and a little less
" reticence would be all to the good, particu-
" larly in stimulating recruiting."

We may remark that our contemporary appears to be a little unfair to those whom he is pleased to call " the authorities." A good many of the deletions made by them in the German official wireless messages consist of paragraphs deliberately fabricated by Germans in order to sow dissension between the various countries with whom they are at war. To allow such baseless fabrications to be circulated in the English Press would effect no good object, and would, indeed, be playing the game for these malicious Teutonic " kite flyers."

* * *

We have often had occasion to refer to the advantages gained by ourselves and our Allies through the employment of wireless in the present war. But the captain and crew of the French steamer *Auguste Conseil* are unfortunately not able to speak with whole-hearted appreciation! The *U29,* which was responsible for the destruction of this French vessel, in the course of the farcical attempt at " blockade," which the Germans vaunt so much, appears to have owed some of her successes to the employment of radio-telegraphy. Captain Léon Gouin, who was a passenger on the unlucky steamer, said that not only did he observe that *U29* was fitted with wireless apparatus, but he actually witnessed the use of it by the German commander. We reproduce above a photograph showing how antennæ are fitted on submarine craft.

* * *

The supreme importance of wireless telegraphy in linking up outlying portions of King George's Realm, Dominions and Colonies was further brought home on the occasion of the terrible explosion which occurred in the Shetland Islands about the middle of April. Nature, by storms and seas, seems to have done her best to cut off the inhabitants of the Shetland and Orkney Islands from the mainland. But radio-telegraphy makes light of such obstacles, and a large number of the public have doubtless heard for the first time from the columns of the newspapers that "the only communication with the Islands is maintained by wireless."

* * *

Considerable interest was aroused during the earlier part of the war in what all the newspapers denominated the "Treasure Ship." Few people can, even now, understand how it was that the *Kronprinzessin Cecile*, with her two millions in gold and six hundred thousand pounds in silver managed to escape the cruisers seeking for her. The full story has recently appeared, and, as wireless was responsible for the success of her elusive feat, perhaps readers of the WIRELESS WORLD may be interested in the narration of how it was done. At the time of the declaration of war, she was 107 miles west of Plymouth, *en route* for Bremen, *via* Plymouth and Cherbourg. With German thoroughness every eventuality had, for years, been provided for. In common with all other commanders of German liners, Captain Polack was in possession of sealed orders which had remained unopened on board his ship for about two years. At ten o'clock on the night of August 1st he received the following message by wireless:—"Eberhard has suffered an attack of catarrh of the bladder. (Signed) Siegfried." He immediately went to his cabin and opened his sealed orders. The translation read "War has been declared between Germany, France and Russia. Turn back." Lights were dimmed, portholes covered, and the *Cecile* hurried at full

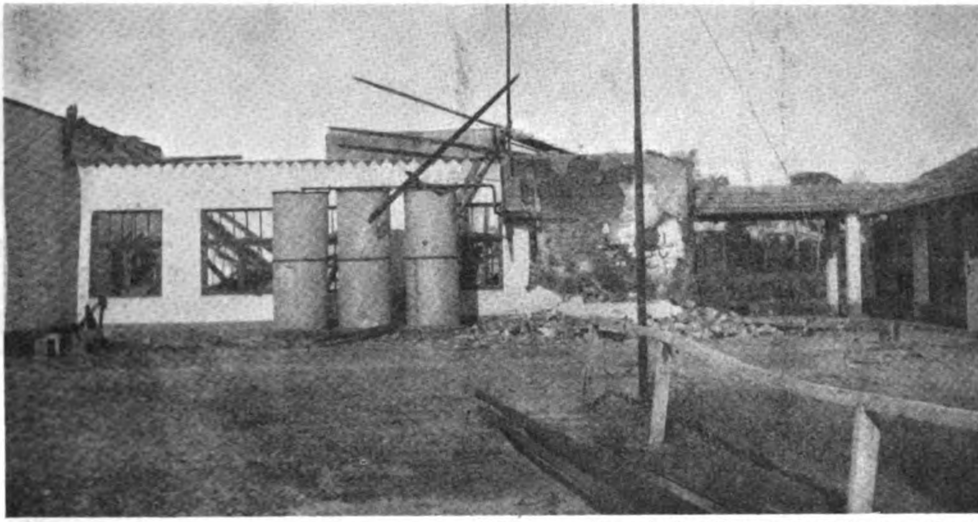
The Fallen Wireless Tower at Duala.

The Wrecked Generators at Duala.

speed back to the United States. More explicit wireless telegrams reached him during the next twenty-four hours, and the result was that, *thanks to wireless aid*, the enemy's treasure ship eluded British cruisers, and put into Bar Harbour on August 4. These sealed orders from the German Admiralty had been distributed amongst the captains of merchantmen as far back as the spring of 1908.

* * *

In the Cameroons the earlier land operations of the British were not very successful. The first expedition, after succeeding in occupying Tebe, was repulsed from the German station at Garua, and compelled to retire into British territory. But, whilst these events were taking place on land, H.M.S. *Challenger* and *Dwarf* had reconnoitred the mouth of the Cameroons river, and the approaches to Duala, the chief town. On September 26th the above-mentioned ships bombarded the town, and the following day both Duala and Bonaberi surrendered unconditionally to an Anglo-French force under the command of Brigadier-General C. M. Dobell, D.S.O., A.D.C. Little damage was done to property by the naval bombardment, but the enemy destroyed their wireless station and instruments before evacuation. Our illustrations will indicate the thoroughness with which this was done. The whole place was set on fire; the roof fell in and completed the destruction that had been begun by smashing the commutator and the motors, besides destroying the switchboard and connections. The station had been placed about two and a half kilometres from the town itself. The wireless tower was visible from the sea for a distance of ten miles. At the time when the warships were preparing for their cannonade there



What remains of the Station Buildings at Duala.

was much speculation among the crews of the various vessels in the port as to when it would be knocked down by the bombarding ships. The Germans themselves, however, saved the enemies the trouble, and destroyed the tower at 8.30 a.m. on September 27th, just previous to the surrender.

* * *

We were all of us glad to hear the news of the safe arrival at Queenstown of the Harrison liner *Wayfarer*, which constitutes, up to the present, the largest victim of the German submarine pirates since the starting of their egregious "blockade." There appears some little doubt, even now, as to whether the injury done to her was wrought by a torpedo or a mine, and the authorities are very properly not allowing any information to be given for the present. But whatever may have been the cause of her disaster, her safety is due to the fact that she was fitted with wireless, and that, in consequence, help was speedily forthcoming in response to her signals. Another British ship which avoided disaster "by the skin of her teeth" was the ss. *Theseus*, a vessel owned by Messrs. Alfred Holt and Company, and belonging to their well-known Blue-funnel Line. She was chased for some hours by one of the pirates. An engineer, writing to the Marine Engineers' Society, at Liverpool, gave a very interesting account of the chase, which was published in the *Journal of Commerce*. In this case the vessel would seem to have been in some measure indebted to the presence on board of five engineers in addition to her own full complement. As soon as the word was passed that the enemy was signalling "Stop and abandon ship," the Chinese crew started deserting the stoke-hole and engine-room. The engineers buckled to, and "a few seconds later they were awaiting the orders of the officers in charge of the engine department." Speed and good handling resulted in the escape of the steamer, but when our engineer correspondent came on deck he was able to perceive the effect of the fusillade of shots fired in the course of the pursuit. He ends up his interesting letter in the following significant terms: "The only regret we have to record is the fact that no wireless was fitted, so as to have enabled other ships to be warned of the danger."

* * *

Officials at the Admiralty hear a great deal that does not find its way to the outside world. A delightful story is going around there anent the way in which the news of the Heligoland Bight fight first reached headquarters at Whitehall. It appears that wireless telegraphy played a naturally important part in this brilliant little engagement, and a number of the messages which flew from ship to ship whilst the messages were in progress were picked up by the wireless operators at headquarters. Most of them consisted of "odds and ends" of

The Nerve Centre of the British Navy.

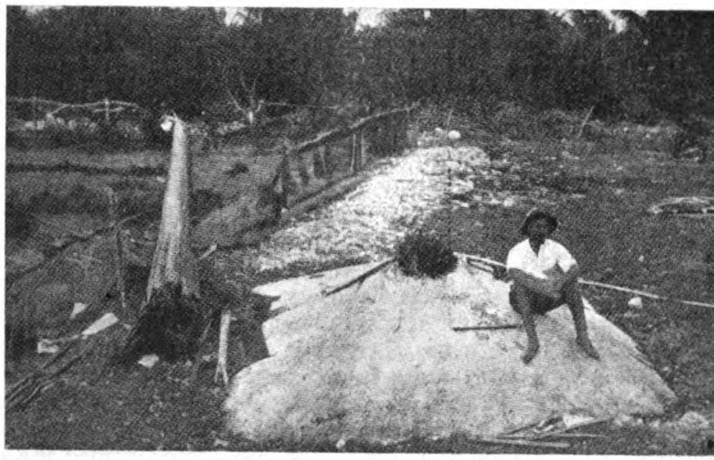
messages—little bits of eager exhortation. One of the sentences thus intercepted ran, "Bear round sharp to starboard and you will catch them." This and similar items, pieced together with other orders that came through, seem to have been the first intimation to the British Admiralty that the "real thing" was going on. We can easily imagine the excitement which must have prevailed amongst those acquainted with these isolated facts before the definite official intimation of the engagement arrived. It is small wonder that the wireless installation of the Admiralty roof should possess, under existing circumstances, a fascinating interest for Londoners and visitors to London. As one passes down Whitehall, or crosses the Horse Guards Parade, folks are often seen pointing out the aerials to one another. It must certainly be a feeble imagination which would fail to be thrilled by the thought of what these wires could tell us if they were at liberty to speak. They form, indeed, what we may aptly term the nerve-centre of the British Navy.

* * *

Our enterprising contemporary, the *Zodiac*, has secured what is known amongst journalists as a real "scoop" for their March number. This consists of a full story of the *Emden's* last effort, the destruction of the wireless station at the Cocos-Keeling Islands. In our Vol. II., No. 21, of December 21st, 1914, we published a note with a view of these islands; and our contemporary is now able to print a full narrative of the incident, together with many illustrations. The landing of the German boat party to the various vital points is very dramatically narrated, and the description of the three dynamiting attempts necessary before the wireless mast was finally dislodged from its resting place (*see illustration, page 95*) indicate how excellently the work had been originally done by the contractors. The work of demolition was most thoroughly carried out. The engine room was wrecked; the dynamos and all the apparatus ruined beyond repair. The switchboard and all the receiving and sending apparatus were smashed to atoms, the latter presenting a spectacle chaotic to behold. Even the unoffending seismograph house, on the outskirts of the town, was demolished. We have reproduced at various times many illustrations of wireless masts in all their glory and pride of place, and it may be interesting to our readers to see a reproduction from a photograph of Mr. R. A. Cardwell, of the Cocos-Keeling mast after its treble dynamiting by the *Emden* party. It would not be possible for us to extract the account of the battle between the *Emden* and the *Sydney* as described in the *Zodiac* article, but such a thrilling incident is one that does not often fall to the lot of a wireless operator to witness.

* * *

Newspaper readers have got so accustomed to trace the influence of the science with which Marconi's name is indissolubly connected in every phase of activity, that, whenever an account of an adventurous nature appears, they expect, as a matter of course, to find some reference to the subject in the narrative they are perusing. We recently read the thrilling experience through which Singapore passed during the late military riots there. This account forms a veritable tale of adventure such as we were used to read in boyish days in the pages of our favourite author, the late Mr. G. A. Henty. The sequence of events seems to have been: first, a feeling of discontent worked upon by "dark conspirators"; secondly, the opportunity afforded by the three days' festival of the Chinese, signalised by the firing of pyrotechnic bombs and crackers—just the ideal surroundings for consummating an insurrection. Up to a point the mutiny seems to have been not unskilfully engineered; possession of ammunition was secured, and the guards of the prisoners of the war-camp overpowered. The loyal regulars on the spot appear to have been exceedingly few in number, and the only assistants immediately available were civilian volunteers. Murder and riot ensued, and the situation seemed black indeed. At this point in the narrative the newspaper breaks into the heading "WIRELESS APPEALS FOR AID." The whole situation was immediately changed. Instructions were issued to the police stations to take measures for safeguarding the women and children. The French cruiser *Montcalm* landed a party of 190 men and two machine guns; the Japanese cruiser *Otawa*, in response to the same signals, landed 75 men, and the *Tsushima* a further complement. The Russians responded to the same appeal, and our allies, joined by "handy-men" from H.M.S. *Cadmus* and local volunteers, speedily dominated the situation and restored order. Singapore, like many another place, owes a debt of gratitude to wireless telegraphy.



The Dynamited Mast—Cocos Islands.

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We are constantly publishing instances of the gallantry displayed by wireless operators under various circumstances of difficulty and danger in different parts of the world. The general public is, as a rule, not slow to recognise their services; but up to the present official Government recognition has been less generous. It is therefore pleasant to notice that the roll of recipients of the D.S.O. in a recently published list includes the names of Theodore Frank Perrow, Petty Officer Telegraphist, O.N. 238640 H.M.S. *Gloucester* for "services rendered during the chase of the German cruisers *Goeben* and *Breslau* by H.M.S. *Gloucester*, August 6 and 7, 1914."

THE MARCONI COMPANIES BENEVOLENT FUND.

THE second annual general meeting of the members of the Marconi Companies Benevolent Fund was held at Marconi House on April 7th, 1915.

Captain H. Riall Sankey took the chair, and amongst those present were Mr. W. W. Bradfield, Mr. H. W. Allen and Mr. W. R. Cross.

The annual statement of accounts was submitted and approved. No claim had been made on the fund up to December 31st, 1914, at which date 493 employees of the Marconi Companies had joined the Staff Superannuation Fund. The number of members had since increased to 543.

The Report of the Committee of Management was unanimously adopted, and the Members' Trustees were re-elected—namely, Messrs. E. C. Richardson and W. S. Purser for Marconi's Wireless Telegraph Company, Ltd., and Messrs. W. R. Cross and W. J. Collop for the Marconi International Marine Communication Company, Ltd.

Wireless in the Courts.

RECENT police court activity in connection with the illegal possession or use of wireless apparatus appears to have been confined to Newcastle.

On March 2nd a Newcastle dealer in electrical and mechanical appliances named Rowland Hill Barnett was charged at the local police court with having in his possession "certain apparatus intended to be used as component parts of apparatus for the sending and receiving of messages by wireless telegraphy contrary to the Defence of the Realm Regulations." The proceedings, it was admitted, were taken at the express request of the military authorities.

According to the evidence for the prosecution, the defendant had exposed for sale in his shop window a wireless spark coil. The military authorities wished to emphasise the necessity for a person who had anything to do with wireless telegraphy to have a licence.

Mr. Barnett's solicitor, in defence, stated that Mr. Barnett was well aware that he must no longer sell the parts of Marconi installations, but he did not understand that it was any offence to keep these parts in his possession. The parts shown in the window were induction coils, which were used for vacuum tubes and X-ray apparatus generally. The Bench, who were of the opinion that Mr. Barnett had unwittingly offended, fined him £10 and costs.

In the same police court, on March 23rd, a 17-year-old youth, William Horsley, of 8 Tenth Avenue, Heaton, was charged, under the Defence of the Realm Act, with having in his possession, without written permission, the component parts of a wireless apparatus. The youth was employed in the drawing office of Sir Charles Parsons' works, and the Deputy Town Clerk, who prosecuted, said that though the case was regarded as a serious one, the police and Post Office authorities were satisfied that Horsley was an amateur in wireless telegraphy. The defendant had imagined that when he had dismantled the aerial he had done everything that was necessary under the Act. In August Horsley and his father, who was an engineer employed at North Shields, understood that they must remove the aerial, but they failed to register the apparatus or its parts at the Post Office. The entire outfit, with the exception of the receiver, was home-made. The receiver was described as a very sensitive one by Mr. H. R. J. Dunthorne, assistant engineer at the General Post Office, Newcastle, who said it was capable of receiving messages from places as far distant as Berlin, and from other high-power stations. As far as could be judged the instrument had not been used recently. A fine of 20s. and costs was imposed by the magistrate.

NOTES OF THE MONTH

THE mystery surrounding the sudden recall home of Major George Langhorne from his post as United States Military Attaché in Berlin has been cleared away by the disclosure that the German Government has been using Major Langhorne's name to send extremely pro-German reports to the United States by wireless, in an effort to deceive the Allied Governments. It is now discovered that Major Langhorne was shown every courtesy by the Germans, and was allowed to visit all the fronts and make extensive observations in the various fighting areas. He frequently sent long descriptive accounts of these observations to his Government by wireless in plain language, which all nations could receive *en route* and understand. In the hope of misleading the enemy the Germans craftily inserted false information and pro-German sentiments in Major Langhorne's messages, and the Allies were for some time at a loss to understand how a man of Major Langhorne's calibre and intelligence could send such reports to his Government. However, these German tactics soon broke down, and the deception was discovered when one of Major Langhorne's messages was addressed to the War College, Annapolis. As no such college has ever existed at Annapolis, the United States immediately instituted an investigation. When the truth was finally arrived at it was apparent that to call the German Government's attention to the fraud would be embarrassing to both countries, as no proof was actually forthcoming that Germany had officially sanctioned the deceit. Major Langhorne's withdrawal was the easiest way out of the difficulty, and Colonel Kuhn was appointed in his place.

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The United States Bureau of the Census reports that from 1907 to 1912 the number of messages sent increased from 154,617 to 285,091, or 84·4 per cent. Employees increased from 176 to 958, or 444 per cent.

* * *

Mr. R. A. Germon, chief operator on the s.s. *Korea*, has written to us from Yokohama, under date of February 17th as follows:

" In an article in the January issue of " THE WIRELESS WORLD, entitled 'Problems of Radio-Telegraphy,' it is stated " that a remarkable rule demonstrated by " the Australian stations was that if signals " from north to south were above the normal " strength, then signals from south to " north were below normal, and *vice versa.* " The article then goes on to say that this " asymmetry had not been detected in east " and west signalling. I conclude that this " latter statement refers only to observa- " tions made by the Australian stations. " For, it is a phenomena noticed by operators " on almost every trans-Pacific ship, running " between San Francisco and Japan, that at " certain times of the year when it is possible " to hear the Japanese Government station " at Choshi and the Marconi station at San " Francisco at the same time, when signals " from the former will fade so as to be " almost inaudible, those from San Francisco " will come in above normal strength, and " *vice versa.* This has been particularly " noticeable this last voyage. We were " able to copy press from San Francisco " at 3,720 miles, and during the whole of " that time Choshi was working with some " Japanese ship. His signals, though, were " so weak as to cause no interference. " Hardly was press time over, than Choshi " signals came in very loud, while San " Francisco faded away almost completely. " I have noticed the same effect when " midway between the San Francisco and " Honolulu stations.

" As to the remarks in the same article " regarding the comparative range of trans-

"mission on the Atlantic and Pacific
"Oceans, I might mention that the record
"distance made by this ship is 4,200
"miles and 3,600 has been done many times
"by this and other ships."

* * *

Last year, after the commencement of the war, it was decided that the McGill University in Montreal should establish a class in wireless work with the object of preparing young Canadians for this branch of the Naval and Military Service in case they should be required by the Dominion or Imperial authorities. A class was accordingly organised under the direction of Prof. L. V. King (of the Physics Department) and Prof. A. Gray (of the Electrical Engineering Department). Prof. A. S. Eve (of the Physics Department), who is an officer with the McGill Regiment, laid the requirements of the class before the Naval and Military Departments at Ottawa, with the result that the Government lent the university two Marconi military sets, which are light, compact, and easily portable. A temporary aerial was erected, but it was found that it was not strong enough to withstand the winter storms, and was finally taken down. It was then decided to erect a permanent aerial at the expense of the university. This work is being undertaken not only with the sanction, but with the active co-operation of the Dominion Government. When completed it will give McGill University one of the highest and longest aerials in Canada. One end of the 450-foot stretch of antennæ will be attached to the top of the power-house chimney, which stands 150 feet above the ground, which again is a considerable height above the lower part of the city, while the other will be attached to the Engineering Building, where the receiving apparatus is kept. The possession of this aerial will give the wireless class opportunities for practice in taking messages. The area for receiving will be about 2,500 miles, while with the equipment on hand messages can be sent about 1,000 miles; but for the present the sending of messages will not be permitted for fear of conflicting with the Admiralty's wireless operations on the Atlantic coast.

* * *

Readers may be interested to hear that Marconi's Wireless Telegraph Company, Ltd., has now arranged, in co-operation with the London County Council, continuation classes for the boy messengers under their control. These classes, which are held at convenient hours during the day, so as to fit in with the duties of the boys concerned and obviate any expenditure in fares, &c., comprise English, Geography, Calculation, Topography of London and general tuition, and are under the charge of a London County Council schoolmaster. Each boy is charged a small fee, but in the event of his attending not less than 75 per cent. of the classes held during the year, the Council provide the second year's tuition free, and the Marconi Company return the full amount. All stationery, books, etc., are provided free by the Council, and the classes themselves are held at Marconi House.

* * *

Those who in the past have so steadily advocated the superiority of cable communication will, perhaps, pause on reading the Postmaster-General's announcement that *within four hours* of the outbreak of war we had severed every German cable that ran from Germany westwards or eastwards under the sea. Germany has thus been almost entirely dependent on her wireless service for communication with many parts of the outside world.

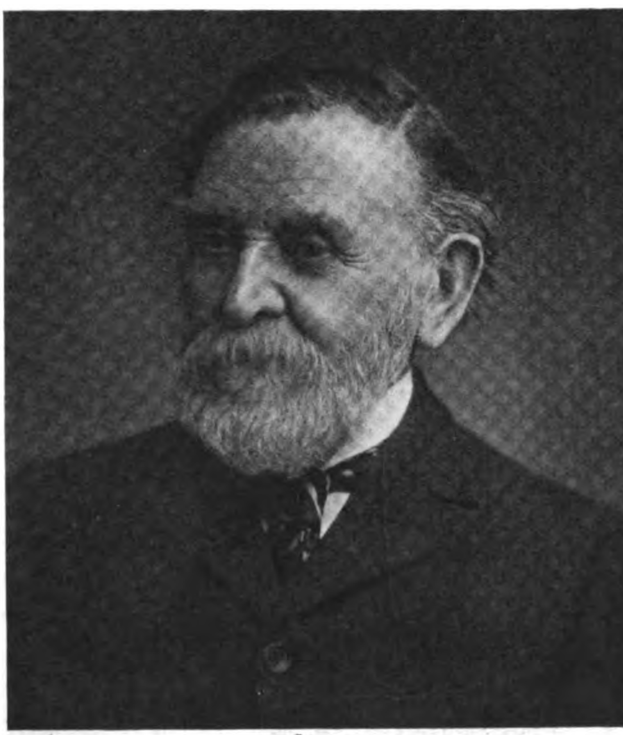
Even assuming, for the sake of argument, that the German fleet was active and had some measure of control over the ocean, the difficulties and delays in repairing a cut cable in war time, when one end lands on hostile or neutral country, would be infinitely greater than the re-erecting of a wireless station that may have been damaged or destroyed through an act of war, provided the enemy can get near enough to it to do so.

* * *

There is a glorious tradition in the British Army which has, ever since its institution, linked two words together, so that, with the rarest possible exceptions (which only go to prove the rule) it is commanded by persons entitled to the honourable hyphenation of "officer-and-gentleman." Major Samuel Flood-Page, who passed away on April 7th last, was an admirable example of the older school of the British officer—a gentleman in his retirement as truly as in his service, and his decease will be very widely lamented.

He was born in the Isle of Man in 1833

and was the son of the Rev. S. Flood-Page, his mother being the daughter of Colonel Shaw, who saw considerable military service, and whilst in the 60th Rifles was wounded in the taking of Quebec in 1759. After receiving his education at Christ's Hospital and Rossall, Major Flood-Page became a cadet in 1854, and in the following year was gazetted to the 2nd Madras European Light Infantry. He served in India and Burmah and was gazetted first adjutant of the Queen's Own Edinburgh Rifle Brigade, afterwards serving for 12 years as Adjutant of the London Scottish. He was the first executive officer of the National Rifle Association, remaining on the council of that body for 40 years. At one time Major Flood-Page held the office of secretary and manager of the Crystal Palace, and in that capacity organised the Electrical Exhibition of 1882. About this time a revolution in electrical lighting took place by the introduction of the carbon incandescent lamp, which provided light in much smaller units than was possible with the arc lamp, and Major Flood-Page, after leaving the Crystal Palace in 1882, devoted his energies to promoting the commercial utilisation of the new illuminant. As general manager of Edison's Indian and Colonial Electrical Company, he visited Australia in order to introduce the incandescent lamp in that country, and on his return in 1883 was appointed secretary and manager of the Edison and Swan United Electric Lighting Company, a position he retained till 1892, when he became a director.



The late Major Samuel Flood-Page.

During the latter part of his life Major Flood-Page interested himself in wireless telegraphy, and in 1899 joined Marconi's Wireless Telegraph Company, Limited, as Managing Director.

He was from the very start fired by enthusiasm both for Mr. Marconi personally and for the future of his invention. He shared in the labours and agitations of the early days when Mr. Marconi was preparing to demonstrate the possibilities of transatlantic wireless transmission. It is but a very few weeks ago since, in the course of an interview, he narrated with pride to one of our staff how largely instrumental he was in the selection of Poldhu in Cornwall, as the *locale* of the first long-distance wireless station. He remained to the day of his death a staunch supporter of THE WIRELESS WORLD, and in his latter days nothing gave him more pleasure than to narrate, for the benefit of its readers, reminiscences of past incidents in the development of wireless.

To the very last he remained an active member of the Boards of Directors of several of the Marconi Companies.

He was buried in the family vault at Wimbledon on April 9th, and a memorial service was held at the Church Army Church, Upper Berkeley Street, where the gallant officer was for some years churchwarden. Prebendary Carlile gave an address and several directors and heads of departments from Marconi House were present.

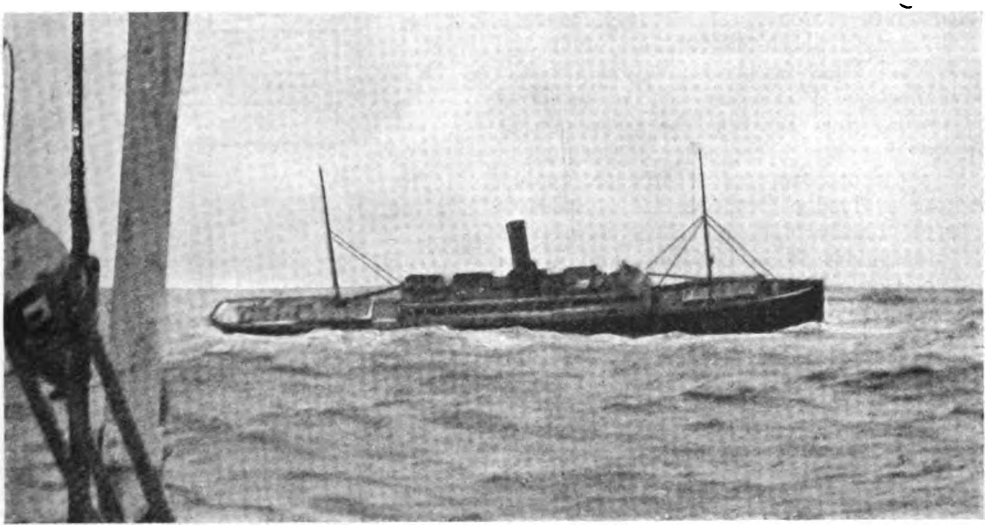
CARTOON OF THE MONTH

Wireless Entanglements for Trenches.

Maritime Wireless Telegraphy

ONCE again "Wireless" has come to the rescue of those in distress on the sea, and has been the means of saving lives that otherwise must have been lost on the storm-tossed Atlantic. The s.s. *Denver*, an American-built vessel of 4,549 tons, belonging to the Mallory Line, was bound from Bremen to New York. When 1,300 miles from the latter port, on March 22nd, it was discovered she was leaking badly, from some, as yet, unknown cause, and was in imminent danger of sinking. She sent out a "wireless" call for help at 3 p.m. on that day, and the liners *Manhattan*, *Megantic*, *St. Louis*, *Lacome*, *Corsican*, *Maryland*, *Vestris*, and others received the signal and hastened to the rescue. The roughness of the weather and the darkness of the night prevented a prompt location of the imperilled steamship, but she was sighted about noon on the 23rd by the *Manhattan*, *Megantic*, and *St. Louis*.

The *St. Louis*, which was eastward bound, had spent practically the entire twenty-one hours searching for the *Denver*, and had gone considerably south of her course in the quest. On the arrival of the rescue steamers three boats were immediately lowered from the doomed ship, which conveyed the officers and crew and the few passengers safely on board the vessels standing by to render aid. Fifty-four persons were taken on board the *Manhattan*, and the remainder on the *Megantic*. The first news that the *Denver* was in danger reached the American continent *via* the Canadian Marconi Company's powerful station at Cape Race, and communication was maintained with the vessels at the scene of disaster until the *Denver* sank, and all on board were saved. It is interesting to note that the *Denver* was one of the ships which has added in a small degree to the international complications between Great Britain and America. When she sank she was on her return voyage from Bremen, whither she had carried a cargo of cotton. On her voyage to the German port, it will be remembered, she was seized by a British cruiser and taken to the Orkneys, being subsequently released and allowed to proceed on her voyage. The illustration which we reproduce was taken from the deck of one of the rescuing steamers, and depicts the *Denver* in the act of sinking.



Sinking of s.s. Denver.

The Wireless Transmission of Photographs.

By MARCUS J. MARTIN.

Article 2.

THERE are only two methods at present available for receiving the photographs, and both have been used in ordinary photo-telegraphic work with great success. They have disadvantages when applied to wireless work, however, but these will no doubt be overcome with future improvements. The two methods are: (1) By means of an ordinary photographic process; and (2) by means of an electrolytic receiver.

In several photo-telegraphic systems the machine used for transmitting has the cylinder twice the size of the receiving cylinder, thus making the area of the received picture one quarter of the area of the picture transmitted. The extra quality of the received picture does not compensate for the disadvantage of having to provide two machines at each station, and in the writer's opinion results quite good enough for all practical purposes can be obtained by using a moderate-sized cylinder—so that one machine answers for both transmitting and receiving—and using as fine a line screen as possible for preparing the photographs.

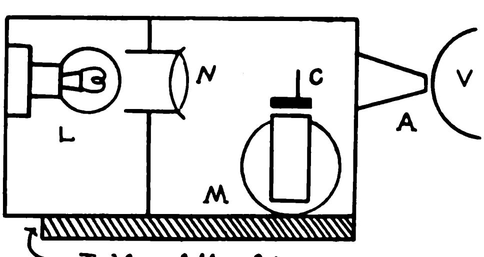


Fig. 22.

The writer, when first experimenting in photo-telegraphy, endeavoured to make the receiving apparatus "self-contained," and one idea which was worked out is given in Fig. 22. The electric lamp, L, is about 8 c.p., and is placed just within the focus of a lens which has a focal length of $\frac{3}{4}$ inch. When a source of light is placed at some point between a lens and its principal focus the light rays are not converged, but are transmitted in a parallel beam the same

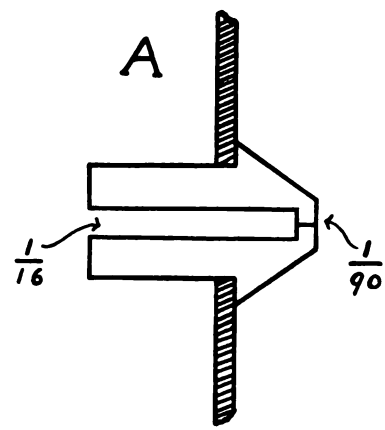


Fig. 23.

size as the lens. It has been found that this arrangement gives a sharper line on the drum than would be the case were the light focussed direct upon the hole in the cone, A. An enlarged drawing of the cone is given in Fig. 23. The hole in the tip of the cone is a bare 1/90th inch in diameter (the size of this hole depends upon the travel per revolution of the drum or table of the transmitting machine used), and in working the cone is run as close as possible to the drum without being in actual contact. The magnet, M, is wound full of No. 40 S.C.C. wire, and the armature is made as light as possible. The spring to which the armature is attached should be of such a length that its natural period of vibration is equal to the number of contacts made by the transmitting stylus. The spring must be strong enough to bring the armature back with a crisp movement. The spring and armature are shown separate in Fig. 24.

The shutter, C, is about $\frac{1}{4}$ inch square and made from thin aluminium. The hole in the centre is $\frac{1}{16}$ by $\frac{1}{8}$ inch, and the movement of the armature is limited to about $\frac{1}{32}$ inch. In all arrangements of this kind there is a tendency for the armature spring to vibrate, as it were, sinusoidally if the coil is magnetised and demagnetised at a higher rate than its natural period of vibration. This

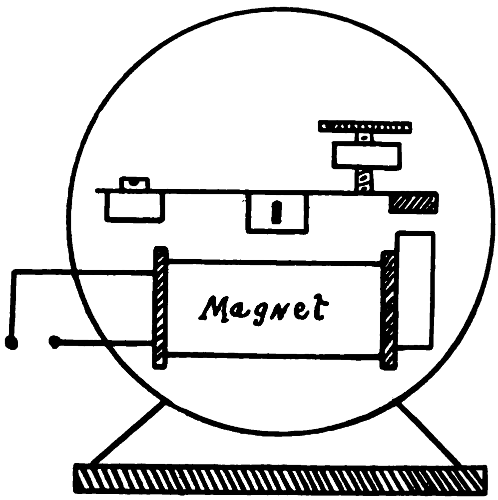


Fig. 24.

causes an irregularity in the rate of the vibrations which affects the received image very considerably. A photographic film is wrapped round the drum of the machine, being fastened by means of a little celluloid cement smeared along one edge. This device, although it will work well over artificial conductors, is not suitable for wireless work, as it is too coarse in its action. It can be made sensitive enough to work at a speed of 1,000 to 1,500 contacts per minute with a current of 0·5 milliampère. It is impossible to obtain a current of this magnitude from the majority of the detectors in use, so that if any attempt is made to use this device for radio-photography it will be necessary to employ a Marconi coherer (filings), as this is practically the only coherer from which so large a current can be obtained. There have been many attempts made to receive with an ordinary filings coherer, but as was pointed out in Article 1, these have now been discarded in serious wireless work, being only used in small amateur stations or experimental sets. As the reasons for this are well known to the majority of wireless workers there is no need to enumerate them here.

In all photographic methods of receiving, the apparatus must be enclosed in some way to prevent any extraneous light from reaching the film, or better still, placed in a room lighted by only a ruby light.

Fig. 25 gives a diagrammatic representation of apparatus arranged for another photographic method of receiving. The machine shown in Fig. 11, Article 3, is used in this case. A is the aerial, E earth, P primary of oscillation transformer, S secondary of transformer, C variable condenser, C^1 block condenser, D detector, X two-way switch, T telephone. A D'Arsonval galvanometer, H, is also connected to the switch, X, so that either the telephone or the galvanometer can be switched in. The D'Arsonval galvanometer can be made sensitive enough to work with a current as small as 10^{-7} of an ampère. The screen, J, has a small hole about $\frac{1}{8}$ inch drilled in the centre. Under the influence of the brief currents which pass through the coherer every time a group of waves is received the mirror of the galvanometer swings to and fro in front of the screen, J, and allows the light reflected from the source of light, M,* to pass through the aperture in the screen on to the lens, N. Round the drum, V, of the machine is wrapped a sensitised photographic film, and this records the movements of the mirror, which correspond with the contacts on the half-tone print used in transmitting. Every time current passes through the galvanometer the light that is received from M passes through the aperture in the screen, J, and is focussed by the lens, N, to a point upon the revolving film. As soon as the current ceases the mirror swings back to its original position and the film is again in darkness. Upon being developed, a photograph similar to the negative used for preparing the metal print is obtained. If desired, the apparatus can be so arranged that the received picture is a positive instead of a negative.

* Nernst lamps are the best to use, as they produce abundantly the blue and violet rays which have the greatest chemical effect upon a photographic film. Carbon filament lamps are vary poor in this respect.

The detector used should be a Lodge wheel coherer or a Marconi valve receiver, as these are the only detectors that can be used successfully with a recording instrument. If the swing of the galvanometer mirror is too great, a small battery with a regulating resistance can be inserted in order to limit the movement of the mirror to a very short range, the current, of course, flowing in an opposite direction to the current flowing through the coherer.

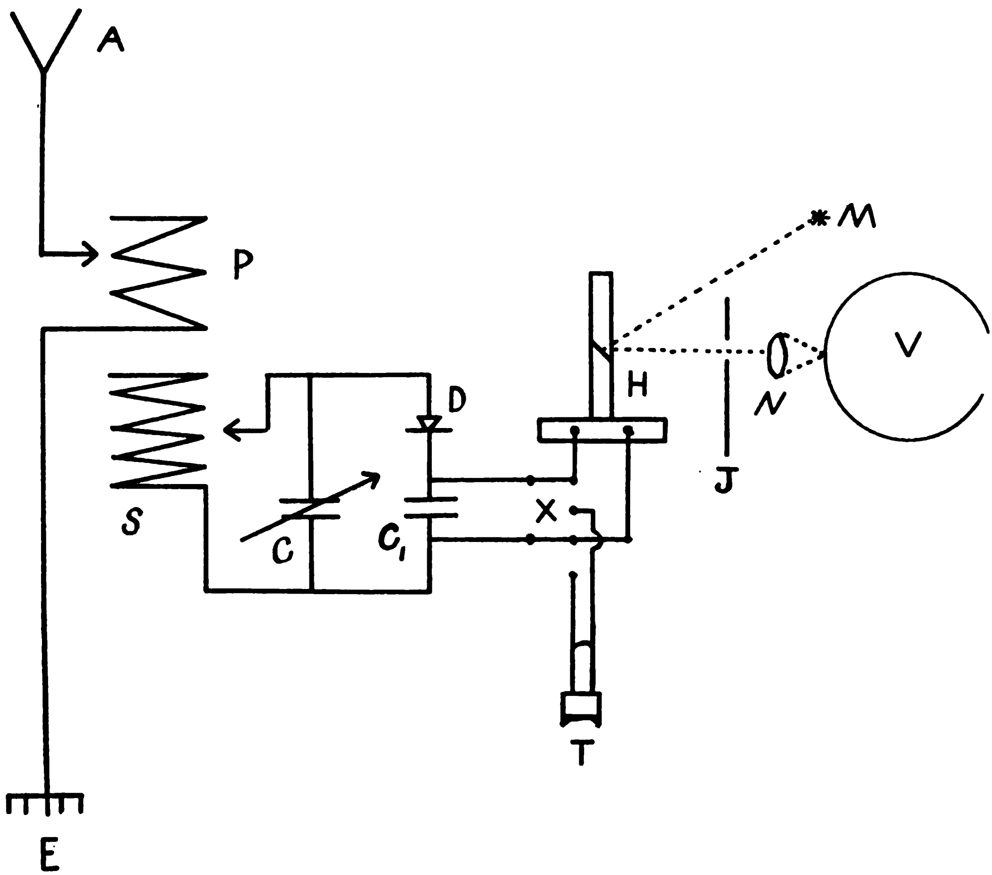


Fig. 25.

In this, as in all other methods of receiving, the results obtained depend upon the fineness of the line screen used in preparing the metal print, and, as already shown, the fineness of the screen that can be used is dependent upon the mechanical efficiency of the entire apparatus.

Another system, and one that has been tried as a possible means of recording wireless messages, is as follows: The wireless arrangements consist of apparatus similar to that shown in Fig. 25. Instead of a Lodge coherer, a Fleming valve is used, and an Einthoven galvanometer is substituted for the reflecting galvanometer. The Einthoven galvanometer consists of a very powerful electro-magnet, the pole pieces of which converge almost to points. A very fine silvered quartz thread is stretched between the pole pieces as shown in Fig. 26. A hole is bored through the poles and one of them is fitted with a sliding tube which carries a short focus lens, N. The light from M passes through the magnets and a magnified image of the quartz thread is thrown upon the ebonite screen, J. This screen is provided with a fine slit, the lens, R, concentrating the collected light upon the revolving film. The connections for the complete receiver are given in Fig. 27. The following method is given more as a suggestion than anything else, as I do not think it has been tried for wireless receiving, although it is stated to have given some good results over ordinary land lines. It is the invention

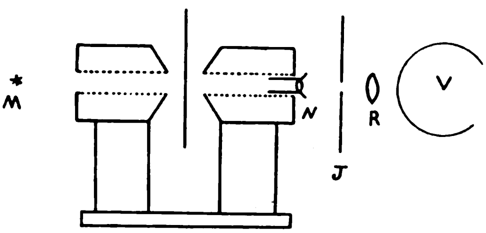


Fig. 26.

of Charbonelle, a French engineer, and is quite an original idea. His method consists of placing a sheet of carbon paper between two sheets of thin white paper, and wrapping the whole tightly round the drum of the machine. A hardened steel point is fastened to the diaphragm of a telephone receiver, and this receiver is placed so that the steel point presses against the sheet of paper. As the diaphragm and steel point vibrate under the influence of the received current marks are made by the carbon sheet on the bottom paper.

Over a line where a fair amount of current is available at the receiver the diaphragm would have sufficient movement to mark the paper, but the movement would be very small with the current received from a detector. This difficulty could, no doubt, be overcome to a certain extent by making a special telephone receiver with a large and very flexible diaphragm and wound for a very high resistance. The movement of an ordinary telephone diaphragm for a barely audible sound is, measured at the centre, about 10^{-6} of a cm. With a unit current, the movement at the centre is about 1/700th part of an inch. Greater movement of the diaphragm could be obtained by connecting a *telephone relay* to the detector and using the magnified current from the relay to operate the telephone. The telephone relay consists of a microphone, C, Fig. 28, formed of the two pieces of osmium iridium alloy. The contact is separated to a minute degree partly by the action of the local current from F which flows through it, and also through the winding, W, of the two magnet coils. The local current from F assists in forming the microphone by rendering the space between the contacts conductive. The vibrating reed, P, is fastened to the metal frame (not shown), which carries a micrometer screw by which the distance between the contacts can be accurately regulated. It will be seen from Fig. 28 that the local circuit consists of a battery, F (about 1·5 volts), the microphone contacts, C, the winding, W, milliampère meter, B, and the terminals, T, for connecting to the galvanometer or telephone, all in series. On the top of the magnet cores, N, S, is a smaller magnet, D, wound with fine wire for a resistance of about 4,935 ohms, the free ends of the coil being connected to the detector terminals. The working is as follows: Supposing the current from the detector flows through the coil, D, in such a way that its magnetism is increased, the reed, P, will be attracted, the contacts opened, and their resistance increased. It

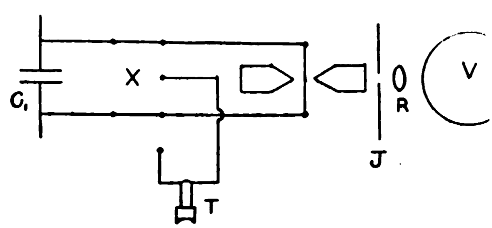


Fig. 27.

will be seen that the current from F is passed through the coils, W, in such a way as to increase the magnetism of the permanent magnet so that any opening of the microphone contacts increases their resistance, causes the current to fall, and weakens the magnets to such an extent that the reed, P, can spring back to its normal position. On the other hand, if the detector current flows through D in such a direction as to decrease the magnetism in the permanent magnets, the reed, P, will rise and make better contact owing to the removal of the force opposing the stiffness of the reed. Owing to the decrease in the resistance of the microphone the strength of the local current will be increased, the magnets strengthened, and the reed, P, will be pulled back to its original

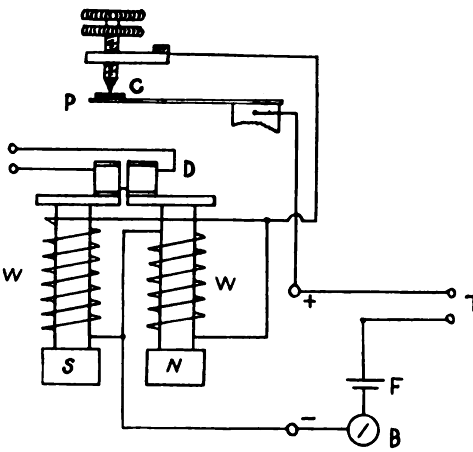


Fig. 28.

position. This relay gives a greatly magnified current when properly adjusted, the current being easily increased from 10^{-7} to 10^{-2} ampères. This relay is very sensitive, but it needs very careful adjustment in order that the best results may be obtained.

ANOTHER HONOUR FOR SENATOR MARCONI.

IN the absence in Canada of the President of the Royal Society of Arts (the Duke of Connaught), the Chairman of the Council, Colonel Sir Thomas H. Holdich, at a meeting of the Council, held on 12th April, presented the Society's Albert Medal to Senator Marconi "for his services in the development and practical application of Wireless Telegraphy." The medal, which was instituted in 1863 to commemorate the Prince Consort's presidency of the Society, is awarded annually as a reward for "distinguished merit in promoting arts, manufactures and commerce."

Institute of Electrical Engineers.

We are informed by the committee of the Institute of Electrical Engineers that the annual general meeting of the Students' Section has been postponed from April 28th to May 5th, at 7.45 p.m., when the president of the institution, Sir John Snell, will deliver an address.

Doings of Operators.

The Wireless Telegraphist's Narrative of the "Falaba" Outrage.

WE left Liverpool on Saturday, March 27, at 6 p.m., and the weather that night and the following morning, although not rough, still subjected us to the discomfort of a lumpy sea.

On Sunday morning, after erecting the aerial, I was carrying out my usual duties in the wireless cabin when the chief officer entered hurriedly and informed me that the ship was being pursued by a submarine, as to the nationality of which we had our suspicions. I thereupon gave a call to St. Just station, informing them of the fact and of our position, and was immediately answered in spite of some interference, apparently from the submarine. I had scarcely done this when the ship was stopped, and I was told by the chief officer that nothing further could be done and I had better get into the boat. Before leaving I had just time enough to send out the SOS signal, which was immediately picked up and passed on. Thirty or forty of us managed to get into the boat, but we had no sooner commenced to descend when (by some means or other which I did not observe) we were precipitated on to the surface of the water with such a shock as to smash the boat, and throw us all into the sea. Some six or eight of us succeeded in struggling over the debris and wreckage into another boat astern of the vessel. The submarine had at first appeared some fifty yards off on the port side, and her captain hailed us through a megaphone, shouting in excellent English, "Get into the boats; I am going to sink your ship." After this he went round to starboard, and at a distance of some hundred and fifty yards fired a torpedo which hit the ship immediately under the wireless cabin. This took place whilst we were in the very act of struggling into the lifeboat at the stern, at a time when the starboard deck of the liner was still black with passengers. A trawler, which was not more than a mile and a half from us, could without any risk have been permitted to save every passenger and the whole crew by being allowed to come alongside; but, with callous disregard of any humane

Mr. Taylor—Wireless operator of the "Falaba."

principles, the vessel was torpedoed at once. Nothing in the whole incident has struck me more forcibly than two facts. First, the daring with which the German submarine approached to within fifty yards, pointing plainly to the fact that her captain knew perfectly well we had no concealed guns on board. Had we possessed even one, his audacity would have entailed inevitable destruction to the under-water craft under his command. Secondly, that the German captain had evidently made up his mind that the incident should not pass without involving loss of life. There was no smoke of any steamer on the horizon, the only vessel other than the *Falaba* being the trawler already mentioned. It is a noteworthy fact that there was no panic on board; indeed, when the submarine first appeared the passengers were laughing and treating the whole matter as a joke. The shock of the explosion from the torpedo sent up a column of water some hundred feet and almost wrecked our boat. It should be mentioned that but for the presence of mind of a passenger (Mr. D. J. Ryder, of Plymouth), who displayed considerable skill in getting a rope fast round the bottom of the boat to hold it together, we should have gone completely to pieces. For the next three and a half hours those of us who were able took turns in holding this rope in position as we drifted away from the scene of the disaster. The unfortunate ship, after being struck, listed heavily to starboard, while the luckless passengers who still remained on board slid off into the sea, vainly endeavouring to save themselves by clutching any form of support on deck. The captain, who was, of course, the last to leave, gave three blasts on the hooter and jumped off the wreck with his papers. All the reports concerning jeers from the crew of the submarine I can fully corroborate, as we drifted quite close by them and they could easily have helped us had they wished. Our earnest appeals, however, met with nothing but taunts and laughter. It was impossible to hear the words they uttered; but the tone and attitude of the six or eight men visible upon the deck of the submarine spoke eloquently of the spirit with which the whole of the operation was conducted. About the time when the submarine first came alongside, the sea, which had been choppy before, increased considerably, and you can picture the plight in which we found ourselves—up to our waists in water, in a bitter temperature, holding on for dear life to the rope whose strands formed the only tie binding us to life, shivering with the cold, our hands so numbed that two of my fingers have scarcely recovered, amidst the sneers and floutings of the Germans. We saw, about this time, one of the boats containing about thirty of our companions capsized by the heavy seas without a chance of our doing anything to save them. So trying were the circumstances under which we were placed that one of the black firemen with us jumped overboard to end his agonies, whilst we found ourselves obliged to restrain another from cutting his throat. One of the first-class passengers—a young man of about twenty-four, who appeared to be in delicate health—expired in the boat through exposure. We ourselves were continually passing fellow-creatures in the last throes of drowning, and I shall never forget the agony of listening to their final and awful cries and watching the heartrending look of horror as they sank from sight. We were finally picked up by the steam trawler *Orient II.*, on board which we received every kindness and consideration that her limited capabilities afforded. We were given hot tea and cocoa, besides some ginger essence heated in order to restore animation to our half-frozen bodies.

For some time, owing to the restrictions of space, most of us were compelled to remain on deck of the rolling trawler, continually drenched by the heavy seas which were running. Finally on our arrival at Milford Haven we were provided at the Seamen's Home, and through the medium of a local outfitter, with the necessary supply of dry clothes, and you can easily understand how glad we were to receive them.

The only souvenir I possess of the ill-fated *Falaba* is the bronze key and tab of my wireless cabin.

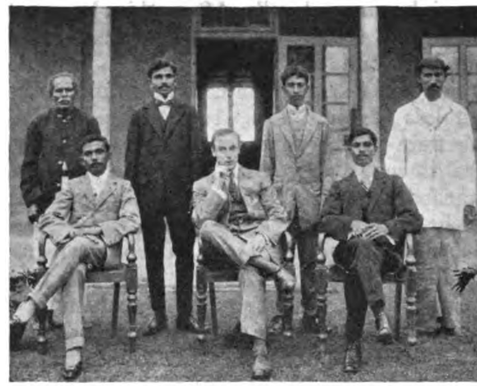
* * *

Members of the Marconi Company's staff will regret to learn that Mr. J. Pringle, the Company's representative at Calcutta, was recently taken ill with smallpox (modified form), and was compelled to spend some time in hospital. Mr. Pringle has now, however, fully recovered, and has resumed duty.

With a view of temporarily lightening Mr. Pringle's labours in these busy times, the Company has sent Mr. H. J. Tattersall to Calcutta, where he will assist in the inspection and fitting work which is being carried on at that port. It is intended at a later date to establish another depôt on the Indian coast, and it is very probable that Mr. Tattersall will remain in India for the purpose of taking up the position of Resident Inspector at the proposed new depôt.

* * *

Operator H. T. Clarke, who is at present serving at the Front, and from whom an interesting letter was published in the April number, writes again from "Somewhere in France" to say that he is still keeping fit and well. He mentions that the worst of the weather is apparently now over, although they are having the usual April showers. Mr. Clarke sends his kind regards to his friends on the staff.



Wireless Staff at Colombo.

The above illustration shows the staff of the Colombo Wireless Station. Mr. J. R. Stapleton, the officer in charge, is seen seated in the middle of the group.

HONOUR FOR MR. A. A. CAMPBELL-SWINTON.

Mr. A. A. Campbell-Swinton, M.Inst.C.E., who recently accepted the office of President of the Wireless Society of London for the second time, has been recently nominated by the council of the Royal Society for election as one of its members. This is a very high distinction, for the society, dating back to the stirring times of civil strife which ushered in the Commonwealth, is exceedingly chary of bestowing its honours, and merely to be nominated for fellowship is in itself a eulogistic recognition of high repute in the world of science.

GERMANY AND THE CAMEROONS.

The history of Germany's piratic colonisation forms as romantic a drama as ever was played at Drury Lane. In 1884 a certain Dr. Nachtigal was sent to West Africa to report on commercial questions, and such was the pusillanimity of the British Government of the day that this German freebooter, for he was little more, actually carried letters of recommendation from the British Government. He showed his appreciation of British courtesy by attempting to filch some French territory. Disappointed by Gallic vigilance, he passed over to the Cameroons, stealing a march on the British consul by a few days. The syren song of this German nightingale (Nachtigal), plus a little bribe of one thousand pounds, secured the goodwill of the leading chieftain, who made over his country to Germany

My Rural Wireless Station

By A. H. JOHNSON.

THE following is a description of my wireless telegraph installation which I have made in my spare time during the past twelve months, and I should like to say that considerable pleasure has been derived from the construction of the same, and that the outlay was very small.

Although I have not yet learnt the Morse code, I have, by writing down the dots and dashes and translating afterwards, read the following stations: Dri-ped, Billericay, Café-au-Lait, Wapping, Zambuk, and several stations having the call letters: GNR, LNWR, GPO, LSD, RIP, ASS, and PTO.

I shall be glad if any of your readers could tell me where these stations are situated, as they do not stand in my copy of "Little Tot's Wireless Guide."

As my father is a county policeman, I am in the fortunate position of not requiring a Postmaster-General's licence, and my father has given me permission to erect my aerial on the roof of the police office, so that we can keep the villagers supplied with war news.

I will begin by describing the aerial. It is of the inverted X type, and constructed of $\frac{48}{50}$ desiccated-bronze wire, a material which is not acted upon by the sulphurous fumes of the atmosphere, and does not present the difficulties of jointing as with aluminium.

The aerial must not be stretched too tight when erected in the summer time, for when the cold weather sets in the wire contracts and frequently breaks down the mast. If it is erected in the winter time, it will be found that the wires sag when the hot summer sun beams upon them. They must not be allowed to sag too much, because people have been known to fall over them. The correct tension of the aerial wire may be calculated from the following:

$$\sqrt{\frac{\text{Cos angle of Sag}}{\text{Temperature}}}$$

This formula is true for all places between the Arctic Circle and the Tropic of Cancer.

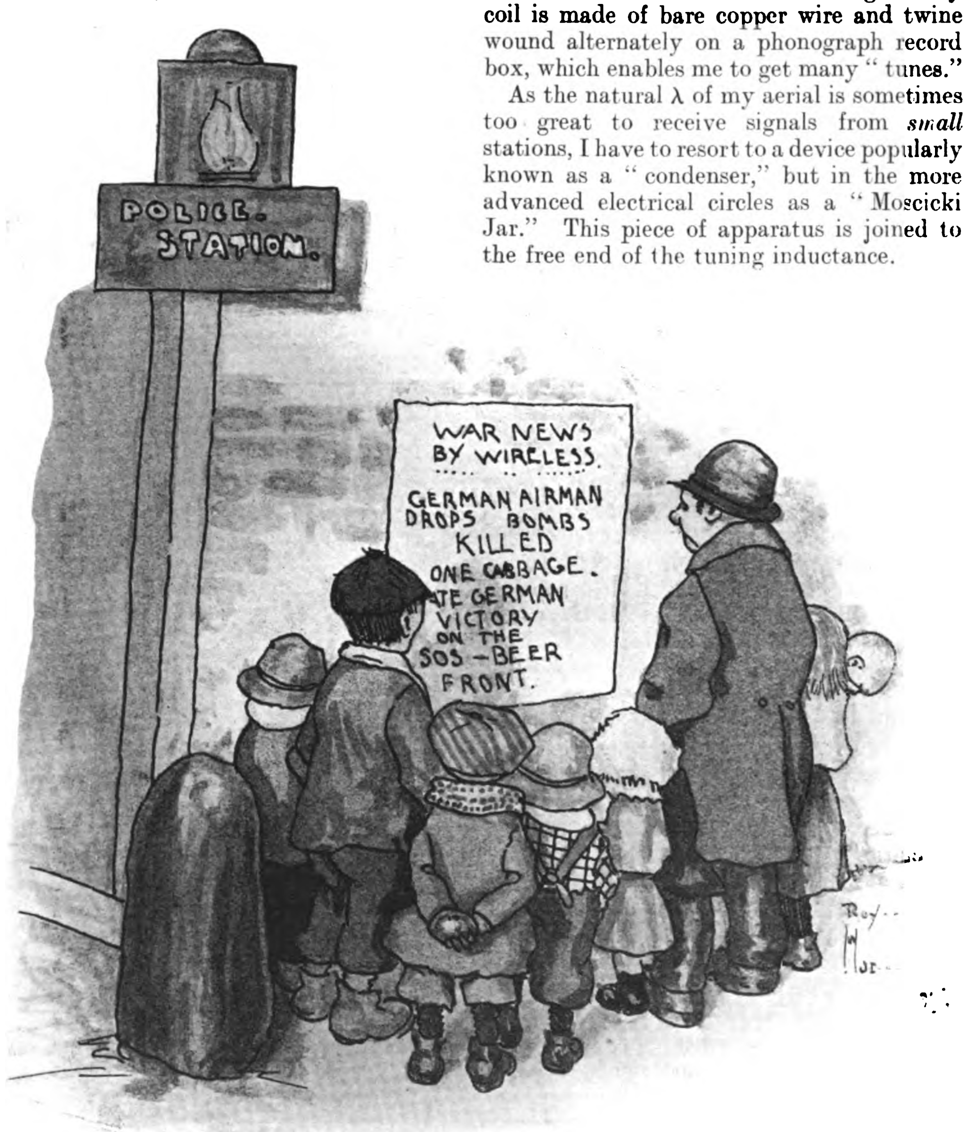
My father collected this for me on his rounds.

If the wires are well greased when put up, it will be found that the speed of the messages is greatly facilitated. My aerial is used for sending and receiving, it performing both operations with ease. I have read that it is necessary to insert a *lightning arrester* in the aerial circuit, but not knowing what it was, I asked my father, and he said there was no such thing —" at least, not in the police force."

My lead-in wire comes through a clay pipe (one I got at the "Gnat and Lobster Arms") which is passed through a hole in the window frame. If the bowl of the pipe is turned downwards outside, it will prevent the rain from coming into the "Instrument Room," for such is the title I have painted on the door. It also prevents the rain from washing off the messages. Before I discovered the clay pipe dodge, I found that the little "irons," for such is what the electric particles are termed, used to bump their heads on the window frame and fall down in a heap outside in an exhausted condition. On one occasion, when a station had been sending v's continuously for a week, we could not open the door, for such a heap of "irons" had accumulated.

I will now describe the receiving apparatus. The lead-in wire passes through to the aerial-tuning inductance or loading coil, so named after the "loadstone," because its principal function is to attract the messages. My coil is made of bare copper wire and twine wound alternately on a phonograph record box, which enables me to get many "tunes."

As the natural λ of my aerial is sometimes too great to receive signals from *small* stations, I have to resort to a device popularly known as a "condenser," but in the more advanced electrical circles as a "Moscicki Jar." This piece of apparatus is joined to the free end of the tuning inductance.



We can keep the villagers supplied with war news.

Not having any Moscicki jars with which to make my aerial tuning condenser, I used 3-lb. marmalade jars, but as these only had a resistance of 1·5 mhos, I threw in a few assorted microhenries to bring the capacity up to 39·3708 volts. By using various sized microhenries, one can easily alter the λ to suit any station, and a boxwood rule tied to the side of the jars forms an easy mode of calculating the necessary amount. As the ratio of the jars to the resistance is half a mho to the pound, it will easily be seen that a more satisfactory result is attained by increasing the number of jars instead of the microhenries, as they must not be packed too tightly. In any case, not less than one jar should be used.

Some difficulty may be experienced in obtaining the microhenries, as these are only to be found in the Ural Mountains, and are consequently now very scarce, but I have found that microfarads may be used in their place, and form a cheap and satisfactory substitute. These may be obtained from almost all grocers and oilmen, the price ranging from 3d. a dozen for the smooth ones to 6d. a dozen for the woolly variety. The ones most suitable for any individual station is best found by experiment.

Small blocking condensers were made from tinfoil (my father used to collect this for me when on his round) placed between waxed paper like a ham sandwich.

After the condensers comes the detector. This piece of apparatus is for dividing up the signals—*i.e.*, retaining the dots and dashes and preventing the spaces from entering the 'phones. There are many types of detectors, but I have obtained the best results from zincite and iron jelloids. Zincite may be used in contact with almost anything, the best substances being: Bornite, erubesite, stalactite, blow-me-tite, sit-tite, and set-em-alight.

There is another type of detector known as the magnetic, and I am fitting one to my set. It consists of a brass band which passes through the loading coil. The noise made by the brass band frightens away the spaces, but allows the dots and dashes to pass (providing they have, as it were, the right password). A German silver band does not work well, as it frightens everything away.

The reason I am making a magnetic detector is because it is not so easily liable to mechanical disarrangement. You see, the charge-room is next to my instrument room, and when my father walks about it upsets things.

Next comes the telephone receiver in which the signals are heard. The telephone was an invention of Alexander Graham Bell, who was born in Edinburgh 1847. The telephone is an extremely delicate instrument, and unless one has had a thorough training in mechanics, it would be better to purchase this part of the installation rather than to attempt to make it. Mine was made by tying a piece of vellum over the end of a round tin box, the bottom of which had been removed. Through a hole in the centre of the vellum is passed a piece of string, a knot being made in the string on the inside. The string should be about 4 ft. long, and the free end tied to the detector. Two telephones of this description may be used, one for each ear: one receiving the dots and the other the dashes, thus enabling signals to be received much faster.

The detector is finally joined to "earth"—a much better plan than that of joining the earth to the detector, as the signals should always be received in one direction—viz., from the aerial to the detector, thence to earth.

According to Sir Erskine Oliver, Professor Fleming Lodge, and other leading authorities on wireless, it is stated that a receiving installation is not complete without a jigger, but my experiments have proved to me that this is wrong. I made a jigger, but I soon got tired of jigging it up and down, so I put it on a piece of elastic tied to the gas bracket and worked it with my foot. As I did not hear any signals with it, I came to the conclusion that it must have shaken them off. This completes the receiving apparatus excepting for the wave-meter—an exceedingly delicate instrument which can only be calibrated at the seaside, the description of which is entirely beyond the scope of this journal.

The sending portion of my installation, sometimes called the transmitting plant, next commands your attention. In this case we also have tuning inductances and condensers, but on a much larger scale. There are many methods of making high-tension electricity. Our forefathers employed a cat's skin and glass rod, but the modern practice is to employ a voltaic pile, an efficient piece of apparatus having low internal resistance and unequalled recuperative power. It is very durable and suitable for all climates, whether tropical or arctic. A voltaic pile is easily and cheaply made by placing alternately pennies and two-shilling pieces, between which are placed small pieces of cloth previously soaked in salt water, also like a ham sandwich.

Join the voltaic pile across the inductance and condenser, having first inserted a Morse key, by means of which the signals are transmitted. After a wire has been led from the sparkgap to "earth," or lower capacity, we shall be in a position ready to transmit. Hold the Morse key firmly between the thumb and first two fingers of the right hand, and a copy of the Morse code in the left hand. When it is desired to send a dot, depress the key and say "iddy," and when a dash, say "umpty." Thus any word may be signalled into space.

I forgot to mention that the usual wireless joints should be used when required in the transmitting connections.

Shortly I hope to be able to send the Editor a photograph of my apparatus, so that those interested can form a better idea of the construction of a modern wireless installation.

Among the Wireless Societies

Notes on Meetings and Future Arrangements.

The Institute of Radio Engineers.—A record-making number of over 200 attended the March meeting of the above institute at 71 Broadway, New York, at which Mr. Edwin H. Armstrong presented an exceptionally interesting paper on "Recent Developments in the Audion Receiver." Mr. Armstrong described in detail the regenerative receiver with which his name has been identified, and outlined its use both as an amplifier and a "beats" receiver for sustained waves. The paper was discussed by Messrs. John Stone Stone, who spoke of some early work with amplifiers, and John L. Hogan, jun., who gave the results of some comparisons of sensitiveness and reliability between a number of forms of heterodyne receiver, including the audion types.

At the next meeting, to be held at Fayerweather Hall, Columbia University, N.Y., on April 7th at 8.15 p.m., Dr. Irving Langmuir will present a paper on "Applications of Thermionic Currents to Radio Telegraphy and Radio Telephony." Dr. Langmuir's work with thermionic currents in very high vacuum tubes is well known. He will outline the theory of such currents in these tubes, describe several pieces of apparatus which have been built for receiving radio signals, and also some devices for producing electrical oscillations and controlling them for radio telephony.

Interested non-members of the Institute are invited to attend.

* * *

London S.M. and E.E.—Special Notice.—A short Paper Competition for members will be held at the Caxton Hall, on Friday, May 7th. Particulars of the awards to be competed for and the conditions governing the competition may be obtained by post from the Secretary, Herbert G. Riddle, 37, Minard Road, Hither Green, S.E.

* * *

The Wireless Society of London.—On Tuesday, April 20th, Professor E. W. Marchant, D.Sc., gave an interesting lecture on "Methods of Measurement of the Strength of Wireless Signals." Owing to the meeting taking place whilst we were going to press, we are unable to deal with the lecture in this issue, but we hope in the next number to give our usual report.

The Amateur Handyman

HOW TO MAKE A TELEPHONE RECEIVER.

By J. W. HOBLEY.

A TELEPHONE receiver is not, as many amateurs appear to think, a difficult instrument to construct, and there is no reason why anyone who can handle tools should not, by following the instructions below, be able to make a 'phone which will be highly sensitive, light, and comfortable to use.

To reduce the weight of the instrument the case should be of aluminium, and if one of the size shown in Fig. 1 cannot be obtained it can easily be made from a casting. The pattern may be turned from beech, or other hard close-grained wood, and $\frac{1}{32}$ in. should be allowed all over for machining. In the sectional drawing of the pattern, Fig. 5, the "draft," which is necessary to enable it to

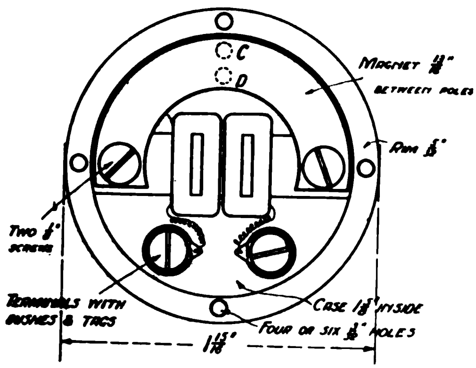


Fig. 1.

draw cleanly from the mould, is slightly exaggerated. With the aid of a lathe, self-centring chuck, and a ∧-pointed chisel the aluminium casting can easily be turned to size, and if a light final cut is taken a fine surface which will not require polishing is easily produced.

It should be noted that the size of the important parts only has been shown; the other parts can be made proportionally without difficulty.

The ear-piece can be turned from sheet ebonite of the requisite thickness, according to whether it is to be screwed to fit the case in the ordinary way, or secured by countersunk screws through the top as shown in

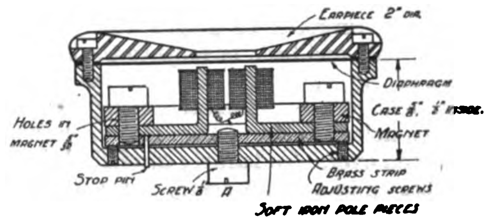


Fig. 2.

Fig. 2. If four or six screws are used the latter way is quite efficient, and the ebonite should be at least $\frac{3}{16}$ in. thick. As the shape of the ear-piece is of importance, both for comfort and efficiency, I have indicated the design which will be found best.

The diaphragm is cut from ferrotype plate, about $\frac{3}{500}$ in. in thickness, which can usually be obtained from a chemist. In Fig. 2 it is shown clamped between the ear-piece and the rim of the case. Small holes for the screws to pass through must be drilled in it, and care should be taken to remove the burrs.

The pole-pieces should be made from a strip of good quality iron plate and must be annealed after they have been drilled, tapped and bent to the shape shown in Fig. 2. The strip should be $\frac{1}{16}$ in. by $\frac{3}{8}$ in. wide. The length of the flat part is approximately $\frac{5}{8}$ in. and the turned up piece should be long enough to clear the diaphragm by $\frac{1}{32}$ in. before the adjusting screws are moved.

To economise space and to allow the wire to be as close to the pole-pieces as possible,

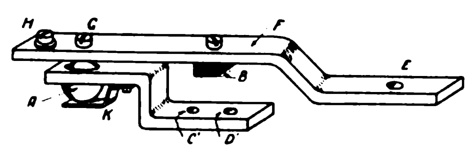


Fig. 3.

and also to enable the pole-pieces to come within $\frac{1}{4}$ in. of each other, spools are not used, but thin brass or german silver cheeks about $\frac{5}{32}$ in. by $\frac{5}{8}$ in. long are soldered direct to the pole-pieces, and are lined with silk for insulation purposes.

The magnet is semi-circular and is not laminated. The shape shown will be found quite efficient. It is much easier to make and is lighter than the circular laminated ones so often used.

As it is a most important part to make I describe the method rather fully. Obtain a piece of tungsten or magnet-steel $\frac{3}{8}$ in. by $\frac{1}{8}$ in., full, and bend or forge to the shape shown in Fig. 1, using a template cut from stout tin to work by. Anneal thoroughly and drill the holes as shown, then file and bring smooth all over. To harden, carefully bring the piece up to a bright cherry red in a clear fire, and plunge into cotton oil, keeping it

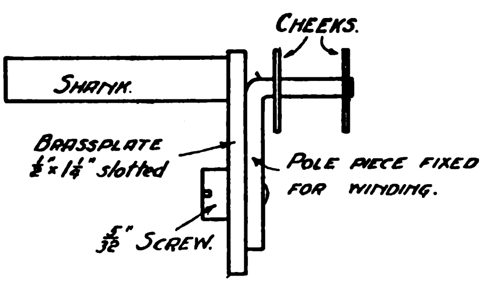


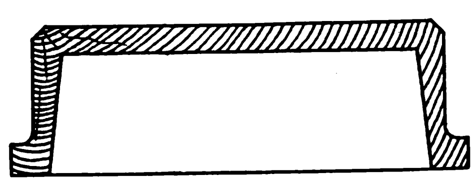
Fig. 4.

under until quite cool; finish by polishing bright, particularly on the sides. Tempering will not be necessary. To magnetise, take an electro-magnet capable of holding 8 lb. or 9 lb. with 4 volts, $1\frac{1}{2}$ amps., and place the magnet to be across the poles for ten minutes with the current on. It is advantageous to tap the steel all over with a lead or brass hammer, and also to make and break the current twenty or thirty times. Immediately before stopping the current and before the piece is removed from the electro-magnet, a keeper of soft iron should be placed across the poles of the new magnet. If the processes described above have been properly carried out a really good permanent magnet will be the result.

As separate spools are not used it is necessary to attach the pole-pieces to a special holder, Fig. 4, for the winding operation. The holes through which the clamping screws pass should be tapped $\frac{5}{32}$ in. and a short screw be used to fasten it to the holder. The bottom cheek on each pole-piece should have a hole drilled or filed down from the slot on the outer side for the inside ends of the windings to pass through; these ends are twisted together when the 'phone is ready. If a hole is first pricked through the silk it acts as a guide and prevents the wire from becoming chafed and short-circuiting. The top-cheek should be soldered within at least $\frac{1}{32}$ in. of the end of the pole-piece, as it is important that the coils should be as near the top as possible. The winding should preferably be done on a lathe by holding the shank of the special holder in a chuck, but with a little ingenuity it can easily be done by a hand-driven arrangement.

Enamelled copper wire answers perfectly for the coils. It has advantages over silk-covered wire in that breakages are at once apparent, and more wire can be wound in a given space; an important consideration in the case of a 'phone. About 1,500 w. can be wound on per instrument if No. 47 gauge is used, with the cheeks $\frac{1}{4}$ in. apart, but much higher resistance can be obtained by using 49 gauge or by lowering the bottom cheeks. The outer ends of the coils are soldered to brass tags fastened under the heads of the terminal screws. The terminals should be insulated by bushes and washers turned from $\frac{1}{4}$ in. ebonite tube.

A simple arrangement to enable the 'phone to be adjusted is shown in Fig. 2. The magnet, instead of being attached directly to the case, is screwed to a piece of hard-drawn brass $\frac{3}{8}$ in. by $\frac{3}{32}$ in. thick, with the ends of the pole-pieces between, thus clamping them to the magnet and forming



SECTION OF PATTERN FOR ALUMINIUM CASE.

Fig. 5.

a complete unit, which is secured to the case by the central screw, A. The two short screws shown in Fig. 2, which should be tightly fitted, come into contact with the brass strip, and thus allow the pole-pieces to be tilted or pressed nearer the diaphragm.

To enable the receiver to rest comfortably on the ear a ball and socket joint or some similar arrangement is necessary. A simple device for the purpose is shown in Fig. 6. The bottom piece is secured to the outside of the case at C D, Fig. 1, by two screws through the holes, C' and D', Fig. 6. The arm, F, is turned the opposite way so that the ebonite stop, B, comes between the terminals. The ball, A, is kept in position by the spring, K, and the straining cord of the flexible can be attached to screw, H.

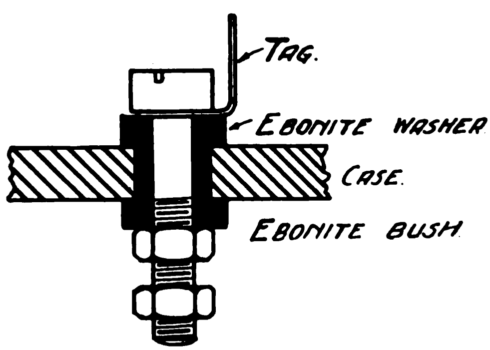


Fig. 6.

The whole, with the exception of the brass ball, can be made from aluminium strip, $\frac{1}{8}$ in. by $\frac{5}{8}$ in. wide.

The weight of the receiver should be not more than $2\frac{1}{2}$ oz., and if a head band of hard drawn aluminium is used this and two 'phones will weigh about $7\frac{1}{2}$ oz.

I do not consider a receiver made in the way described is a good one unless Paris can be read at a distance equivalent to 20 ft., on an aerial 100 ft. long and having a mean height of 36 ft.

The cost of the material per 'phone, including wire, is about 1s. 9d., and the time taken to make one is comparatively little. The results obtained will be found both pleasing and satisfactory, and will well repay the trouble of making.

GOVERNMENT APPRECIATION OF MARCONI COMPANY'S WORK.

Readers of this magazine will be interested to hear that Marconi's Wireless Telegraph Company has received a letter from the Director of Navy Contracts expressing approbation on behalf of the Admiralty for the manner in which Government work has been carried out. The text of the Admiralty letter reads as follows:

"... on behalf of the Admiralty I wish to "express approbation of the energy dis- "played by your company, its sub-con- "tractors and employees, which has resulted "in the exceptional speed with which this "material has been collected and shipped.

"I am, Gentlemen,
"Your obedient Servant,
"PERCY MINTER,
"For Director of Navy Contracts."

As will probably be realised by readers of THE WIRELESS WORLD, the staff at Marconi House and the works has since the commencement of war been working under exceptional pressure, and this official recognition of their loyal services is gratifying to all concerned. At times like these, when we are continually hearing complaints as to lack of zeal on the part of industrial organisations, it is refreshing to turn to another side of the picture. Many institutions have thrown themselves with real patriotism into doing work of public utility and have deserved as well of their country as if they had directed their energies to fighting in the field.

* * *

The Marconi Company has also received the following letter from the Secretary of the Admiralty:

"I am commanded by my Lords Commis- "sioners of the Admiralty to forward the "following extract from a letter dated "14th March, 1915, from Commander "Colpoys C. Walcott, R.N., on being re- "lieved in command of H.M.S. *Empress of* "*Asia*: 'With regard to Mr. Stevens, the "'wireless work on this ship has always "'been very efficient, and the keenness of "'Mr. Stevens has been reflected in his "'junior officer, Mr. Elliot, also the wireless "'yeoman. I submit herewith Mr. Stevens' "'name for any promotion it may be in my "'power to recommend this officer for, in "'the Marconi Company or otherwise.'"

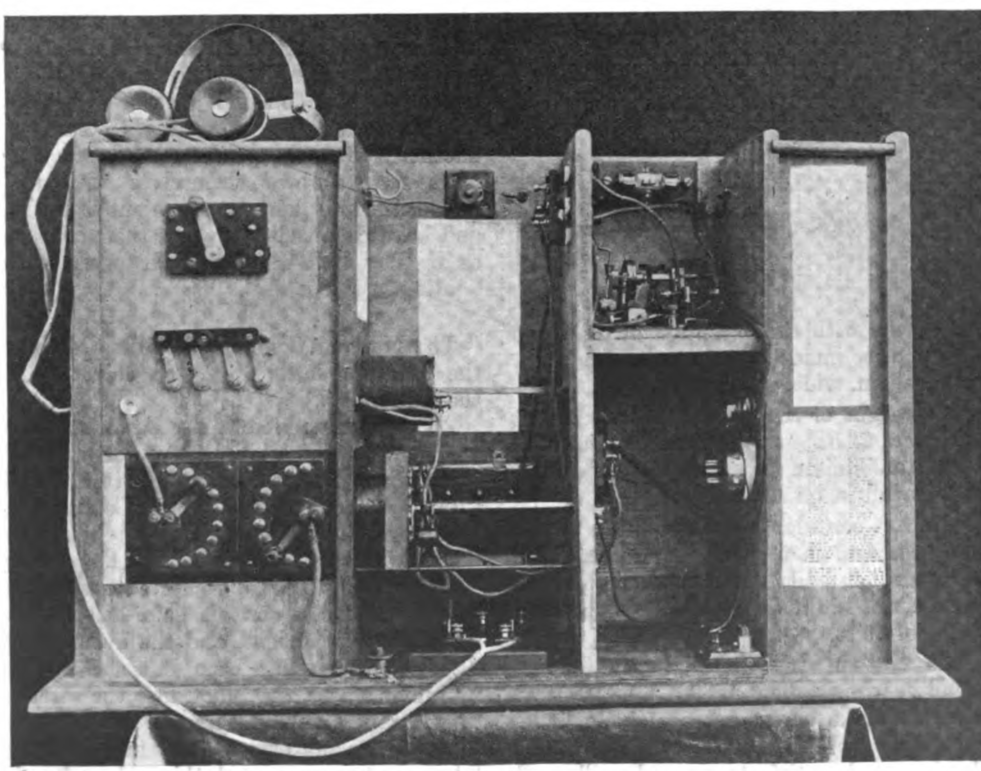
Amateurs' Experience.

An Amateur Station in West Africa.

The following description of a thoroughly practical amateur station has been received from Mr. E. R. Macpherson, of Wilberforce, Sierra Leone, British West Africa. Since receiving the manuscript we have had a further letter from Mr. Macpherson informing us that his apparatus has constantly been used by the authorities for military purposes during the present war, with great success.

THE following description and photograph of my "receiving cabinet," will probably be of interest to readers of THE WIRELESS WORLD.

I have been a very keen student now for several years, and have followed with interest every evolution in radio work. I make all my own apparatus myself, with the exception of the 'phones, of course. It will be noticed how I have mounted all the various instruments, so that they can be easily seen and reached. On the left are the tuning inductance, jiggers (with "four-way" switch to cut out No. 1 jigger), and the shunt condenser. The three detectors are mounted on felt in the top compartment. Underneath them are the switches and potentiometer. In the compartment on the right are situated the batteries and buzzer. The batteries also supply current for a small lamp on a long flexible lead. This enables me to adjust the detectors, and also to examine any part of the cabinet at night. The buzzer is suspended in mid air by its own leads, thus eliminating any mechanical vibration. A lightning arrester is fitted above the detectors. The whole cabinet is of native hard wood, well seasoned. All leads are of heavy stranded "flex," with their ends sealed, and all that can be soldered are soldered. The cabinet measures



Mr. Macpherson's Apparatus.

30 in. long by 11 in. wide by 20 in. high, and fits into a water-tight case for travelling. Packed up it weighs about 40 lb. I find that using two jiggers with their primaries and secondaries in series gives very close tuning for long waves; and with both couplings pretty loose, "strays" are considerably reduced. Wave-lengths up to 5,000 metres can be tuned in. As regards

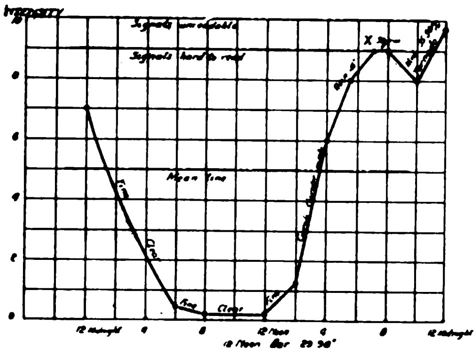


Fig. 1.

detectors for long-distance work I favour galena (with cat whisker contact), partly because I have been lucky in hitting upon good pieces. One piece that I am using now is "ultra" sensitive. The "perikon" combination I place second, and for everyday short distance work, silicon and gold point. Galena is particularly useful for twilight observations of X's. The X storms in these latitudes at times are terrific, and absolutely put the lid on any receiving work. On the other hand freak nights are not uncommon, and from my present station here (800 ft. above sea) I have read EAC (Cadiz) and EAL (Las Palmas) easily. The antenna I am using now is of the fan-shaped type, consisting of four strands, each 200 ft. long, radiating north-east from an 80 ft. pole. My "earth" is the water-pipes, and I also use my zinc roof as a counterpoise in addition. When I was stationed in Jamaica, B.W.I., I favoured a directive triangular-shaped aerial, with wire netting as a counterpoise. This used to give excellent results, as I was able there to read the time signals from NAA (Arlington, U.S.A.), every night at 10 p.m. I was greatly interested to see that the British Association for the Advancement of Science were disbursing forms to all British radio stations for "Observations on Strays," thus standardising the methods of observation; a most praiseworthy effort! For some months past I have been keeping a daily curve of the X's myself, noting at the same time the meteorological conditions. I enclose a copy of May 8th, 1914. (Fig. 1) This is a typical curve for this time of year, dropping down in middle of day and going up at night. It will be remarked that, fundamentally, my idea is on the same lines as Form I., as now issued by the British Association for the Advancement of Science with the exception that on Form I. the X's are further analysed into "grinders," "clicks," and "sizzles." At present, here, we are getting mostly "grinders." One is very puzzled in studying the relationship (if any ?) between "strays" and the local meteorological conditions. X storms here seem to be very local, and "*appear*" to travel along the longitudes rather than the latitudes. I have been experimenting with all shapes and kinds of aerials, and I find that for an amateur who is constantly on the move as I am, a triangular-shaped directive aerial (for receiving only) is the best, with a wire-netting counterpoise. The excess of moisture here at this time of year is appalling! Our "rains" are now in full swing and I am obliged to keep a

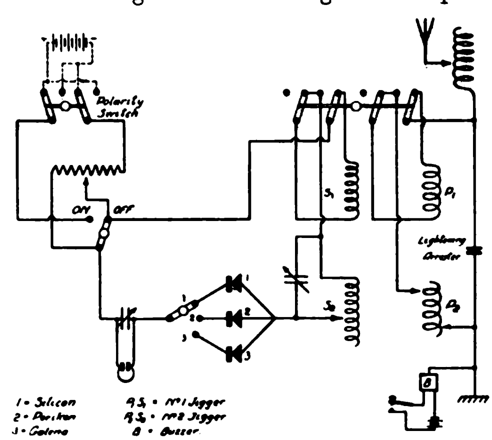


Fig. 2.

charcoal stove constantly burning near my cabinet to prevent "earthing." I am keenly interested in X observations, as communication in this part of the world is seriously interfered with at times. I feel convinced that there is much more to be done in the shape of aerials, etc., to reduce "strays." I should like to say much more about my experiments, but I want to confirm my results by exhaustive tests first.

Exterior of Fenchurch Street Office.

Additional Wireless Facilities for City Men

The Marconi Company opens an Office in Fenchurch Street.

THERE has just been opened in the heart of the City of London a new office specially designed for the acceptance and handling of Transatlantic and other wireless telegrams. This marks a most important step forward in the commercial development of the enterprise with which Mr. Marconi's name is indissolubly linked.

For some years past the Marconi Company has been engaged in handling an ever-increasing amount of traffic of this description, and the development thereof has now reached such a point as to justify them in launching out on the present scale. Old superstitions die hard, and, strange as it may appear to the better informed, it is nevertheless the case that even at this time of day, when huge volumes of long-distance messages are being regularly handled both for Governments and private firms, some business men are still possessed by an idea that wireless trans-ocean messages are handled by relays through ships and not direct. The opening of this handsome and well-equipped office should go far to dissipate once and for all any such illusion; as well as the obsolete idea that radiotelegraphic long-distance messages can only be transmitted at night. The Marconi service under modern conditions is equally available by day and night at all hours, a fact of which all users of this service have long been aware.

INCREASED FACILITIES.

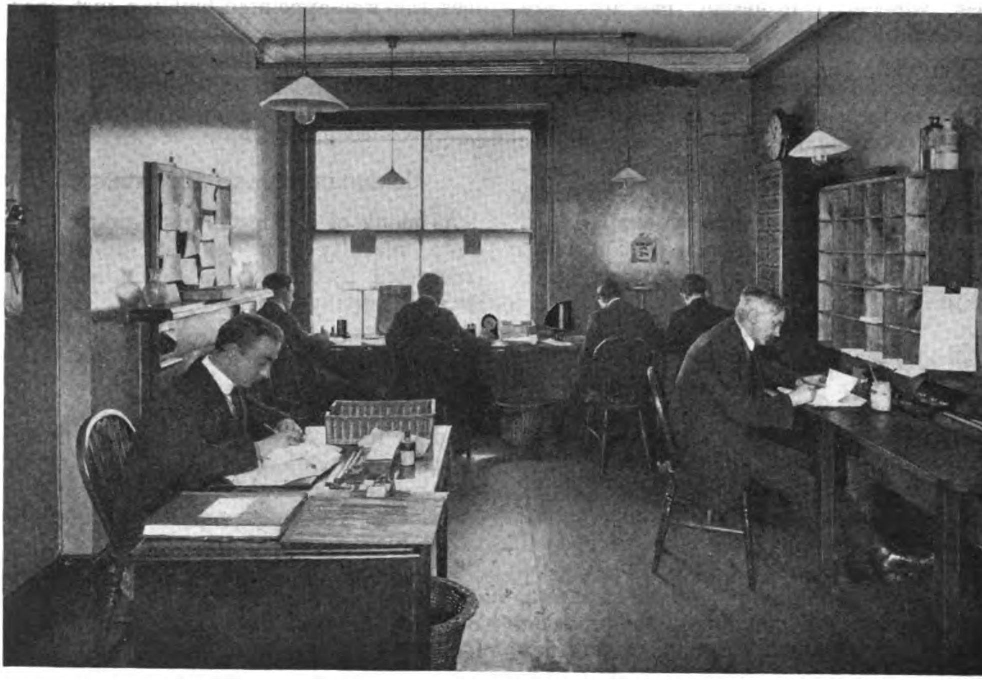
The office, which forms the subject of our remarks and illustrations, was opened for public service on April 12th last. Already a large amount of traffic is handled there, and unmistakable signs point to the fact that the business world of the City of London recognises in it what, despite the fact that the phrase has become somewhat hackneyed, cannot be better described than "a long-felt want." Nothing is of greater importance to the extension of business than the provision of increased facilities of communication, particularly when such increase is accompanied by substantially decreased cost. We would, therefore, remind our readers that not only does the well-appointed building just open represent to commercial men an increase in facilities for their business transactions; but it also provides them at that decreased cost (in most cases amounting to 33⅓ per cent.).

CONVENIENCE AND EFFICIENCY.

As many of our readers are aware, until quite recently the telegraphic business transacted by the Marconi Wireless Telegraph Company has been centred at their headquarters in the Strand, although a certain amount has for the convenience of the City been localised in that district. There is every reason, therefore, to expect a heavy increase in the volume of traffic brought in, and it is hoped that our pictures and printed particulars will indicate that the Company is fully prepared to handle it in the most efficient manner possible.

The situation is particularly central, occupying as it does a corner position in Fenchurch Street, just at its junction with Gracechurch Street, and practically facing Lombard Street. Thus conveniently placed the new office is in a position to collect, by means of its messenger service, telegrams

Accepting Office.



A View of the Instrument Room.

from all parts of the City in a minimum of time, whilst the more westerly parts of London can still be most conveniently served from Marconi House.

The telegrams, as soon as they have been accepted by the counter clerk, are forwarded by pneumatic tube to the instrument room. Thence they are immediately despatched to Clifden, County Galway, by *special direct private wires*. The point just italicised will indicate that there can be no delay involved in retransmission, and, whilst it is not desirable in our present remarks to enlarge upon the technical equipment of the great Irish high-power station, we may remind our readers of its well-tested capacity for traffic.

A "Look Round."

Let us suppose we enter the building from the street. We first find ourselves in the Accepting Office, which is tastefully panelled and furnished in mahogany. In front of us stands a curved counter so arranged as to utilise the space available to the best advantage, and admit as large a number of clients as possible being attended to simultaneously. The white walls are lined with a composition giving an embossed effect, and surmounted by cornices and ceiling supports of white moulded wood reflect the light admitted by the large plate-glass windows, and render the conditions under which business is transacted excellent from an eyesight point of view. The holophane electric pendant provides ample illumination after sunset, and is supplemented by electric standards disposed round the counter. Neither clients nor staff need have any fear of eye strain either by day or night. The floor space on which we stand is covered with a patent composition, which, being jointless, can be easily kept in a thoroughly clean and sanitary condition, however heavy may be the traffic handled. That metal pipe which we see at the back of the counter is the Lamson pneumatic tube, which conveys the messages to the instrument room.

Passing behind the partition at the back of the counter, we reach a room adjoining the Accepting Office, a room destined for the registration of addresses and other clerical work and in direct communication with the messengers' lobby. Here we notice a desk allotted to the messengers' superintendent, the office telephone exchange, a further Lamson tube connection and seats for the waiting messengers.

TO ENSURE CONTINUITY.

Descending to the basement we discover a workshop containing facilities for small repairs, and passing through this we enter a further office wherein is located the motor generating set which supplies current to the Clifden wire. This generating set is reproduced in duplicate and so arranged that to change from one set to another shall be made at regular intervals. In this way both sets are maintained continually in working order, so that in the event of a possible breakdown an immediate change over can be made and the work continued without any interruption. The electricity supply is brought into the office from two distinct mains, each of which is linked with the services of a different supply company. Here again we have fresh evidence of the care taken to ensure absolute continuity of working which characterises the whole equipment of the establishment. Should any part of the machinery perchance break down another is immediately ready to take its place. In the immediate vicinity of the power room we shall notice the electrically-driven blower for the pneumatic tube, and our inspection of the remainder of the basement shows that it has been devoted to providing accommodation for the messengers.

INSTRUMENTS AND ORGANISATION.

Our visit now takes us upstairs to the regions situated above the Receiving Office. Here are located the Superintendent's Bureau (a corner of which may be seen in our illustration), the instrument rooms, an office devoted to general clerical work, and operators' retiring room. Our inspection of the instrument rooms produces a most favourable impression. We find them to be commodious and well lighted, and our picture will show that the windows are especially spacious. At the left hand of the desk by the window(*see* illustration, page 120) we find operators handling messages on the Clifden main lines, whilst on the right hand side run the special wires leading to the General Post Office. The separate desk

Marconi House Circuit and Punching Apparatus.

Mr. W. S. Purser (Assistant to Traffic Manager) on left with Mr. G. E. Clarke (Superintendent) conferring.

standing on the left is occupied by the chief operator on watch, whilst on the right hand sits the service clerk. In one corner of the instrument room we notice the termination of the pneumatic tubes from the counter and messenger department close by a desk occupied by a clerk busy decoding abbreviated telegraphic addresses.

TIME SAVING.

Everything possible is done throughout the establishment to save even the tiniest scrap of time. Seconds are of value in telegraphic work, and the long row of pigeonholes that we notice here contain printed envelopes for all the most frequently used names and addresses. As soon as the Marconigram is ready it is placed in the envelope, and the pneumatic tube transports it almost instantaneously into the hands of the waiting messengers below.

We now pass into the further extension of the instrument room, running at right angles to the portion already noticed and described above.

Against the wall, close by the window, we observe the switchboard. By its agency all the various lines can be changed over, tested, or put into communication with different instruments. Through its medium the current from the generating machines in the basement below (which we have just visited) is also regulated and led to the instruments. At the desk we see on the left an operator is hard at work sending a message over the private wire to Marconi House (*see* illustration page 121). Immediately to the right has been located the slip-punching apparatus for Wheatstone working.

DUPLEX WORKING.

It is sufficient for technical experts if we state that all the telegraph wires which have been examined and described are worked on the duplex system, but it may be as well to add for the benefit of those less versed in scientific detail a few words to indicate the important fact therein implied. It means that messages can be sent and received simultaneously. Each wire under this arrangement has its capacity doubled.

STAFF ARRANGEMENTS.

Despite all the mechanism which is employed in modern industry, and which necessarily plays a large part in such an enterprise as the one which we have been inspecting, the human element has lost none of its importance. In this new office of the Marconi Company the staff has been well considered, and every attention has been paid to their comfort and convenience. A special room has been provided for the exclusive use of the staff members wherein each telegraphist possesses his own locker, whilst a large table is available for reading, writing, meals, etc.

SHARE MARKET REPORT.

London, April 19th, 1915.

Owing to the favourable developments of the business of the various Marconi companies, the speculative account open in their shares at the end of July, 1914, has now been eliminated, the stock having been taken by investors.

The annual report of the American Company shows considerable progress has been made, in spite of the world-wide disturbance of the last nine months, and its issue was followed by considerable buying from the United States.

Prices are: Marconi Ordinary, $1\frac{7}{8}$; Marconi Preference, $1\frac{1}{16}$; American Marconi, 10s. 9d.; Canadian Marconi, 5s. 6d.; Marine Marconi, $1\frac{3}{16}$.

INSTRUCTION IN WIRELESS TELEGRAPHY

(Second Course)

(X.) The Receiving Circuit.

[The dislocation of our arrangements, due to the war, has prevented us from completing, in our last Volume, the second course of Instructional Articles. These are being continued in the third Volume, and we hope to arrange for the Examination (full particulars of which are given on page 333 of our issue of August, 1914) to be held in the early autumn of this year. The present is the tenth of the second series of articles, which will deal chiefly with the application of the principles of wireless telegraphy. Those who have not studied the first series are advised to obtain a copy of *The Elementary Principles of Wireless Telegraphy*, which is now published, price one shilling net, and to master its contents before taking up the second course of instruction.]

753. One of the calculations most frequently required in wireless telegraphy is that of the inductance of a coil, and a simple method is described below.

For the coils which are most often used—namely, those wound in a single layer of wire on a cylindrical former—there are several formulæ by which the inductance can be calculated with a sufficient degree of accuracy for practical purposes.

A formula which is very often quoted for such a coil is

$$L = \pi^2 d^2 n^2 l$$

where d = diameter of coil in centimetres.

l = length of coil in centimetres.

n = number of turns *per centimetre*.

(the inductance being expressed in "centimetres.")

This formula is, however, not at all suitable, since it is only correct for a coil of which the length is many times the diameter, a relationship which does not hold for the majority of the coils used in wireless telegraphy.

754. Professor Nagaoka has obtained a formula which is accurate for coils of all ratios of length to diameter, which is

$$L = \pi^2 d^2 n^2 l K$$

where all the terms have the same meaning as in the previous formula, and K is a factor depending on the ratio $\frac{\text{length}}{\text{diameter}}$.

He has compiled tables giving the values of K for the above ratio between 01 and 10. These tables are to be found in "Calculations of alternate-current problems" by Louis Cohen, and in "Formulas for the calculation of mutual and self-inductance," by Rosa and Grover, Bureau of Standards, U.S.A.

The writer has found it convenient when using this formula to employ the following table for the inductance of a coil wound with 20 turns per centimetre on formers of diameter from 4 to 18 centimetres :—

The inductance of a coil wound with a different number of turns per centimetre, say m, is obtained by multiplying the inductance for a similar coil wound with 20 turns by the factor $\frac{m^2}{20^2}$.

Thus, if there be 10 turns per centimetre the multiplying factor is $\frac{1}{4}$, and for 30 turns per centimetre it is 2·25.

It will be noticed that the values are in microhenries and not centimetres of inductance as the former unit is more convenient.

It may happen that the dimensions of a coil are outside the limits of the table—*i.e.*, the diameter may be greater than 18 centimetres. In this case take the value for a coil half the diameter and half the length and multiply by $2^3=8$, or take a third of the dimensions and multiply the value by $3^3=27$, the result being multiplied by $\frac{m^2}{20}$.

755. The inductance given by the above formulæ are what is known as "current-sheet" values. That is, they are correct for a coil wound with flat strip, the turns of which touch without making electrical contact—*i.e.*, the insulation is infinitely thin. For coils wound with ordinary round wire which have insulation of appreciable thickness or which are separated by air spaces, a correction must be made to obtain accurate results. Where the insulation is not thick compared with the conductor, and the coil has a large number of turns, this correction is small, but for other cases it is appreciable.

TABLE SHOWING INDUCTANCE IN MICROHENRIES FOR COILS WOUND AT 20 TURNS PER CENTIMETRE.

Diameter in Centimetres.

Length in cms.	4.	5.	6.	7.	8.	9.	10.	12.	14.	16.	18.
1	23·02	31·56	40·55	49·98	59·78	69·88	80·26	—	—	—	—
2	66·37	93·11	122·0	152·5	184·7	218·0	252·5	324·5	399·0	478·2	559·0
3	118·1	169·0	224·1	283·5	346·3	388·6	479·9	623·3	783·9	932·2	1095
4	173·6	251·9	338·3	431·7	531·3	636·2	745·2	974·0	1221	1478	1744
5	232·1	339·7	460·1	590·5	718·6	881·4	1038	1369	1723	2094	2482
6	291·7	430·3	587·0	761·0	945·0	1201	1350	1793	2270	2795	3295
7	351·7	522·8	717·1	932·2	1165	1415	1681	2243	2847	3493	4183
8	413·1	616·9	850·2	1109	1392	1695	2016	2707	3454	4249	5113
9	474·7	711·4	984·5	1291	1624	1982	2362	3203	4079	5025	6049
10	536·8	807·4	1120	1472	1858	2274	2718	3681	4725	5857	7050
12	661·0	997·4	1395	1842	2344	2870	3443	4699	6074	7546	9133
14	785·7	1193	1673	2216	2810	3475	4185	5740	7450	9315	11290
16	910·9	1389	1951	2593	3301	4091	4937	6803	8876	11140	13600
18	1037	1583	2231	2972	3800	4711	5697	7879	10310	12980	15850
20	1162	1779	2512	3352	4295	5332	6462	8966	11780	14860	18190
22	1287	1975	2794	3734	4821	5960	7228	10060	13250	16750	20560
24	1414	2172	3005	4115	5289	6588	8000	11160	14730	18670	22940
26	1536	2367	3357	4502	5789	7381	8778	12270	16230	20610	25370
28	1666	2565	3642	4883	6288	7845	9683	13390	17730	22550	27810
30	1792	2761	3922	5264	6790	8480	10330	14500	19230	24500	30260
32	1920	2958	4207	5652	7288	9111	11110	15620	20750	26460	32730
34	2044	3155	4489	6037	7793	9519	11930	16730	22260	28650	35200

To make this correction, having calculated the inductance from the formula or table, subtract from the result $2\pi dnl$ [A+B] where all the terms have the same meaning as before, the inductance being in centimetres, and A and B are given below. Complete tables of the functions A and B are to be found in "Calculations of Mutual and Self-inductance," mentioned above.

VALUE OF TERM A DEPENDING ON THE RATIO $\frac{d}{D}$ OR DIAMETER OF BASE TO COVERED WIRE.

$\frac{d}{D}$	A.	$\frac{d}{D}$	A.
1·00	+·5568	·75	+·2691
·95	+·5055	·70	+·2001
·90	+·4515	·65	+·1261
·85	+·3943	·60	+·0460
·80	+·3337	·55	—·0410
·50	—·1363	·25	—·8294
·45	—·2416	·20	—1·0526
·40	—·3594	·15	—1·3404
·35	—·4928	·10	—1·7457
·30	—·6471		

VALUE OF TERM B DEPENDING ON TOTAL NUMBER OF TURNS OF WIRE ON THE COIL.

Number of Turns.	B.	Number of Turns.	B.
1	+·0000	40	+·3148
2	+·1137	50	+·3186
3	+·1663	60	+·3216
4	+·1973	80	+·3257
6	+·2329	100	+·3280
8	+·2532	200	+·3328
10	+·2664	300	+·3343
15	+·2857	400	+·3351
20	+·2974	1.000	+·3365
30	+·3083		

756. As a numerical example, we will calculate the inductance of a coil wound, at 24 turns per cm., with No. 28 S.W.G. single wound silk wire, on a former 18 cms. diameter, 16 centimetres long.

From the table the inductance of such a coil wound at 20 turns per cm. is 13600 microhenries.

Hence, for 24 turns per centimetre,

$$\text{inductance} = \frac{13600 \times 24 \times 24}{20 \times 20} = 19580 \text{ mhys.}$$

Applying the correction
diameter of No. 28 wire $=$·0376 cms., or it could be wound at 26·6 turns per centimetre

$$\therefore \frac{d}{D} = \frac{24}{26{\cdot}6} = {\cdot}9 \text{ nearly, whence } A = {\cdot}4515.$$

Total number of turns of wire $= 16 \times 24 = 384$.

B $=$·3350.

$\therefore$ Correcting term

$$2 \times \pi \times 18 \times 24 \times 16[{\cdot}4515 + {\cdot}3350]$$
$$= 38160 \text{ centimetres}$$
$$= 38{\cdot}2 \text{ microhenries.}$$

Hence inductance $=$ 19540 microhenries to four significant figures, and the correcting term is small.

As another example, take a similar coil, but wound with 3 turns per centimetre with wire of diameter ·25 cm.

The diameter of the former must be measured to the centre of the wire, and hence we will assume the diameter of the former to be 17·75 cms., which with the wire gives a mean diameter of 18 cms.

From the table

$$\text{inductance} = \frac{13600 \times 9}{400} = 306 \text{ mhys.}$$

$$\text{But } \frac{d}{D} = \cdot 75, \text{ hence } A = \cdot 2691.$$

Total number of turns=48 and B=·3178.

$$\text{Correcting term} = \frac{2\pi \times 18 \times 3 \times 16 \times \cdot 5869}{1000}$$

=3·186 mhys., which is more than 1 per cent. of the total.

The inductances given by the formula are only strictly accurate for very low frequencies, but are not far out even for the high frequencies met with in wireless telegraphy. There is not any simple formula which can be used in place of the one quoted for high-frequency calculations.

Since the current in such cases tends to concentrate near the inside of the coil, the result will be more accurate if the inside diameter of the wire coil be taken instead of the diameter to centre of wire.

For diameters in between those given in the table, a convenient method is to plot the figures on squared paper from which the result for any diameter can be read off.

757. The formulæ given in paragraphs 753 and 754 will be quite sufficient for working the inductance of coils wound on cylindrical formers. The only other shape of former which is used to any extent is a " spherical " one, which is sometimes used for a coupling coil in which variation in coupling is effected by turning a handle and not by sliding the coils to and fro. There is no general formula suitable for this case, since the winding may cover a large or small amount of the surface of the former, and the ratio of the diameter of the outside turn to the diameter of the sphere may vary according to the exact shape of the former.

If, however, the inductance be calculated for a cylindrical former of diameter equal to that of the middle turn and overall length equal to that of the actual winding, an approximate value for the inductance will be obtained.

It is to be noted that, supposing a coil is wound on such a former and the inductance is measured, then for another winding on exactly the same size former and same overall width, the inductance will be exactly proportional to the ratio of the squares of the numbers of turns.

MUTUAL INDUCTANCE.

758. In paragraph 751 it was stated that a knowledge of the mutual inductance between two windings wound separately on one former is of use in designing a receiver.

The calculation of this is easily made if the windings are of the same number of turns per centimetre.

In Fig. 1 let A and B be the two windings. Calculate the inductances of a coil C which would exactly fill the space between A and B.

Calculate also the inductances of coils equal in length to A+C and B+C and A+C+B. These values can be written down from the table above especially if the figures given are plotted on squared paper to allow for cases where the lengths are not even centimetres.

Then, if the inductance of C be L_C,
A+C be L_{AC},
B+C be L_{BC},
A+C+B be L_{ABC},
and the mutual inductance between
A and B be M_{AB},

we have $M_{AB} = \frac{1}{2}\{(L_{ABC} + L_C) - (L_{AC} + L_{BC})\}$

A knowledge of the mutual inductance between a primary and secondary coil would be of use, but unfortunately, there is no general formula for the purpose. At least three or four formulæ would have to be given to meet every case, and these formulas are themselves complicated.

When the primary is right inside the secondary (or *vice versa*) an approximate value is given by

$$M = \frac{4\pi^2 a^2 n_1 n_2 l}{1{,}000} \text{ microhenries.}$$

where a=radius of inner coil and l its length and n_1 n_2 are the respective number of turns per centimetre.

The result will be too large, as it assumes the outer coil to be very long.

CAPACITY.

759. The calculation of the capacity of a condenser is not always such an easy matter for accurate results as the inductance of a coil, since, in most condensers the plates are very close together and it is difficult to measure the small distance to, say, within 1 per cent., unless expensive instruments are available. Moreover, the dielectric coefficients of insulating materials varies to a large extent from sample to sample and figures taken from a book for any material, such as mica, ebonite, paraffined paper, etc., may not be correct for the sample of which the actual condenser is made. In a fixed condenser the pressure to which it is subjected when built up will affect the capacity and in variable condensers the clearance between moving plate and sheet of insulating material has to be taken into account.

Hence, only approximate values can be obtained and, therefore, simple formulæ which are only approximate in correctness will be given.

The capacity between two parallel plates, whose surface is A square centimetres and distance apart d centimetres is

$$C = \frac{A}{4\pi h} \times \frac{1}{9 \times 10^5} \text{ microfarads}$$

if air is the dielectric, and

$$C = \frac{KA}{4\pi h} \times \frac{1}{9 \times 10^5} \text{ microfarads}$$

for a dielectric with a dielectric constant (specific inductive capacity) of K.

For a condenser built up of a number of plates the capacity is (N−1) times the capacity of a single pair of plates, where N = total number of fixed + moving plates.

For semi-circular plates, such as are largely used in variable condensers.

$A = \frac{\pi r^2}{2}$ where r = radius of the plate, and therefore

$$C = K\frac{r^2}{8h} \times \frac{1}{9 \times 10^5}$$

for a pair of plates.

760. Another form of condenser is the tubular design.

The capacity is

$$\frac{Kl}{4{,}145{,}400 \left(\log_{10} \frac{R_1}{R_2}\right)}$$

where R_1 = diameter of outside tube (measured inside the tube);

R_2 = diameter of inside tube (measured outside);

and K = dielectric constant of the medium, which for air = 1.

The above formulæ neglect the corrections due to the "end effects." These corrections

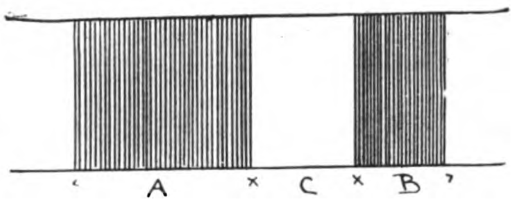


Fig. 1.

have only been worked out for circular plates, which are not used in radiotelegraphic work, and the difficulty of making the small measurements to the required degree of accuracy renders these corrections of little practical value. The capacity of any condenser should, therefore, be determined experimentally.

Although there are methods for measuring the inductance of coils of very great accuracy, these values can be calculated to an even higher accuracy by appropriate formulas, of which the one given in paragraph 754 will be found to be quite sufficient for the coils used in making receivers.

Having calculated the inductance of a set of coils the capacity of any condenser within moderate limits, can be determined if a wavemeter is available, by measuring the wave-length of the circuit formed by connecting the capacity and inductance in parallel.

Capacities between ·00005 and, say, ·1 microfarad can be measured in this manner, which is, however, not suitable for condensers of much smaller capacity owing to the distributed capacity of the inductance.

DECREMENT.

761. For a receiver to be efficient it must be designed so that it does not appreciably increase the damping of the signals.

The decrement of a closed oscillating circuit (*i.e.*, a circuit which does not lose energy by radiation into space) is given by the formula:

$$d = \frac{8{\cdot}33R\lambda}{L \times 10{,}000}$$

where R is in ohms, λ in metres, and L in microhenries. R is the resistance of th-coil at the frequency corresponding to the wave-length of the circuit.

The above formula is based on the assumption that the whole of the damping is due to the ohmic resistance of the inductance. But in addition to this the condenser may introduce a loss which will increase the decrement. For condensers constructed with air dielectric or the best quality of mica or ebonite the decrement is usually very small, but for dielectrics such as glass or celluloid; or paraffined paper, mica or ebonite which are not absolutely freed from the last traces of moisture, etc., the decrement may become large, some of the energy being wasted by electrostatic hysteresis or the low insulation resistance.

Since the decrement depends on the physical state of the dielectric at the time it is not possible to give a formula to calculate it. The usual method is to find by experiment the value of resistance which will introduce the same decrement into the circuit and use this in the formula given above.

762. In ordinary receivers the decrement due to the resistance of the inductance is quite small. Thus, if we wish to receive a wave-length of 300 metres using a capacity of 0001 microfarads our inductance would be 253 microhenries.

If the high frequency resistance of this coil were 2·5 ohms, which is the approximate value for No. 26 S.W.G. wire, the decrement due to it would be

$$\frac{8{\cdot}33\times 2{\cdot}5\times 300}{253\times 10{,}000}=\cdot 0025.$$

the coil being taken as 5 cm. dia. wound with 80 turns.

It must not be forgotten that every circuit used between the aerial and detector adds to the damping. Also the detector itself, since it absorbs energy from the closed detector circuit increases the damping, in the same way, and therefore each circuit must have a small decrement in order that the total decrement may be small.

THE YEAR BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY.

MARCONI HOUSE RIFLE CLUB.

A COMPETITION was held in March for various medals, etc., presented by theNational Rifle Association and the Society of Miniature Rifle Clubs. Each competitor was required to shoot three series of ten shots each, the highest possible score being 150. Thirty-nine members of the club competed, and the result was declared by the committee as follows:

First: Mr. F. K. May (score 128), Donegal Badge and *Daily Express* Medal; *Second:* Mr. A. E. Moore (score 126), Bell Medal; *Third:* Mr. W. Marsh (score 125), *Daily Mail* Certificate; *Fourth:* Mr. F. Atkin (score 124), *Daily Telegraph* Certificate; *Fifth:* Mr. H. W. Corby (score 124), Lord Roberts's Medal.

A LUCKY ESCAPE.

MANY and varied are the experiences recounted by our soldiers and sailors, but perhaps one of the most curious was told by Private Benjamin Driscoll, who was formerly employed by the Marconi Wireless Telegraph Company, Ltd., in their Chelmsford Works. Private Driscoll, who was a Reservist, was called up on August Bank Holiday, and went to France on December 19th. In a letter home he emphasised the need of a cigarette case, and on February 28th he received from his brother a nickel one, which he placed in the left pocket of his overcoat. During the attack on Neuve Chapelle he was struck by a bullet, which by good chance passed through his cigarette case, and in consequence only inflicted a comparatively slight wound. While lying on the ground from the effects of this, a stray bullet struck him in the right arm, and he was eventually picked up and taken to a hospital at Boulogne, and later on to the 3rd London General Hospital at Wandsworth. Blood-poisoning unfortunately set in from this second wound, but, in spite of this, Private Driscoll is wonderfully bright and cheery, and is quite confident that he will recover.

We are sure all of our readers will join with us in congratulating Private Driscoll on his remarkable escape.

The LIBRARY TABLE

"MAGNETS AND ELECTRIC CURRENTS." By J. A. Fleming, M.A., D.Sc., F.R.S. London: E. & F. N. Spon. 5s.

This is the third edition of a work first published seventeen years ago, and the fact that there is still a demand for it is evidence of the clear and able manner in which the subjects it professes to deal with have been treated.

In the preface the author states that "it has not been considered necessary to enlarge the book or alter its scope. It deals with the fundamental and elementary principles on which electrical engineering is based and these are not subject to variation. Hence considerable stress is laid at the outset on quantitative measurements and numerical values."

The work is admirably suited to those who are commencing the study of electrical engineering, either with a view to a complete course of instruction in the subject or, as we hope is the case with many of our readers, for the purpose of obtaining a wider knowledge of the fundamentals which underly or are associated with the fascinating subject to which this journal is more particularly devoted.

There are ten chapters dealing with magnets and magnetism, units, magnetic force and flux electric currents and their measurement, electro-magnetic induction and electro-magnets, and alternating currents. The last two chapters are devoted to electrical measuring instruments and the generation of electric currents.

The whole are treated with only the most elementary mathematics, in a clear manner. For illustrating many of the subjects numerical examples are given.

The methods for making experiments in proof of the various laws stated are given, together with practical hints on the construction of simple apparatus for the purpose.

A large number of useful tables of constants, which are a feature in Dr. Fleming's text-books, are included.

The various memory-aids for the laws as to direction of currents, forces, etc., are stated and, in many cases, illustrated.

There are one or two points in which alterations might, with advantage, have been made in preparing this edition.

On page 290 it is stated that certificates of the resistance of coils can be obtained from the Cavendish Laboratory, Cambridge.

We do not know whether, for special purposes, this is still possible, but the granting of certificates of this nature and of many other electrical quantities has, for several years, been one of the chief functions of the National Physical Laboratory.

The details, which are fully set out, for the construction of the Clark cell might well have been replaced by similar information concerning the Weston Cadmium cell, which has, for all practical purposes, replaced it, and which does not even appear to be mentioned. The Carden voltmeter is not a type which readers are likely to meet with, and therefore the description and illustration might have been replaced by those of more modern instruments.

The great and ever-increasing complexity of the science of electro-magnetism makes it necessary for even an elementary text-book to deal with a large number of subjects which, whilst of the greatest theoretical importance, have not as yet any practical bearing on everyday electrical engineering. The beginner is apt to become confused and bewildered if, with a view to a knowledge of engineering, he commences his studies with a general text-book, and often, after having made a way through it, treats those parts which appear to have but a slight bearing on the subject from his point of view as of mere theoretical importance and beneath the consideration of a practical man. This mistaken view can be obviated if his studies commence with a work which treats of the subject from an engineering point of view, laying special emphasis on the fundamental points without a clear comprehension of which knowledge of the subject must be superficial and scrappy.

Dr. Fleming's book is such a work, and can be confidently recommended to all who are beginning the study of electrical engineering.

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SUBMARINES, TORPEDOES AND MINES. By W. E. Dommett. London and New York: Whittaker & Co.

However necessary may be the censorship for the safety and welfare of a belligerent country in wartime, it has one grave disadvantage. The ability of the people of that country to view things in their true perspective is atrophied, and in some cases entirely lost. On the other hand, the feeling of uneasiness in this country at the beginning of hostilities, inspired by the frequent stories of havoc wrought by German howitzers, passed all rational limits through the inadvisability of any reassuring newspaper articles on the capacity and construction of our own siege guns.

Even at this moment many persons are under the impression that Germany is alone in the possession of submarines that count; that she only can use these vessels to advantage, and that her "Unterseeboot" fleet is growing like a family of guinea pigs.

The public are naturally asking for the whereabouts of our "B's," our "C's," our "Ds," and our "E's." This for good reasons may not be told. Happily, however, for our sense of proportion there has been passed for publication the popular little treatise which is the subject of this review. It is rich is reassuring facts.

We learn therein that, as far as can be ascertained, the number of submarines in commission in January was: British 95, French 95, German 33, Japanese 20, and Austrian 5. Also that 25 more may be completed for the British Navy during the war.

That Germany has not outstripped us in the construction of boats of considerable size is indicated by the details given of the "F" and "G" classes. The "F" class has surface and submerged speeds of 20 and 12 knots respectively, and an armament of six torpedo tubes and four quickfiring 22 pdr. guns. The radius of action is 1,000 miles. The "G" class has a speed of 24 and 18 knots respectively, and a radius of action of 2,800 miles. This class will carry a complement of three executive officers, two engineer officers, one surgeon and forty-six men, also an armament of two 4-inch guns and eight torpedo tubes. The wireless equipment of these boats will provide for "the sending and receiving of telegraphic and telephonic messages."

How great are the strides made with these new classes may be judged by the capacity of the propelling machinery. Whereas the "E" class (the latest pre-war class) had engines of 1,800 and 900 H.P. respectively for surface and submerged work, the "F" class will have engines of 5,000 and 2,000 H.P., and the "G" class engines of 6,500 and 2,400 H.P., the last providing an underwater cruising radius of 900 miles.

Contemporaneously with the building of the "F" and "G" classes, one private yard is stated to be engaged upon the construction of a "super-submarine" named the *Nautilus*. This craft is to be capable of cruises in excess of 3,000 miles.

For a fuller understanding of the use and limitations of the submarine there are chapters on torpedoes and mines, the handmaids and principal foes in submarine warfare. So interesting are these that we look for the day when the author may tell us more.

QUESTIONS AND ANSWERS

Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study to the Editor,* THE WIRELESS WORLD, *Marconi House, Strand, London, W.C. Such questions must be accompanied by the name and address of the writer, otherwise they will remain unanswered.

H. D. (Royston) asks:

(1) I am using a ½ kw. transformer and my source of power is 100 volts 60 ∿ mains. I have a ½ h.p. A.C. motor of 4,000 revs. per minute, and wish to use this coupled directly to a rotary gap. Can you tell me how the latter should be designed in order to obtain the best results, how many studs should there be, &c.? Also please say if, with such an arrangement, I should be able to get a high musical note.

(2) Can you please tell me the method of calculating the length and diameter of a coil of inductance which is required to receive a wave of a certain length? Can you give me a formula for calculating this for any given wave-length which it is desired to receive? Also please explain how the natural wave-length of the receiving aerial would figure in these calculations.

Answer.—Your best plan to obtain a musical note is to make your rotary gap so that it gives two sparks per half cycle or 240 per second. This will be obtained from a rotating disc provided with four studs, running at 3,600 r.p.m., which, being a little less than that of your motor, allows of some regulation.

A good plan would be to make a disc with eight studs, four of them being removable, and try it with eight and four. The best results will depend on the wave form of the supply and inductance of the transformer. Care must be taken that the studs are quite tight when running.

The note of 240 per second which would thus be obtained from four studs is not high, although it is quite a good one to receive; and the eight-stud note of 480 would be better from this point of view if the arrangement suits the supply and the rest of the circuit, which is a matter for trial.

You will find full information as to the calculation of inductance of a coil in the instructional article of the February, 1915, number, which also shows how the value of inductance required to tune to a given wave-length for a certain sized aerial is calculated.

WOLTERS enquires as to what can be done if the iron band of a magnetic detector broke and no crystals were available for receiving signals.

The only way of using the detector is to repair or replace the band, since the windings of the instrument are not at all suitable for working with crystals, if they were available. The only point to be regarded in repairing the band is to see that the strands of iron wire overlap at the join. There is no necessity for the iron wire to be continuous as long as there is always some iron in the band under the magnet poles as the band travels. If a butt joint be made there will be an interval of silence as it comes under the poles, during which time no signals can be received.

PARRY.—(1) You will find full information as to the calculation of the inductance of a coil in the instructional article in the February, 1915, number of THE WIRELESS WORLD at page 734. The curves given are suitable for both receiving and transmitting circuit inductances.

(2) The article "The Life of a Naval Wireless Operator" appeared in the September, 1914, number.

(3) For particulars as to age limit, &c., for wireless operators, your best course is to write direct to the Admiralty, giving full particulars.

(4) We do not know of any book on "How to Become a Wireless Operator." For a thorough knowledge of the theory of wireless telegraphy you cannot do better than obtain "Hawkhead's" handbook. You will, of course, also require proper instruction in the Morse code, which is best obtained from one of the institutions devoted to it.

"FISH" (Dublin) is interested in the standard 1½ kw. Marconi installation. and wants to know: (1) If speeding up the converter gives greater power; (2) what are *all* the results of speeding up the machine; (3) how many times per cycle the main condenser is charged; (4) why there is no means of putting the high-tension circuit in tune with the low-frequency circuit. As these are practical questions which are frequently asked by students, we have pleasure in dealing with them.

Answers.—(1) This is a question that cannot be answered by a direct "yes" or "no," as there is a certain critical speed by means of which the best results are obtained in each particular installation. With a badly-adjusted 1½-kw. set, increasing the speed may either increase or decrease the radiated power, depending on whether the original speed has been above or below the best speed of working. (2) Speeding up the machine increases the frequency of the alternating current and increases the spark frequency. As before stated, increasing the speed may either increase or decrease the efficiency. As the speed is raised by weakening the field current, too high a speed will cause the starter handle to fly back, owing to insufficient current passing through the coil of the "no-load" release. These are the most important results. (3) This depends on the form of discharger. With a fixed discharger, twice per cycle, but if the gap is small the condenser may be charged and discharged a greater number of times. With a rotary discharger the number of charges and discharges per cycle depends on the number of teeth on the disc, if this is driven on the same shaft as the converter. If the disc is being driven by a separate motor (a procedure adopted in many installations) of course both the speed and the number of teeth have to be taken into consideration. With both forms of disc discharger the condenser can roughly be said to be charged and discharged as many times per cycle as the fixed and moving electrodes come together in the time. (4) There is no need of any device for tuning the high-tension circuit with the low tension, as when the low frequency iron-core inductance and the speed of the converter are properly adjusted the low-frequency circuits are correctly tuned.

LT. A. H. W. T. (Shrewsbury) referring to the Instructional Article for March, and speaking of the inductively-coupled receiver, asks whether in the event of the secondary tuning condenser being of zero value, the detector is not in a closed oscillating circuit introducing a high resistance.

Answer.—We would refer A. H. W. T. to para. 745 of the article in question, which points out that each coil has a definite wave-length, due to the distributed capacity. The secondary will thus oscillate freely apart from the detector, which will act in exactly the same way as if the inductance was shunted by a separate condenser. Our correspondent also finds difficulty in obtaining sharp secondary tuning, although the secondaries have been wound for very small ranges of wave-length. We think it probable that he has not allowed for this distributed capacity when designing the coils. In reply to a question as to whether with sharp tuning the maximum strength of signals should be received with moderately loose or tight coupling, this depends on the damping of the wave which is received. Generally speaking, the strongest signals should be received with a moderately loose coupling.

N. J. W. writes: "The main condenser plates of the 1½-kw. Marconi installation are tested to a strain up to 27,000 volts Now, taking an alternating current supply to the primary of the transformer of 150 volts, and presuming the ratio between the primary and secondary to be 1–300, this will give a potential across the secondary of the transformer of 45,000 volts. By putting the secondaries in series we get twice that voltage. I should be interested to know why it is that the condenser plates will stand this excessive voltage."

Answer.—N. J. W. starts his argument with wrong suppositions. With secondaries in parallel the ratio is 1—150 not 1—300; further the usual alternating voltage at the primary of the transformer is not 150, but 70 to 75. If N. J. W. will work through his calculation again, starting with this figure, he will see that the secondary voltage will be well within 27,000 volts. With regard to the secondaries being placed in series, this is done when the two halves of the condenser are connected in series. If our correspondent will refer to the Instructional Article No. 5, which was published in the December 1914 issue, he will see that if we connect two units of a condenser in series we double the potential to which the condenser can be raised before puncture occurs. In cases where a primary alternating voltage higher than 70–75 volts is used, the transformer is specially wound for a different ratio of transformation.

FOREIGN NOTES.

Spitzbergen.

IN the course of an interesting paper on "Spitzbergen in 1914," by Dr. W. S. Bruce and Dr. R. N. Rudmore Brown, which was read before the Royal Geographical Society in London, on March 22nd, mention was made of the Norwegian wireless stations in these high latitudes.

The authors stated that in 1911 Norway erected a powerful wireless installation at Green Harbour with 60 metre masts, at a cost of over £10,000. This station communicates direct with the one at Ingö, in the north of Norway, erected for the purpose, but it can also receive messages from Christiania, Paris and Berlin, and even Poldhu, in Cornwall. It is from the Green Harbour Station that the meteorological data are sent daily to our Meteorological office. A staff of six men is maintained here all the year round; but, except for the convenience of mining camps and the amusement of summer tourists, the station is of little use and certainly can never pay a fraction of its initial cost and annual upkeep. The wireless station is also a Norwegian post office. Letters are carried to Tromsö at unfrequent intervals during the summer by a subsidised motor sloop. However, this service is of little utility since the large mining camps send and receive their own mails with greater frequency and regularity by their own cargo boats. The subsidised Government service is chiefly used by the smaller mining camps and by occasional exploring parties. Norway's only object in erecting this wireless station and maintaining her post office and mail service was to increase her stake in the country. It should be mentioned that two smaller wireless installations exist in Spitzbergen, but these can only communicate with Europe *via* the Norwegian station.

Philippines.

Mr. S. W. Beach, formerly of the Bureau of Posts at Manila, writing to the *Telegraph and Telephone Age* (March) gives many interesting observations and facts concerning affairs in these insular possessions of the United States. Referring to the telegraph and telephone systems he states that when the American Government took possession of the Philippines sixteen years ago there were only 720 miles of lines open. There are now between six and seven thousand miles of telegraph wires and cables alone, and the city of Manila has an extensive modern telephone system owned by a private corporation, and throughout the islands the various provinces operate telephone lines connecting the principal towns. Some of these telegraph lines, says the writer, penetrate hostile districts and were built under an armed guard. The wireless station at Jolo is protected day and night by armed sentries. Mr. Beech remarks that operating the telegraph under these circumstances is no joke, but it has proved an excellent investment, not from a monetary standpoint, but that it has brought those isolated semi-civilised districts into a closer relation with the outside world and has opened up inter-island trade in a wonderful manner.

United States.

On August 25th last the United States Navy Department placed a ban on all amateur and restricted radio plants on the Pacific Coast as a precautionary measure for the enforcement of President Wilson's neutrality proclamation. Now that war vessels of the belligerent nations have virtually disappeared from the Pacific Ocean the Navy Department have removed the embargo, and Admiral Charles F. Pond, supervisor of the Twelfth Naval District, has unsealed no less than 1,400 amateur wireless telegraph stations in California.

PERSONAL PARAGRAPHS.

Mr. John Forster.

CHINAMAN RUNS "AMOK."—A letter received from Captain Head, of the s.s. *Cardium*, dated Abadan, February 9th, contains practically all the information we have regarding the sad stabbing affray which took place on his ship, whereby the wireless operator, Mr. John Forster, together with the third and fourth engineers, lost their lives. The incident took place when the ship was in the Persian Gulf. Captain Head writes: "The stab-"bing was done by the Chinese mess-room boy, "who seems to have gone suddenly mad. He first "went into the galley and stabbed the chief cook "with a big fork. He then seems to have picked "up a galley knife, and rushing aft stabbed the "three victims in their sleep, afterwards shooting "himself with the second engineer's revolver "and jumping overboard. I was on the bridge "at the time, and the first thing I knew about "the affair was when I saw the Chinaman go "overboard. We stopped and put out a boat, "but saw nothing of him after a few minutes. "We put into Jask to land the three wounded "members of my staff, where they received every "possible attention from the English doctor there." Operator Forster, whose photograph we reproduce, lived at Chester-le-Street, co. Durham. He entered the Marconi Company's service on October 7th, 1914, and was appointed junior operator on the s.s. *Briton*, shortly afterwards. In December last he was appointed operator-in-charge of the installation on board the s.s. *Cardium*, on which ship he met with his tragic death on February 4th.

Mr. H. E. Cutbush.

It is our sad duty to record still another death on the operating staff—namely, that of Mr. B. F. Emery. Mr. Emery, of Thrapston, Northants, joined the Marconi Company on June 4th, 1912, and served as wireless operator on board the s.s. *Canada*, *Orana*, *Novara*, *Angora*, *Egra*, and *Arankola*. For some time he had been stationed on the Indian coast, and entered hospital at Bombay on January 29th suffering from suppurative appendicitis. Owing to his critical condition it was impossible to perform an operation for several days, and, although there was a temporary rally after the operation had been performed, Mr. Emery passed away on February 16th. The funeral service was conducted at the Sewari Cemetery, Bombay, by the Rev. Mr. French, a representative of the British India Steam Naviga-

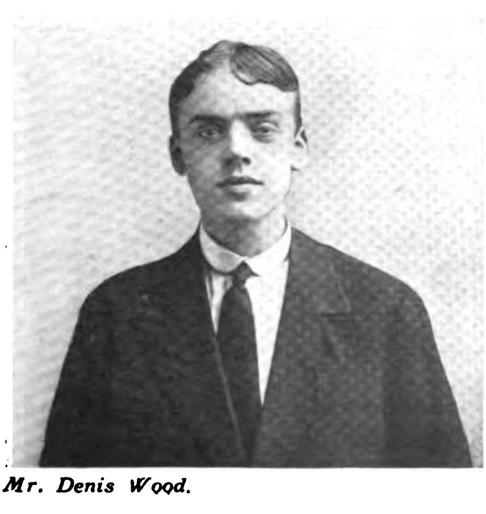
Mr. B. F. Emery.

tion Co. being present together with a few fellow-operators from ships in port. On behalf of the staff we extend our deepest sympathy to the late Mr. Emery's parents.

We have also to record the sad death of another member of the operating staff, Mr. H. E. Cutbush. Mr. Cutbush, who was a resident of Norwich, was born in April, 1894, and joined the staff of the Marconi Company on October 21st, 1912, as learner in the London School. He afterwards served on board the s.s. *Caledonia, Numidian, Sicilian,* and *Karroo.* On March 19th Mr. Cutbush, together with the second officer and third engineer of the *Karroo,* was practising with a miniature rifle. At the moment when the second officer and third engineer were both holding the rifle it was accidentally discharged, with the result that Mr. Cutbush was shot, and he died in hospital at Alexandria on March 23rd. A Consular Court of Inquiry at Alexandria brought in a verdict of "Accidental Death," and no blame attached to anyone. The burial took place on March 23rd at the cemetery at Alexandria. Mr. Cutbush's death will be mourned by the many members of the staff to whom he was known, and their deepest sympathy is extended to his parents in their terrible loss.

We regret to record the death of Mr. Denis Wood, of Egerton Park, Worsley, who entered the service of the Marconi International Marine Communication Co., Ltd., on July 21st, 1913, as a learner in their London school, and afterwards served on board the s.s. *Columbian, Ashtabula, Egba,* and *Lusitania,* as wireless operator. Mr. Wood was recently appointed for special Admiralty duty, but before being able to take up his work in this connection, fell ill with pneumonia, and died on March 18th, aged 21.

It is with much regret that we have to announce the death of Mr. Theodore M. Church, which took place on April 2nd at the Reception Hospital, Winn Road, Southampton. Mr. Church, who has been on military service since the commencement of the war, joined the operating staff of the Marconi Company in June, 1913, afterwards serving on the s.s. *Avon* and *Etonian.* At the time of going to press we have received only a brief intimation of Mr. Church's death, but in the June issue we hope to be able to give more particulars. Meanwhile, we take this opportunity of expressing, on behalf of the staff, our deep and sincere sympathy with the late Mr. Church's relations in their sad bereavement.



Mr. Denis Wood.

Mr. T. M. Church.

The Société Anonyme Internationale de Telegraphie Sans Fil deeply regret to announce the death of two members of their staff—Georges Guyaux and J. van Schoubroeck—who were both on active service with the Belgian Army.

M. Georges Guyaux was born at Vitrival on May 27th, 1888. He graduated at the Polytechnic Institute of Brussels as a Mining Engineer and was attached to the staff of the Société Anonyme Internationale de Telegraphie Sans Fil as Assistant Engineer from October, 1913. When war broke out he took service as gunner in the 63rd Battery, 15th Brigade, and was in the several engagements at Liége, Waremme-Huy, Louvain, Antwerp, and on the Yser in Flanders. On October 13th last he was transported to the hospital at Shorncliffe, where he died on the 13th of the following month.

M. Joseph van Schoubroeck, who was born at Diest in 1889, was a shorthand-typist in the Traffic Department at Brussels since 1908. He also, on the outbreak of the war, was called up for service as a sapper in the Royal Engineers and was drafted to one of the first line forts at Antwerp. After the fall of that city he saw service in Flanders. When the attack on the farm "La Violette," near Ramscapelle, was made early in January, young van Schoubroeck volunteered for the dangerous work of throwing hand-grenades. After having accomplished his mission, and during the fighting that followed, he was struck in the spine by an expanding bullet and died at La Panne Hospital on January 13th, a few minutes after having been decorated for bravery.

COMPANY NOTICES.

MARCONI WIRELESS TELEGRAPH COMPANY OF AMERICA.

Preliminary Report and Statement of Accounts for the Fiscal Year ended December 31st, 1914.

THE following report has been issued by the Directors of the Marconi Wireless Telegraph Company of America to the Stockholders of the Company :—

The Directors of the Marconi Wireless Telegraph Company of America draw attention to the enclosed notice showing that the annual meeting of this company, in accordance with the laws of the State of New Jersey, and the by-laws of the corporation, will be held on Monday, April 19th, 1915, at twelve o'clock noon, at the registered office of the Company, Nos. 243 and 245, Washington Street, Jersey City, N.J.

The balance-sheet and the profit and loss account for the year ended December 31st, 1914, prepared by Messrs. Arthur Young & Company, accountants and auditors, is hereto annexed and submitted to the stockholders.

The results for the year 1914, as shown by the profit and loss account, will, we believe, be found perfectly satisfactory to the stockholders. We feel, taking into consideration the conditions prevailing during the latter part of the year, that the showing is exceptionally good.

The net earnings of the company show $271,888.71; and after placing in reserve $59,511.24 against depreciation of apparatus, plant, etc., " through obsolescence or inadequacy resulting from age, physical change or supersession by reason of new inventions and discoveries," as described by the Interstate Commerce Commission; and $50,000.00 towards the creation of a reserve fund which we expect to add to from time to time against amortization of the amount standing to the account of patent rights, goodwill, etc., and an additional amount of $12,500.00 for contingencies; making a total of $122,011.24; there is left a balance of $149,877.47 as net earnings, which is carried over and placed to the credit of the profit and loss account, and which, added to the balance on hand January 1st, 1914, gives a surplus of $364,571.01.

The above does not include any operation affecting the transoceanic high-power stations, the operation of which we were about to begin when the European war was declared. The war has interfered with and, until its conclusion, will continue to interfere with our transatlantic service and, to a considerable extent, with our transpacific service.

A full report on the workings of the company, approved by your directors, will be submitted to and discussed at the annual meeting, and copy thereof will be mailed to stockholders of record.

Those who are unable to attend the meeting, but who wish to be represented thereat, will kindly fill out and return the enclosed proxy.

By order of the Directors.

JOHN BOTTOMLEY,
Secretary.

* * * * * *

The balance-sheet appears on p. 135, and the following is the summary of operations for the year ending December 31st, 1914 :—

GROSS EARNINGS FROM OPERATIONS		$756,572.75
Deduct:		
GENERAL OPERATING AND ADMINISTRATION EXPENSES		634,958.25
NET EARNINGS FROM OPERATIONS ..		$121,614.50
Add:		
Income from Investment of Surplus Funds		150,274.21
NET INCOME FOR YEAR before charging Reserves		$271,888.71
Deduct:		
RESERVES:		
For Depreciation of Coast Stations	$30,037.74	
For Depreciation of Ship Stations	29,473.50	
Against expiration of Patents	50,000.00	
For Contingencies	12,500.00	122,011.24
NET INCOME FOR YEAR after charging Reserves, Carried to Balance Sheet ..		$149,877.47

Marconi Wireless Telegraph Company of America.

Balance Sheet, December 31st, 1914.

ASSETS.

CURRENT ASSETS:			
Cash:			
At Banks and on Hand	$88,436.26		
At Banks on Deposit	560,000.00		
Call Loans with Bankers	190,000.00		
		$838,436.26	
Accounts Receivable		393,334.70	
Investments at Cost (Market Value March 20th, 1915, $1,402,947.50):			
Railroad Bonds and Notes	$1,101,427.75		
Municipal Bond and Notes	300,000.00		
		1,401,427.75	
Work in Progress, Materials and Supplies		351,637.84	
			$2,984,836.55
STOCKS IN SUBSIDIARY COMPANIES			18,970.00
FIXED ASSETS:			
Real Estate		$314,506.19	
Buildings, Coast Stations, Machinery and Equipment		4,013,875.75	
Ship Stations		294,735.06	
			4,623,117 00
DEFERRED CHARGES			77,243.70
PATENTS, PATENT RIGHTS AND GOOD-WILL			2,763,005.25
			$10,467,172.50

LIABILITIES.

CURRENT LIABILITIES:				
Accounts Payable				$404,228.48
CAPITAL STOCK.				
Authorised 2,000,000 Shares of $5 each			$10,000,000.00	
Less:				
119,486 Shares subscribed for not yet issued.				
100 Shares in Treasury				
119,586			597,930.00	
1,880,414				9,402,070.00
RESERVES:				
For Depreciation of Coast Stations:				
As at January 1st, 1914		$138,387.37		
Add:				
Amount set aside from 1914 Profits		30,037.74		
			$168,425.11	
For Depreciation of Ship Stations:				
As at January 1st, 1914		$11,589.72		
Add:				
Amount set aside from 1914 Profits		29,473.50		
			41,063.22	
Against Expiration of Patents, amount set aside from 1914 Profits			50,000.00	
For Contingencies:				
As at January 1st, 1914		$24,314.68		
Amount set aside from 1914 Profits		12,500.00		
			36,814.68	
				296,303.01
SURPLUS:				
Balance per Certified Accounts, January 1st, 1914			$214,693.54	
Add: Net Income for year ended December 31st, 1914 (after charging $122,011.24 Reserves)			149,877.47	
				364,571.01
				$10,467,172.50

New York City, March 24, 1915. We have examined the Accounts and Records of the Marconi Wireless Telegraph Company of America, and as a result thereof have prepared the above Balance Sheet and accompanying Summary of Operations for the year 1914, which in our opinion correctly set forth the financial position of the Company at December 31st, 1914, and its Operations for the year ended that date.

ARTHUR YOUNG & Co.,
Accountants and Auditors.

Marconi's Wireless Telegraph Company, Limited.

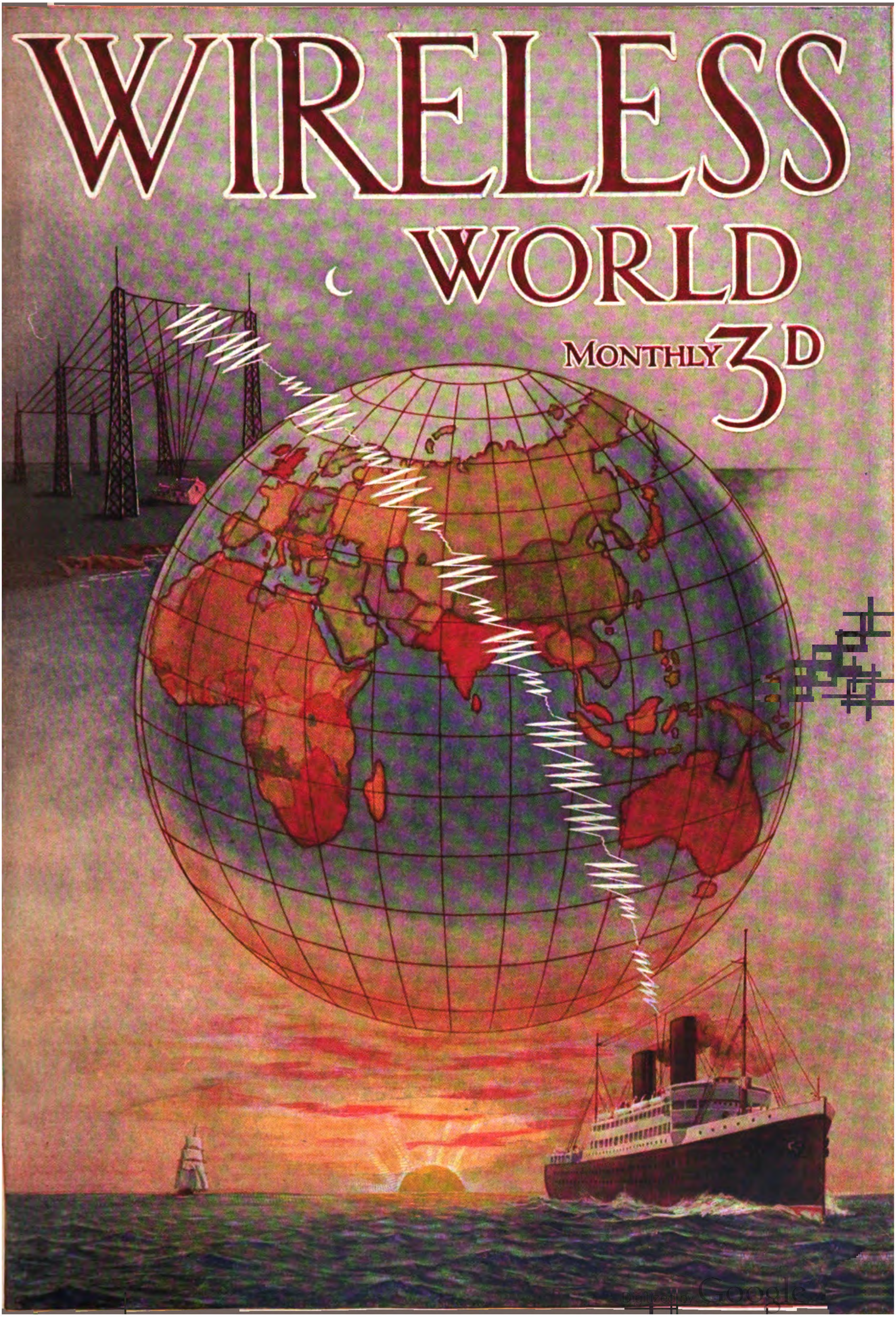
AT a meeting of directors of the above company held on March 24th, it was resolved "That a dividend "of 7 per cent., less income tax, upon the "250,000 7 per cent. Cumulative Partici- "pating Preference Shares be, and the "same is hereby declared, in respect of "the year 1914; that the said dividend "be payable on the 19th April, 1915, to the "shareholders registered on the books of "the company on the 31st March, 1915, and "to holders of Share Warrants to Bearer; "and that the Transfer Books be closed "from the 1st to the 7th April, 1915, inclu- "sive."

The company has continued since the outbreak of war in full control of its business, but its stations have been largely devoted to Government work. For this reason the new direct public service with New York, which it had been contemplated would have been opened in the summer of last year, has had to be postponed. In other respects the company's business has been necessarily disturbed, and considerable business which was pending in many foreign countries has been delayed or deferred. This, however, has been substantially compensated for by Government and other business directly resulting from the War; the works and all the company's staff have been working under the highest pressure throughout the whole period.

A number of matters, including the question of compensation and payment for services, being still in abeyance, the directors are as yet unable to estimate with sufficient reliability the results of the business of last year to warrant them at this moment in declaring an interim dividend upon the ordinary shares. They are, however, of opinion that there is no reason for deferring the dividend upon the preference shares.

The directors contemplated being in a position to give shareholders information with regard to other matters of importance concerning the company's business, but as these still remain under negotiation, it has been resolved not to delay further this announcement and the payment of the dividend.

Warrants for the dividend upon the registered shares were forwarded by post on April 17th.


WIRELESS
WORLD
MONTHLY 3D

THE WIRELESS WORLD

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PRO-PATRIA

IN our March issue, under the heading of "A Word in Season," we exhorted amateur wireless enthusiasts to do their duty towards their Mother Country by ungrudgingly conforming to both letter and spirit of the Defence of the Realm Act. It is a common maxim among lawyers that "Hard Cases make Bad Law," and although each individual may feel in his own instance that there is no danger to the Commonwealth in his possession of wireless apparatus—it is nevertheless true that refusal to obey loyally and willingly hampers the Authorities responsible for the working of the Act. On the one hand they are obliged in the execution of their public duty to see that the Act is rigidly enforced, whilst, on the other hand, they are naturally reluctant to inflict heavy penalties upon people innocent of evil intent.

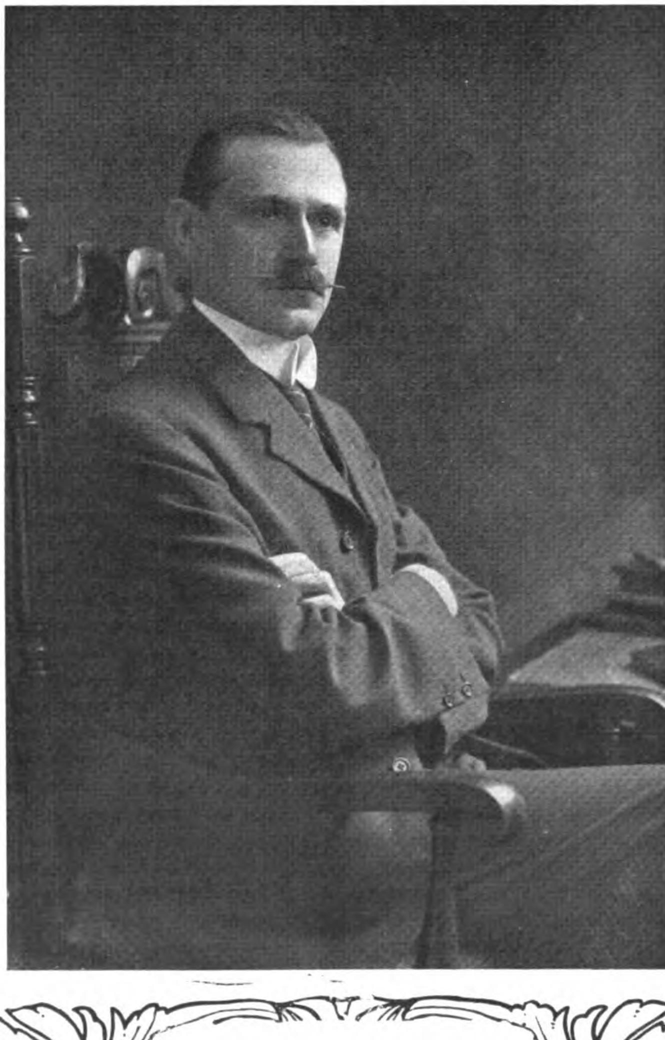
We take this opportunity of informing our readers that we have recently received an official request to endeavour once again to bring this home to those concerned. Since we wrote in March last the Regulations made under the Act have been amended and "tightened up" by an Order in Council. Not only, under the amended provisions, is every person forbidden "without the written permission of the "Postmaster-General to buy, sell, or have "in his possession, or under his con-"trol, any apparatus for the sending or "receiving of messages by wireless tele-"graphy, or any apparatus intended to "be used as a component part of such "apparatus"; but no person is permitted to *make*, without official permission, any such apparatus, or its component parts.

It will, therefore, be seen that the Authorities are armed with full powers, and it is in the interests of individuals themselves to obey implicitly. We have, however, consistently refused to base our appeal to our readers on the grounds of *self interest*. Britishers can show themselves at a time of national crisis as patriotic as Germans, and it is with full reliance on this spirit that we make our appeal.

It has been suggested to us by the Authorities themselves that amateurs might take advantage of the cessation of practical experiments to increase their grasp of the theoretical side of the science. Many of the practical questions which have been asked us indicate most clearly that the questioners have not paid sufficient attention to the main principles underlying the practical applications concerning which they are making enquiries. Our pages will continue to be filled with matter of incalculable value in this direction to both amateur and professional students.

Our issue of December, 1914, emphasised the point that "even experts can always "afford to be learning," and we would once again refer to the excellent opportunity for quiet reading and study afforded by the removal of all possibilities of doing practical work.

No more profitable experiment can at this juncture be made by an amateur than one involving his capacity for answering questions. Such publications as the series of test cards issued by the Wireless Press, Ltd., afford an excellent opportunity for this procedure, and we shall be pleased to answer any questions put by correspondents in cases of doubt or difficulty.



DR. W. H. ECCLES,
D.S.C., A.R.C.S., M.I.E.E.

Personalities in the Wireless World

DR. W. H ECCLES, D.Sc., A.R.C.S., M.I.E.E.

DR. ECCLES was born in North Lancashire in 1875. His early education was mainly obtained at a private school where the hard-work habit was inculcated, but partly also at a secondary school where an inspiring teacher raised an appetite for science. Between school and college his studies suffered from diffusiveness, ranging from the steam engine to anatomy; but the part of this period that ultimately proved to be the most valuable was that spent in his father's workshops and office preparing designs and estimates for structural steel-work. In 1894 he entered the Royal College of Science. During three years at South Kensington he spent most of his energies in the Mechanical and Physical Departments, and in 1897 became a demonstrator there. In 1899, after some experience on the staff of an engineering journal, he joined the Wireless Telegraph and Signal Company, and the greater part of 1900 was spent at the Chelmsford works.

On leaving Marconi's, and after a period as assistant editor of an electrical engineering journal, Dr. Eccles obtained a post in the Department of Electrical Engineering at the South-Western Polytechnic, Chelsea. In 1901 a Mathematics and Physics Department was created in the Institute and he was made Head. Several strenuous years followed in consequence of the rapid growth of the new department. In 1911 he was appointed to the University Readership in Graphics at University College, London.

Dr. Eccles's researches in wireless telegraphy began at Chelmsford, where most of his spare time was spent on the theory of oscillation transformers, and some experiments on filings coherers were carried out for the Company. Since this first contact with wireless he has published upwards of thirty Papers on the science of wireless telegraphy, and numerous technical articles and essays dealing with every section of the subject. A short summary of some of this work may be of interest.

In 1906 there appeared an experimental Paper that did something towards unravelling the action of the magnetic detector; then came experimental work and a theory of the electrolytic detector. In 1909 a rather revolutionary mathematical theory of the single point coherer was developed and supported by experiments. The theory led to the very remarkable conclusion that the coherer can be arranged to generate oscillations in a short circuit possessing capacity and inductance by passing a steady current through it. This was experimentally confirmed, and led to the very general theorem that under certain conditions a rectifying detector could become a generator of oscillations, and conversely a generator of oscillations could be used as a rectifier. The theory of the crystal detectors came later, and their asymmetrical conductivity was traced, not to the ordinary Peltier effect, but to the more obscure property known as the Thomson effect.

In 1911 he arrived at the mathematical result that the electric waves can travel faster in ionised air than in un-ionised air, and this led to a series of speculations that help to explain many of the most striking differences of day and night transmission. Heaviside has suggested that a conducting reflecting layer might exist in the upper atmosphere and be responsible for the propagation of signals far round the globe; the theory advanced by Dr. Eccles showed how a relatively slight ionisation of the upper air, involving a much smaller conductivity than had previously been thought necessary, might do what was required by a sort of "whispering gallery" mode of propagation. It suggested, moreover, plausible explanations of freaks, of the twilight effects, of long-distance daylight transmission, and of the changes sometimes produced in signal strength by slight changes in wave-length. Some of these speculations were supported by his observations during the partial eclipse of 1912.

Dr. Eccles is secretary of the Physical Society of London and secretary of the British Association Committee for Radio-telegraphic Investigations.

Proposed Work to be Undertaken by the International Commission on Wireless Telegraphy*

By W. DUDDELL.

AT the first meeting of the Commission, which was held at Brussels on October 13th, 1913, a provisional plan was drawn up to investigate the following points—viz.: (1) A determination of the best method of assuring a constant emission, and of controlling this constancy; (2) relative measurements of the variation of the signals at different receiving stations from day to day as well as the variations due to a change in the wave-length or to any other characteristic feature of the radiation from the transmitting station; (3) a comparison of the strength of the signals received in different directions and at different distances from the sending station; (4) simultaneous measurements of atmospheric disturbances at different stations. It was also proposed to establish one or two control stations near the sending station, so that the question of atmospheric absorption might not affect the results. There are, therefore, three places where measurements have to be made—viz., at the emitting station, at the control station, where strong signals will be received, and at different stations spread out over the surface of the globe, where the signals will be very weak. It is proposed to deal briefly with the methods and apparatus suitable for the purpose in view with the object of initiating a discussion of the subject.

At the sending station it is necessary first to measure the antenna current, which will require ammeters suitable for high frequencies and strong currents up to 150 ampères at least. All ammeters of this class are of the thermic type, the heated conductor being such that its resistance is sensibly the same for currents of high frequency as for those of direct current. In my opinion the best instrument is that of Hartmann & Braun. The current passes through a wire kept in a state of tension. Any lengthening of the wire, due to heating, produces a bending at the centre, and this movement is registered by a needle through suitable mechanism. With heavy currents several wires are used in parallel. The following apparatus, which is somewhat similar in idea, may be of interest. It consists of two copper tubes; on each tube a series of notches are made. A thin wire passes in zigzag fashion from

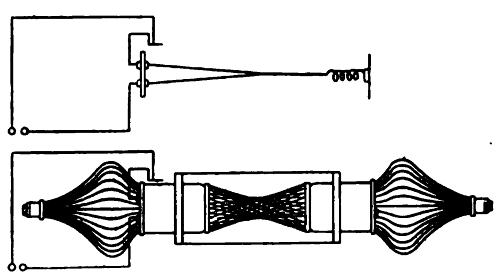


Fig. 1.—Device for measuring current in antenna.

one notch to another, as shown in Fig. 1, so as to form a kind of squirrel cage. The two tubular electrodes are given a rotatory movement with regard to one another, causing the wires to fall on the surface of a hyperboloid of revolution. Two wires are stretched along the axis of the hyperboloid and joined together in such a way that the weld (giving a thermocouple) is at the central part of the narrowing or contraction. These wires are taken to a millivoltmeter.

* Translated from the official French publication.

With an instrument of this kind an E.M.F. of 5 millivolts is obtained when a current of 150 ampères passes. In order to obtain results quickly and satisfactorily it is necessary to place the cold junction of the thermo-electric couple in the neighbourhood of one of the tubular electrodes. The details have not been worked out, but the idea looks hopeful. Ammeters, which work on the principle of shunting a part of the current, give rise to serious errors on high

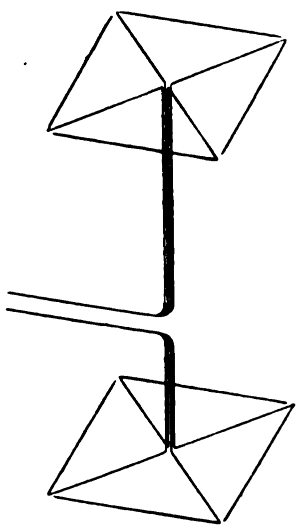


Fig. 2.—Lodge's type of antenna.

frequencies, if one starts with the assumption that the current behaves like a direct current. The ratio of shunting has been arranged in some instruments so as to depend on the ratio of the self-inductions and capacities of the circuits. If a condenser is placed in series with an ammeter for weak currents, and if the whole is shunted by a large condenser, the current passing through the shunt can be easily determined by the ratio of the condensers; if the instrument is only to be used for currents of high frequency, this method ought to give good results.

At the sending station it is also necessary to measure the damping of the antenna, which is usually done by Bjerknes's method. The antenna is used as a wave-meter, and is coupled to a measuring instrument so as to increase the damping as little as possible, while the antenna is excited from another source of energy with a known decrement, or, better still, by means of continuous oscillations. It is uncertain what importance ought to be attached to the value found by this method. It is supposed that the train of waves decreases according to a logarithmic law—that is to say, that the damping in this circuit is perfectly constant and independent of the amplitude of the current that passes. It is doubtful if this result can be obtained in practice, and the value of the damping of the antenna is, therefore, of doubtful importance. The apparent resistance of the antenna is generally calculated from the observed decrement. This implies that the self-induction of the antenna is known as well as that of the circuit to which it is connected. Another method is to place in circuit with the antenna a non-inductive resistance, and to note the change of current produced, from which we calculate the apparent resistance. The interpretation of the results seems clear and definite if a high-frequency alternator is used to excite the aerial. It would, therefore, appear desirable to install at Brussels a small high-frequency alternator. The radiation resistance can be defined as the resistance which, when multiplied by the mean square of the value of the current, gives the amount of energy radiated into space. It is very difficult to determine this. The usual method is to note the effect produced by a change in the aerial. The spark frequency is easily found from the speed of the generator or by Prof. Fleming's method.

The nature of the antenna to be used at the control station requires very careful consideration, in order that changes, for instance, in the earth may not affect the accuracy of the results. Probably Lodge's type, as shown in Fig. 2, is best. On the other hand, it might be well to see whether a receiver with closed circuit, such as has been described by F. Braun, might not be better; amongst its other advantages might be mentioned the fact that the properties of the circuit could be defined very exactly and kept constant. The wave-length then requires to be determined. This can be done by the ordinary method, using a wave-meter with a rather loose coupling. The wave-meter must be calibrated with great exactness. It is probably best to compare it with a standard instrument made in the National

Laboratory in each country. The damping and apparent resistance of the antenna are determined as before. If the damping of the receiving antenna and of the apparatus connected to it is known, the damping of the received waves can be determined by Bjerknes's method; but this implies certain hypotheses concerning the form of the train of waves, which ought to be carefully examined if one wishes to be very exact. If the control stations are at a distance of a few miles, the intensity of the received current is certainly sufficient to allow exact measurements with a sensitive thermal instrument, connected directly to the aerial. If at the control station the currents are of sufficient intensity, it is well to use a measuring instrument with a short period; if available, so short that the individual sparks can be distinguished on the photographic record, so that it is possible to be certain of the constancy of their amplitude and of the regularity of the emission.

At the different receiving stations it is necessary to determine the strength of the signals that are received, partly with a view to comparing results from day to day, and partly to compare the results which are obtained at the different stations on the surface of the earth. There are two ways of doing this: (1) To adopt for antenna and for earth a distinct type, which can be used at each receiving station where absolute measurements are to be made; (2) to adopt a standard method for testing aerials and earthing arrangements, so as to obtain comparable results. This latter standardisation can probably be done by using a radiating circuit that is practically closed, from which one emits definite quantities of radiating energy at known distances from the different receiving antennæ. If we measure the current received in the different antennæ it is thus possible to determine their properties. In choosing a receiving aerial, four types can be taken into consideration. The straight conductor, the umbrella type, the form "T" or "L" with two masts, or Lodge's type with four masts. Each of these kinds of antenna can be connected either with the earth or with a capacity forming a balance. It is probable this latter plan is the more definite. For reasons of symmetry it is well to avoid the "T" or the "L" shape. Probably the best thing is Lodge's antenna with a capacity forming a counterbalance well above the surface of the ground and similar in shape to the upper part of the antenna. Its properties are at any rate better defined. The question of a standard antenna is more difficult, because of the uncertain effects of surrounding trees, &c.

As to the means for measuring the strength of the signals received, this depends on the best type of receiving apparatus and on the methods of measurement. There are five principles on which a measuring instrument can be designed. It may be thermic, electrostatic or electrodynamic; or it may rectify the current, and be used to give results either orally or by means of a galvanometer, with or without a photographic recorder. The first three methods have been most usually employed up to the present. The method of rectifying the current is the most sensitive, but there is a considerable difficulty in standardising and in obtaining a constant rectification and also in interpreting the results. There are a number of crystals that are used for rectifying, and they work well. But their resistance is high, which makes difficulties in the construction of the galvanometer. But there appear no longer to be any serious difficulties in the construction of galvanometers with a short period of sufficient sensitiveness to give measurable elongations of the signals, provided they are sufficiently strong in the ordinary sense of the word. According to experiments made by the author, the high-resistance detector gives a current of 5×10^{-8} ampères and even more in the received signals, and there ought not to be any difficulty in obtaining a measurable elongation by means of a galvanometer with a period of a few tenths of a second with such a current. It is well to point out that from many points of view there is a considerable advantage in working with an instrument with a short period. One of the principal advantages is that an instrument with a long period follows very slowly, and consequently very short signals and atmospheric disturbances may become merged in some sort of way in a kind of general integration of the signal. The thermic and electrostatic methods are much easier to interpret, seeing that they do not necessitate the use of a detector, but, on the other hand, they are much less sensitive. With thermic instru ments the sensitiveness is such that if the resistance of the heated portion is small—say, less than 40 ohms—it is difficult to measure currents less than 20 or 30 micro-ampères, and the instruments in general take an appreciable time before they reach the maximum elongation. As for electrostatic detectors, the author has constructed one which consists of a band of gold leaf or of aluminium foil, attracted by a fixed plate, the whole being placed for examination on a table beneath the lens of a microscope; this gives a deflection of one division per volt of the eyepiece micrometer; the tenth of a division is easy to read, and it is possible to estimate even smaller fractions. Oral methods, such as that of the shunted telephone, do not appear to be suitable for giving exact results, after taking count of the difficulty of eliminating personal errors, and the Commission would do well not to employ this method except in cases where the signals are so weak that galvanometric methods cannot be employed. A method by which the strength of the signals is increased before attempting to measure them is deserving of further study. This amplification would naturally simplify matters. But the only type of apparatus which seems to promise success is the type using ionised gas, with regard to which nothing seems to be known as to the amount of the magnification—in other words, it is not known what ratio the current received bears to that furnished by the valve; neither is it known whether this ratio remains constant. The only information that is available seems to show that the matter depends on the voltage and the length of time the valve is in use. Much more, therefore, remains to be done before its use can be recommended. The method of measuring the signals is connected with the problem of the different connections that can be used between the measuring instruments and the receiving antenna. If the apparatus is to be as simple as possible, there are only two ways: either the measuring apparatus can be directly inserted in the aerial circuit, or the instrument can be put in a special circuit, which can be connected to the receiving antenna by magnetic or electrostatic coupling. This latter alternative may make it necessary to tune the two circuits of the antenna and the receiving circuit, and it is possible that some coupled waves may be produced which will interfere with the standardisation.

The measurement of the damping of the received signals presents considerable difficulties unless the receiving instruments are extremely sensitive, or unless the signals are very well marked. The same principles would hold good as in the case of the control stations. But, considering the difficulties and uncertainties of the matter, it may well be deferred till a later stage. It is necessary to consider whether a photographic record of the signals is necessary or not. From many points of view it is doubtless an advantage. But, on the other hand, it leads to complication and expense. Some system of automatically recording the signals ought to be developed; probably a photographic recorder would work with signals which were received at a distance not exceeding 1,000 km. from the sending station. At greater distances the signals would probably be too weak for any kind of recorder of the automatic type. With reference to atmospheric disturbances, they should be automatically recorded at the same time as the signals are received; no special apparatus would then be necessary. It would probably be easy to adopt some form of registering apparatus suitable for short signals, such as those sent out by an ordinary Morse transmitter.

The author therefore proposes that the Commission should approve of the following course of action. The first point would be to see whether it is possible to standardise existing antennæ in such a way as to obtain comparable results, or whether, on the other hand, it is necessary to construct special antennæ for the purpose. It is thus of importance to have a standard method of measurement or an instrument, which need not be very sensitive, with which the others could be compared. We must also design and construct a closed or nearly closed radiating circuit, capable of radiating definite quantities of energy of different wave-lengths. We must also have a closed or nearly closed receiving circuit, which can be used in connection with the standard measuring apparatus, so as to determine the radiation of the circuit.

Digest of Wireless Literature

ABSTRACTS OF IMPORTANT ORIGINAL ARTICLES DEALING WITH WIRELESS TELEGRAPHY AND COMMUNICATIONS READ BEFORE SCIENTIFIC SOCIETIES.

THE "KENOTRON" RECTIFIER.

In a recent issue of the *General Electric Review* Dr. Saul Dushman gives a description of a new form of rectifier for high-pressure electric currents, to which the name "Kenotron" has been given. The word "kenotron" is derived from the Greek adjective "kenos," meaning empty, and the suffix "tron," indicating an instrument or appliance. The instrument, which has been evolved in the General Electric Company's laboratory at Schenectady, in many points resembles Dr. Fleming's valve rectifier in being based upon the phenomena of emission of electrons from incandescent metals, but is used for much higher pressures. Dr. Fleming's valve, as our readers probably know, consists of a filament sealed in a glass bulb, a metal plate being placed close to the filament so as to leave very little space between the two. The bulb is exhausted of air and the filament is made to glow by means of an accumulator. To obtain the rectifying effect a source of potential is connected to the filament and the plate, the filament being made negative and the plate positive. The space between the filament and the plate then becomes possessed of unidirectional conductivity and is utilised in wireless receivers to rectify received oscillations.

In hot-cathode rectifiers it can be shown that the current from the hot cathode is due to convection of electrons (negatively charged corpuscles having a mass of about 1-1800th of that of a hydrogen atom) by deflecting the current in magnetic and electrostatic fields and determining the ratio e/n.

Dr. Irving Langmuir, who has done considerable work on the subject, has found that in the case of heated tungsten filaments the electron emission at constant temperature increases as the vacuum improves until a constant value is attained, which varies with the temperature in accordance with an equation laid down by Richardson. In the types of hot-cathode rectifiers exhausted by ordinary methods, the electron emission is accompanied by a blue glow, and the cathode gradually disintegrates; it was found that the blue glow was due to the presence of positively charged gas molecules (ions) and that the disintegration of the cathode was due to bombardment by these ions. When the vacuum is made as perfect as possible, however, conduction occurs only by means of electrons emitted from the hot cathode and there is no blue glow.

By means of a special form of air-pump arrangement Dr. Dushman has succeeded in attaining a vacuum as high as 5×10^{-7} mm. of mercury. The thermionic current in a high vacuum depends directly upon the nature of the electrodes and the temperature, values for tungsten being as follows:—

Absolute temperature. Centigrade.	Milliampères per cm.²
2000	4·2
2200	48·3
2400	364·8
2600	2044·0

There is, however, another factor influencing the electron current—namely, the electrostatic field or "space-charge," observed by Dr. Langmuir, which is set up by the electrons emitted from the hot cathode; the effect of this charge is that with a given voltage the current increases with temperature according to Richardson's equation only up to a certain temperature, after which it remains constant. The higher the voltage between the electrodes, the higher is the temperature at which the limit is reached, but in no case does the current at a given temperature exceed the value given by Richardson's equation, no matter what the voltage. As the absence of positive ions, and therefore of gas, is essential, the appropriateness of the name "kenotron" is obvious.

The current-carrying capacity of the kenotron, when given sufficiently high voltage between the electrodes, is limited only by the area of the surface emitting electrons and its temperature. It is necessary to limit the temperature to such a value that the life of the filament is at least 1,000 hours.

An important point in the design of the kenotron is the prevention of electrostatic strains on the filament due to the high voltage, the electrostatic attraction between the electrodes being proportional to the square of the voltage. During the rectifying phase the P.D. is very low, but during the other half cycle the electrodes are subject to the full P.D. of the line. Various symmetrical arrangements have been adopted, one of which is a molybdenum cylinder with a coaxial filament. For direct-current pressures up to 15,000 volts the diameter of the cylinder need not exceed ½ in., while the length may be up to 4 in., with a 10 mil. filament as cathode. For D.C. pressures up to 75,000 or 100,0000 volts the diameter of the cylinder is increased to 5 cm. A tube intended to rectify 10 kilowatts at 100,000 volts, with a carrying capacity therefore of 100 milliampères, has a loss of only 1·25 per cent.

Kenotrons have been constructed for D.C. voltages up to 100,000 volts, and currents up to 1·5 ampères; the author has every expectation of extending their application to 200,000 volts. It is preferable to construct them in the form of 10-kw. units when the voltage exceeds 25,000; for lower voltages smaller units are advisable. Unlike the mercury vapour rectifiers, they can be operated in parallel.

In the laboratory the kenotron facilitates the production of small direct currents at very high voltages, for spectroscopic work, etc., and for testing the dielectric strength of insulation. It is also well adapted for X-ray work. Many other uses will also suggest themselves to the reader. Certain experiments in wireless telegraphy would also be facilitated by its aid.

* * *

EXPERIMENTS WITH LOW HORIZONTAL AERIALS.

In a recent issue of the *Electrical World* Messrs. Charles A. Culver and John A. Riner describe a number of experiments they have performed with low horizontal aerials. In addition to a telephone wire 250 metres in length and 3 metres high, referred to in a previous paper, there was established a second low horizontal system consisting of a single wire of approximately the same length and height, but extending in a southeasterly direction (instead of towards the south). On the night of November 17th, 1913, a heavy mist prevailed at Beloit, and all outdoor objects were thoroughly wet. Owing to poor insulation, the above line was grounded at one point at least, and probably at other points, but even under these unfavourable conditions signals from Atlantic coast and other stations were heard strongly when this line was used in place of the ordinary aerial.

At 7.26 on the evening of November 23rd the Arlington station was heard sending longitude signals to Paris, using either the telephone line or the special low horizontal antenna. The weather was fair and cool. Similarly Arlington and Key West were heard loudly at Beloit on the night of December 8th, the weather being clear and cold. At 11.45 p.m., January 28th, 1914, while rain was falling, a coast station was heard on the horizontal system as plainly as when employing the large aerial of the Beloit station. On the same date the experiment was tried of utilising the horizontal system as a " ground " in connection with the large aerial. This combination likewise gave strong signals.

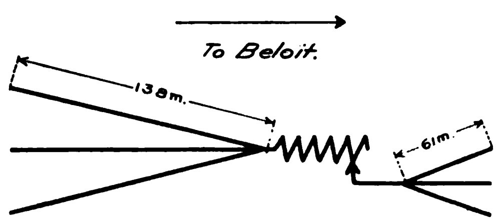
As a result of the above preliminary tests with low antennas, and of those reported in previous papers, it was decided to carry out further experiments of a similar character over distances comparable to those occurring in radio-telegraphic practice. Accordingly a series of tests were conducted between Beloit, Wis., and a temporary field station at Freeport, Ill., the distance covered being approximately 34 miles (54·7 km.). The antenna of the Beloit College station is of the L type, and consists of a four-wire horizontal portion some 90 metres long, with a slanting two-wire section about 30 metres in length. The horizontal section makes an angle of 45 degrees with the meridian, the free end extending to the south-east. Energy is delivered to this system by a 1-kw. transformer operating through a rotary nonsynchronous gap and loosely-coupled oscillation transformer. Signals of a fairly constant intensity were automatically sent out by the Beloit station on a 900 metre wave-length, and received by the field station near the city of Freeport. The logarithmic decrement of the Beloit station when using the above wave is approximately 0·16.

The field station at Freeport employed the usual loosely-coupled receiving transformer with crystal detector and telephone receivers. As no facilities for quantitative measurements were available at the time, the tests about to be described were purely qualitative in character.

The first series of tests were made on July 10th, 1914, the receiving station being established in a field on a bluff about 60 feet above a creek. The receiving wire consisted of a poorly insulated cotton covered wire (No. 18 gauge) 274 metres in length, which in the course of the experiments became bared. One half of the wire was laid on the ground, and the other suspended from branches of trees, etc., at a height of some 7 feet above the ground. The receiving transformer was in this experiment placed in the centre. With this arrangement various signals were heard from Beloit on several days. On July 14th one-fourth of the wire which had previously been kept clear of the ground was lowered so as to rest on the grass, and it was found that signals were still readable. When three-fourths were placed on the ground signals were diminished in intensity, and when it was entirely on the ground no signals could be heard. When, however, the wire in question was shortened by 77 metres and the free end lying on the ground the loud signals which resulted seemed even stronger than when the original wire had been entirely supported.

After this various arrangements were tried, and the wire was placed completely on the ground. The most satisfactory results were obtained when the wire on the Beloit side of the receiver was 61 metres and the wire on the other side 138 metres. Space will not permit us to give fuller particulars of the many interesting experiments which were performed, but it may be stated that, although the wire was bare and lying in many instances on the wet grass, signals were quite easily received.

Having determined the most satisfactory method of receiving by means of a single wire each side of the receiver, the authors next tried the effect of multiple wires, and found much better results to be obtainable by duplicating the wire on the side away from Beloit. By adding still a further wire on the side away from Beloit, making three in all, an additional improvement was obtained. The experimenters next tried the effect of increasing the number of wires on the side towards Beloit, and an improvement again made itself apparent. The result of adding a second wire to the part towards Beloit was most marked in several respects. In the first place the intensity of signals was greatly augmented; in fact, the intensity of certain signals appeared to be as great as when the large elevated aerial at Beloit was used. A third wire still further improved the reception, and signals from Sarnia (600 kilometres away) came in especially loud. An important point was now observed—namely, that the tuning was found to be as sharp as that which obtains when employing elevated aerials of the commercial types.



ALL WIRES ON GROUND.

The best arrangement of wires is clearly shown in the accompanying diagram. The authors, in conclusion, state that the system would appear to operate most effectively when its electrical length, including the winding on the transformer primary, is something like one-fourth that of the incident wave. The receiving instruments, it seems, should be inserted about one-third the distance from the end nearest to the transmitting station, and to operate at the same efficiency the total length of such a ground-wire system should be approximately twice that of the elevated aerial. When used as an absorber, insulation of the wires apparently plays a very minor part. The ease and dispatch with which an earth-wire system may be installed make the plan a valuable one under certain conditions.

Juneau—The Capital of Alaska.

Wireless Development in a Wilderness

By J. R IRWIN.

IN the development of all new countries during the past half century the telegraph has always been one of the most important factors in the progress of the pioneer work. It is doing its full share in Alaska to-day.

Mr. J. J. Underwood, the famous journalist, author, and explorer, whose work on Alaska constitutes a reference and history of that vast territory, has most appropriately named his book—*Alaska: an Empire in the Making.* The sub-title is a statement of a fact. Although the country is old in discovery and early settlement, its " making " has been in progress but a few years—in fact, is contemporaneous with the progress of wireless telegraphy, which to-day is the most important and, at the same time, the most logical and efficient means of communication in the territory.

Alaska was discovered as early as 1728 by Vitus Bering, a Dane, holding a commission in the Russian Navy, but it was not until 1873 that the first settlement was established on Kodiak Island. Thereafter the progress of col·nisation was very slow, and was confined principally to fur hunters, traders, and others of adventurous spirit.

In 1867 Alaska was sold by Russia to the United States for the sum of $7,200,000. From that year up to December, 1914, incomplete statistics show that the exports of the territory during that period are in excess of $500,000,000—a truly wonderful bargain. The trade for 1914 was exceptionally good, totalling more than $72,000,000, with an estimated population of but 68,000, including Indians, Eskimos, and others.

The principal exports include gold, copper, salmon, furs, and innumerable other commodities.

Besides producing gold and copper, Alaska seems destined to become an important factor in another industry—the manufacture of tinplate and steel. Throughout the territory there are immense beds of hematite and magnetite iron, and in the north-western section several tons of tin are produced each year. In the Matanuska coalfields a high-grade coking coal has been uncovered in immense quantities. Some day, perhaps in the near future, these three minerals will be brought together at one point and another big industrial centre established on the Pacific seaboard.

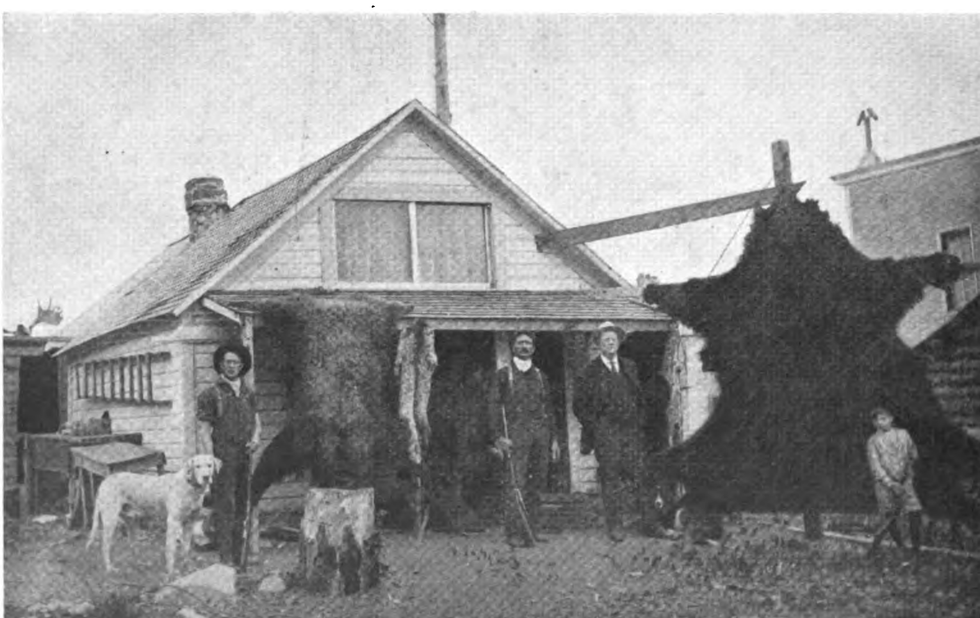
In addition to these minerals, Alaska produces silver, gypsum, marble, graphite, petroleum, mica, and lime. In metals and minerals prospectively valuable, but not being produced in commercial quantities, are tungsten, quicksilver, lead, arsenic, antimony, manganese, asbestos, bismuth, zinc, garnets, and jade.

That Alaska has tremendous agricultural possibilities is the opinion of many agricultural experts in the employ of the Government, who have conducted experimental stations in the territory for a period of fifteen years past. Oats, wheat, barley, rye, and all kinds of root vegetables are successfully matured. Cereals grown in Alaska won the first prize against all comers in the United States at a land and irrigation exposition recently held in Minnesota.

The area of agricultural land in Alaska has been estimated at 100,000 square miles—more than the entire area of similar land in the Scandinavian Peninsula. It has been computed by experts that this area of land will support a population of 10,000,000 engaged in dairying, grazing, and agriculture.

When these various potential resources are developed—and that will be within a few years, for the Government has undertaken the construction of 1,000 miles of railroad in the country—Alaska will, indeed, be an important territory—a territory in the development of which the Marconi Wireless Telegraph Company hopes to play its part.

Alaska has a coast-line of 26,000 miles, and, including its islands, an area of 590,804 square miles, included in which can be found every known topographical and geographical formation yet discovered. It will, therefore, be readily understood what



Trappers' Summer Quarters—Alaska.

tremendous difficulties are encountered in the building of telegraph lines and in the laying of submarine cables.

In fact, so difficult is the problem that, with the exception of the Government cable connecting the territory with the United States, the existing telegraph system of Alaska to-day consists of only a few hundred miles of telegraph lines operated by the Military Signal Corps, over which the rates for the transmission of messages are the highest of any system in the world.

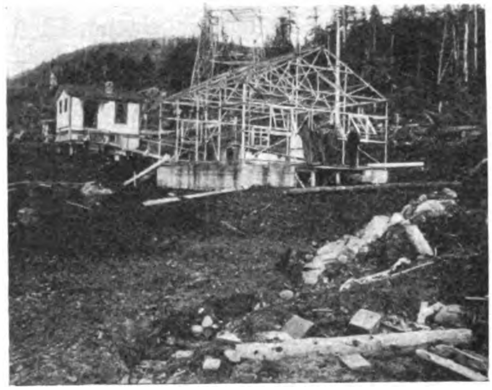
L. C. Smith Building—Seattle—Headquarters of Marconi Company in North-West. Highest Building outside New York.

With the advent of successful wireless telegraphy came a change for the better in so far as communication with points hitherto unserved was concerned. The Government, through the Navy and War Departments, rapidly established stations at convenient points throughout Alaska, and gradually organised a system of wireless stations connecting with its various cable offices. But the same exorbitant rates still prevailed. During this same period private interests, quick to see the great convenience which Marconi had placed at their disposal, installed numerous equipments at their plants, thus enabling them to keep in touch with the outside world, which hitherto they had been compelled to do at very great expense and loss of time. Sometimes a message to the United States would take weeks to reach its destination, generally being conveyed by boat from the cannery, or mine, to the nearest Government cable or wireless station.

At the present time there are numerous privately owned stations leased from the Marconi Company, principal among them being Chignik, Naknek, Kodiak, Nushagak, Koggiung, and Clark's Point, all salmon canneries owned by the Packers' Association.

Other salmon packers prefer to equip their sailing vessels with Marconi apparatus. These ships yearly make the voyage north from United States Pacific ports to the canneries of Alaska, carrying with them the season's supplies and the cannery crews, coming back fully laden with the annual catch, and returning the crews to their southern homes. These vessels upon arrival at their respective plants in Alaska, anchor off the cannery which they serve, and for the remainder of the season are utilised as floating wireless stations, which keep their owners in the south advised of the success or non-success of the season's fishing. Prices can, therefore, be governed, and contracts for future sales be consummated long before the season's pack leaves the cannery. Previous to the advent of wireless in this field such information was unavailable until the return of the vessels to their home ports.

Not even after each ship has left its northern anchorage is the use of wireless completed. By means of the apparatus,



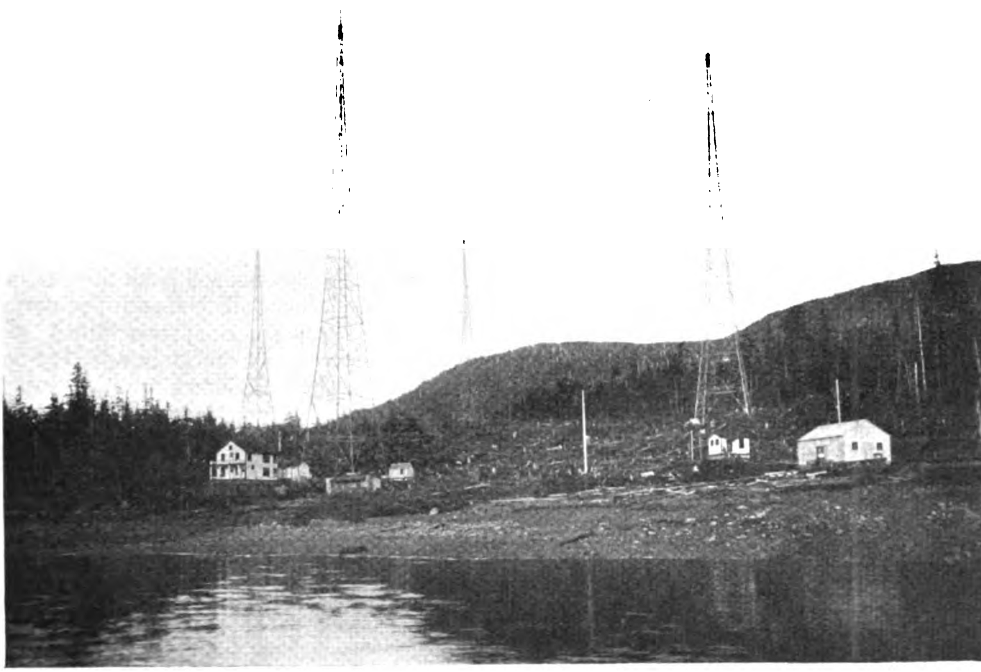
Ketchikan—Operating House completed and Power House under construction.

its progress towards home is despatched nightly to the waiting owner, who can estimate the approximate date of arrival and delivery of fish. Another great money saver which it provides is shown upon arrival off the entrance of the home port. In fog or any kind of weather tugs can be summoned by means of wireless to tow the laden vessel into port, whereas in pre-Marconi days a ship ran the chance of lying off shore for weeks, without means of attracting a tug to her assistance. In heavy weather these vessels sometimes would make the entrance, find no tug, and be compelled to beat off shore again until propitious conditions enabled her to lay-to off the entrance and wait the desired assistance.

In 1913 Alaska's development, and the crying public need for a better system of communication between the territory and the United States, decided the Marconi Company of America to extend its activities in Alaska, and to enter into competition with "Uncle Sam's" cable. To-day there are under construction moderate-powered stations at Ketchikan, the first port of entry into Alaska, and at Juneau, the territorial capital. These stations will communicate with a similar station at Astoria, Oregon, which is also under construction, and will be the United States terminal. Traffic to and from all parts of the United States and the world will connect at Astoria with the telegraph companies, while business destined for the city of Seattle, Washington, which is termed the "Gateway of Alaska," will be relayed by wireless direct to the 42nd Story "L. C. Smith" Building in that city, where a modern station has been installed, and which also contains the Northern Division headquarters of the Marconi Company.

The photographs of the Ketchikan plant accompanying this article will illustrate some of the troubles experienced in carving a Marconi station out of a primeval forest, in a country where the rainfall is over 168 inches a year. At Juneau the difficulties are even greater, as the thermometer in winter descends below zero when the winds blow from the great Taku Glacier.

is also used as a transmitting antennæ for a five kilowatt equipment used for communicating with ships at sea. The towers stand at four corners of a rectangle, 300 feet by 600 feet, the long axis of which points directly towards Astoria, Oregon, where a duplicate of this station is being constructed. A twenty-wire antenna is supported between the towers, and all twenty wires are carried to the fireproof steel power-house, located approximately 300 feet from the first two towers, and exactly on the long axis of the rectangle mentioned above.



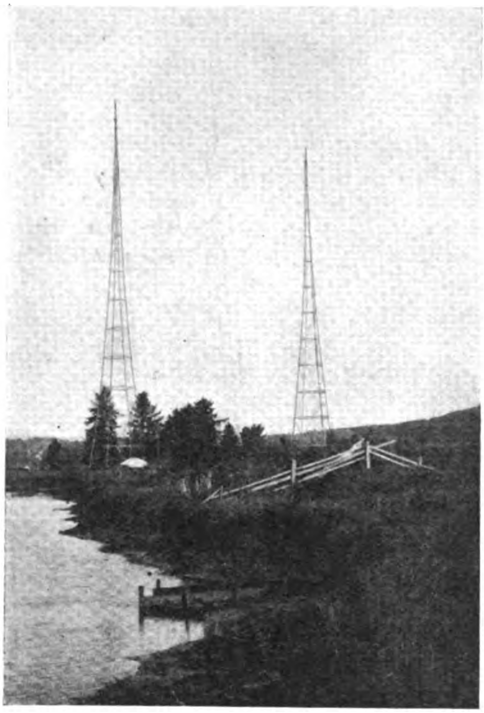
Ketchikan Station.

Ketchikan should be termed the hub of the system, as this station, occupying such a central location, will act as the relay point for the entire Alaskan scheme.

Most people are first attracted by the aerial-carrying structures of a radio station. The self-supporting steel towers at Ketchikan are four in number, and each one is 300 feet high; stepped on top of each tower is a wooden topmast projecting 14 feet above the head of the steel, on which are mounted 80,000 volt triple petticoat porcelain insulators carrying the receiving aerial, which

The ground system consists of some three thousand pounds of zinc plates buried in a circle about the steel-power house, and with three strips 4 feet wide running out on the beach to mean low-tide levels. One strip is placed in the bed of a small creek, and, owing to the excessive rainfall, all plates are continually wet.

Power is obtained from the city plant in Ketchikan, about 2 miles distant, at 2,300 volts, and a frequency of 60 cycles. At a point 300 feet from the power-house the current enters an underground conduit, and



Astoria Station—North Towers.

is taken to the high tension switchboard, and from there distributed to the wireless, lighting, and heating transformers, according to the usual standard methods.

In the steel and concrete power-house are located switchboards, rotary converter for furnishing direct current for the operation of the solenoid keys, side disc motors, remote control switches, and, in addition, the 25-kw. rotary disc is driven by the converter. All power transformers, the 25-kw. condenser bank of 30 tanks, oscillation transformer for the large set, and solenoid key are operated from the receiving house, 75 feet distant.

The receiving office is a wooden building, and contains a 5-kw. plant for corresponding with ships. In addition to the ship station, it contains all controls for the 25-kw. plant. The operator can, without moving from his chair, start and operate either the 5-kw. or 25-kw. plant.

The receiving apparatus consists of two tuners of the latest design—one with a range of 100 to 4,000 metres, and the other from 100 to 7,000 metres.

The living quarters for the staff contain all modern conveniences, and are comfortably furnished by the company in its usual liberal manner.

A splendid water supply is obtained through a 4-inch pipe from a reservoir with a capacity of 12,000 gallons, located on high ground to the rear of the station. The water comes direct through virgin forests from the perpetually snow-clad mountains, but a few miles distant.

At Astoria, Oregon, an exact counterpart of the Ketchikan station is being constructed. There the work is less difficult, as the site is located within the bounds of civilisation.

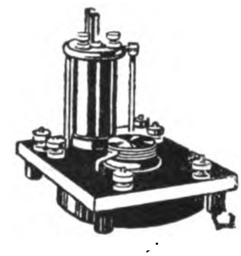
At Juneau, the largest city in Alaska, there is under construction a 10-kw. station, which will communicate with Ketchikan. Only two 300-foot towers are being employed; in all other respects, however, the plant will be similar to those at Ketchikan and Astoria.

Juneau is the headquarters of the mining industry, and is growing with mushroom-like rapidity. From this city the bulk of the traffic will originate.

These three stations will form the nucleus of a system which will embrace the entire territory of Alaska, a system which will cause the name of Marconi to be added to the list of pioneers, explorers, and scientists whose efforts and work will have principally contributed to the development of what promises to be the newest State in the Union of the United States.

Astoria Station—Two forward Towers under construction.

The ENGINEERS Note Book



[Under this heading we propose to publish each month communications from our readers dealing with genera engineering matters of various kinds in their application to wireless telegraphy, and we would welcome criticisms, remarks and questions relating to the matter published under this heading. We do not hold ourselves responsible for the opinions and statements of our contributors.]

The Mechanical and Physical Properties of some of the more common Solid Insulators.

THE mechanical properties of insulating materials are of the greatest importance in the design of radio-telegraphic as well as ordinary electrical engineering apparatus.

In mechanical or civil engineering the machines, or other works, are largely built of one material entirely or of materials of similar natures, such as the metals ; but in electrical work it is necessary to combine metals with parts made of materials with very different mechanical and physical properties, and the problem of making a sound construction, which will withstand the service expected from it, becomes more complex.

From the point of view of their mechanical properties, solid insulators (excluding paper, tape, india-rubber and similar flexible materials) may be divided into the following classes :

Vitreous bodies, such as glass, porcelain, and electrical earthenware, which can be moulded or cast into shapes.

Materials such as slate or marble, which usually occur naturally and can be cut to shape.

Ebonite and several compounds of similar nature which can be moulded or worked into shape.

A large variety of paper impregnated with varnishes or other compounds to form solid boards or tubes.

Mica and the materials made from it.

The above is not exhaustive as there are many materials, now on the market, which have properties similar to one or other of these classes, although manufactured from quite different substances.

The high voltages which are now used by a number of large electric power companies have led to great attention being paid to the manufacture of porcelain for electrical purposes, with the result that it is now possible to obtain insulators of every variety of shape in material of high dielectric strength.

Porcelain is chiefly used for transmission line insulators, and bushes passing for conductors through the walls of buildings or instruments. It is also used for formers, on which reactance coils may be built for enclosing them. The inferior varieties and earthenware are used for small electric fittings and for containers for oil-filled condensers.

These materials have the disadvantage that it is impossible to make the finished articles true to dimensions, and since no work can be carried out on the finished products, fitting them to the work in hand is not so neat a job as it otherwise would be. Thus a large clearance has to be allowed when a metal bar has to pass through a tube in porcelain since the walls are not quite parallel and straight, and, in bolting to metal, lead or rubber washers must be used to take up inequalities of surface and distribute the pressure. This prevents the use of porcelain in many places where its resistance to distortion under heat and other properties would render it valuable.

Some kinds of porcelain are vitrified right through, but others have only a surface glaze. In the latter case the dielectric strength depends greatly on the surface being intact and free from cracks.

In some methods of manufacture the material is subjected to two firings. After the first it is known as "biscuit," and a certain amount of work such as grinding flat surfaces can be done, but even then there will be distortion after the second firing. Porcelain is used in places where it is subjected to pressure only as it is not suitable for withstanding tensile or shearing stresses. It is very suitable for use in exposed situations, such as insulators for wireless aerials and their mast stays.

Glass is not used to any large extent as an insulating material as distinguished from a dielectric.

In the latter capacity it is largely used for condensers for radiotelegraphic transmitting sets, for which its high dielectric strength and dielectric constant make it suitable.

As an insulator it is inferior to porcelain, since the surface of most kinds of glass is hygroscopic—that is, attracts moisture from the atmosphere by which the insulation is reduced even in fairly dry weather.

Ebonite is an insulating material which is very largely used in all kinds of electrical work. This is due to the fact that it possesses high dielectric strength and can be machined with almost the same facility as metals, although it wears the tools used to a greater extent. It can be obtained moulded to shape, and the moulded parts can be trued up to fit the job in hand. It can be tapped to take screw threads of all sizes, which will stand a fair amount of wear. Only threads of moderately large size can be cut in it.

It possesses the great disadvantage of becoming soft under a moderate temperature. For precision work the fact that it shrinks slightly under pressure and contracts with rise in temperature is apt to cause annoyance, and it cannot therefore be used in any standard instrument of which the dimensions must remain constant, such as the spacing of the vanes of an air condenser. The insulation resistance is very high, but is reduced on prolonged exposure to light due to reduction of sulphur from the surface layers, a fact which has caused it to be replaced by other materials in the construction of certain standard apparatus.

Marble is a substance which possesses excellent mechanical properties for many electrical purposes, but unfortunately its electrical properties frequently debar its use. Nearly every specimen has metallic veins running through it, and due to these the insulation resistance is lowered. It is, therefore, not possible to use it for high voltage work or where high insulation resistance is required. Switchboards for low tension work are often made of marble. Slate has more constant electric properties than marble, and is largely used for switchboard work. It is usually enamelled, since this improves the appearance and also prevents the insulation being lowered by absorption of moisture in the pores of the material.

The dielectric strength is not so high as porcelain or ebonite and it is not, therefore, used for high-voltage work.

Mica is a mineral having electrical properties of high value, but the form in which it is found precludes its use for a large number of purposes.

Before it can be used the natural mineral has to be prepared by splitting into flakes so that the impurities which are embedded can be removed. The flakes are then graded as to size and quality.

Mica is not affected by moderate heat and will withstand pressure, but has a great tendency to split into thin flakes and is therefore not suitable in situations where it might be rubbed by adjacent parts. It is used for insulating between commutator bars and also as a dielectric for condensers, and is made up into micanite, which consists of flakes of mica stuck together by shellac or other cement. Micanite is more flexible than mica, but has not so high a dielectric strength.

There is a large number of manufactured materials now on the market for use as insulators for various purposes. A large number consists of paper, impregnated, generally under pressure, with various insulating varnishes or other compounds. As might be expected, these vary greatly in their mechanical and electrical properties. They can be obtained as sheets or tubes, which can be worked with fair facility, although they do not take a screw thread so well as ebonite. As a class they are not suitable for high voltage work owing to the liability of the varnish to absorb moisture from the atmosphere. Great care must be taken in interpreting the results of experiments carried out to determine the dielectric strength.

The alternating-current conductivity for nearly every insulator is greater than the direct current conductivity. For good dielectrics it may be from one and a half to three times as great, but for other materials it may be several thousand times as large. Hence when measuring the spark length which a given thickness of material will withstand before breaking down an alternating potential should always be used. If it be noticed that the spark fails at the gap, although the material is not punctured, this is due to the leakage through it by reason of the large alternating current potential, and the substance can be taken to be unsuitable for alternating current work, especially high frequency circuits.

There are numbers of materials which, more or less, resemble ebonite, and are used as substitutes for it. They are trade preparations by various firms, and hence it is not possible to more than indicate their general nature. Some have high dielectric strength, although inferior to the best ebonite in this respect. The power to withstand a moderate rise in temperature and fair pressure renders their use of advantage in special cases.

The question of the best insulator to use for any particular purpose depends on a variety of circumstances.

Where high voltages are concerned, especially in high frequency circuits, only porcelain or the best ebonite can, with safety, be employed.

For instruments such as radio-telegraphic receivers or the many varieties of electrical measuring instruments, ebonite is used in almost every case in which its cost is not prohibitive or where its contraction with heat or reduced surface insulation after exposure to light renders it unsuitable.

Administrative Notes

Australia.

We are informed that, in accordance with the scheme approved by the International Time Commission of Paris, Melbourne radio-station is now transmitting time signals at the hours of noon and midnight, Melbourne time—which is ten hours ahead of Greenwich mean time. Full particulars of the manner in which these time signals are emitted will be found on pp. 557–560 of the *Year-Book of Wireless Telegraphy and Telephony* for 1914.

* * *

Panama.

The new powerful navy wireless station at Darien in the Panama Canal Zone has been completed and is now undergoing tests. For some time the Darien Station has been receiving messages, but has not been able to communicate with any of the stations in the United States. It is said that the operators at Darien have been able to hear the war bulletins that are nightly sent from Germany to the wireless station at Sayville, Long Island.

When in working order this new station will form one of the many that the American Navy Department is constructing in different insular possessions. It will be manned and controlled by the navy, and has three 600-ft. towers and a capacity of 100 kilowatts. The other stations which will form links in the great navy wireless circuit will be located in Guam, Honolulu, Alaska, Porto Rico and Manila.

South America.

The Rio de Janeiro offices of Marconi's Wireless Telegraph Company, Limited, have been removed to 37 Rua Visconde de Inhauma, which is opposite to the headquarters of the Ministry of Marine. It is near the offices of the Royal Mail Steam Packet Company and at the corner of the Visconde de Inhauma and the Primeiro de Marco. The postbox address remains the same—viz., Caixa Postal 126.

* * *

Austro-Spanish Wireless.

Since March 22nd a radio-telegraphic service has been established between the Austrian seaboard on the Adriatic and the Spanish station at Barcelona. The tariff is 29 centimes per word.

* * *

Tripoli.

The American Consul reports that before the Italian advent in Tripoli there was no wireless equipment in this district, but after they landed twelve installations were set up to replace the telegraph system which was practically destroyed during the war. The instruments are of the Marconi system, and the type most used is the 1½-kw. musical spark station, which, designed for car transport, has been adapted for carriage by camel.

* * *

United States.

It is reported from New York that plans are being prepared by experts of the U.S. Navy Department for the establishment of a wireless telegraph station on Cape Cod, which will be equipped with an apparatus specially designed to give assistance to ships groping their way up and down the Atlantic during dense fogs. The apparatus, although of foreign origin, has been perfected by an American naval officer in such a way that it will, it is claimed, be possible to locate a calling ship by the measurement of the radio waves and the aid of a compass.

NOTES OF THE MONTH

WE have recently received many letters of appreciation of our journal from the pens of constant readers, of which the following communication from Sapper M. F. Gantly, of the 24th Signal Company, Royal Engineers, is a type. He says "Pardon the "liberty I am taking in writing to wish you "every success in your new volume of THE "WIRELESS WORLD. If the present volume "is anything like its predecessors, it will "indeed be interesting and instructive "reading." It is encouraging to know that our efforts to meet the wants of our subscribers are bearing fruit.

A correspondent in the *South Bucks Free Press*, writing over the initials T. J. N., tenders some good advice to an advertiser in a previous issue of that journal. The latter sets himself down as one who "desires to perfect himself in wireless prac"tice, and would much appreciate intro"duction to a gentleman with up-to-date "knowledge of the profession." The advice tendered by the *South Bucks Free Press* correspondent runs as follows:

"If your advertiser is a young man of the "right age I would advise him to join either "the Army or Navy, where he would find "scope for the development of his energies "towards perfection. Or, he might attend "one of the several good wireless telegraphy "schools in London or elsewhere, and gain "a thoroughly practical knowledge under "expert teachers and by the aid of up-to-date "Marconi apparatus, thus enjoying a course "of instruction which would help to qualify "him for the Postmaster-General's certi- "ficate. Thirdly, if he is like so many "others of us, merely a scientific enthusiast, "he could usefully apply his time to a study "of the physical sciences, especially the "branches dealing with electricity and "mathematics, as applied to the theory "and practice of wireless telegraphy. Much "more genuine pleasure will always be "derived in this way than the mere "sucking of the brains of some good-natured "person who has reached a certain measure "of perfection by years of hard study and "personal research."

In view of the fact that such enquiries are constantly recurring, we hope shortly to publish more detailed instructions in our own pages. In the meantime, the general remarks of T. J. N. may be found useful.

* * *

We should like to call attention to an interesting fact latent in the report of the Direct United States Cable Company presented at the annual general meeting held on Tuesday, April 27th, at Winchester House, London, E.C.

The Chairman, Sir James Pender, Bart., called attention to the fact that during 1913-1914 over £100,000 had been spent in connection with the cost of maintaining their cables. The report goes on to speak of other heavy expenditure in the same connection, and when we consider that for the sum of £100,000 an efficient long-distance wireless station could be erected capable, without heavy additional expenses for cable maintenance, of performing exactly the same services, we begin to realise the capabilities of wireless for decreasing the cost of cable messages whilst at the same time increasing their volume. The future expansion of trade and commerce is for this and for other reasons largely bound up with the future of radio-telegraphy.

* * *

A Dutch inventor residing near Amsterdam has invented a simple little telephone, the receiver and transmitter of which are so small that they can be easily carried in the vest pocket, taking up no more space than an ordinary watch. The cost of manufacture is estimated at 1s. 2½d. In spite of its diminutive size this "thermophone"—as the inventor has named it—appears to transmit messages with perfect clearness and distinctness, localisation being particularly good, and there is no confusion of vowel sounds, letters or figures. The receiver is so small that it may be placed within the ear, connection being maintained by a thin wire. Either a single or double receiver may be used, and the hands are left free to make notes of any messages transmitted. At a recent demonstration of the invention at the University of Utrecht the wireless telegraphy was brought into requisition in connection with the "thermophone" with entire success. Subsequently at the inventor's laboratory, the American Consul at Amsterdam, who was present at the demonstration, had the opportunity of transmitting and receiving messages to and from a distant room in the building over the ordinary wires.

* * *

It is gratifying to note the increasing interest displayed by the general public in semi-technical "wireless" questions. A recent issue of our contemporary, *T. P.'s Weekly*, contained a letter from Mr. W. Davidson, of Glasgow, commenting on the fact that it is possible to transmit messages to, and receive them from, much greater distances at night than during the day. The writer of the letter suggests that the following may be a solution of this so far unexplained phenomenon. Light, he says, is transmitted from one place to another by means of ether waves; so also is the electric current sent out by the radio-telegraphic transmitter. During the daytime so many ether waves are required for light that the electric current does not get the same opportunity as during the night.

In a subsequent number of the same journal Mr. W. H. Marchant replies suggesting that the following, taken from the report of the lecture delivered by Dr. Erskine Murray before the Wireless Society of London, may be of interest and assistance to Mr. Davidson :—

"'A first and most important property of "waves, especially in wireless, was to under- "stand that they can cross each other at any "angle whatsoever without in the least dis-"turbing each other. This was demon-"strated in an interesting way by ripples "on water. Dr. Murray said this ex-"plained why any number of sending "stations near one another do not inter-"fere with each other.' It will be seen "from this that the shorter range of a "radio-station during the daytime is not "due to the interference of two sets of "ether waves. There is no general agree-"ment among radio workers as to the "cause of the greatly increased range at "night. One theory is that it is due to "the ionisation of the atmosphere by sun-"light, which by making the air partially "conductive absorbs some part of the "energy radiated. Another theory—and "one which seems to find greater accep-"tance—is that the increased distance is "due to reflection from the upper stratum "of the atmosphere which is conductive. "During the hours of darkness the lower "surface of the conductive stratum is "sharply defined, and is therefore a good "reflector, but during daylight hours the "transition from the conductive to the "non-conductive is gradual, with the result "that clear reflection is impossible."

Mr. Marchant adds that a very interesting article by Dr. Murray on this subject appears in the *Wireless Year Book* for 1914.

* * *

Our weekly contemporary, the *Nation*, in its issue of May 1st, contains a letter signed Hugh Richardson, suggesting "a public world-wide wireless news service" to which every Government might undertake to supply verified news. The function of the private news agency under this suggestion would be to "supply details." For our own part we should have imagined that one of the most striking lessons to be learnt from the present war from the point of view of newspapers was that of "preserve us from Governments"! With the best intentions in the world (for which we are willing to give all credit) it is difficult to imagine anything more fatuous than the handling of news items by public officials. Various Departments of State are affected by the different classes of news, and a State official before passing anything out for publication, would have to consult every Department which considered itself interested. The wireless news in peace time would, under such arrangements, contain matter as little new and information as vague as what we now have to put up with in war time. "*Absit Omen!*" It is far better that "a cobbler should stick to his last" and that *Governments* should occupy themselves with the task (in which they are none too successful) of *governing*. They would be well advised to leave to news agencies the task of providing that which affords the latter their only excuse for existence.

* * *

We notice in the issue of *John Bull* of May 1st that Mr. Horatio Bottomley considers the British Government would have been wise not to "let the enemy know that we are tapping their despatches." Of course, if any action or inaction by the British Government would have resulted in throwing the Germans off their guard and feeding them up with the illusion that their messages were not being tapped, no doubt we might have caught that very wide-awake nation napping, and have extracted all sorts of valuable information *without their knowledge*. But, despite the primitive, savage violence of German "kultur," to exhibitions of which we are being constantly treated, their knowledge of science is very far from primitive. Those responsible for Teutonic wireless messages could not under any circumstances have failed to realise every possibility affecting their utilisation of this wonderful application of modern science. Of course, the great bulk of the "news" bulletins sent out by them are intended for the consumption of neutral nations.

* * *

At the Electrical Show, opened at Urbana, Ill., on April 8th by the students of the University of Illinois, there were several novel devices which attracted considerable attention. Among these the demonstration of wireless control of an automobile was perhaps the most interesting thing in its way ever introduced by students. It is similar in operation to the work of the son of John Hays Hammond, who controlled by means of wireless a small ship off the Massachusetts coast. Another interesting feature was an electrical café, equipped by the students, wherein the cooking, lighting, and serving was all done by electricity.

Maritime Wireless Telegraphy

A RECENT judgment in the Admiralty Court recalls how wireless was employed to summon aid which saved not merely the lives of those on board, but the whole hull and contents of a big steamer with her valuable cargo between Christmas Eve and New Year's Day of this year. The substantial amount of £5,400 was awarded to the owners, master, and crew of the Liverpool steamship *Raphael* for this notable piece of salvage work. It would appear that the *City of Lincoln* was so battered by storms off Cape Finisterre, that she was obliged to follow up her "S O S." call (after finding it answered by the *Raphael*) with an appeal stating that her machinery was helpless, her rudder stock broken, and that she was in serious danger of being driven by the terrific tempest then raging on to the rocky shores off Finisterre. The *Raphael* went to her assistance, and encountered considerable difficulty in preserving the steamer in distress. Tow ropes, and even wire hawsers, kept continually breaking, and the passengers on the *City of Lincoln* passed an extremely anxious Christmastide. The *Raphael*, en route to New Orleans to ship horses for the French Government, was carrying 33 French rough-riders, who gave considerable assistance in the course of the salvage. The *City of Lincoln*, described by counsel as "a veritable treasure ship," was bringing passengers, tea, and rubber from Calcutta to London. Ship and cargo were valued at over £350,000. Of the £5,400 salvage award £4,000 went to the owners, £400 to the captain, and the rest was divided amongst the officers and crew and those who took part in the operations. It is a noteworthy fact that Sir Samuel Evans, the President of the Court, was sufficiently impressed with the share of credit due to the two Marconi operators that he made them special allowances.

Mr. T. D. Sandham.

Mr. A. H. L. Mills.

The operators on the *Raphael* concerned in this adventure were Mr. A. H. L. Mills and Mr. B. A. Gardner, the former an old pupil of the Mercers School, High Holborn, who joined the Marconi staff in May, 1914; the latter, an operator employed by the Marconi Company of America, attached to the *Raphael* at the time as second man. We print a photograph of Mr. Mills, as well as one of Mr. T. D. Sandham, the wireless operator of the *City of Lincoln*, who joined in February, 1913. That of the gallant young American is, we regret to say, not available.

The sum of £4,000, which constituted the owners' share, must, even in the calculations of the most commercially-minded steamship proprietors, have *amply justified the expense of installing wireless on their steamers*—the amount named would go far towards defraying the expense of equipment on quite a number of vessels.

* * *

During the terrific gale which occurred off the Atlantic coast of the United States on April 3rd the Dutch West India liner *Prins Maurits* is believed to have foundered with all hands. With her own wireless apparently out of commission or of insufficient strength to reach shore stations the distress signals were communicated to a British cruiser in the first instance and thence to a shore station at New York. A few minutes before 9 o'clock on the morning of the disaster the operator on duty at the land station heard the cruiser signal for all vessels and land stations to stand by preparatory to sending out the call of distress, and a few minutes later the following message was received at New York: "*Prins Maurits* is in distress and badly in need of assistance in latitude 36.30 north, longitude 74.49 west."

After repeating the message the cruiser stopped sending and nothing further was heard from her for several hours. In the meantime messages from the New York station were received by the steamships *Algonquin*, *City of Memphis*, *City of Montgomery*, and *Princeton*, all of which signified their intention of going to the distressed vessel's assistance. Owing to the severe storm raging southward along the Atlantic coast communication by wireless was extremely difficult, and it was not until noon that the cruiser was heard from again. At 10 o'clock the same night Cape Hatteras reported to the New York station that nothing had been heard of the *Prins Maurits*, although several vessels had heard weak wireless signals which they believed came from the disabled vessel. The *Alliance* and *City of Atlanta* were in the vicinity of the position given by the cruiser, but they could find no trace of the *Prins Maurits*, although they repeatedly called her by wireless. Such tremendous seas were running, it was reported, that had the distressed vessel been found it would have been impossible to take off her passengers and crew. Careful search was made for several hours in the vicinity of the position given by the *Prins Maurits* in her call for help, but no trace of the vessel could be found.

The *Prins Maurits*, which was in command of Capt. H. J. van der Goot, left New York on April 1st for ports in the Caribbean Sea and carried a full cargo and four passengers. The wireless operators on board the ill-fated ship were J. H. Karreman and F. V. S. Kinch, notes about whom will be found in our Personal columns.

* * *

The extremely difficult work which from time to time is undertaken by lighthouse tenders calls for navigation and seamanship of the highest order. Wireless telegraphy, which has proved such a boon on ships both large and small, is now being applied by the United States Government to the boats which ply to and from the lighthouses on her coasts. Wireless equipments are to be placed on five of these tenders, two on the Atlantic and Pacific coasts, and one in Alaska.

MARCONI HOUSE RIFLE CLUB.

THE first Club Handicap Competition was held in March. Silver spoons were won by Mr. A. T. Polden (Engineers' Drawing Office) and Mr. A. W. Torode (Accounts Department) on the handicap result, and by Mr. G. A. Johnson (Accounts Department) for the best score without handicap. Mr. Johnson's score was 91 out of a possible 100.

A second handicap competition was held in April, spoons being won by Mr. S. Anselmi (Engineers' Drawing Office) and Mr. C. H. Hall (Relay Telephone Company) on the handicap result, and by Mr. F. K. May (Managers' Department), with a score of 92 out of a possible 100. There were 30 competitors, and the shooting generally on this occasion showed a great improvement.

In our issue for April we had the pleasure of announcing the nomination of Mr. A. A. Campbell-Swinton for a fellowship in the Royal Society. The election is now consummated and it gives us much pleasure to tender congratulations on behalf of ourselves and our readers to Mr. A. A. Campbell-Swinton, F.R.S.

CARTOON OF THE MONTH

Transmitting the Hymn of Hate.

The Wireless Transmission of Photographs.

By MARCUS J. MARTIN.

Article 3.

THERE are two other possible means of receiving that upon investigation may yield some results, but it is doubtful whether the current available, even that obtained from a telephone relay, will be sufficient to produce the desired magnetic effect, and the insertion of a second relay would detract greatly from the efficiency by decreasing the speed of working. If rays of monochromatic light from a lamp, L, Fig. 29, pass through a Nicol prism, P (polarising prism), then through a tube containing CS_2 (carbon bisulphide), afterwards passing through the second prism, P^1 (analysing prism); if the two Nicol prisms are set at the polarising angle no light from L would reach the photographic film wrapped round the drum, V, of the machine. Upon the tube being subjected to a field produced by a current passing through the coil, C, the refractive index of the liquid will be changed, and light from L will reach the photographic film.*

The second method is rather more complicated, and is based upon the fact that the cathode rays in a Crookes' tube can be

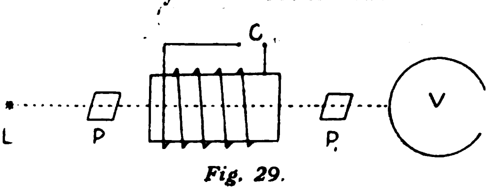


Fig. 29.

deflected from their course by means of a magnet. In Fig. 30 the cathode, K, of the X-ray tube sends a cathode-ray discharge through the aperture in the anode, A, through a small aperture in the ebonite screen, J, on to the drum, V, of the machine, round which is wrapped a photographic film; A and K being connected to suitable electrical apparatus. Upon the coil being energised the cathode-ray is deflected from its straight line course, and the drum, V, is left in darkness.

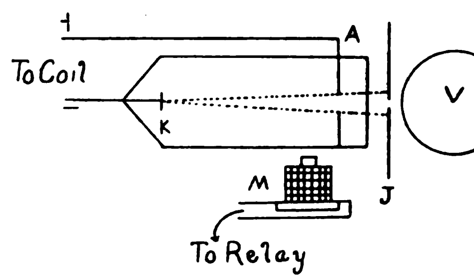


Fig. 30.

The method which is now going to be described is very ingenious, and it makes use of what is known as an electrolytic receiver. This method of receiving has proved to be the most practical and simple of all the photo-telegraphic systems that have been devised. The application of this system to wireless work is as follows: The aerial, A, and the earth, E, are joined to the primary, P, of a transformer, the secondary, S, being connected to a Marconi valve receiver, C. The valve receiver is connected to the battery, B, and quartz thread, K, of an Einthoven galvanometer (already described). The thread, K, is about 1/12,000 part of an inch in diameter, and will respond to currents as small as 10^{-8} of an ampère. The light from M throws an enlarged shadow of the thread over a slit in the screen, J, and as the thread moves to one side under the influence of a current the slit in J is uncovered, and the light from M is thrown upon a small selenium cell, R. In the dark the selenium cell has a very high resistance, and therefore no current can flow from the battery, D, to the relay, F. When the

* A description of the apparatus required will be found in Ganot's *Physics.*

string of the galvanometer moves to one side and uncovers the slit in the screen, J, a certain amount of light falls upon the selenium cell and lowers its resistance, allowing sufficient current to pass through to operate the relay. Round the drum, V, of the machine (shown in Fig. 12) is wrapped a sheet of paper that has been soaked in certain chemicals that are decomposed on the passage of an electric current through them. As soon as the local circuit of the relay is closed the current from the battery, Z (about 12 volts), flows through the paper and produces a coloured mark. The picture therefore is composed of long or short marks, which correspond to the varying strips of conducting material on the single line print. In order to render the marks short and crisp a small battery, Y, and regulating resistance, L, is placed across the drum and stylus. The diagram Fig. 31 gives the connections for the complete receiver. The paper used is soaked in a solution consisting of ferrocyanide of potassium ½ oz., ammoniac nitrate ½ oz., and distilled water 4 oz.* The paper has to be very carefully chosen, as, besides being absorbent enough to remain moist during the whole of the receiving, the surface must also remain fairly smooth, as with a rough paper the grain shows very distinctly, and if there is an excess of solution the electrolytic marks are inclined to spread, and so cause a blurred image. The writer tried numerous specimens of paper before one could be found that gave really satisfactory results. It was also found that when working in a warm room the paper became nearly dry before the receiving was finished, and the resistance being greatly increased, the marking became very faint. A sponge moistened with the solution and applied to the undecomposed portion of the paper while still revolving was found to help matters considerably. Another experience which happened during the writer's early experiments, the cause of which he is still unable to explain, occurred in connection with the stylus. The stylus used consisted of a sharply pointed steel needle, and after working for about three minutes it was noticed that the lines were gradually becoming wider, finally running into each other. Upon examination it was found that the point of the needle had worn away

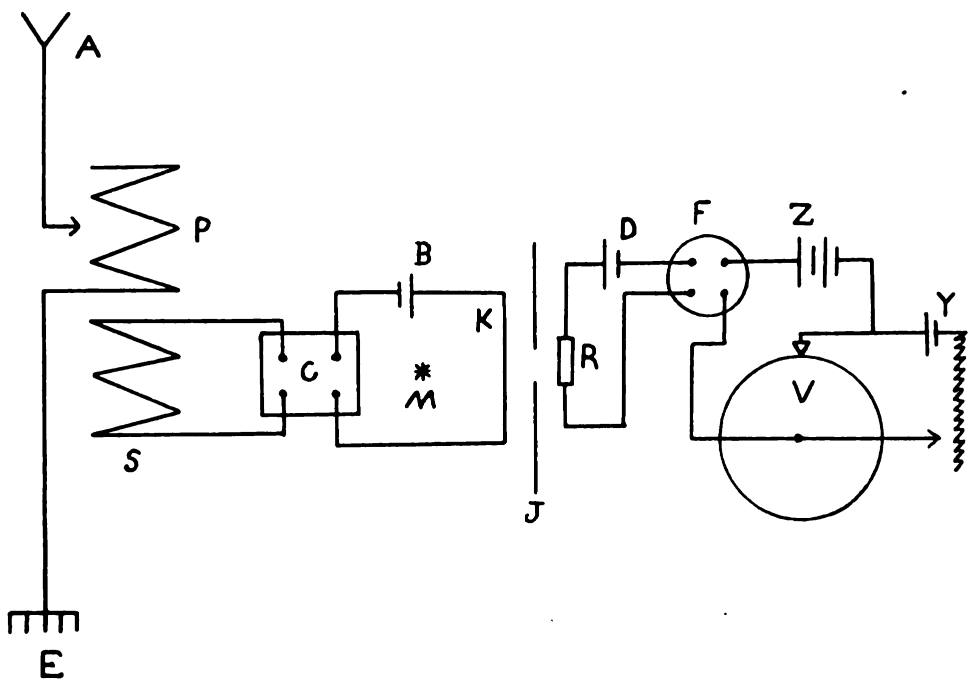


Fig. 31.

* Great care must be exercised in using this solution, as it is exceedingly poisonous.

considerably, becoming, in fact, almost a chisel point. Nearly every needle tried acted in a similar manner, and to overcome this difficulty the stylus shown in Fig. 32 was devised.

It will be seen that it consists of a holder, A, somewhat resembling a drill chuck, fastened to a flat spring, B, in such a manner that the angle the stylus makes to the drum can be altered. The needle consists of a length of 36 gauge steel wire, and, as this wears away slowly, the jaws of the holder can be loosened and a fresh length pushed through. The wire should not project beyond the face of the holder more than ⅛ inch The gauge of wire chosen would not suit every machine, the best size to use being found by trial; but in the writer's machine the pitch of the decomposition marks is much finer than in the commercial machines, and this gauge with the slight but unavoidable spreading of the marks will produce a line of just the right thickness. As already mentioned, no explanation of this peculiarity on the part of the stylus can be given, as there is nothing very corrosive in the solution used, and the pressure on the paper is so slight as to be almost negligible.

No special means are required for fastening the paper to the drum, the moist paper adhering quite firmly. Care should be taken, however, to fasten the paper (which should be long enough to allow for a lap of about ¼ inch) in such a manner that in working the stylus draws away from the edge of the lap and not towards it.

The current required to produce electrolysis is very small, about one milliampère being sufficient. Providing that the voltage is sufficiently high, decomposition will take place with practically "no current," it being possible to decompose the solution with the discharge from a small induction coil. The quantity of an element liberated is by weight the product of time, current, and the electro-chemical equivalent of that element, and is given by the equation $W = z\ c\ t$,

where W = quantity of element liberated in grammes,
Z = electro-chemical equivalent,
C = current in ampères,
T = time in seconds.

The chemical action that takes place is therefore very small, as the intermittent current sent out from the transmitter in some instances only lasts from 1/50 to 1/100 part of a second. The decomposed marks made on the paper are blue, and, as photographers know, blue is reproduced in a photograph as white, so that a photograph taken of our electrolytic picture, which will, of course, be a blue image on a white ground, will be reproduced almost like a blank sheet of paper. If, however, a yellow contrast filter is placed in front of the camera lens, and an orthochromatic plate used, the blue will be reproduced in the photograph as a dead black.

There is one other point that requires attention. It will be noticed that the metal print used for transmitting is a positive, since it is prepared from a negative. The received

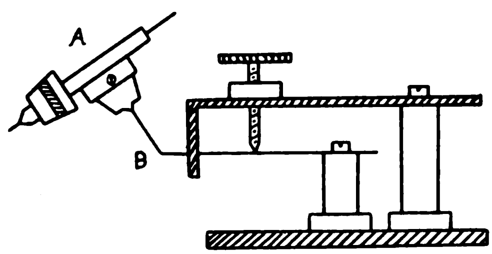


Fig. 32.

picture will, therefore, be a negative, making the final reproduction (if it is to be used for newspaper work) a negative also. Obviously, this is useless. The final reproduction must be a positive, therefore the received picture must be a positive also. To overcome this difficulty matters must be so arranged at the receiving station that in the cases of Figs. 21, 22 and 25 the film is kept permanently illuminated while the stylus on the transmitter is tracing over an insulating strip, and in darkness when tracing over a conducting strip. In Fig. 31 the relay, F, should allow a continuous current from Z to flow through the electrolytic paper and only broken when the resistance of the selenium cell is sufficiently reduced to allow the current from E to operate the relay.

The writer has endeavoured to make direct positives on glass of the pictures to be transmitted, so that a negative metal print could be prepared. The results obtained were not very satisfactory, but the method tried is given as it may be of some interest. The plate used in the copying camera has to be exposed three or four times longer than is required for an ordinary negative. The exposed plate is then placed in a solution of protoxalate of iron (ferrous oxalate) and left until the image shows plainly through the back of the plate. It is then washed in water and placed in a solution consisting of:

Distilled water	1,000 c.c.
Nitric acid	2 c.c.
Sulphuric acid	3 c.c.
Bichromate of potash	105 grammes
Alum	80 grammes

After being in this bath for about 15 minutes, the plate is again well washed in water and developed in the ordinary way. The first two operations should be performed in the dark room, but once the plate has been placed in the bichromate bath the remaining operations can be performed in daylight. As already stated, the results were not very satisfactory, and such a method is not now worth following, as it is comparatively easy so to arrange matters at the receiving station that a positive or negative image can be received at will.

It is necessary to connect the stylus of the receiving machine to the positive pole of the battery Z, otherwise the marks will be made on the underside of the paper. The electrolytic receiver, owing to the absence of mechanical and electro-magnetic inertia, is capable of recording signals at a very high speed indeed.

None of the methods of receiving that have been described can be said to have really solved the problem, as at present they are only in the experimental stage. What is really required is a relay sensitive enough to work on the minute currents obtainable from the various detectors, such as the carborundum crystal, galena-graphite, electrolytic, etc., that are in use at the present time. The only practical instrument that at present can be used with these detectors is a high-resistance telephone. The reason why none of the telephonic detectors are suitable for operating a relay of the ordinary type is that the alteration of their resistance only lasts for a very small fraction of a second, and the relay mechanism is too massive to follow the very transient current produced.

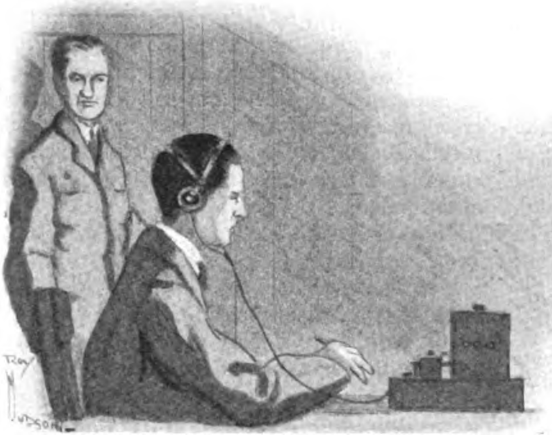
The next article will deal with the subject of driving and synchronising the two stations.

Doings of Operators.

WE print below an extract from an interesting communication sent us by Mr. Walter Condon, wireless operator of the s.s. *Sachem*, which will explain itself.

"I was very fortunate in obtaining the accompanying photograph from the bridge of the s.s. *Sachem* while on the homeward voyage from Boston to Liverpool. It was about 2.30 p.m. apparent time at ship, and the approximate position was latitude 42.35 N, longitude 49.50 W. Thick fog had prevailed for two successive days, with just a few intermittent clearances, and it was during one of these clearances that this iceberg was observed. I was warned of the positions of ice by the United States Government patrol ship *Miami* and the Holland-American Liner *Rotterdam*, who was proceeding to New York. Although in dense fog we knew we were in close proximity to ice on account of the intense cold and the very low temperature of the water. Ice is always a source of anxiety to commanders of Western Ocean liners, especially when accompanied by fog, and they have frequently expressed the wish that if they could only clear the ice track they would not worry about the German submarine blockade."

Iceberg as seen from s.s. "Sachem."



CODE

A story of an intercepted message and what came of it.

By J. W. T. WALSH.

I.

THE MESSAGE AND ITS MEANING.

"NOTHING much doing to-night," said Roger Blake, as he handed over the 'phones to his friend and fellow-enthusiast, Jack Faucet.

They were sitting in a small shed at the bottom of the garden where John Faucet had rigged up a small receiving set in his spare time. Spare time was a commodity rather scarce to a young doctor with a fairly extensive practice in a small isolated country town like Armidale, but Faucet was one of those keen men who can always find time for doing anything they have set their heart upon. He had come down from the 'Varsity full of enthusiasm for wireless and with a firm resolve to have a receiving set of his own as soon as he could find an opportunity of putting one together. The outcome of this resolve and the fruit of many months' patient labour was a very creditable receiving station, with which he used frequently to amuse himself by trying to pick up any messages that might be floating about the ether.

Blake had been his particular chum at college, and both had been signallers in the Officers Training Corps. As a result they had rapidly fallen under the fascination of the "dot-dash-dot." Many a pleasant evening had they spent in each other's rooms, practising with a dummy-key or buzzer, and both, before they said good-bye to 'Varsity life, had become quite proficient amateurs in the gentle art of Morse-reading.

While Faucet was going through the Hospital they had only seen each other at wide intervals, but now that he had settled down to practice their meetings were more frequent. Blake, whose profession carried him from place to place, so that he had no settled home, always looked forward to a short stay with his old chum whenever he got a few days' leave, and it would be impossible to say which of them most enjoyed these reunions. They could then compare notes and talk about old times and all the fellows whom they used to know at college, but who had since drifted out of sight. An added attraction, of course, was the wireless set, and to-night they had been sitting together in the shed taking it in turns to listen to whatever might be going on.

There was not much doing. FL had not yet begun to send out news, while KAV was rather indistinct—besides which, they were neither of them great German scholars. It was a favourite trick of Faucet's to "sweep" for signals; that is, he would travel along the whole gamut of wave-lengths on the off-chance of picking up any stray messages that might be audible. As he took the 'phones the idea came into his head to try this now.

For a few minutes there seemed to be nothing about, and Blake was just going into the house for two cups of something warm—the shed was rather exposed, there was a fairly strong wind blowing, and the temperature was that of a cold, bleak November night—when he was stopped by an exclamation from Faucet, whose attention had suddenly been attracted by a faint call. It was sharply tuned on an unusual wave-length, and if he had not been purposely "sweeping" for messages he would undoubtedly have missed it. Rapidly he began to take it down :—

" . . . ace by hew dress aver visit enim dieser travelled passe an atom break all all at crowing ail a gash outer his above een ambrose to honor errat errat add eye action train tremor moon a faible log a dice sky ash ate none none all leave none 52197065. 323580 — . . . — C C C . . . — . — . . . — . — " Then everything relapsed into silence.

" You don't seem to have picked up much after all, Faucet," said Blake, as he looked over the result of his friend's efforts. " Some amateur practising sending, I suppose."

" It certainly looks like it," agreed Faucet, " but the funny part of it is that the sending was not at all like an amateur's. It was perfectly regular and deliberate all through, without any clipping or dragging. I'm sure I couldn't have sent half as well. Besides, why should he practise sending on his transmitter at all ? Hasn't he got a buzzer or something else he can use without annoying other people ? And what is the meaning of those three C's at the end ? That isn't a miscellaneous signal, is it ? "

Quick as thought he took down the Signalling Manual and looked it up.

" No, I thought as much ; there is no such signal as C C C. It bears a faint resemblance to the cipher signal, doesn't it ? By Jove ! I wonder if it's not as stupid as it looks. The question is——"

" Lend it me for a minute, will you ? " said Blake. " I used to be rather a ' nut ' at deciphering codes in my younger days, but I expect I'm a bit out of practice now ! Let me think a minute. It can't be a simple letter transposition because the groups are real words. That puts all those complicated keyword ciphers out of court, too, and I only know of three other systems in general use. In one of these each word or phrase has its own code word to represent it, so that you need a code book to decipher a message of that kind. I don't think that is the system they have used here, because, you see, in no less than three instances there is a word repeated, and one does not often intentionally use the same word twice running in an ordinary message. Another wheeze is simply to leave the words of the message in clear and mix them up as if you had put them all in a hat and drawn them out

Both seized their hats and made for the Police Station.

haphazard. That, however, is rather a risky practice if any of the words are at all distinctive, and here we have a mixture of four different languages, so I think that, too, is out of the question. The only other system I know of is the simplest of all, and a very favourite one with the amateur cryptographer who doesn't want to be bothered with a key or other paraphernalia. He just puts in a lot of unnecessary letters according to some prearranged plan, so that he gets a series of words which, at first sight, don't look like a code message at all. That is one of the advantages of the system. All the reader has to do is to pick out the letters at stated intervals, when the message appears in clear at once. This is most probably the system they have used here ; at any rate, I mean to try it and see how it works. Let's take the first few words for a start and run them all together so : ' . . . acebyhewdressavervisitenimdiesertravelled . . .' Now put down every other letter. This gives us either ' aeyedesvriieideetaeld ' or ' cbhwrsaevstnmisrrvle.' Neither of those is any good. Now try every third letter. Starting with the ' a ' we get ' aberseitiieree,' which is no better than the other two. The 'b' gives us 'cywearsemerald'—Hallo! What's this? Now, I think, we have found the key." and rapidly he proceeded to write out the remainder of the message.

Faucet, looking over his shoulder, quickly cut up the string of letters into its component words and read as follows: "... cy wears emeralds at ball to-night have motor ready corner of Blackstone Lane 10.30."

Even as he read it the extraordinary nature of the message flashed across the minds of both men, and, as if by a single impulse, each looked at the other and exclaimed "What on earth does this mean?"

Light came rapidly.

"It seems to me," said Blake, "that we have somehow stumbled upon a message meant to be read by no one but the man to whom it was sent. That mention of a motor in the consequent when the antecedent contains the word 'emeralds' is suspicious, to say the least of it. What a pity you didn't get the whole message, Jack!"

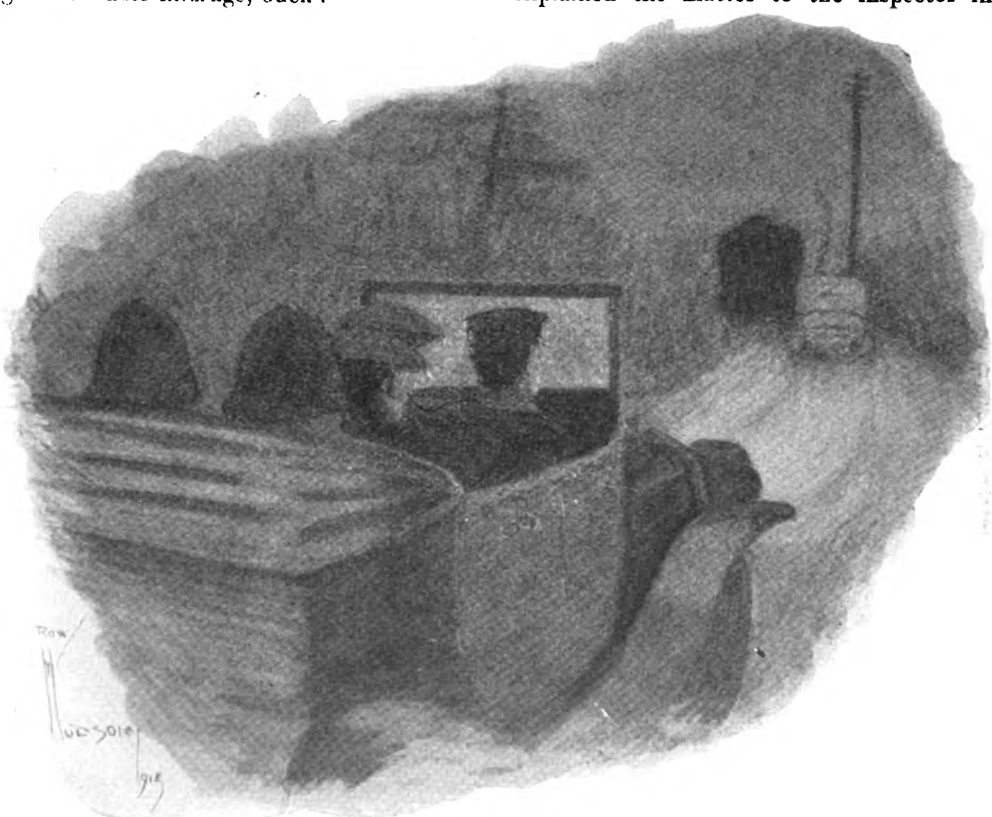
"It certainly does look fishy," agreed Faucet, "but as things stand I don't see what we can do. That '... cy' at the beginning is most tantalising. Anyway, I suppose we ought to let the police know of our discovery and perhaps they may be able to make a better guess than we can as to the missing portion. We'd better look sharp, too. It's nearly 10 o'clock now, and the reference in the message is to 10.30, so we haven't a second to spare."

Quickly Blake turned out the light and locked up the shed, while Faucet went into the house to tell his landlady that they were going out for a short stroll before turning in for the night. As soon as Blake came in, both seized their hats and made for the Police Station faster than either of them had run for the last five years or more.

II.

THE CHASE AND ITS CONCLUSION.

Arrived at the station, Faucet quickly explained the matter to the inspector in



Round a bend in the road there came into sight a lumbering country cart.

charge, who was at first inclined to be sceptical, scenting a possible hoax with unpleasant "consequences" from headquarters. On the other hand, there might be something in it, and, if so, it seemed to offer chances of distinguished service, chances so often wished for, and so seldom obtained, by the police inspector of a small country town. Drunkenness, petty thefts, desertions, and poaching formed the usual routine. But here, to all appearance, was something conceived on a grander scale than anything he had previously dealt with, something that would create a momentary sensation, with perhaps a column in the London papers and certainly a page or more in the local *Gazette*.

Even the wild possibility of seeing his photograph at the head of a lurid description of an exciting chase and capture entered the inspector's head and refused to be dislodged. Chances of promotion, moreover, were few and far between, and his present salary barely adequate to the needs of a steadily growing family. Finally, he decided to take the risk.

The interpretation of the message gave no difficulty. Blackstone Lane he knew well for a lonely country road about 15 miles from Armidale on the main road to Gesborough. It was absolutely deserted at night, and the very place to hide a motor. Close by was "The Grange," the country seat of Lord Dacy, and one of the largest houses in the county. The inspector took down a book and searched for a few minutes. What he found there obviously scattered any remaining doubts as to the genuineness of the message, for there was no hesitation in his manner as he asked the two friends whether they would like to see the matter to its conclusion. With alacrity both accepted, and in a very short time they were seated with two constables in a motor-car rapidly driven by the inspector along the Gesborough Road.

For a quarter of an hour no one spoke as they tore along the deserted road. Half-past ten and they were still five miles from Blackstone Lane, when they saw a large car coming towards them at a speed almost equal to their own. Could that be the car they were in search of, or was it some visitor returning early from the ball?

Quick as thought the inspector slowed the car down until she was almost at a standstill; then steered her across the road as if he were trying to turn round, so that he temporarily blocked the passage of the oncoming car. He could hear the grind of her wheels skidding along the sandy road as her driver jammed the brakes on. Then from within the motor an impatient voice, which the inspector recognised as that of one of the wealthiest residents of Armidale, could be heard inquiring in angry tones what was the matter. An apology from the inspector left nothing possible but a somewhat curt acceptance; the offending car was rapidly turned into her original direction, and both proceeded swiftly on their respective journeys.

"Lost us nearly ten minutes of precious time," growled the inspector, as he looked at the car's clock.

Another minute and they were in sight of the corner where Blackstone Lane entered the main road, and even as they looked they could see a large car without lights move slowly out of the lane and start off down the main road in front of them.

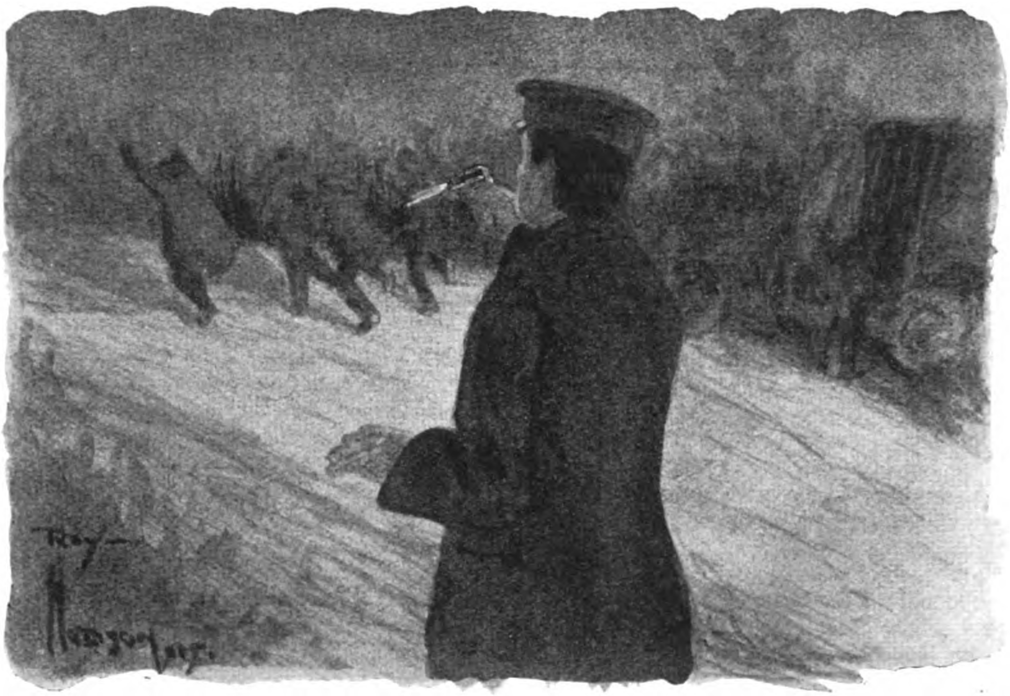
"There she is," came from between the inspector's closed teeth as he gripped the steering wheel and started in pursuit.

At first it seemed as if the occupants did not know that they were being followed, but as the car behind swept past the house without slackening speed and turning in as they expected, some suspicion seemed to cross them that all was not well, and their speed rapidly increased. Soon both cars were travelling at nearly the same speed. A few minutes more and then:

"She's gaining on us," jerked out the inspector as he saw the car in front slowly pull ahead.

Evidently hers were the more powerful engines.

But just at this critical moment the unexpected happened. Round a bend in the road there came into sight a lumbering country cart piled high with produce for the Gesborough market. The driver, with typical rural indifference to other traffic and in conformity with the usual practice of country carts, was calmly occupying the centre of the road. The driver of the first car made a frantic effort on the horn to clear a passage in time. Fruitless attempt to hasten that which was only meant to crawl! The



A shot from the Inspector brought down the lighter man of the two.

horses had scarcely begun to turn their heads when he was upon them. Swiftly he steered to try and pass, but there was no room. One of the front wheels dashed over the path and into the ditch at the side.

Seeing what had happened, the inspector jammed on the brakes just in time to avoid a collision. The fugitives, quickly realising the danger of the situation, quitted the car and made off down the road at their utmost speed. Their pursuers were not far behind.

The chase was short.

A shot from the inspector brought down the lighter man of the two who was in front, while Faucet, who in his college days had always carried off the sprinting races, was more than a match for the other, whom he secured single-handed. Both men were unarmed, having left everything in the car when they abandoned it.

A short search revealed a small attaché case under the seat of the stranded motor, and on opening this the inspector found, lying loose in the corner, the famous Dacy emeralds, which had been handed down in that family for countless generations.

The man in front, whom the inspector soon recognised as one of the most daring and ingenious cracksmen known to the police, was not seriously injured. A very short time saw both men, handcuffed and with a constable apiece, in the police car with the inspector as driver. Meanwhile Faucet and Blake took charge of the other car, and with the help of two horses from the cart soon had her righted and on the road again.

While the inspector with his prisoners returned to Armidale, Faucet and Blake drove back to "The Grange," where they found everything in disorder and Lady Dacy in despair. A few words from Faucet to Lord Dacy, however, rapidly set all minds at ease, and then the two friends between them told the story of the secret message. At its close Lord Dacy came up to them, shook both men warmly by the hand, and expressed his gratitude in words of glowing admiration for the young lawyer's brilliant acumen and ready wit.

There is now a complete wireless station at "The Grange." Under Faucet's direction Lord and Lady Dacy have both taken up the fascinating study, and are now keen amateurs of the new science which saved for them the treasured heirloom of their house.

Photo-Electric Phenomena

The Tyndall Lecture at the Royal Institution on May 1st.

THE Tyndall lectures at the Royal Institution were delivered this year by Prof. Fleming on May 1st and May 8th on the subject of Photo-Electric Phenomena.

As a lecturer Prof. Fleming has few equals. His delivery is emphatic, lucid and continuous. Few men can marshal and collect their facts so well, or use more efficiently the limited time at a lecturer's disposal.

Commencing with the researches of Hertz, published in 1887, on the Influence of Ultra Violet Light upon the electric discharge, he repeated Hertz's experiment, but instead of two induction coils in series he used one with two spark gaps in parallel, one gap being enclosed in a glass box, having above it the second gap, which had a slightly greater length and was not enclosed. When the key completing the induction coil primary circuit was pressed a spark took place at the discharger in the glass box, but no spark at the gap in parallel with it. When a second induction coil in the neighbourhood was working, however, the influence of its spark on the unenclosed gap was sufficient to make this gap spark.

But not only could the light from an electric spark produce this effect, the light from a carbon arc could do the same thing. It is not visible light which is effective in this way, for a glass screen transparent to visible light stops the effect, and so also does a screen of mica. But it is not interfered with by a quartz screen. A magnesium flare showed the effect very strongly, but the light from a candle gave no result. From a knowledge of the substances which permitted or produced this effect it was evident that it must be due to ultra violet light.

Hallwachs in 1888 showed that ultra violet light will discharge a negatively charged plate of zinc, but the experimental results obtained are very much dependent on the surface of the charged plate. Thus, if one side of the zinc is dull and the other is highly polished, ultra violet light will discharge the polished side, but will have only a small effect in discharging the dull side. Prof. Fleming illustrated these results, using a sensitive but very practical form of electroscope of his own invention. In Fig. 1, E is an ebonite stand, B a brass support, A a rectangle of thin aluminium wire, S two silk threads moistened with a solution of chloride of calcium, and C a charging wire. This electroscope gave excellent results, retaining its charge in unionised air for an indefinite period without the necessity of working with it under the usual glass cover. A sheet of copper gauze

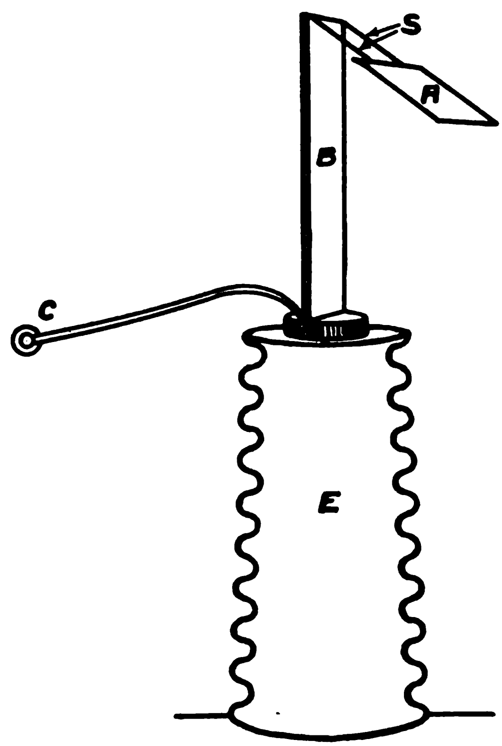


Fig. 1.

charged positively was connected to the electroscope. When ultra violet light was thrown upon it, it still held its charge ; but when the polished zinc was held behind the copper, and the ultra violet light after passing through the copper gauze fell on the zinc, the charge on the gauze began to fall. The ultra violet light set free the negative charge from the zinc which discharged the positive plate. This effect shown by the zinc could be shown by any metal which is highly oxidisable.

The loss of charge is due to the escape of negative electrons from the zinc under the influence of ultra violet light. In this way the material acted on becomes positively charged, and after a time the number of electrons thrown off decreases as those which would otherwise be set free are held back by the positive charge. It is therefore necessary to earth the active plate if the effect is required to be continuous. The resulting flow of electrons causes what is known as the photo-electric current.

The apparatus devised by Prof. Fleming for examining this photo-electric effect is roughly shown in Fig. 3, where S is a spark chamber, the electrodes being made of

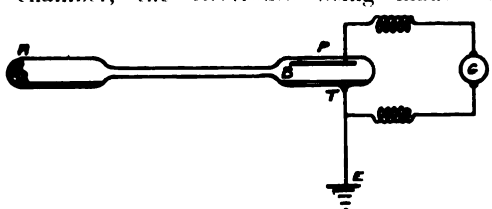


Fig. 2.

invar metal, a non-expanding alloy of nickel and iron. In the base of the chamber is a window of quartz, W, which can be closed by a shutter of cardboard. Below this is a pedestal, on which is placed the plate, P, whose photo-electric properties are to be investigated, and just above the pedestal is a positively charged ring of brass, R. An electroscope is connected to the ring, and an earth connection is made at the plate, and the discharge of the electroscope indicates the flow of electrons set in motion when ultra violet light which is sent off by the spark passes through the quartz window and falls on the plate.

Bodies which are photo-electric exhibit fatigue. Not fatigue in the ordinary sense, which ends in recovery after rest, but a fatigue which shows itself after the bodies have been left inactive, say on a table—for a short time. They have to be scraped and repolished before they recover their old condition.

Materials can be arranged in the order of their photo-electric activity. It is found that this corresponds roughly with their order in the electro-chemical series—the most electro positive elements being the most photo-electric as follows :—

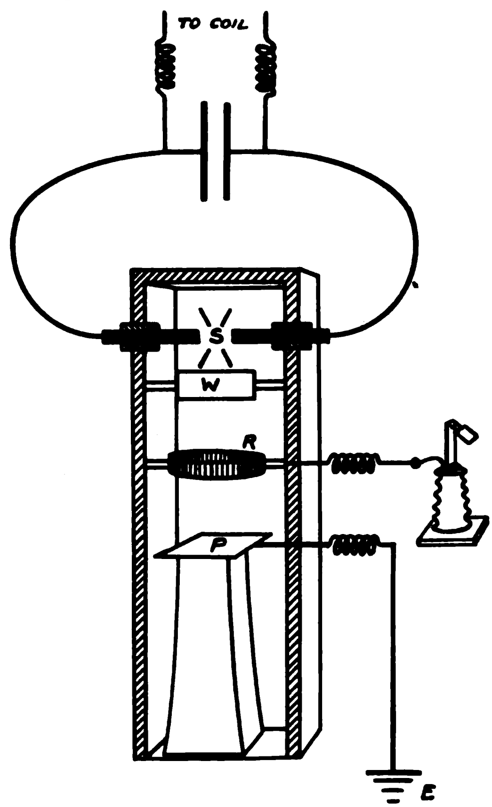


Fig. 3.

Rubidium	Lead
Potassium	Bismuth
Sodium	Gold
Aluminium	Nickel
Magnesium	Copper
Zinc	Silver
Tin	Molybdenum
Cadmium	

Turning to the compounds, Prof. Fleming stated that sulphides were very photo-electric. Galena (PbS) is not conductive enough as a powder to show this effect, but when compressed at 50 tons per square inch into a block it is shown to be very active. On the other hand graphite or plumbago, which has a very similar appearance when polished, will not discharge.

Fatigue is caused by a film of air which settles on the plate like moisture on a glass and prevents the electrons from coming off. A plate left on a table for a few minutes loses from 50 per cent. to 60 per cent. of its activity. For this reason research must be conducted with these plates in vacuum, and a great deal has been done in this connection at Cambridge.

For every substance there is a limiting frequency of light wave-length below which the substance shows this photo-electric effect.

The more electro-positive the body the longer the wave-length which can produce a photo-electric current.

Prof. Fleming made use of a sodium-potassium alloy. He showed a tube, Fig. 2, containing the alloy; parts of each metal were

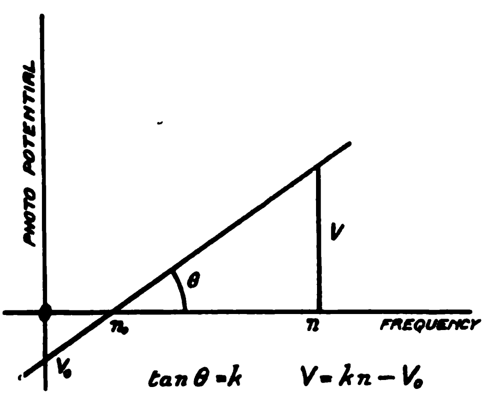


Fig. 4

at one end, A, and the alloy—being a liquid at ordinary temperatures—was run off from the metals when formed, through the reduced part of the tube into the chamber beyond, B, where it made contact with terminals sealed in the glass, T. Above this liquid on the top wall of the chamber was a platinum plate, P, which was connected to a galvo and thence to the alloy which was earthed. In this way the photo-electric current passing between the alloy and the platinum as a result of the influence of light of appropriate wave-length could be measured. The alloy is of an explosive nature and difficult to handle, but is very effective for the purpose of these investigations. Fig. 4 is a diagram showing the photo potential steady rise with increase of light frequency below a certain minimum, N_0, and for every

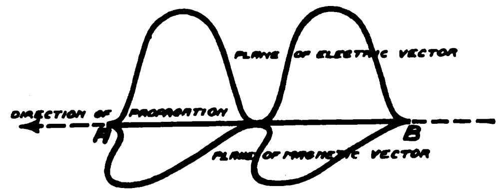


Fig. 5.

substance a constant can be determined given by the relation of working frequency below the limiting frequency, and the voltage.

The velocity of the electrons, or the potential, is independent of temperature and intensity of incident light, but it varies with the manner in which the light is polarised. Prof. Fleming used the sodium potassium alloy to show that no current resulted unless light of a wave-length below a certain minimum was used. Red light caused no movement of galvanometer spot, blue light produced a small movement, white light a considerable movement.

The potassium-sodium alloy is photo-sensitive to visible light, but zinc and magnesium only to ultra-violet light.

Prof. Fleming then referred to some questions on the nature of light. The electro-magnetic theory resolved it into two vibrations in planes at right angles

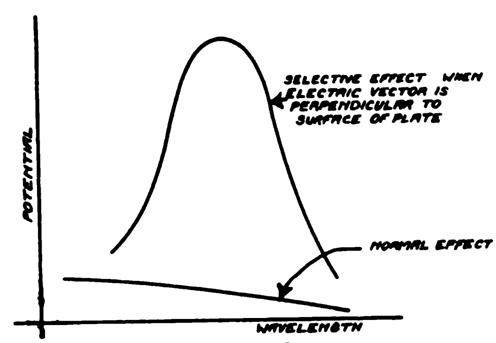


Fig. 6.

to each other. A cardboard model, Fig. 5, served to illustrate this. But instead of the electric vibrations always being in the same plane, one must consider that in ordinary light the plane is always changing, that the wave in progressing has a sort of screw motion. The model must be supposed to move forward and at the same time to turn on its axis, AB. But it is possible to cause light to move in only one plane—to plane polarise it.

Then, if plane polarised light is used, it is found that the strongest effect occurs when the plate under test is in the plane of magnetic vibration, that is the largest deflection occurs when the electric vector is perpendicular to the surface of the sodium-potassium alloy (see Fig. 6).

Oxides are not very photo-electric. Some sulphides are twice as active as polished zinc. Chalco-pyrites or copper-iron pyrites are very photo-electric. All phosphorescent bodies are photo-electric. There is a close connection between the causes of the two effects. But, although many fluorescent bodies are photo-electric, one cannot say that because a body is fluorescent it will also be photo-electric. The connection is not so close as in the case of phosphorescence. Fluorescence transforms radiation of one frequency into another, the light which passes through the substance being different to the light it reflects. To explain electric effects electrons in matter are divided into certain classes. Electric conductivity depends on the presence of free electrons between the atoms moving at a velocity of some 60 miles per second. Under normal conditions these movements are indiscriminate, much the same as a swarm of gnats, but on the application of an EMF these electrons are given a definite order of motion which results in an electronic current.

The question arises, are the electrons sent off by photo-electric activity, these conduction electrons? If it were so, then one would expect the conductivity of a photo-electric body to fall. But in the case of selenium light increases conductivity. Prof. Fleming showed this result by means of an experiment with a galvanometer, two iron wires on a mica plate, and a blob of selenium uniting the two iron wires. The effect of light on the selenium caused a deflection of the galvanometer. Chloride, bromide and iodide of silver also increase in conductivity under the influence of light. Photo-electricity, therefore, must be due to the liberation of the internal electrons from the atoms. There is no difference in conductivity noted in ordinary metals, because the free electrons

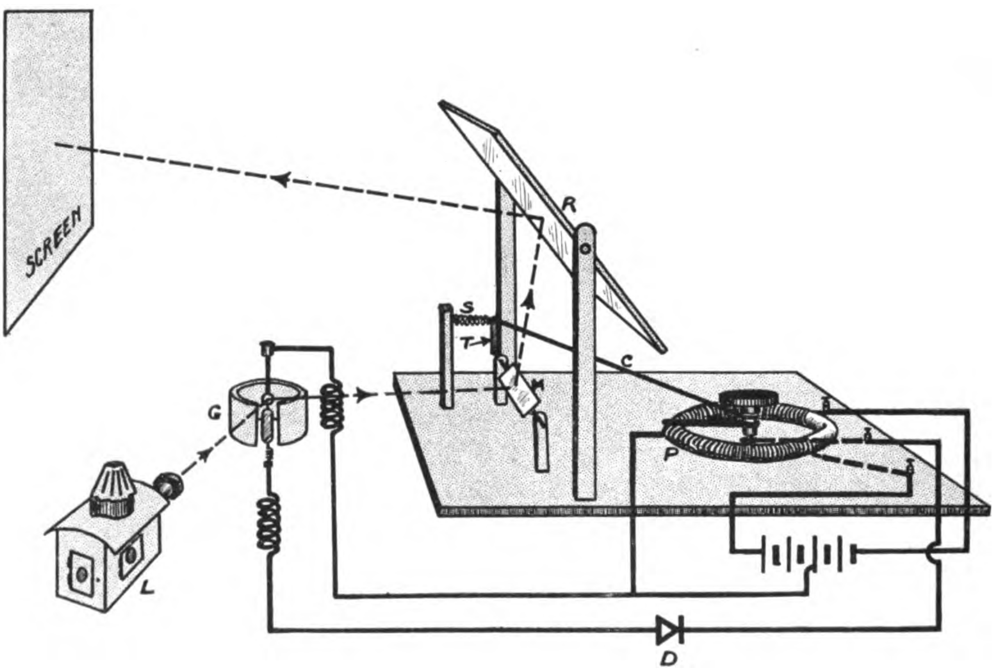


Fig. 7.

are so numerous, their number being of the same order as the atoms themselves, so that any increase of electrons is inappreciable in the total number.

Coming now to the contact potentials between bodies, it is found that chalco-pyrites and zincite conduct much better from chalco-pyrites to zincite than the other way—that is, zincite negative and the chalco-pyrites positive give the best conductivity. A similar effect is noticed between galena and plumbago. Why should these pairs of substances rectify an electric current?

Prof. Fleming has observed that one of the pair is always highly photo-electric and the other is not. Prof. Fleming then described an instrument he had designed and had exhibited recently to the Physical Society for the optical deliniation of curves having two variables, such as current and potential (see Fig. 7). A potentiometer winding, P, has its middle point connected to the middle point of the potentiometer battery. The moving arm is connected to the contact bodies under test and a galvanometer, the circuit being completed at the mid-point on the potentiometer.

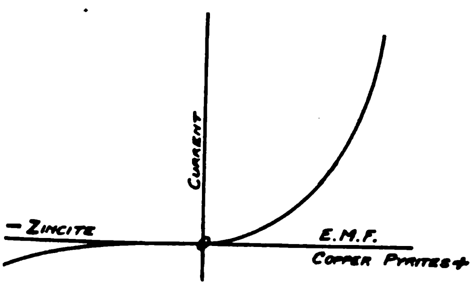


Fig. 8.

With this arrangement the current can be sent either way through the contacts by moving the potentiometer arm to the right or left of the centre.

The current through the contacts, D, deflects the spot of light thrown on the mirror, M, by the galvanometer, and the mirror itself is tilted as the potentiometer is adjusted by means of a cord, C, pulling on the arm, T, against the spring, S, as it is wound up or unwound by the movement of the potentiometer handle.

It had been suggested that the instrument should be called the "Campograph." The combination zincite negative copper pyrites positive known as the perikon detector, has a characteristic, as shown in Fig. 8. Zincite is not very photo-electric, but copper pyrites are distinctly photo-electric. Dr. Eccles has suggested that the rectification effect is due to thermo-electric action. Another theory is that it is a film effect at the junction which acts in the manner of a Lodge coherer. Prof. Fleming suggested a photo-electric explanation. The zincite is reluctant to give up its electrons, but the copper pyrites are ready to give them up. Therefore it is easy to pass a current from the pyrites to the zincite, but not in the opposite direction.

Several theories had been put forward to explain the photo-electric effect. The first one advanced was that the effect is due to resonance. A wave of a certain light frequency corresponding with the frequency of electron vibrations in the atoms would in time increase their amplitude so much that ultimately they would break away from the atom. But this explanation could not be true, as it was not light of one definite frequency which set the electrons free, but all light of a frequency greater than a certain minimum. A resonance effect certainly is suggested by the photo-potential curve for sodium-potassium alloy when the electric vector of the light is perpendicular to the surface.

Another suggestion is that the effect is a trigger action, a small amount of energy setting free a much larger amount. Here, again, one meets with difficulties.

The energy required to pull an electron out of an atom is about one-billionth of an erg, and if there are a thousand billion atoms in a square centimetre and light energy at the rate of one erg per square centimetre per second is applied to the zinc, it would have to be applied for a thousand seconds to pull out one electron. But the effect appears a very short time after the light is applied. Then light energy cannot be spread equally over the surface of the plate. One could explain the effect if the assumption were made that light is concentrated in certain places and in other places there is no light, and thus the total amount of work is done on a few atoms of the substance only, and only a few atoms respond.

This leads to the quantum hypothesis, which assumes that light energy is not emitted in a uniform stream, but in gushes, and in any one gush there may be parts of it concentrated and other parts attenuated so that the concentrated part could do what the average energy of the light could not do were it to be uniformly distributed.

The photo-electric effect then could be explained if there were concentration of energy either in time or space. Such energy could do what uniformly distributed energy could not do. However, a theory of light on this basis breaks down when it is required to explain interference, or the wave extinguishing effect. On the basis of the electromagnetic theory interference is simply explained as the occurrence of the trough of one wave simultaneous with the occurrence at the same place of the peak of another wave so that they mutually wipe each other out. Here the corpuscular theory of light fails.

The theory of Young, Fresnel, and Maxwell explains many light phenomena, such as diffraction, polarisation and interference, but it does not explain photo-electricity. On the other hand the quantum theory explains photo-electric phenomena, but there are many other effects it cannot explain.

Ibero-Roman Intercommunication

Fresh Facilities for Friendly Business Relations afforded by Wireless.

THE linking of Spain and Italy by radio-telegraphy possesses a peculiar interest in view of the close relationship between the two peoples, both with regard to their race and their history. Italy is the home of the Roman Empire, the centre of the civilisation of the ancient European world; Spain, made the base for Carthaginian military operations by Hannibal, and conquered for Rome by the Scipios (father and son) in the third century B.C., formed one of her earliest overseas colonies, and has remained ever since united with her by the closest bonds. The very languages are perhaps as intimately linked as those of any other separate nationalities in Europe.

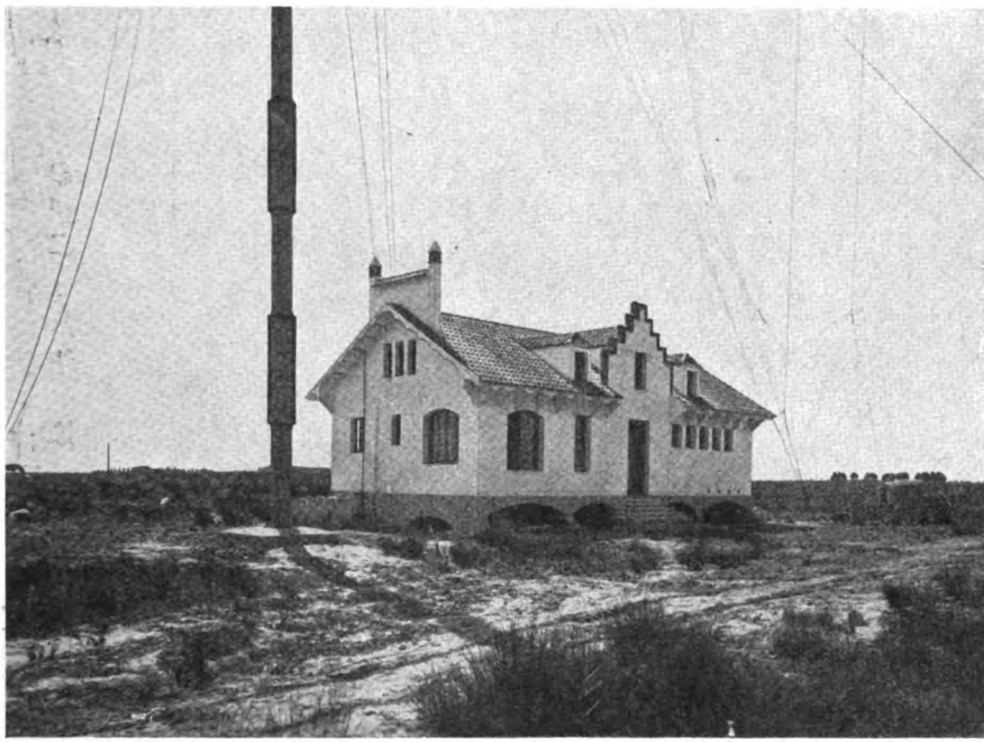
The Spanish station for this service, erected two or three years ago, when Spain first realised the importance of efficient wireless communication, has been located at Prat de Llobregat, near Barcelona—the second largest and most important manufacturing city in Spain; closely linked, moreover, by her history with the erstwhile immense Spanish colonial Empire. It was one of the first Peninsular cities into which printing was introduced. Columbus here received his famous audience by Ferdinand and Isabella after his discovery of the new world. At Barcelona also, as early as 1543, a ship was launched whose motive power was steam. It will thus be seen that this beautiful and prosperous city constitutes a fitting home for the great wireless station which is destined to bind in closer touch the two great Latin Kingdoms.

Although it is probable that the bulk of the Spanish traffic will be transmitted through the Barcelona station, it has also been arranged for the high power station at Aranjuez (near Madrid) to play its part in the communication between the two countries. On the Italian side two stations are to be used for the service—one at Centocelle (Rome) and another at Spezia.

In the days when she was mistress of the world, Rome formed the heart of civilisation, the central point whence radiated the great arteries of administration and commerce, without which no organised community or, indeed, no civilisation is possible. In those pre-Christian days the arteries pulsing the life-blood of trade and intercourse between Rome and the remotest districts of her Empire were her great highways, so famous that much of the world's traffic still follows the lines traced by the original "Roman Roads." Railways have since largely superseded the roads themselves. Hand in hand with their sister services of wired-telegraphy, they have, until recent years, borne the burden of high speed communications, and revolutionised the face of the earth. Now at the end of 2,000 years electric ethereal waves are taking up this task for civilisation, and Rome once more forms the centre of an important system. The Centocelle Station, located within the precincts of the historic "Seven Hills," radiates the ether waves which bind the Queen-mother of Cities with the great Latin Kingdom to whose intimate and historical connection with herself we have already referred. Nor would it be becoming to ignore the fact that the principal part played in the development of this applied science must be placed to the credit of an Italian, Commendatore Guilelmo Marconi, recently added to the historic ranks of the Roman Senate.

Already, during the short time which has elapsed since the installation of this "wireless link," a large amount of traffic has passed to and fro. The service so rapidly developing cannot fail to prove of inestimable value to business men and others in both countries. It must be noted that the new service will not only generally facilitate the volume of communication between the two countries, but will add immensely to its rapidity in view of the fact that despite all the progress of modern days no *direct* telegraphic communication between the two countries has up to the present existed.

In order to ensure greater efficiency and promptitude the Rome and Spezia Stations have organised a co-partnership in working, and it has been arranged that traffic shall pass at certain fixed hours between Barcelona and the two Italian stations alternately. Eventually Aranjuez will play her part in this useful service.



Exterior of Wireless Station Building, Prat de Llobregat, Barcelona.

The ceremony which inaugurated this new development was attended in Rome by the Spanish Ambassador, Señor D. Ramon Piña Y Millet; Señor Almeida, the Secretary of the Spanish Embassy; the high officials of the Ministry of Marine; and the Marquis Luigi Solari, who attended as the representative of Senatore Marconi. In Spain, owing to the distance intervening between the station at Prat de Llobregat and the city of Barcelona, the opening was only personally attended by the high officials of the Post Office and of the Compañia Nacional De Telegrafia sin Hilos.

Both King Victor Emanuele of Italy and King Alfonso of Spain have entered with individual enthusiasm into the scheme. The establishment of wireless communication between these countries owes much to the zeal of their Majesties for the progress of their peoples, and both monarchs have shown a very active interest in the development of wireless telegraphy. The opening ceremony started most fitly therefore with an interchange of messages of true cordiality between H.M. the King of Spain and H.M. the King of Italy. These messages are worthy of textual reproduction, and we accordingly take the opportunity of recording them here for the benefit of our readers.

"Good wine needs no bush." A scene outside a Barcelona inn. Note the vine "bush" hung as a sign outside of what is sold within.

To His Majesty the King, Rome.

"At the moment of the opening of this "new means of rapid communication which "must bind evermore the very cordial "relations happily existing between our "two countries, I send to your Majesty my "most affectionate salutations."

(Signed) ALPHONSE.

To His Majesty the King of Spain, Madrid.

"I thank you infinitely, your Majesty, "for your kind message which you had the "goodness to direct to me on the occasion "of the opening of the new radio-telegraphic "service. I am happy to see that this "new means of communication binds the "cordial relations uniting our two countries, "and I take with pleasure this occasion to "renew to "your Majesty "my most "affectionate "salutations."

(Signed) VITTORIO EMANUELE.

Following the exchange of these two telegrams, a further message was transmitted by His Excellency the Spanish Ambassador to H.M. the King of Spain, as follows:

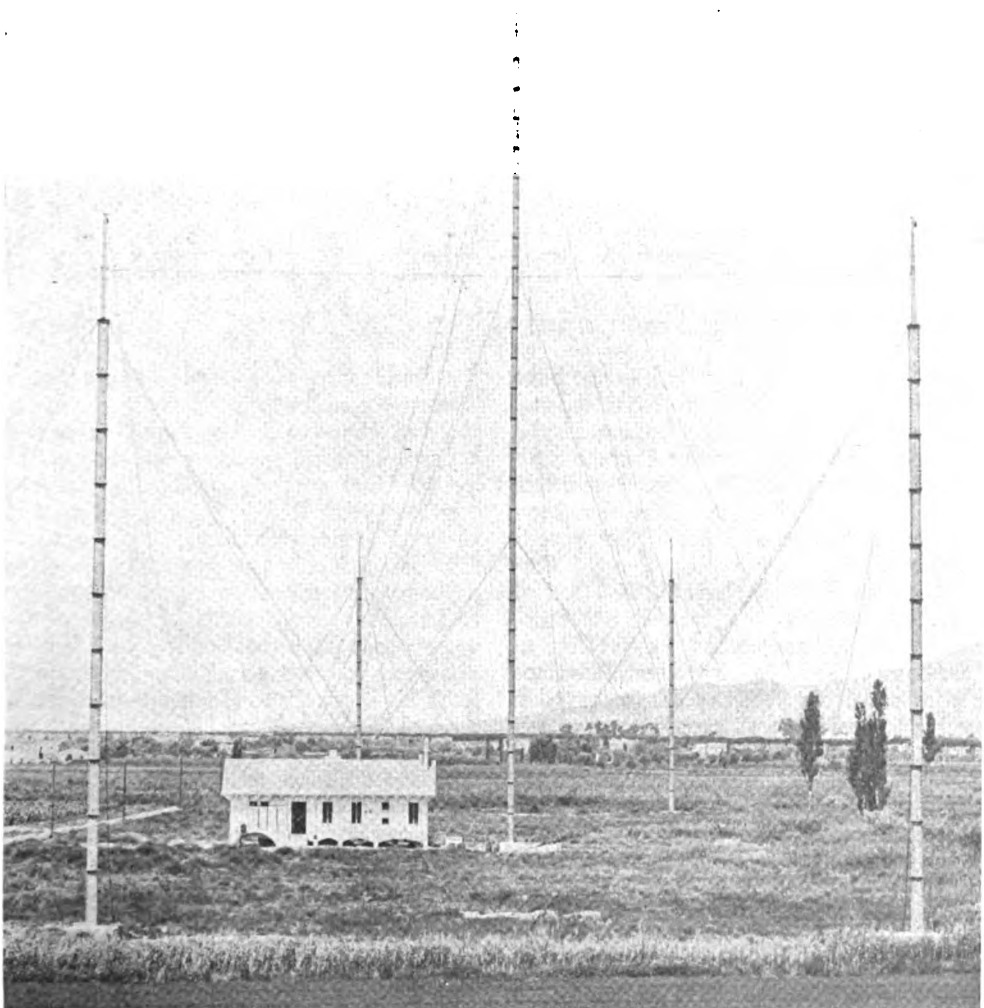
"At the "inauguration "of radio-tele-"graphic com-"munication I "have the "honour to "offer to your "Majesty and "the Royal "Family my "respectful "homage and "personal "adhesion, as "well as that "of the "officials acting under me, and of the "Spanish colony here; all wishes for the "prosperity of the country."

Other telegrams were subsequently transmitted from His Excellency the Spanish Ambassador to the Foreign Office in Spain and to His Excellency the Italian Ambassador in Madrid. Very cordial messages were also received for delivery to His Excellency the Ambassador of Spain in

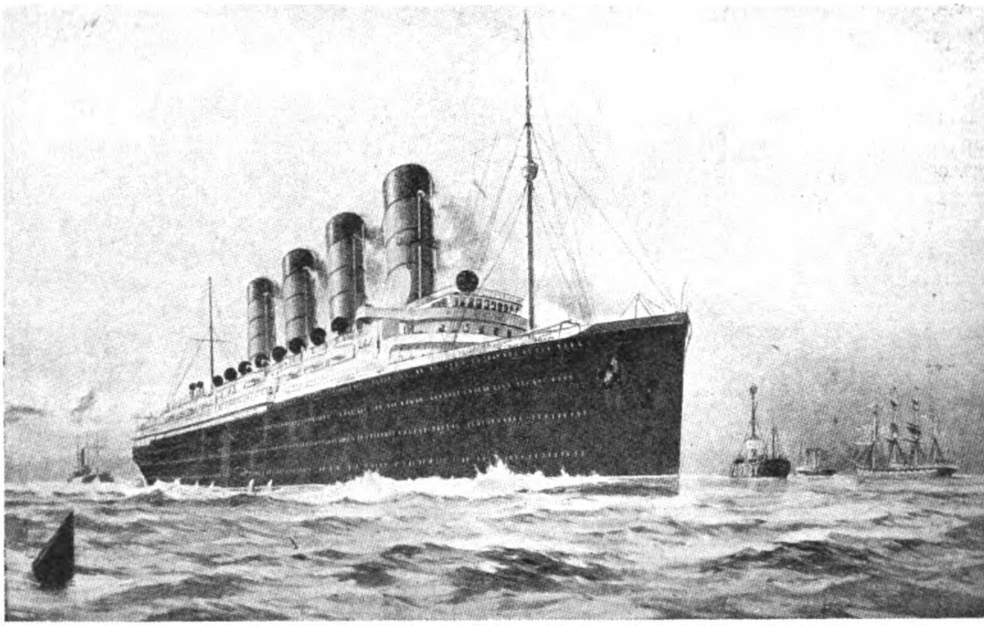
Rome, for Senatore Marconi, and for the Marquis Luigi Solari.

Neither Spanish nor Italian public have been slow in appreciating the facilities which are now open to them. No longer now, as before the opening of the wireless service messages to and from Spain, do messages have to pass over the telegraphic lines of the South of France. These latter, at present overworked in consequence of military exigencies, are relieved of considerable strain, and the rapidity of the new service will not be the least of its advantages.

The message rate has been fixed at 25 centimes (2½d.) per word, and messages can be handed in at any telegraphic office throughout Spain and Italy. Our illustrations depict the exterior of the station building at Barcelona, the disposition of the masts, and a portion of the transmitting plant. Our picture on the opposite page shows the outside of a Spanish posada, with customers sunning themselves on the bench at the doorway. Doubtless, under the vine branches, which still hang in Spain as the sign of an hostelry, they are discussing the passing, thanks to wireless, of *mañana* into *hoy*.



Masts and Station Building, Prat de Llobregat.



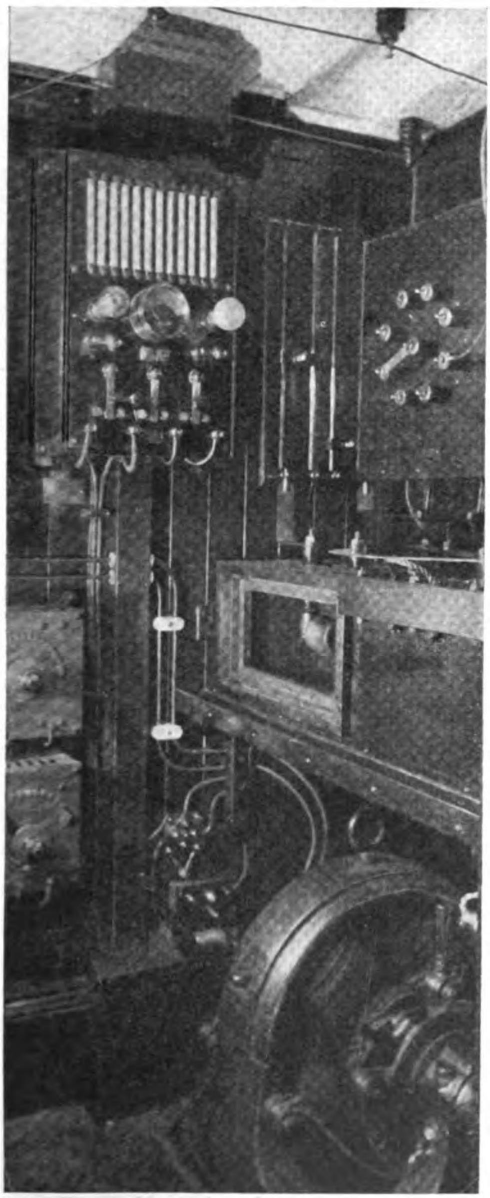
The Crime of the *Lusitania*

A Record of the Facts and of the Part Played by Wireless

FEW incidents in this terrible war have attracted more universal attention and reprobation than the sinking of the *Lusitania* by torpedoes from German submarines on May 7th, 1915. When recording in the *Marconigraph* of May, 1912, the heart-rending disaster of the *Titanic*, which aroused world-wide distress, we little thought that in three years' time we should have to record still another, almost as terrible in its loss of life, occasioned, not by the interposition of "the hand of God," but by the machinations of a jealous rival. The popular imagination has been deeply stirred by the destruction of this ocean leviathan, the materialisation of modern ideals of luxury, unarmed, filled with peaceful passengers—hundreds of them of neutral nationality—crossing on private business and pleasure from the New World to the Old. She left New York on May 1st, and, although a so-called "warning" had been issued (a "surprising irregularity," as Mr. Bryan very justly calls it), nothing was further from the minds of passengers than the imminence of a terrible catastrophe. Twenty-six miles from Queenstown, in the early afternoon of Friday, May 7th, without a word of warning, the vessel was struck by the first torpedo fired. It was soon apparent what had happened, and passengers started making such scanty preparations as were possible in the circumstances. Many of them were in the saloon, in which luncheon had recently been served, and one of the passengers states that having just finished his meal, he went straight to his cabin to fetch his life-jacket. Mounting on deck, he realised the vessel was listing heavily, and two or three minutes later a further tremendous addition to the list was caused, apparently by a second torpedo. From this time it was plain that the ship must go down, and in fact, according to the Captain's evidence at the inquest, she "floated about eighteen minutes after "the torpedo struck, and immersion in "the sea caused the stoppage of my watch "at 2.36½."

On this her last voyage the *Lusitania* carried two wireless operators, their names being Robert Leith and David C. McCormick.

Mr. Leith, who is thirty years of age, and who is a native of Wallasey, was at one time employed as telegraphist on the London and North-Western Railway. He entered the Marconi Company as long ago as 1906, and is therefore one of the most senior men of the service. His experience on the North Atlantic has been gained on some of the finest vessels making the crossing, and few men have spent more time on the ships of the Cunard and White Star Lines. Among the crack North Atlantic liners on which Mr. Leith has served as senior wireless operator are the *Aquitania*, *Lusitania*, *Oceanic*, *Celtic*, *Caronia*, *Franconia*, *Adriatic*, and *Baltic*.



Wireless Transmitter on the "Lusitania."

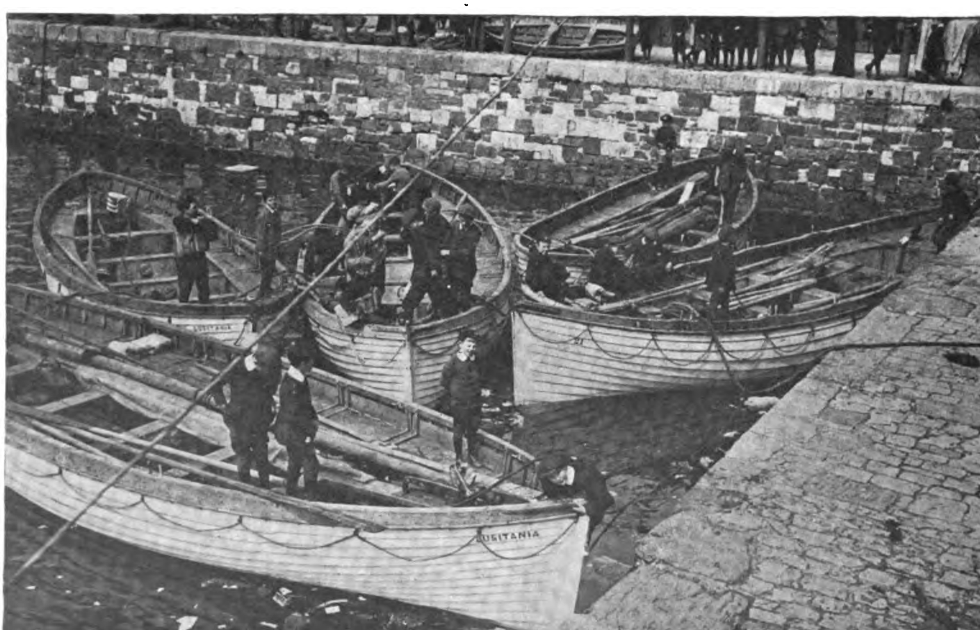
The second operator, Mr. D. C. McCormick, whose home is Glasgow, had previous to joining the Marconi Company been engaged in a solicitor's office. He joined the Wireless Service in 1913, and before being appointed to the *Lusitania* had served on board the s.s. *Ionian*, *Colonian*, *Landon Hall*, and *Warwickshire*. He is twenty years of age.

The voyage up to the time when the first impact was felt had been entirely uneventful, and the wireless operators had carried out their duties as usual. Their conduct throughout appears to have been in accordance with what has now become the *Marconi tradition*. They remained at their posts until the last useful moment, and everyone will be glad to hear that they eventually reached shore in safety. Before the sitting of the Board of Trade Enquiry, under the presidency of Lord Mersey, it is impossible to say just what transpired in connection with their duties; but, in answer to enquiries made in the House of Commons, Mr. Churchill, after pointing out that the reserves at the disposal of the Admiralty would not permit them to supply escorts for all merchant or passenger steamers, said that the Admiralty "had a "general knowledge that a German warning "announcement had been made. From that "knowledge, and from other information of "submarine movements, we had sent warn-"ings to the *Lusitania* and directions for her "course." Supplementary questions asked by Lord Charles Beresford caused the Premier to reiterate the attention given by the Government to German threats; and Mr. Churchill added for the gallant Admiral's benefit that "so far from his warnings being "unheeded, a great many of the measures he "advocated had already been applied on the "largest possible scale." Captain Turner, answering the Coroner's question, stated that, whilst not at liberty to say what the special instructions were that he received, such instructions did not fail to reach him and were carried out to the best of his ability. He also made the statement that he was "in wireless communication with "the shore all the way across."

The senior operator, Mr. Leith, at the time of the impact of the torpedo, was lunching in the saloon, the junior operator being on watch. Mr. Leith tells us that when he came down, a lady on his left remarked that he was late and would not get any lunch. These words of jest came strangely true, for they had hardly been spoken when a dull crashing thud was heard, and it became evident that something serious had happened. Realising that his presence was needed in the wireless cabin, Mr. Leith immediately jumped up from the table and made his way to the upper deck. On arriving in the wireless room he found that his assistant had made everything ready for the distress call to be sent out, and in a moment the famous signal was being made. The SOS call was sent out continually, until it was evident that nothing further could be done; then *and then only* the wireless operators gave a thought to their own safety. Mr. Leith was able to jump some distance into a partially submerged lifeboat which had been launched, and later transferred to another when it seemed that a funnel was falling on top of the occupants. The aerial wires also fell on the boats and to some extent impeded them.

One incident in Mr. Leith's story deserves particular attention. He states that in the second lifeboat unlaunched to which he transferred the ropes holding the boat to the derricks of the *Lusitania* had not been disconnected. An American passenger, Mr. Collis, by the aid of only a small pocket-knife, managed with considerable difficulty to sever these ropes and thus cut the boat away. Had it not been for this prompt and cool-headed action, the boat with all its occupants would have been dragged down with the sinking liner. Among the many fine deeds which have come to light in connection with the disaster, this certainly deserves a prominent place.

After a considerable time in the water, Mr. Leith was picked up by the fishing-smack *Wanderer*, of Peel, and afterwards taken aboard a paddle-boat which had put out from Queenstown in response to the calls for assistance. It was not before a quarter to ten at night that Mr. Leith was put ashore in Queenstown and was able to rest after his terrible ordeal.



Some of the "Lusitania's" Lifeboats in Queenstown Harbour.

Mr. McCormick, who, as mentioned above, was in the wireless cabin at the time of the explosion of the torpedo, has also told his story. He states that at the moment of impact of the torpedo he heard a dull heavy thud, and a number of unsecured articles disposed about the wireless cabin came clattering to the floor. The impression gained in these first few moments was that heavy guns were being fired in the immediate neighbourhood. A few minutes later it became apparent that the *Lusitania* had been torpedoed. As soon as it was useless to remain longer in the wireless room, Mr. Leith and his assistant came out on to the boat deck to see what means there were of escape. Mr. McCormick, who was the possessor of a hand camera, crawled along the heavily listing deck and took a photograph of the scene forward, but unfortunately his film was not rolled back, and when the camera came to be immersed in the water the sensitive surface was naturally destroyed. In making their arrangements for escape there was no attempt at the dramatic, and Mr. McCormick states that Mr. Leith and he did not even say good-bye to one another. Just before leaving the ship the two men lost sight of each other, and did not again meet until they had been safely landed at Queenstown. Mr. McCormick most emphatically denied that he saw any signs of panic on board, and, although one or two passengers were excited, such conduct seemed to be the exception rather than the rule. His statement in this respect has received noble confirmation from the *sang-froid* displayed by the American millionaire, Mr. Alfred Vanderbilt, who devoted the few moments at his disposal, and that of his man, in a successful endeavour to collect as many children as possible for placing in the boats. By this time the *Lusitania* had listed to a very acute angle; so extreme, in fact, that many members of the crew were able to walk down her starboard side into the sea. After this Mr. McCormick's memories became confused, and nothing but hazy recollections of clinging to a collapsible boat, after escape from the suction caused by the engulfing liner, remain to him until his rescue by a torpedo-boat late in the afternoon.

Mr. R. Leith, Senior Operator.

Mr. D. McCormick, Junior Operator.

The famous SOS call naturally played its part in this tragic drama, and some of the papers have reproduced the dots and dashes which go to make up the signal. We are sorry to notice, however, that in some cases the old illusion with regard to its meaning is also reproduced. It is perhaps hardly necessary to remind readers of THE WIRELESS WORLD that the signal was chosen without regard to any significance which might be attached to the individual letters SOS. The three dots, three dashes, and three dots which constitute the distress call are not transmitted as indicating the initial letters of any dramatic sentence (such as "Save our souls," "Send out succour," etc.), but simply make up a rhythmic call which is distinctive from other signals used in wireless telegraphy.

Such are the sober facts of the case; but imagination is allowed to play round mere "Fact" and often goes more nearly to the "heart of things" than do the prosaic realities. Although the great liner now lies beneath the waves, her engines stilled for ever, her dynamos at rest, and her emergency apparatus out of action, she still continues to send her message to the world. SOS may not inaptly be interpreted "Send Out Soldiers," soldiers of righteousness, to crush the infamous Huns whose foul deed cries aloud for vengeance.

Wireless Telegraphy in the War

A résumé of the work which is being accomplished both on land and sea.

WE have had occasion in these columns recently to make several references to *German wireless lies*. Our remarks have been directed towards disabusing our readers of any implication contained in the linking of *wireless* with *lying*. Our German enemies have simply made use of a medium of communication which the present war has proved to be the most reliable from the point of view of any interruption. That they have abused it is only what is to be expected of them. Our daily contemporary, the *Express*, has on several occasions recently pointed out that despite the unreliability of the German messages through the tainted nature of their source, the excellence of their medium has resulted in their reaching the columns of the Press in advance of our own announcements.

* * *

The *Express* has catalogued quite a series of important events thus announcedby wireless ahead of its rivals. In this catalogue figure the British gain of Hill 60, where wireless news was twenty-four hours ahead; the crossing of the Yser and the capture of Lizerne, where it anticipated news from other sources by twenty-four and six hours respectively. In the case of the blockade of the Cameroon coast wireless sources announced it on the 25th April, whilst it did not appear in London until the *London Gazette* notified it on April 27th. These are only a few of the more recent instances which go to show the promptitude of transmission and suitability of the medium for rapid dispatch.

* * *

Our German opponents, who are responsible for popularity of the phrase, *wireless lies*, have added to the "gaiety of nations" recently by a very amusing case in point. Their official wireless intelligence detailed the statement that the submarine *U* 29, which was recently sunk, was engaged at the time in rescue work. This Teutonic explanation sounds more than a little far-fetched. There has been no single instance during this struggle of any German war vessel engaging in rescue work, whilst, on the other hand, there have been many instances of the destruction by such vessels of the lives of helpless non-combatants and even of unsuspecting neutrals. Besides, how came the German Government to know the details of how the *U*29 was sunk? None of the crew returned to tell the tale, and nobody else would be likely to carry the news to Berlin. It is, therefore, very apparent that the controllers of the German wireless do not make a practice of waiting for authentic information, but in default thereof extract their news from their own fertile imaginations.

* * *

An interesting variation in the use of ship's wireless is narrated by Captain W. J. King, of the Aberdeen barque *Invercoe*, which was sunk by the *Eitel Friedrich*, off the Brazilian coast. The information appears to have been given to a newspaper reporter at Newport News, U.S.A., after the internment of the German cruiser. Captain King says:—

"Do you know what they did with their "wireless? They rigged up an eight-foot "kite, used the thinly-drawn wire of Lord "Thompson's sounding machine, made that "fast to the kite and attached it to the "wireless receiver. Then every night they "would send up this kite and catch every bit "of wireless that was going. Their wireless "could send only 900 miles, but by the use "of this kite arrangement they could hear "up to 2,500 miles. The wireless news that "was picked up in this way was written out "in German and put on a bulletin board. "In that way we heard all about the forcing "of the Dardanelles, the fire on board the "*Touraine* and other current news. These "kites had to be flown against the wind, and "on sending them up the course of the ship "had to be altered so as to bring the wind "ahead. They lost sixteen of these kites "while I was on board, due to the wind

"Ophelia" Trial.—Sir S. Evans (President) is examining a Chart, whilst Dr. Pfeiffer (Commander of "Ophelia") stands in the Witness Box.

"suddenly shifting and the kites tumbling "down into the water. But they had "material enough on board to make as many "more as they wanted."

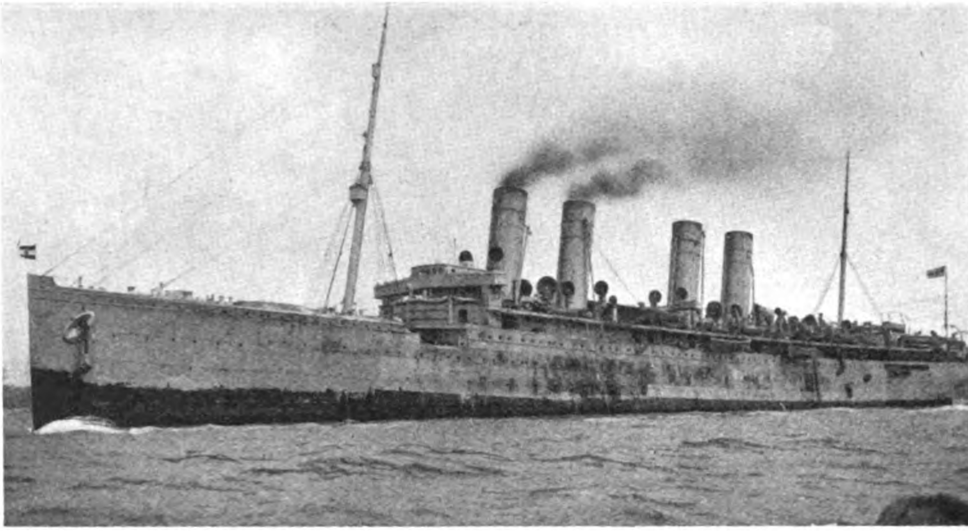
We must decline to vouch in any way for the accuracy of Captain King's statements and figures; but give his account "for "what it is worth"!

* * *

The evidence in the case of the German hospital ship *Ophelia*, the "Mystery Ship," as some of the newspapers call her, deserves careful reading *in extenso*. The evidence of Lieutenant F. T. Peters, R.N., of H.M.S. *Meteor*, indicates that the circumstances attending the destruction of the more important wireless log was considered sufficiently suspicious to instruct him to dismantle the radio-telegraphy apparatus, and order the *Ophelia* to follow H.M.S. *Meteor*. Mr. J. A. Cox, the leading telegraphist in H.M.S. *Lawford* indicated the way in which skilled operators are able to judge the distance of a station whose calls are being received by them. He "heard a loud signal in code on the 300-metre wave and judged it must have been transmitted from a ship not more than ten miles distant." It was answered from "KA..V.," which he knew to be the call sign of the Norddeich station. The plea advanced by the captain of the *Ophelia* that only two communications had been received by wireless—one in code and one open—would appear to be inconsistent with the fact that on October 10th the vessel made a special stay of ten days at Hamburg for the purpose of allowing her masts to be lengthened so as to improve her wireless range. The Germans do not usually spend time and money in improving installations which are not intended to be used. The only wireless log which was seized by the British had been kept on loose sheets, and contained no entries except Press reports. The conclusion is inevitable that the other wireless log, thrown overboard with her papers, contained all entries of importance.

* * *

Some interesting evidence was given by the *Ophelia's* wireless operator, a man named Grau, who stated (in contradiction of the evidence of Dr. Pfeiffer) that he sent several wireless messages while the ship was at Kiel. Naturally he professed that they were harmless, and merely concerned the ship's equipment; but the admission was in itself significant. Grau stated that, on the voyage

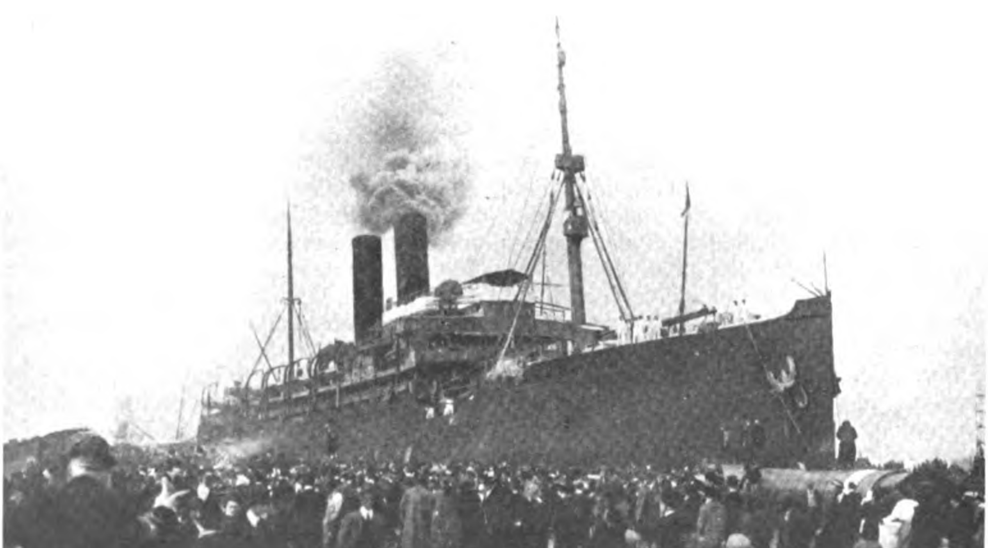


S.S. "Kronprinz Wilhelm," now interned in the United States.

from the Canal to Heligoland, no wireless messages were received, although he acknowledged having taken messages from the *Wurthemburg*, which he called "the head hospital ship." The same witness stated that there was a secret wireless code for the German Imperial Navy, and a separate secret code for auxiliary and non-combatant ships. According to his evidence, the warships were put in possession of both codes, but non-combatants did not receive that of the Imperial Navy. On being pressed by the President of the Court with regard to the codes he had been in the habit of using, he shuffled considerably, and finally took refuge in a plea of ignorance.

* * *

The British Press have been announcing recently that the Germans have secretly trebled the strength of their wireless plant



"Prinz Eitel Friedrich" at Newport News.

at Sayville, Long Island, U.S.A. The enemy would appear to hope that the erection of three 500 ft. towers there will secure them a continuous service between America and Germany under all static conditions. It would seem that one of the chief complaints made by the captains of the *Prinz Eitel Friedrich* and the *Kronprinz Wilhelm* has been the difficulty encountered by them in securing instructions from the German Admiralty owing to the irregularity of the wireless service.

Those genial tergiversators of the truth, Count Bernstorff and Herr Dernburg, also complain of having been handicapped in the " diplomatic work " of presenting their courteously framed official messages to the United States. There is hope, however, for the Americans yet ; for should this wireless plant, manufactured in Germany and transported to the States by the Holland-America Line, prove successful, no doubt they will have ample opportunity of learning their duties to humanity by the official teachings of the " Apostles of Kultur." Sayville appears to be a somewhat out-of-the-way spot, so that the people in the neighbourhood generally seem quite unaware of the arrangements being made to transform the station. Doubtless President Wilson and his colleagues are well aware of their obligations with regard to neutrality, but at first glance such proceedings would appear to be somewhat straining the rights of belligerents in a neutral country.

* * *

One of our daily contemporaries recently published a long account of a visit by its accredited correspondent to the British armies in the field. We cull the following extract from his report :—

" I saw romance of the very latest type— " more wonderful in many ways than that " of Perseus and the Greek heroes—in a " field of France not far from where I " write. Outwardly there was not much to " see—a tall, bare pole attached to earth " by wires, with a wooden hut beside it. " But that pole had more magic in it " than a wizard's rod, and the wooden hut " was a receiving house of astounding " secrets. Here was a wireless station " and while I stood there the officer in " charge brought out a flimsy piece of " paper on which had been recorded the " latest messages gathered in from the " vibrating waves of air which had come " whispering to the wires of the tall pole. " They were the official bulletins of war " issued by the enemy and intended for " publication on our side of the front. A " little while later in the day the receiving " instrument in a wooden hut would record " messages sent by ' wireless ' from British " aeroplanes flying on reconnaissance over " German lines."

Effect of Shell-fire on Trenches at the Front.

* * *

In connection with the *Falaba* outrage, we learn from the New York correspondent of a London paper that the pirate in charge of the operation was Commander Schmidt, of the German submarine *U 28*.

INSTRUCTION IN WIRELESS TELEGRAPHY

(Second Course)

(XI.) The Receiving Circuit.

[The dislocation of our arrangements, due to the war, has prevented us from completing, in our last Volume, the second course of Instructional Articles. These are being continued in the third Volume, and we hope to arrange for the Examination (full particulars of which are given on page 333 of our issue of August, 1914) to be held in the early autumn of this year. The present is the tenth of the second series of articles, which will deal chiefly with the application of the principles of wireless telegraphy. Those who have not studied the first series are advised to obtain a copy of *The Elementary Principles of Wireless Telegraphy*, which is now published, price one shilling net, and to master its contents before taking up the second course of instruction.]

763. The Detector.—At the present time by far the larger number of detectors in use are of the type usually termed "crystals," and these will, therefore, be treated first.

The term "crystal" is a convenient one to use, but it is to be noted that not all crystals are suitable as detectors, and the value of any particular type of crystal depends rather on other qualities than its crystalline form. A more general term is "contact detector," which, however, includes the various forms of coherers.

764. Most of the crystals in use are native minerals, such as zincite, galena, etc., used in the state in which they are found without any chemical or other treatment; one or two are chemical elements, more or less pure, as silicon and tellurium; and some are manufactured products, such as carborundum.

765. The action of a crystal as a detector of wireless signals is fully explained in the instructional articles in the December, 1913, and January, 1914, numbers of THE WIRELESS WORLD.

In these it is shown that this action depends on two properties of the crystal.

(1) If a potential be applied to a crystal, the current in one direction is many times that given when the sign of the applied potential is reversed.

(2) The current is not directly proportional to the applied potential, as it is for an ordinary metallic resistance, but the ratio between them varies with the value of the potential.

The actual detector consists of the crystal and whatever is used to make contact with it, which may be a metallic surface or point or another crystal.

766. If a curve be plotted showing the relationship between the current flowing through any material and the applied potential, this curve is termed the characteristic curve of the material.

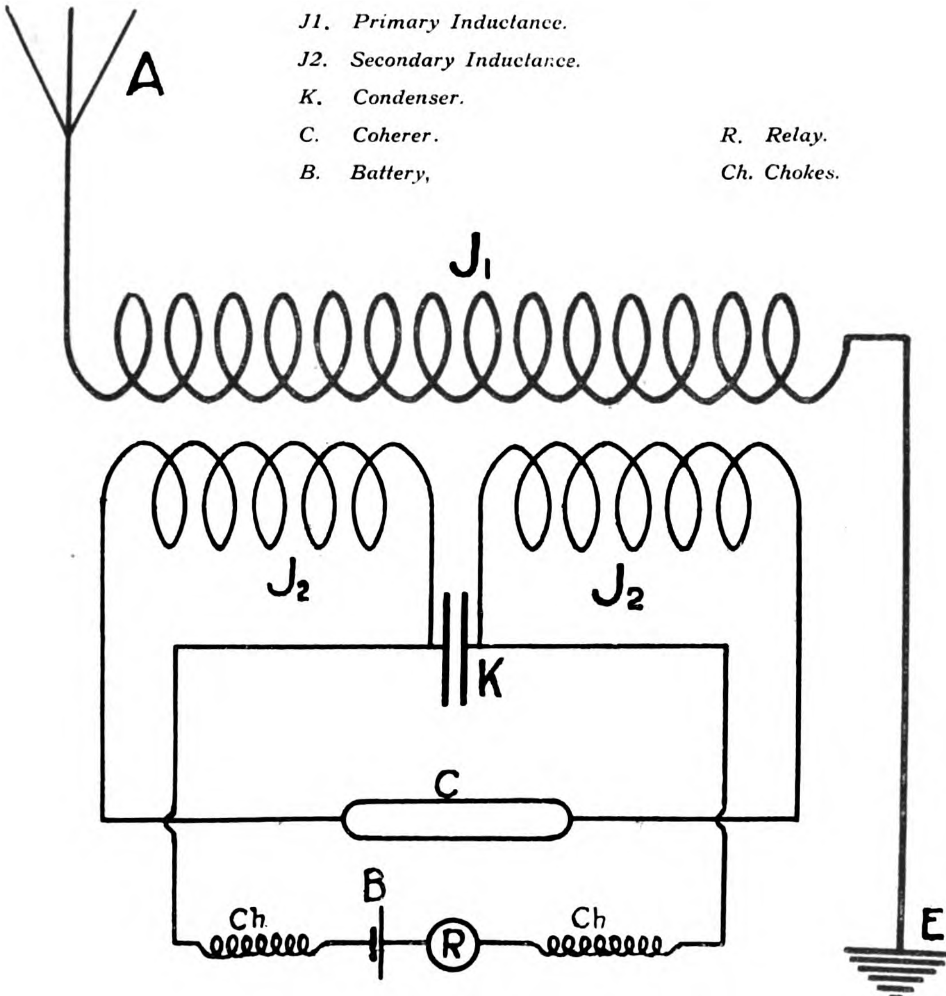
Metallic conductors and other materials of which the resistance does not depend on the current-density, or which, as it is termed, "obey Ohm's Law," have a straight line for their characteristic curve, but crystals and other contact detectors give characteristic curves of varied forms.

767. The theory of the action of a crystal has not yet been fully worked out. The subject presents some difficulties, since it is probable that for many crystals the rectifying property on which their use as detectors depends is due partly to impurities which are present in the mass of the substance and also to the state of the surface at the point of contact—*i.e.*, whether it is covered by a thin film of oxide, sulphide or other compound differing from the composition of the bulk of the specimen.

It has been pointed out also that a proper study of the action must be made using currents of the strength met with in actual practice, which, as is known, are very small and not so easy to measure as larger ones would be. Hence the conclusions reached by some observers cannot always be held to apply to the actual conditions under which the crystals are used as detectors owing to the large currents used by them. Moreover, for many substances it is difficult to keep the sensitivity constant for any length of time.

768. Dr. W. H. Eccles has done a large amount of work on this subject, both experimental and theoretical.

In a paper published in the Proceedings of the Physical Society of London, Vol. XXV., and abstracted in the *Electrician* for September 5th, 1913, and THE WIRELESS WORLD for July, 1913, he has put forward a theory of the action of contact detectors in general. The theory has the merit of dealing with effects which are well known instead of phenomena which have only been partly investigated. A short account of this theory will be of use, not only because it appears to be accepted by a number of physicists, but because it gives an idea of the various methods which might be adopted to attempt to increase the sensitivity of some particular detector.



769. Dr. Eccles shows that the various electrical and thermal phenomena which occur when a current passes across the contact between two conductors can be represented by the terms of an equation, and the various forms of the general equation, for different relationships between the terms, give curves similar to the various classes of characteristics given by detectors.

770. The chief physical effects which occur when a current flows across the junction of two bodies, A and B, are as follows :—

(i.) Heat is generated or absorbed in accordance with the law of Peltier.

The Peltier effect is as follows: When a current flows in a circuit which includes conductors of different materials—*e.g.*, antimony and bismuth, then at the junctions of these two materials heat is liberated or absorbed from the surroundings, and its amount depends on the nature of the two materials. If heat is developed at a junction with the current flowing in one direction, as from antimony to bismuth, then the same quantity of heat will be absorbed when the current flows from bismuth to antimony.

771. (ii.) Heat is developed according to Joule's law.

If the two materials, A and B, are poor conductors of heat and electricity (which is usually the case for detectors), then not only will the amount of heat be relatively large (due to the high resistance), but it, together with any developed by the Peltier effect, will not be dissipated by conduction, but will cause a rise in the temperature of the junction and a local heating will take place.

772. (iii.) It is well known that the resistance of all metallic conductors changes with the temperature, becoming higher for higher temperatures.

The resistance of the materials we are considering also changes with the temperature, but the coefficient of change of resistance is often very large. For many substances the resistance decreases with increase of temperature. Due to this cause, the resistance is seen to depend on the magnitude of the current flowing.

773. For bad conductors of heat the temperature gradient at points near the junction will be steep—*i.e.*, the temperature will vary rapidly at points near the contact.

It has been shown by Lord Kelvin that when a current flows from a colder to a hotter part of a conductor, or *vice versa*, a transfer of heat takes place. In some materials the transfer increases the temperature-difference when the current flows from the colder to the hotter part of the circuit, and in other materials the reverse holds. When the current is reversed, the direction of transfer is reversed. Due to this, the temperature gradient will not be that due alone to the conductivity for heat of the materials, but will depend on the current flowing, since the heat transfer is proportional to this current. When the transfer is such as to increase the temperature at the junction, those effects which depend on this temperature will be enhanced.

774. In his paper Dr. Eccles states that the thermo-electric properties of substances like pyrites, zincite, etc., are difficult to measure accurately, as also are the coefficients of change of resistance with temperature, but, from measurements made, he finds that they are usually larger than for metallic conductors. The temperature resistance coefficients are large and negative for the substances examined.

It is to be noted that the change of resistance with temperature is sufficient by itself to account for all the principal features of the action of the single point coherer (which is a special form of contact detector). A paper by Dr. Eccles on this subject is to be found in the Proceedings of the Physical Society, Vol. XXII., page 869, and *Electrician*, August 12th and 19th, 1910.

775. In addition to the above, various other effects have been brought forward to explain the action of this class of detectors, and probably the complete theory would find place for all these effects.

One theory is as follows: If two conducting bodies are placed very close together, without actual contact, and have a difference of potential established between them, then they will attract each other electrostatically, and if they are separated by an extremely minute distance the force of attraction may be very large, even though the charging voltage is small. It is evident that this large force may modify the conditions at the junction and might influence the passage of the electrons to which the current is due over the interface. If the two conductors were separated by a film of, say, oxide, the resistance at the contact might by this means be varied over a wide range.

776. It will be readily understood that by applying an independent potential to the detector the sensitivity can be increased in many cases, since the various effects enumerated above depend on the magnitude of the current flowing, and a certain value of steady current will give a maximum amount of rectified current, due to the applied high-frequency potential.

Moreover, since the effects are essentially local round the contact, the pressure between the two bodies and the area over which they are in contact has a great influence on the sensitivity. Many substances require a very light contact with a fine wire for best results, and, due to this, are often very variable in action, since the slightest mechanical vibration alters the pressure and modifies the current-flow at the junction.

The pressure not only modifies the area in contact, but also might alter the thickness of some surface layer at the interface. Some experimenters have noticed that immersing a particular detector in oil or other liquid improves the sensitivity, which is probably due to the alteration in the temperature effects.

The rectifying properties of many detectors are localised in spots on the surface and not general over it, and in practically every case considerable variation in sensitivity occurs in different specimens from the same mass.

The majority of crystals are injured by heating, and for this reason it is usual, when it is required to set them in cups, to use low-melting fusible alloy. The object of setting the detectors in cups is to reduce the resistance of that part which is not concerned in the rectification and to provide a convenient means of fixing in the adjustable crystal clips which are used.

Some crystals, such as carborundum, will stand being mounted with ordinary solder.

It is possible to increase the sensitivity of certain detectors; thus, in an article on "Characteristics of Crystal Rectification," in the December 11th, 1914, number of the *Electrician*, Mr. Flowers mentions that by treatment with hot sulphur sensitive spots can be made on galena crystals.

There is room for much experimental work in connection with crystal detectors before a complete explanation is available. The work is difficult, owing to the fact that for many of them the sensitive portions occur in small spots and not throughout the crystal, and it is difficult to determine the difference, between these spots and the surrounding material, to which the sensitivity is due. Those who are interested will find a list of papers on the subject in a paper by Mr. P. R. Coursey, Proceedings of the Physical Society, Vol. XXVI.

The usefulness of any particular substance as a detector can only be ascertained after a trial with several samples over some time, since this largely depends on a balance between the sensitivity and reliability for different conditions.

777. The Coherer.—It is not proposed to give a complete account of all kinds of detectors here, but only of those of general interest to those for whom these columns are more particularly intended. Although for practical wireless telegraphy the coherer is obsolete, yet it still finds employment for particular purposes, such as the fog signalling apparatus described in the June, 1914, number of THE WIRELESS WORLD.

The property of a coherer which renders it useful for this purpose is this, that whilst most other forms of detector act by converting part of the electromagnetic energy received by the aerial into useful signals, in the coherer this energy is not directly so used, but employed to put the detector into such a condition that a current can be sent through a circuit from a local battery. The strength of this current can be adjusted by suitable means, and it can be used to actuate mechanisms, such as the relay which works the balance-wheel of the fog-signalling apparatus mentioned above, or the ordinary Morse Inker.

Although the coherer itself is less sensitive than the ordinary crystal detectors, yet, given sufficient energy in the aerial, it is better adapted to work a relay than they are. Hence the use made of it for the distant control of apparatus.

778. In paragraph 768 above mention was made of a paper by Dr. Eccles in which an hypothesis of coherer-action is put forward with special reference to the form consisting of an oxidised steel point dipping in mercury.

This is briefly as follows: When a train of high-frequency oscillations passes through the surface between the two masses which constitute the coherer, the minute film of oxide at the junction is heated and its electrical resistance is lowered. The lowering of the resistance allows a larger current to flow, the equilibrium of the direct current from the local battery being disturbed.

Dr. Eccles has shown that the equations which express the above facts give rise to curves which follow those actually obtained from coherers.

There are one or two forms of coherer for which the theory is not exactly suitable.

Thus, in the Lodge-Muirhead-Robinson

form, in which a greasy steel wheel revolves in contact with a globule of mercury, it is the breaking-down of the film of oil by the signals to which the action is due. Coherers are of two forms, those which after the passage of a signal require to be brought back to a sensitive state and those which do not. The usual method for rendering the first class sensitive is to provide a tapper, which may be similar to an ordinary electric bell. This can be arranged to work off an independent battery, in which case it is always in action, whether signals are coming or not, or a far better method is to wind the coils so that they can be actuated by the same current, from the relay associated with the circuit, as is used to work the apparatus. In this case the tapper only works when signals are received.

The coherer is an instrument which requires great care in making in order to obtain it sensitive and reliable. The usual form consists of a small quantity of metallic filings enclosed between two metallic plugs in a glass tube which is exhausted. In the Marconi pattern a mixture of iron and nickel filings is used.

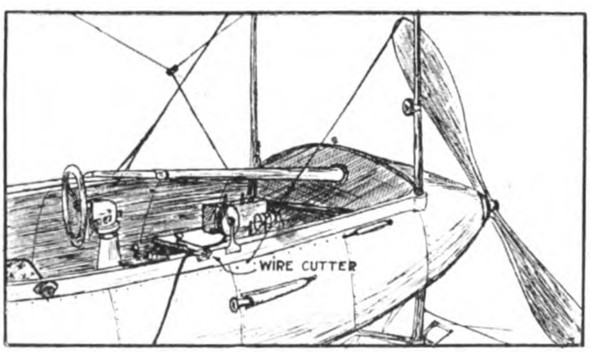
Various other forms are described in *The Principles of Electric Wave Telegraphy and Telephony* by Prof. J. A. Fleming.

The circuits used for the coherer are slightly different from those for other detectors. The secondary coil is wound in two equal parts on one former with a space between them. To the inner ends a condenser is connected and to the outer ends the coherer. The rest of the apparatus is connected as shown in the diagram.

Wire-cutting Device for Aeroplanes.

AEROPLANES fitted with wireless apparatus carry a long length of wire, which trails beneath the machine for the purpose of picking up messages from below when the machine is in flight. In case of a hasty landing this wire is liable to become entangled with the landing chassis, with trees or other objects, and cause a serious accident.

To prevent such mishaps an ingenious device is attached to the machine in the shape of a wire-cutter, which is so placed that the pressure of a lever severs the wire hanging from the aeroplane. Our illustration below shows a machine with this useful device attached. It is V-shaped, with a hinge at the apex. The cable passes from the winding spool through the cutter, the interior edges of which are as sharp as a razor blade. In case of emergency all the aviator has to do is to press down the lever, which is placed conveniently for his right hand, and the cut wire falls away.



Enlarged view of Wire-cutter.

TIT FOR TAT.

The following dialogue is reported to have occurred between French and German wireless stations at the beginning of the war:—

German Operator: "Where are you? Have you had a good sleep?"

French Operator: "Fine here. We slept at Metz."

German Operator: "Oh! Well, to-morrow we shall be in Paris!"

French Operator: "Yes, but as prisoners."

No reply from German station.

Television

When shall we see as well as hear by Wireless?

SOME NOTES BY MR. MARCUS J. MARTIN.

Our well-known weekly contemporary "Answers," in an issue published towards the beginning of May, includes a short article under the heading of "Shall we See by Wireless?" The remarks contained therein cover some points which are doubtless familiar to readers of "The Wireless World" through the series of articles which appeared in volume 2 under the title of "Radio-photography," by Marcus J. Martin. These are being supplemented in volume 3 in a series by the same writer, entitled "The Wireless Transmission of Photographs," dealing further with the subject. The following notes have been especially written by Mr. Martin for us, and will serve to indicate the position in which the development of the televisionary branch of the subject stands at the present moment.

ALTHOUGH many attempts have been made during recent years to solve the fascinating problem of "television," there has been up to the present no system that can claim to be in any way practicable. Experiments have been made in which fair results have been obtained, but as far as the writer is aware these have never passed beyond the laboratory stage. There have been several systems devised that are workable, but to employ them for practical purposes is out of the question on account of the enormous expense entailed. One of the simplest and at the same time one of the oldest systems employs at the transmitting station a screen composed of a mosaic of small selenium cells. These cells are all connected separately at the receiving station with a battery and a small electric lamp, the lamps being arranged in similar order to the mosaic of selenium cells. If a simple picture in monotone be thrown upon the mosaic of selenium cells, the resistance of those cells that are under the influence of the light parts of the picture is reduced, and sufficient current flows through the line to light the corresponding lamp at the receiving station. A picture, constant as long as the cells are under the influence of the original picture, is thus obtained on the receiving screen.

According to some calculations made by Mr. Shelford Bidwell, the cost of receiving a picture 2 in. by 2 in., with a grain as fine as an ordinary newspaper illustration, over a distance of 100 miles, would be *one and a quarter million pounds*, and necessitate the employment of at least 40,000 selenium cells. Many modifications of this method have been devised, the most recent employing only three line wires and a common earth; but, except for the system briefly described above, all television systems depend for their action upon what is known as the "persistence" of vision, the whole process of building up the secondary picture occupying a space of time not more than one-tenth of a second—*the duration of the persistence of vision.*

There is no doubt that in the near future we may have some practical system of television to work over ordinary conductors; the idea of wireless television is, from a really practical point of view, absurdly improbable. The fact that wireless photography and wireless telephony are experimentally accomplished facts in no way proves that wireless television is feasible. The principles involved are entirely different. In telephony the vibrations which affect the ear, causing different sounds, consist of a number of impulses which impinge in very rapid succession on practically one spot on the telephone diaphragm; and while in television we also require a large number of impulses delivered in very rapid succession, or simultaneously, the impulses must also be arranged in proper sequence in order to reproduce correctly the transmitted picture. To construct wireless apparatus capable of transmitting and receiving 40,000 signals in one-tenth of a second, and arrange them in their correct order, would surely tax to the utmost the powers of our cleverest inventors, and prove the limit of even human ingenuity.

Among the Wireless Societies

Notes on Meetings and Future Arrangements.

Wireless Society of London.—At the meeting of the Wireless Society of London on Tuesday, April 20th, Prof. E. W. Marchant gave a lecture in which he described the various methods of measuring the strength of wireless signals. The lecture overlapped, to a certain extent, Prof. Marchant's Paper before the Institution of Electrical Engineers, but a special appeal was made to wireless operators professional or amateur, to pay greater attention to the accurate measurement of wireless signals. The importance of it, said Prof. Marchant, is now generally recognised. The quantitative results obtained by Duddell and Taylor, ten years ago, were the first attempt to make accurate measurements of wireless signals. As a matter of historical record, it may be said that these were carried out in Bushey Park, and were, naturally, over quite small distances. The equation which was arrived at from these experiments is now generally accepted as the one which represents approximately the current received under any given conditions and with a given height of aerial. Reference was then made to subsequent theoretical work and the establishment of the Austin formula, which gives the approximate value for finding the order of the magnitude which has to be measured. It was well known, said the lecturer, that the values undergo large and constant fluctuations, and that the equation is only useful for giving us the order of the magnitude of the values involved. The importance of the subject lies in finding out the extent of the variations.

Before attempting to make any experiments on the strength of received wireless signals, continued Prof. Marchant, it is necessary, as far as possible, to have constant conditions at the receiving station. The aerial should be of a standard form and free, as far as possible, from surrounding obstacles, such as trees and houses. This condition was absolutely necessary when absolute measurements are to be made. A second factor was the resistance between the aerial and earth. In order to get good results, the earth resistance should be as constant as possible. The ordinary form of earth-plate lightning conductor—viz., plate copper and coke, was excellent. At Liverpool he had used a water-pipe system as earth with satisfactory results. He had recently excavated a trench 25 yards long, and used plate copper, 6 feet square, connected with copper strip at the aerial end. The point to be borne in mind was that the strip and earth should extend over as large an area as possible. He had also driven twelve 2-inch cast-iron pipes into the ground. An interesting fact discovered in connection with this work was the amount of moisture in the sandstone which had been covered for ten years with a layer of impervious concrete, this amounting to about 10 per cent. It was a remarkable result, as he had expected to find a fairly dry earth, but the contrary was actually the case, and he had great hopes that the earth which would be obtained by sinking wires in this sandstone would be quite an effective one. At Liverpool the antenna was 150 feet high, with a horizontal span of 500 feet. It was not a very good earth because the ran-over ground there was covered with buildings. Nevertheless, the results obtained gave a fair measure of the variations in the strength of the signals. The best method was to use an instrument which would read actual current or voltage on the antenna circuit. Prof. Howes had used an ammeter to measure signals from Paris of extremely small powers, the Duddell thermo-ammeter was the most sensitive alternating current instrument. The elimination of atmospherics was one of the greatest difficulties. Very frequently in the summer, even in Liverpool, it was necessary to have a conducting leak from the aerial to the earth, and for this purpose he had adopted the Marconi standard method. He had found a choking coil with ten ohms resistance satisfactory, and its connection or disconnection had no appreciable effect. The Fleming valve was not found satisfactory, although at one time he had had great hopes of it. The great virtue of it was that there was nothing to go wrong. If one got an atmospheric the valve was not burned out. It was quite good to use again, but the results of his experiments with the Fleming valve had convinced him that it was very little good for accurate measurement as its sensitiveness was rather irregular. Various other detectors were described by the lecturer, who added that electrolytic and magnetic detectors were capable of good work. The latter, however, was not sufficiently sensitive for measuring weak signals. Similarly, although he had not had much experience of electrolytic detectors, he would not expect to find this type very reliable. In the Marconi form of magnetic detector certain modifications were necessary to make it completely reliable for accurate investigations. The shunted telephone method had been used, but there was no comparison between that and a galvanometer for measuring signal strength. A novel form of telephone condenser or static telephone had received some attention lately. As to galvanometers, the Broca was satisfactory when conditions were good, but when atmospherics were bad the galvanometer was not of much value. The best arrangement was a very high frequency or short-period galvanometer used in conjunction with a crystal detector.

A short discussion followed, in which Mr. P. R. Coursey, Dr. Erskine Murray and Mr. W. Duddell took part. Mr. Coursey, who has worked with Dr. Fleming, whose experiments were described in the discussion on Prof. Marchant's Institution paper, expressed the opinion that better results might have been obtained if they had coupled the antenna on to the circuit. As to the Fleming valve, they had one at University College, which gave maximum sensitiveness almost at zero voltage. Dr. Erskine Murray said that, in spite of the discussion on Prof. Marchant's Paper, no one seemed yet to have put the whole problem of the variations in transmission in a nutshell. Everyone seemed to attack it from different points. Mr. W. Duddell said he had endeavoured to interest as many people as he could in this question of measurement. He had been three times to Brussels in an endeavour to get the nations of the world to make international measurements, but the war stopped the first coordinated measurements of this nature during the eclipse. Even now, however, when all stations were shut down, there was still a lot of work that could be done in trying to develop instruments which would accurately measure an oscillating current either in the aerial or in a circuit coupled to it.

* * *

Barnsley Amateur Wireless Association.—The Barnsley Amateur Wireless Association, like most of the amateur societies, has had to restrict its activities owing to the war, but the classes for the Study of Wireless and Morse Practice are still continued regularly. Two of the members have enlisted as electricians in the Mechanical Transport Service, where no doubt the information they have gleaned at the society's meetings will be of value to them. The society's headquarters are at the Y.M.C.A., Eldon Street, Barnsley.

* * *

British Association Meetings.—The British Association will hold meetings at Manchester from September 7th to 11th next, under the presidency of Professor Arthur Schuster. The Presidents of sections will be: Mathematics and Physics, Sir F. W. Dyson; Chemistry, Professor H. B. Baker; Geology, Professor Grenville Cole; Zoology, Professor E. A. Minchin; Geography, Capt. H. G. Lyons; Economics, Dr. W. R. Scott; Engineering, Dr. H. S. Hele-Shaw; Anthropology, Dr. C. G. Seligman; Physiology, Professor W. M. Bayliss; Botany, Professor W. H. Lang; Education, Mrs. Henry Sidgwick; Agriculture, Mr. R. H. Rew. Evening addresses will be delivered by Mr. H. W. T. Wager on "The Behaviour of Plants in Response to Light," and by Dr. R. A. Sampson, Astronomer-Royal for Scotland.

* * *

Halifax and District Amateur Wireless Association.—The annual meeting of the above Society was held on Friday, May 7th, at the Club headquarters. A report of the year's work was read by the Secretary, and the Treasurer's report showed that the Club was in a good financial position. Meetings will be held weekly and the usual course of instruction will be continued. A series of lectures are to be given during the coming session, which it is hoped will prove both interesting and instructive. Any further information may be obtained from the Secretary, Mr. A. Holdsworth, 3, Kliffen Place, Halifax.

The LIBRARY TABLE

"THE YEAR-BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY." (*Wireless Press*, 3*s*. 6*d*.)

The *Year-Book of Wireless Telegraphy* has so firmly established itself as a standard work of reference on all that pertains to radio-telegraphy and telephony that the publication of the 1915 issue will be welcomed by everyone interested in wireless. During the twelve months that have elapsed since the last issue appeared immense progress has been made in the extension and development of this form of communication, and the present volume contains considerable additions and alterations, bringing it well up-to-date. In addition to its being an invaluable book of reference, it also includes a complete historical *résumé* of the development of etheric wave telegraphy from its inception to the present day.

Regarding the main features of the book, we first find a carefully compiled calendar, which is succeeded by the exhaustive chronological account of the progress of wireless telegraphy. The "Chronicle," set out in diary form, shows at a glance what inventions and improvements were introduced in any particular year. Immediately next in order follows the full text of the International Radio-telegraphic Convention—a valuable contribution embodying the concerted policy of every Government in relation to wireless telegraphy. In close relationship with this international section, "The Safety of Life at Sea Convention" will be found here set out practically *in extenso*. Those familiar with its provisions need scarcely be reminded that this ordinance forms a striking demonstration of the prominent part played in life-saving by radio-telegraphy. Following on this text comes that of the laws and regulations applied by various countries to the control of wireless telegraphy, both with regard to land and ship stations. Another valuable feature consists of a complete list of all ship and shore wireless stations, together with their call signals. This section alone renders a copy of the *Year-Book* indispensable for the shelves containing books of reference in every office. Not only does it show at a glance what ships are fitted with radio-telegraphic apparatus, but also the various coast stations through which one can establish communication with them. An excellent map of the wireless stations of the world completes the information on these points. Ready reference is facilitated by the further addition of an alphabetical list of call letters. Over and above the tabulated information, which forms such a valuable feature of the book, there figures in its pages a most interesting series of articles contributed by eminent experts and scientists, each writing on his own special subject.

Mr. Archibald Hurd, the well-known naval critic of the *Daily Telegraph*, contributes an article on "Wireless and War at Sea," and Colonel F. N. Maude, the celebrated writer on military subjects, describes the influence of radio-telegraphy on modern strategy. These two articles will probably appeal to the general reader more than any of the other contents of the whole volume.

During the last year a considerable amount of attention has been devoted among scientific circles to the functions of the earth in wireless telegraphy, and it is interesting to find that the well-known authority, Dr. J. A. Fleming, has contributed an article on this subject. Mr. H. J. Round summarises the progress that has recently been made in wireless telephony. In this connection it is interesting to note that Mr. Round, at Marconi House, was able to converse with Berlin last year by wireless telephone, although his experiments were still incomplete. Dr. W. H. Eccles contributes an article on Radio-telegraphic Research in 1914. Among other interesting articles which find a place in the volume we find contributions on Wireless Long-Distance Service, Wireless Telegraphy and Meteorology, and International Time Signals.

Further matter, which adds to the value of the volume as a book of reference, includes biographical notices of practically everyone of note in the field of wireless telegraphy, a Directory of Wireless Societies, and a long list of patents applied for during 1914.

* * *

"ELECTRICITY OF TO-DAY: ITS WORK AND MYSTERIES." By Charles R. Gibson, F.R.S.E. London: Seeley, Service & Co., Ltd., 38 Great Russell Street.

The old complaint that the German nation is ahead of ourselves in the matter of applied science is with us once again. Pessimists are greeting every German surprise on the battlefield, humane and otherwise, with "I told you so."

If the British masses show a greater relative ignorance of technical matters than their continental neighbours it is the fault of their educational system rather than their aptitude. The "modern side" of public school life is still looked at askance by parents jealous of the "family dignity." The daily Press, too, has some leeway to make up in interesting the public in scientific developments, though there has been a move in this direction in recent years.

At present we are still largely dependent upon popular treatises issued by the great British publishing houses, but many of these just fail through their inability to keep clear of mathematics. We know it is very difficult to explain certain phenomena without resort to formulæ, but he who once abandons simile in a work of general public interest runs a grave risk of depriving the whole of his efforts of their value. The man in the street is more scared by a cosine and square root than he is by Zeppelins and scarlet fever.

Herein lies the outstanding merit of Mr. Gibson's really attractive work. When the first edition was published in 1907 it struck a new note in scientific literature. There is no question but that it has gained many recruits for the electrical professions, and has lifted the veil for thousands upon mysteries of a baffling description. Mr. Gibson has discovered the secret of being homely: his ability to weave romance into a fabric hitherto lacking in human interest has given him the success so vainly sought by many who have essayed similar tasks.

The edition now before us excels all others inasmuch as it gives greater attention to wireless telegraphy and telephony than was possible in 1907. Mr. Gibson has followed not only the development of the Marconi system, but all the other systems that have gained more than passing prominence. By way of emphasising the delicacy of construction of some of the parts of a wireless equipment he details the manufacture of the "barretter" or detector invented by Professor Fessenden. This, he explains, consists of a platinum wire one-thousandth of an inch in length, and one-twenty-five-thousandth part of an inch in diameter. In a chapter on telephones, he reminds us of an oft-forgotten fact that a wireless telephone existed long before any wireless telegraph experiments were made. The radius of action, however, was very limited, as speech was actually transmitted along a beam of light.

To readers of THE WIRELESS WORLD the chapters on Wireless Telegraphy and Telephony will be appreciated as setting old facts in a new and popular light. The author makes no pretence at introducing new theories, but wireless enthusiasts may find in the chapter on Medical Applications facts that are little known even to those who make electrical phenomena their constant study. How many of us, for instance, are aware that the X-rays have a useful field in dentistry, or that high-frequency currents may be used as an anæsthetic for superficial operations? These facts, and hundreds of others equally interesting, are explained in a specially attractive manner in Mr. Gibson's really excellent book.

* * *

"ELECTRICAL INSTRUMENTS IN THEORY AND PRACTICE." By W. H. F. Murdoch, B.Sc., and U. A. Oschwald, B.A. London: Whittaker & Co. 10s. 6d. net.

The importance of measuring and testing instruments to those who are concerned with any form of electrical engineering cannot, of course, be overrated, and any book which assists to a clearer understanding of the principles on which these instruments are based will be welcomed in many quarters. In the book under review the authors set out to deal with something more than the elementary theory of electrical measuring instruments, and by selecting instruments which are typical of their class, make plain to the reader the underlying principles.

Chapter 1 is devoted to an historical summary. The "wireless" student and experimenter will find on pages 11, 12 and 13 an interesting reference to the instruments used for measurement in wireless telegraphy, in which it is made clear that the "skin" effect of high-frequency currents is a very important consideration. Chapter 2 deals with the damping of various instruments. Next follow chapters dealing in detail with moving coil, iron-cored, hot-wire and other instruments, the text being illustrated by numerous diagrams. A large section of the book is devoted to the theory of supply meters of all types—an extremely important subject in these days when electricity is so widely used both domestically and commercially—and the concluding chapters treat of magnetic testing instruments and the Post Office box.

Oscillographs and many alternating current instruments have not been dealt with in this book, as it is the intention of the authors to deal with these in a further volume.

The book is of a convenient size, well printed and on good paper. The diagrams have also been very clearly prepared. The authors have certainly prepared a work of great value, and one which will doubtless occupy an important place on the bookshelves of many theoretical and practical electricians.

GERMAN WIRELESS IN AMERICA.

Senator Marconi attended the hearing on May 5th in the Federal Court, Brooklyn, U.S.A., of the suit of the American Marconi Company against the Atlantic Communication Company operating the Telefunken system at Sayville. The plaintiffs contended that the German concern is using two patents, one invented by Senator Marconi and the other bought by him from Sir Oliver Lodge. Senator Marconi will probably give evidence regarding the facts of the case.

WIRELESS ORNITHOLOGY.

A West of England newspaper prints a paragraph in which it states that some birds—particularly sea-gulls—are disturbed in a very curious way by wireless waves. We would like to point out to our contemporary that they are not the only "gulls" affected by wireless.

A TRIBUTE TO RADIO-TELEGRAPHY.

A British explorer and elephant hunter writing from Bangui, French Equatorial Africa, to a Yorkshire newspaper makes the following remark:

"It will interest all your readers to know "that, thanks to 'Wireless' linked up by "land services, we—in the heart of Africa "(over six thousand miles from Europe)—"receive daily reports of the progress of "battles now raging in Europe a few "hours after the events."

SHARE MARKET REPORT.

London, May 18th, 1915.

Dealings in the shares of the various Marconi Companies have been on a small scale during the past month although there has been considerable investment buying of the Preference shares. The shares of the American Company have fallen back slightly owing to the unrest in the United States.

The latest prices are: Marconi Ord., $1\frac{23}{32}$; Marconi Pref., $1\frac{5}{8}$; American, 10s.; Canadian, 5s.; Marconi Marine, $1\frac{3}{16}$.

QUESTIONS AND ANSWERS

Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study to the Editor, THE WIRELESS WORLD, *Marconi House, Strand, London, W.C. Such questions must be accompanied by the name and address of the writer, otherwise they will remain unanswered: and it must be clearly understood that owing to the Defence of the Realm Act we are totally unable to answer any questions on the construction of apparatus during the present emergency.*

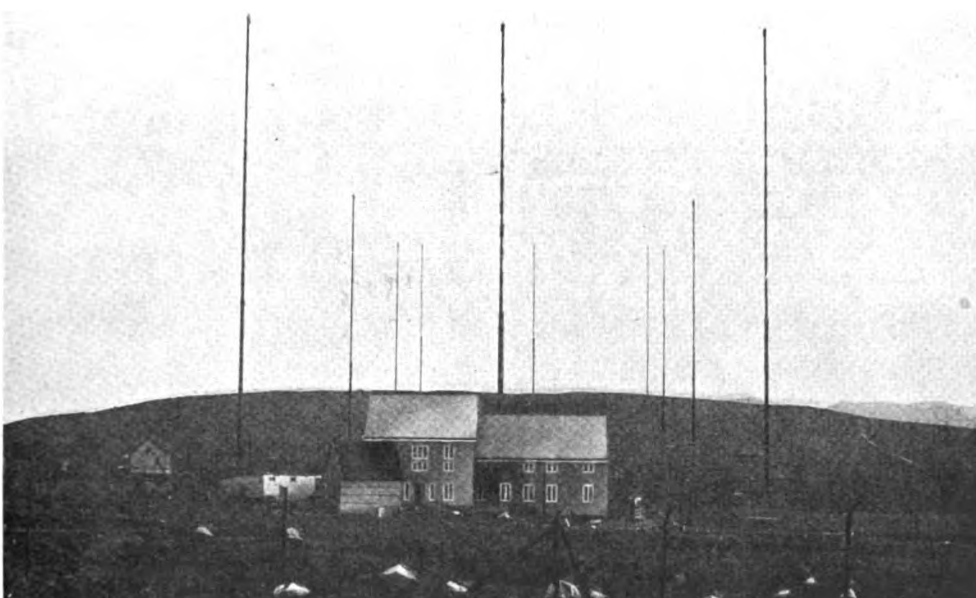
L. E., W. D. (Surbiton), W. C. (Peterborough), C. F. Stoke Newington), C. F. (Watford, Ontario), J. E. P. K. (Cape Town), W. R. (Swinton, Lancs.), Fr. D. (Cherbourg), H. H., Jr. (Rotterdam), M. Bony (Bordeaux), A. Rowlands (Swinton), ask questions which we cannot answer during the present emergency owing to the Defence of the Realm Act.

G. P. (Wavertree) writes concerning the differences of value obtained by working out inductance by the various formulæ that have appeared in THE WIRELESS WORLD and the "Year Book." One of the reasons for the differences which have arisen is that the first formulæ he quotes are simplified as much as possible, and the results are therefore only fairly approximate. Unfortunately, for several reasons it is impossible to give a formula which is absolutely accurate, but Dr. Cohen's formula in the "Year Book" can be taken as a standard.

N. C. de O. (St. Vincent, Cape Verde Islands) will find what he requires in "Wireless Telegraphy," by W. H. Marchant, 5s. 4d. post free, from the Wireless Press, Ltd.

W. D. L. (Port Stanley, Falkland Islands) asks whether there is such a thing as a "directional earth," and instances a great improvement which was apparent in his station when an extension of the earth wires was made in the direction from which it was desired to receive signals. The extension wires *terminated in the sea*, which fact, and *not* the direction, accounts for the improvement of signals. By leading the earth wires into the sea a much better "earth" connection is made. Our correspondent also asks if a number of extensions of the earth wires were made—say one each north, south, east and west—and were brought into the station in such a way that any one of them could be used at choice, whether there would be a directional effect in the direction of the system used. We think not. Any improvement that might become evident through the extension of the earth system would be due to a general improvement in the earth connection as a whole.

FOREIGN NOTES



The Aerials of the new Wireless Station at Stavanger.

In THE WIRELESS WORLD of February, under the title of "From Continent to Continent," we published particulars of the new wireless station at Stavanger erected recently by the Marconi Company for the Norwegian Government with the object of placing them in direct communication with the United States of America. We understand that the working of the station is giving great satisfaction to the Norwegian Government, and we produce below a view of the aerials which has just recently come into our hands.

PERSONAL PARAGRAPHS.

C. J. Shepherd and his son, A. Shepherd.

Among the many employees of the various Marconi companies that have left their peaceful callings to wear the "khaki" and go to the war, are Mr. C. J. Shepherd and his son, A. Shepherd. Most of the staff at Marconi House will remember the former as the lift-man at the Aldwych entrance. He is now a corporal in the "Queen's." His son started his career at Marconi House as a messenger boy, and at the time of his enlistment in the Oxford and Bucks Light Infantry, was boy clerk.

We regret to have to record the death of a youthful "wireless" enthusiast in the person of G. D. Lascelles Harcourt, who died on March 29th at Winchester College, aged sixteen. At the age of thirteen he began the study of Wireless Telegraphy, to which he became entirely devoted, and, young as he was, he constructed his own apparatus, with which he had great success. He was a constant reader of THE WIRELESS WORLD. As his knowledge of the subject increased he continued to improve his wireless plant, and was able to receive from all the principal European stations, including Clifden, Pola, Madrid, and numberless intermediate ones. His early death closes a career which gave promise of considerable achievement in the sphere of electrical science, and we take this opportunity of expressing our sympathy with his relatives in their sad loss.

G. D. Lascelles Harcourt.

The Société Anonyme Internationale de Télégraphie sans fil regrets to announce the deaths of three members of its operating staff—F. V. S. Kinch, J. H. Karreman and J. Lluel-Garcia.

J. H. Karreman was born at Maassluis, Holland, on April 15th, 1894, and was appointed telegraphist by the S.A.I.T. on August 1st of last year, after having followed a course of training at the Rotterdam School.

F. V. S. Kinch was born at Copenhagen on December 8th, 1892, and received his training in wireless at the Svendborg School in Denmark. He was appointed telegraphist by the S.A.I.T. on August 16th, 1914.

Mr. J. H. Karreman.

These two young men were Officer in Charge and Assistant respectively of the wireless station on the s.s. *Prins Maurits,* of the Koninklijke West Indische Maildienst, when that unfortunate vessel was lost with all hands in a gale at sea on April 3rd last.

That they stuck to their post to the last is known from the reports of other vessels that received the distress calls from the stricken ship, and it is profoundly sad that, through stress of weather and other adverse circumstances, no timely assistance could be brought to the sinking ship.

Julio Lluel-Garcia, who was born in Havana on December 12th, 1887, was appointed telegraphist on the staff of the S.A.I.T. on January 1st, 1913. For some time past his health was not all that could be desired, and on February 1st of this year he was taken ill with bronchial fever, from which he died at Jimena, Spain, on April 19th.

The company deeply regrets the loss of these three young men, who all gave promise of a successful career in the service.

We give below a photo of the late M. Joseph van Schoubroeck, which unfortunately came to hand too late for inclusion in our May issue. We would refer our readers to p. 133 of our last number for the particulars of the sad death of this gentleman, who died in Flanders from the effects of an expanding bullet.

M. Joseph van Schoubroeck.

Whilst replacing some wires at the Marconi Wireless Station on Cefndu, Mr. Barrington, one of the engineers, who resides at Llannig, touched a live wire, and sustained severe injuries to his hands. He was unconscious for some time after the accident, but subsequently made satisfactory progress towards recovery.

To the roll of honour of those who have lost their lives in the wireless service of the Empire during the present war, must be added the names of George Clarkson and William Henry Silvester, both of whom are reported as having been drowned in the sinking of the trawler *Columbia.* The *Columbia* and some other vessels were attacked on May 1st by two German torpedo-boats, the engagement lasting about a quarter of an hour. The Germans then retreated, and the direction of their retreat having been communicated to British destroyers, these latter gave chase and destroyed the enemy craft. The *Columbia* was, however, sunk, with the loss of sixteen officers and men, amongst whom were Messrs. Clarkson and Silvester, the R.N.R. Warrant Telegraphists of the vessel. George Clarkson, whose home was at Ballingaddy, Kilmallock, co. Limerick, Ireland, was twenty years of age, and was educated at Fermoy and Cork. He entered the service of the Marconi Company as learner in September, 1913, and on appointment to the

Mr. G. Clarkson.

operating staff served on the s.y. *Arcadian* and the ss. *Toledo.* At the outbreak of war he volunteered for naval service, and was in due course appointed to the *Columbia,* which was carrying out Admiralty duty. William Henry Silvester, of Reigate, Surrey, was twenty-six years of age and was educated at Folkestone. He entered the Marconi Company from the telegraph staff of the South-Eastern and Chatham Railway, and after serving a short period in the Marconi Company's School, was appointed to the ss. *Victorian.* He afterwards served on the ss. *Merion, Haverford, Inanda* and a number of other vessels, and for some time previous to the war had been engaged as wireless operator on board trawlers at Hull. On behalf of our readers we offer our sincerest sympathies to the relations of the deceased in the terrible bereavement they have suffered.

We regret to record the death of Lieut. David E. Hooper, who was killed in action on April 30th. Lieut. Hooper, who was the eldest son of Mr. and

Mr. W. H. Silvester.

Lieut. D. E. Hooper.

Mrs. David Hooper, of Weston-super-Mare, was born in India in 1893. He was educated at Birkenhead and in Switzerland, and two years ago entered Bristol University as an engineering student, with a view to joining the Public Works Department in England. Deceased was a keen student in wireless telegraphy, and had won a prize offered by the Marconi Wireless Telegraph Company. He was serving in the 3rd Battalion East Lancashire Regiment when he met his death.

Friends and fellow-operators of Sergeant A. H. Brown, of Seapark, Nairn, will be delighted to hear that he has been appointed to a Second Lieutenancy in the 10th Battalion Seaforth Highlanders. Lieutenant Brown joined the Scots Greys in 1902, and after seven years' service left the Colours with the rank of sergeant. On the completion of his army service he was appointed a clerk in the Nairn Post Office, where he was employed for four years. In June, 1913, he entered the Marconi Company as learner in the Company's London School, and after a short course of training was appointed to the ss. *Aragon*. He afterwards served on board the ss. *Zeelandic* and the ss. *Demerara*. In October last Lieutenant Brown rejoined the Army in the Greys, and has since been stationed at Dunbar. Lieutenant Brown is the only son of the late Mr. C. H. S. Brown, who was postmaster of Nairn for a number of years. We offer Lieutenant Brown our heartiest congratulations.

The *Yorkshire Daily Herald* publishes a portrait of Corporal J. H. B. Taylor, of the Northern Wireless Section, Royal Engineers, now on active service. He is one of the old boys of the Scarborough Municipal School, and at the age of 13 years won the Science and Art Scholarship of South Kensington.

PATENT RECORD.

The following patents have been applied for since our March issue:

(MARCH, APRIL, MAY, 1915.)

4604. March 24th. Fred. L. Field, C. Lewis Fortescue, and Brian S. Gossling. Receiving instrument for wireless telegraphy. (*Provisional.*)

4862. March 29th. Henry R. Rivers-Moore. Electric oscillating system. (Addition to No. 1649/1910. *Provisional.*)

5342. April 9th. Gesellschaft für Drahtlose Telegraphie M.B.H. Receiving arrangement for wireless telegraphy. (*Complete.* Convention date, April 9th, 1914. Germany.)

5630. April 14th. Wm. J. Mellersh-Jackson. Mounting of electric oscillators for submarine signalling. (Submarine Signal Co., U.S.A. *Provisional.*)

5783. April 17th. Marconi's Wireless Telegraph Co., Ltd., and Chas. S. Franklin. Aerial conductors for wireless telegraphy. (*Provisional.*)

5784. April 17th. Marconi's Wireless Telegraph Co., Ltd., and Chas. S. Franklin. Means for indicating and correcting small changes in the speed of a machine. (*Provisional.*)

5794. April 17th. Edison & Swan United Electric Light Co. and Stanley R. Mullard. Electric arc-forming device for use in electric valves or rectifiers or in oscillation generators. (*Provisional.*)

5955. April 20th. Lucien Rouzet. Polyphase generators for high-frequency currents with polyphase tuned spark-gap. (Addition to No. 519/15. Convention date, April 20th, 1914, France. *Complete.*)

6217. April 26th. Chester M. Agner. Wireless telegraphy. (*Complete.* Convention date, June 8th, 1914, United States.)

6296. April 27th. Louis Mauclaire and Alfred Bréon. Arc lamps adapted to be used also for the production of electrical oscillations for wireless telegraphy, wireless telephony, and for other purposes. (*Provisional.*)

6476. April 30th. Marconi's Wireless Telegraph Co., Ltd., and Henry J. Round. Cathodes of vacuous tubes suitable for use in wireless telegraphy. (*Provisional.* Divided application on No. 13,247/14.)

6486. April 30th. Lee de Forest. Wireless telegraph and telephone systems. (*Provisional.*)

6551. May 1st. Oliver Imray. Arrangements for transmitting and receiving signals by electromagnetic waves. (*Complete. Samuel M. Kintner* and *Halsey M. Barrett*, United States.)

6669. May 4th. John Hays Hammond. Gaseous or vacuized detectors for radiant energy and method of controlling the action thereof. (Addition to 8,568/14. *Complete.*)

6753. May 5th. Guillaume A. Nussbaum. Microphones for wireless telegraphy. (*Provisional.*)

6813. May 6th. Axel Orling and Orling's Telegraph Instruments Syndicate, Ltd. Means for amplifying the effects of small vibrations for telegraphic and other purposes. (*Provisional.*)

COMPANY NOTICES

AMALGAMATED WIRELESS (AUSTRALASIA) LIMITED.

THE half-yearly ordinary general meeting of the Company was held at Sydney on March 18th last to receive the balance sheet and report of the Directors of the Company for the half-year ended December 31st, 1914, Mr. H. R. Denison, Managing Director, presiding.

The Directors' report states that trading for the period had been satisfactory from various points of view, but it must be borne in mind that certain departments of the Company had been much disturbed since the commencement of the war.

The ships' message traffic, upon which the Company depends for part of its profits, had been reduced to a low ebb, which, under the circumstances, was unavoidable—censorship, naval restrictions, the use of some of the Company's subsidy passenger ships for Imperial purposes, and other causes beyond the control of the Company, had contributed to this result. Fortunately, since the beginning of the current year, conditions had slightly altered for the better, and indicated a gradual upward tendency.

The subsidy ships had slightly increased since the last Directors' report of June, 1914, and stood at 80 passenger and cargo steamers. New business was periodically coming along, and this department was steadily advancing to a satisfactory stage.

Since the outbreak of war over 70 men had been sent away to carry out naval and military work of various descriptions on the battlefields of Europe and Egypt, as well as on transports and special service Government vessels. The Company had successfully coped with all the demands made upon it, thereby proving that its organisation was not only sound commercially, but was also a national asset.

The net profit standing to the credit of Profit and Loss Account amounted to £7,828 17s. 3d., from which the Directors recommended the distribution of an interim dividend of 2½ per cent. on the capital of the Company, which absorbed £3,500, the balance being carried forward to next account.

The Chairman, in addressing the meeting, remarked that the Company had made very material advance in profit earning since the last half-yearly meeting.

He went on to point out that the profit for the six months was greater than that for the previous sixteen months in which the two now amalgamated companies were operating. While they had profited from the fitting out of troopships that revenue would be non-recurring. At the same time there had been such an immense falling off from ships' traffic during the war that it might fairly be said that the one balances the other. They might expect after the war to make up that falling off in traffic earnings, and that would replace the non-recurring revenue from the troopships.

The profit made would have justified giving the shareholders a rather larger dividend than had been recommended, but it was thought that as this was only a half-yearly meeting, an interim dividend should not be up to the full amount that could be declared, but that something should be kept in hand until the full accounts for the year came forward.

On the basis of the half-year's trading it was reasonable to expect that the next dividend would be increased. They had reason to be proud of the result, for there had been many difficulties to contend with. They had not received any help where they might reasonably have expected help, and that the Company should have been able to make an amount equivalent to 10 per cent. of its capital spoke well for the future.

The half-yearly report and balance-sheet were adopted unanimously, and the interim dividend at the rate of 2½ per cent., absorbing £3,500, was passed. The sum of £4,328 was carried forward to next account.

In proposing a hearty vote of thanks to the Chairman of Directors, which was carried unanimously, Mr. W. Fordyce Wheeler said the position of the Company reflected the highest commendation upon the management. The result was more than satisfactory.

MARCONI WIRELESS TELEGRAPH CO. (AMERICA).

WE printed in our last issue the preliminary report and statement of accounts of the above company for 1914. The annual meeting took place at the registered office of the company in Jersey City on April 19th. It was then stated that the acquisition in 1912 of the tangible assets of the United Wireless Company by this company placed under its control all the coast stations of importance on both the Atlantic and Pacific coasts, besides which practically the whole of the American mercantile marine is now fitted with wireless apparatus. The number of ship and shore equipments which it works is approximately twenty times as large as it was three years ago. This remarkable growth has necessitated a proper organisation to operate the company as an institution of national importance, and the development of a competent working staff to conduct the business economically and efficiently, which achievement has been one of the most noteworthy of the past twelve months.

In conformity with public demand, the company's service has been steadily extended and its apparatus developed to a standard recognised by the Government, the steamship owners, railroads, and large industrial companies. In order to secure a return commensurate with investment and cost of operation, it was found necessary to raise the rental of ship equipment contracts taken over from the United Wireless Telegraph Company. As rapidly as the old contracts expired they have been renewed at a higher figure and the officers report that they have been able to convince steamship owners of the justice of the rate of increase. In addition to the progress made in ship and shore communication, much has also been accomplished during the year with high-power stations for long-distance work. In the northern district of the Pacific coast there has been completed a powerful station at Ketchikau, Alaska, and a chain of wireless stations to cover this large territory has been planned. At Juneau the company has another station under construction, and the United States terminal at Astoria, Oregon, is nearing completion. Trans-Pacific service between San Francisco and Honolulu was opened on September 24th and with few interruptions has been working continuously ever since.

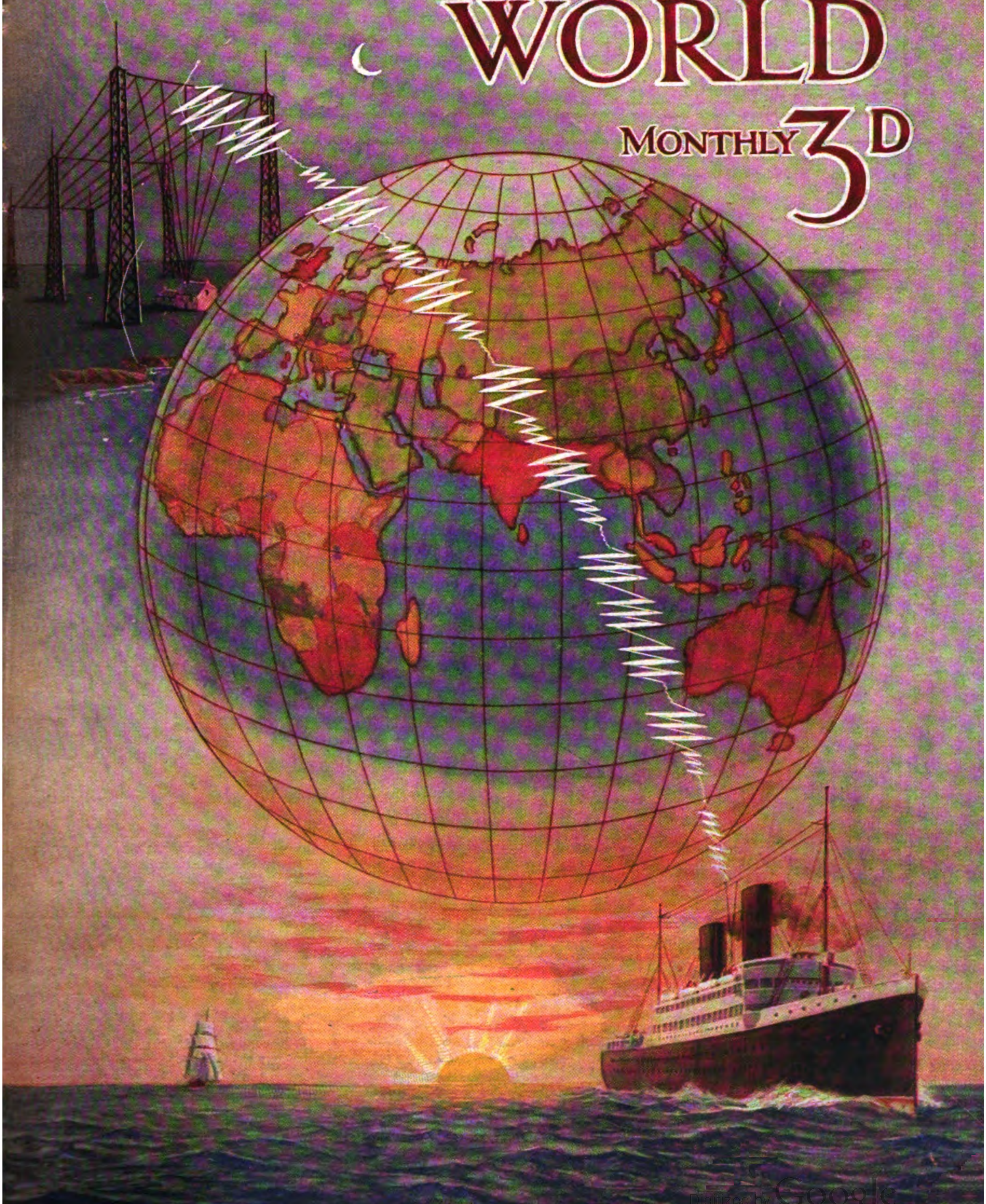
The direct New York-London service had to be suspended at the outbreak of war.

The duplex stations at Belmar, N.J., and New Brunswick, N.J., were completed and being tested when word came through that the corresponding English stations at Carnarvon and Towyn had been commandeered by the British Government for the use of the Admiralty. This was a serious blow to the company's hopes. A transoceanic department had been organised and a twenty-four hour service was to have been provided through a new commercial office opened in the heart of the New York financial district.

The financial statement of the company for the year under revision appeared in our May issue.

WIRELESS WORLD

MONTHLY 3D



THE WIRELESS WORLD

Vol. 3.—No. 28. (New Series) July, 1915. Subscription 5/0 per annum post free. Price 3d. Post Free 5d.

LINKED BY WIRELESS

The Revivification of Traditional Bonds between England and Italy.

MEN have long recognised that it was an unnatural alliance which placed Italy in a camp adverse to Great Britain. The national sympathy which has so long existed between the two liberty-loving countries is at length free to act once more in the world of politics and war.

Luigi Galvani, the pioneer discoverer of animal electricity, was a native of Bologna, an old University city at the foot of the Apennines, and the early name by which British scientists denominated that branch of electrical study is derived from the patronymic of this distinguished eighteenth-century Italian. Alessandro Volta, another son of Italy, born at Como in the middle of the eighteenth century, has in like manner bequeathed the epithet *Voltaic* to the development of current electricity along purely physical lines. The initiating genius was Italian, but much of the practical development of the Italian discoveries is due to the activity of British scientists.

Both of the foregoing electrical pioneers flourished during the period before Italy attained her freedom. England not unjustly boasts that the Italian path to liberty was smoothed by British hands, and the periods which have elapsed since the days of bondage have been no less prolific than their predecessors in their production of Italian scientific discoverers.

Not only did the City of Bologna give to the world Galvani in the eighteenth century, but also Marconi in the nineteenth. Just as the name of the former has become so closely linked with his special branch of electrical science that we have to recall it every time we wish to speak of that particular phrase, so the name of Marconi has become practically inseparable from wireless telegraphy. Cases must constantly have occurred to our readers where writers on the subject, with all the will in the world to avoid reference to the great Italian of modern days, have found themselves totally unable to do so. Englishmen in general, however, are as proud of the fact that their country has been chosen for the principal sphere of Marconi's practical activities as are Italians of the genius of their distinguished compatriot.

We may passingly allude to the many other examples of the closeness of the sympathetic link between Italy and England. Englishmen are proud to remember that Cavour and Mazzini found a congenial home in our island in the dark days of Italian liberty, whilst our greatest mid-Victorian poet, Robert Browning, lived a large part of his life in Italy, and died under Venetian skies.

It is no matter for wonder, then, that England rejoices to grasp in full comradeship the hands of a nation linked in such traditional harmony with herself. The electric waves which pass between our countries telling Englishmen and Italians of the progress made against the modern foes of liberty are only symbolic of links in many another field. The wish for a formal alliance has long been present with us all ; but Italian hands have until recent days been held back by Teutonic bonds. Every strand has been parted now, and England linked with Italy is pressing forward towards a common goal.

ADMIRAL SIR HENRY
JACKSON,
K.C.B., K.C.V.O., F.R.S.

Personalities in the Wireless World

ADMIRAL SIR HENRY JACKSON, K.C.B., K.C.V.O., F.R.S.

THE appointment of Admiral Sir Henry Jackson to be First Sea Lord, in the place of Admiral of the Fleet Lord Fisher of Kilverstone, will be noted with great interest by all concerned with wireless telegraphy. Sir Henry Bradwardine Jackson is a Yorkshireman, and was born at Barnsley on January 21st, 1855. At the age of thirteen he entered the Navy, and when the Zulu War broke out in 1878 he was a lieutenant on H.M.S. *Active*, and served on that vessel during the war. Originally Lieutenant Jackson specialised in navigation, but in September, 1881, he entered the *Vernon* to qualify as a torpedo lieutenant, and for three and a half years was a staff officer of this ship.

While on the *Vernon* Lieutenant Jackson was associated with many officers holding high appointments to-day, amongst others, Sir Frederick Sturdee, Sir Frederick T. Hamilton (Second Sea Lord), and Admiral Sir George Egerton. After completing his course, he was appointed torpedo-lieutenant on the battleship *Alexandra*, flagship of Admiral Lord John Hay in the Mediterranean. In 1886 Lieutenant Jackson was appointed to command the special torpedo vessel *Vesuvius*, attached to the *Vernon* as an experimental ship, and here he remained until January, 1900, when he was sent to Fiume, the home of the Whitehead torpedo, "for torpedo service." On leaving the *Vesuvius* Lieutenant Jackson was promoted to the rank of Commander, and at the end of his service at Fiume he took duty for a short time on the battleship *Edinburgh* in the Mediterranean.

It has been stated that Sir Henry Jackson preceded Mr. Marconi in the invention of Hertzian wave wireless telegraphy, and that prior to 1896 he had telegraphed in this manner from one ship to another. Some confusion still seems to exist in the minds of many people regarding the difference between *ether-wave* wireless telegraphy and the various inductive and conductive wireless systems which operate by means of electric currents through the earth or water. Sir Henry Jackson, whilst commander of the *Edinburgh*, and later when commander of the Devonport torpedo school ship *Defiance*, carried out a number of experiments with this older form of wireless telegraphy, and it is these experiments which have given rise to the statement above referred to. In the year 1896 Sir Henry made the acquaintance of Mr. Marconi, and thereupon turned his attention to the new invention which was destined to play such a leading part in naval warfare. From that time forward his name has been closely associated with naval wireless telegraphy, and great credit is due to him for many improvements and the extensive application of this priceless asset to Britain's sea power.

He remained responsible for the progress of wireless telegraphy in the Navy until 1906, on October 18th of which year he became a Rear-Admiral. During these years his appointments had been such as to facilitate the experiments and research work which he pursued. In 1902 he became Assistant-Director of Torpedoes at the Admiralty. Early in 1905 Lord Fisher, under whom he had served in the Mediterranean, selected him for the office of Third Sea Lord and Controller of the Navy. In 1906 the distinction of K.C.V.O. was conferred on him. On leaving the Admiralty in 1908 Sir Henry was given command of the Sixth Cruiser Squadron in the Mediterranean, where he remained for two years. In February, 1913, Sir Henry was transferred to the position of Chief of the War Staff at the Admiralty, and after eighteen months there he was nominated to be Commander-in-Chief in the Mediterranean in succession to Sir Berkeley Milne, but the war intervened, and Sir Henry was kept at the Admiralty in a special capacity. Admiral Jackson, besides being a Fellow of the Royal Society, is a member of the Institute of Electrical Engineers, and also an associate of the Institution of Naval Architects. He was created a K.C.B. in 1910, and on the list of admirals stands next above Sir John Jellicoe in seniority. Lady Jackson is a daughter of Mr. S. H. Burbury, F.R.S.

Dr. Fleming on Photo-Electric Phenomena.

THE SECOND TYNDALL LECTURE AT THE ROYAL INSTITUTION ON MAY 8th.

A full report of the first lecture appeared on Page 171 of our June issue.

RESUMING his subject on May 8th, Dr. Fleming said:

The action of ultra-violet light on metals was discussed in the last lecture. We have now to consider its action on gases.

The energy expended to pull an electron out of an atom is one-billionth of an erg. A figure like this is awkward to handle, but its electrical equivalent can be easily understood. Thus it requires from 2 to 10 or 11 volts to displace an electron. Electro-positive atoms give electrons up very readily, but electro-negative atoms hold on to them much more strongly.

The ionising volts for sodium potassium alloy are 2·1 volts.

There is a minimum ionising light frequency for all substances. No electrons are liberated from sodium by red light, the frequency must be increased to that of yellow or green light for ionisation to occur.

It is found that the product of the ionising potential in volts into the minimum light frequency in Ångström units gives a constant of 11,000 or 12,000 for all substances, as shown in the following expressions:

$$V_0 e = hn. \quad V_0 \lambda = \frac{hc}{e} = 12{,}000.$$

when V_0 is in volts and λ in Ångström units.

Or, again, if

V = maximum photo-potential in volts.
n = light frequency.
V_0 = ionising potential in volts.
n_0 = minimum frequency for photo effect.
h = Planck's constant $= 6{\cdot}55 \times 10^{-27}$.
e = electron charge $= \frac{16}{10^{20}}$ coulombs.
v = maximum velocity of photo-electrons.

$$V = kn - V_0 = k\,(n - n_0).$$
$$Ve = ken - V_0 e = hn - W_0.$$
$$\tfrac{1}{2}mv^2 = hn - W_0.$$

Therefore $v^2 = \frac{2h}{m}(n - n_0)$.

$$\frac{2h}{m} = 14{\cdot}6.$$

Therefore $v = 3{\cdot}82\sqrt{n - n_0}$.

For sodium illuminated by green-blue light v, is of the order 400 kilometres per second, or say 250 miles per second. Sodium potassium alloy which requires about 2 volts to start photo-electric action works at a minimum frequency of 5,500 Ångström units. This gives a product of 11,000, which agrees with the constant. The minimum light frequencies for the alkali metals are in the visible spectrum, but electro-negative oxygen which requires the large ionising voltage of 9 volts works at 1,350 Ångström units. This wave-length is in the ultra-violet spectrum two octaves below the visible spectrum.

The following data were given relating to the electron:—

Charge $e = \frac{4{\cdot}772}{10^{10}}$ coulombs.

Mass $m = \frac{9}{10^{28}}$ grammes.

Charge/Mass $= \frac{e}{m} = 1{\cdot}772 \times 10^7$ e.m.u.

Diameter $= \frac{3}{10^{13}}$ centimetres.

Density $\frac{7}{11} \times 10^{11}$.

The experimental proof of the ionisation of a gas by ultra-violet light is difficult, as the ionisation may proceed from the walls of the chamber holding the gas or from dust particles suspended in it. The gas may not be bubbled through a liquid as it may carry up electrons with it obtained from the liquid. Also the number of substances transparent to ultra-violet light are very few, and one such substance must be used for containing the gas to be influenced by the rays. Quartz is partly transparent to ultra-violet light. Fluorite is much more so.

Prof. Fleming then made an experiment to show the ionisation of the gas by ultra-violet light. For this purpose he used two quartz tubes through which dry and dust-free air passing through a plug of cotton-wool could be sucked, the air finally passing between the walls of a charged tubular condenser connected to an electroscope.

Both positive ions and negative ions were sent off by the flame of a candle, as air passed through the flame and thence to the tubular condenser, discharged it when it was positively charged, and also when negatively charged.

Next tubes of fluorite were used and sparks were made to pass along their length and outside them, with the result that the air inside became ionised and discharged the condenser.

Now the question arises, Does sunlight contain wave-lengths which can ionise the atmosphere ?

The shortest wave-length of light to reach this earth from the stars and sun is about 2,950 Ångström units, but the sun is probably sending us shorter waves which do not reach us, due to the wave absorption of the oxygen element in the air.

The sun is a mass of gas. The photosphere—the part we see—is probably glowing carbon at a temperature of 5,000 to 6,000 degrees C., or twice that of the electric arc, radiating not only ether waves, but like other hot bodies, it is sending out streams of electrons as demonstrated by Arrhenius. To illustrate this a Fleming valve was shown having a glowing carbon filament in an exhausted glass bulb, the filament being surrounded by a metal shield. When an electroscope charged negatively was connected to the shield it was discharged very slowly. When charged positively, however, as soon as the valve shield was connected to it the charge disappeared instantly. The sun's photosphere can be regarded as a great carbon filament radiating heat, light, and electrons. Outside this photosphere and for a great depth—some 500 miles thick—is what is known as an absorbing or reversing layer of metal vapour containing iron, sodium, and other metals in large quantities. Outside this is the chromosphere, composed mainly of hydrogen, helium, and calcium vapour.

The corona, which is only seen at times of eclipse, assumes different forms corresponding with the occurrence of sun spots. Near the poles it appears to radiate as do iron filings at the poles of a magnet. This appearance may be due to the electrons ejected from the photosphere, which pass through the condensing layer and act as nuclei for atoms, and are then forced out and onwards, if small enough, by the pressure of light. Maxwell showed theoretically that light exerts a pressure. This light pressure, however, must not be confused with the working of a Crookes' Radiometer, which works from the bombardment due to heat of the few gas molecules left in the partly exhausted tube.

Nicholls and Hull experimentally proved that light pressure exists. The instrument used for measuring light energy is called a pyroheliometer, and consists of a copper box filled with water having a thermometer attached to it to measure the temperature. The energy received from the sun per one square centimetre of surface is 2·1 gramme calories per minute, which is known as the solar constant, and thus the amount of energy contained in one cubic mile of sunlight at the earth's surface is 14,720 foot-lbs. The intensity of the light at the sun's surface is 46,000 times greater than on the earth at the tropics, which gives a figure for one cubic mile of sunlight at the sun of 302,300 foot-tons. Light pressure at the tropics is 2 lb. 13 oz. per square mile. At the sun it is 58 tons per square mile.

Gravitation near the sun is 27 times more than at the earth's surface, and its pull on a body decreases as the cube of the body's diameter, whereas light pressure decreases as the square of the diameter. At a certain critical diameter a particle will neither be attracted nor repelled. Below this diameter it will be repelled. Thus a particle having a diameter of 13,000 Ångström units will be in a state of balance, and it would appear that light pressure exerts a maximum repelling effect for bodies having a diameter of 1,600 Ångström units.

Now it is not impossible to obtain free particles with diameters as small as this. Prof. Fleming exhibited a slide covered with gold leaf beaten to the thickness of one-hundred thousandth of an inch, which is equal to half the wave-length of green light. The following table has been calculated by Prof. Fleming for three particles of very small diameter having the density of water :

Diameter Angström units.	Hours to reach earth.	Velocity kilometers per sec.	Energy brought to earth by one kilogramme. H.P. hours.
1,600	25	1,700	540,000
5,000	55	800	120,000
10,000	112	350	45,000

But some ions may start with a velocity given to them by sun spot upheavals of 200 or 300 kilometres per second. Some prominences have been observed to grow to a height of 70,000 miles in a few minutes. Then energy is conveyed to the earth by this impinging dust, which has a predominant negative charge.

The upper atmosphere of the earth contains hydrogen and helium, and these invading electrons and dust particles appear to wind themselves round the lines of magnetic force of the earth, and render the gases of the upper atmosphere luminous in the form of auroræ.

It has been noticed that the disturbances of the magnetic needle correspond with auroral disturbances, also that at places so far apart as Singapore, Toronto and Hobartstown the same magnetic variations occur. The number of auroræ, the daily range of magnetic declination, and relative extent of large sun spots, are co-related. Magnetic storms follow the meridianal disturbance of sun spots. It has been pointed out by Arrhenius that there is an interval in some cases of twenty-one hours, in others of forty-two hours or more, between the passage of a sunspot across central solar meridian and the maximum magnetic disturbance. This agrees with the time taken for very small solar dust to travel from the sun to the earth. There is therefore good reason for the view that the upper layers of the earth's atmosphere are invaded by ions which naturally give it some degree of conductivity.

We must also conclude that, due to ultra-violet light, ionisation takes place in the atmosphere on that side of the earth which faces the sun. As soon as sunlight is withdrawn the ions recombine.

There is first a permanent conducting layer at the outside of the atmospheric belt, and then another region below it which becomes ionised by day and unionised at night—a diurnal layer—and at lower levels what conductivity there is is not due to ionisation from the sun but to photo-electric action in dust or ice particles at high altitudes. Suspended water in the form of clouds, however, is not photo-electric. Our knowledge of the condition of the upper atmosphere is purely inductive. The greatest height a recording balloon can ascend, carrying meteorgraphs but no operator, is some nineteen or twenty miles only. Above this height our knowledge must be obtained indirectly.

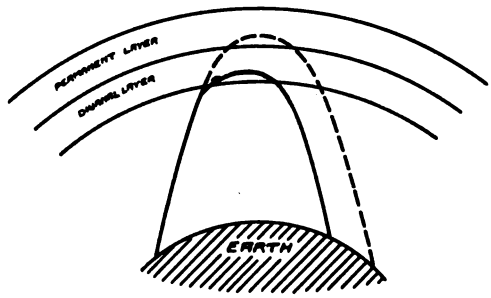


Fig. 9.

In 1902 Mr. Marconi described the effect that signals received over the Atlantic at Poldhu were stronger during the night than during the day. At that time the wave-length used was between 2,000 and 3,000 feet. A range of 700 miles during the day was increased to 1,500 and 2,000 miles at night. Mr. Marconi suggested that daylight had some effect on the radiating antenna ; but this cause could not be held adequate, as the effect only became apparent when signalling over considerable distances. However, his suggestion is worth attention. The experiments of Hertz with ultra-violet light showed that there was no difference in the effect whether the spark balls were of one metal or of another. In fact, all substances are photo-electric if raised to a potential sufficiently high to give off sparks, such as is the case with an antenna.

How is transmission over the Atlantic to be explained ? As long as the distance between two stations does not exceed 200 miles, the current in the receiving antenna is found to be inversely proportional to the distance, and this can be proved theoretically from Hertz's equations. Messrs. Duddell and Taylor were the first to prove this fact experimentally.

The experiments conducted by Dr. Austin between Brantrock station and the United States warships the *Birmingham* and *Salem*, carried out in July, 1910, show that the intensity of the received current for big distances fall off much more quickly than the distance increases ; also that the night during the day and night, the effect noticed by Mr. Marconi in 1911 that the strength of signals east and west is often very different to the strength north and south, all require some explanation. Prof. Fleming showed Mr. Marconi's curve, exhibited at his 1911 lecture, showing the variation of Transatlantic signal strength during twenty-four hours. The strength was steady during the day ; then a fall after sunset ; and two hours after sunset signals were at their weakest. As four hours is the difference in time between London and New York, at two hours after sunset in England the base of the earth's shadow cone would be half way

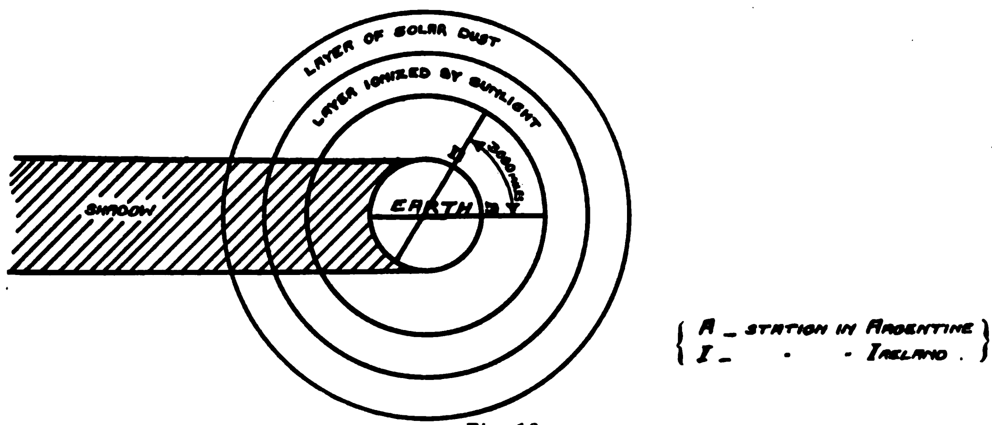


Fig. 10.

observations are more irregular than those taken in the day.

What explanation can be offered of these facts ? Lord Rayleigh was the first to point out that the curvature of the earth must be taken into account when signalling over long distance. The earth has a diameter of some 42,000,000 feet. Light, we know, bends round small objects, and this phenomenon is called diffraction ; but this diffraction depends on the ratio of wave-length to the size of the object. At first it was considered that diffraction by itself was not sufficient to explain long-distance radio transmissions ; but now Professors MacDonald and Love, on re-examining the subject from the mathematical side, think that diffraction will account for the day effect. Dr. Austin has represented the results of his tests as if they were carried out on a flat plain and the falling off in strength as an absorption. This method does not meet the case.

The night effect, the abnormal effects between the two stations. After the minimum position the curve rises to a maximum corresponding with sunset at Glace Bay, when both stations would be in darkness. Then follows a return to the normal, a strengthening before sunrise, and finally a fall to the normal after sunrise. A curve showing the variation of day and night signals between Paris and Liverpool obtained by Prof. Marchant shows a steady rise in signal strength from light to darkness.

In order to completely explain the facts observed we must fall back on some form of theory of ionic refraction as given by Dr. Eccles, by which the wave velocity in the ionised atmosphere is greater than in the unionised air, so that the wave front bends forward. The effect is that of an inverted mirage.

Prof. Fleming then showed a working slide (Fig. 9) to illustrate the action of ionic refraction on radio-telegraphic rays.

The sharp divisions between the layers as shown in the diagram, of course, do not exist. One layer merges into the other. When the stations are not in the shadow the result of the effect of ionisation which increases the speed of the wave is shown in Fig. 10.

A ray starting from earth in the direction shown by the heavy line, when it reaches the temporarily ionised belt caused by ultra-violet light, has its path bent downwards, and thus describes a trajectory which reaches the earth much sooner than if the ray had to proceed higher right into the permanently ionised layer before undergoing the refracting process as it would have to do when travelling in the earth's shadow.

When the diurnal layer is disappearing under the influence of night it will leave behind patches of ionised air here and there, roughening the under surface of the permanent layer. Now it is well known that a perfectly transparent solid when powdered up becomes opaque. Thus powdered glass is opaque; so is snow, which is simply powdered ice. Light is dissipated by reflection from the small particles; so it is with a liquid. Shake up paraffin and water, two transparent substances: the oil will emulsify —be broken up into small particles—and the mixture will become opaque. In this state the material will reflect light far more than before.

And so also we may expect the under surface of the permanently ionised layer to act as a much better reflector where these irregular patches of ionised air occur, thus accounting for the irregularities of signal strengths observed at night time.

Not only is there a diurnal but there is also an annual variation in signal strength which follows the path of the sunset line. The whole question of wireless transmission over great distance is very complex. Diffraction of the space wave, wave energy also travelling through the crust of the earth, refraction and interference, all play a part. No theory can be complete which does not admit the photo-electric effect of solar light and the effect of solar dust.

Finally, Prof. Fleming referred to the two Committees established for wireless telegraph research—one suggested by Dr. Fleming, under the auspices of the British Association, with Dr. Eccles as secretary; the other established mainly through the instrumentality of Mr. Goldsmidt, of Brussels, having Mr. Duddell as first chairman. The labours of these Committees were brought to a sudden and untimely end, but it is to be hoped they will resume their useful functions in the near future.

Maritime Wireless Telegraphy

ONCE again wireless telegraphy has come to the aid of lives imperilled on the high seas.

In the very early hours of May 27th the steamer *Ryndam*, of the Holland-America Line, collided with the Norwegian vessel *Joseph J. Cuneo*. The accident took place in foggy weather in the vicinity of the Nantucket Lightship, and as a result the *Ryndam* was badly damaged. The latter vessel had left New York the previous day with about 90 passengers, 25 of whom were in the first saloon, 40 in the second, and the rest steerage. She had on board a cargo valued at over £200,000.

When the collision occurred both vessels sent out wireless calls for help. Fortunately the American Atlantic Fleet was manœuvring in the neighbourhood, and the battleship *Louisiana* answered the call from a distance of about 20 miles and was the first to appear on the scene. When she arrived the *Joseph J. Cuneo*, which was the less damaged, was already engaged in taking off the passengers from the *Ryndam*. Later on in the day the passengers were transferred to the battleship *South Carolina*, as the *Cuneo* was considered to be unsafe. For some time there was considerable doubt as to the chance of the *Ryndam* reaching port in her damaged condition, as wireless messages reported she was able to steam but very slowly and had a heavy list owing to two of her holds being filled with water. However, eventually her commander was able to bring his vessel safely back to New York.

The *Cuneo* also reached that port, and the two vessels are effecting repairs. The *Ryndam* is a favourite passenger ship of over 12,000 tons register, and was making the voyage from New York to Rotterdam when the disaster overtook her.

Digest of Wireless Literature

ABSTRACTS OF IMPORTANT ORIGINAL ARTICLES DEALING WITH WIRELESS TELEGRAPHY AND COMMUNICATIONS READ BEFORE SCIENTIFIC SOCIETIES.

CALL SIGNAL DEVICES.

At a recent meeting of the Institution of Post Office Engineers Mr. L. B. Turner read a paper entitled "Wireless Call Devices," in which many points of interest were considered. At the commencement Mr. Turner said that, in the main, the problem was to provide an apparatus which was sufficiently sensitive to respond noisily to such a stimulus as may be got from an antenna supplied with about one hundredth of a milliwatt, but would not respond to unwanted signals such as those given by foreign wireless stations discharging their ordinary traffic, or atmospherics. The author next described the attempts which had been made in various directions to actuate a call signal device by means of the received messages. It was comparatively easy to actuate a bell with the old style of coherer, but such a receiver was not nearly sensitive enough for present day work. The power received by the ordinary telephone was not of the order required to actuate the Post Office relay, but such instruments as the Orling jet relay, the Brown telephone relay, the Heurtley amplifier (depending on the change of resistance produced in a hot thin platinum wire when slightly displaced across the edge of a blast of cold air), or the Lieben-Reiss cathode ray amplifier, might be employed. A certain amount of selectivity was necessary, and the simplest arrangement was to use a long "dash" as the call signal, and to arrange the receiving apparatus so that it did not respond to a short signal. Another method depended on musical note syntony, and an analogous device was that responding only to dashes at regular intervals.

Mr. Turner also referred to the Marconi Company's device for the remote control of fog-signalling apparatus. In this a coherer, in a specially reliable and therefore insensitive condition, controls a relay of conventional pattern, the local circuit of which energises magnets acting on a pendulum of balance-wheel form. Dashes sent out automatically from the calling station at equal intervals give a series of impulses to the balance wheel, which is mechanically tuned to their frequency, so that its amplitude is increased until a fork wherewith it is furnished dips into mercury cups and the fog gun is switched on or off.

The Post Office has ten wireless stations in use for communicating between the mainland and outlying islands, or between the islands of a group, and Mr. Turner showed a call device which had been specially designed for use with such installations. At frequent prearranged intervals, say four times an hour, a clock switches in a crystal receiver, which is of ordinary character except that a sensitive d'Arsonval galvanometer takes the place of the telephone. The receiver remains in circuit for only seven and a half seconds; and, if during this period the key of the calling station is kept depressed, the needle of the galvanometer is deflected into position between the jaws of a hit-or-miss device actuated by a local circuit. If the needle is not deflected, the closing of the jaws is without effect, for the jaws are slightly staggered, but if it is in place between them, it is gripped by them, a local circuit is closed, and continuous ringing bell relay actuated, and the bell rung. Neither atmospherics nor signals of any kind have any effect unless they occur during the activity of the receiver, and therefore the probability of damage to the crystals and of false calls is reduced by the clock switch in the ratio of 15 minutes to one-eighth minute, or 120 times, whereas the delay to a telegram under this system cannot exceed quarter of an hour. To guard against the contingency of the crystal being "knocked-off" by atmospherics, two crystals are provided and are switched in alternately by an ingenious mercury switch.

Another apparatus was also described, in which the swing of a galvanometer is gradually built up from the sending station by keeping the key depressed every alternate five seconds. With a signal of ·063 micro-ampère, a call could be made in this way in 2½ minutes. In this case a Fleming valve is used in place of the crystal.

* * *

WIRELESS TELEGRAPHY AND THE WEATHER.

Dr. H. R. Mill, Director of the British Rainfall Organisation, at a recent meeting of the Royal Meteorological Society, discredited the theory that the heavy rainfalls of last winter was due to the firing at the seat of war. In the same way, he said, the heavy winter of 1903 had been explained by the general adoption of wireless telegraphy. The fact that 1873 was equally as wet, if not wetter, without the aid of Hertzian waves, and that no year since 1903 had been nearly so wet, in spite of the enormous increase of radio-telegraphy, showed the fallacy of the inference.

It had been argued that it was the concussion caused by high explosives which determined the precipitation of rain from supersaturated vapour. The difficulty arose that if concussion was the cause, precipitation must occur immediately and presumably over the area within sound of the explosions. That, at least, was the principle which people who tried to induce public bodies to cannonade for rain had always adopted. The dryness of September, October, March and April, however, were difficult to explain on this hypothesis.

* * *

THE "ELECTRIC DOG" AND CONTROL BY LIGHT.

With reference to our note in the May issue and the wide publicity given to the invention of an "Electric Dog" in the United States, some particulars of its construction may be of interest. A detailed account of the ingenious apparatus appears in a recent issue of the *Electrical World*, and a suggestion is made regarding the possibility of equipping torpedoes with such directive mechanism. This mechanism could perhaps automatically cause the torpedoes to be steered towards—and to follow and sink—battleships or other hostile vessels from which search-lamps were being operated. The apparatus has been constructed by Mr. B. F. Meissner, a student of electrical engineering at Purdue University, Indiana, and was recently demonstrated before several meetings of electrical men in the United States.

By means of a small hand flash-lamp, of the "electric torch" variety, the speaker was able to control the movements of the "dog," which is really a peculiar box on wheels. The box has two "eyes," consisting of lenses, mounted on the front, and behind these are placed the selenium cells which control the interior mechanism. Directly the beam of light is thrown upon the "eyes" the box commences to move towards the source of light in a most uncanny manner. At the demonstrations the speaker caused the box to follow him about the stage, turning corners and avoiding chairs with no other control than that of the beam of light. By reversing a switch on the "dog," it can be made to back away from the light. The apparatus in each case started into motion quickly when the light was thrown upon it, and stopped just as promptly when the lamp was extinguished or turned away.

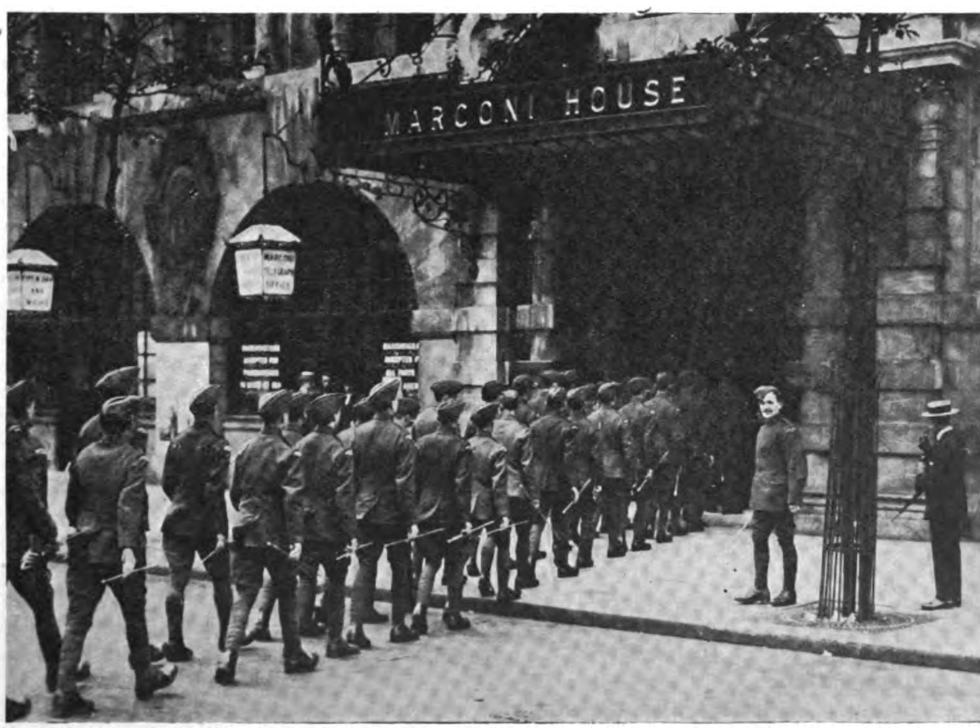
The motive power is provided by storage cells contained in the body of the box, and propulsion is effected by means of an electric motor. Each of the selenium cells behind the eye lenses controls a relay which actuates the motor and one of the two steering magnets at the rear of the device. Illuminating a cell on one side starts the motor and turns the rear wheel to that side; illuminating both cells equally causes the mechanism to run straight forward. Thus the action of the control mechanism is to keep the two lenses always equally illuminated and pointed at the source of light, in whatever direction that source moves. The idea of the light-controlled "dog" was suggested by Mr. John Hays Hammond, jun., and the mechanism was worked out by Mr. Meissner. A number of proposals, more or less practicable, have been made with regard to the control of mechanism by means of light beams, amongst them being that of the control of torpedoes mentioned above.

During the demonstrations Mr. Meissner performed a number of other experiments, such as firing a revolver, ringing a bell, extinguishing lamps, etc., all by means of a light-controlled selenium-cell mechanism. At the close the speaker showed the electric "thief catcher," which is actuated by the light of the supposed thief's hand lantern. At the slightest illumination of the sensitive cell by the rays from the marauder's flash-lamp an alarm was sent in and a bell set ringing, a revolver began firing, and a flash-light powder was ignited, taking the burglar's photograph. Mr. Meissner has suggested that the directive mechanism employed in the "dog" might be applied to the aiming of a revolver, thus leaving the robber no chance to escape.

Wireless and Aircraft

THE magnificent achievements of the Allied airmen during the present war in learning the disposition of the enemy's troops and artillery have largely depended for their success upon the facilities offered by wireless telegraphy for communication between the observer in the aeroplane and the staff officers below. Of such vital importance is a knowledge of wireless to the members of the Flying Corps that the Government has made arrangements for them to receive instruction in radio-telegraphy at Marconi House. Our picture shows the corps marching into the well-known Strand building at nine o'clock in the morning.

A certain famous animated picture firm has taken a short cinematograph film of the Flying Corps men training at the Hendon aerodrome, and also a picture similar to that reproduced here depicting their entry into Marconi House. These films have been incorporated with their weekly review of current events.



Entrance to Suez Canal—Port Said.

Wireless in the Near East

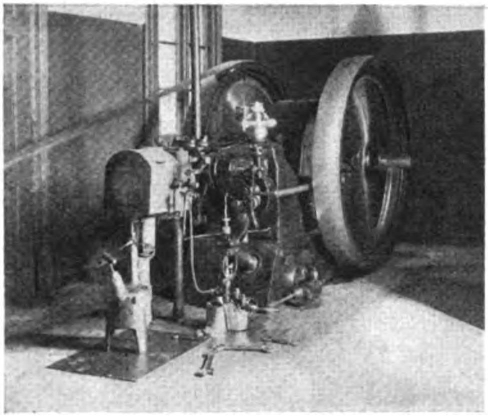
The Port Said Station

THE annexation of Egypt by the British, the abortive "invasion" of that country by Turkey, and the movements of our over-seas forces who spent the winter in training by the Nile prior to the commencement of the Dardanelles campaign have drawn the world's attention to this corner of the Mediterranean and have emphasised the importance to England of the Suez Canal as a means of communication with our Eastern Empire. It is hardly possible to realise that less than fifty years ago travellers to and from India and the Far East were obliged to take either the lengthy sea route *via* the Cape or else make a laborious journey on camel back between Alexandria and Suez. Although as far back as the reign of Rameses II. a canal for small boats is said to have been excavated between the Nile delta and the Red Sea, it was not until the time of Napoleon that serious consideration was given to a project for linking these two seas by means of an artificial waterway sufficiently large to take ocean-going ships. The engineer Lepère, who was commissioned by the Emperor, in 1798, to examine and report upon the practicability of such a scheme, at the conclusion of his investigations stated that the surface of the Red Sea was 30 feet higher than the Mediterranean, and therefore the scheme was for the time being abandoned. Forty-three years later some English officers proved Lepère to be wrong, and once again a Frenchman, this time the diplomat de Lesseps, set to work to make a study of the isthmus. The interest of the Khedive Said Pasha having been enlisted in the new project, certain concessions were obtained, and on April 25th, 1859, the first spadeful of earth was turned at Port Said. In ten years the Canal was completed, and on November 16th, 1869, after some twenty million pounds had been expended, the first ship passed through.

The tremendous utility of wireless telegraphy for notifying the Canal authorities of the times of arrival, delays, and the many other matters connected with the passage of vessels was early realised, and two small wireless stations, one at Port Said and the other at Suez, were erected by the Committee of Lloyd's.

The two installations were of a very simple nature, each comprising merely a 10 inch induction coil connected directly to the aerial, and a Marconi magnetic detector for receiving. The power for the coils was provided by batteries of large dry cells, and the range of both stations was limited. At Port Said the wireless plant was installed in the lighthouse, a familiar landmark to all who have had occasion to pass through the Canal.

Although these two stations did excellent work, after a little time it became apparent



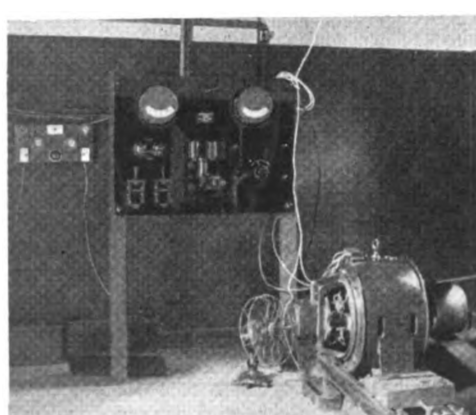
The Oil Engine

that something more powerful was needed, and an entirely new station, on a different site and equipped with much more powerful apparatus, was commenced at Port Said. When this was finished, the smaller station on the lighthouse was dismantled, and that at Suez also removed. The reason for the last step was that the new station was sufficiently powerful to handle all the traffic which had previously been dealt with by both stations, and its range extended to the whole length of the Canal and beyond.

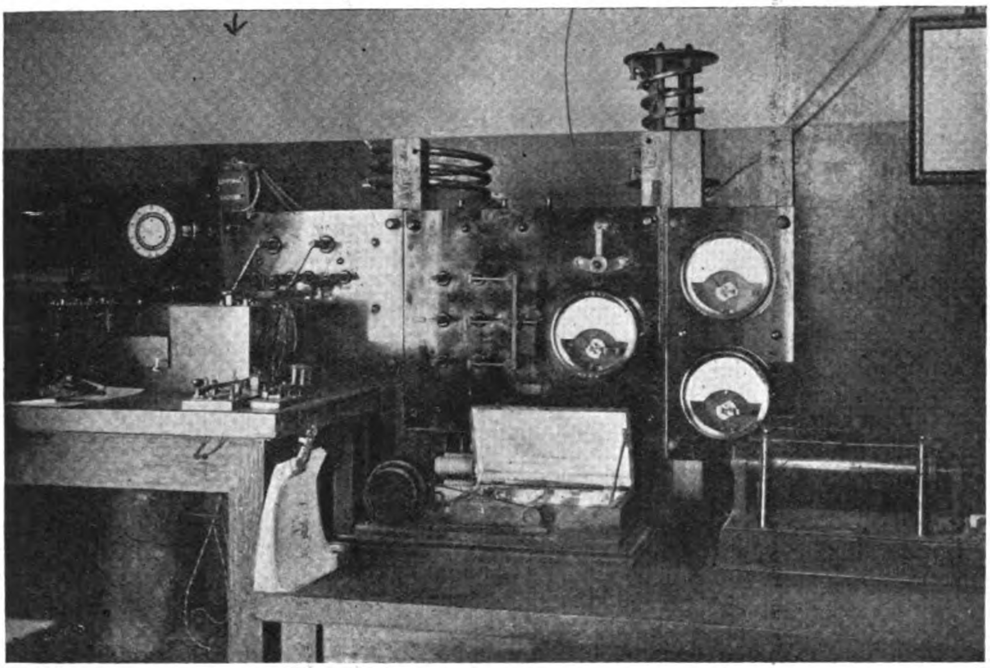
Port Said, as we know it nowadays, owes its existence solely to the Canal and the traffic which passes through it. Almost every steamer, whether east or west bound, stops some hours at Port Said for the purpose of replenishing her bunkers with coal, and in the case of mail steamers, to transfer mails with the fast packets *Isis* and *Osiris*, which run to and from Brindisi. A considerable passenger traffic has also to be catered for at certain times of the year, fast trains conveying tourists and others to and from Cairo and other Egyptian pleasure and health resorts. A number of large hotels have been erected to provide accommodation for these transient visitors, and a colony of rapacious and very cosmopolitan hawkers earn a more or less honest living by selling Eastern curios and other wares to the confiding European. It is at Port Said the new traveller to the East receives his introduction to Oriental life, and if on leaving he has not learnt the meaning of "baksheesh" it is no fault of the industrious inhabitants.

The wireless operator who is acquainted with the eastern route knows that he may expect to hear the distinctive musical note of "S.U.B." (Port Said) several hundreds of miles to the west, and on favourable nights, when "atmospherics" are not too frequent and strong, communication can be effected from as far away as Malta. The continual stream of traffic which passes through the Egyptian station relates to coaling, mails, passengers, stores, and every conceivable kind of shipping business, whilst passengers make extensive use of the wireless facilities for communicating with their friends and relations. A not inconsiderable amount of wireless traffic is normally exchanged with vessels trading between the Black Sea and Egypt, but, of course, during the war this is temporarily suspended.

The station itself is situated in a large building known as "Navy House," from the courtyard of which rises the tall mast which supports the aerial. Navy House was at one time, many years ago, the residence of a wealthy Dutch trader, and the building is of a typically early colonial type, with balconies surrounding an inner square or courtyard. A part of the house is now unoccupied, and the footsteps of the visitor echo sadly through the great rooms and corridors. When one stands on the verandah shaded from the bright eastern sunlight, listening to the harsh intermittent singing of the wireless spark, it is difficult to avoid dwelling on the changes that have taken place since the Dutchman and his family last occupied their eastern home. If in



The Dynamo and Switchboard for charging Accumulators.



A View in the Instrument Room.

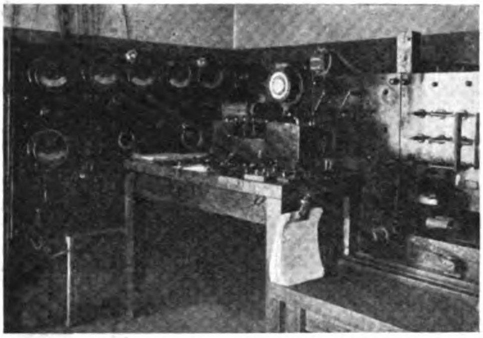
the midnight hours the shade of this merchant should ever pace the corridors it would surely be strangely disturbed by the blue-white flash which sends forth so many winged words into the night.

The installation, which is of a composite system, has a power of some five kilowatts. Current for transmission is supplied from a large battery of accumulators, which are periodically charged from a dynamo driven by an oil-engine. In the photograph, which shows the dynamo, an accumulator-charging switchboard will be noticed. In the centre of the board is placed an automatic "cut-out," which protects the cells in the event of the engine stopping by accident or the charging current being reversed. The photograph of the oil-engine will perhaps be of interest to amateur photographers, as it received half a minute exposure whilst the machine was running full speed. The impression of motion which is conveyed by the blurred spokes seems to add considerably to the effectiveness of the illustration.

The accumulator room and the room containing the oil-engine and dynamo are both situated at a little distance from the operating room, so as to avoid interference from the noise of the engine. In the machine-room there is also situated a motor-generator, which converts the direct current from the accumulators into alternating current for the transmitting plant. The controls of this machine are placed within easy reach of the operator in the instrument room, and thus it can be started and stopped in the minimum of time.

The power and control leads are carried overhead across the courtyard to the operating room, which also contains the wireless transmitter. In this room the receiving instruments are arranged immediately in front of the operator on duty, and the transmitting instruments to the right of him. On the left is a large switchboard with measuring instruments and the necessary controls for the motor-generator. Reference to the illustration will show the transmitting key on the right-hand side of the table.

The transmitting instruments contain a step-up transformer, an oil condenser with copper and glass plates, and "open" type jigger with a copper-tube primary and secondary, and a non-synchronous rotary discharger. The discharger is contained



Receiving Instruments and Power Switchboard.

in the small box, the lid of which is open and which can be observed in the illustration. The white light seen in the box proceeds from the spark, which was in operation for a few seconds during the time the photograph was being taken. A small separate motor is used for driving the discharger, and as this is often still speeding up when the operator commences to send, the musical note from it heard on board ship often mounts in tone during the first few words, with rather peculiar effect. In a similar way, when the operator is finishing a message he sometimes cuts off the motor during the last few words, so that by the time "Gdbi" is reached the spark sounds quite melancholy. The note variations, however, make little difference in the audibility of the signals, and it is an advantage to have the motor stopped during receiving.

The aerial lead is conveyed through the side of the room to the instruments. The aerial itself is of a modified umbrella form, and is held aloft by a tall wooden mast.

For the purpose of measuring the radiation and checking the efficiency of the transmission, hot-wire ammeters are provided with means of placing them in the aerial circuit. These can be seen on a switchboard on the right of the illustration, which shows the instrument room.

The receiving instruments have a wide range of wave-lengths, and are of the inductively-coupled type. Reception is effected on crystal detectors, which are rapidly interchangeable.

In a room adjoining the operating room are situated the land lines to the Eastern Telegraph Company and the Egyptian State Telegraphs. Should calls from these come through, an indicating lamp lights immediately in front of the operator on duty, and he can then see that the calls are answered. During the busy hours a telegraphist is always on duty on the land lines, and a small window in the wall enables the messages to be handed directly from one operator to the other. In this way a message received by wireless is put on to the land line in the minimum of time, and *vice versa*.

The staff accommodation is very comfortable, and is situated in Navy House itself, so that the operators can come on watch and go off duty to their quarters without any delay. The wireless conditions in this part of the world are not by any means ideal, as atmospherics are at times very strong and troublesome. Owing to the large number of vessels equipped with wireless passing through the Canal, the traffic is very considerable, and Mr. Robinson, the genial superintendent, is to be congratulated on his efficient staff and the dispatch with which the traffic is handled.

And so daily as the vessels come and go with their merchandise and living freights this station speeds out its messages across the Mediterranean waters and over the desert sands to Suez.

Little did the Dutchman think, when in those old days he sat out on the balcony calculating the time of arrival of his trading

Mr. Robinson, the genial Superintendent.

Street Scene in Port Said.

ship, that one day in the future a dozen argosies a hundred miles away would almost in a dozen moments announce their coming, by means of quiet invisible waves in the imponderable ether, the existence of which had not even occurred to him.

The Merchant Service Man

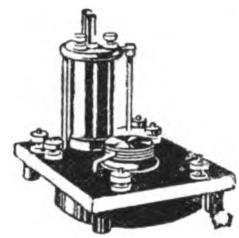
By DOUGLAS R. P. COATS

WHEN you've fêted Tommy Atkins at the finish of the War,
And he's had the credit given which is due:
When you've sung about Britannia, and you've cheered for Johnny Tar,
Who has kept her ever Mistress of the blue;
When the nurses and the doctors and the "coppers" all have been
Duly praised—and they'll deserve it, I admit—
Will you kindly then remember Mr. Mercantile Marine,
Who has also helped and done his little bit?

He is dodging German cruisers in the open southern seas,
With his hatches full of contraband of war;
He is navigating channels where the mines are thick as peas,
And with half the lights extinguished on the shore;
From your colonies he's bringing many sturdy British sons,
And from ev'ry place that's red upon the map:
He is carrying your horses, ammunition, aye, and guns,
And he's really quite a useful sort of chap.

While your Johnny Tar is busy holding "Billy's" fleet at bay—
In the metaphoric sunshine, be it said,
Mr. Merchantman is toiling, making metaphoric hay,
And he's working so that England may be fed.
In his twenty thousand tonners, in his cockleshells and tanks;
Or in aught a trifle larger than a tub;
Full laden to the Plimsoll—he is worthy of your thanks
Who supplies the Mother Country with her grub!

The ENGINEERS Note Book



Whilst we usually devote the pages under this heading to the consideration of the practical problems with which the wireless engineer is confronted in his work, and to the publication of hints and notes on engineering matters, we venture to think that we cannot do better this month than devote our space to a matter which is of vital interest to the nation at this juncture, and which must appeal particularly to our engineer readers, whose work is of such high importance and is so ungrudgingly accorded to the Motherland.

The Mobilisation of Invention.

THE urgent need for the application of all our national resources to the successful prosecution of the present war has called forth many excellent ideas, particularly with regard to scientific research. We therefore welcome the appearance of the following circular, which has been issued by the Hon. Secretary of the National Inventions Development Association :—

"The news has just been published that "the French Government has decided to "ask the Academie des Sciences to nominate "a number of military officers to serve in a "consulting capacity on Commissions, de-"voting themselves to the study and inves-"tigation of inventions likely to be of "service to the Allies in the war. An "important movement looking to a like "result has been in existence in this country "for several months. Its most recent "development was an influential meeting "held in London, on June 9th, at the office "of a prominent War Relief Organisation; "Admiral Lord Charles Beresford, M.P., "presided, and on the motion of Admiral the "Hon. Sir E. R. Fremantle, the project of a "*National Inventions Development Associa-*"*tion* was cordially approved and com-"mended to public support. Messrs. Jack-"son, Pixley & Co., Auditors and Accoun-"tants, 58 Coleman Street, E.C., were "appointed Hon. Treasurers, and the Hon. "Secretaryship was entrusted to Mr. E. "Jerome Dyer, Alderman's House, Alder-"man's Walk, London, E.C., who is widely "known as the organiser of the Vegetable "Products Committee, which with 230 "branches throughout the country is now "sending over 100,000 lbs. of fresh fruit "and vegetables every week to the North "Sea Fleet.

"So far as the Government is concerned, "it has already been stated semi-officially "that the authorities are not likely to be "able to find time to 'investigate more than "'a small proportion of the undeveloped "'inventions submitted.' The promoters "of the new body were told that this is all "that can be expected of Government. They "think that the time of the ablest officials "is fully occupied, and that as it is mani-"festly undesirable that any but highly "competent persons should pronounce judg-"ment upon inventions and discoveries "which may be of vital importance, what is "needed is that men of equal competence "with those in Government service, but "now in private practice, should be got "together into one body for this special "work. Accordingly, the various societies "and institutes representing scientific pro-"fessions will be invited to nominate "representatives to serve on the Associa-"tion's General Committee, and to appoint "expert consultants and advisers in their "respective branches.

"In the first place, all inventions, etc., "will be considered by a small staff of men "sufficiently qualified to sift the promising "from the impracticable. Inventions of "merit will be promptly referred to the "expert consultants. Inventions will be "patented where this is necessary, the "inventors' rights being fully safe-guarded. "Practical tests will then be made, and if "these are satisfactory the Government "will be approached. Funds are to be "raised by public subscription, and specific "donations, payable upon successful appli- "cation of the invention, will be invited to "provide rewards for notable improve- "ments in submarines, air-craft, aerial "weapons, trenching and sapping ap- "pliances, etc."

In the columns of the *Times* many letters from eminent men have lately appeared on this subject, notable among them being expressions of opinion from Mr. H. G. Wells, Sir Hiram Maxim and Dr. J. A. Fleming. In view of the important part played by wireless telegraphy in the world conflict now progressing and the eminence of Dr. Fleming in this particular sphere, readers of THE WIRELESS WORLD will be especially interested to read what the famous scientist has to say on the subject. In the *Times* for June 15th, Dr. Fleming writes as follows :—

"It would be difficult to overstate the "importance of the discussion on the above "subject in your columns which was "initiated by the letter of Mr. Wells. At "the present moment the scientific ability "of this country is in the position of the "magnetic molecules of iron as regards "external magnetic effects. They produce "no result until some external magnetic "force compels them all to orient them- "selves in the same direction.

"There is no want of ability, but there is "an entire absence of external directing "power. Nay, rather, special steps have "been taken to inhibit scientific activity "in directions which might assist the nation.

"Take, for instance, the subject of electric "waves, which might be used as an imple- "ment of warfare in certain ways I forbear "to point out for obvious reasons. It was "unquestionably right for the General Post "Office to put a stop at the outset of the "war to all amateur wireless telegraphy, "to prevent German spies conducting their "communications with antenna wires put "up a chimney.

"Is it, however, an advantage to the "country that all the expert knowledge on "the subject outside certain official circles "should be cast on one side and neglected ?

"A few days ago an eminent electrical "engineer was sitting in my room here, and "said to me, 'I am too old to enlist, or even "'to do manual work in the manufacture "'of shells, but I have a considerable "'scientific knowledge which I am just "'yearning to employ in the service of the "'country, yet I cannot find any person in "'authority who will tell me how to do it.'

"This sentence expressed concisely not "only my friend's feelings, but my own, and, "I am confident, that of hundreds of other "scientific men as well. At the present "moment, after ten months of scientific war- "fare, I myself, although a member of "several scientific and technical societies "and a Fellow of the Royal Society as well, "have not received one word of request "to serve on any committee, co-operate in "any experimental work, or place expert "knowledge which it has been the work "of a lifetime to obtain at the disposal of "the forces of the Crown. It is not enough "to make vague suggestions as to the detec- "tion of submarines or destruction of "Zeppelins. Rough ideas have to be "hacked into shape, reduced to practice, "and tested on a large scale. All this "means organisation, expenditure, assist- "ance, and definite practical experiments. "It seems to demand a special Government "department, which shall enlist in its ser- "vice trained and experienced investigators "for definite ends. This war will be won "in the laboratories and workshops almost as "much as in the field, and it will only be won "when the Government organise the scien- "tific intellect of the country as well as the "manual labour with that single purpose."

Dr. E. H. Griffiths, Principal of University College, Cardiff, in a letter to the *Times* of June 16th, says that our energies appear to have been chiefly employed in endeavouring to find the means of neutralising the advantages obtained by our enemies due to their application of the principles of science to the purpose of warfare. He believes that this merely defensive attitude is due to no lack of scientific ability or inventiveness on our part, but rather to a want of organisation of our intellectual reserves. Dr. Griffiths goes on to point out that amongst the flood of suggestions which are received every week, some at least must be of value, and the Government can scarcely be expected to spend its time searching for "a diamond "in such huge masses of blue clay." The association to which we have made reference above will, we think, prove exactly what is required in organising for the Government the scientific and inventive genius of our countrymen.

Administrative Notes

Brazil.

DR. PEREIRA GOMEZ, President of the United States of Brazil, in his message to the National Congress at its opening on May 3rd, made reference to the control of wireless telegraphy which is exercised by that Republic. Owing to the extensive coastline of the country, considerable difficulties have been encountered by the Brazilian Government in restricting the use of wireless and in suppressing clandestine installations. The Brazilian people themselves are unquestionably friendly to the Allies, but the difficulties with which the Government was faced on the outbreak of hostilities were not lessened by the fact that, as in the case of the United States, the country contains a large number of German settlers, who naturally did all they could for their own side.

The use of wireless telegraphy apparatus by ships of belligerent nations is prohibited by Article 6 of the Regulations of Brazilian Neutrality.

According to the notice by the Ministry of Marine dated August 24th, and the circular notes sent by the Ministry for Foreign Affairs on September 15th and 16th to the Embassies and Legations of the various belligerent countries, the use of wireless telegraphy by foreign merchant vessels, without distinction of nationality, is for the duration of the present war subject to the following regulations :

1. In the case of all foreign ships entering Brazilian ports, the Port Authorities will cause to be sealed up or enclosed all radio-telegraphic apparatus until the departure of such vessels.

2. All ships, if they remain in the port for more than forty-eight hours, will be obliged to take down the antennæ.

3. Ships detained in the ports must keep their aerials dismantled and must have the radio-telegraphic receiving apparatus and the rooms containing such apparatus sealed up.

4. The harbour masters are authorised to arrange with the commanders of ships detained in Brazilian ports an hour during which the rooms containing the wireless apparatus may be opened, in order that the persons in charge of them may clean and make proper provision for the preservation of the said apparatus.

The Brazilian President finally dealt with the means taken by the Government to suppress secret wireless stations, and stated that the General Department of Telegraphs had issued instructions for a most strict supervision to be exercised by means of the inspectors of various districts so that all private installations might be discovered.

* * *

Panama.

With reference to the new navy wireless station at Darien, to which we referred under " Administrative Notes " in our June number, it has now been announced that the first daylight message from this station to the navy radio station at Arlington, overlooking Washington from the south bank of the Potomac, was received on April 30th. It was the first official message between these two links in the chain of high-power radio stations that the U.S. Navy will have in operation between Washington and the Philippines next winter. Until the receipt of this all messages from the Navy Department to the Canal Zone had to be sent at night and be relayed. In the future these messages will be handled day and night *via* the new Darien Station. The distance from Arlington to the Canal Zone is 2,000 miles, and the sending and receiving radius of the new Darien Station is stated to be about 4,000 miles. The opening of the direct communication will effect a material saving to the Government in cable tolls, as it is expected that in a short time all official telegrams of the Government to the Canal Zone will be handled by the Arlington-Darien radio route. It is not intended for the present to handle commercial messages over this route, as the business of the Government with the vessels of the Navy and that of the War Department with the Canal Zone will be of sufficient volume for the capacity of the plant.

The transmitting plant at Darien is of the continuous wave type.

* * *

Russia.

The Russian authorities have decided to erect and equip a radio-telegraphic station at Nicolaieff, in the Odessa district, for the purpose of receiving time-signals from the Eiffel Tower, Paris.

* * *

South Africa.

In a White Paper issued on May 21st, containing a report of His Majesty's Astronomer at the Cape of Good Hope, it is stated that arrangements have been completed, and are in working order, for the daily transmission of a wireless time signal for the use of shipping in South African waters through the medium of the Union Government wireless station at Slangkop. The system is actuated automatically throughout.

This service of radio-time signals will be of inestimable value to shipping in South African waters. By means of it vessels within range of the stations can ensure a precision of standard time which it would otherwise be impossible for them to obtain, and the new facilities should make for additional safety in navigation. The Cape Town and Durban stations are open night and day and work on a 600-metre normal wave. A special clock at Cape Town Observatory is adapted to give automatically a series of signals extending over an interval of half a minute. The signals are transmitted at 11 p.m. Union time, which is equivalent to 9 p.m. Greenwich mean time, and shortly before that hour the clock is brought into conformity, daily, with the Observatory standards. The time signal proper, which is preceded by the usual warning signal, consists of twelve dashes, each of about three-quarters of a second in duration, divided into five groups, the commencement of the separate dashes corresponding exactly with the following Greenwich mean times :

Group I.	Group II.	Group III.	Group IV.	Group V.
H. M. S.	H. M. S.	H. M. S.	H. M. S.	H. M. S.
8 59 30	8 59 38	8 59 44	8 59 48	8 59 54
ŀ59 32	8 59 40	—	8 59 50	8 59 56
59 34	—	—	—	8 59 58
				9 00 00

By means of a special relay the time signal is simultaneously transmitted to the Cape Town and Durban wireless stations, the signal to the latter station passing over the land telegraph wire connecting Cape Town and Durban, a distance of 1,100 miles. In addition to the time signals, both stations transmit each day at 1 p.m. a report in plain language containing information concerning the meteorological conditions prevailing on the whole coast of the Union of South Africa.

* * *

United States.

We are informed that the American Marconi Company's station at Miami, Florida, is now transmitting press messages on a wave length of 550 metres instead of 1,610 metres.

WIRELESS AND COALING THE FLEET.

One of the lesser-known uses of wireless telegraphy in warfare, and one which has an important bearing on the efficiency of our Fleet, is the rapid summoning of colliers for the replenishing of a war vessel's bunkers. A collier packed to the hatches with coal gets into touch by wireless with a battleship whose bunkers require refilling. On sighting the parent vessel the supply ship manœuvres into the right position, about 400 feet astern of the battleship, and then despatches a small boat carrying the cables, one set of which stretches from the masthead of the supply vessel. When it reaches the warship the cables are made fast on the port and starboard sides of her stern, and the two lines being brought to the right tension, the two ships travel on in a straight line fastened together, whilst from the mast of the collier to the deck of the warship stretches a transport cable for carrying coal bags. By means of wheels running on the cable the load is forced by automatic winches along the sloping transport line at the rate of some 3,000 feet per minute. This apparatus enables about sixty tons of coal to be transferred every hour across the gap of water separating the vessels. It will be readily realised that Mr. Marconi's invention, in being the means of rapidly summoning the colliers, adds considerably to the speed at which the whole operation can nowadays be carried out.

NOTES OF THE MONTH

WHEN so many novelists and writers, in dealing with wireless telegraphy, exhibit so complete an ignorance of the simplest principles of the science as to spoil their stories entirely for those who know, it is refreshing to find that Mr. William Le Queux, in the June number of the *Royal Magazine*, has contributed a story which is both interesting in itself and from the technical point of view practically blameless. Under the general heading of "The Spy Hunter," the author in question introduces a new series of "spy" stories under the title of "The Green Blackbird." He tells how a young Marconi operator, working in conjunction with the authorities, was instrumental in ferreting out a hidden wireless installation on the East Coast, and thus bringing to book the German spies who were operating it. The illustrations are for the most part correct from the wireless point of view, although for some reason the artist has drawn in the first picture what appears to be a transmitting jigger immediately adjacent to the receiving instruments. As the remainder of the apparatus has been depicted in "correct" Marconi style, it is unfortunate that this error should have crept in.

Perhaps the talented author will pardon us for pointing out one or two points in the story which might create a wrong impression. For example, the operator who is supposed to be telling the story states, when speaking of the Poldhu news service, "It was the usual old story . . . brought to a conclusion by those eternal quotations from the German newspapers upon European affairs. In common with every wireless operator on the high seas, I have always wondered why we have been so constantly compelled to swallow German opinion by wireless. . . ."

We would not comment on the above were it not for the fact that the story is introduced by the following note:

"No man knows more of the Secret Service of the countries now at war than Mr. William Le Queux. . . . The following story is the first of a thrilling series based upon facts within his own personal knowledge, and which, owing to the strict censorship now necessary, it is only permissible to publish in the guise of fiction. . . ."

In these circumstances the reader might quite possibly take the statement concerning the predominance of German opinion in Poldhu news to be a true record of fact. We scarcely need say that the suggestion is totally unfounded. Before the outbreak of war the news programme commenced with extracts from the leading articles of the *Times*, *Le Temps*, and the *Koelnische Zeitung*. No other German newspapers whatever were quoted, and the remainder of the message was composed of ordinary news. The Poldhu press messages are reproduced in various ocean newspapers on board not only British, but French, Italian, Dutch, and other steamers, so that it is necessary for the bulletins to have an international character, and for this reason three leading European newspapers were quoted. It would be as true to say that French opinion was thrust upon the public by wireless as to suggest that German opinion was forced upon the readers of these newspapers. With regard to the statement "In common with every wireless operator I have always wondered . . .," etc., the writer of this note spent some years at sea as a wireless operator and never once heard anything from his fellow operators which would indicate that any such wonderment existed.

Mr. Le Queux is also slightly in error as to the abbreviations used at sea. In the story we find "TQ" given as "Am I through?" and "DF" as "You are now through." Both of these abbreviations are novel and are certainly unknown to any of the ordinary mercantile operators. The same remark applies to "CCC," which is given as "Outward foreign."

These, however, are minor points, and detract very little from the interest of the story. Mr. Le Queux is to be congratulated on having produced a yarn which is of great interest both to the general public and to the wireless expert.

* * *

On June 16th a message was received from Petrograd by the Marconi Company and delivered to the Speaker of the House of Commons. It consisted of a complimentary announcement sent on the occasion of the official inauguration of a new and powerful wireless station erected by the Russian Marconi Company for the Russian Government.

The text of the message ran as follows :—

To the Speaker, House of Commons, London.

On the occasion of their visit to the largest Russian wireless station, which was built during this war, the Chairman and the members of the Duma send their best wishes to you, to the British nation, and to the Allied Army, and are firm in the faith that the definite victory will soon come for the happiness of all nations and to the glory of the Allied arms. God save England!

In replying to the Russian complimentary message, the Speaker transmitted by the same radiotelegraphic means the following answer :—

To the Chairman, The Imperial Duma, Petrograd.

The Speaker of the House of Commons has received with much interest and gratification the message from the Chairman and members of the Russian Duma; he reciprocates their good wishes, and prays for the success of the Russian arms. Long live the Tsar! Long live the Russian people!

* * *

Amongst the legislative changes due to the present war we must record the postponement of compulsory wireless on board British merchant ships. Readers will remember that at the enquiry held to investigate the tragedy of the *Titanic* the need for wireless equipment on board practically all merchant ships was strongly emphasised, and as a result certain provisions were made in the Merchant Shipping (Convention) Act, 1914. This Act stipulates that, after a certain date (originally July 1st, 1915) all British ships carrying fifty or more persons, and also foreign ships entering British ports, must carry an efficient wireless telegraph installation. The Board of Trade has now announced that the coming into operation of the Act has been postponed until January 1st, 1916.

* * *

We have pleasure in calling our reader's attention to another page of this issue on which we give a full and illustrated account of Dr. Fleming's new instrument, the "Campograph," brief particulars of which were given in our last month's report of the Tyndall Lecture at the Royal Institution. The "Campograph" is not only an extremely interesting invention, but is destined to play a very important part in future wireless research.

We also print a report of Dr. Fleming's second Tyndall lecture at the Royal Institution, in which he dealt further with the fascinating subject of photo-electric phenomena. This, together with our previous report of the first lecture, furnishes by far the fullest and most complete account which has appeared of these two interesting and important discourses.

* * *

In dealing with the naval and military possibilities of American intervention, a writer in the columns of the *Manchester Dispatch* alluded recently to the possession by the American Fleet of a specially powerful torpedo directed and worked by wireless. A weapon of similar design is said to have been submitted to the Italian Admiralty some few months ago by a native inventor. In view of the extremely practical interest which the Italian Government has always demonstrated in the invention of its illustrious son, Mr. Marconi, we may feel assured that any such device will be submitted to thorough trials and, should it prove practicable, will assuredly be adopted.

CARTOON OF THE MONTH

British Wireless Station receiving the Hymn of Hate.

C

The Wireless Transmission of Photographs.

By MARCUS J. MARTIN.

Article 4.

CLOCKWORK and electro-motors are the sources of driving power that are most suitable for photo-telegraphic work, and each has superior claims depending on the type of machine that is being used. For general experimental work, however, an electro-motor is perhaps most convenient, as the speed can be regulated within very wide limits. For a constant and accurate drive a falling weight has no equal, but the apparatus required is very cumbersome, and the operation of winding both tedious and heavy. This method of driving was at one time universally employed with the Hughes printing telegraph, but it has now been discarded in favour of electro-motors, which are more compact, besides being cheaper to install in the first instance.

Synchronising and isochronising the two machines are the two most difficult problems that require solving in connection with wireless photography, and, as previously mentioned, the synchronising of the two stations must be very nearly perfect in order to obtain intelligible results. The limit of error in synchronising must only be about 1 in 500 in order to obtain results suitable for publication.

The electrolytic system is perhaps the easiest to isochronise as the received picture is visible. On the metal print used for transmitting, and on the commencing edge, a datum line is drawn across in insulating ink. The reproduction of this line is carefully observed by the operator in charge of the receiving instrument, and the speed of the motor is regulated until this line lies close against a line drawn across the electrolytic paper. Although this may seem an ideal method, there are one or two considerations to be taken into account. Unless the decomposition marks are made the right length, and are properly spaced, however good the isochronising may be, the result will be a blurred image. Anyone who has worked with a selenium cell will know that it cannot change from its state of high resistance to that of low resistance with infinite rapidity, and the effects of this inertia or " fatigue," as it has been called, are more pronounced when working at a high speed. When working, the effects of this inertia would be to increase the time of contact of the relay, F (Fig. 31), as the current from E would flow for a slightly longer period through R to F, than the period of illumination allowed by J. This, of course, would mean a lengthening of the marks on the paper. Results would also differ greatly with different selenium cells. There is a method of compensation by which the inertia of a cell can almost entirely be overcome, but it will add greatly

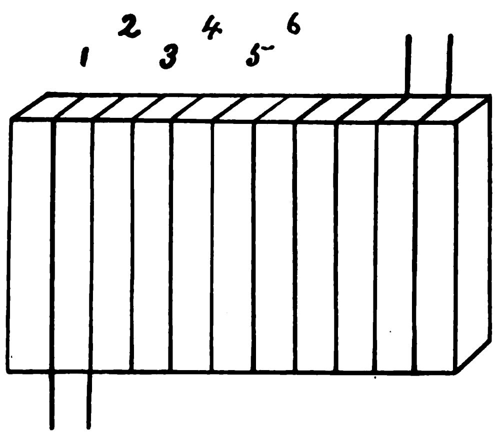


Fig. 33.

to the complications of the receiving apparatus.

As a selenium cell has been occasionally mentioned throughout these articles, the following brief description may perhaps be of interest. A selenium cell in its simplest form consists merely of some prepared selenium placed between two or more metal electrodes, the selenium acting as a high resistance conductor between them. The cell used for commercial purposes is usually made as follows. A small rectangular piece of slate, porcelain, or other insulator, is wound with many turns of pure platinum

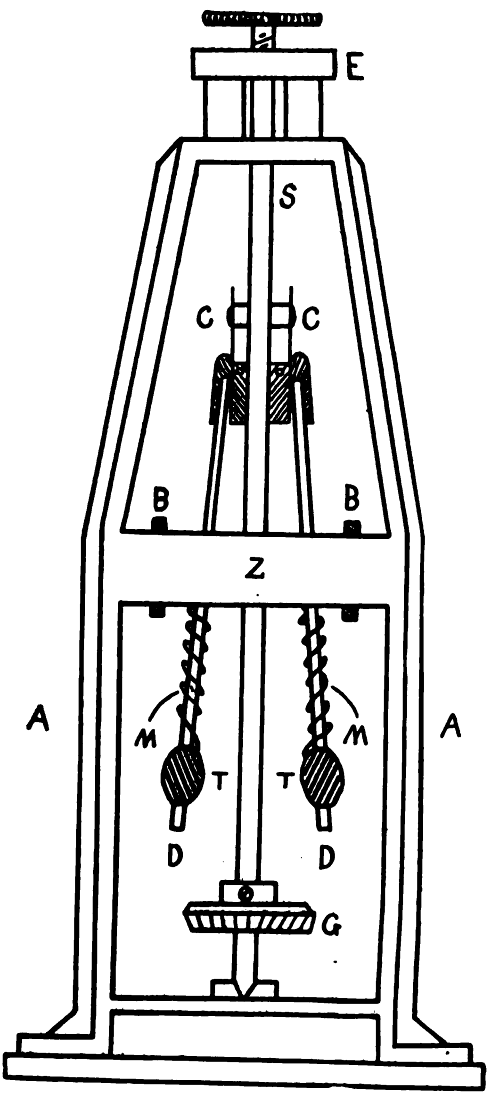


Fig. 34.

wire. The wire is wound double, as shown in Fig. 33, the spaces between the turns being filled with prepared selenium. The selenium is prepared by being kept at a very high temperature, when it assumes the crystalline form in which it is sensitive to light. The light is apparently absorbed and made to do work by varying the electrical resistance of the selenium. A strong light falling upon a selenium cell lowers its resistance, and *vice versa*, the resistance of a cell being at its highest when unexposed to light. The resistance of cells the same size may vary from 50 to 200,000 ohms, or more.

In using an electro-motor with any optical method of receiving, there are two methods available. The first is an arrangement similar to that used by Prof. Korn in his early experiments with his selenium machines. The motor used for driving has several coils in the armature connected to slip rings, from which an alternating current may be tapped off, the motor acting partially as a generator, besides doing good work as a motor in driving the machine. This alternating current is conducted to a frequency meter, which consists of a powerful electro magnet over which are placed magnetised steel springs having different natural periods of vibration. By means of a regulating resistance the motor is run until the spring, which has the same period as the desired armature speed, vibrates freely. The speed of the motors at the two stations can thus be adjusted with a fair amount of accuracy.

Another method is to make use of a governor similar to those employed in the Hughes printing telegraph system. A drawing of the governor is given in Fig. 34. It consists of a metal frame of the shape shown, which supports an upright steel bar, S, whose ends turn on pivots. This bar is rectangular in section. The gear wheel, G, is fastened near the bottom of this rod, and gears with a similar wheel on the shaft of the driving motor (not shown). Suspended from the broader sides of S are the two flexible arms, D, each carrying a brass ball, T. These balls are not fastened to the arms, but can slide up and down, being held in position by the wire springs, M, one end of each spring being fastened to the screw, C. These screws work in a slot cut in the upper part of S, and are connected to the adjusting screw, E. When E is turned the screws are raised or lowered accordingly, and also the balls on the arms, D. Fastened to the arms are two brushes of tow, B, but these revolve inside, just clearing the inner surface of the steel ring, Z. Upon the motor speed increasing above the normal, the arms, D, and consequently the balls, T, swing out, making a larger circle, causing the brushes, B, to rub against the steel spring, Z, setting up friction, which, however, is reduced as soon as the motor regains its ordinary working speed. By careful adjustment the speed of the motors can be kept perfectly constant. The object of having the balls, T, adjustable on D is to provide a means of altering the motor speed, as the lower the balls on D the slower the mechanism runs, and *vice versa*.

A simple and effective speed regulator, devised by the writer, is given in the drawings 35 and 36. It comprises two parts, A and B, the part A being connected to the driving motor and the part B working independently. The independent portion, B, consists of an ordinary clock movement, M, a steel spindle, J, being geared to one of the slower moving wheels, so that it makes just one revolution in two seconds. This spindle, which runs in two cone bearings, carries at its outer end a light pointer, D, about two inches long, to the underside of which is fastened the thin brass contact spring, S, which presses lightly upon the ebonite ring, N. The portion A comprises a spindle, pointer and contact spring, similar to those employed in B, the spindle, J[1] being geared to the driving motor by means of F, so that the pointer D[1] makes a little more than one revolution in two seconds. By means of a special form of brake on the driving motor, the speed is reduced, so that both pointers travel at the same rate—*i.e.*, one revolution in two seconds. By careful adjustment the two pointers can be made to revolve in synchronism * and when this is obtained, the contact springs, S and S[1] pass over the contacts, C and C[1], completing the circuit of the battery, B, and lamp, L. When working properly the lamp, L, lights up once every second.

This regulator is an excellent one to use for experimental work, although it depends a great deal upon the skill of the operator, but good adjustment should be obtained in about two minutes. It is a good plan to insert a clutch of some description between the driving motor and the machine, so that the regulator can be adjusted prior to the act of receiving or transmitting, the machine being prevented from revolving by means of a catch. The motor used should be powerful enough to take up the work of driving the machine without any reduction in speed. The clocks, M, can be regulated so that they only gain or lose a few seconds in 24 hours, which gives accuracy in working sufficient

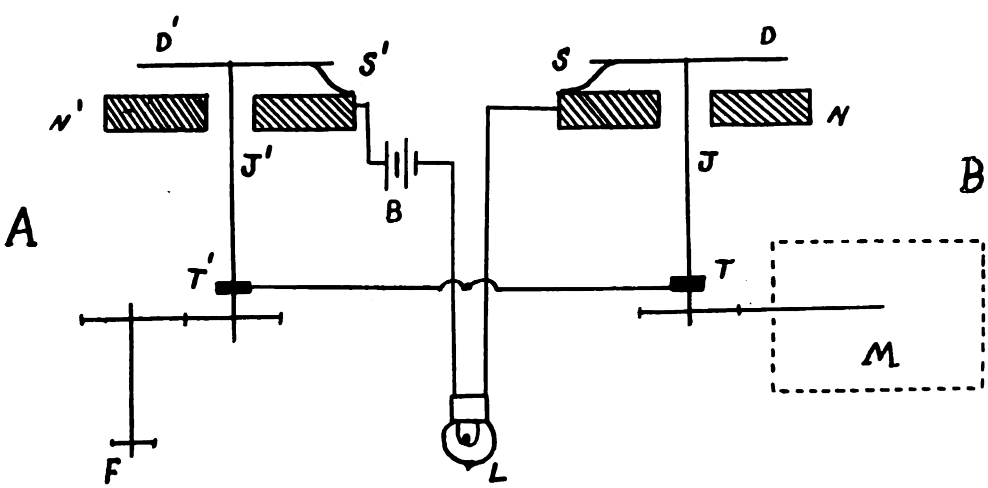


Fig. 35.

* Two clocks would isochronise if their hands travelled at precisely the same rate round the dials, but would not synchronise unless they registered the same time as well.

for all practical purposes. Connection is made with the contact springs S, S' by means of the springs T, T', which press against the spindles J, J'.

Another important point is the correct placing of the picture upon the receiving drum. It is necessary that the two machines, besides revolving in perfect isochronism, should synchronise as well; begin to transmit and record at exactly the same position on the cylinders—*i.e.*, at the edge of the lap, so that the component parts of the received image shall occupy the same position on the paper or film as they do on the metal print. If the receiving cylinder had, let us suppose, completed a quarter of a revolution before it started to reproduce, the reproduction when removed from the machine and opened out would be found to be incorrectly placed, the bottom portion of the picture being joined to the top portion, or *vice versa*, and this means that perhaps an important piece of the picture would be rendered useless, even if the whole was not spoilt. It is evident, therefore, that some arrangement must be employed whereby synchronism as well as isochronism of the two instruments can be obtained.

There are several methods of synchronism that are in constant use in high-speed telegraphy, in which the limit of error is reduced to a minimum, and some modification of these methods will perhaps solve the problem, but it must be remembered that synchronism is far easier to obtain where the two stations are connected by a length of line than where the two stations are running independently. In one system of ordinary photo-telegraphy synchronism is obtained in the following manner. The receiving cylinder travels at a speed slightly in excess of the transmitting cylinder, and as its revolution is finished first is prevented from revolving by a check, and when in this position the receiving apparatus is thrown out of circuit and an electro magnet which operates the check is switched in. When the transmitting cylinder has completed its revolution (about 1/100th of a second later) the transmitting apparatus, by means of a special arrangement is thrown out of circuit for a period, just long enough for a powerful current to be sent through the line. This current actuates the electro magnet, the check is withdrawn and the receiving cylinder commences a fresh revolution in perfect synchronism with the transmitting cylinder. As soon as the check is withdrawn the receiving apparatus is again placed in circuit until another revolution is completed. As the receiver cannot stop and start abruptly at the end of each revolution a spring clutch is inserted between the driving motor and the machine.

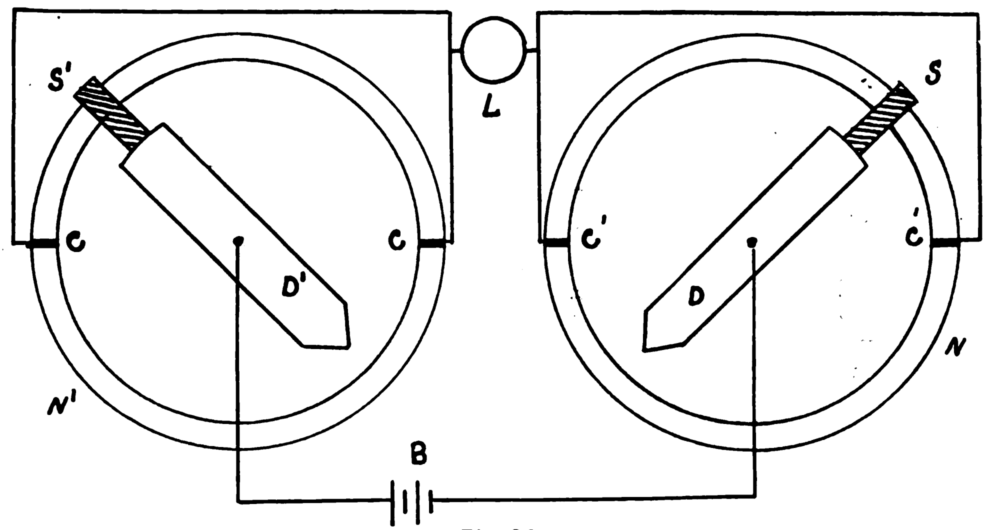


Fig. 36.

Although a method of synchronism similar to this may later on be devised for wireless photography, the writer, from the results of his own experiments, is led to believe that results good enough for all practical purposes can be obtained by fitting a synchronising device whereby the two machines are started to work at the same instant and relying upon the perfect regulation of the speed of the motors for correct working.

The method of isochronism must, however, be nearly perfect in its action, as it is easy to see that even with only a very slight difference in the speed of either machine this error will, when multiplied with 40 or 50 revolutions, completely destroy the received picture for practical purposes.

From what has been written in this and in the preceding chapters it will be evident that the successful solution of transmitting photographs by wireless methods will necessitate the use of a great many pieces of apparatus, all requiring delicate adjustment and depending largely upon each other for efficient working. As previously stated, there is at present no real system of wireless photography, the whole science being in a purely experimental stage, but already Prof. Korn has succeeded in transmitting photographs between Berlin and Paris, a distance of over 700 miles. If such a distance can be worked over successfully, there is no reason to doubt that before long we shall be able to receive news pictures from America with as great reliability and precision as we now receive messages.

In nearly all wireless photographic systems devised up to the present the chief portion of a receiver consists of a very sensitive galvanometer, and although good results have been obtained by the use of such instruments, they are more or less of a nuisance, as the extreme delicacy of their construction renders them liable to a lot of unnecessary movement caused by external disturbances.

A galvanometer of the D'Arsonval pattern used by the writer was constantly disturbed by a person walking about the room, although placed upon a fairly substantial table, and for the same reason it was impossible to attempt to place the driving motor of the machine on the same table as the galvanometer. For shipboard work it will be evident that the use of such a sensitive instrument presents a great difficulty to successful working, and a good opening exists for some piece of apparatus (to take the place of the galvanometer) that will be as sensitive in its action but more robust in its construction.

While experimenting with the device given in Fig. 26, the writer introduced improvements that may, when perfectly developed, solve the problem of a suitable receiver, it being practically unaffected by external disturbances besides being capable of recording signals at a speed as high as 250 a second. A method of synchronising has also been developed which, by means of a very simple adjustment, can reduce the limit of error to 1 in 1,000 very easily.

In concluding these articles on radio-photography the writer would like to express his thanks to Messrs. Wratten and Wainwright for their permission to use extracts from their work *Reproduction Work with Dry Plates*. Also to the proprietors of *Electricity* for allowing him to reprint portions of articles that have already appeared in their journal on this subject.

WIRELESS MUSIC AT SEA.

THE *Adelaide Advertiser* recently contained an account of the novel experience of the wireless operators on board the American steamer *Port Kembla*, which arrived at Fremantle, W.A., from New York early in April. Shortly after the steamer left New York, one of her operators, who had the receivers to his ears, was surprised to hear a human voice come from his instrument. Listening intently he was able to hear the voice call " Hullo Philadelphia," to which the answer came " Hullo Boston," followed by a further call from the first station, " Stand by for a little music."

After a slight interval the grating sound of a gramophone came to his ears, followed by the rendering of the song " Sister Susie Sewing Socks for Sailors." The operator could hear each note as plainly as if the gramophone were in the wireless room.

On the arrival of the *Port Kembla* at Bermuda, it was learned that other operators had experienced the same musical treat, and it was eventually ascertained that the reason for it was that some experiments were being carried out by a wireless telephone at Boston.

Doings of Operators.

IT is sometimes said that the excitement of a wireless operator's life is more imaginary than real, and that the chance for the average man of a thrilling experience is small, to say the least. When it is considered that during the course of a year not one vessel in a hundred experiences even a slight mishap, the statement would appear to be borne out by hard facts. Statisticians with time to spare could no doubt show that the chances of adventure in wireless are smaller than in many seemingly dull and uneventful professions; whilst the chance of more than one exciting episode coming the way of any individual operator would tax the decimal system of enumeration.

Whether or not such thoughts as these passed through the mind of Mr. E. T. Shrimpton when he joined the Marconi Company we cannot say, but at the present time he is thinking that there is a lot of wisdom in the old saying that "the exception proves the rule." It will not be without interest to consider the reasons which have led him to this belief.

Mr. Shrimpton on first joining the Marconi Company was engaged upon clerical work in Marconi House. Thinking, however, that the open-air life of a wireless operator would prove more congenial, he undertook a course of study, and in due time was appointed to the operating staff. Five days after joining he was appointed to his first ship and commenced his operating career.

For some reason the number thirteen is supposed to be unlucky, but Mr. Shrimpton was not superstitious. If he had been he might have demurred at joining the Company in 1913. Probably he did not notice that his appointment to the operating staff dated from the 26th day of the month (thirteen twice) and that he was instructed to take duty on his first ship on the 31st (thirteen backwards). Incidentally, we may remark that the vessel in question, the s.s. *Cobequid*, is stated to have had thirteen officers.

All went well with the subject of our notes until in January, 1914, the vessel on which he found himself struck a rock off the Canadian coast and became a total wreck. It is scarcely necessary to point out that the date was the thirteenth.

Of course, thirteen cannot really be unlucky, or Mr. Shrimpton would not have been saved. As it was he suffered no hurt, and in due course was appointed to another ship.

The next vessel to which the new operator was appointed was the s.s. *Kaipara*, and on this he remained for several months. On the thirteenth day of the war a large vessel with four funnels made her appearance on the horizon and in a most objectionable manner compelled the *Kaipara* to heave to. She proved to be the notorious *Kaiser Wilhelm der Grosse*, whose raids on merchant shipping were a feature of the early days of the conflict. The passengers and crew of the *Kaipara* had to pack up their few belongings and were transferred to the German pirate, which promptly sank the *Kaipara* and sailed away.

Mr. Shrimpton and the others made the best of things and congratulated themselves that they were not sunk at the same time as their late vessel. Eleven days later the Britishers were transferred to the attendant German collier *Arucas*, and had all their doubts as to whether a war was really in progress promptly dispelled by a shower of 6 in. shells from the British cruiser *Highflyer*. Mr. Shrimpton, with his usual good luck, avoided any injury, and a little later was landed at Las Palmas.

Arriving home, the subject of our article received an appointment to another vessel, the s.s. *Cluny Castle*, on which he made an uneventful voyage. On January 16th he was transferred to the s.s. *Drumcree*, and made a voyage across the Atlantic. It must have felt pleasant to settle down to a quiet, uneventful life again. It was certainly rather annoying when at the beginning of a second voyage on this vessel a German submarine made her appearance on the surface of the sea close to the ship. The submarine proceeded to fire a torpedo, which struck the *Drumcree* amidships and smashed up the wireless cabin in excellent fashion. The condition of the cabin after the explosion would have delighted a Post Office Examiner in fault tracing, as everything was nicely out of adjustment. Fortunately, Mr. Shrimpton had previously given a distress call before the dislocation occurred. He tells us that the silence cabin doors were blown off their hinges, the short-wave condenser thrown across the room, the coil wrenched off its base, and the thick shelf in the silence cabin broken through. The nicely disarranged accumulators filled up what vacant space remained on the cabin floor.

In spite of the force of the explosion and the damage which it effected, the ship did not immediately sink, and by good fortune a Norwegian steamer near by was able to take the *Drumcree* in tow. Mr. Shrimpton was just meditating on his invariable luck when a second torpedo finished matters and the entire crew transferred to the rescuing steamer.

Mr. Shrimpton is now ashore recovering from a wound in the scalp caused by some falling apparatus, and his cheerfulness regarding the whole of his experiences is a good example for many who have been through a far less trying time.

* * *

It is remarkable that whilst we were preparing the foregoing notes we should receive a visit from another wireless man to whom adventures have not come singly. Mr. Douglas R. P. Coats, who is a native of Gravesend, first entered the telegraph service with the Pacific Cable Board, but like many another telegraphist, felt the call of wireless and the sea, and in 1913 joined the staff of the Marconi Wireless Telegraph Company of Canada. After serving some little time on that company's land stations at Quebec and Montreal he was appointed to the s.s. *City of Sydney*, a steamer trading between the St. Lawrence and St. John's, Newfoundland. She was not a large steamer—some 2,500 tons gross—and when the winter set in and closed the St. Lawrence for shipping, she made a passage to St. John's, Halifax, Nova Scotia, and New York. On March 17th, 1914, at 3.30 a.m. the *City of Sydney* struck a reef outside Halifax in the midst of a thick fog. Wireless distress calls were sent, and a

Mr. D. R. P. Coats.

speedy answer obtained, but owing to the weather and the dangerous shoals by which the vessel was surrounded, the rescuing vessels could not at first approach nearer than about a quarter of a mile. Finally the crew and the passengers (thirteen of them, by the way) were saved by the lobster catcher *Rosemary*, and safely conveyed to port. The officers of the *City of Sydney* remained behind after the others and were taken off later in the day by the tug *Togo*.

After this exciting adventure Mr. Coats was appointed to the s.s. *Morwenna*, and later to the Donaldson steamer *Lakonia*, on neither of which ships did anything of an unusual nature occur, but another transatlantic vessel to which Mr. Coats was sent took part in a collision and had to put into Hull. On leaving this vessel our friend rejoined the s.s. *Morwenna*, and, strange to relate, this vessel, too, was the victim of a collision and had to put back for repairs. When these were effected Mr. Coats again took duty on the vessel and all went well for several trips. But all was not to continue peacefully. Having tasted a little of adventure Mr. Coats was to have still more. The s.s. *Morwenna* called at Cardiff for bunkers in May of this year and on the 25th left for her next port. On the 26th (twice thirteen again), in the middle of the morning, an enemy submarine was sighted on the port bow about two miles distant. The captain of the *Morwenna* immediately turned his vessel round and attempted to " run for it," but the superior speed of the submarine prevented his escape. The wireless distress call was sent out, and answers received, but before assistance could arrive the German pirate had commenced to shell the merchantman. The decks from bow to stern were swept by shells from the submarine's two guns, one of the shells completely wrecking the Marconi cabin, which Mr. Coats very fortunately had just vacated. One member of the crew was killed and several injured as a result of the pirate's cultured and humane methods and, finally, a torpedo sent the good ship *Morwenna* to the bottom. The force of the explosion was so great that the foremast was blown right into the air. In about three minutes the ship had sunk from sight, the last of her to be seen being the stern, and the crew made away from the scene as best they could. About this time a little trawler made her appearance in the vicinity and steered straight for the scene of the wreck. With all their usual consideration for humane principles the Germans turned their attention to shelling the rescuing vessel, which nevertheless came onwards without a pause. Shell after shell exploded round the trawler as nearer and nearer it came. Suddenly there was a quick movement on the part of the brave little fishing vessel, and in a moment from the masthead there fluttered the famous tricolour of Belgium! Still the shells were falling, but not a single one exploded on the trawler and at last the pirate ceased fire and moved away, closing down her hatches as she went. When the *Morwenna's* crew were rescued the captain grasped the hand of the fisherman and said, " By Jove! I never thought anyone would have come through those shells!" The reply was simple and modest: " A Belgian never turns back, sir!"

Two of the ship's boats were so seriously damaged that they were of little value, so these were cut adrift, but the remainder were taken in tow by the trawler. In a little while all the rescued crew were safely ashore at Milford, where willing hands attended to their wants.

Mr. Coats is just as cheerful about his adventures as Mr. Shrimpton is about his. This is the proper British spirit, which always comes out in times of emergency. If the German Secret Service should obtain a copy of this issue of THE WIRELESS WORLD, will they kindly note the fact?

Mr. Coats, in addition to being an experienced wireless operator, is a poet of no mean ability. Contributions from his pen have appeared in several of the leading Canadian papers, and his recent poem, entitled " The Merchant Service Man," has been reproduced in several London and provincial newspapers. With the author's kind permission we are printing it on p. 220 of this number. Such a poem, coming from the pen of one whose acquaintance with the perils of the sea is actual and not imaginary, and whose emotions have been stirred not by a passing fancy but by the vivid reality of wrecks and bursting shell, breathes the true spirit of Britain and her peoples.

As to the " Thirteen " problem, you can make of it what you will. The superstititious will probably say that the fatal number accounted for the young men's perils, whilst their antagonists will maintain that the men had remarkably good luck. Anyway, both sides will be quite satisfied.

MARCONI HOUSE NEWS.

STAFF FIRE BRIGADE.

The First Annual Competition amongst the members of the Marconi House Staff Fire Brigade was held on Friday, May 21st, for the Challenge Cup presented by the Company.

Five teams of three men each competed, the test consisting of two drills.

The winning team, Messrs. E. E. Hughes, J. Foster and J. Moore, completed the drills in 2 minutes 57 seconds, being an excellent record, and 16 seconds better than the second team.

Mr. J. Westhrop, the house fireman, who had trained the teams, superintended the competition.

Mr. Godfrey C. Isaacs, in presenting the cup to the winning team, complimented them and the fireman on their performance.

RIFLE CLUB.

The result of the May Handicap Competition was as follows:—

1. Mr. W. J. Collop (Accounts Dept.) ... 92
2. Mr. R. Price-Smith (Engineers' Drawing Office) 90

For the third spoon, presented by C. B. Clay, Esq., Mr. W. Holloway and Mr. A. Dalgairns tied with a score of 90. The tie was shot off, and resulted in favour of Mr. Dalgairns (Engineers' Drawing Office).

Wireless Gardening

or, High-Frequency Horticulture

By P. W. HARRIS

I APPROACHED the house with a feeling of trepidation born of intense respect and reverence for one who was undoubtedly the greatest wireless experimenter living. I trembled still more when I thought of the great responsibility which was resting on my shoulders. I was to interview Mr. Sparkington Gapp on behalf of THE WIRELESS WORLD. It was quite clear in my mind that if the interview came off badly, millions of readers of that magazine would angrily retrace their steps to the bookstalls to demand the return of their threepences, whilst special trains would bring further thousands to protest outside the editorial offices. With such thoughts in my mind I braced myself together, and, mounting the steps with great importance, endeavoured to send " V's " on the bell. Although I tripped over the top step and was precipitated against the door with considerable force, I still retained my dignity when the door opened and the footman picked me up.

" I wish to see Mr. Sparkington Gapp," I said.

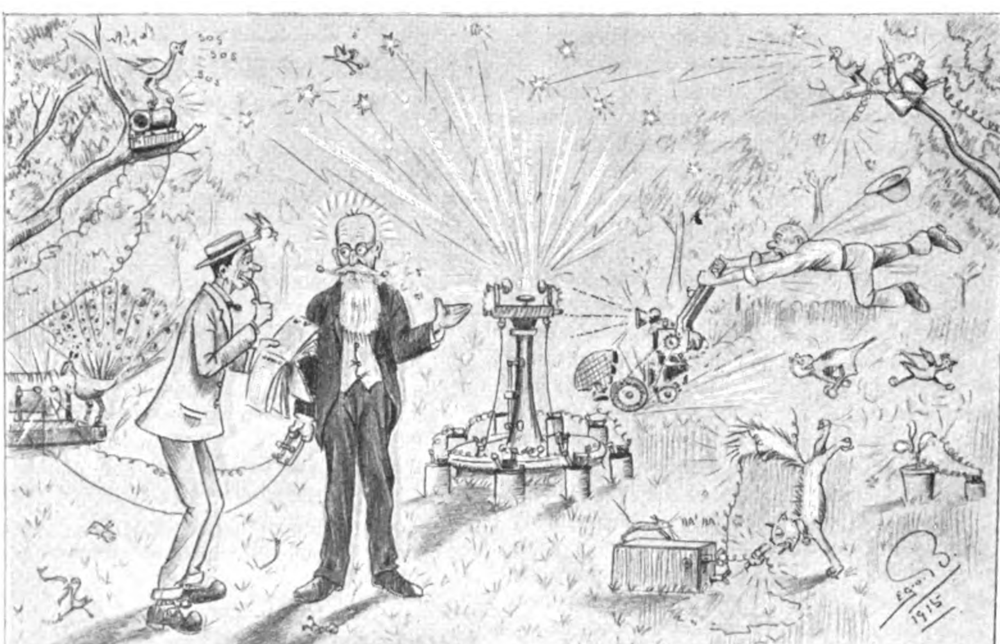
" Yes, sir," replied the footman. " Your call-letters, please ? "

" W.W.," I answered briefly.

" O.K., R.D., Stdbi," was the reply as the man disappeared.

" Bitis," I observed, and sat down.

Whilst waiting I had an opportunity of remarking the luxurious nature of the surroundings amongst which the great scientist spent his time. In the large hall where I sat fingering the brim of my hat statues amid palms were distributed on every side. On the left I noticed a female figure delicately carved out of zincite and resting on a bornite pedestal, whilst on the right I remarked a



" We found ourselves on a velvety lawn."

silicon figure of Mercury poised on a brass point. At the far end could be seen a carborundum statue of Pan playing tunes on a potentiometer. From a distant room came sweet strains from the band of a magnetic detector, accompanied by a lilting melody from a multiple tuner.

Mr. Gapp now advanced towards me and bowed with a characteristic curve. He then rectified himself, and asked to what he owed the pleasure of my visit. I explained to him that THE WIRELESS WORLD was anxious to publish an account of the wonderful wireless garden he had formed and in which he spent so much time, and that if he would only favour me with an interview the thousands of amateur and professional wireless experimenters throughout the kingdom would be eternally grateful.

"You are welcome to all the information I can give you," said Mr. Gapp, smiling. "Since the outbreak of war, and owing to the restrictions placed on all ordinary wireless working, I have spent a considerable time in the garden investigating and experimenting on somewhat novel lines. Perhaps you will be so kind as to accompany me."

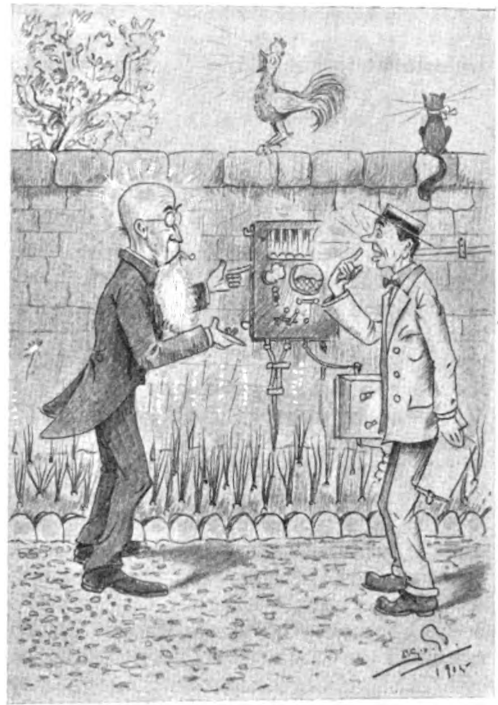
With this the great experimenter rose and led me past the crystal statues through a French window into the famous garden. We found ourselves on a velvety lawn, in the midst of which a fountain threw a delicate spray of electrolytic into the air. Rare birds piped notes of various frequencies, and a peacock was quenching its gap in an ornamental basin.

"On the left you will notice my chief gardener operating the rotary lawn mower," commenced the scientist. "It is of the synchronous variety, and gives, as you will observe, a clear musical note. The distance of transmission is considerable, to judge from complaints I have received from the neighbours."

"For what precise purpose," I queried, "is the ingenious apparatus being used at the moment?"

"I find that it affords an excellent means of shortening the wave-length of the grass," was the gracious reply.

As we paced the broad gravelled walks together my wonder and admiration increased by leaps and bounds. On every hand could be seen fresh evidence of the marvellous creative power possessed by the great inventor. We turned a corner and came upon a magnificent croquet lawn, whose brilliant verdure spoke eloquently of the care that had been bestowed upon it. In the centre stood a nickel-plated stand with a circular top, which rotated and glistened in the afternoon sun. From it there shot in all directions a whirling shower of water drops.



"The Radiation of the Onion Bed."

"And that," I queried, "is another of your inventions, is it not?"

"That," answered my guide modestly, "is what I term my rotary aquifier. I designed it expressly for the purpose of increasing the damping of the lawn. As an example of the value of pure research, I might mention that shortly after it was erected my wife happened to be sitting beneath it, thinking it might be some sort of protection from the sun. When my gardener turned on the water (or H_2O, as my children call it), my wife was not only highly damped, but suffered all the symptoms of shock-excitation. Whilst the connection between shock-excitation and high damping has been investigated before, I think I may justly claim to be the first to demonstrate it in so effective a manner. Unfortunately Mrs. Gapp does not seem to appreciate pure science."

I expressed a few words of sympathy and instanced other great men whose studies had been interfered with in this way—Mrs. Euclid, I believe, had strong views. Mrs. Diogenes is also said to have interfered with her husband's correspondence classes. Mr. Gapp thanked me for my sympathy, and magnanimously remarked that women had their uses. This, after some thought, I agreed with, although I had not looked at the subject in that light before.

"You play croquet here, I presume?" I next queried.

"At times we do," Mr. Gapp replied, "although, owing to my uncertainty regarding the inductance of the hoops, my own score is not usually as high as it might be. I presume you are acquainted with the game? A series of impulses is given to a spherical body by means of an instrument which resembles the hammer-break of an induction coil. Although by design the spherical body should pass through a turn of inductance, resembling the primary of a jigger, nevertheless, from carefully compiled statistics, I find that in 99·9 cases in 100 the spherical body, or ball, as it is termed, hits the inductance and does not traverse it. I believe it is a case of molecular attraction, but I am loth to pass an opinion at the present stage of my researches."

Again I was deeply impressed. Here was a man to whom even a game, a pleasant sport, gave opportunity for grave and interesting scientific research. I thought of Newton and the apple, and laughed aloud with derision. Newton! Who was Newton to be compared with Sparkington Gapp?

With such pleasant converse we occupied a few moments until our wanderings led us into the vegetable garden. Noticing a twitching of my nasal organ, Mr. Gapp remarked that since he had commenced wireless gardening he had increased the radiation of the onion-bed to at least 25 amperes. This, he continued, would account for my nose acting as a sensitive detector. With an S. G. Brown relay he hoped to make the smell of onions audible.

The inventor next pointed out an elevation in the corner of the grounds. "Allow me to bring to your notice the Heaviside Layer on the Manure Heap," he said. "With its assistance the capacity of my vegetable marrows bids fair to reach two microfarads. There seems much to learn in that direction, and whilst the common variety of wireless expert spends his time arguing, I hope to attain something practical."

"Wonderful!" I commented with admiration. "And tell me, have you any other vegetable researches in progress at the moment?"

"Several, my dear sir, several!" came the answer. "Here, for instance, is my latest apparatus for the examination of potato-electric phenomena. In conjunction with my eminent friend Professor Boilingbroke Spudd, I hope in the autumn to stagger the world. But I regret my time is limited. Please convey to the readers of THE WIRELESS WORLD my best wishes, and tell them that even in these troublous times pure wireless research can still go on. Detectors may be locked in cupboards; inductances are seen no more; the aerials are bottom uppards; Excelsior, Excelsior!"

And with these poetic sentiments echoing in my ears I made my departure.

A PRIMITIVE WIRELESS TELEPHONE.

People who spend their time in belittling great inventions, attributing great inventions to any but the proper source, have now the chance of their life with regard to the wireless telephone. The researches of Mr. Marconi and other scientists in this direction will in future go for naught. The *African Mail* of recent date gives a short account of the interesting experiences of Mr. James Chaplin, of the American Museum of Natural History, in his recent six years' expedition along the banks of the Congo. Among the many wonderful stories of native and animal life that Mr. Chaplin has brought back with him, not the least curious is his account of the "wireless telephone" used by the natives in the forest country of the Congo. It is a wonderfully efficient system, and is quite unlike the Morse or any other that we use. The natives make noises on drums which will carry quite ten miles, these noises resembling the sounds of words in their own language.

The Campograph

An Instrument for the Delineation and Photographic Recording of Physical Curves

DR. J. A. FLEMING recently described, and exhibited to the Physical Society of London, a new and ingenious instrument he has invented for recording by photography or projecting on a screen physical curves of various kinds. This instrument he has called a campograph (from *καμπή* a curve and *γραφω* I draw). The instrument enables a curve such as the resonance curve of a wireless telegraph transmitter, or the characteristic curve of a wireless detector, or the hysteresis curve of a sample of iron wire to be projected and rendered visible on a screen, or to be photographed in a few moments on a photographic plate. It will be seen, therefore, that the instrument will have great uses in connection with radio-telegraphy and many other branches of physics. The appearance of the instrument is shown in Figs. 1 and 2—Fig. 1 showing the arrangements for projecting the curve on a screen, and Fig. 2. for photographing it on a plate.

The instrument comprises a long rather narrow mirror, which is pivoted on an axis parallel to its long diameter. This mirror is carried on supports with its long axis horizontal. Its axis carries a lever which is constrained by a spring, and also has on it an adjustable block to which a string is fastened. When the string is pulled the mirror is tilted through an angle proportional to the pull of the string.

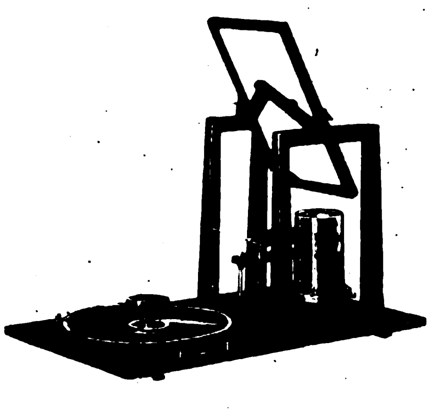


Fig. 1.

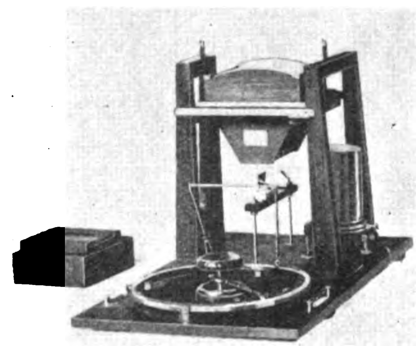


Fig. 2.

Over this mirror is fixed another mirror slung on an axis at right angles to the first, which can be arranged and fixed at any angle ; or else a photographic camera having a cylindrical lens takes its place.

On the same base board is fixed a mirror galvanometer, or a mirror magnetometer, and a beam of light from an arc lamp lantern falls on the mirror of this instrument, and is then reflected to the narrow tilting mirror, and then from the fixed mirror it falls on the screen, or else it enters the photographic camera. A second element in the invention is a device Dr. Fleming calls a circular potentiometer for producing a continuously varying voltage or potential difference between two terminals.

It consists of a thin wooden or ebonite hoop about 1 foot in diameter, which is wound over with insulated high-resistance wire in one layer of close turns. The two ends of this wire are brought to two terminals called the battery terminals. The silk or cotton covering is rubbed off the wire on the top edge of the hoop, so as to expose

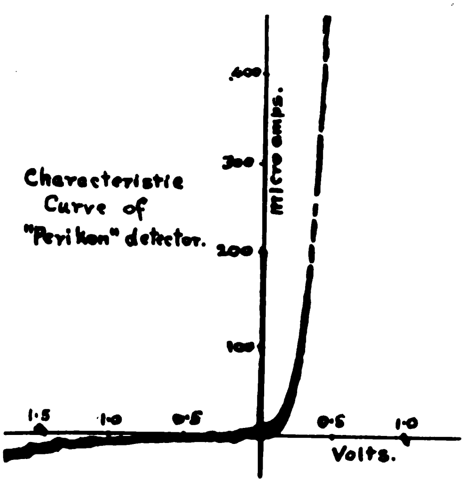


Fig. 3.

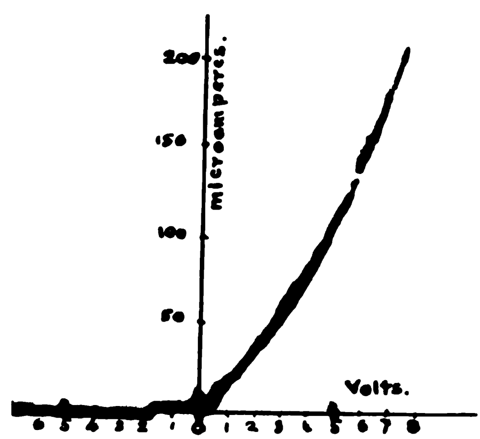
the metal wire. This hoop is fastened down on the base board. At the centre of the hoop is pivoted an axis which can be rotated by a large milled head. This axis carries a brass radial arm, the end of which rotates with rubbing contact on the bare turns of eureka wire wound on the hoop. There is a terminal in connection with the centre point of this wire on the hoop, and one in connection with the axis of rotation of the arm, and these two terminals are called the potentiometer terminals. It will be evident that if a battery, say, of 10 cells has its poles attached to the battery terminals, it will make a fall of potential down the wire, and that if the radial arm is turned into various positions, we can create between the potentiometer terminals any required fraction of the half-battery voltage in either direction.

The string which pulls over the tilting mirror is then attached to the rotating axis of the radial arm in such manner that when the arm is rotated the tilting mirror is pulled over and moves the spot of light on the screen through a distance exactly proportional to the angle of rotation, and therefore to the potential difference created between the potential terminals.

Suppose, then, that we place a galvanometer on the board and connect in series with it any conductor, say, a crystal detector, and also join the two in series across the potential terminals. Then on turning the radial arm we shall apply to the detector any required voltage one way or the other. and the galvanometer will be traversed by the corresponding current. Hence the spot of light falling on the screen or photographic plate will have two motions given to it—viz., a horizontal motion proportional to the applied voltage, and a vertical one proportional to the resulting current. Hence it will describe a curve called a characteristic curve, which shows the relation of current and voltage for the detector under test. In Fig. 3 is shown such a curve for a Perikon detector or Zincite-Chalcopyrite rectifier.

In Fig. 4, the same for a Fleming oscillation valve or glow lamp detector, it will be seen that the curve reveals at once the unsymmetrical conductivity of the contact, the current being greater for a voltage applied in one direction than in the opposite.

Again, suppose we substitute for the detector a long magnetising helix containing an iron wire, and replace the galvanometer



" Characteristic Curve of Carbon-filament Valve No. 12.

Fig. 4.

by a mirror magnetometer. We can then make the horizontal movement of the spot of light be proportional to the voltage applied to the terminals of this helix, which is a measure of the magnetising force on the iron, and the vertical movement is proportional to the resulting magnetisation of the iron. Hence the spot of light then

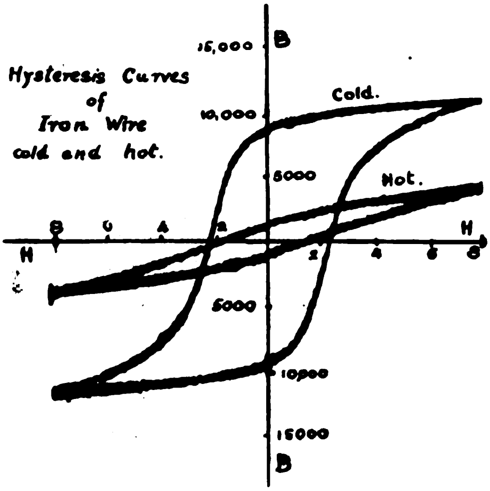


Fig. 5.

describes a magnetic hysteresis loop for the iron or other metal (*see* Fig. 5). In this manner we can use the campograph to study the effects of heat, oscillations, or mechanical shocks, etc., on the hysteresis of iron or steel. In the third place we can employ the instrument to describe a resonance curve and obtain a decrement as follows :

The circular potentiometer is removed, and in its place is fixed a condenser of variable capacity with rotating plates, the condenser being so made that its capacity is varied by rotating an axis proportionately to the angle of rotation. The string attached to the tilting mirror is then wound round the axis of this variable condenser. On rotating the axis it moves the spot of light horizontally through a distance proportional to the change in the capacity of the condenser. The condenser circuit is then completed by an inductance, and a hot wire thermoelectric ammeter inserted, the thermocouple of which is connected to a low resistance galvanometer placed on the base board. The spot of light will then be given two motions, one a horizontal one proportional to the change in the capacity of the condenser, and the other a vertical one proportional to the galvanometer current.

Suppose, then, that this condenser and inductance forms a cynometer or wavemeter circuit, and is brought near to the circuit of any wireless transmitter. The oscillations set up in the condenser circuit will create a thermo-current, and the value of this will depend upon the degree to which the condenser circuit is in tune with the transmitter. If the condenser capacity is varied gradually, the spot of light will then rise and fall on the screen, and describe a resonance curve (*see* Fig. 6), from which by the usual methods we can obtain the decrement of the transmitter. In this manner we can in a few seconds photograph a resonance curve of a transmitter or any other oscillatory circuit.

The photographs here given in the illustrations must not, however, be taken as examples of the best that can be done with the curve-tracer. The sharpness of the lines depends upon the smallness of the spot of light, and this, again, upon the perfection of the mirrors. In the case of the photographs here given only ordinary student's galvanometers and magnetometers were used, having very imperfect mirrors, but by the use of specially formed mirrors it is possible to obtain far better results, and Dr.

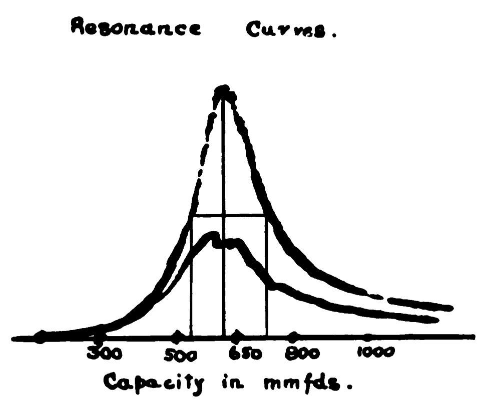


Fig. 6.

Fleming hopes soon to improve the instrument in this respect very greatly. It will then form a very useful addition to instrumental resources.

General view of Battery Park, New York.

A Monument in New York

To those who saved life but lost their own

BATTERY PARK, New York, has received a new decoration. It is no Iron Cross bestowed for the slaughter of the helpless and unresisting, but a Memorial to Wireless Operators who have died at their posts, saving life instead of destroying it.

"Yonder simple and beautiful testimonial "to manly courage and noble self-sacrifice in "the face of tremendous odds will stand an "elevating influence to the thousands daily "passing along the sea wall of this great "city." Such are the words in which one of the American orators taking part in the opening ceremony referred to the wreath crowned column and basin. Our illustrations adequately indicate the general appearance of the memorial, which, although of classic form, is wrought not in marble but in the unclassic material of sea-shells, sea-weed and sea creatures. The idea of the monument was conceived during the time when the world was just recovering from the shock of the *Titanic* tragedy. Originally intended to be known as the "Philips Memorial," and to constitute a tribute to the gallant young Englishman who lost his life at the post of duty on that occasion, the project widened out as time proceeded. The initial contribution to the fund came from the *New York Times*, and was closely followed by a subscription from the Marconi Company; whilst Harold Bride, Philips's wireless assistant on the *Titanic*, contributed the first amount sent by a private individual. Under the direction of Mr. C. C. Galbraith, a permanent fund for the relief of the widows and families of wireless operators who died in the performance of duty was established, and already a number of appropriations have been made in furtherance of this good work. Thus, as it stands, the memorial represents simultaneously a tribute to the honoured dead and a reminder of our duty towards those they left behind them.

The Hon. George McAneny, Mayor of New York, performed the unveiling ceremony. He dwelt feelingly upon the life-saving side of wireless telegraphy, and emphasised the double character of the memorial to which we have referred above. He expressed peculiar gratification that amongst those present at the time when he addressed them was Jack Binns, the hero of the first spectacular instance which emphasised the capabilities of radiotelegraphy in this respect.

The administration of the fund has been vested with the officials of the Maritime Association of the Board of New York, and representatives of the Administration attended the ceremony. Amongst the assemblage gathered within the enclosure there were noted Mr. James C. Perkins and Mr. and Mrs. Kuehn. These latter possess a peculiarly close personal interest in the monument, for the names of their sons appear upon the column.

The full list on the Roll of Honour as it stands at present covers the following names :—

George C. Eccles, steamship *Ohio*, August 26th, 1909; Pacific Coast.

Stephen F. Sczepanck, steamship *Père Marquette*, Car Ferry No. 18, September 9th, 1910; Lake Michigan.

Jack Philips, steamship *Titanic*, April 15th, 1912; Atlantic Coast.

Lawrence Prudhunt, steamship *Rosecrans*, January 17th, 1913; Pacific Coast.

Donald Campbell Perkins, steamship *State of California*, August 18th, 1913; Pacific Coast.

Clifton J. Fleming and Harry Fred Otto, steamship *Francis H. Leggett*, September 18th, 1914; Pacific Coast.

Ferdinand J. Kuehn, steamship *Monroe*, January 30th, 1914; Atlantic Coast.

Walter E. Reker, steamship *Admiral Sampson*, August 25th, 1914; Puget Sound.

Adolph J. Svenson, steamship *Hanalei*, November 23rd, 1914; Pacific Coast.

Space is left blank for others, whose fate is at present "on the knees of the gods." "The Marconi Tradition" is sure to claim further tribute in the future. Only the other day we narrowly missed having further names to add. We refer to the occasion of the crime of the *Lusitania*, almost equal in its magnitude to the disaster of the *Titanic*, but differing from it in the fact that it was caused not "by the hand of "God" but by the work of men—if the perpetrators of the crime can be judged not to have forfeited the right to be so considered.

The design was presented gratuitously by the firm of Messrs. Hewitt & Bottomley, and the key which turned on the water was handed to Park Commissioner H. C. Ward by Mr. W. L. Bottomley. The Commissioner in accepting the responsibility of keeping the monument for the public pledged the resources of his department, and stated that the task represented for him "not a "duty, but an honour."

Commodore F. B. Dalzell, of the U.S. Navy, introduced the Rev. Raymond Meagher, D.O., who pronounced the bene diction and delivered a short address, in which, after extolling the performance of duty under difficulties, he passed on to contrast the old-time attitude of the Church towards science and the view taken by that same body in modern times: "To-day in "the person of Marconi we extol science "because science is truth," said the reverend gentleman.

* * *

Most of the exploits which have won for their heroes a place upon this column are well known to our readers, but a note or two on the subject may stand not inappropriately here.

The earliest in point of date was Stephen F. Sczepanck, who perished on September 9th, 1910, on Lake Michigan. Car Ferry No. 18, was carrying a long train filled with passengers between Ludington (Michigan) and Milwaukee, a distance of about 100 miles. The ferry boat struck a rock just after Sczepanck had announced their approach to the Milwaukee station. He sent out the signals of distress, and after receiving assurances of rescue, he passed along the whole length of the train,

The Unveiling Ceremony.

stopping at every seat to reassure passengers who had been thunderstruck to find, when stepping from the coaches, that the decks were already awash. There was room on the small boats for everyone but four—three officers and the wireless operator. The latter returned to the wireless room and was seen no more.

George Eccles perished on an Alaskan reef on August 26th, 1909. The *Ohio* went ashore, and in the midst of an indescribable turmoil, Eccles stuck to his post and summoned rescuers, who unfortunately went off forgetting him altogether. They attempted to return; but too late! a mountainous wave lifted the *Ohio* from the reef, she disappeared in the seething waters, and Eccles was never seen again.

The story of the great *Titanic* disaster of April 15th, 1912, is so familiar that it is almost superfluous to remind readers how Jack Philips, although worn out from seven hours' unremitting toil just in front of the disaster, superintended the rescue messages, and remained at his post until the last of the lifeboats had gone. Rescued from the icy water, he died from exhaustion and exposure during the night.

Lawrence A. Prudhunt is the youngest but one of the band; he was operator on the *Rosecrans*, when she was wrecked in the Pacific on January 17th, 1913; he refused to take his chance of rescue in the boats in the hopes that, by sticking to his post, he might expedite the arrival of the rescuers.

Donald C. Perkins was on the *State of California* when she struck a reef in Gambia Bay, Alaska, August 18th, 1913. In his case, also, a sense of duty kept him directing the rescuers until it was too late to save himself.

Ferdinand J. Kuehn was the operator on the *Monroe*, which went down on January 30th, 1914, in 12 minutes after a collision in the fog off the Virginia Coast. His work had been done; but on going on deck he found a woman who had not been supplied with a life preserver, he took off his own and saved her at the expense of his life.

W. E. Reker was the wireless man on the s.s. *Admiral Sampson*, which sank after collision with the *Princess Victoria* off Seattle (Washington), August 25th, 1914. Here, again, the steamers were victims of a dense fog. As the cargo of his vessel consisted of oil, the horrors of fire were superadded to the situation, and Reker found too much work to do to think of his own safety. He shared the fate of the captain side by side with him on the bridge.

The youngest on our roll is Clifton J. Fleming, aged only 17 years; he and Harry F. Otto were lost in the wreck of the *Francis H. Leggett* off the Oregon coast, September 18th, 1914. The ship foundered after having been breached by heavy seas. Here, again, we have the case of a youth who sacrificed his life for a woman's. The floating timber to which they clung was not sufficient to support the pair, and he dropped quietly off.

A. J. Svenson perished with the *Hanalei* on November 23rd, 1914; the vessel grounded on Duxbury Reef, 15 miles north of San Francisco, and only the utmost heroism and ingenuity on the part of the wireless operators succeeded in the saving of the survivors. His comrade's comments form his most fitting epitaph: "Throughout our "terrible experience he remained cool and resource-"ful, upholding in an exemplary manner the tradi-"tions of the Marconi service."

The Reverend Raymond Meagher, D.O., pronouncing the Benediction.

Wireless in the American Army

The Marconi 2 Kilowatt Cart Set

THE situation which so recently arose in Mexico, together with the firm tone of President Wilson's Note to Germany, has drawn the attention not only of Americans themselves, but of the world at large, to the state of preparedness for war which exists in the American Army and Navy. The vital and increasingly important part played by wireless telegraphy in the present conflict of nations is fully realised by the Government of the United States, and as a result the wireless equipment of the U.S. Forces is of a thoroughly up-to-date nature. In the Navy, radio-telegraphy has long been assiduously studied, and on the completion of the Panama Canal and the Canal Zone stations exhaustive tests with long-distance communication were undertaken. In the Army a large amount of important work has been done with portable stations.

The Marconi Cart Set described in this article is practically standard with the United States Army Signal Corps for general field service, and has been designed and constructed by the Marconi Wireless Telegraph Company of America. The complete installation, with sectional masts, aerial and aerial counterpoise, guys, etc., is carried in two carts, which are shown in the accompanying illustration. Every part has been designed for the maximum of portability commensurate with strength and efficiency, and the rapidity with which the apparatus can be set working after "halt" has been called is not the least remarkable feature.

The two carts are termed the "Power Cart" and the "Instrument Cart" respectively. The former contains the power plant, consisting of a four-cylinder, four-cycle gasolene engine, coupled direct to a 2-kilowatt, 500-cycle, 220-volt alternating

Fig. 1. Complete Installation on Two Carts. Instrument Cart in front, Power Cart behind.

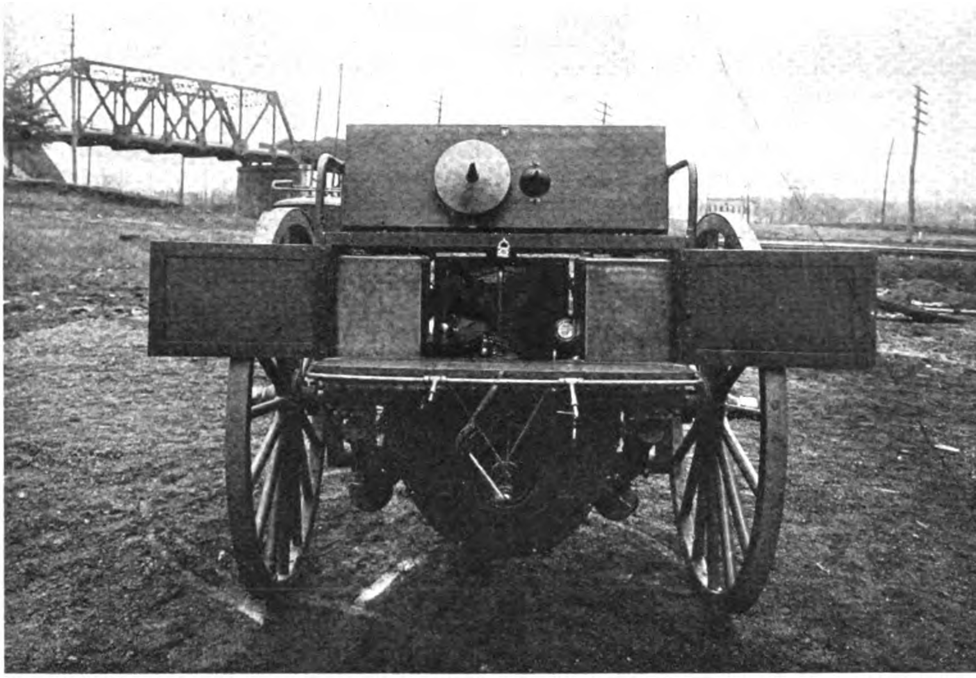


Fig. 2. Power Cart.

current, and 500-watt 110-volt direct current generator. The direct current serves the purpose of exciting the field of the alternator. In addition to the power plant, this cart has provision for carrying the mast, antenna, guys, and the counterpoise. Connection to the Instrument Cart is made by a flexible cable.

For the storage of gasolene two tanks are provided, one on each side of the engine, with a total capacity of sixteen gallons. The tanks are piped together and have separate shut-off valves.

The Instrument Cart contains the 500-cycle transformer and the high and low frequency apparatus for both sending and receiving. On the rear panel is mounted the oscillation transformer, aerial tuning inductance, with the necessary arrangements for rapid changing of wave-length and a special ammeter in the aerial circuit for indicating the radiation. The spark-gap, with motor and blower, together with a protective device for the motor, and one of the operating keys are mounted on the bottom in front of this panel. In the interior of the cart (and well protected) is situated the 500-cycle, oil-cooled, closed-core type resonance transformer, with a protective device, the switch connections for changing from sending to receiving; the transmitting condenser; the coils and working parts of the jigger and the aerial tuning inductance; besides the generator field rheostat. The 500-cycle ammeter, voltmeter and wattmeter are mounted on a separate panel over the driver's seat.

For the purpose of connecting the aerial and counterpoise (which latter takes the place of an earth connection) two porcelain insulators are provided on the top of the cart. These can be seen in the illustration on page 247. A portable wave-meter is also carried. The receiving instruments, which are of the Marconi standard 101 type, are mounted in shock absorbers, and occupy the space underneath the driver's seat, as shown in the illustration. The receiving batteries and the control handles for the generator field rheostat, the switch for changing from sending to receiving, and the second operator's key are all conveniently to hand. On the doors at the rear of the cart are two portable lamps and four spare condenser units.

Coming now to a more detailed description of the apparatus, Fig. 2 shows the rear of the Power Cart. The two tanks for gasolene can be clearly seen one on each side of the cart, and funnels for filling are visible above. Underneath will be noticed the starting handle for the engine. The flexible cable which connects the Power Cart with the Instrument Cart plugs on each end will only fit into the plug socket in one position, so that it is only necessary to push them well in and note that the five spring clips within the socket are making proper connection.

Fig. 3 shows a side view of the Instrument Cart with the casing removed. The transmitting inductances, which are wound in the form of flat spirals, can be seen at right angles to the plane of the picture. The variation of inductance is brought about by means of sliders which are attached to radial arms in such a manner that when the rod to which the arm is attached is rotated the inductance is regularly varied. The dark body which can be distinguished between the inductances and the driver's seat is the 500-cycle transformer. On the top of the cart the aerial lead-in insulator and the earth counterpoise insulator will be noticed.

The transmitting condenser, which does not appear in the illustration, is situated on the other side of the cart, and comprises a number of tubular glass units, each with electrolytically deposited copper coatings. The discharger is of the quenched-gap variety, and consists of a number of circular plates separated by insulating gaskets in such a way that the sparking space is air-tight. A motor blower cools the plates with a strong current of air. The discharger and blower are placed at the rear of the cart immediately behind the inductances already mentioned.

When operating, the transmitter gives a pure musical note with a frequency of one thousand sparks per second. It will be

Fig. 3. Instrument Cart

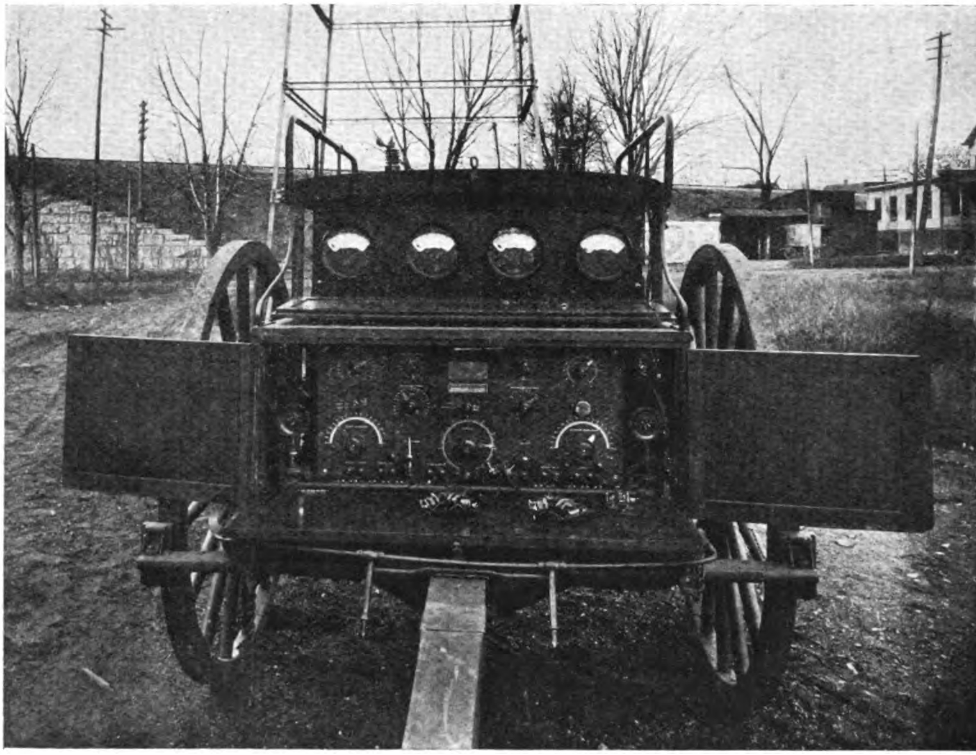


Fig. 4. Instrument Cart, showing Operating Table.

noticed in the foregoing description that two transmitting keys are mentioned. One of these, situated on the operating table, is in use during the ordinary operations of sending and receiving; the other, at the rear of the cart, is very convenient for use when adjustments of the transmitter are in course of being carried out.

Fig. 4 shows the front of the Instrument Cart with the operating table open. On the panel at the top the ammeters and voltmeters can be seen. Immediately below these is located the receiver, with its various capacities and inductances. The handle in the space to the right of the receiver controls the field rheostat, and that in the space on the left the switch for changing from sending to receiving. The operating key will be noticed on the right-hand side of the table, immediately adjacent to the right hand pair of telephones. The receiver itself consists of an inductively-coupled transformer with two crystal detectors and the necessary accessory apparatus mounted on an ebonite panel, and contained in a mahogany case. In the aerial circuit the aerial tuning inductance is varied by circular switches making contact with rings of studs and a variable condenser and can be connected in series with the aerial tuning inductance, in shunt with it, or cut out entirely. By varying the inductance and capacity, wave-lengths between very wide limits can be " tuned in.". In the secondary circuit the inductance can be varied over a wide range by means of a ten-stud switch, and a variable condenser enables capacity to be shunted across the inductance when required. Two crystal detectors are provided, one of cerusite and the other of carborundum, either of which can be switched into circuit as needed. A potentiometer for the carborundum detector is controlled by a rotary switch.

A further handle controls the variable coupling between the primary and secondary, and a pointer connected with it runs over a scale marked in degrees. Finally, a buzzer enables the detectors to be tested and adjusted with facility.

Wireless Telegraphy in the War

A résumé of the work which is being accomplished both on land and sea.

A NUMBER of paragraphs have been recently going the round of the daily Press announcing the difficulties that our German enemies are at present finding in communicating directly between their country and the United States. It has for some years past been a matter of pride to the Teutonic heart that, thanks to their excellent wireless installations, they have had ample means of direct communication between Berlin and America. They have made full use of their opportunity, and the facility has enabled them to bring all sorts of influence to bear upon American public opinion in favour of the Austro-German Alliance. All through the winter months wireless communication has gone on fairly continuously, but now that warmer weather has made its appearance the great German stations at Sayville (Long Island) and Tuckerton (N.J.) are finding considerable difficulty owing to adverse atmospheric conditions. Our newspaper paragraphists have sought for an explanation in the natural electric phenomena recurrent at this period, and generally known as the *Aurora Borealis*. *Post hoc* is not necessarily *propter hoc*, and evidence as to the connection between the *Aurora* and radio-telegraphic troubles is up to the present a little conflicting. The investigation of the matter is interesting, and we shall hope to take an early opportunity of dealing with it a little more in detail.

The general problem of adverse atmospheric conditions at certain different periods of the year has confronted those engaged in commercial long-distance communication ever since they first commenced operations. Up to the present the only way of overcoming the difficulty appears to be that of providing a considerable reserve margin of power. It is for this reason that the Marconi Transatlantic and Transpacific stations are put in possession of a power considerably in excess of what is required under normal conditions. At periods of "static" interference these reserves of power are brought into the firing line, and "our positions maintained in their entirety"!

As far as it is possible to ascertain from the Press reports, this lack of reserve power would appear to be one of the causes that lie at the root of Germany's present difficulty in trans-ocean communication. We read, of course, claims (which keep perennially "cropping up"!) of long-distance communication established with small power. These communications more or less belong to the class of "freaks," possible only in favourable weather circumstances, and cannot be classed with commercial services, for which it is essential to maintain day and night communication over the whole year.

* * *

The modern Huns have been treating with the contempt so truly characteristic of savage tribes the war power of the United States: "let them think" was the phrase employed by the egregious Dernburg. Even highly placed German diplomatists have not hesitated to express their contempt of diplomatic pressure backed by what *they* consider feeble military resources. Nevertheless, despite this attitude on their part, it has been recently pointed out that America claims to have three monster weapons of war "snugly hidden up her sleeve." These comprise the most powerful demolition explosive in the world, and a wonderful submarine designed by Edison, which, according to the American claim, "inhales its own oxygen from the water." Over and above this they are believed to have available a number of *wireless torpedoes* possessing a speed of sixty miles an hour, with a range of 28 miles. Being under the control of a special wireless device it is claimed that within its range "it can be made to go anywhere until it finds its mark."

Lord Mersey, President of Court of Enquiry into "Lusitania" outrage, leaving the Court with Capts. Davis and Speeding, Nautical assessors.

It is not often that a man engaged in fighting a foreign government in civil courts is called away and his case hung up in order that he may take part in fighting that same government in active military operations. The career of Senatore Guglielmo Marconi has been full of incidents out of the usual order of human affairs, and once again the abnormality which in his case has become so frequent as to be almost normal, has occurred. At the very moment when he was in the thick of a fight against the encroachment by the German Government against the fruits of his genius in the American Courts his country declared war, and his king summoned him to fight the same enemy for public rights as he was engaged in combating on personal grounds. The case against the company using the Telefunken system in the United States (really the German Government) was therefore hung up and Senatore Marconi hastened to his native land. The summons came direct from King Victor Emanuel through the Italian Ambassador in Washington. Senatore Marconi's connection with the Italian Navy has for many years been of the closest character, and the Senatore himself is a close personal friend of the Duke of the Abruzzi, the supreme Italian Admiral. In view of his intimate knowledge of the Italian Marine, Senatore Marconi's *Ipsissima Verba* are worth recording:

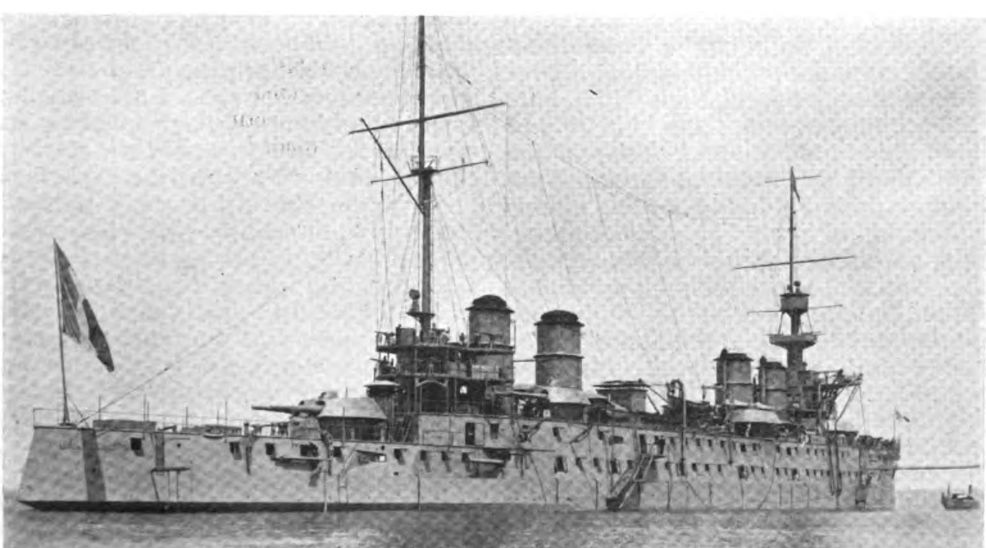
"He says the Italian Navy is perfectly "fit, its officers and men are perfectly "trained. Since the war in Europe started "several new ships have been commissioned, "amongst which figure a number of the "Dreadnought type."

The Commanding Officer is the Duke of the Abruzzi, and the world knows what a fine and capable type of seaman he is. Under his direction the fleet has been undergoing a constant training in marksmanship and manœuvring exercises, and never before has the fleet been so ready as now.

The essential necessity for preserving wireless apparatus in active working under all circumstances has been very sadly instanced in the case of the *Léon Gambetta*. This powerful battle cruiser of our French Allies was torpedoed twenty miles off the Italian coast on April 28th last. The fact that she was proceeding at no more than seven knots afforded an opportunity to an enemy submarine for choosing the best spot in which to torpedo her. The vital point, therefore, situated amidships abreast of the engine-room was struck, and the explosion wrecked the dynamos, immediately plunging the vessel in complete darkness *and rendering useless the wireless apparatus*. On the larger number of British vessels, mercantile as well as naval, although the dynamos are used under normal conditions for working the wireless, a supplementary system of accumulators is usually arranged for when the vessels are fitted by the Marconi Company. These supplementary arrangements have proved their utility over and over again in cases where—as with the *Léon Gambetta*—the injury to the ship entailed cessation of normal working. Accounts giving particulars as to times, etc., are not yet to hand in sufficient detail for us to speculate profitably as to the possibility of saving some of the gallant French sailors had wireless been able to exercise its customary function of instantly summoning aid. Very fortunately, vessels of the Italian Navy were in close proximity, and rushed with extreme gallantry to the rescue of the ill-fated Frenchmen so closely related to their Italian rescuers—not only by avocation but by consanguinity. The French must feel a sad pride in the gallantry displayed by Admiral Sénès and Commander André Deperiere, who refused to leave the ship. Just before she took her final plunge a stirring shout arose from the deck of the *Gambetta*: "Here we die for our country—"Vive la France!" whilst the survivors in the solitary boat which had managed to keep afloat re-echoed their cry of "Vive la "France!"

* * *

The latest terror which the *Daily Mail* has sketched for the benefit of its readers is the "aerial torpedo which is proposed (*sic*) to be used by the new super-Zeppelins." This marvellous creation is made of aluminium, filled with gas, sustained by gas and controlled by "wireless." A wonderful creation truly! Only a few weeks ago the *Sphere* brought out a series of interesting drawings of suggested possi bilities for aerial torpedoes directed by "wireless" which were highly ingenious and not outside the bounds of possibilities as far as we know them. But the possibilities



French Battle-Cruiser, "Leon Gambetta."

The latest "Dumping Ground" of Austrian Aircraft bombs. Venice—the Grand Canal and ***Rialto Bridge.***

of aerial torpedoes being controlled by such weak installations as are possible on Zeppelins in face of the powerful land stations in the neighbourhood of which they would have to operate draws a larger cheque upon the bank of our credulity than we are willing at present to honour.

* * *

The news of the gallant successes of the British submarine which torpedoed a large German transport in Panderma Bay recently does not appear, on the face of it, to bear much reference to "wireless." This 8,000 ton victim of our gallant seamen constituted not merely a transport, but a travelling wireless installation of a very powerful character. It is claimed that her installation enabled the German Embassy, Constantinople, to so direct the operations of the *Goeben* and *Breslau* as to enable those steamers to escape from their British pursuers and take refuge in the Golden Horn. It is sometimes forgotten that vessels fitted with powerful installations are often even more useful than land stations on account of their mobility. There can be little doubt that the *Corcovado* and the *General*, one of which was sunk, have proved extremely useful to the German authorities and their Turkish Allies in the Black Sea and in the Sea of Marmora.

* * *

Motor transport of all descriptions is playing a far more important part in the present European struggle than in any previous wars. A large number of machines are being utilised by ourselves and our Allies. These are mostly of the four-wheel drive type, this form having proved to be the most suitable for use on fields or rough country unprovided with roads. A collapsible wireless mast, sometimes nearly 100 feet high when fully extended, is carried on a specially strengthened roof. When these machines are ready for use they present a ludicrous likeness to a gigantic maypole. The radius of such wireless outfits amounts roughly to 200 miles as far as despatching is concerned, whilst the distance from which messages may be received is very much greater. The same motor which propels the cars drives the small electric generator, whence the apparatus obtains all the electricity required for working.

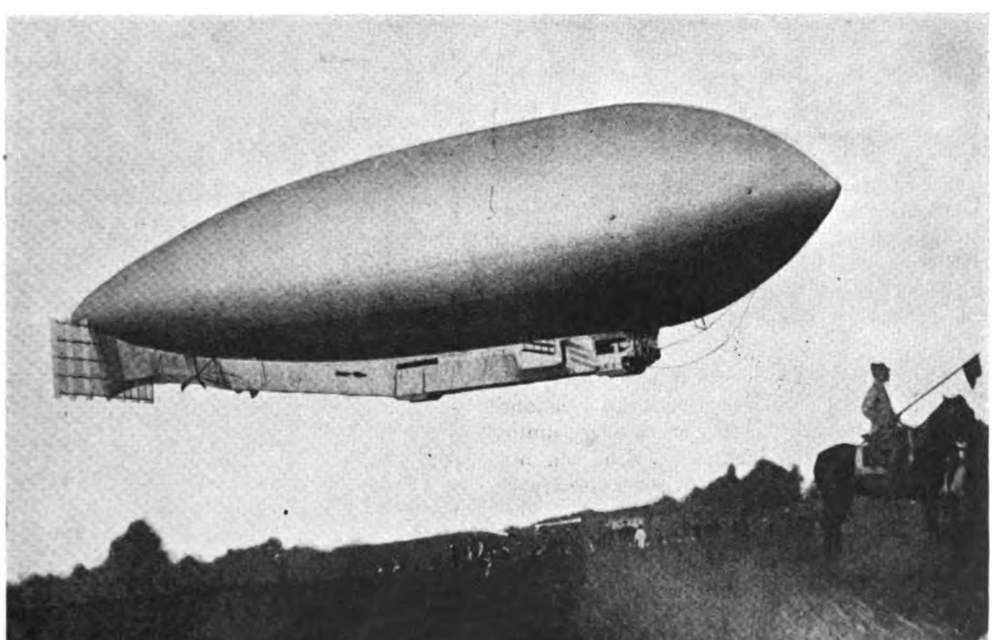
* * *

Our issue for February, 1915 (page 719), contains an interesting letter from a German lady resident at Kamina in the earlier days of the war when the wireless station there was in full working activity. The British despatches above referred to show that the fighting followed the same lines at Kamina, in Togoland, as that in other outlying portions of the once proud German Colonial Empire. Combined land and sea operations (in which the British displayed a skill which has become traditional) resulted in the unconditional surrender of the chief town of the colony, preceded by German destruction of their own wireless station, which was carried out with the same thoroughness as that described in our last (May) issue with respect to Duala in the Cameroons. Despite the fact that Colonel Bryant (commanding the British) had been obliged to notify the German Governor of flagrant breaches of the "laws of war," he himself in his letter of protest asked the truculent German to convey to *Baroness Colelli, the wife of the designer of the wireless station at Kamina*, that her husband was safe and sound and a prisoner in British hands. Moreover, in order to save the women of the beleagured garrison from the horrors of warfare, he offered to give permission for them to pass out under a flag of truce.

It is conduct such as this (which contrasts most favourably with that of the enemy) that is very largely responsible for the goodwill towards the British so prevalent in neutral countries, and for the reverse sentiments which are being increasingly aroused everywhere by the Austro-German Allies.

* * *

Captain A. S. Greene, Commander of the *Nebraskan*, an American steamer which was torpedoed off the Irish coast at the end of May, narrates a somewhat curious experience. He was going along on his regular way quite comfortably, and resting in his own State Room, when suddenly a violent shock occurred, which "felt as though the "ship was being blown out of the water. "Almost immediately there was a terrific "explosion." Investigation showed that the forward part of the vessel had been almost completely wrecked. The mast, the derricks, and the booms were lying on the deck, whilst the hatchways had been blown clean away. The lower hold was full of water, and the vessel appeared to be rapidly settling by the head. The crew were ordered to take to the boats, whilst the wireless operator set to work the SOS signal. The



The "Forlalini" type of Airship used by our new Italian Allies. The car is a rigid structure forming part of the actual balloon.

boats hovered round the ship, and—as nothing further seemed to happen—they rowed up, examined her, and returned. There can be little doubt that the *Nebraskan* was torpedoed; the chief engineer saw one of those missiles approaching the ship just before the explosion.

* * *

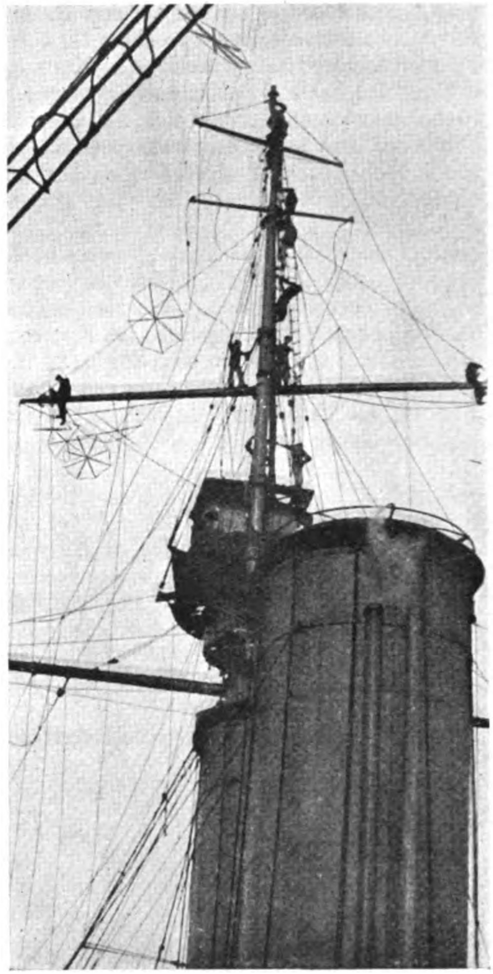
It is hardly too much to say that her salving was largely due to the confidence inspired by the fact that through "wireless "telegraphy" it was possible to communicate and ask for help at any time. The vessel was ultimately manœuvred under her own steam into Liverpool. Many a steamer unprovided with such safeguarding apparatus has been abandoned by her crew and left to drift helplessly to and fro at sea, useless to her owners and dangerous to other vessels. The Crookhaven land wireless station received the call of the *Nebraskan,* and was able to *keep in touch* with what was occurring all the way through.

* * *

On the recent occasion, when the White Star Liner *Megantic* (14,878 tons), outward bound from Liverpool with a large number of passengers, was saved from being torpedoed by a German submarine pirate, the Admiralty and people ashore were kept fully in touch all the time. The *Megantic* announced, when 60 miles south of Queenstown, that the German submarine had been sighted, and all the time that she was zigzagging at full speed she sent message after message, until finally she was able to announce that she had succeeded in shaking off her treacherous foe.

* * *

We have heard a very great deal with regard to secret wireless stations in England and other parts. There can be little doubt that no end of espionage is going on, but few of these tales of secret wireless apparatus have stood the test of examination. The case, however, in which figured the parish



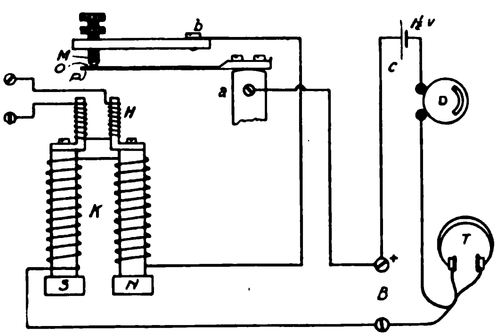
Repairing Wireless at Sea.

priest of Caporetto, recently captured by the Italians, seems to be genuine enough. After the legions of modern Rome had entered Caporetto, it became plain that the enemy's information concerning movements of troops was somewhat too detailed to be accounted for in any other way but treachery. Information was given by the rector, and under the high altar of the church itself a wireless apparatus was discovered. The traitor priest was tried and shot at Udine.

QUESTIONS AND ANSWERS

Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study to the Editor, THE WIRELESS WORLD, *Marconi House, Strand, London, W.C. Such questions must be accompanied by the name and address of the writer, otherwise they will remain unanswered: and it must be clearly understood that owing to the Defence of the Realm Act we are totally unable to answer any questions on the construction of apparatus during the present emergency.*

N. H. E. (Fulwood, Preston, Lancs) is troubled with a problem in connection with Mr. S. G. Brown's telephone relay. Speaking of the principle of the instrument he says: "It seems to depend on the principle of the ordinary microphone, but what I fail to understand is the action of the so-called 'self-regulating' winding, K. Suppose a slight E.M.F. across the terminals A causes the magnetism of H to be increased a little. Then the pressure between the contacts M and P is slightly reduced, and the resistance is correspondingly increased. This would therefore reduce the value of the current through the winding, K, and consequently would tend to demagnetise the magnet, thus neutralising the effect of the original E.M.F. across the terminals, A. In his description Mr. Brown says 'The contact pieces are opened to an infinitesimal degree to form the microphone by the fine adjusting screw, W, and by the action of the local current, which passes through the contacts and self regulating winding, K. The local current thus assists to form the microphone and to keep the instrument in adjustment.' I see that the arrangement would tend to obtain a uniform pressure between M and P, but although this is a desirable feature provided one understands it to mean 'a uniform pressure *apart* from the effect of signals,' it seems to be the last thing one should aim at *during the actual reception of signals*, for the object is to get as great a variation of resistance between the contacts as possible."



Answer.—We think that N. H. E.'s enquiry is of sufficient interest to warrant our reproducing it practically in full, as the problem has very likely occurred to a number of our readers. As regards the principle of the instrument, if the metallic circuit of a dry cell be interrupted by a minute opening or space of the order of 5×10^{-7}cm., the metal at the point of interruption being platinum, the current will continue to flow round the circuit and across the opening, and any slight alteration in the length of the space, which can be called the conduction space, will vary its resistance and greatly affect the value of the current which flows round the circuit. The dimensions of the conduction space are so small that it is difficult to ensure and maintain it by mechanical means. The current which flows across the space is, therefore, made to do its own adjustment, very much in the same way as the current that passes through the arc of an arc lamp is made to strike and maintain the length of the arc.

By the action of the local current through the winding, K, the space is formed and afterwards maintained. Now we come to the important point raised by our correspondent. The regulating winding must not, of course, act when traversed by the rapidly varying telephonic currents. Many of the descriptions which have appeared omit to mention that a special arrangement to overcome the difficulty has been devised. The iron under the coil is surrounded by a close circuited copper sheathing, and when the telephonic currents traverse the winding, K, eddy currents are set up in the copper. By mutual induction these destroy the self-induction of the coil, and in this way the action of the winding, H, on the reed, P, is not interfered with.

It will be noticed that our correspondent is slightly in error regarding the working of the relay. He speaks of the "pressure between the contacts M and P." The relay does not work by virtue of any variation in resistance of a *contact*, but by the alterations in resistance of a microscopic *gap*.

W. J. H. (Timaru, New Zealand).—We regret that we cannot depart from our practice of not publishing constructional details of patented apparatus. By the time this answer appears you will have had an opportunity of perusing the instructional article on the calculation of inductance, and this, together with the others that have appeared, should greatly assist you in your studies. There is an error in the first part of your letter which is apparently leading you wrong. You say the book says the wavemeter in question should have for a range of 100 to 750 metres, "a fixed induction of about 15 mhys., and the maximum capacity should be 10,000 cm. (3.3 mfds.). 10,000 cms. is *not* 3.3 mfds. If you calculate the equivalent of 10,000 cms. in microfarads, and then compare the statement in the first book you quote with that in the second, you will see in what particulars the two agree. You might then work out the wave-lengths obtainable with the capacities and inductances given, and you will soon see which is wrong.

We are very glad to hear that your society is devoting its time to theoretical study during the suspension of practical working, and shall be very glad to hear from you on any points which present difficulty.

Wm. H. R. (London).—We regret that we cannot publish information of the nature you mention during the present emergency.

E. K. B. (Sydney, New South Wales).—Thanks for your interesting letter. It is by no means certain that the gasometer would interfere with your reception when you are able to erect a station after the war. Do not attach too much importance to the station being on elevated ground. Not being acquainted with your locality, which is more than a few minutes' walk from our offices, we could scarcely express an opinion as to the best site to choose. With regard to your second query, although a "plain aerial" radiates very strongly damped waves which affect a receiver tuned to almost any wave-length, if the aerial in question has considerable capacity, such as would be the case if there were a long, low horizontal component, the radiated waves would be sufficiently persistent to give a good building-up effect with a receiver tuned to the particular wave-length. You do not give sufficient particulars of your friend's receiver to indicate to us whether this tuning effect was a spurious one, as sometimes happens when a receiver is wrongly or badly designed.

A. J. H. (Forest Gate) asks a number of questions which are of such a nature that we cannot deal with them during the time that the present restrictions are in force.

INSTRUCTION IN WIRELESS TELEGRAPHY

(Second Course)

(XII.) The Receiving Circuit.

[The dislocation of our arrangements, due to the war, has prevented us from completing, in our last Volume, the second course of Instructional Articles. These are being continued in the third Volume, and we hope to arrange for the Examination (full particulars of which are given on page 333 of our issue of August, 1914) to be held in the early autumn of this year. The present is the twelfth of the second series of articles, which will deal chiefly with the application of the principles of wireless telegraphy. Those who have not studied the first series are advised to obtain a copy of *The Elementary Principles of Wireless Telegraphy*, which is now published, price one shilling net, and to master its contents before taking up the second course of instruction.]

THE ELECTROLYTIC DETECTOR.

779. This detector in its most usual form consists of a small vessel containing an acid solution, sulphuric or nitric acid being the ones chiefly used. In this are placed a fine platinum wire and a lead plate. The platinum wire is fixed on a screw so that the distance of its tip below the surface of the liquid may be adjusted. For a sensitive detector the wire must be very fine, and in one form this is obtained by using Wollaston wire, which is made by covering a fine platinum wire with silver and drawing the composite wire till its diameter is as small as is practicable. When this is put into the acid the silver is dissolved off, leaving a platinum wire of extremely small size.

By means of a battery and adjustable resistance a potential is applied similarly to that used for a crystal, and high resistance telephones are included in the circuit.

The action of the cell as a detector is due to the annulment of the polarisation which is set up by the applied potential. The resistance falls and an intermittent current is sent through the telephones.

Another form is due to Fessenden. This has two fine platinum wires dipping into acid, or the vessel containing the acid may be divided into two parts by a partition with a fine hole between. In this case when oscillations are applied the resistance increases, due to the heating effect of the current, the heating being localised round the fine wires or the small hole, and hence if a steady potential be applied a greater current will pass in one direction than in the other.

THE MAGNETIC DETECTOR.

780. This detector, on account of its reliability and robustness, is still widely used in places where these qualities are of importance, as in ship installations. It requires a minimum of additional apparatus to fit it for the reception of signals with a suitable aerial. It is, however, not so sensitive as most of the more modern detectors. It consists of an endless band of a number of strands of fine iron wire, which are silk-covered, both to insulate them one from another and to increase the strength without diminishing their flexibility.

The band passes through a small glass tube on which is the primary winding; which consists of a short length of a single layer of fine copper wire.

Over the primary is placed a bobbin wound to a resistance approximately that of the telephones used, which are connected in parallel with it and are of 120 to 180 ohms per pair.

A magnet is placed with one pole as near the bobbin as possible, the other pole being tilted up away from the band. A second magnet is fitted and adjusted to diminish a "breathing" sound heard in the telephone.

To keep the band moving it passes round two large discs, one of which is actuated by a clockwork, which must be silent. The speed at which the band moves largely depends on its tension, and means must be adopted to vary this in order that it may move at a sufficient speed. This is usually done by an adjustment on the second pulley by which it can be moved backwards or forwards relatively to the first. A fan governor is provided to prevent the clockwork running down too fast. The primary can be connected in the aerial circuit and then only requires a tuning inductance and condenser to receive signals, or the primary can be connected in series with a secondary circuit of small inductance and relatively large capacity which is inductively coupled to the aerial.

The action as a detector is as follows: The slowly moving band is magnetised by the magnet, but owing to the hysteresis of the iron the magnetic state of the band at any particular point lags behind what it would be for the strength of the field at that point if the band were stationary. When the oscillations pass through the primary winding the effect is to annul this hysteresis effect, and a sudden change in the magnetic state of the band results. This change induces an electro-motive force in the surrounding secondary bobbin, which gives a signal in the telephones.

Several other forms of magnetic detector have been proposed, a description of which will be found in Dr. Fleming's "Principles of Electric Wave Telegraphy and Telephony."

The Fleming Valve.

781. If, in a highly exhausted tube or bulb, such as an incandescent electric lamp, two electrodes be sealed, one of which can be heated, then when both electrodes are cold the space between them is practically non-conducting, except for very high voltages.

If the electrode be heated, however, there is an appreciable conductivity in the space, and a fraction of a volt will send a current between the two electrodes. But the current only flows when the cold electrode is at the higher potential (*i.e.*, is positive to the hot electrode).

Hence the device is a rectifying one, and if an alternating current be applied to it an intermittent direct current will be obtained. The hot electrode is made in the form of a lamp filament, either of carbon, tungsten, etc., and in practice is constructed to work with a battery of from 4 to 16 volts. The cold electrode is usually a metal sheath surrounding the filament.

If the characteristic curve of this detector be plotted it is found that keeping the heating voltage, and hence the temperature of the filament, constant, the current between the electrodes is at first proportional to the applied voltage.

At a certain point the current increases more rapidly for a given increase in voltage and continues to do so till a point is reached when the current remains practically constant for a considerable increase in voltage.

On further increasing the voltage a second point is reached at which the current increases again until another stationary value is attained.

If a steady potential be applied between the filament and sheath and adjusted to the point where the current begins to increase more rapidly, the valve is in its most sensitive condition for receiving signals, and may be used on the same circuits as carborundum or other high resistance crystals. The valve is a very sensitive and reliable detector.

The Use of Balanced Crystals for Diminishing the Strength of Atmospherics.

782. Most crystals require an applied potential to bring them to their most sensitive condition for receiving signals. This potential is that for which a given small additional oscillatory potential gives the largest rectified current through the detector and telephone.

If a smaller applied potential be used the oscillatory potential has to be greater in proportion to give the same rectified current or strength of signal in the telephone—in other words, the detector is less sensitive.

Consider the curve shown in Fig. 1, which represents diagramatically the characteristic of a carborundum crystal, then if OB be the applied potential and BC the potential due to the oscillations, the increase in current due to this is KP, and this is the value of the intermittent current in the telephone which gives the signal strength. If the applied potential be OC and the oscillation potential be $CD = BC$, the signal current is QL, which is much larger than KP, giving stronger signals.

Suppose, now, a strong signal act on the detector working under the above conditions. Let BE be the oscillation potential for the first case, then UM is the signal current. For the second case the potential is $CF = BE$, and the current is VN.

If we have two exactly similar crystals connected to one circuit, and so arranged that they rectify in opposite directions, then if the applied potentials be the same value, as OC, every oscillation which reaches them sends equal currents in opposite directions through the telephones. Now, if the applied potential of one crystal be reduced to OB, an oscillation of potential BC will send a current equal to KP in one and QL in the other direction, the strength of signal in the telephone being due to the difference between these values, which is about *two-thirds* of QL in the diagram.

If a stronger signal of strength, BD or CE, be received, the current in the telephone will be VN—UM, which is only *one-fifth* of the strength of VN.

Hence strong signals are reduced in much greater proportion than weak ones, so that the method affords a valuable means for reducing the strength of atmospherics and jamming signals without appreciable weakening of the required signals.

The method can only be applied to crystals which are absolutely steady in their behaviour, like carborundum. It is not necessary for the two crystals to be absolutely the same; in fact, the balancing is best attained if one has a steeper characteristic than the other.

This method of reducing atmospherics is due to Mr. H. J. Round of the Marconi Company, and has been patented. A method also devised by Mr. Round, which has, however, been superseded by that described above, consists in coupling the aerial to two separate detector circuits—one tuned to the wave-length of the signals, and the other thrown out of tune to a certain extent. The detectors are connected to the same telephone (or telephone transformer) in opposite senses. In this case the atmospherics come through in equal strength on both receivers, and hence are neutralised in the telephones, but the required signals only give signals in one.

THE MEASUREMENT OF THE STRENGTH OF SIGNALS.

783. The measurement of the strength of received signals is one of the most important investigations which can be carried out in practical wireless telegraphy. It is not only of importance in giving figures in reference to the efficiency of the apparatus which is in use, but it is essential for supplying data by which theories concerning the propagation of electric waves round the earth, the effect of daylight and darkness, and many other subjects, can be elaborated and tested. Investigations into the properties of detectors are of little value unless accompanied by these measurements.

For some purposes it is necessary to directly measure the actual current received by an aerial, for others an indirect determination will suffice, whilst in many cases all that is required is a comparison of strength of received signals under certain conditions.

784. The measurement of small high-frequency currents can be made by various forms of thermal indicators, such as the thermo-junction and galvanometer, or the Duddell thermo-galvanometer.

The thermo-junction consists of a short length of high-resistance wire, the ends being soldered to suitable connectors. To the centre is soldered a thermo-electric couple consisting of short lengths of, say, bismuth and constantan in the form of fine wires. The other ends of these wires are soldered to stout connectors. The fine resistance is connected in series with the

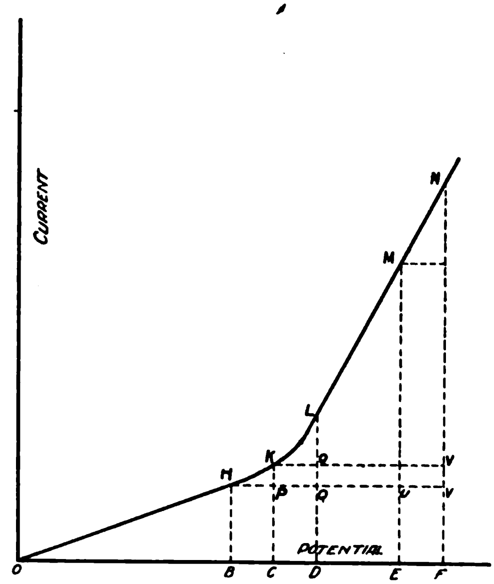


Fig. 1.

aerial, or more usually in a circuit coupled to it, and the free ends of the thermo-junction are joined to a low-resistance galvanometer, either of portable or mirror type. By placing the thermo-junction in an evacuated vessel, it can be made more sensitive.

785. The Duddell thermo-galvanometer consists of a fine wire resistance called a heater, and a thermo-junction. The latter is connected to a single loop of wire, which is suspended in the field of a permanent magnet, and has a mirror attached for registering the deflection, the combination forming a galvanometer. These instruments are suitable for measuring received signal currents of moderate strength, and have the advantage that they can be calibrated with direct current.

The Duddell thermo-galvanometer, in particular, is very useful, as its sensitivity can be varied by using heaters of various resistances, and also by varying the distance between the heater and thermo-junction by means of a screw provided for the purpose.

One disadvantage is that, when in the aerial circuit these instruments register the total current received at the time, including that due to signals, atmospherics, and static discharge. Moreover, as the galvanometer takes some time to reach its maximum deflection, it often requires signals of some duration to be sent specially for the test. In using these instruments, the higher the resistance the smaller the current which can be measured, but it is not possible to insert very high resistances in an aerial circuit without modifying its behaviour.

786. The method which has been adopted for measuring the strength of signals by several observers is as follows :

The aerial is inductively coupled to a detector circuit, and also to a closed wave-meter circuit, all tuned to the same wave-length. The wave-meter is excited by a buzzer, or other means, so that it induces a current in the aerial. A thermo-junction or thermo-galvanometer is included in the wave-meter circuit (or a circuit coupled with it), so that the strength of signals given by it may be watched and kept constant.

The signals in the detector circuit given by this local circuit may now be compared with those which are being investigated by some means such as those mentioned below.

By using sufficiently strong oscillations in the wave-meter circuit, the actual current induced in the aerial can be measured by a thermo-galvanometer, and hence the relationship between aerial current and signal strength in the detector circuit may be deduced.

787. For comparison of strength of signals the following methods are employed.

A telephone in series with the detector has a resistance box connected in parallel with it, and the amount of resistance required to shunt the telephone to bring the signals to a certain standard of strength is noted.

This method is convenient, since it only requires a resistance box in addition to the aerial and detector circuits, and may be used at a portable station, where the use of galvanometers, etc., is difficult.

The strength of the signals is deduced from the value of the shunt. Both the resistance and inductance of the telephone should be measured, and its impedance for the frequency of the signals calculated for obtaining the true shunt value. Even then the method is not very trustworthy, since it is difficult for an observer to always judge correctly when the signals are reduced to the standard strength.

788. In many cases it is possible to connect a sensitive ordinary direct current galvanometer in series with the detector and measure the rectified current. The more sensitive a galvanometer is, the longer is its periodic time, and hence it becomes difficult to use, since the conditions may alter whilst it is taking up its full deflection. There are, however, now some galvanometers which are very sensitive and have a quick period.

For this method a preliminary calibration of the detector, giving the galvanometer deflection for wave-meter currents of known strength, is required. Unfortunately, for most detectors the deflection is proportional to the square of the oscillatory current, and hence is very small for weak signals.

A paper on "Methods of Measurement of the Strength of Wireless Signals," by Prof. E. W. Marchant, will be found in the *Electrician* for May 28th, 1915, and should be read in conjunction with his paper in the March number of THE WIRELESS WORLD.

789. For comparison of strength of signals a very convenient and, at the same time accurate, method is as follows.

The aerial is coupled to a detector circuit using a Fleming valve or carborundum crystal. By means of the potentiometer, adjust the potential till the detector is at its maximum sensitivity, adjusting the coupling between the circuits, if necessary, to avoid very strong signals. Note the position of the slider of the potentiometer, or connect a voltmeter to measure the voltage applied by the potentiometer. A pivot galvanometer, with resistance in series, will make a suitable voltmeter for this purpose. Now, move the potentiometer slide back towards zero of potential, until the signals are just not heard, which can be done with great exactness, and measure the *change* in applied potential.

This potential may be taken as a measure of the voltage applied by the signals to the crystal or valve, and the signals can be compared by means of these potentials. In using a Fleming valve the current through the filament must be kept constant, and for a crystal the adjustment must not vary during the test, hence only carborundum is suitable.

It will be noticed that the method does not depend on any judging by ear of a standard strength of signal, and is free from error due to this cause.

Among the Wireless Societies

Notes on Meetings and Future Arrangements.

Institute of Radio Engineers.—At the regular meeting of the Institute of Radio Engineers held at Columbia University on the evening of May 5th, Mr. Benjamin Liebowitz presented a paper on "The Pupin Theory of Asymmetrical Rotors in Unidirectional Fields." The paper dealt first with a simple circuit having no resistance, and with a periodically varied inductance, showing in a simple manner that an infinite number of harmonics are generated therein. Leading on to the Pupin theory of two circuits, one of which is radiated in the field of the other and upon which a constant voltage is impressed, it is shown that the general theory may be simplified to the extent that it becomes analogous to the first case. The explanation of Pupin's theory to the case including condensers was then taken up, and a general application to the theory of the Goldschmidt radio frequency alternator was made.

* * *

Radio Society of Western Pennsylvania.—More than 150 amateur wireless operators and experimenters are members of the newly organised Radio Society of Western Pennsylvania, which holds monthly meetings at the University of Pittsburgh, Pittsburgh, Pa. Dr Powers, of the School of electrical engineering, will give a series of lectures on recent advances in the technique of wireless operation. The university is also arranging to have its own model wireless station co-operate with amateurs in high schools of western Pennsylvania.

INTERNATIONAL ENGINEERING CONGRESS, 1915.

It is announced from San Francisco, Cal., U.S.A., that an International Engineering Congress, under the auspices of the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the Society of Naval Architects and Marine Engineers, and the American Institute of Electrical Engineers, is to be held in that city during September. Numerous places of interest will be visited.

SHARE MARKET REPORT.

There has been a steady investment demand in the share market, more especially for the shares of the parent company, it being rumoured that the company is very busy with work in connection with the war. Prices: Ordinary, $1\frac{3}{16}$; Preference, $1\frac{3}{4}$; Marine, $1\frac{1}{4}$; American, 10s. 3d.; Canadian, 5s.

The LIBRARY TABLE

"EVERY BOY'S BOOK OF ELECTRICITY."
London: Percival Marshall & Co. 1d.

This little book, issued at the modest price of one penny, sets out to give a very simple introduction to electrical apparatus and the uses of electricity. Having carefully perused its pages (there are sixty-three of them), we have come to the conclusion that the task has been achieved remarkably well. In the first pages we find some electrical terms explained in simple language, and a brief consideration of "What is Electricity?" Various types of primary cell are next considered, followed by descriptions of simple accumulators. Dynamos, motors, electric lighting, and X-rays all find their place in the descriptions, and telegraphs and telephones are duly noticed, The final chapter deals with "How to Become an Electrical Engineer." Wireless telegraphy has six pages allotted to it, and is quite lucidly treated. It is, perhaps, rather a pity that, whilst the coherer receiver is illustrated and described and reference is made to the crystal detector, the extensively used magnetic detector is entirely overlooked. As the majority of ship installations have this latter type of detector, we trust that in future editions some mention will be made of it. One other little point is also worthy of mention. It is stated that "the operator listens at a telephone, and adjusts his apparatus to suit the note he wants to hear." We think it is not made sufficiently clear that there is an important difference between the audible *note* of the spark and the inaudible wave frequency to which the apparatus is tuned.

These, however, are minor points, and only serve to emphasise the value of the rest of the book. As a "start off" in the study of electricity this little treatise should be of great value to many boys, and may lead quite a number to become serious students.

* * *

"MICROMETERS, SLIDE GAUGES, AND CALIPERS: THEIR CONSTRUCTION AND USE."
By Alfred W. Marshall, M.I.Mech.E., and George Gentry. London: Percival Marshall & Co. 6d. net.

We know that among our readers there are a large number with a mechanical turn of mind who in normal times spend many pleasant hours in constructing wireless apparatus, and, judging from descriptions and photographs which from time to time reach this office, some of our subscribers have reached a high level of mechanical skill. On the other hand, it is evident that a good proportion would benefit vastly from a little study of engineering principles and design. We often find an otherwise ingeniously constructed piece of apparatus marred by a fault in design which would have been avoided had the constructor spent a little more time in studying engineering.

Careful design and construction entails careful measurement, and this can only be undertaken with proper instruments. In the book under review we have an excellent little manual devoted to micrometers, slide gauges and calipers, written in such a way that much can be grasped in little time and without superfluous reading—and dealing not only with the principles of the instruments in question, but with their construction and use. Practically all the matter is, of course, known to the trained engineer; but there must be a very large number of our readers who will welcome such a book.

As an instance of the value of this little volume to the experimenter who possesses a workshop and a few tools, but who has not had any real engineering training, we would draw attention to the particulars given in Chapter I. regarding calipers. Here the authors show that the engraving of the scale of registering calipers is not the simple thing it appears to be on the surface, but involves the use of very accurate geometrical dividing devices. Again, it is pointed out that manufacturers of calipers often finish off the points rounded, with the idea of allowing for the extreme wear to which they are subjected. In the case of registering calipers, however, an element of inaccuracy creeps in, in proportion to the size of the point, which renders it absolutely necessary to have as sharp measuring points as are consistent with strength. How this error arises is very clearly explained. A clear understanding of such matters constitutes an essential feature of a young engineer's training.

In Chapter III., on "Vernier Scales and How to Read Them," there is much of value and interest to the young mechanic, and in Chapter V. a good deal regarding the details of micrometer construction which might with advantage be perused by more experienced workers. The final chapter deals with "Hints on Reading and Using Micrometers."

Altogether the book is an excellent one, and its price (6d.) is low enough to bring it within the reach of everybody.

* * *

"OUR GOOD SLAVE ELECTRICITY." By Charles R. Gibson, F.R.S.E. London: Seeley, Service & Co. 3s. 6d.

In a series of volumes which Mr. Gibson is bringing out, expressly meant for the reading of the young, he tells in a most interesting way the wonderful stories of many sciences. It is not everyone, however gifted, who has the knack of bringing his knowledge to the level of a child's mind, and there are few of us who at one time or another have not been at our wits' end to know how to satisfy the curiosity of children in the realms of the natural sciences. To the young the wonders of natural history and geology and electricity, when properly explained, are like so many interesting fairy tales; and it is in the form of a story that Mr. Gibson deals with his subject, and he deals with it in such a way that, while maintaining scientific accuracy throughout, there is no lack of interest in all he tells.

In the first chapter of the book under review the author summarises in brief the various wonderful things that our "good slave" does, and, by reminding the reader of the means of communication upon which we had to rely prior to the application of electricity, he brings home very vividly to our minds the wonderful benefits which our "slave" now helps us to enjoy.

The discovery of electricity is dealt with in the next chapter, and the author shows that although Dr. Gilbert three hundred years ago named the unknown agency from the Greek word elektron (amber), it was not until the reign of Queen Victoria that electricity became a true slave. He then goes on to describe the taming of the "slave," and points out how, in the first days of applied electricity, people were inclined to look upon it rather as an enemy than as a friend. Other chapters deal with the present-day applications of electricity, such as the telegraph, both wire and wireless; the lighting of houses and streets; electric traction, hospital work, and many other important uses to which it is put.

We hope in future editions the error will be corrected on page 67 which shows the letter *q* as two dashes alone, instead of two dashes, a dot, and a dash. We notice that in the chapter on wireless telegraphy there is no mention whatever of Mr. Marconi's name. Seeing that we find reference to both Clerk Maxwell and Hertz, this will probably occasion some surprise, particularly when we consider that practically every child has heard the name *Marconi*, and would naturally look for it in such a book as this. Surely the part played by Mr. Marconi in the discovery and development of "wireless" merits a passing mention!

Another little point is that Mr. Gibson in his explanation of the reception of messages deals solely with the coherer. As the coherer is as extinct as the dodo, and as we can safely say not one ship in a thousand fitted with wireless ever carries a coherer on board, it would have been much better to have given a simple explanation of aural reception by means of a telephone headpiece.

The book is admirably illustrated with both photographs and sketches, and we notice with pleasure the plates showing children performing simple experiments.

Although this delightfully lucid book is primarily designed for "the rising generation," we can safely say that most of the "grown-ups" will peruse it to the end before it finally reaches the nursery.

* * *

"BROWN'S SIGNAL REMINDER" (All Methods). By D. H. Bernard. Glasgow: James Brown & Son. 9d. net.

This handy publication consists of four cards of convenient size bound together with linen at the top edge, and printed in colours with the International code flag signals, distant signals, semaphore, Morse code, and other signals used at sea. In these times, when hostile vessels may be sighted at any moment, it is important that all concerned with navigation should be thoroughly acquainted with signalling in all its forms, for upon rapid signalling the safety of a ship may depend. Until all ships are fitted with wireless there must occasionally come times when flag and semaphore signalling have to be resorted to, and by lack of sufficient knowledge the person signalling may cause many errors and much exasperation. This "Reminder," which can be slipped into the pocket, will come as a great help to many. Wireless operators will no doubt make use of it for ready reference to those forms of signalling which are outside their sphere.

* * *

"QUESTIONS AND SOLUTIONS IN TELEGRAPHY AND TELEPHONY." By H. P. Few. London: S. Rentall & Co. 2s. 6d. net. (Postage 3d.)

This book, which has already run into four editions, aims at providing students preparing for the City and Guilds Examination in the ordinary grades of telegraphy and telephony with a reprint of the questions that have been set since 1904, together with their solutions. In the new edition the section containing solutions to questions set at the Departmental written examinations, for Overseers and Assistant Superintendents, has been extended, and a special feature is the inclusion for the first time of questions set in the *oral* examinations by the departmental examiner. Whilst, as above mentioned, the book is primarily designed for students preparing for the City and Guilds Examination, any student of telegraphy and telephony would do well to work through the questions and compare his answers with those given. The solutions are well illustrated by line drawings and diagrams, and an index enables any special subject to be traced with ease.

THESE ALSO.

"They also serve who stand and wait."

NOT only those who on the battle's plain
Brave the swift death, nor they that moanless face
The weary hours in corridors of pain;
Not only these shall win themselves a place
On honour's roll, but also those whose days
Are spent in toil amid o'ershadowed ways.

Such as must bear the furnace' flaming breath,
Who with firm hand, true eye, and wondrous skill
Fashion to form the messengers of death,
Such as apart, steadfast, and unnoted, still
Their vigil by the lonely hearth-fires keep,
Women who hope, and pray, but must not weep.

And these the guardians of the midnight sky,
And such as keep the pathways of the sea,
Hearts big with courage, resolute and high,
Fearless to face whatever terrors be,
Eager to answer to their country's call,
And on her altars gladly off'ring all.

When all the glorious, bitter tale is told,
When we shall count our heroes, name by name,
Such as have come through suff'rings manifold
Such as endured, and strove, and overcame,
Among the great, the noble of our race,
Shall not these also find a fitting place?

T. IDDON.

Foreign Notes

Australia.

The proposal recently brought before the Chamber of Commerce Conference in Australia has brought into the Australian Press a considerable amount of "copy" dealing with the question of the equipment of coastal steamers with wireless telegraphy. The Sydney Press rightly emphasises, with regard to coastal services, both passenger and cargo, the importance of wireless fitting.

"The necessity and value of wireless "telegraphy to owners of this particular "class of vessel is almost as great as its "value to owners of oversea vessels. In the "case of most oversea ships it will in the "near future be compulsory; but in recent "years, and without compulsion, wireless "telegraph equipments have been almost "universally adopted for both passenger "and cargo ships. There is hardly a ship "of any size coming into Sydney from "oversea ports now without an equipment."

The extract given above is taken from one of the great daily newspapers of Sydney. The Australian Press generally emphasises as the main points in favour of the universal adoption of radio-telegraphy:

(*a*) The additional safety of navigation.

(*b*) The opportunity afforded shipowners of communicating amended instructions at any time.

(*c*) The convenience of knowing exactly the expected time of arrival in port.

They point out that all three considerations involve a saving of expenses, which applies equally to coastal and oversea traders. They take considerations (*a*) and (*b*) as self-obvious, with special emphasis upon the fact that if the exact hour of arrival is known the shipowner is released from paying a staff uselessly to await arrival, consignees are able to save both money and time with regard to cartage and other means of conveyance.

We are glad to observe that the system advocated by the Marconi Companies of "the provision and maintenance of wireless "communication by those who are expert in "this work" is recommended, in preference to its undertaking by the shipowners themselves. Experience extending over a number of years has now demonstrated this to be the most satisfactory method from all points of view.

* * *

Canada.

In the course of a recent debate on the Marine and Fisheries Department Estimates in the Canadian House of Commons, the navigability of the Hudson Bay route was one of the subjects of discussion. The Hon. J. D. Hazen, Minister of Marine in the Dominion Cabinet, announced that during the coming season the first wireless station will be placed on the Hudson Strait. This station will be able to work with those at Port Nelson and Le Bas. In answer to a question put to him, Mr. Hazen replied that more than one station would be required on the Strait in order to keep in touch with ice conditions. Twelve beacons had already been erected in the Strait. With an improvement of facilities the trade of a large area, *via* this route, would be certain to considerably increase.

* * *

United States.

We learn from New York that the judges sitting in the Circuit Court of Appeals have given their decision affirming the order of Judge Hough to grant a preliminary injunction restraining the de Forest Radio Telephone and Telegraph Company, the Standard Oil Company of New York, and Dr. Lee de Forest from infringing the fundamental Marconi and Lodge patents relating to wireless telegraphy. The defendants had maintained it was unfair that they should be restrained from the using the de Forest system, pending the decision of the patent action brought by the Marconi Wireless Telegraph Company of America against the Atlantic Communication Company. They urged this on the ground that the Marconi Company had recently raised the price charged to steamship companies for the use of its system to $100 a month for each vessel. Judge Hough, in granting the injunction, stated that owing to the expenses of operation and litigation to which the

Marconi Company had been put in the past, no fair return had so far been made on its invention. He also upheld the contention of the Marconi Company that it was only fair, in reckoning the rental they charged to steamship companies for the use of their apparatus, the cost of the establishment and maintenance of shore stations should be taken into account.

The Circuit Court of Appeals in affirming the ruling of Judge Hough also denied the motions to make void or modify the injunction.

* * *

During the trial, in Brooklyn, of the suit brought by the Marconi Wireless Telegraph Company of America against the Atlantic Communication Company, referred to on p. 198 of our June issue, Mr. Marconi, who was so important a witness in the case, was suddenly called to Italy in connection with the war.

For this reason the judge announced that the trial would be adjourned for two months, and that if Mr. Marconi was still unable to attend at that time a further adjournment would be ordered by the court. At the time of the adjournment the action had been in progress three weeks.

* * *

Australia.

A South Australian correspondent sends us a copy of an amusing letter which was received by an officer of one of the State post and telegraph organisations at the time when the erection of the first Australian Commonwealth wireless stations was under consideration. It may be mentioned that the official in question was not even remotely connected with the wireless proposals. The letter reads as follows:

"SIR,—Understanding the system of Mar-"coni telegraph, with the exception of the "sending and receiving instruments, I beg "to apply for same. I would require a "little tutoring with a scientific Marconi "telegraphist. Hoping this may meet with "a favourable consideration, and the "Government will find a good use for the "telegraph.

"I remain,

"Your obedient servant,

"——."

German Wireless Outrivalled

OUR contemporary, the *Sporting Times*, recently contained an amusing skit on German "Wireless," from which we give below some extracts:

"An official telegram from the German "headquarters, dated May 19th, says:

"'North of Ypres, on the west side of the "'canal, and at several other places in this "'sector, we brilliantly evacuated our "'advanced positions after a severe struggle, "'and withdrew from them the forces that "'had become panic-stricken. Up until "'now, in this sector, there has not been "'the least indication of our fresh advance.

"'Yesterday one of our Zeppelins dropped "'bombs on the fortified citadel Pigton-"'cum-Slush, and completely demolished "'the Orphanage and Sanatorium, which "'probably contained a great quantity of "'ammunition. The armoured pleasure "'boat *Skylark* had twenty or thirty bombs "'dropped somewhere near it.

"'In the North Sea a squadron of cruisers "'under the command of Admiral von "'Ingenohl, ventured a quarter of a mile "'beyond our mine field, but on sighting "'an armoured British trawler they soon "'showed their superior speed, and returned "'safely without casualties.'

"The following official telegram from "Turkish headquarters, dated May 20th, "states:

"'Yesterday, in the Dardanelles, we sank "'the British super-Dreadnoughts *Lion*, "'*Tiger*, *Hippotamus*, *Skunk*, *Botfly*, and "'*Paregoric*, together with a large number "'of destroyers, submarines, and aircraft.

"'On the Asiatic side and in the Sea of Mar-"'mora there is nothing further to invent.'

"An official telegram from Austrian "headquarters, dated May 20th, says:

"'On the Dukla-Dwina sector we made "'our usual week-end retreat, and during "'the operation we captured a great "'number of exploding shells. In the "'Bukovina our Third Army Corps made "'a brilliant sortie into an enfiladed posi-"'tion, and have not yet returned.'"

A Night of Peril

By RALPH BAILEY.

VICTOR OSBORNE lay in a nursing home, recovering from the effects of wounds he had received three months previously. He had been before a Medical Board at the Admiralty, and much to his disappointment had failed to impress upon the faculty that he was once more fit for service.

He decided to see a specialist, with the result that he had made rapid progress, and looked forward with great excitement to presenting himself for survey once more. His exit from the firing line had been swift and sure, but during that short period he had sufficiently distinguished himself to obtain his promotion.

By his bedside sat his fiancée, Phyllis Roper, a young girl not yet twenty, whose love had, if possible, grown stronger since he had once more been given back to her. They had agreed not to consider matrimony until the war was over, but fate had proved too strong, and they were only waiting till he should shake the dust of the nursing home from his feet before the ceremony should take place.

"Victor, I feel I cannot let you go from me again," she said, and then, lowering her voice to a whisper, "those horrible hours of anxiety till you came back——"

"Poor old girl, cheer up; I'm afraid your wish will come true—they are not likely to let a crock like me have another go at them."

"You have done your share," she eagerly replied. "Now I am going to have you, they shall not take you away again——"

At this moment their conversation was disturbed by a knock at the door, and the nurse entered.

"A telegram for you, Sir."

"A telegram," he said, wondering. "Must be old Aunt Clara coming up to town, she mentioned in her letter that she might be coming up. Open it, Phyl, let us hear the worst."

Phyllis broke it open, and as she read on, anxiously clutching the small piece of paper, she uttered a loud exclamation of joy.

"Well—don't keep it all to yourself," cried Victor, "out with it."

"Read it," she said cheerily, scarcely knowing how to suppress her feelings.

Victor grasped the wire, and slowly read aloud the contents:

"You have been appointed in Command of the Wireless Station at Crome. Proceed forthwith. Admiralty."

"Well, haven't you got anything to say?" burst in Phyllis excitedly.

"Yes," replied Victor. "Damn!"

. . . .

A few days later he arrived at Crome to take up his appointment. The wireless station had only just been installed, and was one of the most powerful in existence, lying on the rugged coast of Scotland, miles from everywhere. What concerned him most for the moment was a suitable dwelling place close to the station, for he had been through the marriage ceremony the day before leaving town, and this matter was therefore of no small importance as far as he was concerned. He happened to be extremely fortunate, for within a quarter of a mile of the wireless station lay one solitary bungalow, furnished, but deserted by the owners, who had had it specially built, and then been utterly dissatisfied when it was completed.

Having made the preliminary preparations in connection with his future domain, he set to work to organise the defence of the station. Fifty men of the National Reserve formed the guard under Lieutenant Croft, a man somewhat ancient for his seniority, but who had volunteered on the outbreak of hostilities in order to free younger men for more active service. Victor found in him a most congenial and welcome companion; a perfectly invaluable asset to the comfort of no man's land.

The entanglements and general defence

Strolling after dinner.

having been prepared, the guards were posted, consisting of one sentry in each blockhouse surrounding the compound, one on the engine house, and one on the bungalow which was on the boundary of the enclosure.

Victor, having satisfied himself that all the arrangements were in order, sent for the Senior Engineer, a man of great energy, who took little interest in anything outside his own work. He had started as an operator, but owing to his abilities and zeal his merits had received exceptional consideration, and he had been appointed to the wireless station as Engineer-in-Charge.

"Ryan, I want you to connect up a line to my bungalow as soon as possible, in order that I can hear all the messages that go out —also an alarm bell in the camp, which I would like connected to the sentry box outside the engine house."

"I will have them fixed up at once, sir," replied the other, and the rapidity with which the work was carried out only proved to Victor that they had undoubtedly got the right man in the right place.

Two days later Phyllis arrived. She was blissfully happy—how could she feel otherwise? She had been released from the great strain of anxiety and worry, and everything had come right—and here, in the wilds of the Scottish coast, she was alone, or practically so, with the man she loved. What else mattered?

The routine was somewhat monotonous, but Victor grew to like it, satisfying himself that he was at present physically unfit to go to war, and he was therefore serving his country in the best possible way. At midnight a programme was sent out giving the general news to all ships afloat.

At 3 a.m. the important programme commenced. At this hour all messages from the Admiralty were sent out to the Fleets in code, giving them instructions of vital importance. Victor Osborne listened each night to the messages as they were despatched, following them word for word, in order that there should be no deviation after he had once signed them as correct.

One beautiful evening Phyllis and Victor strolled down to the cliffs after dinner. The night was beautifully clear, with a gentle breeze from the sea, scarcely perceptible, but sufficient to cool the air, which had made it almost impossible to remain indoors. To the westward clouds had gathered along the horizon, but at intervals the moon would reveal some craft steaming on its mysterious journey, for men-of-war and merchantmen alike were subject to the same uncertain treatment at the hands of the enemy.

Presently Phyllis spoke.

"It seems impossible to realise all the horrors," she said; then, after pausing a moment, continued: "One sees a ship to-night peacefully gliding its way down the coast, and then to-morrow we may read of its destruction, with all the details of brutal and sordid treatment which accompany it."

"Don't think of it, Phyllis; we should be thankful we can be so happy—they could not have appointed me to a safer and more peaceful spot. Let us be happy while we can."

They turned from the sea, and silently walked back to the bungalow. Victor knew the horrors and Phyllis imagined them. And so, as they turned their footsteps in the direction of home, they each were thinking of the suffering and sorrow which was rapidly increasing throughout the country.

"Come back to earth," he said suddenly, as he realised that they had both become rather engrossed in their thoughts—and then, with a merry little laugh, they stepped on to the verandah.

Phyllis retired to bed, while Victor proceeded to his office, which he had fitted up to his own satisfaction in order that he could listen to all outgoing messages. He realised himself that it was not much of a job, but he intended to carry it out conscientiously, since he had been given it. Croft usually dropped in for a whisky and soda about eleven o'clock, and on this particular evening saw no reason for departing from his usual custom.

"Hello, Croft! Is that you? Come in," called out Victor.

"I was wondering whether you had got back," shouted the other from the verandah. "I saw you go out. Lovely evening, wasn't it? Didn't see any submarines, I suppose?"

"No," said Victor, laughing. "The moon is a bit too sprightly to-night."

"*Was*, you mean," put in Croft. "Those clouds to the westward seem to be coming over, and it is as black as pitch outside now."

"Oh, well, I don't expect they will trouble us here. Help yourself," he said, passing him the decanter. "The programme will be starting soon—I always follow it right through, just in case——"

"Yes, you cannot be too careful. Well, good night, Commander," and stepping out into the verandah, he walked back to the camp across the compound, having satisfied himself that the sentries were at their posts and everything was correct.

At five minutes to twelve Victor put on the ear pads, and at midnight the programme commenced. He had grown so accustomed to following it, that he took it in quite mechanically, leaning back in his armchair with his pipe as his sole companion, and all the lights throughout the station extinguished.

It must have been about a quarter past one, when the signalling suddenly ceased—an incident to which he paid little attention, for minor breakdowns were frequently causing slight delays. He readjusted the ear pads, and then, refilling his pipe, settled himself in his chair, and listened for the programme to continue.

It must have been ten minutes after the interruption that he rose from his chair, and walked over to the window leading out on to the verandah. The blind was down, but as no lights were showing from within, he drew it back and quietly opened the door. He then removed the ear pads and stepped out. As he did so the noise of the spark reached his ears across the compound, some three to four hundred yards distant, but plainly audible on such a still night, with a light breeze blowing towards the bungalow. Instinctively he put the ear pads on, but he could hear nothing through them; removing them once more, he listened intently to the spark.

Reading the good news.

"Strange, very strange," he muttered; then suddenly he gripped the rail of the verandah, for the spark was not sending out the usual programme. "What was that?" he reflected. "178—234—numbers —the Secret Code."

Instinctively he jumped to the conclusion that something singular was happening. He paused for a moment to think, then, slipping back into the office, snatched up his revolver, and passed out on to the verandah again. In a low voice he addressed the sentry. There was no reply. He stepped down from the bungalow, and as he did so he stumbled against something on the ground. Instantly he was down on his hands and knees, groping about to find out the nature of the object which was obstructing his way.

Suddenly he stood up and gripped his revolver, but not a sound reached his ears beyond the dull angry throb of the spark. His hand was wet, covered in blood, and at his feet lay the sentry, motionless, stabbed through the back.

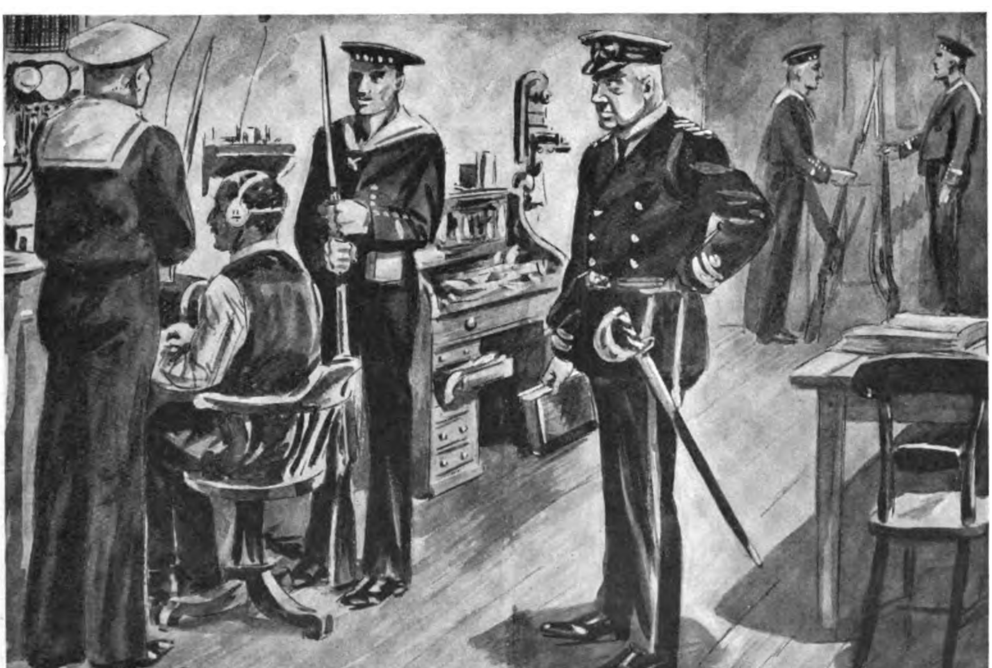
Meanwhile, the signalling was going on. The ground was soft, and consequently he was able to make his way over to the "Engine House" noiselessly. When he was within fifty yards he went down on his hands and knees again, and in a few minutes reached the sentry box. The sentry was nowhere to be seen, and he calculated that he must have met with the same fate as the other.

Quickly he reached for the Alarm Bell, then waited, "Curious," he thought, "I should be able to hear it quite clearly from here." He pressed it again, and then the truth dawned on him: *the wires had been cut.*

He glanced towards the bungalow, and instantly the situation became apparent to him. The wires to the bungalow from the engine-house had been cut as well.

For the moment the thought occurred to him to rush over to the camp, and then he realised the delay. Crawling close up to the engine-house he climbed on to a box from which he could manage to see inside, provided the blind was not drawn fully down. There was only an inch uncovered, but it was quite sufficient.

He was quite dumfounded at the sight which met his eyes. At the signalling



"A German Officer, with the secret code in hand, was standing close by."

key—operating with apparent composure—sat Ryan, and on either side of him a German bluejacket with fixed bayonet. A German officer, with the Secret Code book in his hand, was standing close by; at the door two men guarded the entrance. What should he do? He must act at once. There was only one way—he must stop the signalling, which was obviously decoying the battle-fleet into a neighbourhood infested with submarines.

He took a piece of paper from his pocket, and scribbled something on it, clutched it in his left hand, then he cocked his revolver. His aim must be true; one shot suffice. He worked himself into a position from which he would be able to get a steady aim, then fired. Quickly he peered through the small space between the blind and the window sill, a smile of uncertainty playing on his lips. Ryan lay dead at the foot of the signalling key. For a moment his guard seemed taken aback, but the sound of the shot brought four more bluejackets into view. Two more shots rang out, and one of them dropped.

A slight movement behind caused Victor to turn; he was only just in time, for as he dropped from his position a shot pierced his left shoulder. As he fell to the ground he saw a figure silhouetted against the sky. There were three rounds left in his revolver; he couldn't afford to miss, so he waited. Presently the figure began to move towards him, but within ten yards of Victor he fell, a huddled mass, shot through the body.

Victor, thinking he was dead, began to crawl away to a safer refuge, an action which might have proved fatal, but fortunately the darkness saved him. His last victim had fallen, mortally wounded, but had rallied sufficiently to fire one more shot. An inch lower, and nothing could have saved Victor's life, but as it was the shot struck the top of his head, fracturing the skull.

The sound of hurried footsteps reached his ears. He could dimly see the forms of some twenty to thirty men outlined against the sky, but his strength was fast leaving him. It must be the guard, he thought; they had heard the firing. He tried to shout, but he was too weak; he had lost much blood and was growing faint and dizzy. He recollected someone bending over him, and with a superhuman effort muttered, "Croft. My left hand." Then he became unconscious.

* * *

It was not till five days later that Victor showed signs of returning to life. The doctor was standing by his bedside and a nurse, who had been summoned from the nearest town. He had just recovered consciousness, and the news had been conveyed to his wife.

"Croft," he muttered. "I must see Croft at once."

Fortunately Phyllis was not in the room as he uttered his first words, for it would have been heart-breaking to have heard any other name except her own after such a trial.

"I must see Croft," he went on, "please send for him at once. And now," he almost sobbed out, "where is Phyllis? Let her come to me; let me see her, if only for a minute."

And so Phyllis came. She could have cried with joy and sorrow, but, straining every nerve to remain calm, she went quietly to the bedside and held his hand, while they just remained silent, with all the most perfect love passing from one to the other without a single word.

"Now I must go," she said quietly, "and you must promise me to obey the doctor, and you will soon be quite all right again."

He promised, and when she had gone he sank back into a natural, peaceful, and perfect sleep, forgetting all that had passed and the excitement of seeing Croft.

Some hours later he awoke, and found Phyllis sitting by his bedside.

"Will you be very good," she said, "if I grant you a little favour?"

"Yes," he said, "very," and tried to smile.

"Well, then, you shall see Mr. Croft."

He had almost forgotten Croft for the moment, but the name seemed to agitate him, and he anxiously gasped out:

"Yes, quickly. I forgot Croft. Where is he?"

After extracting a further promise to remain calm, Croft was admitted. He had scarcely crossed the threshold when Victor blurted out:

"You found the paper in my hand?"

"Yes," replied Croft. "It was brought

to me, and everything came right. We found three more bluejackets in the engine-house, and they surrendered, with the officer, without further opposition, after which your instructions were carried out."

He then handed the slip of paper to Phyllis, on which were written the following words:

"Germans sending messages to British Battle Fleet. Cancel as soon as possible."

. . . . .

A week later Victor had passed all danger and was rapidly recovering, although the doctor announced that it would be a couple of months before he could leave his bed. This was of little importance to Phyllis or Victor; those hours and days were full of happiness, slowly and steadily recovering, while the anxiety was well recompensed by the joy in nursing him back to life.

A few days before he was to be allowed up Phyllis entered his room, scarcely able to conceal her excitement and joyful spirits.

"Vic, I have some good news for you," she said.

"Oh," he grunted. "Have I been granted a month's sick leave?"

"No," she replied. "Vic, I hardly know how to tell you; my heart is so full, I am so proud. Can't you guess?"

"No; give it up."

"You have been awarded the Victoria Cross."

Then she leaned over the bed and kissed him, and though he had braved the tempests and fortunes of war in the North Sea, and practically saved the situation single-handed a few weeks previously, his courage failed him and he cried like a child.

Presently she stood up and, looking into his eyes, said:

"Aren't you proud, Vic?"

To which he replied: "Nothing matters to me, you dear child, except you."

And so they stayed for hours, happy and contented, till they were disturbed by a knock at the door.

"Come in," cheerily shouted Victor, though he scarcely recognised the sound of his own voice. Then, as the door opened, Croft stepped in.

"Let me congratulate you, Commander," he said. "I am so glad."

"Thank you, Croft," he replied, "though it is you I must thank for my life, for had you not arrived at that critical moment they would probably have finished me." And then he added, as if suddenly recalling some forgotten link, "How about Ryan—what became of him?"

"Ryan is dead," said Croft quietly.

"I'm sorry," replied Victor, "very sorry; he was a good man, but I weighed everything up in my mind before I fired—and I came to the conclusion it was the only way."

"There is no need to be sorry," replied the other. "It *was* the only way."

For the moment Victor could not quite understand, and he felt that underneath Croft's words lay some hidden meaning.

"Why, what do you mean?" he said hesitatingly.

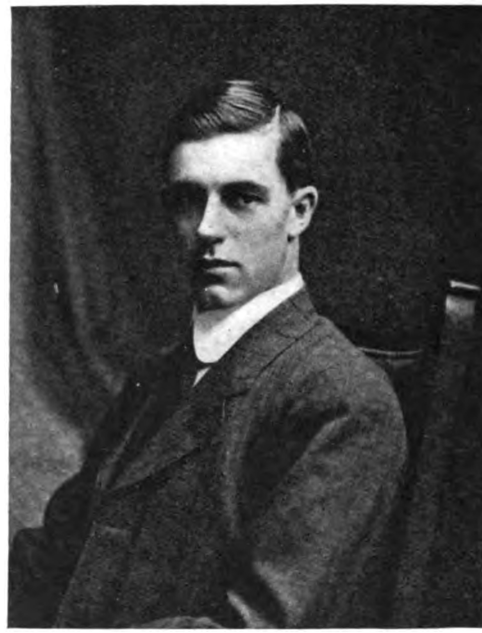
"I mean," said Croft, "that after Ryan's death the papers in his room were gone through, and he met the only fate that he deserved. *He was a spy.*"

PERSONAL PARAGRAPHS.

Readers of this magazine will be well acquainted with the name of Lieutenant-Commander Hubert Dobell, one of the Marconi Company's most experienced engineers, who prior to the commencement of the war so ably conducted the Questions and Answers column in our pages. We are sure all will hear with regret that this gallant expert is now a prisoner of war in Germany. At the time of his capture Lieutenant-Commander Dobell was engaged upon observation work, and as a result of the aeroplane in which he was flying being subjected to shrapnel and rifle fire, his companion the pilot was wounded and the machine had perforce to descend into the German lines. Lieutenant-Commander Dobell is in the captured officers' camp at Bischofswerder, unhurt and well treated.

Lt.-Commander Dobell.

Congratulations to Mr. F. J. Linnell, who has just received his commission as Flight Sub-Lieutenant in the Naval Air Service. In the time long ago when peace was still unbroken Mr. Linnell was a wireless telegraphist in the Marconi Company, having entered that service in 1909. On the outbreak of hostilities he volunteered for active service in a "wireless" capacity, and received an appointment as Warrant Telegraphist, R.N.R. Apparently the close alliance between wireless telegraphy and aviation is partially responsible for Lieutenant Linnell's appointment, and his many friends in the radio service will join with us in wishing him every success in his new sphere of activities.



Mr. F. J. Linnell.

On page 202 of our June issue we announced that Sergeant A. H. Brown, formerly a wireless operator in the Marconi Company, had obtained a commission as second lieutenant in the 10th Battalion Seaforth Highlanders. We now have much pleasure in reproducing his photograph.

Second-Lieut. A. H. Brown.

Mr. C. F. Warren.

We regret to announce the death of Mr. C. F. Warren, killed in action on May 26th last. Mr. Warren was attached to the publishing staff of this office, and joined the 24th County of London Regiment (The Queen's) at the end of August last. Although only holding a junior position, he showed marked ability, and was exceedingly popular with those with whom he came into touch. As one who entered thoroughly into the social as well as business side of the office, he will be greatly missed by his fellow-workers.

We have the pleasure of announcing the marriage of Mr. J. E. Catt and Miss Dorothy Harrison, which took place at West Kensington Park Wesleyan Chapel on June 3rd. Mr. J. E. Catt is chief petty officer in the Royal Naval Air Service, and before the war was in the land operating service of Marconi's Wireless Telegraph Co. Mrs. Catt was formerly engaged in the telegraphic service of Birmingham. Many friends in the Marconi service will be glad to hear of their colleague having taken rank amongst the benedicts.

Mr. J. E. Catt.

We regret to record the death of Mr. Richard Kerr, the genial and well-known lecturer on astronomy, microscopy and other scientific subjects. Mr. Kerr passed away on May 19th, at sixty-five years of age, after suffering greatly from a complication of disorders. For the last two years he had shown signs of breaking down in health, partly owing to anxiety and the difficulty of getting and fulfilling a sufficient number of engagements to keep him fully employed. He frequently lectured on wireless telegraphy, and spoke proudly of an early acquaintance with Senator Marconi, when the latter first visited this country. One incident in relation to wireless telegraphy and the late Mr. Kerr is perhaps worth recording here. By arrangement with the Home Office he was lecturing to the prisoners at Portland on the subject of wireless telegraphy, and the audience were much interested. On arrival home Mr. Kerr found that a member of the burgling fraternity, probably possessed with a sense of humour, had broken into his house and removed several articles of value!

The late gentleman was an artist of no mean ability, and drew the illustrations for his lantern slides and books with his own hand. He was also an author of several interesting books, such as "The Hidden Beauties of Nature," "Nature, Curious and Beautiful," and "Wireless Telegraphy Popularly Explained." Much sympathy will be felt for the late lecturer's widow and four children.

BRITISH COMMAND OF THE SEA.

A LETTER from a Birmingham surgeon of an armed liner of 18,000 tons which has been scouring the seas since September in search of enemy ships and commerce raiders, contains, *inter alia*, some gratifying compliments on the service of war news sent out nightly by wireless from Poldhu. He speaks, moreover, in the most glowing terms of the officers (mainly R.N.R.) with whom he is serving. One little extract from his long letter is worthy of special mention, because it emphasises a point in the present situation which frequently escapes notice:

"We were rather curiously placed the "other day when we actually anchored for "a few hours off a neutral port, right in "amongst a crowd of German ships, while "a consort steamed to and fro outside "keeping watch. The nearest one was a "fine liner with guns on board, stowed "away below, which she cannot mount in "neutral water, and would find it a longish "job to do at sea. She dare not come out "the neutral limit without them, and so is "practically helpless. If she did slip out "and get them mounted she had better keep "out of our way, as this ship would soon "polish her off."

Few people realise the amount of German shipping which is thus lying, helplessly eating its head off, in neutral waters.

SANG-FROID.

A WIRELESS operator attached to the Royal Flying Corps in France has written to Mr. A. King Davies, a solicitor at Maesteg, in Wales, a cleverly-worded description of his doings. Amongst other incidentals he appears to have been struck by the *composure of everybody and everything.*

"The birds sing in the thick of bursting "shells, cows quietly graze, and horses are "entirely undisturbed. One day I got a "surpassing surprise. Picture a country-"side of what was once well-farmed land, "now absolutely torn to tatters, furrowed "with huge gaping holes, the railroads "torn to shreds, with their metals twisted "like writhing snakes, whilst shrapnel is "bursting at a little distance off, and "might easily find you at any moment. "But between you and the bursting shells "you may observe a Belgian farmer, sitting "quite composedly on a horse-drawn rake, "putting the finishing touches to a lucky "spot in the fields."

Mr. Powell seems to have been so struck with the Belgian's coolness as to have vented his astonishment in a burst of laughter at what he avers appeared to him "almost to amount to cheek!"

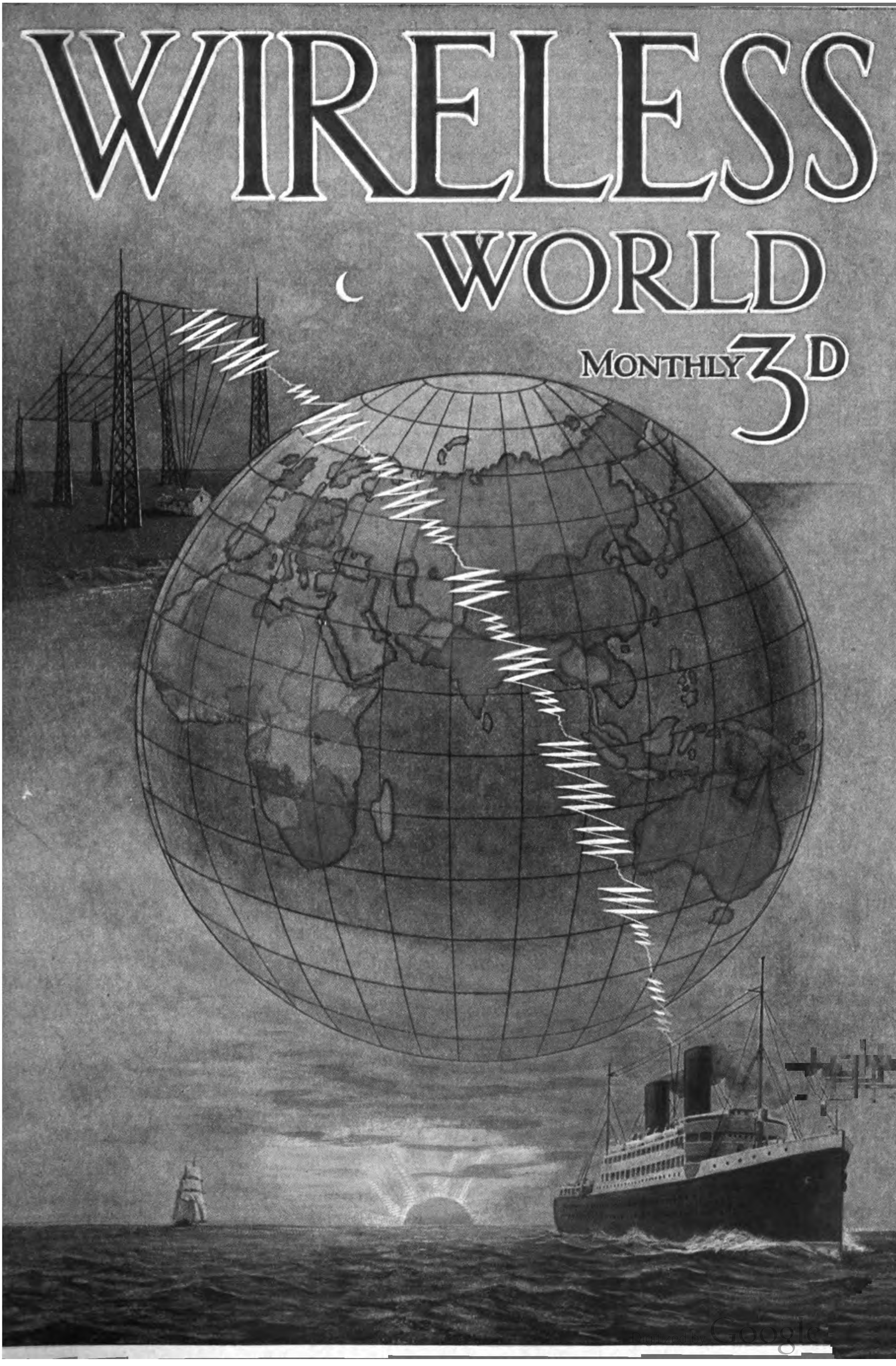
WIRELESS IN THE COURTS.

CASTLE EDEN, in County Durham, is the latest place to record a prosecution for the possession of wireless apparatus contrary to the provisions of the Defence of the Realm Act.

William R. Walker, a school teacher, aged 26, was fined five guineas for this offence. A police sergeant visited Walker in April last, and was shown parts of a dismantled aerial which had been taken down shortly after the commencement of war.

Walker remarked to the sergeant that he had never been able to transmit anything, and that the only thing he could receive was the time signal from Paris, as he did not know the code. Henry Dunthorne, Post Office Engineer at Newcastle, said the apparatus formed the dismantled parts of a wireless receiving set, and that it would have been possible to put it together for receiving messages in about two days. It was not a transmitting set at all. In May the military authorities advised that the man should be warned, and no further proceedings taken. This was duly done. Subsequently, however, the authorities deemed it advisable that he should be prosecuted.

The Chairman of the Bench, in trying the case, said the defendant had been foolish enough not to protect himself, and seemed to have been led into his present position by the Post Office authorities, who had apparently been extraordinarily lax. There was no suggestion of defendant's wishing to communicate with the enemy. The case, however, he went on to say, must be taken as a definite warning that if anything of the kind happened again in that district, which had already been attacked from the sea, excuses of that sort would not be taken into account.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THE WIRELESS WORLD

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A CROWDED YEAR

Strident Warfare and Silent Waves.

WITHIN a few days of the date when this number comes into our readers' hands we shall reach the first anniversary of Britain's entry into the great world-war.

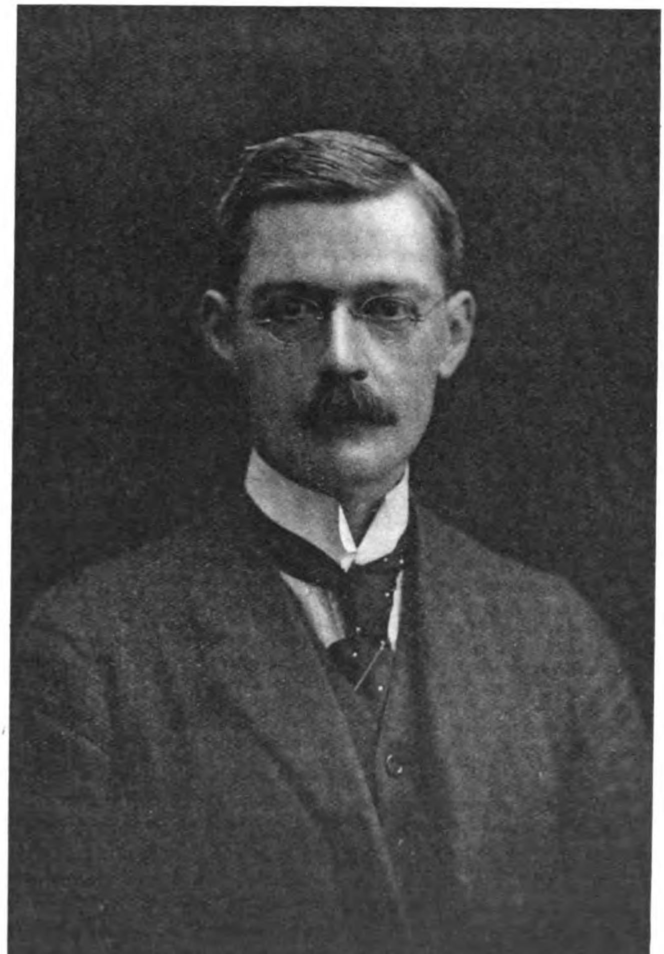
In the field of radio-telegraphy, one of the most fruitful for prophecy, incessant and ever-increasing activity reigns, providing a striking refutation of the idea previously so widely held, that " wireless " in war-time would be virtually useless, owing to deliberate and intentional interference on the part of the opposing nations. We were emphatically assured that each fleet would " jamb " the messages of the other, so that nothing of importance would get through. So far as we are allowed to judge, the reverse has actually occurred. Each side is trusting increasingly to its powers of wireless communication with its own fleet, and devoting less expenditure of energy to attempts for deliberately interfering with the enemy. Such interference has been attempted, but, as far as we can judge from available information, with little success.

On the field of battle in Flanders, in the plains and marshes of Galicia, on the Gallipoli Peninsula, on the sun-baked veldt, and in the steaming morasses of what was erst German South-West and East Africa respectively, wireless portable stations are carrying out useful work. We publish in this issue a note showing the important part played by " wireless " in General Botha's victorious progress, where vast areas combined with sparse population to render its aid invaluable.

Aeroplanes and airships daily use the medium of radio-telegraphy for transmitting the results of their reconnoitring work, and even submarines utilise the æther-wave telegraph when cruising on the surface. With regard to the latter, however, Britishers are more concerned with " wireless " as a potent weapon of defence against German submarine piracy. Wireless calls for aid form the only weapon available to most British merchantmen, and in an astonishing number of cases this resource has proved the salvation of the craft, its personnel, and its passengers. Instances are so constantly multiplying that it has become almost monotonous to chronicle them in the pages we devote monthly to "Wireless and the War."

One of the most striking achievements was undoubtedly the severing, within four hours of the declaration of war, of the whole of Germany's submarine cables. As far as wired communication is concerned, that country has remained ever since virtually isolated. The only direct telegraphic communication possible between Germany and such neutral countries as do not border her boundaries has been effected by means of wireless telegraphy through the high-power stations at various points in the Fatherland.

Our ancestors with their poetic idealism used to picture the air as peopled by invisible spirit-strife contemporaneous with the struggles on the surface of the earth. The Valkyria of our northern ancestors form only typical instances of a widespread belief. To-day we have turned this poetic fiction into a reality, and perhaps it is hardly too much to say that the strife in the æther ranks only second to the titanic struggles beneath it.



MR. WILLIAM LLEWELLYN PREECE,
M.I.C.E., M.I.E.E.

Personalities in the Wireless World

MR. WILLIAM LLEWELLYN PREECE, M.I.C.E., M.I.E.E.

THE paper read recently by Mr. Preece before the Institution of Electrical Engineers on "Telephone Engineering in the Tropics," has brought our headlight more conspicuously before the public, if that be possible. Mr. Preece is the eldest son of the late Sir William Preece, K.C.B., F.R.S., and first saw the light at Southampton, on March 4th, 1866. He early developed a leaning towards science in its widest aspect, and in order to foster this interest he was sent to King's College School. After a preliminary education at that well-known foundation his parents deemed it advisable to send him to Switzerland and Germany, where his general education was completed. From the technical standpoint, however, his mind had only then commenced to broaden, and in order that his desires might be given full play he spent the year 1885 at the Electrical College, in Hanover Square, London. His special bent, however, appears to have been telegraphy and telephony, and in 1886 he joined the staff of the Midland Railway Telegraph Department at Derby under Mr. W. E. Langdon, the superintendent. Here his progress was so rapid that he became Telegraph Inspector in 1887, Electrical Light Assistant Engineer in 1888, and was appointed to fill the post of Chief Assistant to the Superintendent in 1892. After having satisfactorily discharged the duties imposed upon him by the railway company he decided to widen the scope of his activities and seek "fresh fields and pastures new." With this object in view he placed his resignation in the hands of the railway company, and retired from their service in 1898.

Turning his attention to the channels of commerce he took up a partnership in his father's firm, Preece & Cardew, consulting electrical engineers, the other directors of which were his father (the late Sir William Preece), Major Cardew, and Mr. A. H. Preece. Here he was entrusted with all telegraph and telephone matters with which his firm was directly or indirectly concerned. This included telegraphs and telephones in all the Crown Colonies, South Africa, New Zealand, and, until the formation of the Commonwealth, the Australian Colonies.

Subsequently his name was brought before the Government of that day, and he acted as Consulting Engineer to the Colonial Office for the wireless telegraph stations erected at Aden, Somaliland, Fiji Islands, Ceylon, Accra, Gold Coast, Singapore, Penang, Hong Kong, Solomon Islands, Ocean Island, and, conjointly with Captain Brunot, represented the French Government in the New Hebrides. As a result of the British Government's decision to inspect the telegraphs and telephones in the East, he was in 1912 asked to undertake a tour in the Malay Peninsula and Ceylon and report on the systems of the various local Governments. In the same year sat the special Parliamentary Committee on the Contracts for the Imperial Wireless Scheme, and the valuable knowledge and clear insight into the technical problems connected with telegraphy and telephony, which Mr. Preece had perforce acquired, were requisitioned. In November of the same year he gave evidence before this special committee.

In 1914 Mr. Preece conceived the plan of entirely revising and partly re-writing the well-known text book on "Telegraphy," compiled by his late father and Sir J. Sivewright. The energy necessarily expended in the revision of a book is great. Mr. Preece, however, set himself the laborious task, not only in the interests of science, but also as a labour of love in order to bring up to date the work of his eminent father. That this was necessary has been frequently demonstrated since the issue of the revised edition.

Mr. Preece has been admitted to full membership of the Institutions of Civil and Electrical Engineers, and we trust that he will long be spared to continue his notable work in the advancement of science and the propagation of its study.

The Physical and Electrical State of the Atmosphere

By H. M. DOWSETT.

SO much is spoken and written nowadays on the mechanism of wave propagation through the atmosphere, while the physical and electrical state of the atmosphere itself is still very imperfectly understood, that it may be useful here to shortly describe and discuss what is known of this groundwork on which all sound theory must be based.

Commencing with the earth's surface, we must first note that it is always negatively charged. The charge appears to increase with the growth of vegetation and to decrease when the sap in the trees ceases to rise.

The skin of air in contact with the earth is also negatively charged, but on fine days this skin is very thin, no more than a foot or so above ground level.

Extending for some few miles above the earth's surface is the "troposphere," or region of winds, of vapour and dust clouds, Fig. 1.

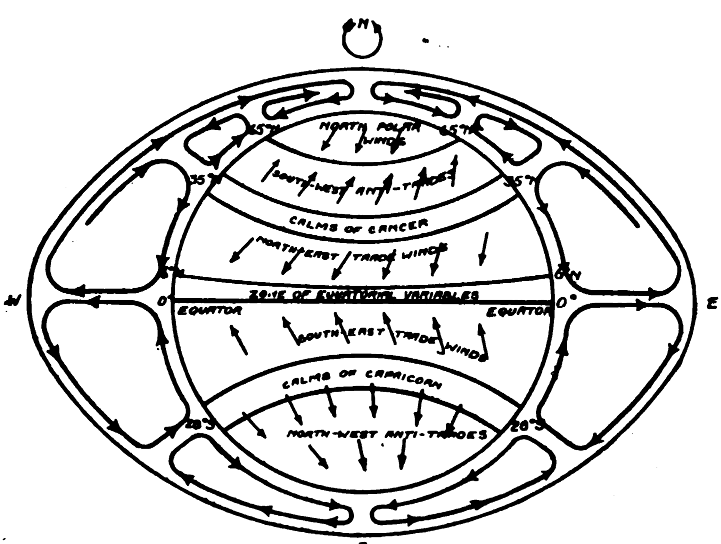


Fig. 1.—The Winds in the Troposphere.

The height to which the winds are felt is not constant. In the temperate zone and over the same position on the earth it may vary from 4½ to 7 miles. At the equator the winds travel higher than this, and at the poles they reach a much lower level.

The atmosphere from the earth upwards is normally positively charged, having a gradient of about 2½ volts per inch, but under favourable conditions this may increase to 25 volts per inch. But this condition is frequently disturbed by the dust-laden winds which circulate over the earth's surface and sweep up in them a considerable negative charge. In consequence a fog of such negatively charged air may sometimes exist in patches extending from the earth's surface upwards. Under favourable conditions and in the presence of water vapour these patches may show themselves as mist. This wind-carried negative charge may, however, part company entirely with the earth, and by establishing an abrupt potential gradient may give rise to thunder clouds and lightning displays. Finally, near the top of the troposphere, where there is a scarcity of water vapour, it may exist as a negatively charged invisible cloud of air.

This would appear to be the case at an elevation of 5 miles and over, as the cirrus which float at this height do not show any lightning discharge, although in polar regions, where the cirrus float lower, they have sometimes been observed to glow to such an extent as to be mistaken for aurora.

Above the cirrus the probability is that the air has still a positive charge although the potential gradient may be very small. Clouds become very infrequent and the temperature ceases to fall with increase of height, although there is sensible variation from day to night, and from day to day. There is no wind, and in consequence the chemical constituents which nearer the earth are kept in a well-mixed state now tend to sort themselves out in layers according to their densities.

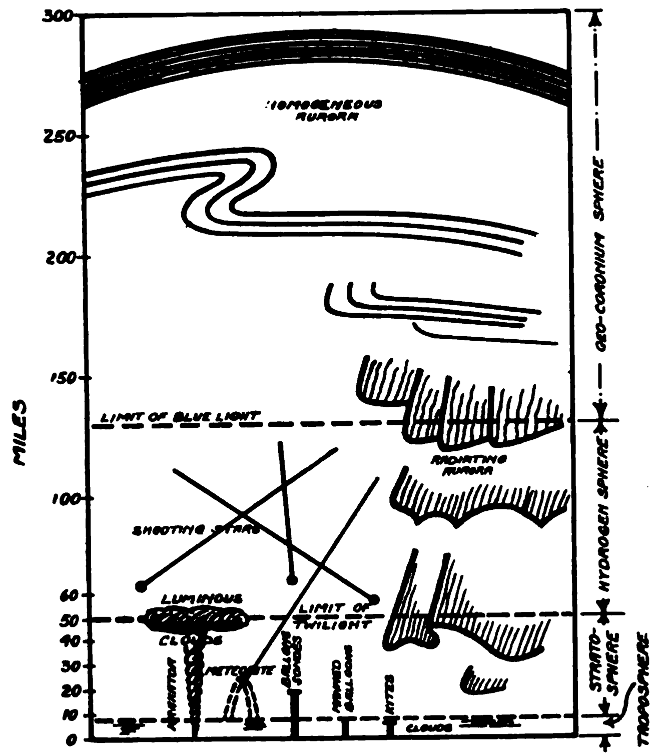


Fig. 2.—Cross Section of the Atmosphere (after Wegener).

The "troposphere" of the meteorologist is now succeeded by the "stratosphere," or the "lower atmosphere" of Dr. Eccles, by his "middle atmosphere." The upper limit of the "stratosphere" is placed at 45 to 50 miles above the earth (see Fig. 2) where the atmospheric strata are so tenuous that they cease to reflect light; but even as high as 54 miles up, "luminous night clouds" can sometimes be detected photographically, the composition of which can only be very vaguely surmised.

The "middle atmosphere" is the lower part of the stratosphere. It corresponds to Dr. Fleming's "diurnal layer," and is defined by Dr. Eccles as the region included between the 10 and 20 mile levels. Within these limits the air is supposed to become ionised by the sun rays in the daytime, and to return to its un-ionised condition at night. At the commencement of the ionised strata there must be a sudden change from the non-conducting to the badly conducting state, but there is no abrupt change from a non-conducting to a good conducting state.

According to Dr. Chree, "The intensity of "the earth's vertical field is known from "balloon experiments to diminish very "rapidly as we rise in the lower atmosphere. "At the 3-mile level it seems to be of the "order of a tenth of what it is at ground "level, and whether it has a finite value at "the 12-mile limit, is, at least, somewhat "doubtful." *

It may, therefore, be more accurate to assume that at some level, say at 12 miles up, the potential gradient dies away to nothing—the air at this level has no charge at all. But this uncharged region in the daytime ends at an elevation of at least about 15 miles, where it takes on the character of the "diurnal layer."

Dr. Eccles's "upper atmosphere" extends from 20 miles upwards. We may assume it to commence at the 25-mile level to correspond with the correction suggested above for the lower limit of the middle atmosphere. Here the air is supposed to be strongly charged and permanently ionised, the ions to be of molecular size and to have long free paths.

The charge in the atmosphere is now preponderatingly negative, and this increases up to the 37-mile level, where it probably reaches a maximum.

* "The Marconigraph," Nov. 1912, p. 314.

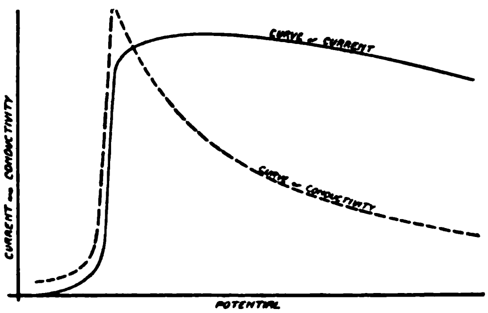


Fig. 3.—Curve showing change in Conductivity of Rarefied Gas with increase of Ionising Potential.

At this level the air pressure is reduced to about 1/760th of its value on the earth's surface when ionised air then has greatest conductivity. Un-ionised air at this pressure would still be an insulator.

Conductivity, however, depends very considerably on the strength of the ionising field, as we know from experiments with vacuum tubes (see Fig. 3). For weak values of field, the current which results is also weak consisting mainly of electrons, but as the field grows stronger and the gaseous ions themselves commence to carry the current, it begins to increase very quickly. Finally, when all the ions are in motion the current reaches an almost steady value, independent of any further increase in field. When it has reached this final state the whole gas glows; but the initial stages of conduction can exist without any glow. Evidently the belt at the 37-mile level is not highly conductive, as it does not glow, but it is no doubt the most conductive region in the whole atmosphere. Also there is no reason to suppose that there is any other than a gradual increase in conductivity from the badly conducting lower limit of the diurnal layer right up to the best conducting layer at the 37-mile level. At night time, however, when the diurnal layer has disappeared, the increase in conductivity should be less gradual.

The earth is a huge magnet with a complex field, having an axis which is neither straight nor rigid.

The greater part of this field is due to subterranean causes, possibly fluid currents. The free charges in the ionised layers come under the influence of the earth's field. The negative ions and electrons in the equatorial belt are deflected and moved by this field in the direction of the earth's rotation, and the positive ions against the direction of the earth's rotation.

This probably constitutes the principal motion of the ions in the good conducting layer, and the resulting currents, creating a magnetic field of their own, give rise to the diurnal variations in magnetic field strength noted on the earth. The effective thickness of this revolving shell—the part which matters—may be tentatively said to extend from 25 miles up to 60 miles, the lower part of it moving slowly as it consists mainly of molecular ions, the upper part, consisting mainly of electrons moving much quicker, the greatest current intensity however being in the middle thickness. As whatever potential gradient exists is normal to the earth's surface, and in the equatorial belt this must be normal to the magnetic field, the magnetic field tends to break up the continuity of the ionic and electron currents, which is one reason why the conductivity of this belt remains low.

If we consider the motion of these ions at other latitudes instead of at the equator, there is reason to think that they tend to

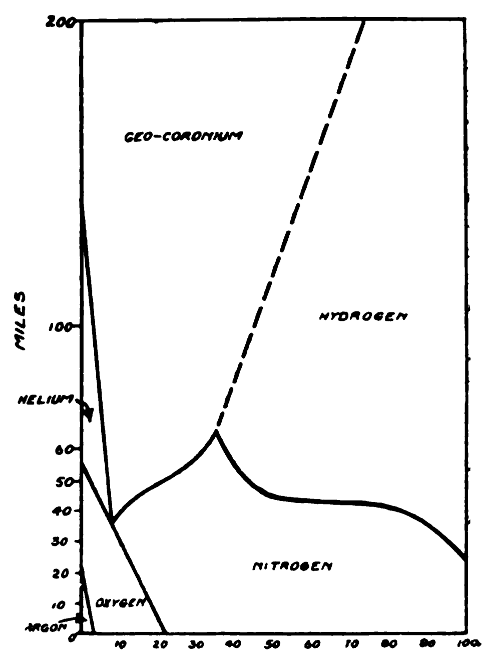


Fig. 4.—Percentage Composition of the Atmosphere at various heights (after Wegener).

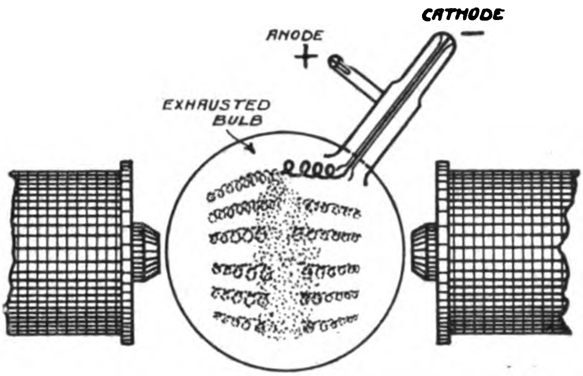


Fig. 5.—The Behaviour of Cathode Rays or Electrons when projected obliquely into a Magnetic Field.

have a spiral movement to and away from the poles. And near the poles where the lines of magnetic field coincide with the direction of the potential gradient, and the field therefore assists the discharge, the conductivity is so much increased that the belt glows, producing the well-known auroral drapery display.

But rarefied ionised air in the glowing state has been shown by Sir J. J. Thomson to act as a good screen for stopping electron discharge. This may explain why the aurora always ends some considerable distance above the earth,

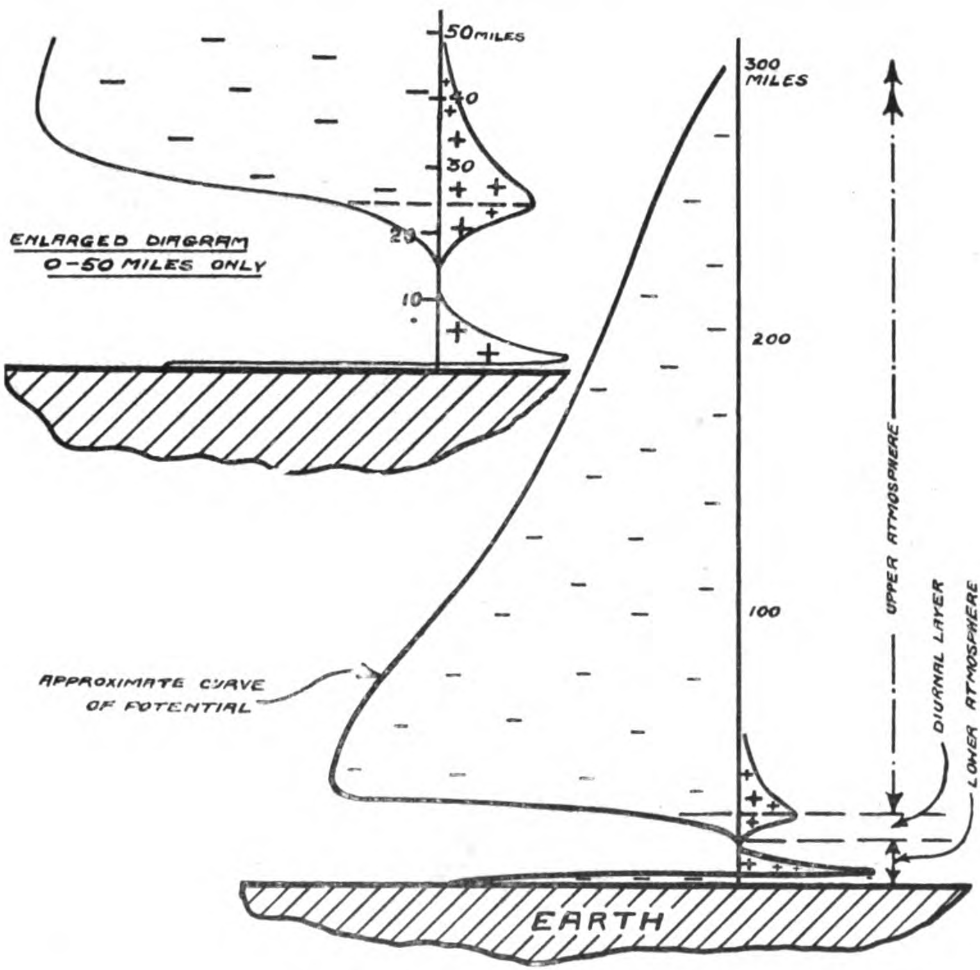


Fig. 6.—Rough representation of Electric Charge in Earth's Atmosphere at different elevations in Daylight.

and suggests a reason why the lower atmosphere does not become charged by electron diffusion from above.

From the 37-mile level upwards, the conductivity must fall off gradually, more gradually even than it increases to this level. Very useful information about the constitution of the upper atmosphere has been obtained from auroræ. The elevation of streamers and arches have been measured at different points by theodolite, and their light spectra have been analysed with the result that our knowledge of the gases composing the upper atmosphere has been much extended.

We know, for instance, as shown in Fig. 4, that hydrogen commences to make its appearance about 25 miles up, at 70 miles both nitrogen and oxygen cease to form part of the atmosphere, and at 100 miles above the earth where the auroral arch and crown are formed, and the atmospheric pressure has fallen to about 1/1,000,000,000th of what it is at sea level, the atmosphere consists mainly of hydrogen and an unknown gas—named by Dr. Wegener "Geo-coronium"—and a small percentage of helium.

Independent testimony that air still persists at this elevation is given by the appearance of meteors, which are set ablaze when travelling at a height even of 120 miles, although the air pressure at such a height cannot be more, and is probably less, than 1/250,000,000,000th of an atmosphere. Not only the resistance of the air, but its negative charge may have a good deal to do with the amount of light these meteors give out.

Artificial auroræ produced in the laboratory (see Fig. 5) confirm the view that the streamers are composed of electrons descending from the outer gaseous envelope of the earth sometimes from a height of 300 miles. They spiral down following the lines of magnetic force towards the poles, the spirals at the same time gradually closing up and decreasing in diameter as the field strength increases. The glow becomes brighter, due to this concentration and the improved conductivity which results—the combined effect of the magnetic and electric fields which are parallel at the poles also helping to increase the conductivity.

In the neighbourhood of the conducting layer the auroral streamers come to an end, as the electrons then return upon their paths and spiral up again.

No better proof of the negative charge of our atmosphere, or of its continuous character for at least some 270 miles, could be wished than that given by the existence and character of the northern and southern auroræ.

It must be of such an order as to exert a very considerable repulsive force on any negatively charged bodies the earth may meet on its journey through space. Fig. 6 is an attempt to show very approximately the distribution of charge at different elevations above the earth during the day-time. The effect of sunlight will be to add an equal amount of positive and negative ions to the atmosphere. In the diagram it is assumed that sunlight has little effect on the saturated outer envelope, some effect at the bottom on the permanently ionized layer and a marked effect in the region of the diurnal layer where its ionizing energy is completely used up. The maximum height of the atmosphere is shown as 300 miles, as at this elevation it must be so extremely tenuous that for all practical purposes it may be supposed to end.

Digest of Wireless Literature

ABSTRACTS OF IMPORTANT ORIGINAL ARTICLES DEALING WITH WIRELESS TELEGRAPHY AND COMMUNICATIONS READ BEFORE SCIENTIFIC SOCIETIES.

WIRELESS TIME SIGNALS.

In a lecture before the British Astronomical Association recently, on latter developments in the applications of electricity to precision clocks for observatories, Mr. F. Hope-Jones, Chairman of the Wireless Society of London, spoke feelingly of the loss of the wireless time signals in war time. Throughout the year 1913, and until that fateful Saturday in August last, when all privately-owned wireless installations were dismantled by order of the Postmaster-General, the rhythmic signals were observed every night at 11.30, and by means of the " acoustic vernier " the rate of an astronomical regulator running on test was determined in 100ths of a second. Since then the old laborious method of testing and rating has had to be reverted to, requiring months instead of days.

Referring to the fight for freedom to listen to the international wireless time-service signals without taxation and its successful issue shortly before the war, he expressed the hope that these privileges would be restored in their entirety on declaration of peace. When that happy day arrived it might be necessary for the scientific world to act in consort, and present this claim with unanimity and force.

* * *

PROCEEDINGS OF THE INSTITUTE OF RADIO ENGINEERS.

Number 2 of the third volume of this excellent publication, just to hand, contains a number of exceedingly interesting papers which have been delivered before that Society, together with the discussions which have followed. First, in order of place, we find a paper by Dr. L. W. Austin on " Seasonal Variation in the Strength of Radiotelegraphic Signals." This is an account of results obtained from a series of experiments made by the Bureau of Standards between the Philadelphia and Norfolk Navy Yards for the purpose of determining the variation of strength of signals at different times of the year. The conditions of the experiments were carefully arranged for constancy of wave-length, spark frequency and antenna current, and the method of measuring antenna current was that described in the Bureau of Standards Bulletin No. 7, page 295, 1910. From the results obtained certain conclusions can fairly be drawn. The seasonal variations seem to be different in different years, the minimum of 1912 being higher than that of 1913. The rise in the curves which were shown seems also to be steeper at some times than at others. It has not been possible definitely to connect the changes in foliage conditions with the strength of signals, although it is possible that these changes play an important part in the variations.

Mr. Henry E. Hallborg, who is well known to our readers by his recent contributions to THE WIRELESS WORLD, has next place in the " Proceedings " with a paper on " Resonance Phenomena in the Low Frequency Circuit of Radio-Transmitters." It is unnecessary to summarise the paper in question, as it was fully dealt with in the April and May issues of this magazine. In the discussion which followed the reading of the paper, Mr. Alfred S. Kuhn said that in some recent radio work with transformers the closed core type had been used by him, and it was found unnecessary to use external reactances in either the primary or secondary of the transformer. High efficiencies were therefore obtained. Results obtained by the use of such equipment, said Mr. Kuhn, warrant his objection to the author's statement that in the case of quenched gap sets " the choice naturally lies between a clear note with diminished efficiency and a ' medium ' note with high efficiency." In Mr. Kuhn's experience improving the note did not at all impair the efficiency, but rather augmented it.

Mr. Julian Barth next dealt with the mathematical side of the problem, and Mr. Alfred N. Goldsmith expressed the opinion that it is very desirable that the radio engineer should regard the complex audio or low frequency circuit (consisting of the alternator, choke coils, primary of the transformer, secondary of the transformer, and capacity load of the secondary) as an equivalent simple circuit. It is this equivalent circuit which is to be tuned to resonance, or rather, as Mr. Hallborg has explained, to a frequency somewhat different from that of the alternator. Mr. Goldsmith also asked what was, in Mr. Hallborg's experience, the effect of a resonance setting on sparking at the relay key contacts.

Mr. Hallborg, in dealing with the comments and criticisms, gave an interesting answer to this last question. He stated that he had found, in general, that there was less arcing when working above resonance, although it was difficult to draw general conclusions since the results are largely dependent on local conditions. He recalled an attempt to shunt a reactance across the relay key of the 100 kilowatt, 500 cycle, synchronous rotary gap set at Brant Rock, breaking about 400 amperes. It so happened that the reactance was accidentally of a value just sufficient to tune the generator-transformer circuit, and as a result a most violent arcing took place each time the contact was broken, accompanied by a noise almost as deafening as that of the spark itself. On replacing the reactance by a non-inductive water rheostat, excellent results were obtained. When the fixed and movable contacts had become burned into a good fit, satisfactory operation was obtained without a relay shunt of any kind.

Another paper of considerable interest to radio engineers bears the title "Design and Construction of Guy-Supported Towers for Radio Telegraphy." The author, Mr. Roy A. Weagant, states that the purpose of the paper is to develop methods of determining the stresses in the guy-supported type of radio-telegraph tower. The methods and their application are illustrated in a complete design of a 625-ft. structure of cylindrical form. The effects of the various strains upon the tower and guys are considered in detail, and due consideration is given to the design of foundations and anchorages. Proceeding on the assumption that a guyed tower inclined bodily by the pressure of the wind should have the points of guy attachment remain in a straight line, methods are given for calculating the following quantities: guy tensions (for windward, leeward, and perpendicular guys), horizontal and vertical forces acting on the top section of the tower, stresses in the middle section, stresses in the bottom section due to bending, design of flat-topped and umbrella aerials, changes in stresses due to temperature variation, and dimensions of foundations and anchorages.

In the discussion following the delivery of the paper, Messrs. Hallborg, Louis Cohen, George S. Davis, and Alfred N. Goldsmith spoke of their experiences and dealt with several points of great practical importance.

Aerial supports are also dealt with in a paper by Mr. Cyril F. Elwell, entitled "Wooden Lattice Masts." The paper in question is not intended to cover all the various types of masts used in past and present radio installations, but rather to give details of the design and erection of one type developed by the author from the original design advanced by Professor C. B. Wing, of Stanford University, and many examples of which have been erected.

The author of the paper advocates the use of wooden guyed structures on the grounds that they are inexpensive and suited to the doubtful permanency of some stations. Photographs of several high masts constructed on the plan above mentioned accompany the paper, amongst them appearing one of the radio tower at Ballybunion, Ireland—a wooden lattice structure 492 ft. in height. Mr. George S. Davis, in the subsequent discussion, expressed the opinion that although wooden lattice masts may have certain advantages in certain localities, experience had shown that they were at times very unsafe. He instanced a fatal accident which occurred last year to some workmen who were dismantling a wooden structure at Colon. The masts of which the one being dismantled was a unit had been subjected to the unusual climatic conditions of the Tropics, and possibly to the ravages of insects, and for these reasons the use of wooden structures in such countries appeared to be undesirable.

The final paper in the "Proceedings" is one by Mr. Haraden Pratt, on "Long Range Reception with Combined Crystal Detector and Audion Amplifier." It is stated by the author that if an audion bulb is used as an ordinary receiver, across the "stopping" condenser in series with a galena detector, an amplification of about ten times is attained. The audion bulb used, to be effective for this purpose, must have certain definite voltage-current characteristics. In the discussion which followed, Mr. Alfred N. Goldsmith said that those who have worked with the extremely sensitive receivers of the audion amplifier type will agree that the sensitiveness of the detector, at least for work in the summer months, cannot be profitably increased because atmospheric disturbances already produce sounds many times louder than the desired signals. Until we learn to overcome the problem of static, any further increase in detector sensitiveness is of no practical advantage.

* * *

NATIONAL PHYSICAL LABORATORY.

The following is extracted from the statement of the proposed work of the National Physical Laboratory for 1915–16.

Electricity.—The usual experiments will be carried out for the maintenance of the electrical standards.

In connection with the wave-meter and high-frequency work it is proposed to complete the series of current transformers so as to afford a good range of current measurement. It is hoped to finish the construction of the Poulsen arc lamp and to investigate methods of decrement measurements with continuous oscillations. Wattmeter methods may also be tried.

The constants of the standard wave-meter set at the laboratory were determined over a range of from 200 metres to 11,000 metres by the direct measurement of the frequency, using a photographic method. With a view to securing international agreement it is desirable to arrange for some inter-comparison of standard inductances and capacities, and probably to repeat some of the fundamental measurements on which the laboratory standard depends. Arrangements for this are under consideration.

It is proposed to continue the construction of a set of oil-cooled resistances for high-frequency work; also to construct several high resistances of very small but calculable self-inductance, consisting of long thin wires supported at a definite distance from one another and immersed in oil.

It is proposed to continue the research on the power factors of condensers of various dielectrics, both solid and liquid, at different temperatures and frequencies.

For very high and low ranges it is proposed to construct inductometers of more permanent form, similar to the models described in the report for 1913. Two marble cylinders have been obtained, on which it is hoped to wind standard single-layer inductance coils.

Electrotechnics.—Some investigations on micanite, which are at present in hand, will probably be concluded early in the year. The new dividing resistances capable of being used up to 40,000 volts, now in process of construction at the laboratory, have to be completed. These are of the woven-wire type, and their use on high voltages requires investigation, particularly in regard to their capacity currents to earth. The testing of such resistances for change of accuracy under different conditions of loading also requires investigation, which will, it is hoped, be undertaken.

If opportunity permits, an investigation will be made into the production of high-frequency currents for instrument testing by methods which may serve provisionally until a high-frequency generator set is available. Such a set is eminently desirable.

* * *

WIRELESS TELEGRAPHY AND SUBMARINES.

Considerable attention is at present focussed upon the activities of submarines, and the problems connected with their design and construction Wireless telegraph apparatus is extensively installed on under-water craft, an aerial mast being erected when the vessel emerges on the surface. On first consideration it would seem a simple matter to arrange for this to be done, but it should be remembered that time is occupied in putting up and taking down such structures, and time is an extremely important consideration with the submarine commander. Many extremely interesting points concerning submarines are brought out in a paper by Lieutenant C. N. Hinkamp, United States Navy, which recently appeared in the *Journal* of the American Society of Naval Engineers

It should be understood, says the writer, that there is nothing mysterious in the operation of a submarine. The orders used in the handling of the boat are few; they are made as comprehensive as possible and are so given as to eliminate any possible confusion. Preparing to submerge includes all preliminary work up to the closing of the conning-tower hatch. This comprises the stowing of the deck gear, taking down the bridge, unrigging the wireless telegraph gear, closing the hatches, unlocking the valve-operating mechanism, securing the engines; in fact, a clearing ship for action. The operation requires from two to twenty minutes, depending on the amount of rigging to be taken down.

The actual submerging of the boat can be done in two ways, one called the "static" dive, and the other the "running" dive. In the static dive, also known as "balancing," the boat is submerged but does not move except in the vertical plane. This dive may be accomplished in two ways: by trimming the boat and maintaining her trim by adjusting her ballast, or by dropping the anchor, trimming the boat to within a few hundred pounds positive buoyancy, and the heaving in or veering on the anchor cable. The latter way is the simpler method for easy control, and can be used where there is no current or only a small amount of current, if the sea is not too rough. Before submerging, the vessel is usually brought to a fore and aft trim, which will cause the boat to be level when submerged.

The running dive is made from the awash condition. In the awash condition the trimming tanks and auxiliary ballast tanks are flooded to the amount necessary for the proper trim when submerged; the main ballast tanks are empty. The running dive is used for all tactical purposes except balancing. The vessel being under way "awash," the order is given to submerge. All hands get into the boat, the engines are stopped, and the electric motors started. As soon as the engines are stopped the conning tower is closed, all ventilators housed, and the main ballast tank flooded Knowledge that the trim will be approximately correct when totally submerged renders careful adjustment of ballast unnecessary. The boat is inclined slightly, about one-half of a degree down by the head, and the inrush of the water controlled by manipulation of the valves. All this is done in the short period of from one to two minutes.

Submerging a submarine is distinctly a "one-man" job. The commanding officer must be thoroughly conversant with all the details of the actual submerging of the boat, and he must at all times be thoroughly informed as to existing conditions in the boat. None of the important features can be delegated to anyone else, as each condition or state of affairs has a distinct relation to every other condition.

Signalling while submerged is a subject of much interest. In the early days of submarine navigation signalling under water was done in a most crude manner, for which the hull of a vessel was found to be peculiarly adapted. Sending was accomplished by tapping on a rivet with a hammer, and receiving by holding the forehead to a frame of the boat. For several years inventors have investigated and experimented extensively, with the result that there are now in practical use in submarine signalling the submarine bell, the Fessenden oscillator, and the vibrating wire, by which it is possible to signal effectively at distances greater than five miles under favourable conditions. All these systems set up vibrations in the water, which are detected by microphones and heard through the ordinary telephone receiver. Inventors are now endeavouring to devise means for increasing the speed of transmission.

The primary object of a submarine is to fire torpedoes, and all other considerations must be subordinated to this as far as the tactical value of the vessel is concerned, but not to such an extent as to lose sight of the fact that the torpedoes cannot be fired at a target unless the vessel arrives on the scene of action. The efforts of the crew are aimed at one thing—sinking an enemy—and the placing of the boat in position to accomplish this end calls for the co-operation of all the departments in the boat.

Rubber Plantation on River Jurua.

Through South American Jungle-Land

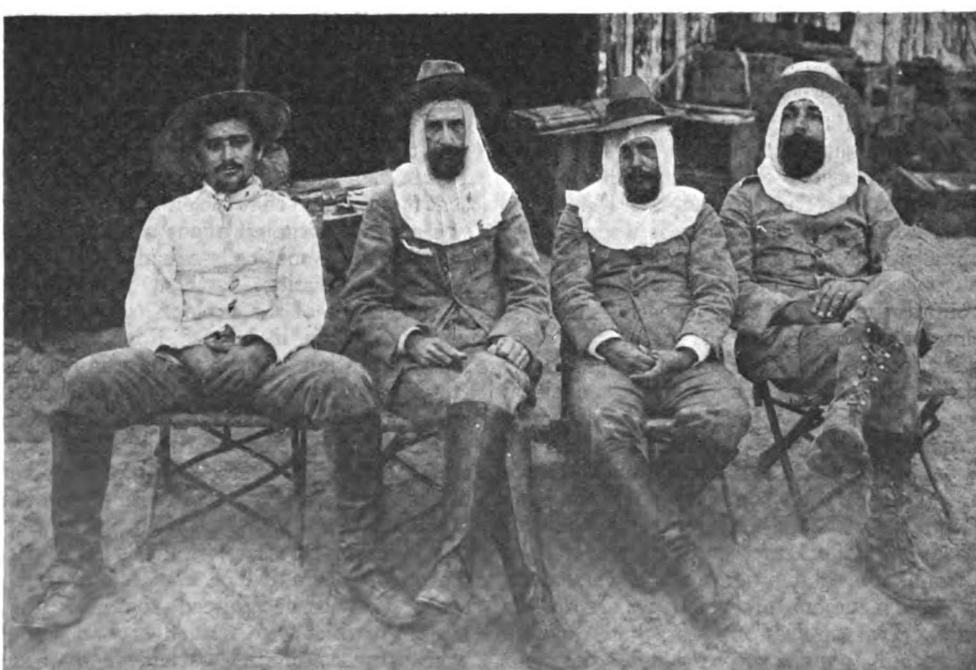
Radio-telegraphy and the Brazil-Peru Boundary Commission

THE recent tour of ex-President Roosevelt through the chaotic wilderness of the Brazilian jungle, and his controversial claim to have discovered a new and large river running through the heart of that vast country, open up in the minds of most people an era of thought as to what secrets the virgin forest still holds. So vast an acreage does this tract of country comprise that more than a casual consideration of its mysteries appears desirable. Manifold are the attractions of exploration when undertaken voluntarily, but a less pleasing tone is rung when orders are given for the peregrination to be started at a particular stated time. Such in effect was the decision imposed upon a small party of three explorers by the Government of the Republic of Brazil. Its duty was to define and locate the boundary between the Republics of Brazil and Peru. To this end about 25 labourers were engaged by the Commission, a photograph and particulars of the members of which we reproduce here. Two wireless operators were deputed to accompany the expedition, as frequent use was expected to be made of Radio-telegraphy in defining the boundary. To prove how valuable an asset wireless telegraphy can be, the experiments by the French Government to determine the geographical position of Timbuctoo may be cited. Similar trials have also been conducted between the Eiffel Tower Station and that located at Arlington, Va., U.S.A. Indeed, so successful were the discoveries that it was found that the city of Washington was actually situated about a mile from its previous mathematically-calculated position.

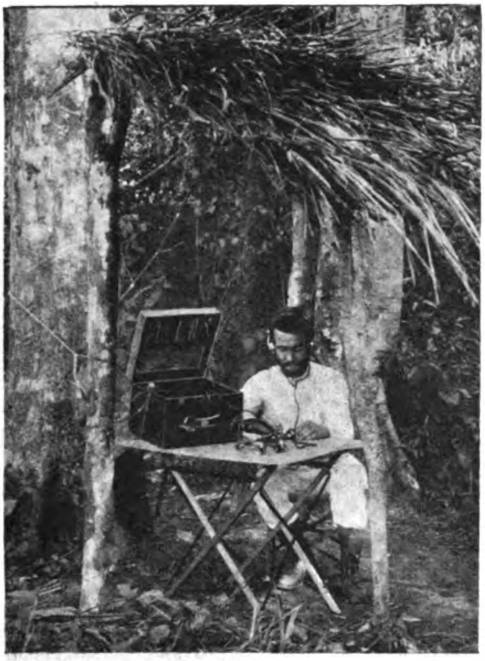
The Commission, fortified with all the paraphernalia of the explorer, set out on its journey. Very little was done until the Rubber Station at Santa Cruz was reached. Here the party established its headquarters and from this point conducted its investigations. A camp was formed, tents were erected, and in order that the members might be kept in touch with the outer world an aerial was "rigged up" between two tall palm trees, as seen in the illustration reproduced here, which was taken on the spot. It will be noticed that the palm trees to which the spreaders and aerials were attached offered a decided advantage to the height obtained from stems in the immediate neighbourhood. It will not be out of place here to make allusion to the fact that these palms are found throughout tropical Brazil and are put to considerable use as telegraph and telephone poles by the authorities there. The Commission was provided with special Marconi receivers, and by this means time signals were received from the wireless stations at Manaos and Porto Velho, situated respectively 900 and 450 miles away. Through the high-power station at Iquitos in Peru the Commission was kept *au courant* with the doings of the world in general. Every night this station sent out a Press bulletin which was received by the temporary installation accompanying the explorers.

The fact that the members of the party had embarked on no light task may be gathered from the careworn expressions on their faces. Not only had they to contend with the ordinary hardships which necessarily accompany travel through an unknown land, but they were subject to special difficulties. In the low-lying basins of the tributaries of that mightiest of rivers, the Amazon, the germs of malarial disease did their deadly work, and several of the labourers were temporarily placed *hors de combat*. But that was not all; their nights were rendered fearsome by the stealthy depredations of the wild beasts seeking their prey, and by the continual croaks of the reptiles, whilst the screeches of the night birds raised a din which was well-nigh unbearable. By dint of perseverance, however, progress was made, and each successive day added its quota to the work accomplished and saw the registration of further effort on the part of those who had "something attempted, something done."

The earliest attempts at providing wireless telegraph communication in the tropics brought the engineers face to face with a number of minor, but nevertheless important, problems. Not the least troublesome of these were the ravages of insects, which bored into the wooden portions of the apparatus, thus disintegrating its substance and causing the wood to crumble to dust. Ebonite parts also suffered from the effects of the constant variations in temperature which are so prevalent in tropical regions. This is caused by the great contrast between the unbearable heat of the day and the keen chilly mists of the



The Brazilian Commission



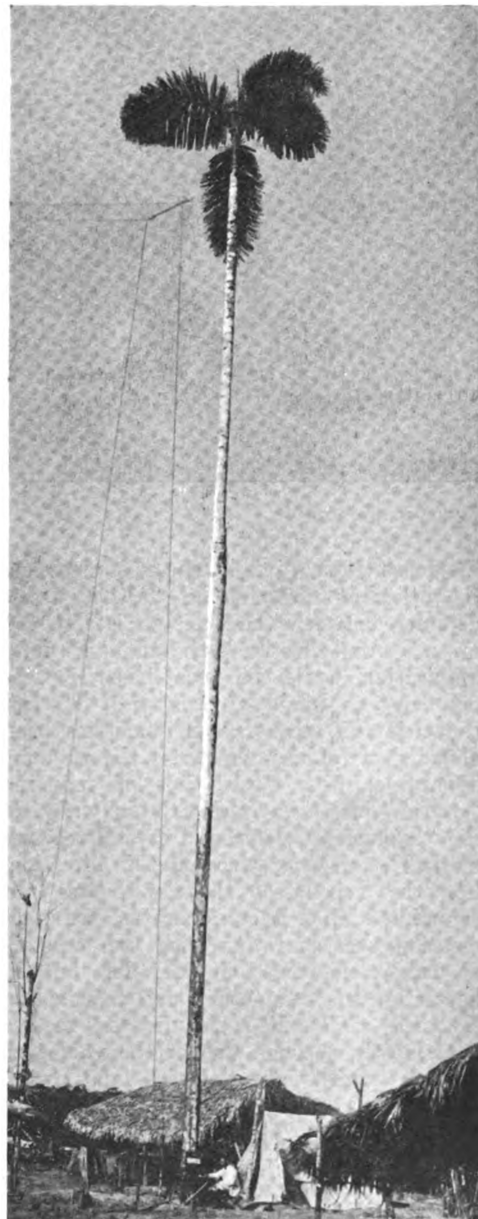
Operator receiving Time Signals from Manaos.

hours of darkness. From the human point of view it is these sudden changes which form the root evil of physical troubles experienced in the tropics.

The severest of all the troubles, however, was the difficulty of maintaining insulation, as the surface of the apparatus was perpetually covered with a film of moisture from the heavily-charged air drifting from the swampy regions of the jungle.

Apart from minor difficulties, some of which we have cited above, the major problem of how to work during the periods of intense electrical disturbance in the atmosphere always existed. Only those operators who have had occasion to work in equatorial and tropical regions can possibly realise the exasperating "static" interference through which wireless signals in these parts have to be sent and received practically throughout the whole year, but with a maximum intensity during the hottest seasons. The atmospheric noises almost drown every other wireless signal, and at times deafen the operator by their din and persistence. As a consequence the power used for transmission has to be many times greater than would be needed for effective communication did these disturbances not exist.

As an instance we may quote the case of the two wireless stations erected by the Marconi Company for the Madeira-Marmore Railway. They are situated in the heart of



Aerial for Reception of Time Signals.

Camp in the Jungle.

the dense tropical jungle, one at Manaos and the other at Porto Velho. Although the distance between these places is but 400 miles, before effective day and night communication could be established it was necessary to instal apparatus of 70 kw. capacity. In recent years much has been done by way of improvement in the receiving apparatus, with the object of reducing "static" interference, and the invention of the "balanced" valve and crystal receiver marked a great advance in this direction. For the benefit of those who are not acquainted with this apparatus, we may mention that it works with two crystals or valves connected in parallel, but in opposition to one another, and adjusted so that the signals it is required to receive pass mostly through one of the valves or crystals whilst atmospherics and other interferences pass more or less equally through both, and thus counteract their own effect.

Amidst all the difficulties and troubles which we have related, the Commission succeeded in attaining its object. We can well imagine the pleasure with which the news bulletins were received, and how they served to disperse the feeling of isolation which otherwise would have weighed heavily on the spirits of the whole party. But although the news bulletins were most welcome, it must not be forgotten that without the time signal from Manaos and Porto Velho the Commission could not have carried out its work with the accuracy and certainty which, from the beginning, was its sole aim.

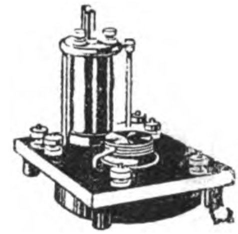
THE PROGRESS OF RADIO-TELEGRAPHY.

The remarkable progress achieved by wireless telegraphy is exemplified by the following table of statistics compiled by the Berne International Telegraph Bureau. They represent the number of ship and shore stations of the world from the year 1908 to the year 1914 inclusive.

1908 ..	508	1911 ..	1,740
1909 ..	755	1912 ..	2,280
1910 ..	1,217	1913 ..	3,998

1914 .. 5,277.

The ENGINEERS Note Book



[Under this heading we propose to publish each month communications from our readers dealing with general engineering matters of various kinds in their application to wireless telegraphy, and we would welcome criticisms, remarks and questions relating to the matter published under this heading. We do not hold ourselves responsible for the opinions and statements of our contributors.]

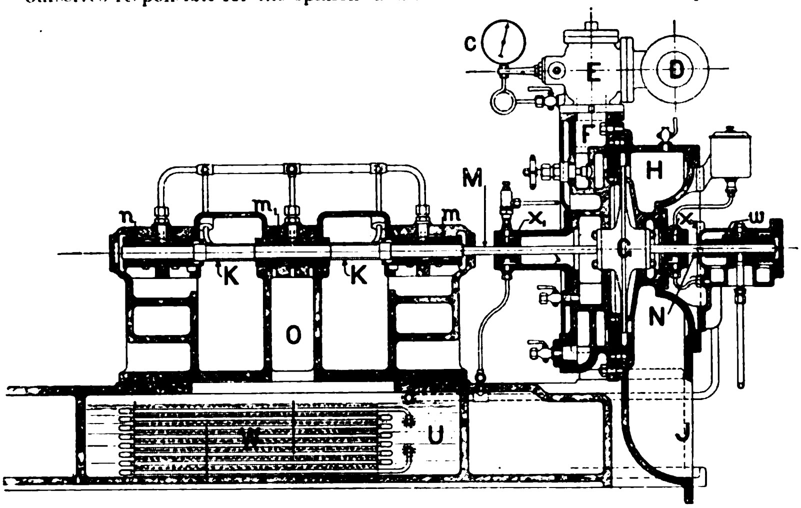


Fig. 1.

The De Laval Steam Turbine.

THE growing use of steam turbines for driving engineering plant of all kinds will perhaps warrant our devoting some space this month to a consideration of the De Laval Turbine, a machine which presents a number of interesting features. Our readers will remember that when the Poldhu station was reconstructed a year or two ago two De Laval turbines were installed, one of 110 h.p., coupled to an alternator, and the other of 15 h.p., driving a D.C. dynamo. At the Chelmsford works of Marconi's Wireless Telegraph Company there are also two 225-h.p. (150 kw.) De Laval turbine dynamos and two 15 b.h.p. (10 kw.) sets, the latter being used for pilot lighting, testing, etc.

The De Laval turbine differs from others in having only one wheel and only one row of moving blades. The nozzles are so shaped that the steam is fully expanded in them, to the pressure of the condenser. During this expansion the available Heat Energy of the steam is converted into Kinetic Energy, with the result that the blades are struck by steam of high velocity which drives the wheel round

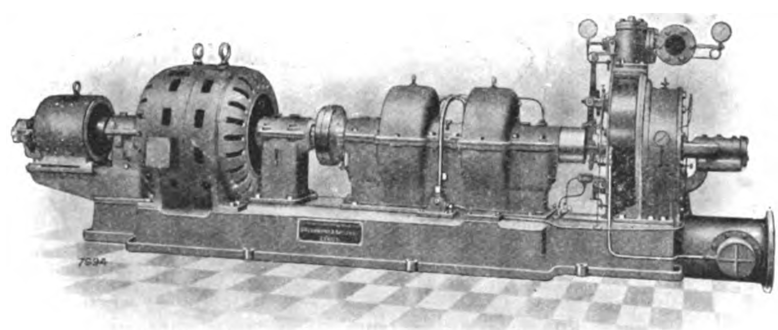


Fig. 2.

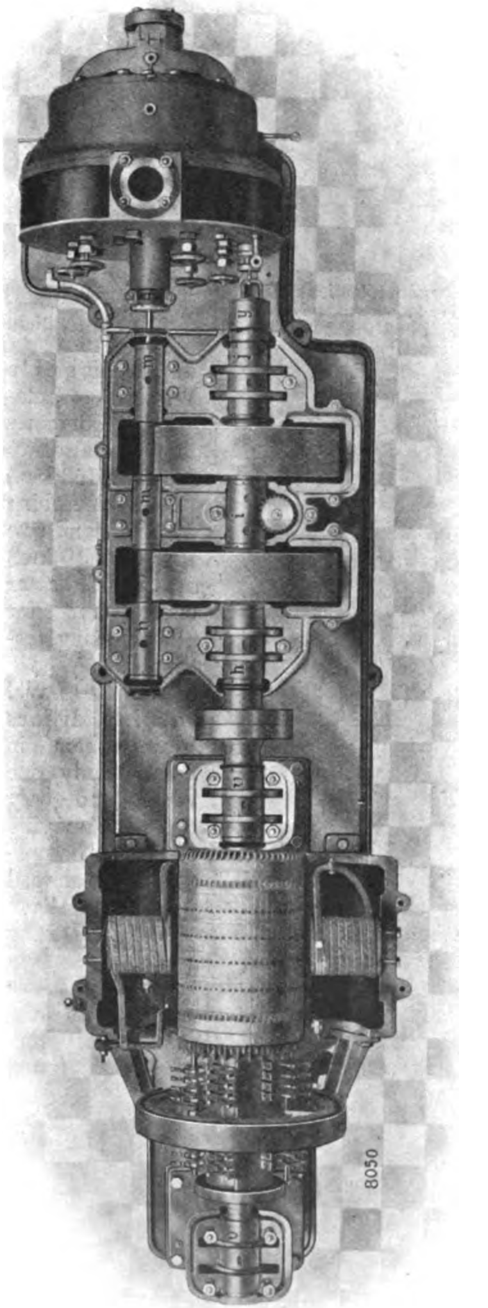


Fig. 3.

by its momentum. It will thus be seen that the De Laval is a pure *impulse* turbine.

It is a well-known fact that to obtain efficiency with a steam turbine high speed of rotation is necessary. In many cases this high speed is a disadvantage, particularly on board ship, where it is difficult to design propellers to work at a high speed of rotation. The obvious solution of the difficulty is to gear down, but it was a long time before a satisfactory reducing gear was evolved. The difficulty was finally overcome, and now geared turbines are in common use.

In the turbine with which we are dealing a double helical gear reduces the speed to 1/10th or 1/12th of that of the blade wheel. (See Fig. 3.) The loss in the gearing is very slight.

Fig. 1 shows a large De Laval turbine in section. The steam when admitted by the stop valve passes through the strainer D, and is regulated by the governor valve E before it enters the steam chest F. In the older designs the steam passed through a few large nozzles, but in the latest type there is a ring in which a number of small nozzles are bored. The introduction of a larger number of small nozzles enables the blades of the turbine to be made much shorter, with the attendant advantages that the buckets are lightened and the stress in them due to centrifugal force reduced, and the windage of the wheel (an important point) is lessened.

The tightening bushes on all turbines of 55 h.p. and above are steam sealed, thus preventing oil getting into the exhaust steam and therefore into the boilers. This is an extremely important arrangement in a plant having surface condensers and water-tube boilers.

The De Laval turbine is largely used for driving dynamos and alternators, and in such cases the turbine and dynamo are mounted on a common bedplate—which acts as an oil reservoir—and are connected together by a flexible coupling.

Turbine alternators are standardised in sizes from 75 h.p. to 600 h.p. inclusive, but smaller machines can be made if required. Figure 2 shows a standard turbine alternator of the 300 kw. size.

We are indebted to Messrs. Greenwood and Batley, Ltd., of Leeds, the makers ot the turbines above mentioned, for permission to reproduce the illustrations accompanying this article, and for many of the particulars which have been given.

Administrative Notes.

Italy.

THE Italian Government has issued a memorandum giving notice that on Italian or Italian-Colonial lines all telegrams and radio-telegrams, except those written exclusively in plain language (*i.e.*, Italian, French or English), have been suspended. Registered addresses and signatures and telegrams without text are not allowed. It is to be understood that all telegrams or radio-telegrams are subject to censorship, and are only accepted at sender's risk. The Italian Government further states that all Italian or Italian-Colonial radio-telegraphic coast stations are closed to private service.

* * *

Panama.

Vessels intending to traverse the Panama Canal or finding themselves in its vicinity must conform to some new rules issued by the Hydrographic Office of the United States Navy. They read thus :—

1. "As soon as communication can be established with the Canal, vessels should report their name, nationality, length, draft, tonnage, whether or not they desire to pass through the Canal, require coal, provisions, supplies, repairs, to go alongside a wharf, the use of tugs, probable time of arrival, length of stay in port, or any other matters of importance or interest. If this information has been previously communicated through agents or otherwise to the captain of the port it will not be necessary to report by radio, but the probable time of arrival should always be sent."

2. "No radio tolls, either coast stations or forwarding, will be imposed against ships on radiograms transmitted by ships on Canal business. There will be no charge made against the Panama Canal by Canal Zone land lines or radio stations for the transmission of radiograms to ships on Canal business."

The Office advises that no charges will be exacted by the naval service on messages sent by masters of vessels to any Government official in the Canal Zone. If such messages contain information as set forth in paragraph 1 they will be treated as Canal business. The Hydrographic Office, however, makes one request in order to facilitate accounting. It is that such messages be prefixed "CB," indicating that they are sent on Canal business.

* * *

In order to avoid confusion in sending wireless telegrams a general order has been issued by the authorities of the Panama Canal prohibiting the dispatch of long-distance messages by vessels whilst they are within the jurisdiction of the Canal.

* * *

United States.

It has long been realised that means of communication should exist between the little supply craft which regularly visit isolated lighthouses and lightships and the shore. Wireless telegraphy naturally suggests itself, and now we have to record that wireless apparatus is being manufactured for, and will shortly be installed on, the tenders *Columine*, *Cypress*, *Orchid*, *Sequoia* and *Manganita*, with a range varying from 100 to 300 miles. The apparatus is being made under the supervision of the Bureau of Standards of the United States.

* * *

It is announced that the naval authorities of the United States have decided to establish a wireless station at Cape Cod, specially equipped to guide vessels along the Atlantic coast in time of fog.

* * *

We are advised by the International Bureau at Berne as follows :—

Argentina.

Private radio-telegrams from, for, or in transit through the Argentine Republic coming from or addressed to Europe, Africa, Asia and Oceania are only accepted at sender's risk and are subject to censorship. Code telegrams are not permitted, and telegrams affecting the neutrality of Argentina will not be forwarded. Any language may be employed, having due regard to the restrictions imposed by the country to which telegrams are addressed.

* * *

Australia.

The Commonwealth Administration will no longer accept on their telegraph lines, or those of their dependencies, telegrams either arriving, leaving, or in transit, except telegrams and radio-telegrams of foreign Governments written in plain language (English or French). They are subject to censorship, and should bear the signature of the sender at the end of the text. They will only be accepted at sender's risk and abbreviated addresses are not permitted.

* * *

British Honduras.

Radio-telegrams sent from or to the station at New Orleans during the interruption of the ordinary cable must be written in plain language with the complete address and signature and must bear the direction "*via* New Orleans." They are subject to censorship and are only accepted at sender's risk.

* * *

France.

The French Government only accepts in France, Algeria, French Colonies and Protectorates radio-telegrams written in plain language (French or English) and bearing the signature of the sender. They are only accepted at sender's risk, and no responsibility will be accepted by the French Government concerning them.

* * *

South Africa.

Radio-telegrams from or for the Union of South Africa, or in transit through that country, must be written in English, French, or Dutch, and bear the name of the sender. Radio-telegrams in plain language are only accepted at sender's risk. Abbreviated addresses are not permitted.

* * *

Spain.

Radio-telegrams in code, emanating from private persons, from ships of the Navy or Mercantile Marine, or from Consuls of any nationality are no longer accepted. Radio-telegrams, in plain language, must be written in German, English, French, Italian or Spanish.

* * *

Sweden.

The use of code for private radio-telegrams is forbidden. Private radio-telegrams addressed to Sweden or emanating from that country must be written in plain language (Swedish, German, English, Danish, French, Norwegian, or Russian). Meteorological telegrams are not subject to this restriction.

* * *

United States.

We are advised that the Marconi station at Friday Harbour, Washington, U.S.A., was dismantled on May 27th, 1915.

"THE LOST WORD."

(*With apologies.*)

WORKING one night at the wireless,
In the Mediterranean Sea,
I was tapping a message crossly
From the operating key.
I forget to whom I was speaking,
But know he'd been trying to "Jamb,"
And I sent out a word in anger
Like the sound of a great, big D——.

It flashed through the troubled ether
With the speed of a ray of light;
'Twas as if some evil spirit
Were bent on a mischievous flight.
It blotted out all other signals,
And smashed detectors galore;
'Tis doubtful if ever receivers
Had been so shaken before.

It fused all tuning condensers
Into one solid piece,
And it made all aerials vibrate
As if they would never cease.
I have sought, but I seek it vainly
That long-lost angry cuss,
Which leapt across the electrodes
And caused such a fearful fuss.

It may be that some other station
Will send out that word once more,
It may be that from Head Office
I shall hear of that swear I swore!

ALEC. BAGOT.

Correspondence

The Wireless Transmission of Photographs.

IN connection with the series of articles which have appeared in our pages on the above subject we have received from Mr. O. A. Zappulli of Lausanne the following letter, which is reproduced in full together with the accompanying diagram. The points raised are of considerable importance, and our readers will note with interest Mr. Martin's reply, which is also given below. We are always pleased to receive correspondence of this nature and to facilitate discussions on points of technical interest:

To the Editor of THE WIRELESS WORLD.

"I have read with great attention the "interesting article on 'Wireless Trans- "mission of Photographs' in THE WIRELESS "WORLD. On the use of selenium cells "suggested by Mr. Marcus J. Martin, in "his last article (June issue of THE WIRELESS "WORLD), I would like to make a few "remarks. A few years ago, experimenting "in connection with recording wireless tele- "grams, I conceived a similar arrangement, "using an Einthoven galvanometer working "with a selenium cell in series with a relay "which closed the circuit of an ordinary "Morse-inker, which in my experiments held "the place of the 'Electrolytic receiver.'

"Matters worked well, but . . . terribly "slowly, because, as I afterwards found out, "selenium varies its resistance very irregu- "larly. As is shown in the curve, whilst the "resistance rapidly decreases, it increases "but very slowly after the light action has "ceased. The result of my experiment was "as follows:

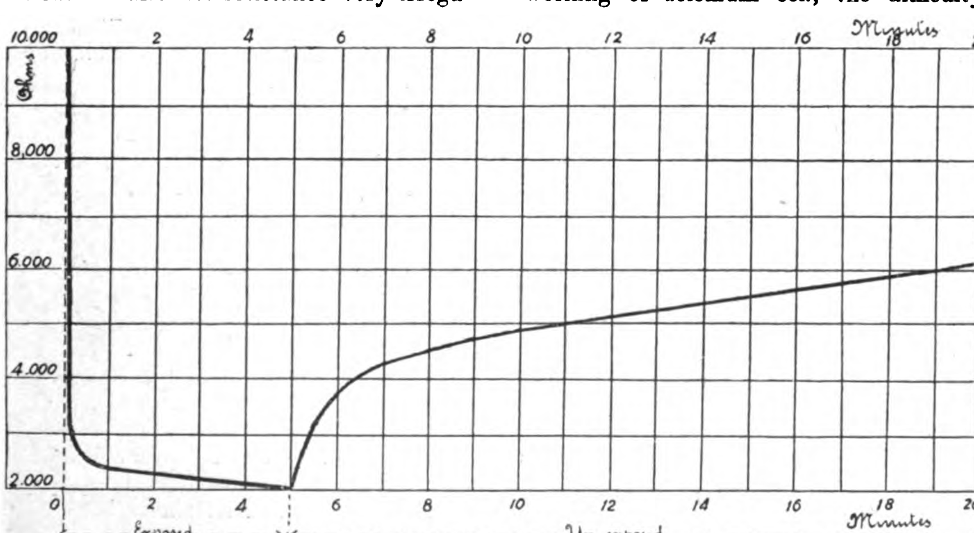
"When light fell on the cell resistance "decreased relatively rapidly and sufficient "current passed through the selenium to "open the relay, but when the cell was "left in darkness the resistance required so "long a time for returning to the initial "value that current passed through the "cell and opened the relay even when the "light action had ceased, with the result "that a short galvanometer deflection, "such as originated by a transmitted dot, "was recorded on the inker as an immense "dash. Consequently all possibility of "practically applying this recording system "was excluded. Therefore I think it "would be useful to many readers if Mr. "Marcus J. Martin would state what "quality of selenium he uses in his system, "in order to obtain a sufficient working "speed. The annexed curve has been "obtained experimenting by diffused day- "light.

"(Sgd.) O. ARNOLDO ZAPPULLI."

MR. MARCUS J. MARTIN'S REPLY.

To the Editor of THE WIRELESS WORLD.

"In reply to Mr. Zappulli's letter, *re* the "working of selenium cell, the difficulty



"which he experiences is a very common one. "Selenium cells vary very considerably as "regards their quality as well as their electri- "cal resistance. Thus it is possible to obtain "cells of any resistance between 10 and "250,000 ohms, or even more, and also a "cell may remain in good working condi- "tion for several months, while another may "become useless in as many weeks. The "ability of a cell to respond to very rapid "changes in the illumination is deter- "mined largely upon its inertia, it being "taken as a general rule that the higher the "resistance the greater the sensitiveness. "The sensitiveness of a cell is the ratio "between its resistance in the dark and its "resistance when illuminated. The majority "of the cells have a ratio between 2 : 1 and "3 : 1, but Professor Korn has shown "mathematically that by conforming to "certain conditions regarding the construc- "tion the ratio of sensitiveness can be "between 4 : 1 and 5 : 1. Take, for "instance, a cell of R = 125,000 ohms. "When exposed to a definite amount of "illumination the resistance will be re- "duced, say one-fifth, almost instantly, but "upon the illumination being discon- "tinued the inertia interferes, and the "resistance, instead of returning to its full "value at once, only partially rises, and "some time elapses, perhaps several "seconds, before the cell returns to its "normal condition. By continuing the "illumination the resistance of the cell may "be still further decreased, but the result "would probably cause the cell to become "'fatigued,' in which case its sensitiveness "gradually becomes less and the rate be- "tween its resistance when dark and its "resistance when illuminated may be de- "creased by as much as 30 per cent. Ex- "cessive illumination will produce similar "results.

"This is plainly shown by the curve re- "produced with Mr. Zappulli's letter. It "will be noticed that the resistance drops "almost at once from 10,000 ohms to "6,600 ohms, but takes nearly five minutes "to drop from 6,000 to 2,000 ohms. The "cell from which the above curve was taken "has been evidently over-illuminated, judg- "ing from the excessive time taken for the "resistance to return to only half its "original value.

"Many attempts have been made to "overcome the effects of inertia, the most "successful being the method adopted by "Professor Korn, by keeping the cell "always sufficiently illuminated to over- "come it so that any additional light acts very "rapidly. Another method worked out and "patented by Professor Korn and known as "the 'compensating cell' method gives a "practically dead beat action, the cell "returning to its normal condition as soon "as the illumination ceases. The arrange- "ment is somewhat complicated and requires "careful adjustment to get the best results. "By enclosing the selenium cells in ex- "hausted glass tubes it is claimed that their "inertia can be greatly reduced and their "life considerably prolonged.

"The writer is preparing an article on "selenium cells which he hopes to publish "shortly, in which the Korn compensating "method will be described. Yours, etc.,

"(Sgd.) MARCUS J. MARTIN."

With reference to the discussion at the Institute of Electrical Engineers on the "Application of Electrical Engineering to Warfare," an abstract of which we published on p. 10 of our April issue, we have received the following letter from "T. O'R." of Bombay, India:

To the Editor of THE WIRELESS WORLD.

"With reference to an article in the "April issue of THE WIRELESS WORLD, "Mr. P. R. Coursey states:

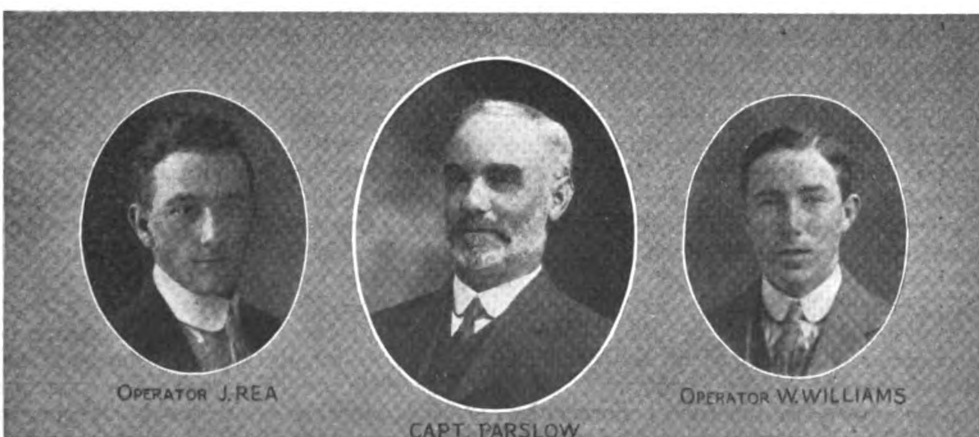
"'The Boer War furnishes us with the "'first example of the use of the electric "'telegraph for military purposes, although "'it had not then the reliability that is "'now regarded as essential.' I should "be pleased if you would inform him "through your valued organ that a body "of military telegraphists, numbering about "1,000, have been operating in all frontier "wars and expeditions in India since the "Indian Mutiny of '57–8. We now man "about 250 vessels sailing to all parts of "the world where British interests are "concerned; moreover, we are represented "in France, Belgium, and China by men "who are working Wheatstone, Baudot, "Field Telegraphy, and Wireless; in short, "practically all the latest known and up-to- "date systems of wireless telegraphy, "wire telegraphy, and telephony."

Wireless Telegraphy in the War

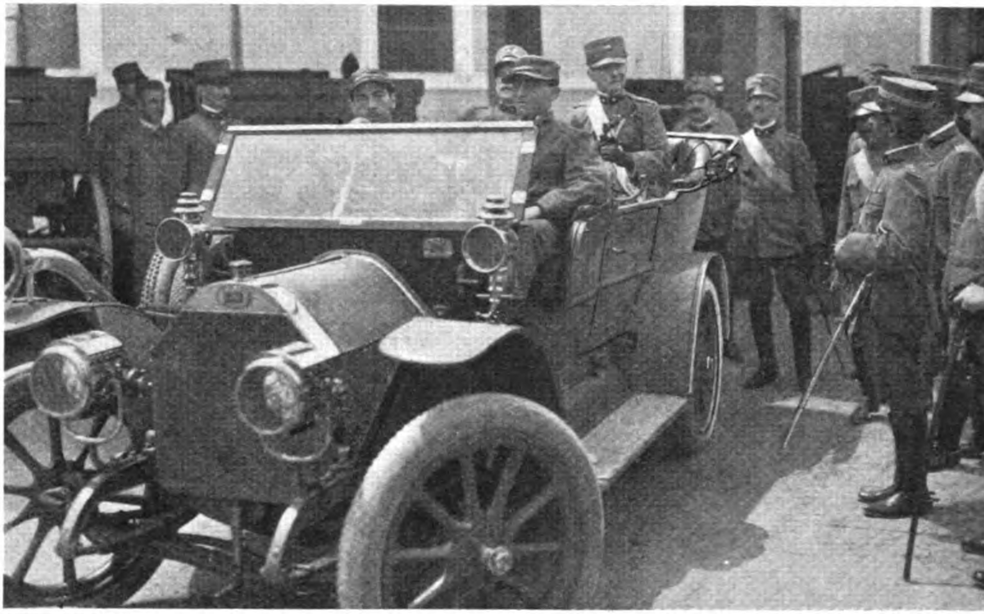
A résumé of the work which is being accomplished both on land and sea.

IT is curious to contemplate how completely the modern engines of warfare have upset preconceived notions. It was always assumed in previous naval warfare that the most vital spot for the attack on a steamer was her engine room. That part of the ship was accordingly protected by heavier belts of armour. But from the date of the advent of submarines there is a feature which, from the standpoint of the attacking under-water craft, is more vitally dangerous even than the machinery which may drive the attacked vessel on top of it. This is the wireless apparatus, which —if allowed to work undisturbed—is certain sooner or later to summon aid, and foil his attempt, if it does not bring about his destruction.

We have this point very eloquently exemplified in the story of the London steamer *Anglo-California*, whose record of heroic endurance under fire has justly gone home to the minds of all who can appreciate true courage. On a Sunday morning at 8 o'clock, when folk ashore were attending or preparing to attend their places of worship, a German submarine pirate, steaming awash, in vain summoned the gallant Captain Parslow to heave to. On his refusal she started circling round the vessel, endeavouring to get into a position suitable for launching a torpedo. All the time the wireless operator was radiating his calls for help. This was the only weapon which the peaceful British trader possessed. The captain was obliged to stand, without the slightest hope of "hitting back," the hail of shot and shell which his "brave" enemy poured in upon him and his shipmates. For four long hours this continued, the captain manœuvring in such a way as to ward off the deadly blow of his enemy's fatal weapon. But the ship was seriously damaged, the unfortunate captain blown off the bridge with terrible wounds, eight members of the crew killed, and seven others seriously injured. Still the wireless operator sent out his call for help. After his father's death, second mate Parslow took up the task; and finally assistance arrived, the pirate foe was forced to relinquish his prey, and the *Anglo-California* steamed into Queenstown Harbour. It forms a stirring



The Captain and Wireless Operators of the "Anglo-California."



Senator Marconi on Active War-service.

narrative of British pluck and tenacity under adverse circumstances; but why had nobody on board a rifle to send at least one of the German bullies to his last account?

* * *

One of our contemporaries recently published an amusing paragraph in connection with a telegram from Rome announcing the appointment of Senator Marconi to a Lieutenancy in the Engineers. Our contemporary appears to regard the matter rather from the characteristically English standpoint of Gilbertianism. Those, however, who know the spirit animating the great Italian inventor will recognise that he has been true to himself in subordinating all personal considerations to those of how best he can serve his country. After all, the mere insignia of rank matter very little, it is the service itself which counts. Our picture shows Senator Marconi as the Chief of the Wireless Department. He is leaving headquarters on a tour of inspection.

* * *

A Liverpool journal, in an interesting article entitled "War in the Woods," describes an adventure of a journalist with the army in the Argonne. "One "of the most useful functions performed by "the Air Service is that of sending wireless "messages from a height of thousands of "feet in the air." In this manner the narrator starts one of his most interesting paragraphs before proceeding to describe how he witnessed the starting of one of these wonderful new machines at work.

We extract his concluding paragraph:

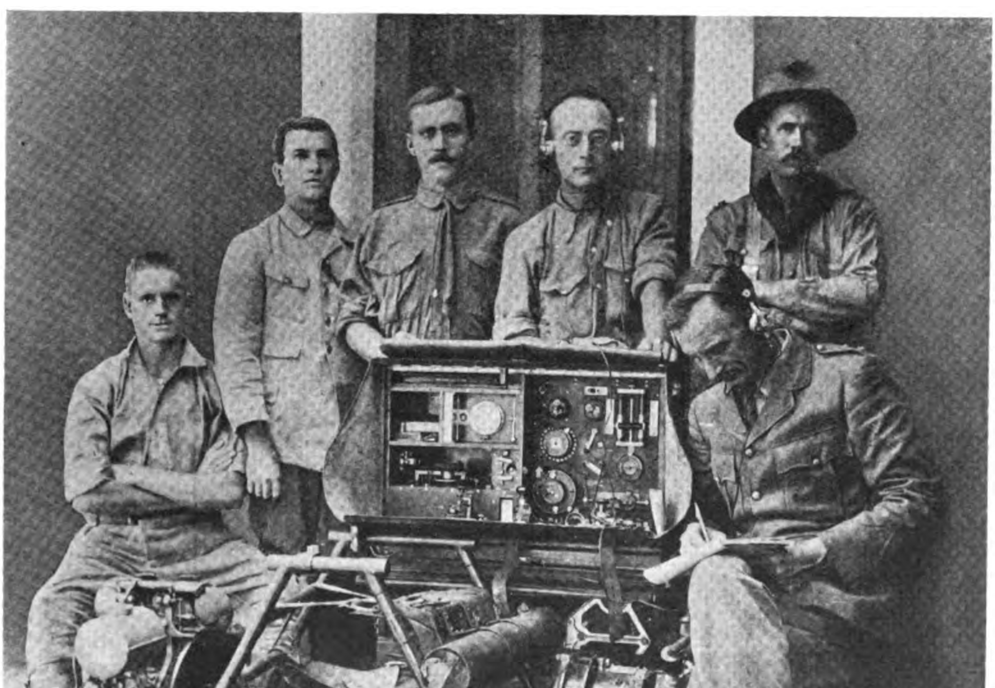
"We saw this machine rise and become "a speck in the air, and then we were "taken to the wireless station in the woods. "It was simply a little wooden hut, so small "that we had to stand outside while the "General talked to the operator. The "latter explained the nature of his work. "When the machine went up to direct "artillery fire he was warned by telephone "to be on the look-out for messages. 'Do "'you get any of the communiqués?' "asked the General. 'Yes; we always "'look out for the French communiqué "'from the Eiffel Tower, and occasionally "'we intercept German fairy tales from "'the Norddeich and Nauen stations, but "'up till now we have never managed to "'pick up a Turkish communiqué.' 'Can "'you tell where the message comes from?' "'Yes, we can distinguish them as a rule "'by their varying power. For example, "'this morning early we intercepted a "'message from Madrid.' It was curiou-

"to think that this little hut in the woods "was able to gather the world's news "before it was known to the cities."

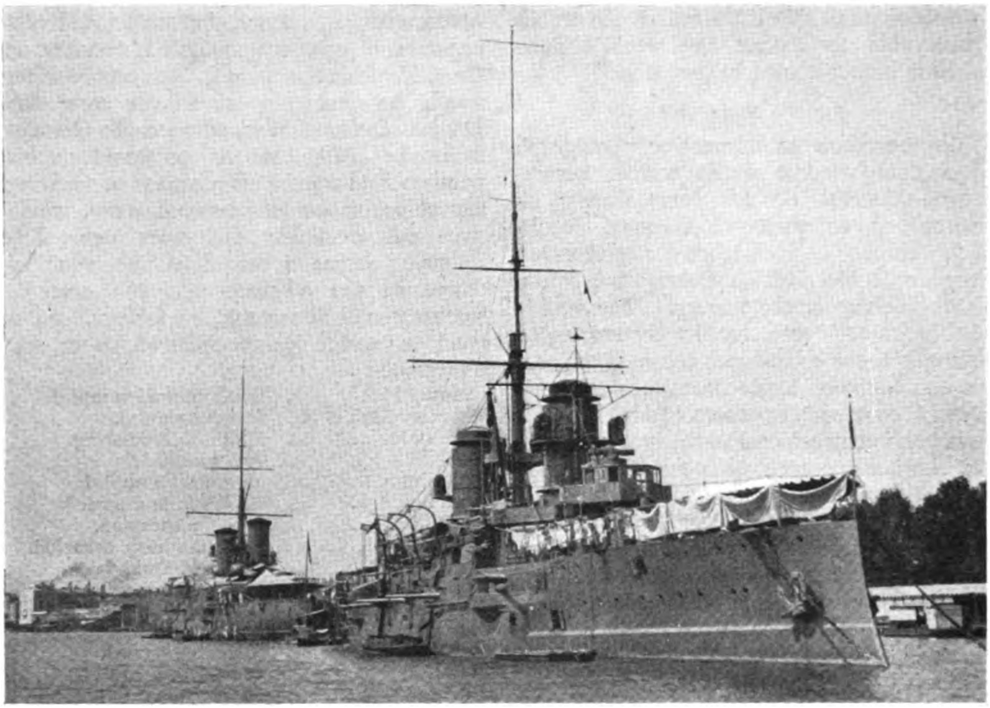
* * *

We reproduce an interesting photograph of a field wireless outfit which accompanied General Botha's force during its triumphant conquest of German South-West Africa. In this respect the General-Premier of the British Colony was quite as up-to-date as the enemy. The utility of "wireless" was amply demonstrated throughout the campaign; the field apparatus enabling the Anglo-Boer forces to keep in touch over wide expanses of country. We have previously referred to the importance of the British success which resulted in the occupation of Windhoek, with its valuable German high-power station. So sensible was the enemy of the value of this station, that all particulars thereof had been kept as a State secret. General Botha's strategy was worked out as mathematically as von Moltke's campaign of 1870. The British Commander had on the one hand the disadvantage of difficulties of transport, absence of roads, scarcity of water, and vast expanse of sparsely-populated country as the field of his operations. But, on the other hand, he had the advantage over the Danish Master of War, who led the German forces in 1870, that he possessed in his wireless field apparatus a means of securing the co-ordination of scattered units, which was not available 45 years ago. The following forms a record of the principal stages in the advance into the enemy's territory and illustrates, if followed on a good map, the points referred to in our paragraph:

January 14th	...	Swakopmund occupied.
February 22nd	...	Garub occupied.
March 20th ...	...	Battle of Pforteberg.
April 1st ...	...	Aus occupied.
April 3rd ...	...	Warmbad occupied.
April 5th ...	...	Kolkfontein occupied.
April 18th ...	...	Seeheim occupied.
April 20th ...	...	Keetmanshoop occupied.
April 26th ...	...	Battle of Trekkopjes.
April 28th ...	...	Battle of Gibeon.
May 1st ...	...	Kubas occupied.
May 2nd ...	...	Otjimbingwe occupied.
May 5th ...	...	Karibib occupied.
May 12th ...	...	Windhoek occupied.
July 2nd ...	...	Otavi captured.
July 8th ...	...	Tsumeb occupied.



Field Wireless of the South African Army.



Italian Warships at Venice.

An amusing incident in the course of what we may call the siege of the German cruiser *Königsberg*, which was shut up in the Rufigi river at the end of October last, and was finally destroyed on July 4th, illustrates not only the scouting value of aeroplanes fitted with "wireless," which located the ship and directed the fire of the British monitors *Severn* and *Mersey*, but also wireless possibilities in the way of establishing communication between the commanders of rival enemy forces. The incident we have in view was merely an interchange of jests, but there is no reason *in principle* why it should not be repeated in earnest on some future occasion.

* * *

The story comes through a Lancashire naval officer just returned home from the British operations on the German East African coast. It appears that the *Königsberg* was attacked several times, in the course of her "internment," by bomb-dropping seaplanes. During these hostilities the captain of a British warship, waiting at the mouth of the river, sent sarcastic greetings to the German commander through the medium of "wireless," saying "I hope "to see you soon." The latter replied "thanks for invitation, but if you wish "to see me you will always find me at home."

* * *

Italy is justly proud of her distinguished son Senator Marconi, and now that she is at war on the side of righteousness and peace her battle fleet—whose vessels have formed the field for many of the Italian inventor's recent experiments—is engaged in the stern struggle. Our illustration shows some of the Italian battleships lying at anchor off Venice. Under the supreme command of the Duke of the Abruzzi, King Victor's men-of-war are sure to be skilfully handled, and as far as wireless telegraphy is concerned, no fleet could possibly enter into conflict under better auspices than does that of our gallant Italian allies.

* * *

The iniquitous attempts on Sir Cecil Spring-Rice and Mr. J. P. Morgan constitute only instances of the ruffianly spirit widely prevalent amongst a certain section of German Americans. The warning letter sent to Mr. Daniels, Secretary for the United States' navy, reveals the possibility of further attempts at even more wholesale murder. Mr. Daniels was, *thanks to "wireless,"* able to communicate those warnings to the vessels concerned, probably an eventuality overlooked by the criminal, whose boasting words were intended to advise the New York authorities—too late. The utility of this capacity of radio-telegraphy for keeping vessels at sea in touch with land has been once again eloquently exemplified.

* * *

The old proverb that "the pen is mightier than the sword" still embodies a truism, although in terms which are slightly out of date. To express the same fact in modern phraseology we should have to put our apothegm in some such phrase as this: "The printing-press is mightier than the bomb-mortar." A shipload full of printing-press bombs consigned to Herr Dernburg has recently been prevented from reaching the hands of that expert juggler through the instrumentality of wireless. The commander of the Italian liner *Dante Alighieri* on his arrival in New York with this incendiary cargo excused himself from delivering it on the plea of a promise given to the British authorities at Gibraltar. After passing that port he was recalled and allowed to proceed without the delay involved in dragging the "stuff" up from the bottom of his hold on the strength of "the word of an Italian."

* * *

The various members of the Marconi staff who are serving King and Country in divers capacities all over the world occasionally favour us with letters describing their personal adventures. The following extract comes from a letter written by Private L. Juniper, of the 1st Essex Regiment. This gallant young man has been serving with the Forces ever since the beginning of the present struggle:

"I expect you have seen by the papers the "reception the Turks gave us at our landing on "the Dardanelles. It was a terrible task, as we "had to force a footing on the beach. We were "taken from the transport boats at 7 a.m. on "April 25th, and put into small rowing boats, "manned by sailors, about a mile from the shore. "We had to proceed most of the way under fire, "but about 50 yards from the beach we received "a regular fusillade from their forts; many "of our fellows being shot out of the boats "and drowned. Off shore they had laid mines "and barbed wire entanglements 25 yards away "from the beach level. We were losing such a "lot of men that we finally got orders to fix "bayonets, and on the word of command to charge "each man jumped out of the boats and found "himself well over his waist in the water. This "was a terrible time, and we lost a great many "killed over it, because the wounded were drowned "as they fell. When, however, we got a fair "landing, the Turks did not stay long, as they "would not face our steel. I don't want to boast, "but I must say that every man who got through "that landing is something of a hero, and I think "that if our people had had the position the "Turks had, it would not have been possible for "men of any nation to land there."

A Russian Giant Aeroplane.

THE FAR-FAMED BERSAGLIERI.

Mr. Marconi's gallant compatriots, whose proficiency in mountain warfare is being so brilliantly exemplified at the expense of their traditional foes.

* * *

In our *Notes of the Month* we refer to the report of the Royal Commission on Aeronautics as to the supreme importance of wireless telegraphy for aerial machines. Our illustration, depicting one of the giant Shumski aeroplanes, will perhaps bring this home more forcibly than any words of ours can possibly express it. It is only wireless telegraphy which has rendered it profitable to build, equip, and utilise these vast war birds of Russia, whose example is being followed in this respect by our own country.

* * *

Some of our contemporaries, on the arrival of the *Dunvegan Castle* at Plymouth, under the heading of "Recruiting on a Liner," published some gushing remarks concerning what happened "when it was announced "on board that General Botha had accepted "the surrender of the enemy in German "South-West Africa." The journalistic reporter responsible for this "copy" evidently forgot the existence of wireless ocean newspapers. The passengers on the *Dunvegan Castle* received *by wireless* full information about the great success of General Botha before reaching Madeira, five days previous to their arrival at Plymouth.

* * *

It is usually the unexpected that happens! One of our daily contemporaries recently published an answer to a correspondent under the title of "Wireless Telegraphy." It appears evident from the answer that the letter replied to was from a domestic servant, who, weary of washing pots and pans, aspired to transmitting electric waves through the ether. The journalist in charge of the correspondence column appears to have poured cold water upon the soaring aspiration. But why? Was it not the kitchen that gave us Cinderella? For aught we know there may be an embryo Marconi in petticoats attending to the humdrum duties of daily life, only awaiting the wand-touch of the fairy Opportunity to rise to the occasion and widen her sphere of usefulness.

* * *

The sinking of the Leyland liner *Armenian* (8,825 tons, with a length of 512·5 ft. and speed 14 knots) does not present any special feature, for the heroic tenacity of the wireless operators under the most adverse circumstances has become traditional. It was displayed on this occasion almost as "a matter of course." The ship's "Marconi House" was carried away by shell fire, but not before she had got into communication with the West African Mail Steamer *Tarquah*, which arrived at Plymouth on the 1st July, without having herself been attacked by the enemy's vessel. The first message appears to have been picked up on the 30th June at 4 p.m., and the final message at 6 p.m. Just after the latter had been received all communication suddenly ceased, and it was evidently at that hour that the Marconi gear was destroyed by the enemy's shells. The captain made a gallant effort to escape, but the speed of his vessel was not sufficient to entail success.

* * *

One of the recent victims of German submarine piracy was the Norwegian mail steamer *Venus*, which was on her way from Bergen to Newcastle when she was held up. The captain of the Norwegian vessel went on board the submarine with the ship's papers, which showed that this vessel was freighted with a small-sized cargo consisting of 416 casks of butter and 69 boxes of salmon. The German commander declared this, as food for the enemy, to be contraband of war, and sent two of his subordinates to see the cargo jettisoned and examine four British passengers who were on board. The German submarine during the two hours that she was alongside *hoisted her two masts and wireless gear*, by way of protection, because the *Venus* was also fitted with wireless and might have been sending out undetected messages asking for help. A number of Dutch fishermen were in the neighbourhood, and the captain is of the opinion that a good deal of the floating cargo would find its way on board their smacks. It is a curious coincidence that the *Venus* has met with submarines four times recently; on two occasions she was stopped and on two occasions she managed to get clear away.

* * *

Mr. J. B. Maxwell recently contributed an excellent article on the Royal Naval Division to one of our Western contemporaries. The account constitutes, perhaps, as eloquent a testimony to the value of hard physical training as it is possible to imagine. Mr. Maxwell gives instance after instance of not only the methods adopted but of results obtained. Naturally signalling forms an important branch of the special training, and those applicants already provided with a fairly good education take eagerly to this branch. All forms of signalling seem to appeal to the recruits and the instructors' verdict is "they gain efficiency in a wonderfully short time." Wireless is the most popular of all, according to Mr. Maxwell, who remarks, "Of the quick-"ness of the men to read the *buzzers* so "baffling to the uninitiated I had an object "lesson. Nearly two dozen recruits sat "down to the desks ranged around the walls. "Only that day had they entered the class "and this was the beginning of the second "lesson. The wireless began to buzz out a "medley of a dozen letters. Only two mis-"takes had been made by the man whose "paper I picked out at haphazard."

* * *

On June 24th an important meeting was held by the Manchester Education Committee to deal with the subject of technical students and the war. The Chairman of the Committee, Sir Thomas Shann, gave some details of the way in which the School of Technology was assisting the local Munitions Committee. His remarks were supplemented by particulars of the various branches of work already undertaken, in an able address delivered by Mr. Maxwell Garnett, Principal of the Municipal School. The record as set forth by Mr. Garnett constitutes one of which Manchester has good reason to be proud. No fewer than 967 of the men attached to the school have either enlisted or received commissions; 13 have already been killed. Prof. Miles Walker, Head of the Electrical Engineering Department, had designed all the motors which are being put into submarines at the present time. In the radio-telegraphic sphere Prof. Field had done valuable work in connection with the wireless installation of aeroplanes. Other valuable technical assistance has been rendered to the Government by Prof. Knecht, Prof. Fox, and Mr. Gamble. Manchester has always been famous for her zeal for the organised instruction in practical science, and her technical teachers and pupils have "risen to the occasion" in the present crisis in a manner worthy of their city's proud traditions.

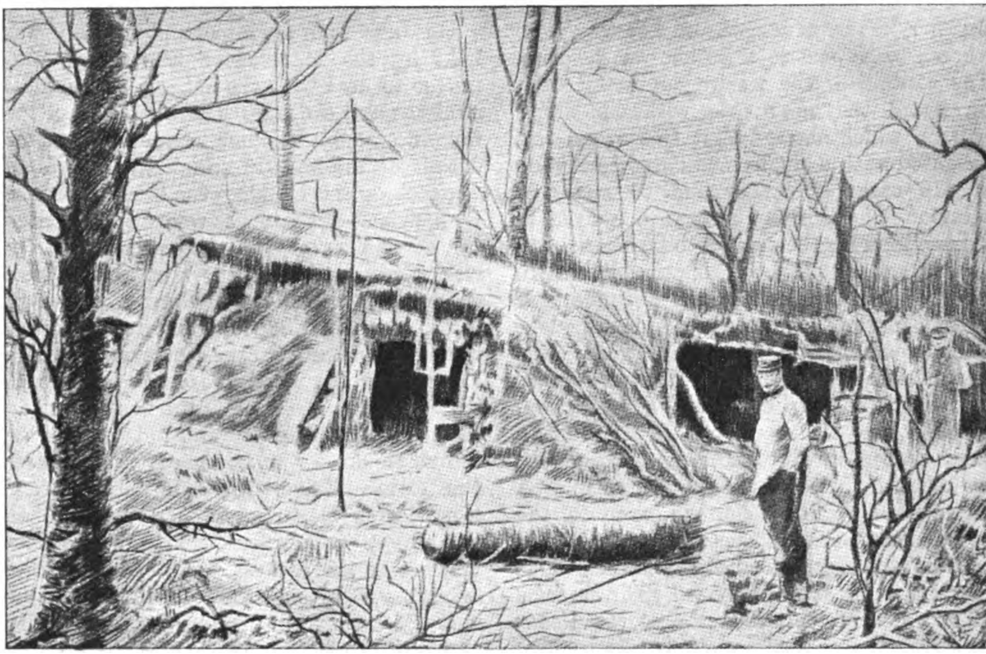
* * *

It is with very great pleasure that we record a correction of the final paragraph under this heading included in our July issue.

The information available at the time of writing impelled us to say that a Roman Catholic priest, at Caporetto, had been caught by the Italians communicating with the enemy by means of a wireless apparatus concealed under the High Altar of his church.

It is gratifying in the highest degree to find that the "traitor priest" was no priest at all, but an Austrian officer disguised in priestly garb.

Every Catholic has a right to be proud of the way in which the priests of Belgium have discharged their pastoral duties in the true spirit and in accordance with the holy tradition of their church. Such action as was recorded in connection with the Catholic priest involves a desecration and a crime that it is impossible to imagine any Catholic priest perpetrating.



The " Wireless Station " which controlled the attack.

An artist correspondent (Monsieur F. Gueldry, one of the eight artists specially commissioned by General Niox to work for the *Musée de l'Armée*), contributes to the *Graphic* of July 10th a couple of sketches of the French operations at Les Eparges. Next in importance to a general panorama of the countryside, the artist chooses for his illustration what he denominates as " the wireless station which controlled the attack." It was at this point that one of the greatest successes achieved for many months by our gallant Allies took place. As a result of five days' continual hand-to-hand engagements, the French succeeded in mastering the position, which had been converted by the enemy into a powerful fortress. The enemy's entrenched position dominated the plain of the Woevre at this point, and in their attempt to hold it at all costs the Germans lost the equivalent of an army corps.

* * *

The distances in Africa are enormous in comparison with the population (especially, of course, the white population). The result is that news of happenings in the British-African campaigns come through at such long intervals that public interest is not aroused in them anything like the extent to which the country and the operations deserve. The same characteristics of preparedness on the German side, and utter lack thereof on the British, which have recently become so notorious in the Mother Country, are prevalent also in these Colonial possessions. British resourcefulness is inevitably destined to triumph in the long run everywhere, and at certain points in the African Colonial possessions the British command of the sea has accelerated this process. The recent operations in East Africa and the Uganda have resulted in the destruction of the German base in this part of the " dark "continent," the Port of Bukoba, on the western shore of Lake Victoria Nyanza. The town had been fully equipped for defence; it possessed a fort and a *fine wireless installation*, besides military stores of all kinds. The British expedition took the form of joint operations by water and land, and started on June 20th last. At the end of the month they returned after attaining a complete success and destroying the fort and wireless installations, besides a number of boats belonging to the enemy, and capturing his guns, rifles and stores.

NOTES OF THE MONTH

THE association of wireless telegraphy in the lay mind has up till now been almost exclusively with the sea. It is in this connection that it has shone more conspicuously than in any other. But the utility of wireless is not confined thereto. Its application to the services of an army in time of war has been ably demonstrated by its use by all the belligerent Powers in the great European conflict now raging. To many, however, the idea of timing races by wireless will seem far-fetched, but such has actually taken place. The Mississippi Valley Power Boat Association, at Hannibal, in the United States, employed wireless for timing their races at the annual regatta, held on July 5th, 6th and 7th. This system of timing was tried at Buffalo last season, and it was found that a difference of over one second to a mile existed between the wireless and the old system of sight timing. Wireless is absolutely instantaneous, and racing men will benefit by every fractional part of a second of speed made.

* * *

The necessity for the exercise of extra vigilance during this time of national emergency was exemplified recently when a charge was preferred against an English Justice of the Peace. This was made under the Defence of the Realm Act, and the complaint was that the accused, a civil and mining engineer, "did unlawfully, without "the permission of the competent naval or "military authority in that behalf, make a "sketch or plan, or representation of a naval "or military work, and being in the vicinity "of such work did unlawfully have in his "possession apparatus or material suitable for "use in making such representation, such "representation being of such a nature as is "calculated to be, or might be directly or in-"directly useful to the enemy." The "naval "or military work" mentioned were the towers of the Marconi high-power station at Towyn. For the defence, accused contended that there was no line or bit of colour in his picture which could possibly indicate any Government work. There was no sign of a Marconi installation or of a railway line, for the all-sufficient reason, from an artist's point of view, that these objects mar the beauty of a picture. After evidence had been given the bench decided to dismiss the charge with a caution, and ordered the picture to be interned until after the war. A warning was conveyed to the public that neither sketching nor painting is allowed in this or similar areas.

* * *

Over two years ago a traveller on a steamer off the coast of Japan sent a wireless message to a friend in Peking. This man was "not "at home," but had been called to the interior of China on a tour of inspection. The telegram followed him, and was finally delivered in December last, after having taken twenty-two months. This is a victory for wireless. Had the telegram been sent over land-wires it would probably never have been delivered in the "Celestial" Republic.

* * *

That excellent little magazine *St. Martin's le Grand* prints the following paragraph concerning the hardships of the staff of the International Telegraph Bureau at Berne :—

"The staff of the Radio-Telegraphic Section of this Bureau at Berne consists normally of a Secretary, a Registrar, and two clerks. Switzerland is a neutral country in the present war, and one would assume therefore that its public institutions could have gone on the even tenor of their way. But no. Taking the above-mentioned Bureau as a sample we find that pressure of business necessitated the employment of an extra clerk on July 3rd, 1914. War broke out in August, and there was a general mobilisation of Swiss troops. The temporary clerk had to answer the call. In view of the publication of an official chart of radio stations, a cartographer was engaged on August 1st. In four weeks his place was vacant, and he was under arms. In addition to this, the Secretary and the two clerks were mobilised, and the Registrar was left alone to work the section 'dans la mesure du possible.' We think the brave Registrar deserves a St. Martin's medal! But the whole incident is remarkable as showing how the actions of the 'mad dog of Europe' affect a peace-loving and neutral nation."

* * *

The report for the year 1914–1915 of the Advisory Committee for Aeronautics, recently issued, emphasises the essential connection between this branch of the National Service and "Wireless Telegraphy." One of the paragraphs dealing with a number of special investigations undertaken for the Admiralty and the War Office makes special mention of "Tests of magnetos forming part of wireless installations to determine their liability to ignite explosive mixtures of gases." Here we have a reference which indicates the activities of the Committee in the direction of "lighter than air" machines. It is obvious that there are certain dangers in connection with gas-filled aircraft which do not occur in the case of "heavier than air" machines. Both come within the province of this Committee, and on page 7 we find reference to fresh designs of wireless and other signalling apparatus attached to aeroplanes. It is obvious that under existing circumstances it is undesirable in the public interests for the Committee to make public any details, but it is at all events interesting to know that these affairs are occupying the full attention of our public experts.

In connection with this subject it is interesting to note the essential connection between aeroplanes and wireless installations, indicated by the Inventory published by the Italian Government of the recent sequestration of the German steamer *Bayern* at Naples. This Inventory includes a number of comprehensive wireless station outfits, besides "four aeroplanes complete with wireless installations and machine guns."

A curious case recently came before Judge Shearn in the Supreme Court at New York. The facts are these. During a voyage of the *Minneapolis* from London to New York a passenger died, and, following the customary practice, the body was immediately consigned to the deep. On the arrival of the ship at New York one of the relatives of the deceased sued for £600, claiming that the steamship company had no right to dispose of the body. The Company contended, however, that the practice of immediate burial at sea is countenanced by custom, but the Judge ruled that in view of the facilities afforded by wireless telegraphy the relatives should have been consulted. He allowed the Company ten days in which to reply preparatory to trial.

* * *

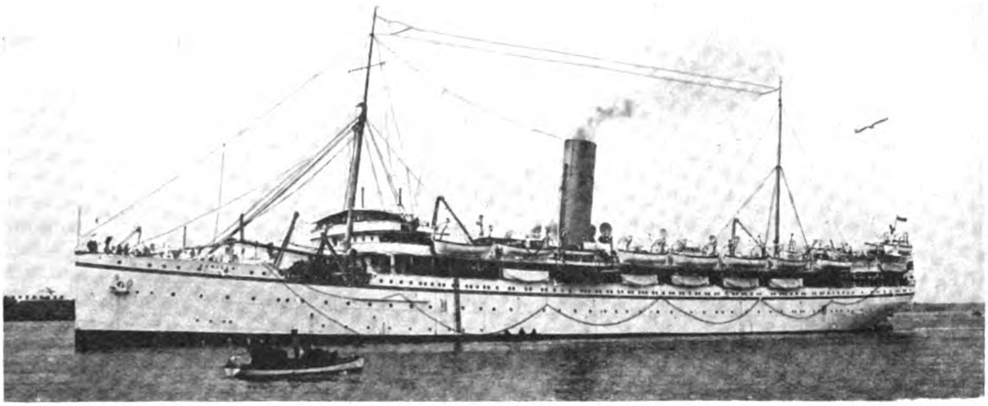
We take the opportunity afforded by these columns to call our readers' attention to an article of quite unusual interest, which will be found on page 278 under the title of "The Physical and Electrical State of the Atmosphere." This article contains the results of a considerable amount of original research by Mr. H. M. Dowsett. His general idea in the contribution is to enable the reader to visualise more clearly what is meant by terms like: The "Diurnal layer," the "Heaviside layer," etc. To many of our readers such phrases are probably merely terms and nothing more.

Mr. Dowsett's contribution forms an attempt to get a better perspective of the principal medium through which the electric waves used in wireless telegraphy are propagated. The subject is of extreme interest, strikes right at the root of wireless theory, and should form an excellent starting point for further discussion of the various theories of wave propagation round the earth.

We invite correspondence on the subject from other investigators and theorists.

WIRELESS TOWERS FOR THE UNITED STATES.

TWELVE steel wireless towers have recently been constructed for the Government of the United States. All these towers will be used for the radiotelegraphic stations which are to form the links of a chain of powerful Government stations now in course of erection.



The Hospital Ship "Rohilla."

Maritime Wireless Telegraphy

TRAGIC pathos constitutes the keynote of human feeling in connection with the wreck of the hospital ship *Rohilla*. At the end of last year, with her complement of doctors and nurses, she left a Scottish port for France to take up her work of mercy. She only succeeded in getting as far as the north-east coast of England when she was driven ashore by the boisterous weather. We are now enabled to give a full account of this calamity from the pen of the senior operator on the ship, Mr. Robert T. Utting:

"The *Rohilla* left the Firth of Forth on Thursday afternoon, October 29th, 1914, bound for Dunkirk, with a light N.N.E. breeze; when off St. Abbs Head the weather came on to blow very hard, with a very heavy beam sea. The rolling of the ship was terrible, so much so that the large sideboards and tables in the saloon and smoke-room became unshipped and careened madly about. This rolling of the ship lasted all night. Unaware of our position, at 4.15 a.m. on the Friday morning, after a series of violent bumps, the ship finally stopped, her engines refusing to go astern. Second Officer Winstanley came to the wireless room and said: 'Send out the SOS quickly; she is ashore. Operator Wilson, who was on watch at the time, sent out the call, but no answer was received. By this time I had slipped on my pants and taken the 'phones over from him. I again sent out the distress call, and received a reply from Cullercoats (coast station). I had just switched off the motor when the lights went off. I immediately joined up the emergency set, and had obtained a spark when a huge sea broke full on top of the wireless cabin, carrying away the Bradfield insulator and trunk, which put the whole wireless apparatus out of use, as the aerial came down at the same time.

"Several of the crew had by this time taken shelter in the wireless room, all practically naked. I told them to put on some of my clothes which were in the cabin. By this time the wireless room became untenable owing to the tremendous seas attacking it on the port side, which caused the cabin to break up very fast. This soon all disappeared over the side.

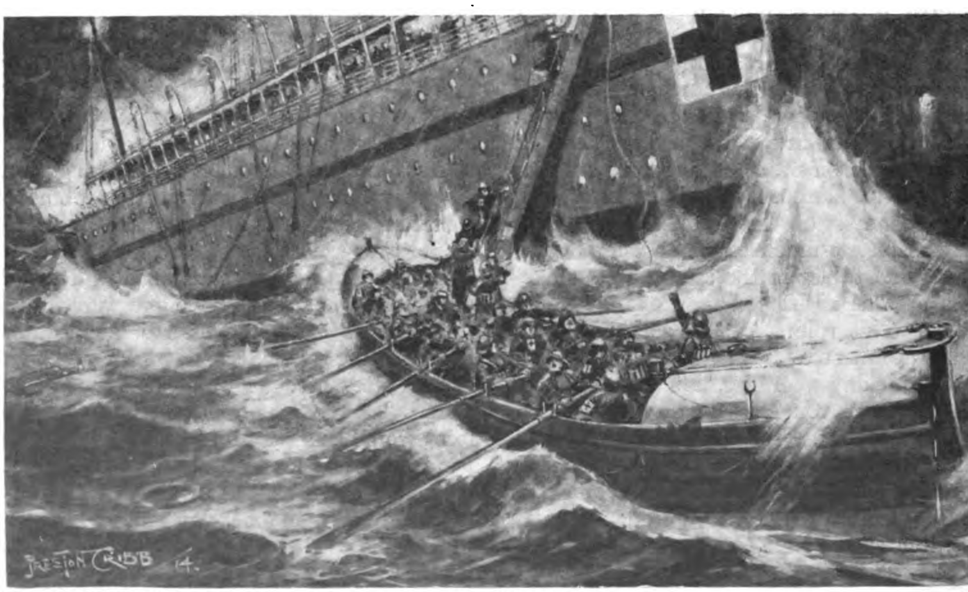
"Our boats had all unshipped, and out of twenty-nine boats twenty-eight were stove in and useless; the one left was launched at daylight, and with Second Officer Jwyn in charge attempted to take a line to the shore. This they had to cut to prevent the boat from being swamped, the breakers being much too large to allow sufficient line to be paid out to the boat.

"The Whitby lifeboat now made a successful trip to the doomed ship, which was now breaking up very fast. It took off the four nursing sisters and our stewardess.

On the second trip it took off more men, but on arriving back ashore it had the misfortune to have a large hole stove in its bottom, and had to be abandoned.

"The gale blew furiously all day, the force of the wind being seven to nine.

"The shore people now accomplished a splendid piece of work by bringing the Upgang lifeboat by road and lowering it down the cliffs, a height of 200 feet, by ropes. All attempts at launching it, however, failed owing to the tremendous breakers. We hung on in despair all through Friday night. At daybreak on Saturday, after all attempts by both rocket apparatus and lifeboat had failed, Captain Neilson told all who could swim at all that, as the ship was breaking up so fast, and could not last through Saturday night, he thought it was their one chance to put a lifebelt on and swim for it, the distance to shore being about 700 yards. About fifty men started to swim ashore, including Mr. Wilson, the junior operator. About forty reached the shore in an exhausted condition. The Scarborough lifeboat arrived about 10 a.m. in tow of a steam trawler, but could not do anything at all for us, as the sea was much too fierce. At low tide the Upgang lifeboat was launched, but failed to reach us owing to the fierceness and tremendous size of the breakers. The captain now signalled to the shore: 'Have ambulance parties ready to-night at low water; all leaving ship on rafts, as she will not last the night.' We set to work hard, and made rafts of gratings and drawers from the bridge and captain's cabin. Darkness came on, and we all made up our minds to try to swim at 10 p.m., but our luck was dead out again. The weather freshened up harder still, and Captain Neilson ordered all to stay on, saying: 'As long as there is anything to hang on to, we will stop, boys.' About thirteen, however, left, and out of that number only three succeeded in getting to the shore, one being the Chief Officer. A message was now received from the shore saying: 'Motor lifeboat coming at daylight'; but as we had had so many disappointments, the captain would not tell the men. About midnight Saturday a powerful searchlight arrived by special train from Newcastle, and was put to play on us. This greatly gave us hope and lit up the chartroom, where we were all huddled together soaked to the skin and being cold and hungry, most of the men not having had a morsel to eat or drink since Thursday night. At daybreak Sunday morning our faith in being rescued was very small, but presently appeared a small craft rolling heavily in the tremendous sea. This craft turned out to



The Whitby Lifeboat taking off Four Nursing Sisters.

be the South Shields lifeboat, and after a terrible buffeting and splendid behaviour of its crew they came alongside, pouring oil on the sea, and which ultimately took off fifty survivors. With one huge cheer we greeted them with what little strength we had left, and another cheer when they told us the Chief Officer had been saved. The *moral* of the men from Friday morning to Sunday morning was splendid. They always looked on the bright side all through this awful time, although all attempts at rescue by both rocket apparatus and lifeboat had failed. They made cigarettes from magazine paper obtained from the captain's cabin, and those who had a pipe would have a draw and then pass on to one of his mates. The captain and officers were splendid, and all did their duty. The people of Whitby were beyond praise, and did everything in their power to alleviate our sufferings — in fact, they practically killed us with their kindness."

* * *

Once again it has to be recorded that wireless telegraphy was used to good purpose in bringing aid to a stranded vessel. The s.s. *Colon* left San Francisco for Mexican ports on January 16th of this year, and after making a call at Guaymas proceeded to Topolobampa. On the morning of February 4th, about 10.30 o'clock, she stranded on the bar at the entrance to the latter port. Mr. W. R. Lindsay, the wireless operator, immediately sent out the distress signal, to which the U.S.S. *Maryland* responded saying she was coming to the assistance of the *Colon*. She arrived about 6 p.m. The steamers *Cetrianna* and *Korigan III*. also arrived late in the afternoon, whilst the U.S.S. *Annapolis* appeared next morning. The transfer of the passengers and crew to the United States war vessels commenced forthwith, whilst the Marconi operator, with the wireless apparatus, found a temporary dwelling on board the *Cetrianna*. This removal of the installation to another ship enabled the commander of the *Colon* to communicate with his owners in San Francisco. The *Colon* was floated on February 10th, and accordingly her wireless apparatus was re-installed.

* * *

The following report, received from the senior operator of the *Ancona*, forms evidence of the important rôle played by wireless telegraphy :—

"On May 14th, at 2.5 a.m., near Europa Point, during a very thick fog, the s.s. *Lætitia* issued the signal SOS after having collided with another vessel. The position as soon as received by the *Ancona* was transmitted to the Commander."

In this connection the Ministry of the Italian Navy, to whom the incident was reported, writes as follows :—

"This Ministry thanks you for having "communicated to him the report of the "s.s. *Ancona's* operator, referring to the "rescuing of the s.s. *Marcorusco's* crew, "during the night of the 14th May last, "by means of the Marconi's wireless tele-"graphy. The wireless also in this case, as "in other circumstances, has demonstrated "to be very efficient."

* * *

"We mentioned in our July issue that the s.s. *Rijndam*, of the Holland-America Line, had been in collision with s.s. *Joseph J. Cuneo*. We are now able to give a full account of the catastrophe from the pen of the wireless operator :

"We left New York on Tuesday, May 25th, bound for Holland, under the most promising circumstances, the weather being fine and clear. We all felt we should make a quick passage home, but we did not get far before the following incident occurred. In the early morning of May 26th, a little while after my assistant had relieved me, I was awakened by a heavy shock. I first thought of the aerial coming down. It was something worse, however. Suddenly my assistant jumped in and said, 'We have been in collision ; you had better put your clothes on.' I looked out of my porthole, and saw the boats lowered and passengers and crew with lifebelts on. I dressed in record time. I then took charge of the station, while my assistant was busy looking up the lifebelts. Shortly afterwards the chief officer came with the order to send out the SOS signal. Not a second later many operators were startled by hearing this well-known wireless cry for help. We were then twenty-six miles south-west of Nantucket Lightship. It was distressing to see the lifeboats with passengers and crew leaving the ship for s.s. *Cuneo*, a Norwegian fruit steamer, with which we had been in collision, and which had made a big hole in our side. It was a lucky thing the ship's dynamo could be kept going. Communication was so much the better for it.

"Not for a moment did we really think about the danger. My assistant, who was making his second trip, stuck on board as well, and was of service by taking messages to the bridge and relieving me now and again. The only steward left made coffee and tea and was serving the officers on the bridge. After all the passengers had left the ship in strict order and calmness, only some thirty people were left—Captain P. v. d. Heuvel, some officers, all engineers, and a few firemen, and sailors. Everybody did his utmost to save the ship, sailors relieving firemen and acting as trimmers. Everybody knew it was a last effort, and this co-operation resulted in success.

"Immediately after the collision we stopped, and the *Cuneo* stood by until help should come. The distress signal was readily answered by several ships, amongst them U.S.S. *Wyoming* (NWQ), s.s. *Nacochee* (KFP), *North Star* (KJS), *Cretic* (MRC). I sent out our position, and all were coming to our rescue. The *Wyoming* then informed us that U.S.S. *Texas* and *Louisiana* were coming at top speed to our assistance. This was considered sufficient, and the other merchant vessels were told to proceed on their way. The damage done was rather bad. The bow of the *Cuneo* was smashed and our ship had a big hole amidship on the port side extending 9 ft. below the water-line, through which the water was rushing. Soon holds Nos. 5 and 6 were filling, and the stern sank dangerously deep into the water. We went down aft for about 6 ft., and that seemed to be the limit, for we remained afloat. Then came the good news: 'Battleship division coming to your assistance. Hope to intercept you at seven.' Soon afterwards the battleships *Texas, South Carolina, Louisiana,* and *Wyoming* were noticed, and from another direction the *Michigan* (another U.S. battleship) arrived. As soon as they hove in sight we felt safer, and the captain wirelessed that we were proceeding full speed and gave his course. Now we did everything possible to bring the ship quickly back to New York, but if any contingency should arise help was near. The passengers were taken from the *Cuneo* by the *South Carolina*, and three battleships were coming towards us. Soon they were alongside, and after wireless conference it was resolved that the *Texas* should accompany us to port. It may be stated here that a message was filed in New York at 3.18 p.m., and its answer delivered at 3.45 p.m. in New York. At 8.30 p.m. we arrived at Sandy Hook, where tug-boats were awaiting us, and the *Texas* returned to join the fleet again. The last message we received from the *Texas* congratulated us upon our safe arrival so far.

"About 10 p.m. we arrived safe and well at New York Quarantine. We dropped anchor till daylight and docked again in Hoboken early Thursday morning.

"We need not point out the great service the wireless once more rendered in a very bad accident. No doubt the possibility of calling ships to his passengers' and his own ship's assistance gave the captain a free hand to make a rush for port, and so save the valuable ship and cargo.

"B. P. MOREL,
"*Officer-in-Charge.*"

* * *

Since the disaster to the *Volturno*, which caught fire in mid-Atlantic, the seas have been remarkably free from such catastrophes. Notification was recently received by wireless telegraphy, however, announcing that a fire had broken out in No. 3 hold of the *Minnehaha*, a vessel of 13,714 tons belonging to the Atlantic Transport Company. Subsequent wireless messages from the captain stated that the fire on board was completely got under without having recourse to outside help. The *Minnehaha* had on board about 12,000 tons of cargo, but no passengers.

ANOTHER WIRELESS DOG.

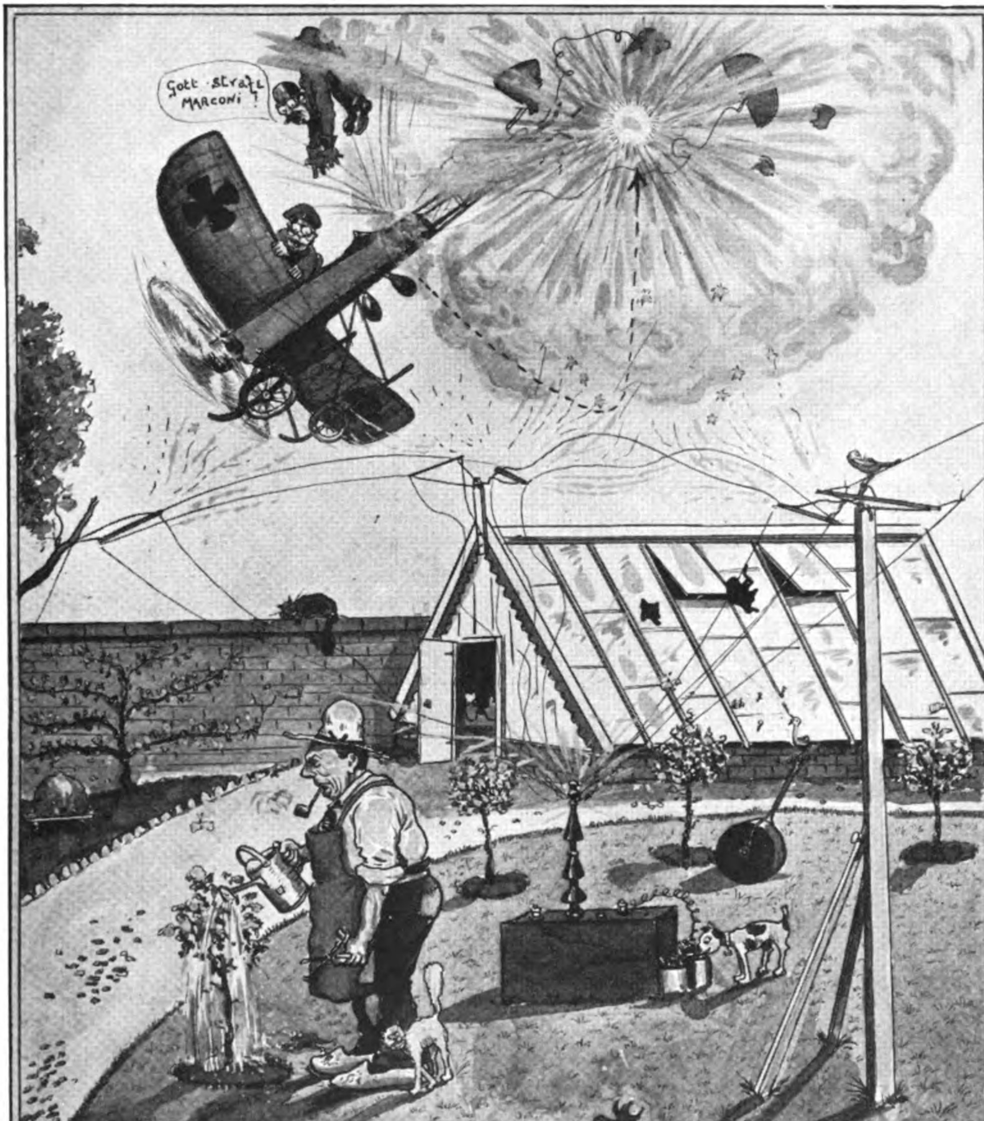
The references in previous numbers to a wireless-controlled dog have evidently aroused some amount of jealousy in the canine tribe, for we have received from a Dutch correspondent the following letter:—

"Dear Sir,

"Volume 3 No. 27, new series June 1915 is eaten by my dog. Do you have please another copy for *me*, thanking you in advance."

We trust that the dirigibility of the animal in question has been considerably improved.

CARTOON OF THE MONTH



Wireless Netting for Aerial Bombs.

The Effect of Coupling in Eliminating Atmospherics.

By LOUIS COHEN.

A SERIOUS difficulty to contend with in the reception of wireless signals is that of interference, and particularly that due to disturbances caused by atmospherics, or strays, as they are sometimes called. Every experienced operator knows how annoying the atmospherics are at times, and during the summer months they may become sufficiently troublesome to make it altogether impossible to maintain regular communications between stations. The importance of overcoming this difficulty is fully appreciated by wireless engineers, and various schemes have been proposed to remedy this evil, but none, to the author's knowledge, have proven effective in practice.

The only method which is at all helpful in reducing atmospheric disturbances is the use of loosely coupled circuits. It is a matter of experience that within certain limits loosening the coupling between the secondary and antenna circuits reduces the atmospherics at a more rapid rate than the signals from another station, and this is particularly more marked the less the damping factor of the incoming signal. In fact, if the oscillations of the signals are sustained, or only feebly damped, the intensity of the signals at first increases as the coupling is decreased up to a certain point, and then gradually diminishes as the coupling is further decreased; but in the case of atmospherics the intensity is continuously diminished as the coupling is decreased. It is proposed to give here a brief discussion of this problem to show the law of variation of the strength of signals for different degrees of coupling for free and sustained oscillations which will throw some light on the question under consideration.

Let us first consider the case of sustained oscillations. We will assume that the incoming electro-magnetic waves impinging on the antenna induce in it an e.m.f., $E \sin \omega t$, no damping, and let us denote by R_1, L_1, C_1 and R_2, L_2, C_2 the resistance, inductance and capacity of the antenna and secondary circuit respectively. We have then the following equations giving the reactions in the circuits :—

$$\left.\begin{aligned} L_1\frac{dI_1}{dt}+R_1I_1+\frac{1}{C_1}\int I_1dt+M\frac{dI_2}{dt}&=E\,\mathrm{Sin}\,\omega t\\ L_2\frac{dI_2}{dt}+R_2I_2+\frac{1}{C_2}\int I_2dt+M\frac{dI_1}{dt}&=0\end{aligned}\right\}\quad(1)$$

I_1 and I_2 denote the currents in the antenna and secondary circuits respectively. The general solutions of the above two equations are well known and need not be discussed here; we shall consider here only the important case when the two circuits are

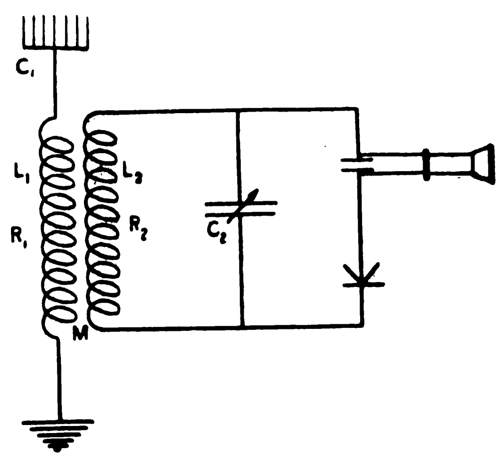


Fig. 1.

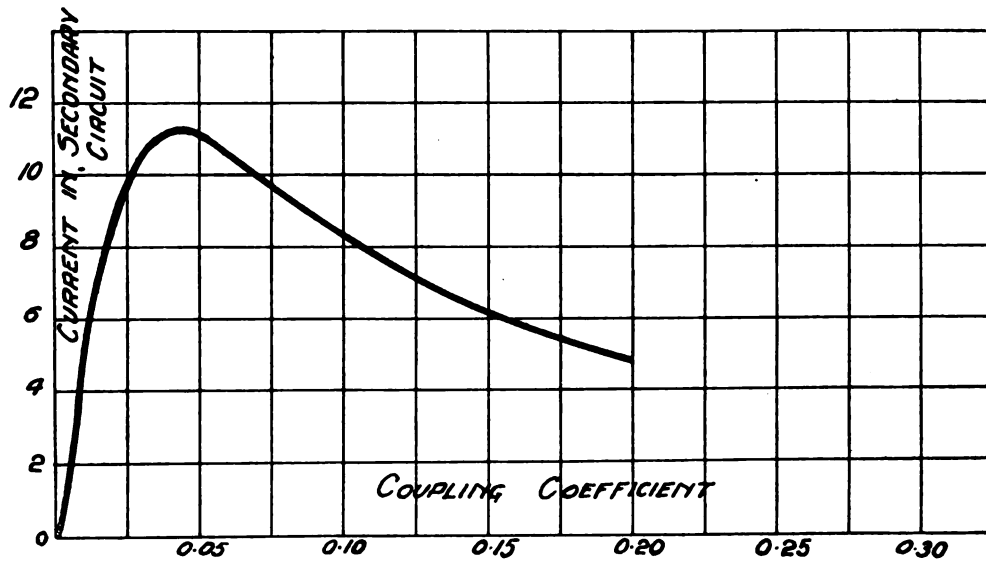


Fig. 2.

separately tuned to the frequency of the incoming waves, and we have then :—

$$\left.\begin{array}{l} L_1\dfrac{dI_1}{dt}+\dfrac{1}{C_1}\int I_1dt=0 \\ L_2\dfrac{dI_2}{dt}+\dfrac{1}{C_2}\int I_2dt=0 \end{array}\right\} \quad . \quad . \quad (2)$$

Under this condition the current in the secondary circuit is given by the expression:

$$I_2=\frac{E\,M\omega}{M^2\omega^2+R_1R_2} \quad . \quad . \quad . \quad (3)$$

or we may put above equation in the following form :—

$$I_2=\frac{E\sqrt{L_1L_2}\omega K}{L_1L_2\omega^2K^2+R_1R_2} \quad . \quad . \quad (4)$$

where $K=\dfrac{M}{\sqrt{L_1L_2}}$ is the coefficient of coupling. The current in the secondary circuit has its maximum value when

$$K^2=\frac{R_1R_2}{L_1L_2\omega^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

and

$$I_{2,\max.}=\frac{E}{2\sqrt{R_1R_2}} \quad . \quad . \quad . \quad . \quad (6)$$

If we assume now certain values of L_1, L_2, R_1, R_2 and ω and plot a curve with I_2 as ordinates and K as abscissa, we find that the current rises in value as K is increased until we reach the value of K given by equation (5), and then gradually diminishes as K is further increased. The curve shown in Fig. 2 gives the values of I_2 as a function of K for the following values of the constants of the circuits :—

$L_1=L_2=1$ mh., $R_1=20$ ohms, $R_2=100$ ohms, $\omega=10^6$.

R_1 represents the total resistance of the antenna, including the radiation resistance, and R_2 represents the resistance of the secondary circuit and the energy absorption factor of the detector.

Let us now consider the case of free oscillations—that is, we will suppose that the e.m.f. induced in the antenna is caused by an atmospheric discharge generating in it electrical oscillations. The problem to consider is the character of the current, and the variation of the current in the secondary circuit for different degrees of coupling. The analysis required for the complete investigation of the problem is very complex, and we shall give here only the final formulæ and illustrate by a numerical example the points under consideration.*

It is well known that in the case of two coupled circuits an electrical discharge will generate oscillations of two distinct frequencies and two different damping factors, and if we denote by ω_1 and ω_2 2π times the frequencies, and denote by a_1, a_2 the damping

* The complete solution of the problem is given in a forthcoming book by the author on the "Theory of Electrical Oscillations."

D

factors, we have for the square of the total current for a discharge :—

$$I^2 = \frac{E_0^{\,2} C_1 C_2}{4} \left\{ \frac{\omega_1^2}{4a_1} + \frac{\omega_2^2}{4a_2} - \frac{(a_1+a_2)\omega_1\omega_2}{(a_1+a_2)^2+(\omega_1-\omega_2)^2} + \frac{(a_1+a_2)\omega_1\omega_2}{(\omega_1+\omega_2)^2} \right\} \quad . \quad . \quad . \quad . \quad (7)$$

E_0 is the maximum potential on antenna, and C_1, C_2 are the capacities of the antenna and secondary circuits respectively. The values of ω_1, ω_2, a_1 and a_2 are approximately given by the following formulæ :—

$$\left.\begin{aligned} \omega_1 &= \frac{1}{\sqrt{LC(1+K)}} \\ \omega_2 &= \frac{1}{\sqrt{LC(1-K)}} \\ a_1 &= \frac{a_1+a_2}{2(1+K)} \\ a_2 &= \frac{a_1+a_2}{2(1-K)} \end{aligned}\right\} \quad . \quad . \quad . \quad (8)$$

where

$$a_1 = \frac{R_1}{2L_1},\ a_2 = \frac{R_2}{2L_2},\ K = \frac{M}{\sqrt{L_1 L_2}}$$

In the above formulæ it is assumed that the two circuits are syntonised, $L_1C_1 = L_2C_2$.

It is obvious that since ω_1, ω_2, a_1, a_2 are functions of K, the coupling coefficient, the current in the secondary circuit as given by equation (7) is also a function of the coupling, and it can be shown that on substituting the values of ω_1, ω_2, a_1, a_2 as given by equations (8) into (7) will give an expression for I_2 which would show a continuous increase of the current in the secondary circuit as the coupling is increased. A numerical example will bring out this point clearly.

Let us assume the following values for the electrical constants of the circuits :—

$L_1 = L_2 = 0{\cdot}5$ mh., $C_1 = C_2 = 0{\cdot}002$ m.f., $R_1 = 10$ ohms, $R_2 = 100$ ohms, $a_1 = 20 \times 10^3$, $a_2 = 100 \times 10^3$.

The values of a_1, a_2, ω_1, ω_2, and I_2 for different degrees of coupling are given in the following table :—

K	ω_1	ω_2	a_1	a_2	I_2
0·05	$1{\cdot}025 \times 10^6$	$0{\cdot}975 \times 10^6$	$6{\cdot}31 \times 10^4$	$5{\cdot}76 \times 10^4$	$1{\cdot}2 \times 10^{-6}E$
0·10	$1{\cdot}05 \times 10^6$	$0{\cdot}952 \times 10^6$	$6{\cdot}67 \times 10^4$	$5{\cdot}45 \times 10^4$	$1{\cdot}96 \times 10^{-6}E$
0·15	$1{\cdot}085 \times 10^6$	$0{\cdot}933 \times 10^6$	$7{\cdot}06 \times 10^4$	$5{\cdot}22 \times 10^4$	$2{\cdot}25 \times 10^{-6}E$
0·20	$1{\cdot}11 \times 10^6$	$0{\cdot}917 \times 10^6$	$7{\cdot}41 \times 10^4$	$5{\cdot}04 \times 10^4$	$2{\cdot}44 \times 10^{-6}E$
0·30	$1{\cdot}19 \times 10^6$	$0{\cdot}877 \times 10^6$	$8{\cdot}57 \times 10^4$	$4{\cdot}26 \times 10^4$	$2{\cdot}75 \times 10^{-6}E$

It is seen from the values given in the above table that the current continuously increases as the coupling is increased.

Let us see now the significance of the above results in connection with the use of coupled circuits for wireless signalling. If the signals to be received consist of sustained oscillations, then, as was shown above, it requires only a comparatively weak coupling to get the maximum current in the secondary circuit. Any other electrical disturbances which may give rise to free oscillations in the antenna circuit, such as atmospheric discharges, or disturbances from other stations using highly damped oscillations, affect the secondary circuit only to a small extent, since the free oscillations require a strong coupling to induce a maximum current in the secondary circuit. It is evident, therefore, that there is considerable advantage in using sustained oscillations for signalling, since it enables one to use weak coupling, and thus insure comparative freedom from interference of foreign disturbances. In using damped oscillations the current generated in the receiving antenna consists of forced and free oscillations ; the less the damping of the oscillations of the transmitting station the greater the predominance of the forced oscillations in the receiving antenna. The coupling required for this case will be intermediate between the two extreme cases considered above, and obviously the less the damping of the oscillations the smaller the coupling required at the receiving station, thus making it more possible to eliminate interferences.

WIRELESS AND ELECTRIC POWER SUB-STATIONS.

The *Electrical World* states that the Public Service Company of Northern Illinois has been experimenting with storm detectors of the Hertzian wave type used at the waterside station of the New York Edison Company, and in installing these detectors at various points on its system has added the small additional equipment necessary to make full-fledged wireless telegraph stations of the local equipments. Messages have been exchanged between the system operator's office at Joliet, Ill., and the company's generating station at Blue Island, but the wireless method has not yet been called into service because of the failure of the means of communication that are ordinarily employed.

Doings of Operators

LAST month we spoke in this place of the experiences of Messrs. Shrimpton and Coats, to whom not one but many adventures had come to prove their mettle. This month we must tell of operators Swift and Murphy, who " kept their end up " and maintained the tradition whilst the good ship *Armenian* suffered, and was sunk by an under-water and underhanded enemy.

There were two wireless operators on the *Armenian*—John Stafford Swift, the senior, and James Dominick Murphy, as assistant. Swift had been at sea for some three years, working the wireless key mostly in South American waters. His home is at Southend-on-Sea, and his opinions of Germany are those of all the residents of that watering-place. Murphy comes from O'Leary's country and resides at Cork when at home. His service in the wireless cabin has not been as long as that of Swift, for he only joined in November last. Both men had been on the *Armenian* for several trips, and so were well acquainted with the vessel.

In the late afternoon of June 29th—a fine day with a calm sea—the periscope of a submarine appeared above the water, followed by the deck and hatchways. Hoisting the German ensign, the submarine peremptorily called upon the British vessel to stop, but the commander of the *Armenian* had his own opinions, and did not show that courtesy which the humane methods of German submarines might be considered to invite. Much to the annoyance of the " culture " craft, he put on full speed ahead, and the submarine, foiled for the moment, put on full speed also. In the tense moments which followed the submarine slowly overhauled the *Armenian* and fired shell after shell on the steamer. When first the hostile craft appeared Murphy was on duty, but Swift immediately took charge and sent out the signals of distress and indications of the ship's position. For twenty-five minutes the signals were sent out, and then with a deafening explosion a shell burst on the engine-room skylight, blowing away by its force the whole of the wireless cabin roof. Hardly had Swift left the cabin when a further shell completely demolished the cabin. The rain of bursting shells created a carnage on deck as ghastly as could be imagined, and Swift tells us that even now he can scarcely realise how he managed to escape death, for the dead and dying cattlemen and crew were strewn on every side.

Their wireless duties perforce at an end, the operators rendered assistance in lowering boats. How great the peril still continued to be may be gauged from the fact that whilst they were assisting the commander and some of the officers to lower one of the boats a shell carried away half of the ropes. The boat thus partially released shot all who were in it down into the water; no less than fourteen were thus thrown out, and several were never recovered. When the boat was righted again eighteen people slid down the ropes into it and were able to make away. Other boats were also lowered, although a number were smashed to atoms by the bursting shells. Murphy was in the water for fifteen minutes before being picked up.

When all who could had left the vessel

Operator Swift.

Operator Murphy.

the pirates sent a torpedo to finish their fiendish work, and the *Armenian* sank stern first beneath the waves. In the boats the cattlemen and crew made the best of the position and rowed about until three hours later a Belgian trawler found them and took them all on board. Some time after the trawlers picked them up the survivors were transferred to patrols, which landed them a little later at the port of Avonmouth.

Apart from slightly injured hands, Swift seems no worse for his experiences and is taking a short rest. Murphy sustained some slight hurt, and is also resting for the moment.

COMPANY NOTES.

THE Annual General Meeting of the Compagnie Française Maritime et Coloniale de Telegraphie sans fil (the French Marconi Company) was held in Paris on June 30th. The annual report submitted to the meeting stated that the Company had fitted fifteen additional ships during the year 1914, and had a total of 89 ships fitted at December 31st, 1914. In spite of a reduction in the ship telegraph traffic due to the war, the accounts show an available balance of 142,288.86 fr. as compared with 63,867.33 fr. for the previous year. A dividend of 10 per cent. on the ordinary shares and 31.25 fr. on the profit shares payable on July 15th was declared, and Messieurs Dal Piaz and Musnier were re-elected directors of the Company for three years.

Marconi International Marine Communication Company.

Despite the troublous times which caused disorganisation of business and restriction of shipping during the last five months of its financial year, the Marconi International Marine Communication Company's report and balance sheet recently issued proved satisfactory reading for the proprietors.

This company, which possesses the rights of Marconi wireless telegraphy for marine purposes, was bound to share for the latter five months of 1914 in the lean times generally prevalent in shipping circles. Taken as a whole, however, the year's work shows a marked improvement on its predecessor's financial results. The gross revenue from ships, telegrams, subsidies, news service, rentals and sundry receipts amounted to £175,021, an increase on the preceding year of about £29,000. After providing £21,188 for depreciation and £6,812 for debenture interest, the net profit amounted to £55,668—an improvement of £18,500. Some loss has been sustained through attacks on the mercantile fleet by enemy submarines, and (despite anticipation of compensation in due course) the directors consider it desirable to place £10,000 for the time being to a special reserve.

For the third year in succession the shareholders receive the satisfactory dividend of 10 per cent., and the result of this favourable report has been shown in the hardening of the market quotation to $1\frac{3}{16}$. The war has clearly demonstrated in a very striking and continuously increasing manner, the paramount importance of wireless fittings for vessels of all descriptions, so that when the war-cloud lifts and British commerce is able once again to progress under the stimulating effect of peace, there is every reason to expect that the Marconi International Marine Communication Company will more than maintain its past uninterrupted progress.

* * *

The report and balance sheet of Marconi's Wireless Telegraph Company will be found on pp. 345–6 of this issue; but the meeting will not take place until July 26th, too late to be reported in this issue. We feel certain that the shareholders of this company, like that of the "International," will find good reason for self-congratulation in the results attained.

How to Become a Wireless Operator

WE are so frequently receiving letters from correspondents asking us to explain how they can join the ranks of the professional operators that we think it advisable to devote some space this month to considering the subject rather more fully than is possible in the column for "Questions and Answers."

Wireless operators can be divided into two classes: naval operators and commercial operators. The wireless telegraph service of the Navy is under the sole control of the Admiralty. Now that the war has increased the demand, a number of wireless operators have been enrolled for the duration of the war from men who are physically fit and in possession of the Postmaster-General's certificate, or otherwise sufficiently qualified. In normal times, however, the only way to join the wireless telegraph staff of the Navy is to enter as a boy or youth, just as one would do to become a gunner or any other skilled rating.

Commercial operators can further be divided into two classes: ship operators and shore operators. The ship operators are employed either by the shipping companies direct, or by the Marconi Company on behalf of the shipping companies. As by far the greater number of ships are operated by the Marconi Company on behalf of the shipping companies, it will perhaps be best to consider first what it is necessary to do in order to join the Marconi Company.

The applicant for the Marconi Company's service must be physically fit in every way. Slight defects of sight, providing they are properly corrected by glasses, do not debar the applicant from admission; but lameness, even slight, will debar. Before being accepted, all applicants have to pass the Company's doctor.

A thorough practical acquaintance with telegraphy is required, and a speed of eighteen words per minute, sending and receiving, is the very lowest that is usually accepted. It should be remembered that in normal times the number of applications for employment usually exceeds the vacancies that can be offered, and therefore if there are more applicants than vacancies the best men are selected. It is highly advisable to acquire a speed of at least twenty-five words a minute, sending and receiving, before applying for employment, if the applicant wishes to stand a good chance. For the same reason it is advisable to obtain the Postmaster-General's first-class certificate of proficiency before applying, although at present, when the demand for operators is very great, suitable applicants may be taken without the certificate and their training completed in the Company's school in London. The certificate is obtainable by study at any of the numerous colleges and schools such as those advertised in THE WIRELESS WORLD.

One of the most important qualifications, and one which is often overlooked by intending applicants, is good clear and rapid writing. Several cases have been known where applicants, possessed of the Postmaster-General's certificate and otherwise quite suitable, have been rejected because their writing was wholly useless for practical telegraph work. Too much importance cannot be attached to this subject.

All applicants must be British subjects and within the ages of eighteen and twenty-five. The greatest importance is attached to a man's previous record and character, and references are required from independent sources and from past employers. If the intending applicant can comply with all the above requirements, he should write to the Traffic Manager, Marconi International Marine Communication Company, Ltd., Marconi House, Strand, W.C., setting forth clearly his qualifications, and asking for a form of application and conditions of employment.

In the event of an applicant being considered suitable, the man in question is asked to call at Marconi House for the purpose of an interview and test. The test comprises telegraphy and writing and any further subjects which the Company may consider advisable. If he is approved, the budding operator visits the Company's doctor for a medical test, and on passing has to be prepared to spend some time in the Marconi House School. Here he will learn the various methods of accounting for messages and other matters connected with the Marconi Company's business. If he has not yet obtained the Postmaster-General's certificate, he will have to stay in the school until his studies are completed and he is able to sit for the examination.

Telegraphists with previous land-line or cable experience, able to send and receive twenty-five words per minute, are accepted without any previous wireless training, and are paid 17s. 6d. per week until they have obtained the certificate and are appointed to the staff. Other applicants who are accepted receive 5s. per week whilst in the school. On appointment to the operating staff the minimum commencing salary is £1 per week and all found on board. Annual increases of salary are given as set forth in the Conditions of Employment sent to every applicant. An applicant with the Postmaster-General's certificate is not likely to remain more than a very short period in the school.

Positions in shipping companies who employ their own operators are obtained by applying to the companies direct.

Vacancies on land stations in Great Britain do not occur very often. All of the commercial coast stations except those of high power are owned and operated by the Post Office, and the operators are recruited solely from the Post Office staff. The big power stations at Poldhu, Clifden and Carnarvon are operated by Marconi's Wireless Telegraph Company, Ltd., and when men are required for these advertisements appear in the daily press. For the guidance of those who wish to obtain such positions we would say that a high degree of telegraphic skill is required, and only those with previous professional experience in telegraphy are usually taken.

There is one accomplishment which in both land and ship wireless operating is of the utmost importance, and cannot be too highly valued. We refer to tact. On many occasions an operator will find that the man at " the other end " is sending perhaps too fast or too slow. It is useless for him to pass sarcastic remarks regarding the " other man's " abilities at the key, and just as foolish to get offended when he himself is asked to send slower or faster, as the case may be. For the conscientious man there is only one thing to be thought of in such circumstances, and that is an efficient service. Amicable working on a circuit between two operators of average ability will clear much more traffic than recriminations between experts.

Positions on coast stations abroad are often filled from the ranks of the experienced ship operators in the Marconi Company. It is not usual for these positions to be given to men with less than two or three years' experience. They are, indeed, reckoned as the " plums " of the service, and are usually given to men who have shown themselves to be of more than average ability. Positions on the Inspecting Staff are also recruited from the senior men.

Altogether the profession of a wireless operator is a very pleasant and interesting one, with many opportunities for seeing the world. In these times, too, the wireless operators on merchant ships are doing a magnificent work in carrying out their duties, for they are assisting in bringing safely to this country the valuable cargoes of food and merchandise. The Admiralty fully recognises the importance of their work, and has stated that it considers that the mercantile operators in performing their ordinary duties are serving their country just as truly as if they were with the fighting forces.

AMONG THE WIRELESS SOCIETIES.

Notes on Meetings.

The Institute of Radio Engineers.—The June meeting of the above society was held on Wednesday evening, June 9th, in the Columbia University. A paper on " Engineering Precautions in Radio Installations " was read by Mr. Robert H. Marriott, and the result of much experience with methods of installing radio apparatus was given. An address was also given by Dr. Alfred N. G. Goldsmith on " Static Elimination—Some Suggested Methods." Much material of interest to all those working at this great problem was contained in the address, a digest of which we hope to give at a later date.

The Two Strange Men

A Story of the Crusades.

By P. W. HARRIS.

Editorial Note.—In the course of excavations for the foundation of a wireless mast somewhere in England the following parchment (apparently a portion of a letter written from Palestine by a gallant knight of the Crusades) was discovered in a battered and much bent casket. Certain portions of the letter indicating the position of the forces of the Duke Robert of Normandy have been deleted in deference to the present censorship of news, but otherwise the parchment is reproduced practically as found. The old spelling has been slightly altered so as to make the wording more easily intelligible to modern readers.

* * *

(Portion torn) . . . for in good faith the elements have not favoured our movements.

This morn at daybreak the messenger brought thy message, written on good parchment by the Friar Thomas. It gladdened my heart to hear that thou art in good health and that our little maid Elfrida is growing so bonnily. If the varlet cometh again for the income tax whilst I am in a foreign land straightway have him cast into the dungeon that he may join his predecessors. Please convey my greeting to the lady Winifred and thank her for the respirator, which came to hand yestereve.

We are making good progress against the forces of the Saladin, and his troops are retreating towards the coast. I trust that by the time I write again there will be a great victory to record. Let us hope that it may be so.

But, before all else, I must recount a strange occurrence which hath befallen us, and which hath occasioned much controversy amongst the wise men. On the eve of Candlemas there arrived at the camp two old men, bent and careworn and dusty with much travel through the desert sands. The elder of the two immediately demanded an audience with the Duke, saying that he had matters of great urgency to lay before him. He was straightway brought before Sir Stilton Parmesan, who at that time was Chief of the Guard, who forthwith demanded to know what the old man had to tell.

" Good, my Lord," quoth the man. " In very sooth I cannot tell thee, for my message is for the ears of the Duke alone."

" Then canst thou not see him," was the reply. " I forbid thy approach even to the door of the tent."

" Be it so then," answered the old man. " I must depart and my mission must remain unfulfilled. Had I been allowed to enter," wistfully continued the old traveller, fingering his wallet, " peradventure certain shekels might have found their way to a welcome quarter. Farewell ! "

" Tarry thee a moment," exclaimed the good Sir Stilton, hastily. " Methinks I did judge thee too harshly. In plain language of the good King Henry, how much ? "

The matter was soon arranged, and the old man led before the Duke. Making deep obeisance he spoke as follows :

" My Lord Duke, I have hastened hither from the plains of Araby, whither thy fame has spread, and where thou art known as a great deliverer. It is claimed amongst my people that thou wilt overthrow the power of the Saladin, and as we ourselves are sworn enemies of the Infidel, I have been sent to aid thee with the magic box."

" The magic box ! " quoth the Duke, " and what might that be ? "

" Truly it is marvellous," replied the old man, " for in it is a spirit which doth journey at our bidding. My brother who doth await without hath also a magic box with an attendant spirit and the two sprites do act as messengers. Although thou wilt scarcely give credence when I tell thee, in sooth we can talk by these spirits for a distance of three full days' march. I pray thee, therefore, allow my brother to accompany the next expedition against the Saracens, and I, thy good servant, will remain here, and will hold frequent intercourse with my brother who is with the troops far distant. In this manner, my Lord Duke, thou wilt be informed right speedily of what occurs in battle, and there will be no need for constant envoys and messengers."

The Duke was evidently much impressed, for he called to his trusty friends Count Gorgon de Zola and Sir Robert Gruyere, who were standing by, and said :

" Thinkest thou, my friends, that this old man doth speak sooth ? If it is as he doth state the box will help me mightily."

" We cannot say," was the answer, " but we would suggest that if he cannot do what he claimeth he be forthwith put to death."

" Ha ! ha ! " said the Duke, " a right good plan thou hast suggested ! Old man ! To-morrow the Count Gorgon de Zola and Sir Robert Gruyere set forth upon an expedition against the great Saladin. After three days they will come upon the enemy and do battle for the good cause. Thy brother shall accompany them and daily I shall expect to hear how all matters progress. But if thou fail in what thou hast set thyself to do, thy life will be held forfeit. Sergeant, lead him away and give him food and drink. His brother also must be cared for."

And so it was arranged ; the younger of the two men set forth with the Count Gorgon. On the third day the Duke Robert called a council of all the nobles and knights, and ordered that the old man be brought before him with the magic box.

" My Lord Duke," said the old man, " I am here ready to do thy bidding. But first I must crave indulgence while I make a small preparation. In order that the spirits may know the tent in which we are I lead this golden thread away from the tent to a high lance-pole which I have placed without." As the old man spoke he unrolled a coil of golden thread and went out through the door of the tent. In a short time he returned with his task completed.

" I now open the magic box and place upon my head the casque which is a sign that the spirit must speak to my ear and my ear alone. Next with this crystal set in a golden mounting I invoke the spirit and command him to go forth to thy good servant, my brother, who is three days' journey from here. I charge him ask my brother all the news, and as he tells me so I will write. He is gone ! He returns ! Ha ! I hear the voice ! ! ! "

All in the tent were now possessed of a

"All in the tent were now possessed of excitement."

great excitement. The Duke Robert leant forward in his chair and shook with expectancy. The nobles and knights all held their breath as the old man inscribed on the parchment line after line in feverish haste. For five long minutes he wrote silently, and intense was the anxiety with which the assembly waited. Then the old man spoke :

"Behold, my Lord, I have the message. With thy permission I will read it forth. 'Crusaders' Headquarters fourth day after Candlemas. To the north of Jerusalem our troops continue to advance. In the region of the Dead Sea there is nothing to report stop The Jerusalem'sche Zeitung commenting on the Crusaders' advance states that it is established fact that poisoned arrows being used appeals to neutrals protest against this flagrant breach rules civilised warfare stop.'"

"Yes, yes!!" cried the Duke. "'Tis in sooth a marvellous power thou hast shown to us. Read on!!"

"'Saladin addressing assembled troops before Jaffa states Damascus must be occupied by Saracens fourth February latest stop Saracen prisoners just captured report bad morale Saladin's army. Mohammedan commercial industrial activity paralysed stop Market report Circassian slaves spot 22/6 October delivery 18/- Georgian ditto dull some transactions effected low prices Jerusalem selling plate won by Deadsea Fruit with Sally Dean second large field stop Latest during the operations last two days our troops captured three million four hundred twenty-five thousand six hundred four prisoners seven hundred fifty machine bows quantity stores stop...'"

The Duke now sprang from his chair with flaming eye. "Stop, thou sayest! Stop it shall be, in sooth, for thou liest!! In the whole of Islam there is not that number of troops to be found!!! Sergeant! Take the perjurer forth and have him executed, for . . ." (the remainder of the parchment is illegible).

WIRELESS IN ROUMANIA.

ONE of our contemporaries eloquently entitled the *Near East* recently published the following paragraph :—

There is now in existence at Bucharest a wireless telegraph station which is more powerful than the older one. On Tuesday night the new station *spoke* to Athens, which replied, and messages have since been exchanged with the Eiffel Tower.

Such a paragraph makes a peculiar appeal to those of us who take an interest in the history of civilisation. The Balkan kingdom of Roumania in its very title enshrines two important phases of European history. "Roumi" is the name traditionally given by Turks and Arabs to Christians in general, and is a mere corruption of "Roman." The reason is, of course, that the first Christians with whom the Mohammedan invaders came directly into contact were the Christians belonging to the Christian Roman Empire, whose seat of government was Constantinople. Thus the term Roumania speaks eloquently both of the Roman civilisation imposed by force of arms upon the Thracian and Dacian tribes and of the Mussulman invasion of Southern Europe, which in the fifteenth century threatened to penetrate into the very heart of Europe. When we find Roumania, once the fringe to the Roman Empire and afterwards the bulwark of Christian Europe against the Turks, communicating by wireless ether waves on the one hand with Athens, whose valiant sons in ancient days preserved Europe from the Persians, and on the other hand simultaneously interchanging wireless messages with Paris, the centre of the great Carlovingian Empire which rose from the ashes of Western Rome, we have brought home to us in a very graphic way a lesson of faith in general human progress, despite dark epochs of reactionary struggles, which appears peculiarly appropriate during the present days.

* * *

Our contemporary concludes the paragraph above referred to by calling attention to the fact that

Wireless apparatus and material being uniformly contraband of war, every part of the new installation has been constructed in this country, partly at the State railway workshops and partly in those of the Postal Service.

The pride of nationality which finds its (perhaps most legitimate) expression in conscious independence of outside support, remains as strongly developed a feature amongst the descendants of Wallachia and Moldavia as was the case in the days of Roman imperialism or those of Michael the Brave (the Roumanian hero in their Turkish struggle), whose memory is perpetuated by a beautiful equestrian statue at Bucharest.

Amateur Work during the War

A Few Suggestions.

IT is much to be regretted that in the world of amateur wireless there are appearing signs of stagnation—a stagnation which, if continued, cannot fail to have a serious effect on the progress of the science as a whole. Although for the moment all practical work has ceased perforce, amateurs should remember that the restrictions will not last for all time, and that directly the war is over many of them will be immediately removed. The great field of theoretical work is still open, and as practice without theory can only progress very slowly, it behoves every experimenter to be fully prepared with sound theoretical knowledge in readiness for resuming practical work.

In normal times we find wireless telegraphy taken up by three distinct types of amateurs. Firstly, we have what may be termed the "fully qualified expert," with a thorough theoretical and practical acquaintance with electricity in its many applications, a sound knowledge of technical mathematics, and plenty of leisure in which to conduct his experiments. He either possesses or has access to a well-equipped laboratory, and his work is usually of an extremely advanced nature. To him the cessation of practical working means some inconvenience, but, knowing the importance of theoretical work, he continues his studies and investigations with considerable benefit both to himself and to the world at large.

Secondly, we have the "serious experimenter," who occupies his spare time with the study of the theory and practice of radiotelegraphy, and, by means of his home installation, investigates to the best of his ability the many practical problems which come his way. He endeavours to find a reason for the phenomena which he encounters; as experience and theory give him new ideas from time to time he alters the construction and arrangement of his apparatus accordingly. Unlike the "fully qualified expert," his experience of electrical work is not great and his knowledge of mathematics is often far smaller than he would like it to be. Nevertheless, he is able to do much excellent work, as the pages of this magazine have amply demonstrated. To him the cessation of practical work is a very serious matter, as most of his time at wireless is spent in practical experiment.

Lastly we have the large—perhaps too large—class of "wireless dabblers," who with crude apparatus jamb their own friends, use excessive power, and think they are brilliant and unrecognised geniuses because Paris and Poldhu come through on their receivers. Their bedrooms and studies are full of weird apparatus, notices of "Danger" appear on every side, and intricate coils and jumbles of wire indicate the position of what is called their "station." Their ideal of a private installation is a roaring and deafening spark, thousands of terminals, insulators like those of a million-volt transmission line in the wilds of America, and crystals, potentiometers, and switches galore. Their work is aimless, and they never worry about theory, for they think it too "dry." Directly the present restrictions came into force and their apparatus had to be packed away and sealed up, the "dabblers" believed their hobby to be completely stopped, and as a consequence have turned their energies in other directions.

Whilst we are mainly concerned in this article with the second class of amateur—namely, the serious experimenter—we trust that the "dabbler" will not overlook what we have to say. Dabblers not only do themselves no good by irresponsible experimenting, but are likely seriously to harm the cause of amateur wireless by bringing amateurs into disrepute with the authorities. In the United States the abuse of wireless by such experimenters resulted a year or two ago in legislation of such a stringent nature that now before a licence for experiment can be taken out the experimenter must fully satisfy the authorities as to his capabilities. Faced with official questions, the transatlantic dabbler is in a very unhappy position.

Wireless telegraphy as a science has no clearly defined boundaries, for it is intimately connected with many other branches of electricity. Before it can properly be studied, a sound knowledge of elementary electricity and magnetism is required, and the principles at least of alternating current work should also be mastered. It would be well, therefore, if each amateur were to subject himself to an examination in these two subjects by the aid of the well-known "Test Cards" issued by our publishers.

An excellent way of testing one's knowledge of wireless theory is to undertake the complete calculations of a wireless transmitter and receiver for a certain range of wave-lengths. This will, of course, comprise the working out of inductances, capacities, wave-lengths, aerials—in fact, everything that pertains to the installation. Where points of difficulty occur, the Instructional Articles which have appeared in THE WIRELESS WORLD or Bangay's *Principles of Wireless Telegraphy* should be consulted. It is surprising what interest can be derived from work of this kind.

The student who proceeds beyond the superficialities of the subject will soon find that without a fair knowledge of mathematics he is severely hampered. For those who have not had the advantage of a mathematical training we can recommend *Engineering Mathematics Simply Explained*, by H. H. Harrison, a little book selling at 1s. 6d. and obtainable through the Wireless Press, Ltd. This will be found to give the student much help and an excellent grounding in mathematical work. More advanced books should, of course, be studied as soon as this has been mastered. It may be mentioned that we are considering the advisability of publishing a series of articles on the Mathematics of Wireless Telegraphy especially for the benefit of those who wish to improve their knowledge in this direction.

The *Wireless Telegraphist's Pocket Book*, by Dr. J. A. Fleming, advertised on another page and now in the press, will also render great assistance to all who are intent on mastering the principles of wireless. The Mathematical Notes which form the first chapter will be found especially valuable for those who already have some knowledge of mathematics, and we would strongly advise every serious student to obtain this book and devote himself diligently to its study.

The amateur who intends to train for the wireless operating profession will, of course, make a point of studying the construction and use of the commercial apparatus which he will be called upon to handle. For this purpose the *Handbook of Technical Instruction for Wireless Telegraphists*, by J. C. Hawkhead, is indispensable. The official *Handbook for Wireless Telegraph Operators*, issued by the Postmaster-General, should also be obtained, so that the rules for the handling of traffic may be mastered.

In conclusion, we need hardly mention that Morse Code practice should be kept up at all costs, as it is wonderful how rapidly one can lose speed from want of practice. In this direction the societies should afford great help, for one experienced telegraphist can give expert instruction to a large number simultaneously.

We will welcome suggestions from our readers regarding the lines of study which they think it desirable to take, and shall be particularly glad to hear what is being done in this connection by the various wireless societies distributed throughout the kingdom. We are sorry to notice that the activities of several of the societies have considerably lessened. This should not be so, as so much work needs to be done in connection with theory.

NEWFOUNDLAND IMPORT TARIFF.

Amongst the articles removed from the free list and made dutiable at the rate of 10 per cent. *ad valorem* under the Newfoundland Import Tariff appears material for installing wireless telegraphic apparatus on ships engaged in the trade and fisheries of that Colony.

New Applications for Wireless

No. 2.—The Case of the Undesirable Members.

By W. B. COLE.

A WEEK after the dramatic exposure of the famous thought-reading Zananis* our amateur wireless "investigators" met Weston, their *Daily Thunderer* friend, at Frascati's.

Dinner over, and the first glass of comradeship drunk, Clifford leans forward and starts yarning.

"Holland and I believe that we are on the track of a regular little secret society, up to every move on the modern scientific board, and specially proficient in wireless. We have selected two of their number for our next investigation, and want you to come along and help us. It'll be best for you to wait for explanations until afterwards, because if you act in the dark all your actions will be perfectly natural, and no suspicion can be aroused of our working in collusion."

"Right you are," Weston answers, "but you must take care to make your final explanations in full, for I shall expect to be provided with fresh 'copy' for another article. You may rely upon me implicitly."

"Thanks awfully!" replies his friend; "and to start with, I may tell you that to-night, as soon as we are all ready, we are going to take you to a club, most of whose members hail from foreign parts. Holland and I joined a fortnight ago for this special purpose, and are fairly well known by now. You are to be my guest for the evening, and the club committee is expecting you."

Clifford had during the past week left his face unshaven, and a fair silky down appears upon his fair white skin. He sports a loose black velvet coat, and his general appearance is carefully calculated to suggest a man in easy circumstances slightly negligent with regard to personal appearance. Holland wears his usual clothes, but Weston had been instructed to "make up" for the *rôle* of a wealthy plunger.

*See "The Case of the Empress Music Hall," WIRELESS WORLD, April, 1915.

Soon the trio arrive at an ugly red brick building several storeys high, standing in a quiet street not far from Soho. The place is brilliantly lighted, dark hangings drape all the lower windows, whilst the upper ones—glazed with opalescent glass—remain uncurtained. A large double door divides the ground-floor front rooms and opens on to a narrow hall. At the doorway they are stopped by a pleasant-faced man of stalwart stature and swarthy complexion. After a few sentences of cautious parley, in the course of which Clifford whispers the password, this un-uniformed custodian steps aside with the words, "Monsieur will find the key on the table under the book; my place is here." Clifford and Holland sign their proper names, whilst Weston inscribes the borrowed patronymic of A. Wilson. Passing up a wooden staircase and along a corridor, they come to a door bearing an inscription, in many different languages, which announces that the room is used as a photographic dark-room, but has been temporarily closed for repairs. Side by side therewith, a half-open doorway shows a large room crowded with men of all nationalities, some talking in groups, whilst others are engaged in games of dominoes, cards, or chess at the small tables which cumber the floor in large numbers. They unlock the dark-room door, enter, and switch on the electric light. Besides the usual photographic fittings a rough improvised bench stands in the farther corner covered with various wireless instruments.

"This is surely a piece of retrogression, isn't it?" remarks Weston, touching one of the items of apparatus. "I thought the days of coherer receivers were over years ago."

"We all hoped so," replies Clifford "Most of *this* set, however, is home-made. That brute of a coherer nearly wore out our patience days ago, but we have got it into good going order now."

"It doesn't give bad signals," remarks Holland, as he sends V's on a small buzzer key. In response to his fingers the paper strip starts forward from under the guide roller of the inker, whilst its little well-inked wheel jumps up to the paper at every impulse of the key, marking it with three dots and one dash of the Morse code letter "V." At the same time the tapper, in synchronism with the inker movements, with gentle and rhythmic insistence raps back the coherer tube into a state of de-coherence.

"You've got a jolly small aerial," remarks Weston, as he traces out a wire mounted on porcelain cleats running along the wall under the bench; "it only amounts to about ten feet or so."

"You just *wait and see*," quotes Clifford. "I think you will find it prove long enough."

Five gentle knocks at the door, delivered in quick succession, interrupt further conversation.

"One of the committee," says Clifford, as he opens to admit a middle-aged man, who bows ceremoniously to them. "My friend Mr. Weston, of the *Daily Thunderer*—Mr. Alexander Wilson for the nonce." Then, turning round, he completes the introduction by: "This is Mr. Stoneham, the secretary of the club."

Mr. Stoneham's name strikes Weston as the only British thing about him. He has come to see that all is ready for the night's experiment, and, learning that this is the case, passes out of the room with an enigmatic smile, as he murmurs, "It is *au revoir*, is it not so?"

Leaving Holland to act engineer-in-charge for the evening, Clifford and Weston pass into the next room and start a game of chess. All around them men of every nation, as foreign in their apparel as in their talk; some play dominoes, others draughts and chess, but cards obtain the greatest favour, and for the most part the games played appear to be for fairly high stakes.

"You would never expect to find such a thorough-going gambling den right in the heart of London," remarks Weston. "Aren't they ever raided?"

"I should say," returns Clifford, "that it would be very difficult to get evidence, if the police tried it on. I know for a fact that there is a most elaborate system of electrical warnings arranged for, and though you may only have noticed our stout friend at the door on guard, other eyes are watching us all the time."

After sitting a little while at chess our two friends perceive a pair of men whose accent and appearance plainly bespeak their south European origin. They have just come in, seated themselves, and started shuffling two packs of cards at one of the small tables. In a minute or two the younger of the pair whispers to his companion, and they come across the room. After the usual preliminary greetings the elder stranger asks, "Do you vant your revenge thees efening, Mistair Clifford?"

"I do very much, Mr. Browski," replies the latter, introducing Weston as "My friend Wilson, who would like to make the fourth in our game."

Mr. Browski in turn presents Monsieur Zepachi, and the four adjourn to one of the larger tables in the corner of the room. After the polite but unnecessary preliminary of each offering the other his chair on the plea of its being the more comfortable, the quartette settle down for an evening's battle with luck and skill at the good old game of whist, each player taking his place with a little pile of gold and silver on his left-hand side.

Our friends' adversaries are well-known members of the club—called by their fellow-clubmen "the twins." This sobriquet is not due to any physical resemblance, for with regard to appearance they were literally "the long and the short of it," but is bestowed on account of their inseparable companionship. They pursue an invariable habit of partnership, and such is their power of co-ordination that even with moderately bad hands they seldom lose. As a rule, they rise from an evening's play considerably the richer than when they sit down, and have issued a standing challenge to club members offering to play any other pair for high stakes. This challenge, though many times taken up, has up to the present almost without exception ended in favour of the challengers.

There is no suspicion of foul play, but this constant success and refusal of "the twins" to mix in the social life of the club has brought in its train a certain amount of unpopularity. Little is known about them except that they appeared to have travelled together all over Europe and America, and visited most of the principal clubs. Club etiquette usually demands that silence from which whist derives its name, but—as the game proceeds—Weston notices that Clifford, contrary to his usual custom, is taking every opportunity of interpolating remarks in a slow and distinct tone of voice, most of what he says bearing upon his opponents' luck, and he neglects no chance of mentioning the cards played.

In less than an hour Weston's little pile is exhausted, and he finds himself obliged to appeal to his friend for assistance. The stakes had just been regulated accordingly, when Mr. Stoneham, the secretary, accompanied by his assistant and three members of the committee, enter the room and walk up to the table. Turning to "the twins," Mr. Stoneham, in a loud, staccato voice, so pitched as to reach the whole apartment, exclaims: "You are a pair of card-sharpers and cheats!"

Conversation is immediately hushed. You might hear a pin drop. A player lets his ivory domino fall upon the floor. The sound seems to penetrate to every corner of the room, and gives the effect of the striking of a stroke of fate. Browski and Zepachi jump to their feet.

"Monsieur," Browski screams, "what mean you? I will—I will——"

"Take your hand away from your hip pocket; I have you covered," says Weston sternly, as with his right hand in the side of his jacket he pushes the corner of the table towards Browski. The latter, finding himself surrounded by alert men, obeys reluctantly. By this time the committee have placed themselves round the table.

The members present desert their games and crowd round.

"I repeat what I said just now," says Stoneham quietly. "You two are card-sharpers and cheats."

There is no necessity to indicate which two of the four he accuses. Browski, livid with rage, jumps up and faces his accuser. His friend, still seated, turns white with fear and rage, whilst with trembling fingers he twists his moustache, his eyes are roaming round seeking an outlet for escape.

"Prove it," snaps back Browski.

"Very well, then," replies Stoneham. "Take your coat off and open your waistcoat."

Browski is evidently not prepared to hear this. His companion leans back in his chair, and again his hands nervously seek comfort from the hairs on his upper lip. Browski alone continues defiant, and seems the only one capable of acting as spokesman.

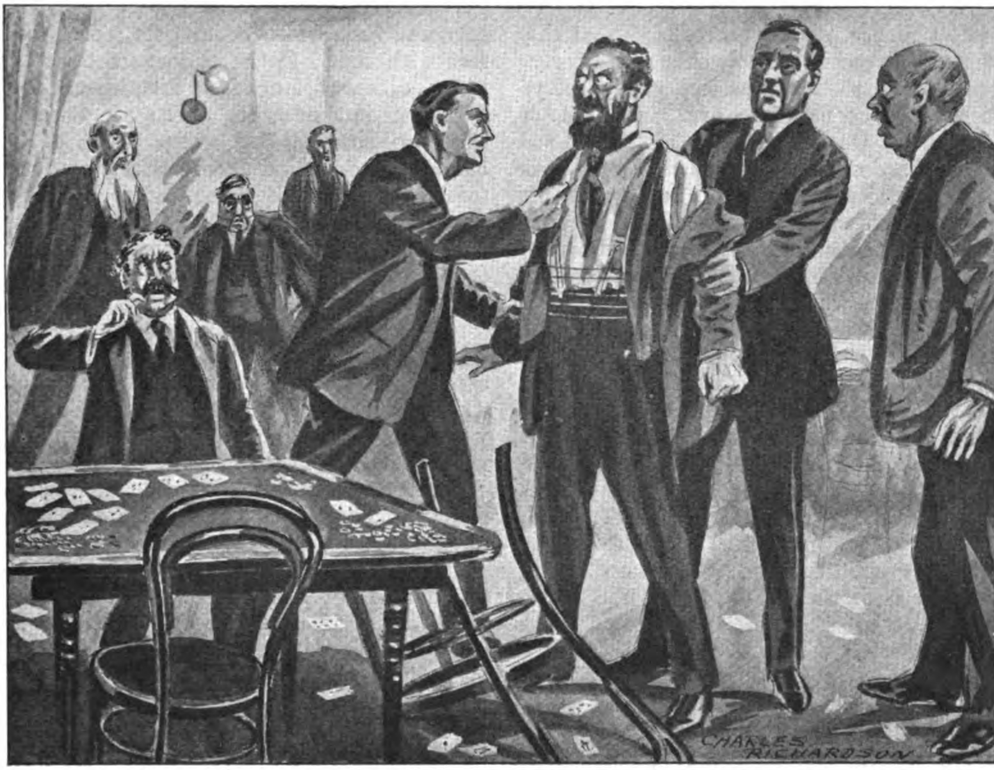
"Why should I take my coat off? Is this a dressing-room? Perhaps you wish to fight me?" rapidly questions Browski. "Yes, yes, I am quite willing to fight you with the usual weapons, but I will not take my coat off! Yes, yes, I challenge you to fight me. To-morrow I will come here with my friend, who will be my second, and we can settle this affair below. Follow me, my friend," he adds, turning to Zepachi and taking his arm. "We will show them to-morrow we cannot with impunity be abused as card-sharpers and cheats!"

"One moment," says Stoneham quickly. "Listen to me, all of you. I accuse these men of having wireless telegraph instruments concealed on their persons, and by its means they have passed messages between them describing their cards. If they will take their coats off you will see the wires and connections. It is the business of all the members here who have lost money by playing with these men to help me to prove this."

"Let us see what's under your waistcoat," shout several members.

In a moment Browski's coat is half-pulled off and his waistcoat torn open, revealing to the astonished spectators a coil of wire as thick as one's little finger wrapped round his body. This disclosure brings forth a chorus of exclamations and execrations, and things look very ugly for the two sharpers. Browski, pale with fury and fear, makes a rush to break through the throng now pressing him on all sides.

"Sit down!" shouts the secretary sternly; and a dozen willing hands force Browski heavily into his chair, where he sits glowering at them. "Gentlemen," continues Stoneham, "in the next room we have had installed a small wireless telegraph receiving-station, which has picked up a series of messages and recorded them on the tape. I have that tape here for your inspection. It shows the signals, with a translation of them underneath. Behind that picture, gentlemen, hangs a telephone transmitter, and all the conversation that has passed at



Browski's coat is half-pulled off, and his waistcoat torn open.

this table has been taken down by one of the committee downstairs. I have that here also. A comparison of the conversation with the tape will amply prove my case, for the cards played by these men correspond with the wireless tape."

This damning evidence produces a tremendous sensation among the crowd.

"Cads! Cheats! Scoundrels!" is shouted simultaneously by a dozen voices, in almost as many languages.

"Now we know why we always lost!" cries one.

"Down with the sharpers!" cries another.

Seeing that the crowd is beginning to look threatening, a member, known as the "Colonel," steps forward and proposes that, in view of the seriousness of the charge, the matter should be fully "investigated at a court-martial downstairs."

"No, no!" shriek the two culprits together.

"I will return all the money I have won," screams Browski, trembling. "Yes, yes, to each one I will give double—there—there—double the money. I will write a cheque now, and then never, never come back again—I promise you," he added rather unnecessarily.

"That will hardly do now, or satisfy us," replies the Colonel, with ominous quietude. "This club is run on military lines, as you know well enough, and you will have to stand your trial."

"Quite right, Colonel," shout many voices behind him.

The room is strangely silent now, save when the principals speak; and the words of the Colonel as he turns to a military-looking friend sound strangely impressive. "Please remove the prisoners downstairs. We must look at this wireless installation and satisfy ourselves of the correctness of the evidence. Mr. Secretary, I will take the tape and the conversation notes. Thank you."

The body of some thirty members who are crowding round the door make way amid perfect silence. Browski, realising that this moment gives him his sole chance of liberty, makes a dash for freedom, and displays his ample acquaintance with the art of *la savate*. On the one side his right knee strikes hard on to the stomach of one of his captors, whilst on the other he digs his left elbow into the nearest face. Both victims fall with a gasp. From the recoil Browski leaps forward, flinging his arms outwards as if swimming, whilst his feet keep time with vicious sideway kicks. By means of this determined and vigorous onslaught he actually covers a good deal of the road to liberty, whilst his companion in wireless iniquity follows in his footsteps and guards his rear. Now they are within a few feet of the door, but two against thirty forms hopeless odds. The members close round, and a fierce struggle ensues. Two tables are reduced to splinters, electric lights are broken, the fuse is blown and the room plunged in perfect darkness. Browski rises to the occasion, and for a while the advantage seems to rest with him. Oaths and execrations in many different languages issue from the darkness, but numbers at length prevail. The two sharpers are overpowered, their hands bound behind their backs with four table-covers hastily requisitioned. They now present a pitiable sight; their coats are in shreds and covered with blood, personal and acquired, whilst the aerial wires originally wound round their bodies are trailing on the floor. Dejected beyond description, and sullen at their defeat, they are led, or rather shuffled, downstairs. Noticing the wire of the aerials trailing behind them, one man, with a significant gesture, picks them up and winds them round their necks.

Dejected beyond description . . . they are shuffled downstairs.

All through the fracas Clifford and Weston have remained pinned behind a card-table, unable to render any assistance. From their position they have but acted the parts of fascinated spectators, and Weston has lost few significant acts and gestures of the crowd.

"There is no need for us to stop any longer," he says. "They do not require *our* evidence now; we can leave it to the others. Come to my club and have some supper; there are many little points which I should like you to clear up for me."

An hour later, after treating themselves to the sorely needed refreshment of oysters and wine, our trio are seated in a private room in Weston's club. As the first clouds of smoke ascend from their cigars Weston opens the discussion, hitherto suspended by tacit mutual consent, by suddenly remarking, "I suppose it is all over by now."

"Yes. I wonder what the sentence has been?" ejaculates Holland. "There cannot be much doubt about the verdict."

"No; and I can pretty well guess the sentence also. I have had some experience of these clubs run on military lines before. You remember when one of the committee picked up the aerial wire trailing from Browski's concealed equipment he wrapped it lovingly round the scoundrel's neck with the remark that it would serve the purpose excellently and save expense. His smile as he made this remark was diabolical."

Clifford starts jerkily in his chair. "Yes, I noticed," said he; "but you don't think they mean to hang them?"

"From what I know of these people's methods," replies Weston seriously. "I should judge that that is exactly what happened half an hour ago, and that by this time they are being buried in quicklime under the flagstones of the basement."

"Good heavens!" exclaims Clifford; "that's awfully like murder."

"Well, they don't think so," says Weston. "They consider they are a law to themselves. Under the rules of the club, subscribed to by every member, the decision of the majority of the members in any dispute is absolute and final. I am quite sure that they had a fair trial, but would naturally be obliged to plead guilty. Their own words in offering to pay back double damned them completely."

"Well," comments Holland, "we are well out of that part of the business; but it must have been rather an interesting trial, for I suppose that it will be the first time in history that wireless tape has been put into a court as evidence."

Silence falls upon the group for a few minutes, all of them quietly reviewing the exciting succession of events through which they have recently passed. The solemn stillness is at length broken by journalistic curiosity, and Weston asks for the full explanation he had been promised. "There are several points I do not understand about that wireless plant. I suppose the transmitting arrangements were similar to those employed by Signor Zenani last week?"

"Yes, I think so," admits Clifford, "except that to-night each had a transmitter."

"But in this case they could not have had wires passing into their mouths to their dental plates," argues Weston.

"No; but you remember," answers Clifford, "last week I told you we were experimenting on a new physiological receiver. Holland and I have devised quite a satisfactory one. Inside two half walnut shells a tiny spring presses down on a perforated copper plate. Around the spring a piece of sponge soaked in vinegar keeps the copper plate moist. These are fitted one on each of the two sensitive spots on a man's chest, and wires run from them to the usual rectifier."

"A truly great and simple idea," admits Weston. "I suppose the sending was done by the big toe again in this case also."

"Most probably," agrees Clifford, "but Browski and his pal would probably use both toes—that in one boot for sending, and that in the other to cut off his receiving circuit when transmitting. It would be distinctly uncomfortable to receive his own messages."

"That accounts for everything, then," says Weston. "Anything more in this line for me to join you in?"

"Yes, there is," says Clifford. "We are on the track of another group of the 'wireless gang' now. This, I am afraid, involves a very serious matter. I have excellent reason for believing that some mysterious businesses which have completely baffled police investigations are due to the diabolical ingenuity of these scientific criminals. It may take us some weeks to unravel the skein. Can you spend the whole time with us?"

"Won't I!" exclaims Weston enthusiastically. "I can easily manage that, if you promise me a scoop for my paper."

"Right you are," answers Clifford; "that is agreed, and I will drop you a line as soon as we are ready to start again."

BIG WIRELESS STATION AT BRUSSELS.

IN a recent issue of THE WIRELESS WORLD we gave an account of the destruction of the high-power wireless station which had recently been erected at Brussels. It subsequently transpired that it had been the aim and hope of the invading German armies that this powerful station would remain intact. The Belgians, however, were more than a match for their adversaries and succeeded in reducing to a shapeless and unrecognisable mass the whole of the installation. The Germans were disappointed and furious, but this did not deter them from expending time and energy in the erection of a wireless station in the Park at Brussels.

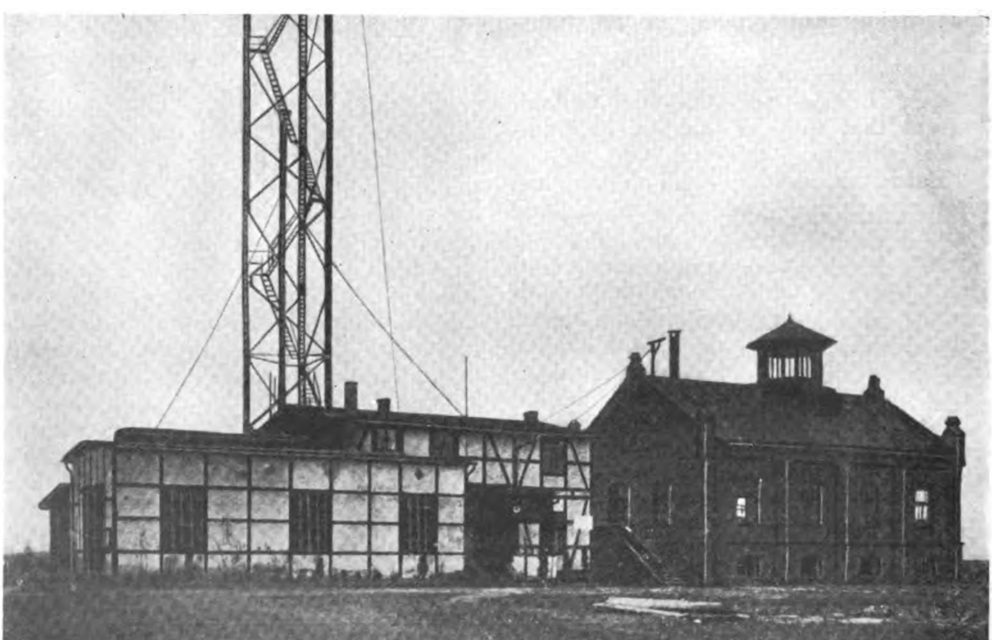
By way of Rotterdam a message comes to us from the capital of Belgium that the Germans have enlarged this station, which they constructed four months ago. It is now capable of tapping all wireless telegraphic messages sent out within a radius of 1,250 miles, and there is no doubt that they consider the greater range will be a great deal more useful to them than that attained by the old installation.

Germany's Transatlantic Wireless Schemes

FOR some time prior to the outbreak of war the German Government occupied itself in the perfection of a system of communication with distant parts of the world by means of wireless telegraphy, and, unlike our own Government, which in the Imperial scheme was hampered by political controversy, proceeded apace with little interruption. In Togoland, in both German South-West and East Africa, large and powerful wireless stations were erected; even in the distant Pacific Islands, which quite early in the war were lost to the German Empire, great aerials were raised to signal in the ether. Nor did Germany ignore the importance of communicating with neutral countries, and as it was obvious that the submarine cables could easily be severed, wireless communication with America was regarded as of primary importance.

A straight line drawn between Berlin and New York will be found to pass over France and the Atlantic for no less than 4,300 miles. Between Berlin and Togoland there was almost as great a distance. The German Government therefore set to work to increase the power of their great station at Nauen, near Berlin, so that communication could easily be effected.

Nauen is some few miles from Berlin, and the land in the neighbourhood is eminently suitable for a wireless station, the soil being marshy and the surroundings clear and open. The wireless station which was built in 1906 at first was of comparatively small power—some 10 to 15 kw.—but the plant which now occupies the buildings bears no comparison with that then installed. The present transmitters are of at least 250 kw. capacity. The aerial mast—really a steel tower insulated at the bottom—at first



Nauen Station Buildings.

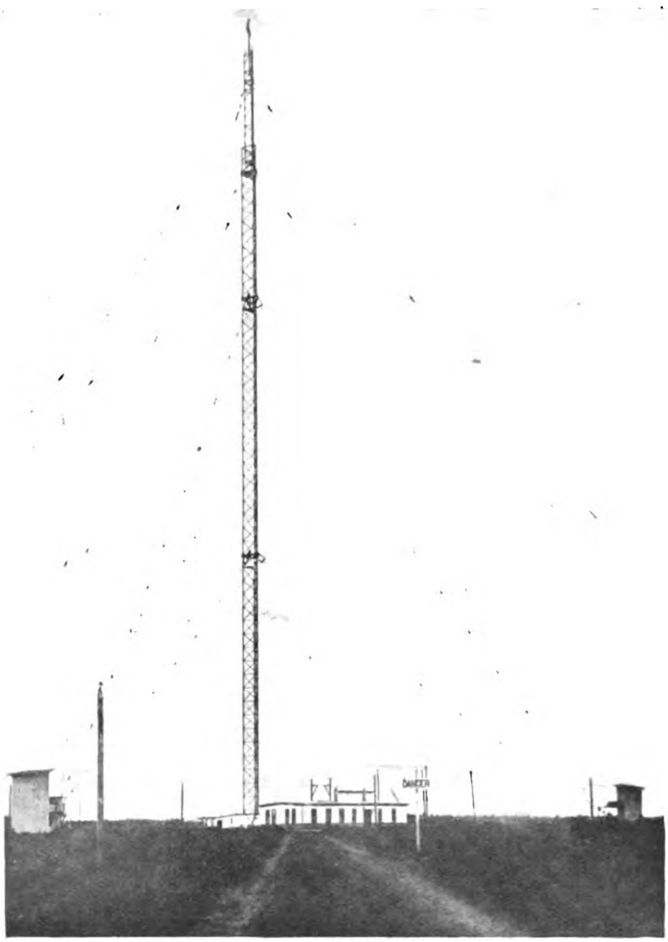
Instrument Room, Nauen.

reared itself for 300 feet: no mean height for any structure. A year or two ago the height was increased to 600 feet, and even this dizzy altitude would scarcely give the results required. Communication with Togoland and other parts was being steadily attempted when suddenly, in the middle of a windy day, the whole aerial structure came crashing to the ground and lay a heap of ruins. This would be thought sufficient to discourage the engineers engaged upon the work, but it was not so, and in a little time another tower arose, this time not 600, but no less than 750 feet in the air!

In America the wireless company which represented the German interests erected in the year 1912 a station at Sayville, Long Island, nominally for the purpose of communicating with German ships at sea and for distributing a service of news. As first erected the station had two sets of transmitting apparatus, one said to be of "five kilowatt antenna energy," and the other of "thirty-five kilowatt antenna energy." The smaller plant was designed for communicating with the ships and the larger for the press service. We would draw special attention to the method used by the Germans for indicating the power of the station. To say that a station has a power of so many kilowatt "antenna energy" does not mean that the apparatus uses only that amount of power, but that after all losses have been allowed for there remain so many kilowatts for *radiation*. Both in England and America it is customary to refer to a station as having a power of, say, five kilowatts when the alternator output has that figure. As efficiencies count at present, a five kilowatt station would have about three kilowatts "antenna energy." It will thus be seen that Germany systematically misstates the power of her installations.

Although, as we have remarked, Sayville was ostensibly intended for communicating news and messages to ships, soon after the station was completed it was announced in Germany that "easy communication" had been effected at night between Nauen and Sayville. No attempt, however, was made at sustained day and night communication, and Sayville became quite fully occupied in handling the traffic for which it was nominally designed.

Upon the invention by Dr. Goldschmidt



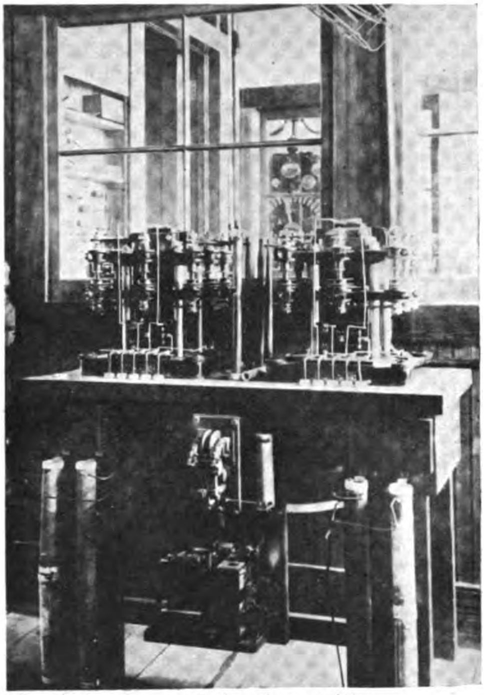
The Big Wireless Tower at Sayville.

of the famous high-frequency alternator which bears his name, a very powerful wireless station was erected in Hanover at Eilvise, and a second station at Tuckerton, New Jersey. Both aerials were of enormous size, that at Tuckerton being no less than 820 feet high. On the opening of the Tuckerton station President Wilson and the Kaiser exchanged messages of a cordial nature, and made reference to the link which was formed by these two gigantic stations.

At the outbreak of war the British Government, it will be remembered, succeeded in cutting every German Trans-Atlantic cable within four hours of the commencement of hostilities. Wireless telegraph communication thus became at once of vital importance to Germany—in fact it offered the only direct means of communicating with the United States. With Nauen and Hanover in Germany, and Sayville and Tuckerton in the U.S.A., Germany seemed sufficiently well equipped for Transatlantic work, but diplomatic difficulties arose, and after only a few weeks Washington notified the owners of the station at Tuckerton that the licence granted them was only good for three weeks' experimental work, and that the station must therefore cease operating as the three weeks had expired. Sayville, too, was not working satisfactorily, as the power was insufficient for any but occasional communications in good atmospheric conditions. Questions of neutrality were also raised concerning this station, and for the moment wireless communication between America and Germany seemed threatened.

After some amount of negotiation between President Wilson and both England and Germany, it was agreed to allow belligerent nations to send code and cypher messages through the American stations provided they were censored by U.S. Government officials, and Tuckerton once more resumed transatlantic work. The Tuckerton station, however, could scarcely cope with the enormous traffic between the embassies, quite apart from the volume of commercial and newspaper traffic, and the position for Germany became difficult indeed. Something had to be done.

What actually happened was that the American public became aware one morning that the power of the Sayville station had been quietly and secretly increased. Before the war the larger plant was a spark transmitter working with alternating current of



The Relay Keys of the Transmitter at Sayville.

500 cycles supplied from a 60-kw. generator. The aerial was supported by a single steel tower.

The new installation was found to consist of a 100 kw. antenna energy transmitter, and to possess an aerial much larger in extent, supported by no less than three 500-foot steel towers. With this apparatus it was confidently expected that all difficulties would be overcome, but predictions proved false in practice, and with the approach of the hot season atmospheric conditions became so bad that for long periods scarcely a word could be read by the operators at either end. The Marconi Company, whose long experience of transatlantic work has taught them the need for special apparatus to counteract the effect of these electrical disturbances in the atmosphere, have at their transatlantic stations sufficient power to work through interference of this nature even in the worst seasons. The Germans, however, lacked the necessary experience, and suffered accordingly. Experienced wireless men can well imagine the state of nerve-tension produced in the operators at Sayville, who day and night were straining their ears to read the feeble musical note through the crash of continuous atmospheric noises.

Whilst the Sayville engineers were attempting to grapple with the problem of atmospheric interference, an enterprising American morning newspaper, the *Journal*, deliberately accused the Sayville wireless station of being part of the German spy system. It declared that a great part of the information that has reached the War and Admiralty Departments in Berlin has been sent through by Count Bernsdorff, the German Ambassador, and Captain Boy-Ed, Attaché to the Embassy, both in their own names and in secret code, but very much more frequently by signing fictitious names. The *Journal*, by means of a collection of messages which it had taken some months to prepare, submitted to the U.S. Government evidence which, it claimed, proved conclusively that the Government had been persistently and deliberately misled by the German Embassy, who were also accused of furnishing a false translation of the codes to the Government officials. Several statements had been made by various papers as to how the fraudulent transmission of messages was being carried out, one of the

One of the Concrete Anchors to hold the Wireless Towers.

most likely being that fictitious " repeats " were asked for and given. These " repeats," ostensibly repetitions of messages previously sent and which had not been properly received, were alleged to consist really of entirely new matter.

With this, and probably further evidence culled from other sources, the Secretary of State, Mr. Lansing, and the Secretary of the Navy, Mr. Daniels, held close conference as to what steps it would be proper to take. On July 8th it was announced in the American press that as a result of the conference the Government had decided to take over the control of the Sayville station, and thus once more the German Government is shown in its true light.

WIRELESS TELEPHONES IN PENNSYLVANIA.

WE read in the *World's Advance* for July that a Pennsylvania Electric Power Company is contemplating the installation of wireless telephones for ensuring communication between their power houses and sub-stations at all times. These scattered points are now joined by ordinary wired telephones, and the wireless apparatus is to be used in emergencies.

WIRELESS TELEGRAPHY AND THE "FAIR SEX."

IT is a somewhat curious thing that up to the present the practice and study of wireless telegraphy does not appear to have attracted much attention from women. Their energies have in the past been mainly directed in a certain few well-defined directions. Whatever else it may be doing, the war is undoubtedly exercising an influence in the direction of practicality, and some of our contemporaries have been recently chronicling the activities of the Women Signallers' Territorial Corps, who have placed themselves under the Commandant-in-Chiefship of Mrs. E. J. Parker, sister of Lord Kitchener. They invite any woman of good education, who is prepared to devote a certain number of hours daily to learning the art of signalling, to apply at their headquarters, 184a Oxford Street. Their activities are apparently intended to cover every branch of the occupation, and to include the methods of flags, air-line, buzzer, cable, wireless, whistle, lamp, and heliograph signalling. Most of these form exceedingly interesting subjects in themselves; and wireless telegraphy, which forms the most modern and most scientific, should make a strong appeal to feminine intelligence.

MARCONI HOUSE NEWS.

THE NEW WAR LOAN.

A MEETING was held on Wednesday, June 30th, 1915, in the Lecture Room of Marconi House, Strand, at which Mr. Godfrey Isaacs, Managing Director of the Marconi Companies, announced that the Directors are anxious to offer assistance to the staffs of the Companies in subscribing to the War Loan now being raised by the Government. For this purpose the entire sum required to meet applications for Stock would be advanced, free of interest, subject to such applications being approved by the Secretary of the Marconi Companies and to the subscribers undertaking to repay by instalments the amount so advanced by the Company within a certain period.

The Directors' objects, said Mr. Isaacs, were twofold. Firstly they wished to arouse a patriotic spirit which should find expression in subscribing to the National Loan, and secondly to stimulate individual thrift amongst their staff.

Mr. Gray proposed, and Mr. Vyvyan seconded, a vote of thanks to the Chairman of the meeting and to the Directors for their generosity, which was carried with acclamation.

RIFLE CLUB.

The result of the June Handicap Competition was as follows:

1. Mr. W. H. Smith, Ship Fitting Department, with handicap... 102
2. Mr. H. S. Pocock, Secretary's Department, with handicap... 98

Mr. F. Atkin, Secretary's Department, won the third spoon for the highest actual score—namely, 88.

QUESTIONS AND ANSWERS

Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study to the Editor, THE WIRELESS WORLD, *Marconi House, Strand, London, W.C. Such questions must be accompanied by the name and address of the writer, otherwise they will remain unanswered: and it must be clearly understood that owing to the Defence of the Realm Act we are totally unable to answer any questions on the construction of apparatus during the present emergency.*

A. M. (Melbourne, Vic.) refers to certain formulæ which he has found in THE WIRELESS WORLD, and asks the meaning of "2 π and 4 π." We should have thought that most wireless amateurs were acquainted with the use of the Greek letter π to indicate the relationship between the circumference of a circle and the diameter. π equals 3.1416 approximately. Other questions asked by our correspondent indicate most clearly that he is commencing his studies, and in these circumstances it would be much more to his advantage to discover the answers to his questions by studying such a book as Bangay's "Elementary Principles," rather than that we should answer them for him. The purpose of this column is to give assistance in cases where the correspondent cannot very well solve the difficulty himself, and to help with advice and comments.

Pte. T. D. (Llanelly, Wales) and others who ask what steps they should take to become operators are referred to the article on the subject which appears in this issue.

C. J. M. (Upminster) writes to ask whether wireless telegraphists must transmit with the right hand. He says that at present he can transmit 20 words per minute with his left hand, but only 15 or so with his right.

Answer.—We would strongly advise C. J. M., and any other students who have acquired the habit of sending with their left hand, to confine their practice to the right hand until they are able to send at a good commercial speed. Ability to send with the left hand is an accomplishment of some value when the possessor is already expert with his right hand, for on occasions where a considerable amount of traffic is being handled a change from one hand to the other may come as a welcome relief. Normally, however, all wireless work is done with the right hand, and the apparatus is arranged on the operating table in such a way that left-hand working is most inconvenient.

J. J. M. (Co. Limerick) asks us to inform him what we would consider a good course to pursue to enable him to follow the technical points (mathematical and otherwise) arising in THE WIRELESS WORLD. We would refer him to the article on "Amateur Work During the War," which appears in this month's issue, and in which points of this nature are specially considered.

"BIRMINGHAM READER."—We think you are a little confused between "half a millionth of a second" and "a half millionth of a second." Think it out!

C. J. S. J. (Halesowen).—There are several methods of which the power of the 1½ kw. installation can be temporarily decreased, one of which is to insert more L.F.I.C.I., and thus put the low frequency circuit out of resonance. The spark-gap will, of course, need to be adjusted accordingly. A better method is to loosen the coupling between the primary and secondary of the jigger. In the case of fixed-discharger installations the power can also be reduced simply by shortening the spark-gap, but as this tends to make the spark "arc" and give poor signals it is not a very satisfactory method to use. The coupling method is probably the best and simplest. We regret that a detailed consideration of your other questions would occupy too much space.

T. R. W. (South Grafton, N.S.W.).—Many thanks for your kind appreciation of our magazine. You say that when you were working before the war you could not get a metal filament lamp to glow when connected up as a tuning lamp in the aerial circuit, notwithstanding that a carbon filament lamp of higher voltage acted well. The probable explanation is that the metal filament lamp had far more *inductance* than the carbon filament lamp, and therefore acted as a choke. On referring to your diagram we see that you have the tuning lamp shown in a shunt circuit *above* the secondary of the jigger. This is about the worst place that you could have chosen. Tuning lamps should always be placed between the secondary and the earth. We are glad to hear that you have had good results with your installation, and trust that after the war you will write us again concerning your experiences.

PATENT RECORD.

The following patents have been applied for since our May issue:

(MAY, JUNE, JULY, 1915.)

7358. May 17th. Gesellschaft fur Drahtlose Telegraphie M.B.H. Receiving arrangement for wireless telegraphy. (Addition to No. 5342/15. Convention date, May 30th, 1914. Germany. *Complete.*)

7367. May 17th. British Thomson-Houston Co., Ltd. (General Electric Co., United States). Wireless signalling systems. (*Provisional.*)

7953. May 28th. Alban J. Roberts. Wireless telegraphy. (*Provisional*).

8321. June 4th. M. F. Sueter, R. M. Groves, and B. Binyon. Apparatus for use in wireless telegraphy and the like. (*Provisional.*)

8923. June 17th. Rene Jean Bourgeois. Method for the production of an electric discharge of high frequency by means of sparks. (*Complete.*)

8926 and 8927. June 17th. Marconi's Wireless Telegraph Co., Ltd., and George M. Wright. Wireless telegraph receivers. (*Provisional.*)

8928. June 17th. Marconi's Wireless Telegraph Co., Ltd., and George M. Wright. Wireless telegraphy. (*Provisional.*)

9007. June 18th. Henry J. Furber. Process of determining the distance and direction relatively to pre-established points of an unknown source or point of projection of vibrating impulses. (*Complete.*)

9374. June 26th. James R. Halliwell. Method of, and means for, producing undamped or persistent high-frequency electric oscillations for telegraphic or like purposes. (*Provisional.*)

9720. July 3rd. British Thomson-Houston Co., Ltd. (General Electric Co., United States). Wireless signalling systems. (*Provisional.*)

INSTRUCTION IN WIRELESS TELEGRAPHY

(Second Course)

(XIII.) The Receiving Circuit.

[The dislocation of our arrangements, due to the war, has prevented us from completing, in our last Volume, the second course of Instructional Articles. These are being continued in the third Volume, and we hope to arrange for the Examination (full particulars of which are given on page 333 of our issue of August, 1914) to be held in the early autumn of this year. The present is the twelfth of the second series of articles, which will deal chiefly with the application of the principles of wireless telegraphy. Those who have not studied the first series are advised to obtain a copy of *The Elementary Principles of Wireless Telegraphy*, which is now published, price one shilling net, and to master its contents before taking up the second course of instruction.]

THE TELEPHONE.

790. By far the greater proportion of the reception of wireless messages is carried out with the aid of the telephone.

Although there are several schemes for the automatic reception of signals, some of which have been proved by practical trials to be well adapted for the purpose, they are all more complicated and, for the most part, require stronger signals than a telephone.

Moreover, there is an interval of time between the actual reception of a message and when it is read and dealt with at the receiving station. For large stations dealing with a large amount of traffic this interval is not detrimental, but for small ones, such as ship or field stations, where a large proportion of the traffic necessitates an immediate reply, the telephonic method of reception has an additional advantage above the greater part of the apparatus in use.

791. The usual form of telephone receiver used for wireless reception is well known, and need not be described here (see previous Instructional Articles or Bangay's handbook).

The resistance of the coils in the usual patterns varies from 60 to 4,000 ohms per head, according to the particular circuit with which the instrument is to be used.

For a carborundum crystal or Fleming valve detector the telephones are of 8,000 ohms for the two heads in series; lower resistance crystals work best with telephones also of less resistance, and the magnetic detector is arranged for use with telephones of 120 to 180 ohms.

792. For a telephone to be sensitive it is essential for the diaphragm to be as close as possible without touching the magnets, and in some patterns a fitting is provided by which this distance can be adjusted.

A very sensitive form of telephone is that due to Mr. S. G. Brown. In this a stiff steel reed is fitted near the poles of the magnets so as to be acted on by them in the same way as the ferrotype diaphragm in the ordinary pattern.

A thin aluminium, cone-shaped diaphragm is screwed to the reed at its centre, the rim being held by a thin paper ring fixed to the rim of the receiver case. An adjustment is provided for altering the distance of the reed from the poles, by which the sensitivity can be adjusted.

When telephones are in constant use a certain amount of moisture condenses on the diaphragm, and some will find its way into the case. To prevent this from rusting the magnets or spoiling the insulation of the windings they are sometimes embedded in wax, leaving only the pole faces projecting.

793. In place of high-resistance telephones a telephone transformer and low-resistance telephones are often used.

By proper design the combination can be made more sensitive than the equivalent high-resistance telephones. The transformer is constructed by winding the high-resistance coil round a core of iron wire, and winding the low resistance coil outside. The whole should be embedded in wax.

794. In previous articles attention has been drawn to the necessity for careful tuning of the various circuits to the wave-length of the signals received. In the telephone circuit the current due to the signals is in the form of impulses, all of one sign (*i.e.*, not alternating), the frequency being that of the spark at the transmitting station. These impulses, although not alternating, require the circuits through which they pass to be tuned to their frequency just like alternating currents. Since the telephones and telephone transformer are highly-inductive circuits, condensers must be connected in parallel with them to tune them for the best results.

The capacity required to tune a circuit of inductance L henrys to a note of frequency n per second is given by $4 \pi^2 L C n^2 = 1$ where C is in farads.

Where a telephone transformer is used a condenser of the proper capacity should be connected across each winding. The values of the capacities can be worked out if the inductances of the various parts are known, but a simpler way is to connect a variable condenser across the terminals of the instrument and note when the signals are best. The condensers must be of low dielectric loss or the note heard will to a certain extent have a muffled tone.

Although the best results will be obtained if these condensers are adjusted exactly to the note of the signals, this would entail, in a receiver for general use, a large variable condenser on the low-resistance side (where the inductance is small) and a correspondingly smaller one on the high-resistance side, and these would complicate the receiver. For practical purposes an average value of the capacity is selected, and fixed condensers of this value connected to the windings.

By a careful adjustment of this note tuning, however, interference from stations having a different spark note from that of the one required can be greatly reduced.

795. In receiving signals by the ordinary headgear telephones it is to be noted that the metal cases are either directly connected to the observer's body or form a condenser with it. They also form a condenser with the coils carrying the signals.

Similarly the observer's body is connected with the earth either directly or by a capacity.

A certain fraction of the signal current flowing through the coils will pass through this system of condensers to earth.

It is sometimes noted that, particularly when receiving signals from a local buzzer circuit or near-by transmitting set, on touching some parts of the receiver signals are increased in strength. This is due to a modification of the capacity current referred to, which causes the current in the coils to be increased. Interfering sounds from local alternating current leads are similarly increased by earthing certain parts of the instrument with the fingers. Hence there is an additional necessity for keeping the receiver and all its accessories, such as connecting leads, batteries, etc., well insulated and arranged to have a minimum capacity to earth.

In bringing this series of instructional articles to an end with this number it is not to be supposed that the subject of wireless telegraphy has been exhausted. The object of the series has been to explain the absolutely necessary parts of an installation.

Hence no mention has been made of the various devices, such as telephone relays, automatic recording or transmitting devices, etc., which are, in every case, additional to the apparatus which has been described.

In a later series we may perhaps be able to amplify the subject by descriptions of these.

TEUTON TRICKS

The following paragraph appeared in the *Daily Express* from the pen of a Special Correspondent:

" I noticed a huge mast belonging to the
" great wireless station in Constantinople.
" ' What do you think of that, eh?' a
" ' German lieutenant asked me. ' With
" ' this wireless station we can communi-
" ' cate with Berlin.'
" ' Is this the wireless station from the
" ' *Goeben*?' I asked innocently.
" ' Oh, no; ships do not carry masts
" ' of that size. It came from Germany,'
" was the reply.
" ' From Germany? But a wireless
" ' apparatus could never pass Rumania!
" ' That would be against her neutrality!'
" ' Well, it did not pass as a wireless
" ' apparatus. *We got it here as a circus.*' "

Considering that the station in question was erected by the Marconi Company long before the war commenced, our contemporary's quip would appear to lose some of its force.

WIRELESS FABLES.

A NUMBER of marvellous fairy stories with regard to the figures of prisoners captured by the German and Austrian armies form the subject of an amusing little article appearing in a recent issue of the *Birmingham Post*. The fancy figures given are dealt with under the head of "Wireless Fables." There seems to be just this amount of justification for the title, that the medium of "Wireless" has been the favourite method of propagating these absurd claims. The authors of these imaginative "yarns" mainly affect the Russian campaigns, the idea evidently being that the number of men ranged against them on this frontier are so stupendous that it is absolutely necessary for them to be destroyed if only fictitiously. So effectively does the German wireless romanticist do his work that, if we could believe him, the Grand Duke Nicholas's army must by now have been reduced to a mere phantom. On unsubstantial unrealities Von Hindenburg, Mackensen, and the rest of them are expending endless ammunition, striking "sledge-hammer" blows, and they are incidentally suffering huge losses at the hands of mere shades! Unfortunately, at one point of this story "murder came out," and the "Wolff Bureau" not long since was actually obliged to announce to the world at large on behalf of the German Government that to attain exactitude their figures required dividing by ten. Never in the history of "Wireless," or, indeed, in any other history, has such a confession been made officially by any Government.

TRAWLERS AND WIRELESS.

WITH reference to the fitting of trawlers with wireless, the *Grimsby Saturday Telegraph* recently published the following remarks :—

"As a means of securing revenge on these "submarine pirates, wireless on trawlers "would have been all that was necessary. "For an illustration we have only to re- "member the lively little naval action last "week-end, which resulted in two German "torpedo boats being sunk by British "destroyers. The trawler *Columbia*, for "the destruction of which the German boats "set out, was one of the very few vessels "of its type fitted with a wireless installa- "tion. No sooner had the attack on her "developed, than British destroyers ap- "peared on the scene, with the very happy "result that we all know. But how many "trawlers have been sunk by the enemy "without their ever having an opportunity "to send out a call for help? We do not "know, nor shall we ever be informed.

"In times of peace, when the trawler "has been following its occupation of fishing, "a valuable food for the nation, the posses- "sion of wireless has been proved of almost "inestimable value for commercial pur- "poses. Many a call from shore to ship, or "*vice versa*, has more than covered the "cost of the installation by the enhanced "value of the catch landed on specific "days. Surely, with the present means of "organisation in a port like Grimsby, it is "not expecting too much to suggest that the "trade should tackle the proposition at an "early date."

In view of the trawler interests which are so ably represented by this paper, such remarks from them should bear fruit in due season.

NEW WIRELESS STATION AT SEATTLE.

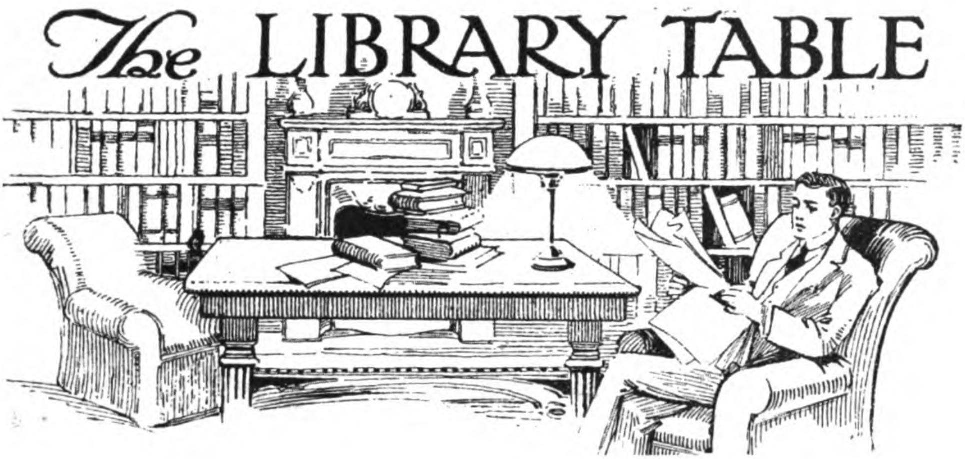
At Seattle there has recently been erected and placed in commission a wireless telegraph station for the use of the Port Warden. The call letters "KPE" have been assigned to it.

SHARE MARKET REPORT.

The Share Market in the various Marconi issues has been very active during the past month in anticipation of the annual report, which appeared on July 16th.

The excellent results shown by the parent company and the continued progress of the subsidiaries were well received by the market.

The closing prices as we go to press are: Ordinary, $1\frac{7}{8}$; Preference, $1\frac{5}{8}$; American, 12s.; Canadian, 4s. 6d.; Spanish, 3s. 6d.; Marine, $1\frac{3}{16}$d.



"BEHIND THE SCENES AT THE FRONT." By George Adam. London: Chatto & Windus. 6s. net.

It is not often that such singular facilities are vouchsafed to newspaper correspondents to visit the battle area as were afforded to the author of this book. Mr. George Adam, the Paris correspondent of the *Times*, rather than attempt any coherent chronicle of things, has given us in his work a series of impressions, obtained at first hand, of the events which daily take place at the "back of the Front." In his preamble Mr. Adam goes so far as to state the opinion that the disclosures in the French Senate on July 11th, 1914, concerning the defective military organisation of France, figured prominently amongst the important considerations which caused Germany to launch the present war on Europe. Among other things, these disclosures stated that the French frontier wireless station at Verdun was operated only by sufferance of the powerful German apparatus at Metz; and that while the French guns only numbered 2,504, the Germans possessed 3,370. Despite this latter disadvantage, on the declaration of war Frenchmen rallied round the flag right nobly, and Mr. Adam shows how, inch by inch, step by step, the French Army has proceeded with its work of reorganisation. And this has proceeded *pari passu* with heroic endurance of the terrible ordeals of the modern battlefield. The author, taking us successively through the preliminary engagements, describes the great German rush on Paris, the big retreat from the Marne to the Aisne, and dwells on the system of trench warfare which dragged its heavy weight all through the winter months. He speaks in glowing terms of General Joffre, and eulogises General Foch as "the "man with the brain to plan vast strategic "movements . . . the man with the obsti- "nacy and decision, the strength of character "necessary for the actual translation of "strategy into action." Altogether it is a well-written volume, and makes very agreeable reading.

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"ADVANCED THEORY OF ELECTRICITY AND MAGNETISM: A TEXT BOOK FOR COLLEGES AND TECHNICAL SCHOOLS." By William S. Franklin and Barry MacNutt. New York: The Macmillan Company; London: Macmillan & Co., Ltd. 1915. 10s. 6d. net.

Whilst numerous excellent books are published from time to time dealing with the elementary theory of electricity and magnetism, the number treating of the advanced theory is comparatively small. This is quite easy to understand, as the majority of people who buy elementary manuals do not require to enter deeply into electrical matters. There are, nevertheless, a not inconsiderable number of students who, on mastering the contents of an elementary manual, desire to proceed further with their studies, and to these we can recommend the volume under review.

Hailing from the other side of the Atlantic, the book immediately arrests our attention by the breezy style of its preface. After remarking that in order to make the study of theoretical physics something more than a purely formal mathematical exercise, it is necessary to keep physical things always clearly in mind, the authors state that "The character of the treatment in this book has been determined throughout by the desire to keep the student's mind jammed up tight against physical things!" An excellent idea, truly, but rather picturesquely phrased.

About a quarter of the volume is occupied by a consideration of elementary theory, after which we come to an exceedingly clear chapter on ship's magnetism and the compensation of the compass. Chapters follow on the Electric Charge and the Condenser, the Electric Field, the Idea of Potential, and Electric Oscillations and Electric Waves. A final chapter is devoted to a consideration of the Electron Theory.

Throughout the volume are scattered many parallels which assist the student to grasp the subject thoroughly. Chapter Nine, for example, commences by giving three parallel columns showing the identity of many equations of mechanics and electricity. The first column deals with Translatory Motion, the second with Rotatory Motion, and the last with Electricity and Magnetism. Such treatment as this is undoubtedly of great value.

During this time when restrictions are placed on amateur wireless working we would especially commend to amateurs the study of electrical theory. It is our constant experience to find experimenters designing apparatus in such a way as to indicate that they have no idea of subjects such as high-frequency resistance and much time and labour is wasted as a consequence. To all experimenters who have mastered the elements of electricity and magnetism we can recommend the volume under review as one which will render them much valuable assistance.

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"SCANDINAVIA OF THE SCANDINAVIANS." By Henry Goddard Leach. London: Sir Isaac Pitman & Sons, Ltd. 1915. 6s. net.

The recent opening of the Marconi high-power wireless telegraph station at Stavanger, concerning which an article appeared in the February number of THE WIRELESS WORLD, has brought us into touch with those eminently interesting people, the Norwegians. They form part of the great Scandinavian family which finds a home in those lands of the Midnight Sun, the pine, and the elk—to wit, Norway, Sweden and Denmark. Mr. Leach devotes a section of his book to each of these countries and has a word for the religion, politics, art and social life of all of them, whilst prefixing his book with a brief survey of Scandinavia as a whole. Dissertations on the industrial and commercial possibilities of the three kingdoms occupy a large share of attention, but no mean space is given to historical notes on manners, customs and folklore. A high place in the destinies of Europe is allocated by the author to the people who "have not failed to furnish the modern world with their growth of successful plans for social betterment, working men's insurance, co-operative methods of farming, discoveries in physics, ... inventions of mechanical devices, and important contributions to music, painting, poetry and drama." Mr. Leach eulogises the inhabitants as hospitable, warm-hearted people. In connection with the Norwegians, the author calls attention to the fact that they have realised the commercial possibilities of wireless telegraphy, and he refers to the suggested establishment of direct wireless communication between Norway and the United States. As mentioned above, this project is now an accomplished fact. The book is excellently illustrated by reproductions from photographs, and Mr. Leach, who, by the way, holds the office of Secretary of the American-Scandinavian Foundation, seems to have given his heart to his work. Altogether it is a very creditable and interesting book.

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"CONTINUOUS CURRENT ELECTRICAL ENGINEERING." By W. Tolme Maccall, M.Sc., A.M.I.E.E. London: W. B. Clive, University Tutorial Press, Ltd. 10s. 6d. net.

This volume, which runs into some 450 pages, is designed to provide a good text book on Continuous Current Engineering concerned mainly with engineering practice. Its scope is sufficient to meet the requirements of most technical colleges and schools, and the instruction given will be found to cover all the C.C. work that is required in the usual three years' course in Electrical Engineering. It also well covers the Continuous Current Section of the Grade II. Examination in Electrical Engineering of the City and Guilds of London Institute. The book is well illustrated by numerous diagrams, line drawings and photographs of apparatus, and the inclusion of questions and answers adds considerably to the value of the volume for those who study privately without a teacher.

* * *

"MONTHLY WEATHER REVIEW." Vol. 43, No. 2. February, 1915. Government Printing Office, Washington, U.S.A.

We have received from the Weather Bureau of the U.S. Department of Agriculture a copy of the February issue of the above. It contains contributions on the research work of the Weather Bureau, and deals with climatic, aerologic, meteorologic and seismologic conditions generally in the United States. Several tables, diagrams, and charts are appended, whilst a very comprehensive index for Volume 42 (1914) is included.

* * *

"THE 'STEP-UP' BY 'WIRELESS.'" The Marconi School of Wireless Telegraphy, "Wireless House," Sydney, Australia.

This is a little booklet issued for the benefit of our friends "round underneath" who wish to take up the art of radiotelegraphy and obtain employment as wireless operators on board ship. Issued by the Marconi School in Sydney, a school conducted under the auspices of the Amalgamated Wireless (Australasia), Ltd., it gives full particulars of the various courses which can be taken and the fees charged for the tuition. The first pages, which are devoted to a very brief, but nevertheless interesting, account of what is being done by wireless telegraphy, explain that the field of work for wireless operators is now full of opportunities. The School and its aims are next described and photographs convey to the reader a clear idea of the class rooms and equipment. Altogether the pamphlet is a bright little book and no doubt will help many to decide on their future career.

* * *

"SCOTLAND FOR EVER." With a Preface by the Earl of Rosebery, K.G. London: Hodder & Stoughton. 3s. net.

We have hitherto been regretfully obliged to defer our notice of this excellent book owing to lack of space for a reasonable consideration, but we are unable to withhold some form of recognition any longer. In this time of stress and tumult our thoughts naturally go out to the societies which are subscribing to the tenets of mercy by the alleviation of pain and suffering. A book such as that before us is therefore particularly welcome at this time. It is a work of art containing some beautiful illustrations reproduced from paintings, and a large number showing the uniforms of various Scottish regiments at different periods. The record of their exploits is each dealt with in its own section by a different author, and herein the glorious traditions of the Scottish army are splendidly upheld. These same regiments are now represented on the battlefields of France and Flanders and are gaining fresh consecration in fire and blood. These traditions "are only maintained by lives gallantly laid down and by wounds and suffering patiently endured." The production of the work represents an effort to obtain subscriptions in the worthy cause of the Scottish Red Cross, and in this we trust it will receive high and well-merited support.

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"SELL'S WORLD'S PRESS." 34th Year: 1915. Sells, Ltd., London. 5s. net.

Once again we are reminded of the flight of time by the arrival of a copy of Messrs. Sell's excellent newspaper press directory. Its continued successful existence affords proof of the need it fills, and this year it appears more comprehensive than ever. In addition to the actual sections concerning the British, Colonial and Foreign Press, a number of articles are presented dealing chiefly with the war and consequences of the war. In fine, the whole publication merits the thanks of the newspaper world, whose needs it so aptly supplies, and it should certainly find a place on the bookshelves of all whose business carries them into the "Realm of the Press."

Foreign and Colonial Notes

Alaska.

A rate-card showing the tariff for the wireless telegraph service to Ketchikan has just been issued by the Marconi Wireless Telegraph Company of America. On comparison with the cable rates now in force these Marconi rates show a considerable reduction. This link forms the first of the Marconi Alaskan Chain of Stations now approaching completion. It is hoped that the extension to Juneau will be completed shortly.

* * *

Argentina.

In view of the difficulties which have arisen in connection with the European War in the way of securing the necessary materials, the period within which vessels sailing under the Argentine flag were to be equipped with wireless telegraph apparatus has been extended to May 1st, 1916.

* * *

Caribbean Sea.

Patience in loneliness is the forced virtue of many an islander who is cut off from the world for months at a time. Such was the condition of the inhabitants of Swan Island only a short while ago before the United States Fruit Company erected a powerful wireless telegraph station there. This island is situated in the Caribbean Sea, ninety miles to the north-east of the coast of Honduras, and in a particularly ideal location for a wireless station. It is secured from interference by other stations by its perfect isolation, and this very reason enhances its efficiency. Eight years ago the apparatus was installed on this land of coral and sand to fill the position as "clearing house" for all the wireless business between the station in New Orleans, 800 miles away, Santa Marta 700 miles away, and the smaller stations throughout Central America and the West Indies.

* * *

Ecuador.

The linking up of the interior points of South America proceeds apace. Machacala, Ecuador, is the latest town to announce the construction of a wireless telegraph station.

Japan.

As the result of satisfactory investigations on the part of the Japanese Government, it has been decided to erect wireless telephone stations at Shinojima, Saksishima, and Himakashima in the Chita Peninsula bordering on Ise Bay. This course has been adopted in order to prevent, in some measure, the frequent calamities which befall fishing vessels in the neighbouring waters, which are very liable to sudden squalls from time to time. An important factor is that the cost will be considerably less than would be the case were submarine cables laid. It is understood that if the installation of this wireless telephonic system be followed by good results, the Government will extend it all over the country. As the wave-lengths of each wireless telephone station will vary, there is no fear of interference or confusion.

* * *

United States.

Condemnation Commissioners have been appointed at Trenton, N.J., to fix upon a fair valuation for the right-of-way for the line of poles and wires along the high road connecting the high-power wireless stations at New Brunswick and Belmar.

* * *

Some months ago we were enabled to give full particulars of the wireless installation on a passenger train belonging to the Lackawanna Railroad Co. We now learn that quite recently the wireless operator on board the train reported by wireless telephone to the dispatcher at Scranton station as the train passed through each station between that town and Cresco, a distance of forty miles.

* * *

In this time of stress and warfare it is interesting to note that Mr. John Hays Hammond, Junr., the well-known wireless expert, has proposed a system of aero-radio scouting districts or zones along the seaboard of the United States as a defensive measure against attacks. He argues that with such a system the land forces can co-operate with the fleet at sea in preventing landing operations by the enemy.

COMPANY NOTICES

THE MARCONI INTERNATIONAL MARINE COMMUNICATION COMPANY, LIMITED.

DIRECTORS' REPORT AND BALANCE SHEET, 1914.

DURING the last five months of the year under review the Company's business suffered considerable disorganisation and some loss in consequence of the state of war, entailing a great increase of work and strain upon those responsible for the conduct of the business. It therefore affords the Directors considerable satisfaction to inform you that notwithstanding the adverse circumstances the Company's business has continued to show substantial progress.

The net profit for the year amounts to £55,668 1s. 1d., after deducting the sum of £28,000 8s. 10d. for depreciation and debenture interest, compared with a net profit of £37,029 5s. 7d. for the preceding year. The revenues from ships' telegrams, subsidies, etc., amounted to £175,021 1s. 10d., which is a substantial increase over the amount of £146,316 18s. 11d. for the year 1913.

The number of telegraph stations owned and worked by the Company as public telegraph stations on the high seas increased from 788 at the end of 1913 to 905 at the end of 1914. Although these figures denote a marked appreciation of the Company's organisation, the increase would have been even more satisfactory had normal conditions prevailed. It will be a matter of some satisfaction to the Shareholders to know that during the current year further progress is being made, the number of steamers fitted to the 19th June having increased to 970.

It is of the highest satisfaction to the Directors, as it will be no doubt to the Shareholders, that having regard to the present circumstances, the vast organisation that for so many years has been patiently and laboriously built up by the Company at great cost and without return should now prove to be of the utmost utility, besides being financially successful. The fact that there are now over 2,000 ships, exclusive of ships of war, fitted with Marconi telegraph stations, and for the most part worked under the direction of this Company and its associated companies, has an importance in these times which all Shareholders will appreciate.

The Amalgamated Wireless (Australasia), Limited, in which this Company is interested, has paid a dividend of 4 per cent. in respect of the period to June 30th, 1914, and an interim dividend of 2½ per cent. in respect of the half-year ending December 31st, 1914.

The amount to the credit of Profit and Loss Account now stands at the sum of £64,855 14s. 11d., including the sum of £6,067 13s. 10d. carried forward from the preceding year.

The Directors have pleasure in recommending the payment of a final dividend for the year 1914 of 5 per cent., which, with the interim dividend of 5 per cent. paid on February 1st last, will make 10 per cent. for the year, the total amounting to £30,608 8s.

The Company has sustained some loss in consequence of the attacks upon our mercantile fleet by enemy submarines, for which it is contemplated compensation will be received. However, your Directors think it desirable that £10,000, a sum far in excess of all losses to date, should, in the meantime, be placed to the credit of a Special Reserve Account, and having regard to the prevailing circumstances and the desirability of their holding a strong financial position, with ample cash resources to provide for the continuous increase of telegraph installations on board ships, it is deemed prudent to carry forward the sum of £20,747 6s. 11d., after allocating the sum of £3,500 to the repayment of debenture account.

The option on the 43,916 unissued shares of the Company for two years from June 27th, 1913, mentioned in the last report, has not been exercised.

The Directors deeply regret having to record the death of two of their colleagues, General Albert Thys, of Brussels, who died on February 10th last, and Major Samuel Flood Page, who died on April 7th.

The retiring Directors are Captain H. Riall Sankey and Mr. Henry S. Saunders, who, being eligible, offer themselves for re-election.

The Auditors, Messrs. Cooper Brothers & Co., also retire and offer themselves for re-appointment.

The Marconi International Marine Communication Co., Ltd.

BALANCE SHEET, December 31st, 1914.

Dr.

	£ s. d.	£ s. d.
To Capital.—		
Authorised.		
350,000 Shares of £1 each	350,000 0 0	
Issued.		
306,084 Shares, fully paid		306,084 0 0
To 6,094 5½ per cent. 1st Mortgage Debentures of £20 each		121,880 0 0
To Reserve for Repayment of Debentures ...		5,630 0 0
To Share Premium Account		17,639 14 3
To Creditors		76,855 18 9
To Profit and Loss Account—		
Balance as per last account, December 31st, 1913 ...	40,171 14 4	
Deduct—		
10 per cent. Dividend for 1913 ... £30,604 0 6		
Reserve for Repayment of Debentures 3,500 0 0	34,104 0 6	
	6,067 13 10	
Amount taken from Reserve to redeem 156 Debentures	3,120 0 0	
Add—	9,187 13 10	
Balance of account for the year ending December 31st, 1914	55,668 1 1	
		64,855 14 11
		£592,945 7 11

Cr.

	£ s. d.
By Plant, Apparatus, Furniture and Stores	252,288 16 1
Note.—Owing to the war it has not been possible to obtain certified Inventories for Apparatus and Stores amounting to £45,505 5s. 5d. The balance, £206,783 10s. 8d., has been certified by representatives of the Company.	
By Consideration for Licence and Rights and Shares in Associated Companies	219,381 11 7
Note.—The Licence and Rights are subject to the provisions of five Agreements between this Company and five Associated Companies, under which this Company received Shares in Associated Companies for this Company's rights in Canada, Australasia, Argentina, Uruguay, and all European Countries and their Dependencies except Great Britain and Ireland and Italy.	
By Debtor Balances	61,024 19 9
By Debenture Discount	13,457 11 8
By Cash at Bankers and in Hand	6,792 8 10
By Loan against Securities	40,000 0 0
	£592,945 7 11

PROFIT AND LOSS ACCOUNT for the Year ending December 31st, 1914.

Dr.

	£ s. d.
To Salaries and Directors' Fees	14,054 18 5
To General Charges	8,004 6 4
To Expenses of Ship Telegraph Stations, including depreciation of Plant and Apparatus	90,565 18 11
To Debenture Interest	6,811 16 1
To Balance carried to Balance Sheet	55,668 1 1
	£175,105 0 10

Cr.

	£ s. d.
By Ships' Telegrams, Subsidies, News Service, Rentals and Sundry Receipts	175,021 1 10
By Transfer Fees	83 19 0
	£175,105 0 10

GODFREY C. ISAACS, *Director.*
H. RIALL SANKEY, *Director.*

Report of the Auditors to the Shareholders.

We have audited the above Balance Sheet with the books in London and accounts from Rome. We have obtained all the information and explanations we have required, and in our opinion such Balance Sheet is properly drawn up so as to exhibit a true and correct view of the state of the Company's affairs according to the best of our information and the explanations given to us and as shown by the Books of the Company.

COOPER BROTHERS & CO.,
Chartered Accountants, } *Auditors.*

London, *June 23rd,* 1915.

MARCONI'S WIRELESS TELEGRAPH COMPANY, LIMITED.

DIRECTORS' REPORT AND BALANCE SHEET, 1914.

As will be seen from the Profit and Loss Account the gross profit for the year amounted to the sum of £371,071 14s. 6d., and the net profit carried to the Balance Sheet to £232,716 8s. 11d., showing an increase of net profit over the preceding year of £110,392. The net profit of the year, added to the sum of £76,549 15s. 7d. brought forward from the previous year, increases the balance now to the credit of Profit and Loss Account to £309,266 4s. 6d.

The basis of remuneration from the Government for the use of the Company's high-power stations since the beginning of the war and other services not yet having been settled, it has not been possible to include any sum is respect of them in the Profit and Loss Account of last year.

In the Balance Sheet, Shares in Associated Companies and Patents are again taken into account at their cost price—viz., £1,360,125 15s. 4d., showing an increase of £61,382 1s. 10d. This addition is mainly comprised of the Company's proportion of the increased capital of the Russian Company. The Company's holdings in Associated Companies, except for these additions, have undergone no change during the year. The par value of shares held in Associated Companies, as shown in the margin, now stands at £2,469,858 14s. 10d., exclusive of shares which have no capital denomination.

The amount which stood to the credit of Share Premium Account has been transferred to General Reserve Account, which now stands at £867,530 0s. 6d.

The French Company (Compagnie Française Maritime et Coloniale de Télégraphie sans Fil) has declared a dividend for the year 1914, at the rate of 10 per cent. on the Ordinary Shares and 31.25 francs per share on the Founders' Shares.

The Marconi International Marine Communication Company has again shown substantial increase of business and profits, as shown by their report on page 343.

The Russian Company (Société Russe de Télégraphes et Téléphones sans Fil) has made satisfactory progress. A dividend at the rate of 15 per cent. for 1914 compares with 6 per cent. for the previous year.

The Marconi Wireless Telegraph Company of America earned increased profits, but owing to present conditions in Europe, and the consequent postponement of the opening of their Transatlantic Service, the Directors decided not to declare a dividend.

The outbreak of war caused considerable dislocation of our Company's affairs as well as those of the Associated Companies. Businesses of importance which were on the point of fruition have had to be deferred; many negotiations which were in course of successful progress with Foreign Governments had for the time being to be abandoned; the opening of the direct public telegraph services between this country and the United States of America and Spain have had to be postponed. In some cases, owing to unfavourable exchange, substantial sums have had to be deposited at interest with bankers abroad, and some payments from Foreign Governments deferred with interest accruing until after the war. The sum of £4,347 0s. 6d., due from the Turkish Government, has not been received.

In all these circumstances the Directors consider it prudent to recommend the declaration of a dividend of 10 per cent. upon the Ordinary Shares; to place a further £100,000 to General Reserve Account, increasing that account to £967,530 0s. 6d., and, after deducting the dividend of 7 per cent. paid earlier in the year upon the Preference Shares, to carry forward the sum of £69,497 8s. 6d. The Directors do not contemplate that any loss in consequence either of loss in exchange or deferred payments will result, but having regard to the war, they consider they are best studying the interests of the shareholders in adopting a conservative policy.

The Board are gratified to be able to state that during the current year the Company has been engaged to its fullest capacity in supplying the demands of the British, Colonial and Foreign Governments. The orders in hand justify the anticipation that the volume of business this year will exceed that of any previous year. The Directors retiring are Mr. H. S. Saunders and Mr. S. Geoghegan, who offer themselves for re-election. The Auditors, Messrs. Cooper Brothers & Co., also retire and offer themselves for re-appointment.

Marconi's Wireless Telegraph Company, Limited.

BALANCE-SHEET, December 31st, 1914.

Dr.		£ s. d.	£ s. d.
To Capital—			
Authorised.			
1,250,000 Ordinary Shares of £1 each	£1,250,000 0 0		
250,000 7 per Cent. Cumulative Participating Preference Shares of £1 each	250,000 0 0		
	£1,500,000 0 0		
Issued.			
1,222,688 Ordinary Shares of £1 each, fully paid		1,222,688 0 0	
250,000 7 per cent. Cumulative Participating Preference Shares of £1 each, fully paid ...		250,000 0 0	
			1,472,688 0 0
To Bills Payable			19,973 9 0
To Sundry Creditors			170,398 8 6
To Reserve for Expenses Unpaid and Payments in Advance			28,035 17 11
To General Reserve Account			867,530 0 6
To Profit and Loss Account—			
Balance as per last account, December 31st, 1913		76,549 15 7	
Profit for the year as per Account		232,716 8 11	
			309,266 4 6
To Contingent Liability on Shares in Associated Companies and Investments of which £40,000 has since been paid	£90,862 10 0		
			£2,867,892 0 5

	£ s. d.	£ s. d. Cr.
By Cash at Bankers and in Hand		57,486 19 1
By Temporary Investments and Loans Against Securities		270,304 1 8
By Sundry Debtors, Debit Balances and Expenditure on Foreign Developments		726,252 2 3
By Stock at Cost or Under as certified by Officers of the Company		164,142 3 10
By Freehold Works at Dalston	38,677 7 3	
Deduct Mortgage	13,611 12 4	
		25,065 14 11
By Freehold Property at Chelmsford and Plant, Machinery and Buildings at Chelmsford and Genoa Works		101,983 11 1
By Long-distance Stations in Ireland and Cornwall (including Stores) and Movable Plant at other Places		132,197 17 9
By Expenditure on Leasehold Premises, Office Furniture and Fittings, London, Chelmsford, and Foreign Agencies		30,333 14 6
By Shares in Associated Companies and Patents ... Shares held in Associated Companies are of a par value of £2,469,858 14s. 10d.		1,360,125 15 4
		£2,867,892 0 5

GODFREY C. ISAACS, *Director.*
HENRY S. SAUNDERS, *Director.*

Report of the Auditors to the Shareholders.

We have audited the above Balance Sheet with the books in London and accounts from Rome. The item, Shares in Associated Companies and Patents, includes shares held abroad without nominal value entered in the Balance Sheet at £23,986 1s. 3d. and shares of the nominal value of £1,253,548 10s. 2d. out of a total nominal value of £2,469,858 14s. 10d. Except as to a small part we have seen letters stating that these shares are held on behalf of this Company. This item also includes shares for which certificates have not been issued. We have obtained all the information and explanations we have required. In our opinion such Balance Sheet is properly drawn up so as to exhibit a true and correct view of the state of the Company's affairs according to the best of our information and the explanations given to us and as shown by the books of the Company.

COOPER BROTHERS & CO.,
Chartered Accountants, } *Auditors.*

London, *July 14th*, 1915

Marconi's Wireless Telegraph Company, Limited.

PROFIT AND LOSS ACCOUNT

For the Year ending December 31st, 1914.

Dr.	£	s.	d.	Cr.	£	s.	d.
To Rents, Rates, Taxes, Travelling and General Expenses ...	21,138	14	1	By Balance of Contracts, Sales and Trading Account	371,071	14	6
To Salaries of Staff, Contribution to Staff Superannuation Fund and Directors' Remuneration	58,434	11	4	By Transfer, Share Warrant and other Fees	716	10	8
To Law Charges, Professional Fees and Patent Expenses ...	12,872	13	10				
To Depreciation of Plant, Machinery, Buildings and Furniture	19,668	8	7				
To Foreign Agencies Expenses	3,653	10	1				
To Station Expenses and Experimental Work	23,303	18	4				
To Balance, being Profit for the year carried to Balance Sheet	232,716	8	11				
	£371,788	5	2		£371,788	5	2

APPROPRIATION ACCOUNT.

Dr.	£	s.	d.	Cr.	£	s.	d.
To Dividend of 7 per cent. on Preference Shares for the Year ending December 31st, 1914, paid April 19th, 1915	17,500	0	0	By Profit and Loss Account—			
To Dividend proposed for the Year ending December 31st, 1914, on the Ordinary Shares at the rate of 10 per cent. per Annum	122,268	16	0	Balance Brought Forward as per Directors' Last Report ...	76,549	15	7
To General Reserve	100,000	0	0	Profit for the Year as per Account	232,716	8	11
To Balance carried to next Account	69,497	8	6				
	£309,266	4	6		£309,266	4	6

Marconi International Marine Communication Company (Ltd.)

Account of General Meeting

THE 15th Ordinary General Meeting of this company was held on July 7th last at the Whitehall Rooms, Hotel Métropole, Mr. Godfrey C. Isaacs (managing director) presiding.

The Secretary (Mr. Henry W. Allen, F.C.I.S.) read the notice convening the meeting, and the auditors' report.

The Chairman, after apologising for the enforced absence of Mr. Marconi, proceeded to deal with the balance-sheet, and to give some explanation of the figures.

On the debit side the Debentures are reduced from 6,250 to 6,094, representing £121,880 instead of £125,000, as appeared in the balance-sheet of 1913. This difference is accounted for by the purchase by the Company of 156 Debentures of a value of £3,120. The amount appearing to creditors is some £8,000 to £9,000 in excess of the figure of the preceding year, accounted for merely by the normal increase of business. On the credit side the plant, apparatus, furniture and stores show an increase of between £39,000 and £40,000, due to the additional number of telegraph stations installed on board ships during the year, after making the customary substantial allowance for depreciation upon all installations fitted in previous years.

The debtor balance shows an increase of some £13,000 to £14,000, consistently with the growth of the business. The available cash, represented by cash at bankers and loans against securities, is less than in the preceding year, in consequence of the considerable sum to which I have already referred which has been added to plant in the shape of additional stations installed.

Turning to the profit and loss account, it will be observed that, in consequence of the bigger business, expenses and salaries show an increase over the figures of the preceding year, but it will be satisfactory to note that these figures have not increased in the same ratio as the increase of business. Whilst each new installation entails additional salaries to operators, the establishment costs of the complete world-wide organisation increase but slightly. The revenue on the other side shows an increase amounting to between £28,000 and £29,000. I would point out, however, that in consequence of the outbreak of war the receipts from ships' telegrams and news services during the last five months of the year suffered very materially. In the circumstances, and bearing in mind that ours is not the nature of business which derives any advantage in consequence of the war, I think you will agree that the result of the year's operations is the more satisfactory. It shows a continuous development year by year of a sound and growing organisation. The net profit for the year, £55,668 1s. 1d., after deducting £28,000 8s. 10d. for depreciation and Debenture interest, will, I am sure, be regarded as highly satisfactory. This sum, added to the amount carried forward from the preceding year of £6,067 13s. 10d., leaves an available balance to the credit of profit and loss account of £64,855 14s. 11d. An interim dividend at the rate of 5 per cent. has already been paid, and it is now recommended that a final dividend of 5 per cent. in respect of the year 1914 should be declared, making 10 per cent. for the year.

As you have been informed in the report, some loss has been sustained in consequence of the destruction of ships by enemy submarines, and, having regard to the fact that this method of warfare continues, your directors have thought it desirable to place a sum of £10,000 to a special reserve account to provide for any eventualities as being the prudent course, although they contemplate that compensation will be received. After allocating a further sum of £3,500 to the repayment of Debenture account, there will remain an amount of £20,747 6s. 11d., which, it is recommended, should be carried forward in order that the Company shall have at its disposal ample cash resources. Every week we are adding new installations entailing additional capital expenditure, but adding steadily to the growth of our revenue. At the end of last year we had installed and were operating 905 telegraph stations upon the high seas; up to June 19th this year the number had increased to 970, and contracts continue to be entered into in much the same ratio.

It is with very great regret that we have to record the deaths of two of our colleagues, General Albert Thys, of Brussels, and Major Samuel Flood Page. These two gentlemen were associated with the Company from its very earliest days. They took a considerable part in the great struggle which the Company had for its existence. It is hard to appreciate to-day that an invention of this great value, and an organisation of such immense utility, should have required many years of very hard work and persistent canvassing before justifying its existence. At no time before, perhaps, has the value of Mr. Marconi's invention and the utility of this Company's organisation been more prominently emphasised than since the outbreak of war, and when peace once more obtains an interesting chapter may be written of the part played by the 2,000 Marconi stations fitted upon the vessels of the mercantile marine under the control and management of the Marconi Companies.

Our great thanks are due to our manager, Mr. Bradfield, and the other members of the staff, who have so ably handled our business during very difficult times; and the greatest appreciation is due to our magnificent army of telegraph operators, who have unflinchingly carried out their duties on board ship. As an instance I would mention the operator of the *Armenian*, whose cabin was blown to pieces by shell fire, but who stood to his duty to the end, and I am glad to say that Mr. Swift was miraculously saved and is unhurt. Again, all will probably have read of the admirable conduct of the operators on the *Lusitania*, who never left their wireless cabin until the hurricane deck alone remained above water. Upon the outbreak of war we called upon our operators for volunteers to serve as operators both in the Navy and the Army, and there are some 400 of our men now in those Services. We regret to have to record the death of five of them, who went down with their ships or were killed in action. On more than one occasion the Admiralty have expressed their satisfaction and appreciation of the resource and courage displayed by our men. (Cheers.) Ladies and gentlemen, I have nothing further to tell you with regard to the Company's affairs, and I now formally move, "That the report of the directors submitted together with the annexed statement of the Company's accounts at December 31st, 1914, duly audited, be received, approved, and adopted." Captain H. Riall Sankey, R.E., seconded the resolution.

No questions being asked, the Chairman put the resolution to the meeting, and it was carried unanimously.

The Chairman then moved, and Mr. Alfonso Marconi seconded, "That Captain H. Riall Sankey and Mr. Henry S. Saunders, the retiring directors, be re-elected directors of the company." The motion was unanimously agreed to.

Captain H. Riall Sankey moved, and Mr. Henry Saunders seconded, "That the remuneration of the directors for the year 1915 shall be the sum of £2,000, subject to such further sum, if any, as may be determined at the next general meeting of the Company, and that in respect of the year 1914 an additional £1,000 shall be paid to the directors," and the resolution was unanimously carried.

The Chairman moved, and Mr. Alfonso Marconi seconded, "That a final dividend of 5 per cent., equal to 1s. per share, less income tax, upon the capital now issued and paid up, be and the same is hereby declared for the year ended December 31st, 1914; that the said dividend be payable on July 31st, 1915, to the shareholders now registered on the books of the Company and to holders of share-warrants to bearer." The resolution was unanimously passed.

Mr. W. W. Bradfield moved, and Mr. C. J. Ketteridge seconded, "That Messrs. Cooper Brothers & Co. be re-elected auditors for the ensuing year, and that their remuneration for auditing the accounts to December 31st, 1914, be 250 guineas." The resolution was unanimously agreed to and the proceedings then terminated.

PERSONAL PARAGRAPHS.

Air-Mechanic Leonard Newns.

It is right that the authorities should take stock of the talent and skill of the nation in order that they may best apply it to the needs of the country in a time of national emergency like the present. Many ways in which the wireless telegraphist can serve his King and Country have presented themselves, and not a few of these practical young men have volunteered for service at home and abroad. It is with pleasure, therefore, that we hear of the award of the D.C.M. to Air-Mechanic Leonard Newns, of Tabley, near Knutsford, for plucky conduct in France. He joined the service of the Marconi International Marine Communication Co., Ltd., in 1912, and served on board the s.s. *Devonian*, *Mechanician*, *Manco*, and *Canning* in the capacity of wireless telegraphist. When war was declared Newns' ship was then lying at New York. His patriotic instincts at once came to the fore, and on his return to England he immediately enlisted in the Royal Flying Corps. Within three weeks he found himself in France, and in a very short time his expert knowledge of wireless telegraphy was detected. He received promotion from mechanic to the Wireless Telegraph Department, and thus became the medium between "men in the clouds" and the officers in charge of the guns. The act which gained him the coveted distinction was of a high degree of gallantry. He was in the trenches when a shell shattered a huge oak tree in whose shadow he was stationed. He thought it time to quit, and he set off on his three-mile run along the bank of the river Yser. When quiet ensued, he remembered his instruments and records, and of what advantage would fall to the enemy if they came into his possession. He was warned not to return, but he did so and secured the tackle. Altogether his act constituted a brilliant achievement, and we take this opportunity of offering him our congratulations.

We are advised that in connection with the proposed wireless service between the United States, Honolulu, and Japan, Mr. E. J. Nally, the vice-president and general manager of the Marconi Wireless Telegraph Company of America, has left New York. He will visit the Pacific Coast and the Hawaiian Islands. The Japanese Government stations are nearing completion, and preliminary tests are in course of progress.

At the meeting of the Council of Armstrong College held recently at the Medical College, Newcastle, the secretary was instructed to convey to Mr. Morris-Airey, Lecturer in Physics, the congratulations of the Council on his appointment to H.M.S. *Vernon*, with the rank of Lieutenant, R.N.V.R., specially for the purpose of wireless work. Mr. Morris-Airey has devoted special attention to radio-telegraphy.

We are sure a large number of our readers will be pleased to hear that Mr. H. Francis White, of the Marconi International Marine Communication Company, Ltd., was happily married on June 23rd to Miss Gertrude Edith Thomas, of Crouch End.

The ceremony took place at Christ Church, Crouch End, and was solemnised by the Vicar, the Rev. C. J. Sharpe, in the presence of a large gathering of relatives and friends. The bride, who was dressed in white charmeuse and carried a sheaf of lilies, was attended by four bridesmaids attired in white taffeta and voile, carrying bouquets of pink roses. The bride was given away by her father, Mr. J. Thomas, of Crouch End, and the duties of best man were ably carried out by Mr. J. C. Hawkhead, who for a number of years has

Mr. and Mrs. H. F. White.

been closely associated with the bridegroom during his long service with the Marconi Company. Dr. Robson officiated at the organ.

After the ceremony a large company of guests was received at the bride's house, where the many presents received were displayed. Mr. and Mrs. White afterwards proceeded to Torquay for the honeymoon, and were favoured by most delightful weather.

The bridegroom's old associates and many friends in the Marconi service presented the happy pair with a handsome canteen of cutlery, and amongst the numerous presents were a handsome dinner service and a cheque from the bridegroom's father, a cheque from the father and mother of the bride, a set of fish carvers from Mr. and Mrs. G. A. Manson, and a French onyx clock from the best man. Many other presents of silver and glass were received from friends and relatives, and by good fortune the too frequently occurring duplication was conspicuous by its complete absence.

A few words dealing with Mr. H. F. White and his association with the Marconi organisation may be of some interest. Mr. White was educated at Blackheath College, and joined the Marconi International Marine Communication Company on August 1st, 1904. He spent a number of years at sea as a wireless operator, serving on the *Teutonic, Majestic, Caronia,* and other liners of the North Atlantic trade, and afterwards spent some time on the South American runs, being one of the first operators on the Royal Mail Steam Packet Company's ships. In due course he was appointed to the rank of inspector, and whilst holding this position spent an exciting and interesting time in the North American icefields with the Newfoundland sealing fleet.

About three years ago Mr. White took an active part in the then newly formed London school of the Marconi Company, and will be remembered in this connection by many of the junior operators in the service. At a later date he was appointed to his present position as manager and agent at the Company's depot at Newcastle-on-Tyne. Many of his old *confrères* will remember the occasion on which, as conductor of the Marconi House Orchestra, he was the first recipient of the handsome silver cup which was presented by Mr. Godfrey Isaacs for competition between the bands of Marconi House and the works at Chelmsford.

Mr. White has asked us to take this opportunity of thanking on his behalf the many kind friends in the wireless service who sent telegrams of congratulation and subscribed to the handsome canteen of cutlery.

Mr. Bradley John Bartlett, of Roundmead, Malmesbury, has attained a notable success in a recent naval examination in Wireless Telegraphy. Of a large number of candidates he was placed first, and gained 100 per cent. of marks in that subject. He also passed his rating examination with 93½ per cent. of marks. At the beginning of July he went to Portsmouth for further tests, in which he hoped to be successful. Mr. Bartlett was educated at Malmesbury Secondary School, of which last year he was top boy. He is an accomplished cornet player, and in that capacity has joined the naval band of H.M.S. *Impregnable*, on board of which ship he is training at Devonport.

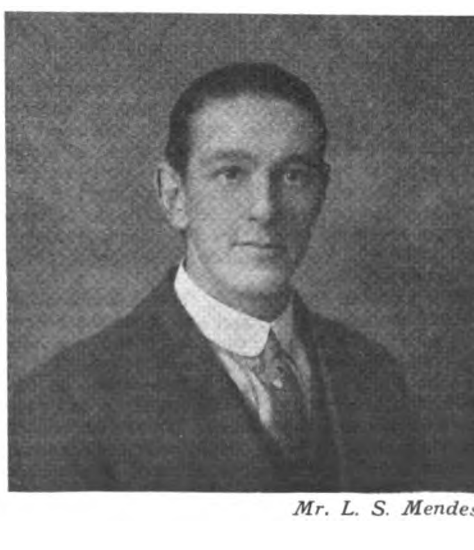
Pluck and endurance have again asserted themselves, this time through the person of Mr. Claude Hendry. He acted for some considerable time as wireless operator on board H.M.S. *Vulcan*, whilst that ship was lying in the River Tay at Dundee. He had, however, relinquished the post to become wireless telegraphist in the Air Service. His Majesty the King has now been graciously pleased to confer upon Mr. Hendry the Albert Medal. The act which gained him the coveted distinction is as follows :

Whilst in flight 10 miles to the north of Yarmouth a bomb accidentally exploded, destroying the aeroplane and precipitating the occupants, Flight Lieutenant Lan Davies and Telegraphist Hendry, into the sea from a height of about 150 feet. When the machine fell Hendry managed to swim clear, but the Flight Lieutenant remained in his seat and quickly became unconscious. Hendry, seeing this, immediately returned, and diving under the wreckage, succeeded in rescuing the officer. Some half an hour later the steam drifter *Noreen* of North Shields arrived at the spot. By that time, owing to the fact of his having supported the insensible man, Hendry was very exhausted, and both the aviators were taken aboard and conveyed to Lady Crossley's Hospital on the Quay at Great Yarmouth.

We congratulate Mr. Hendry, and would say that he is only the fifteenth recipient of the Albert Medal since its institution in 1867. The honour of its receipt is eagerly sought, and the last medal was granted in 1913.

Last month, in this column, we recorded the promotion of Warrant Telegraphist F. J. Linnell to the rank of Flight Sub-Lieutenant. Whilst the magazine was in the press, Sub-Lieutenant Linnell succeeded in obtaining his pilot's certificate at the Hendon Aerodrome, where he had been for some time training. We must again congratulate our friend on his progress, and wish him every success in other interesting if somewhat perilous duties.

It is with deep regret that we have to record the death of Mr. Leonard S. Mendes, a member of the



Mr. L. S. Mendes

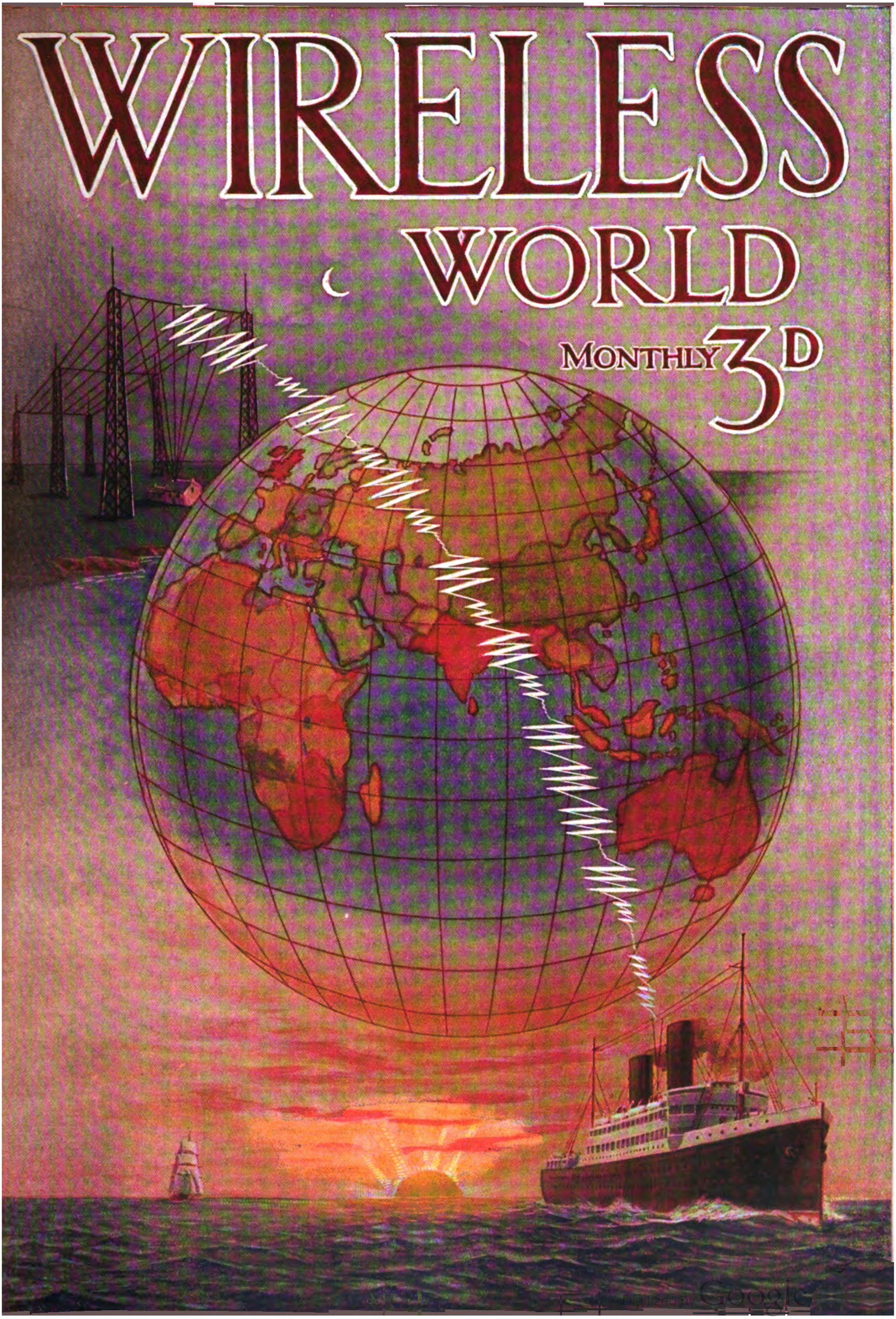
operating staff of the Marconi International Marine Communication Co., Ltd. Mr. Mendes, whose home was in Manchester, joined the Marconi Company in December last, and, after performing some special duty in connection with the war, served for some time on the s.s. *Minnewaska.* On April 4th Mr. Mendes was landed from his ship at Alexandria and placed in hospital suffering from tubercular pleuritis. As soon as he was well enough to be moved he returned to England, and proceeded home on sick leave. Although everything possible was done to facilitate his recovery, Mr. Mendes made no real progress, and, becoming worse, passed away on June 21st. Deep sympathy is felt for Mr. Mendes's mother in her sad bereavement.

Sergeant R. Shorter.

One of the first of the Marconi House uniformed staff to be called up for service at the beginning of the war was Bombardier R. Shorter, a reservist of the Royal Field Artillery. Bombardier Shorter, soon after rejoining his regiment, proceeded to France and took part in the great retreat at Mons. Amongst the exciting experiences through which he has passed may be mentioned an attempt to stop a motor-car containing some German officers. Shorter managed to achieve his object, although he himself was knocked down and suffered injury to his leg and head.

As a result of the injuries sustained, Bombardier Shorter returned to England and spent some time in hospital. We are glad to record that he has now completely recovered, and was able recently to visit his friends at Marconi House attired in the uniform of a sergeant, to which rank he was promoted in the middle of June. We are sure all of the staff will join with us in offering Sergeant Shorter heartiest congratulations and best wishes for the future.

To the long list of brave men who have gone unflinchingly to their doom has yet to be added another name, that of "Pegg," a wireless boy on board H.M.S. *Majestic,* who was drowned when that ship was torpedoed on May 27th last whilst fighting Britain's battles in the Dardanelles. He died, as do most of those who "go down to the sea in ships," like a hero. A correspondent writes that the torpedo struck the *Majestic* just by the sea gangway. He says, "The poor old ship shook terribly. A huge volume of water shot up to port some 250 feet in the air. Her end had come. Men obeyed orders to the last. All recognised that it would be a fight for life. Everyone aft was cool. There was no panic whatsoever. Transports sent boats; trawlers and tugs came close in, but all had to take to the water to get saved." Such is a pen portrayal of the last anguish of the good ship *Majestic,* and in this turmoil one yielded up his life, the promising life of a youth.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THE WIRELESS WORLD

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WHAT WOULD HAVE HAPPENED?

WHAT would have happened during the past year if Germany had not been in wireless connection with America? Mr. Isaacs reminded the shareholders of the Marconi Company in a fine speech, reported elsewhere in this issue, of the fact that within a few hours of the declaration of war Germany's cables had been cut, and it was thanks only to the fact that she had not, like Great Britain, postponed her imperial wireless chain that she owed the preservation of many million pounds' worth of shipping and cargo. If it had not been for her wireless that would have been lost. If it had not been for her wireless the whole of Germany's Press campaign against England in the United States of America would have failed through sheer inanition. The U.S.A. would still have been full of "hyphenated Americans," whose efforts to serve their derelict Fatherland have made them notorious all the world over, but their Press artillery would have been useless for lack of munitions. As it is, these have been all the time provided in one steady unceasing torrent of radio-waves from the Fatherland. Such would have been one of the results of Germany's inability to communicate directly with America, but how about loss of communication the other way round? Let us suppose that Captain Boy-Ed, Count Bernstorff, and the egregious Dernburg had been unable to concoct their apparently innocent messages aimed at the destruction of British commerce. The German Pirate King would have been unaware of the dates of sailing, the routes, the cargoes, the armament, or lack of armament, of his possible victims. It is not impossible that the *Lusitania* might be still afloat, and that diplomatic relations between Germany and the States might not have been in the strained condition which characterises them to-day. We do not blame our cousins across the water; honourable persons like ourselves, they are prone to "think no evil." They, like us, have had to learn the lesson that they are dealing with a nation to whom confidence means not obligation, but an opportunity for villainy and deception. They are "still learning," and their recent action in the case of the Sayville station is one of the "firstfruits" of that knowledge.

Even as it is, with all the aid that wireless and their own duplicity have been able to give them, Germany is far from satisfied with the condition of affairs in which she finds herself. She is straining every nerve to devise fresh ways of communicating with the New World across the seas. Day by day in the American papers we find advertisements announcing that the German Atlantic Cable Co., of Cologne, in connection with the Commercial Cable Co. and the Postal Telegraph Co., offers the most direct cable route to Germany "and countries beyond," *via* the Azores. These routes can take messages by cable as far as Lisbon, but, in order to cross the intervening space into Germany, messages from the Peninsula are obliged to cross France or Italy, gallant Allies, whose territory and people form part of the belligerent forces investing the Teutonic Empire. In order to leap across the intervening space, there can be little doubt that the aid of wireless telegraphy has to be called into operation.

CAPTAIN W. H. G. BULLARD,
U.S.N.

Personalities in the Wireless World

CAPTAIN W. H. G. BULLARD, U.S.N.

THE recent appointment of the subject of our illustration to take charge of the Sayville (Long Island) wireless station, which has just been taken over by the United States Government, prompts us to believe that a few words concerning the career of this gentleman may be opportune at this juncture.

Captain William Hannum Grubb Bullard was born on December 6th, 1866, in the State of Pennsylvania, U.S.A. He early developed a taste for the life of the sea and his greatest ambition as a boy was to visit every quarter of the globe. In order to encourage this ambition his parents sent him at the age of sixteen years to the United States Naval Academy, and he graduated from that institution four years later (1886) with a brilliant scholastic record.

The next sixteen years of his life saw him on service in the United States Navy, and during that time his work carried him aboard various war vessels belonging to that country. At the end of this period of sixteen years Captain Bullard's sea life ceased, and his Government then commissioned him to look after important shore business in the United States Navy Department, having particular regard to electrical engineering, in which he had specialised throughout his career.

In 1912 the organisation of the Naval Radiotelegraphic service was seriously undertaken by the United States Government, and in November of that year Captain Bullard was appointed to the post of Superintendent of the Naval Radio service. In this position he has been the guiding spirit of the policy in regard to the development of wireless telegraphy in the United States Navy, and upon his department has devolved the responsibility of selecting sites and erecting the numerous high-powered radio stations situated at various points in the United States and its colonial possessions. When, as a direct result of the foundering in mid-Atlantic of the steamship *Titanic*, it was decided to hold an International Conference for Safety of Life at Sea, Captain Bullard was deputed to act as one of the delegates-plenipotentiary of the United States. In this connection he proceeded to London, where the Conference took place in November, 1913.

Reference has been made in the pages of this journal to the series of experiments carried out to determine longitude by means of wireless telegraphy. These trials were conducted between the Eiffel Tower station, at Paris, and Arlington station, in Virginia, U.S.A., and Captain Bullard was in charge on behalf of the United States Navy.

In the August number of our journal we printed an illustrated article on Germany's transatlantic wireless schemes in which it was shown that Germany had deliberately and persistently violated the neutrality of the United States in working this station. Under the care of Captain Bullard the Sayville station will now be worked by the United States naval radiotelegraphic operators, and, no doubt, under these new arrangements it will transact legitimate business and fulfil the uses which will be required of it by its present owners.

He is well known personally to radio engineers in England and on the Continent, as well as in the United States, and he is respected by all in the United States Naval service which he loves so well and serves so devotedly.

The Influence of Temperature and Pressure on the Sensitivity of the Carborundum Crystal Detector.

By BERTRAM HOYLE, A.M.I.E.E., Assoc.M.S.T., School of Technology, Manchester.

INTRODUCTION.

THE author has experimented on carborundum and other crystals used in wireless telegraphy, and thinks that a description of some of the results obtained may be of interest. He shows that at the temperature of liquid air carborundum ceases to be useful as a wireless detector; whilst at a high temperature of the order of 500° C. carborundum becomes very sensitive; in fact, more sensitive than under any other circumstances, even without the use of a local auxiliary voltage.

G. W. Pierce,* G. W. Pickard,† and P. Brenot ‡ and others have experimented on crystals of carborundum, and the conclusions arrived at by Prof. Pierce are as follows:

(i.) That the ratio $\frac{I_1}{I_2}$ of the two currents obtained for the same applied voltage in each direction diminishes as those currents increase.

(ii.) That the rectified current for a given alternating voltage is of the order $\frac{1}{2}(I_1—I_2)$ for the same continuous voltage.

(iii.) That there is distortion of the current wave form at or near zero due to $\frac{d\,R}{d\,V}$ being very great.

(iv.) That increasing one contact area and reducing the other gives larger rectification. Apparently, therefore, the rectification is conditioned by the localisation of the energy of the circuit at the high resistance boundary between two different classes of conductor—*i.e.*, the crystal and the metal contact.

[I_1 being the larger current.]

The experiments of Pierce (*loc. cit.*) were made at ordinary temperatures, but he makes the suggestion that it would be interesting to see what effect, if any, low temperature had on the unsymmetrical conductivity of carborundum. The author

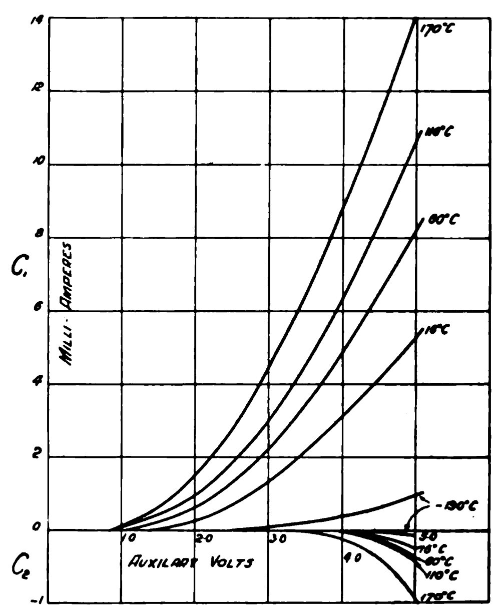

Fig. 1.

* G. W. Pierce, on "Crystal Rectifiers for Electric Currents and Electrical Oscillations," *Phys. Review*, Vo. 25, p. 31, 1907; Vol. 28, p. 153, 1909.

† G. W. Pickard, on "The Carborundum Wireless Detector," *Elec. World*, N.Y., Vol. 48, p. 994, 1906.

‡ P. Brenot, on "Détecteurs à contacts imparfaits fonctionnant sans source d'énergie auxilia re," *La Lumière Electrique*, Tome VIII., 2e Série, No. 48, p. 265, 1909.

TABLE I. CURVES 1 AND 2.

Volts. c.c. and a.c.	Temperatures and Currents.														
	—190° C. Milliamperes.			+16° C. Milliamperes.			+60° C. Milliamperes.			+110° C. Milliamperes.			+170° C. Milliamperes.		
	I_1	I_2	Ir	I_1	I_2	Ir	I_1	I_2	Ir	I_1	I_2	Ir	I_1	I_2	Ir
0·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1·0	—	—	—	—	—	—	—	—	—	·02	—	—	·05	0	·05
2·0	—	—	—	·4	—	·2	·62	—	·35	·95	—	·65	1·5	0	·75
3·0	·1	—	·1	1·5	—	·65	2·3	—	1·1	3·0	—	1·7	4·4	0·01	2·1
4·0	·4	·01	·25	3·2	·04	1·4	4·9	·05	2·3	6·4	·07	3·5	9·3	0·1	4·2
5·0	1·0	·06	·42	5·2	·26	2·3	8·3	·32	3·7	10·8	0·38	5·8	14	1·0	6·7

has been experimenting with carborundum and other materials when worked as detectors in wireless telegraphy and has investigated the influence of low temperatures on many combinations.

The method employed was to apply an adjustable known c.c. voltage, first in one direction and then in the other, obtaining the value of the corresponding currents, I_1 and I_2 In the complete experiments an alternating voltage was also applied, and for the same voltages the mean rectified current obtained was always of the same order as $\frac{1}{2}(I_1—I_2)$ within the limits of experimental error; $\pm$ 5 to 7 per cent.

A dash in the above table signifies that the current is less than 0·01 milliampere, and since this is negligible compared with the total range of current employed, and could not be shown on the graph, it has been omitted.

The curves show that at the temperature of liquid air the resistance rises considerably and that the mean unidirectional current obtained (Ir) for a given R.M.S. alternating voltage is reduced.

The high-temperature experiments described above were made before the low-temperature ones, since it was found to be very difficult to remove drops of water formed after the crystals had thawed without altering the pressure of setting and, therefore, affecting the constancy of the results obtained. The crackling due to the presence of a drop of water in the hot oil was sufficient to completely upset the constancy of readings obtained at any given voltage and temperature. The values of Ir plotted agree very well throughout with $\frac{1}{2}(I_1—I_2)$, as Prof. Pierce has shown for ordinary temperatures, for carborundum.

The family of curves (Curves 1 and 2) were obtained with a crystal of carborundum supplied for use in the Marconi portable wavemeter; and they show that the effectiveness of carborundum is improved with rise of temperature above normal; apparently because the resistance is thereby reduced.

Employing an auxiliary pressure of four volts, the mean rectified current obtained at 16° C. is six times as great as that obtained at —190° C.; the applied R.M.S. voltage being constant. A further increase in Ir, amounting to about three times, takes place from +16° C. to +170° C. Temperatures much in excess of +170° C. could not be investigated without a different construction of apparatus. At +170° C. the oil

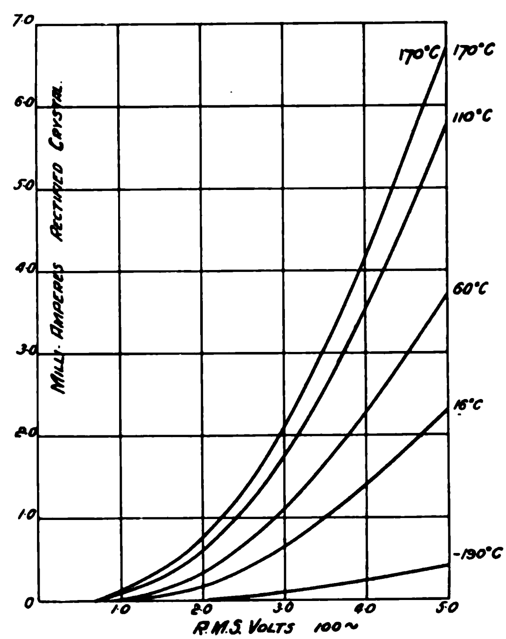

Fig. 2.

employed boiled or distilled off the lighter constituents and at 180° C. the solder or lead used for mounting melts and drops the crystals. On this account a totally different arrangement of crystal holder was devised by the author, whereby the crystals could be heated by radiation from a surrounding steel tube and their temperatures were determined by means of a copper-eureka thermo-junction. The constancy of temperature obtainable at 500°–700° C. was of the order of 5° C. change over a period of one minute, during which time all the necessary readings for one curve could be taken for that particular temperature. The crystal was subjected to an adjustable known pressure applied by means of a lever and running weights.

Various preliminary measurements were made, using an auxiliary voltage in series with the crystal, and the author found that over a wide range of strength of received signal the mean rectified current in the crystal circuit was a maximum for some definite auxiliary voltage, which maximum was a function of both temperature and pressure.

Maintaining the oscillatory current constant while raising the temperature was found to raise the maximum value of the mean rectified current obtained (I*r*) and to lower the value of the auxiliary E.M.F. at which this occurs—*i.e.*, the optimum auxiliary voltage is reduced.

The following results embodied in Curve 3 illustrate the constancy of the optimum value of the auxiliary voltage for the temperatures. See Curves A and B at 16° C and A and B at 120° C. They also show that increasing temperature lowers this optimum auxiliary voltage; in the case shown from about 1·05 to 0·8 volts.

For Curves A: V.R.M.S.=0·625 volts. ~0·3×10⁶ per sec.

For Curves B: V.R.M.S.=0·3 volts. ~0·3×10⁶ per sec.

TABLE II. CURVE 3.

V. (aux.)	Mean Rectified Current in Micro-Amperes. Ir. Curve A. 16° C.	Curve B. 16° C.	Curve A. 120° C.	Curve B. 120° C.
0·0	2·4	0·95	3·2	6·0
0·2	2·5	1·0	4·0	8·1
0·4	3·0	1·3	5·0	10·0
0·6	3·8	1·8	6·1	11·3
0·8	4·5	2·4	6·5	11·9
1·0	5·2	2·8	5·5	10·4
1·2	4·5	2·6	4·0	8·0
1·4	3·8	2·2	—	—

The author found it possible to make this maximum sensitivity occur at zero auxiliary voltage by suitably adjusting the temperature.

The following results embodied in Curve 4 show the type of result obtained; and in this particular case they show that the best temperature is about 500° C.

TABLE III. CURVE 4.

Auxiliary Voltage.	Micro-amperes Rectified. Ir. 16° C.	150° C.	280° C.	400° C.	500° C.	600° C.
0·0	1·05	3·0	6·4	10·4	12·4	0·2
0·1	1·2	3·3	6·8	12·0	14·5	0·5
0·2	1·35	3·85	7·75	13·0	12·2	—
0·3	—	4·2	9·0	12·0	10·5	—
0·4	1·8	4·85	9·9	10·5	—	—
0·6	2·25	6·25	9·2	—	—	—
0·8	3·0	7·1	8·8	—	—	—
1·0	3·35	7·1	—	—	—	—
1·2	3·2	6·1	—	—	—	—
1·4	2·85	—	—	—	—	—

The sensitivity obtained in the present case at 500° C. (optimum temperature) with zero auxiliary voltage is greatly in excess of that obtained at ordinary temperatures using the optimum voltage in the latter case. At any given temperature the sensitivity is a function of the mechanical pressure applied to the crystal contacts. Hence there must be some optimum pressure and temperature with no auxiliary voltage for a given crystal setting, which can be found by trial.

Oscillations having an R.M.S. value of 0·01 volts on the receiving circuit condenser were generated, the frequency of oscillation being 300,000 per sec., and train frequency

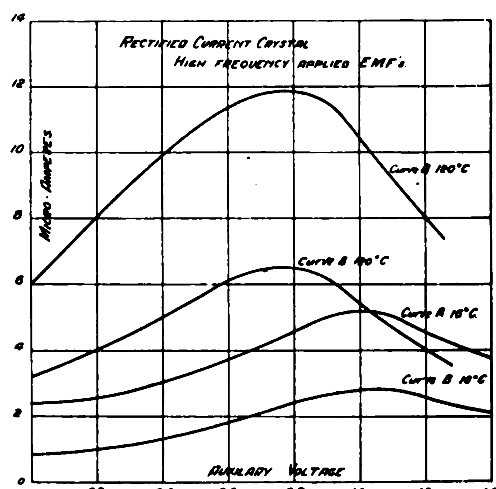

Fig. 3.

500 per sec. Readings were taken of I_r at various mechanical pressures for various temperatures, from 16° C. to 550° C. for different grs. load on the crystal.

TABLE IV. CURVE 5.

Temperature.	Micro-amperes Rectified. I_r for Various Loads.				
	5 grs. (*a*)	16 grs. (*b*)	33 grs. (*c*)	66 grs. (*d*)	100 grs. (*e*)
300° C.	0·13	0·24	0·28	0·36	0·45
350° C.	0·4	0·54	0·58	0·65	0·65
400° C.	0·77	0·96	1·1	1·16	0·81
450° C.	0·46	0·66	0·88	1·01	0·6
500° C.	—	—	0·23	0·35	—
550° C.	—	—	—	—	—

From other curves (not shown) the optimum temperatures and pressures are found to be 425° C. and 55 grs. load on crystal. Experiment on the crystal which had yielded the results expressed by Curve 5. showed that at 16° C. with 55 grs. load the optimum auxiliary voltage was 0·85 volts, at which voltage the mean rectified current was 0·3 μa for the same oscillating voltage (0·01 v.) as used for the results given in Table IV. and corresponding curves (5).

Without an auxiliary voltage and at ordinary temperatures, the crystal in question showed no measurable I_r (*i.e.*, not more than 0·01 micro-amp.) for the strength of signal used ($V_{R.M.S.} = 0·01$). The value of $V_{R.M.S.}$ was calculated, knowing the R.M.S. current, using a Duddell thermal galvanometer in the oscillatory circuit and knowing the capacity and train frequency.

In this case $V_{max.} = V_{R.M.S.} \sqrt{\frac{N}{8nd}}$,

n being oscillation frequency $= 300{,}000$,
N being train frequency $= 500$,
d being the logarithmic decrement $= 0·05$.

$$V_{max.} \doteqdot 0·01 \sqrt{\frac{500}{8 \times 300{,}000 \times 0·05}} \doteqdot 0·02 \text{ volts.}$$

Thus it is to be expected from previous characteristics of I_1 and V that no appreciable current flows for such a low voltage, Curves 1 and 2.

Another interesting point to be noticed from the results given in Curves 4 and 5 is that there is no rectification current obtained under any circumstances at 500° C. to 700° C. In fact, tests show that at these temperatures crystals of carborundum lose their unsymmetrical conductivity, and begin to obey Ohm's law. It is about 50° C. to

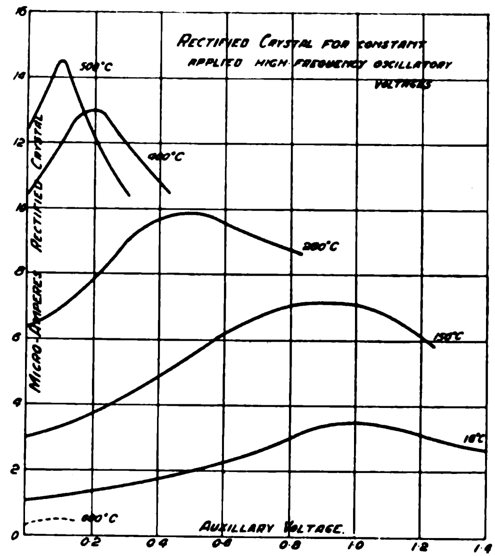

Fig. 4.

100° C. below this point that the best temperature is found.

For many radio-telegraphic measurements some form of detector giving a unidirectional current is highly desirable, but it must be constant and sensitive.

With good specimens of carborundum working at a high steady temperature with a suitable constant mechanical pressure applied, such measurements could be made with considerable accuracy. Carborundum hitherto has always been worked at ordinary temperatures with an auxiliary applied voltage, and is then of very stable sensitivity. Greater sensitivity, as has been shown, can be obtained by means of high temperatures with the additional advantage that the local auxiliary voltage and attendant apparatus is done away with. Thus it is not so much the experimental apparatus, *per se*, that is on the whole simplified, but a smaller amount of apparatus is in electrical connection with the receiver oscillatory circuit, and this reduces damping due to leakage and charging currents for such auxiliary apparatus.

CONCLUSIONS.

(i.) At the temperature of liquid air, —190° C., the ohmic resistance of carborundum is enormously greater than at ordinary temperatures for currents in both directions, and as a detector of oscillations the crystals become useless.

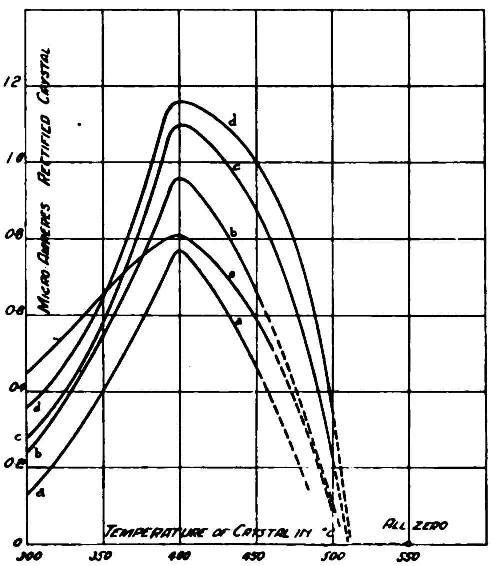

Fig. 5.

(ii.) At ordinary room temperatures (15° C.) the characteristic curves showing the relation between current and voltage show no appreciable current until a certain minimum voltage (from 0·5 to 1·5 volts) is exceeded.

(iii.) At ordinary temperatures it is well known that there is some "optimum" auxiliary voltage, and its value is in the neighbourhood where $\frac{d^2i}{dv^2}$ is a maximum.

(iv.) Rise of temperature up to a certain high value (500° C.) increases I_r, other things being equal, when no auxiliary voltage is applied.

(v.) For a given crystal working at high temperature without auxiliary voltage there is an "optimum" mechanical pressure for the particular "optimum" temperature.

(vi.) By suitably choosing the crystal, the mechanical pressure, and the temperature, it is possible to obtain from ten to fifteen times the value of I_r that one could obtain at ordinary temperatures without auxiliary voltage and for a given signal intensity.

In conclusion the author desires to thank the Manchester Education Committee for the facilities afforded for carrying out the above experiments at the wireless station laboratory of the School of Technology, Manchester.

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"SPARKS" FROM THE TROOPS.

That the London electrical engineers are far from being depressed is evident from the cheery tone of their publication, *The Eclipse*, which contains some very amusing matter. The following conundrums, perhaps of a highly technical nature, are culled from the back page of the journal in question :—

Where did the Ammeter ? In the Magnetic Field.

Why do the British Forces offer such good resistance ? Because they are OHMS.

Why did the Voltage ? Because it was told it would Die-in-a-mo.

"You know we are leading a shocking life," remarked the medical coil to his partner, the dry cell.

"Yes, I think we shall have to rest soon," replied the dry cell. "I'm beginning to feel a bit run down."

WIRELESS OPERATORS MUST NOT SWEAR.

A wireless operator in Massachusetts was recently admonished by the United States Department of Commerce for swearing by wireless, and warned that his licence would be revoked if he were not more careful with his language.

Digest of Wireless Literature

ABSTRACTS OF IMPORTANT ORIGINAL ARTICLES DEALING WITH WIRELESS TELEGRAPHY AND COMMUNICATIONS READ BEFORE SCIENTIFIC SOCIETIES.

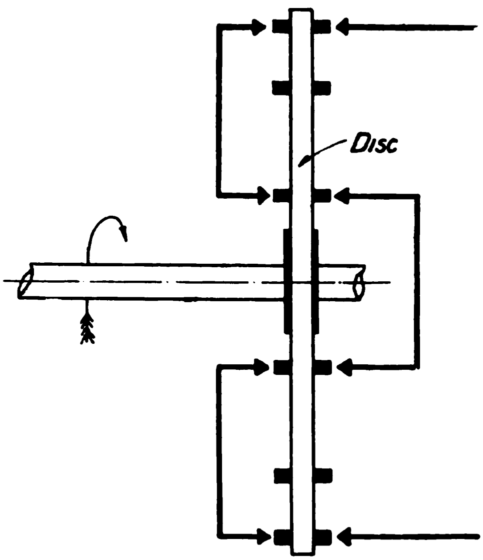
SPARK-GAPS AND EFFICIENCY.

In the July number of the *World's Advance* Mr. A. S. Blatterman contributes a paper of considerable interest to amateurs, under the title of "Spark-Gap Efficiency and a New Type Gap." Firstly, Mr. Blatterman refers to the spark-gaps used in the early days of wireless and the difficulties which had to be overcome. The first gaps were merely two brass balls, which rapidly became blackened and pitted by the oxidising and corroding action of the spark. With the introduction of higher powers it was found that this form of gap gave rise to a powerful arc following the first discharge of the condenser, which effectually prevented further oscillations. Various methods were tried for the purpose of overcoming the difficulty, amongst them being the use of a transverse magnetic field and a strong blast of air. Further experience led to the utilisation of resonance in the transformer circuits, the inductance in the circuit preventing the heavy rushes of current necessary for maintaining the arc.

The writer next deals with the subject of spark frequencies. The spark rate of apparatus using the early spark-gap in connection with induction coils, and later with transformers, was very irregular, so that the signals produced in the telephones at receiving stations were of a more or less crackling sound, often difficult to separate from the similar sound effects of atmospheric electricity. Wien, Austin, and others who investigated the subject of spark frequencies found that the telephone receiver as well as the human ear is not as sensitive to low-pitched sounds as it is to those of higher frequency, the best results being obtained with frequencies in the neighbourhood of 900 or so per second. Accordingly experimenters set to work to devise means for producing sparks of this frequency. Mr. Blatterman then refers to disc dischargers and the use of special alternators having a frequency in the neighbourhood of 500 cycles per second. What is required, says the writer, is a rapid, regularly recurring discharge, which is damped out after a few oscillations. An arrangement whereby tight coupling with high efficiency at the oscillation transformer can be utilised and still maintain single wave radiation is much to be desired.

After referring to the quenched gap and its requirements for successful working, the writer states that he has recently built a spark-gap of a rotary form, in which, instead of only two sparks in series, there are eight. By this arrangement the total discharge voltage is distributed over eight gaps instead of two, so that, while the total gap length through the discharger remains practically unaltered, the length of the individual gaps is reduced approximately fourfold. There is, says Mr. Blatterman, a certain peculiar advantage in thus dividing the discharge among several gaps in series. The possibility of arcing is greatly reduced, for the voltage required to maintain an arc in the gaps is approximately eight times that required to sustain the *arc* with a single gap, whereas the voltage necessary to produce a *spark* through the eight gaps is about the same as (and sometimes less than) that required for the single gap.

The construction of the discharger is next described and illustrated by diagrams. It consists of a disc of insulating material ⅜ in. thick and 12 in. diameter, carrying 24 studs, which are threaded into the disc and clamped with lock-nuts. The fixed electrodes are arranged on each side of the disc, so that in passing from one terminal of the discharger to the other the current has to traverse the disc four times and pass through eight gaps. The manner in which



the gaps are arranged will be seen from the accompanying diagram.

Interesting particulars are given regarding the alloy used for the studs and electrodes. Copper and zinc were both found to have disadvantages, but an alloy of both proved very satisfactory. Finally an alloy was chosen in which copper predominated.

In operation the discharger is found to give excellent results. As far as the aerial current alone is concerned, the use of the eight gaps gives aerial ammeter readings from 20 per cent. to 30 per cent. higher than those obtained with two gaps.

In conclusion Mr. Blatterman states that it has been found that this series gap exhibits properties approaching those of impact excitation. This is due at least in part to the inherent cooling properties of the rotary gap and to the favourable relation of arc voltage to spark voltage in series gaps. The proper selection of a spark-gap alloy is of importance. In this connection zinc is one of the so-called non-arcing metals, and in general its addition to an alloy renders the alloy non-arcing. The series gap in the present case gives an improved power factor on the transformer and an increased overall efficiency into the antenna with lower aerial decrement.

ELECTRICAL STRENGTH OF AIR.

At the Annual Convention of the American Institute of Electrical Engineers Professor J. B. Whitehead, of Johns Hopkins University, in dealing with the electric strength of air, outlined the experimental basis upon which the modern conception of the structure of the air rests, and described several resultant theories of the nature of high-voltage corona. One of the strongest evidences of the correctness of modern theories of the electrical behaviour of gases is found in their accord with the kinetic theory of gases. The conductivity of the air is due to its having mixed with it electrified particles, or ions—some positive, others negative. With uniform ionisation between two parallel plates and a voltage high enough to produce saturation the current increases with increasing distance between the plates. The current passing through a gas is equal to the difference between the number of new ions formed per second and the number which disappear by recombination and diffusion. One of the most important properties of gaseous ions is their motion through the gas under the influence of an electric field. Values of the velocities of the ions and methods of finding them for different gases were given. The charge on an ion is the same for all gases, its value being that carried by the hydrogen atom in the electrolysis of solutions. The author presented a brief history of the physical researches which led up to the discovery of the electron, following this with a review of conductivity due to electrons. The second half of the paper was devoted to theories of corona formation, including those of Townsend, Russell, and Davis, and developing in particular the first named, which argues that the corona may be explained on the theory of collision.

In the discussion which followed, Professor Ryan remarked that the theory of ionisation by collision is now merely in its infancy, but is rapidly growing. He said that the studies of corona phenomena have not been completed, citing the case of the effect of increase in the frequency upon the sparking distance. With a 15-inch gap only one-fifth as great an increase in the voltage is needed to break down a certain added length of air-gap, with a frequency of 90,000 cycles per second, as with a frequency of 60 cycles per second. This result is attributable probably to the holding over of the ionisation from cycle to cycle (*Electrical World* Report).

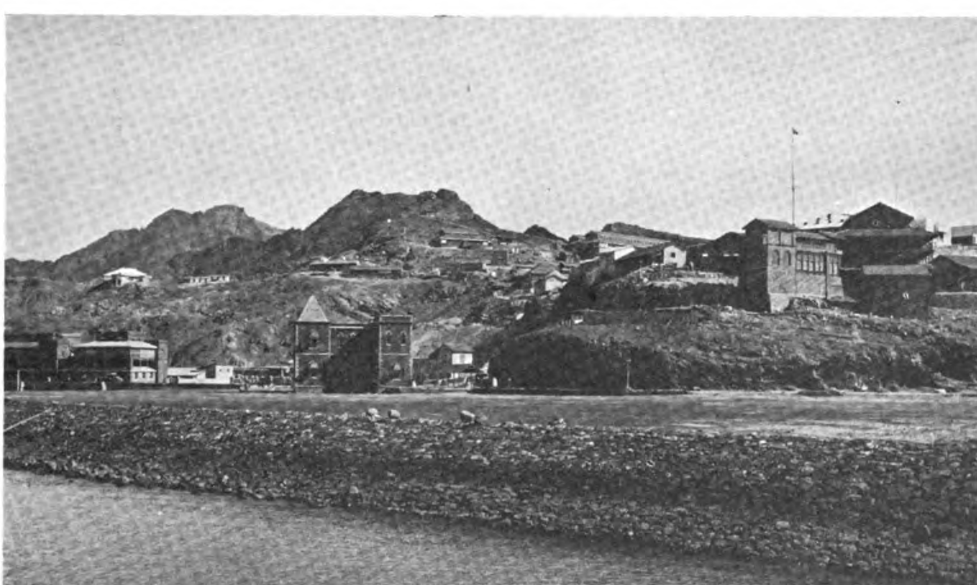
Wireless in Darkest Africa

A Visit to the Aden-Berbera Stations

AFTER having been roasted, broiled, skinned, and at times even driven to the use of bad language, by a burning sun mercilessly beating down out of a cloudless sky, cloudless from year end to year end, a request from the Editor for a few remarks about wireless in " DARKEST " Africa has anything but a stimulating effect.

On certain matters the mind of the native, undoubtedly, is plunged in impenetrable darkness, so in order to more or less justify the heading to these lines, and as an excuse for treating a serious matter lightly, a few remarks about the inhabitants of the particularly brilliantly-illuminated portion of " Darkest Africa " with which I am acquainted may not be out of place. As a rule the language employed to describe articles or phenomena which strike the imagination of the " unsophisticated savage " is full of poetic imagery, but in the case of "Wireless Telegraphy" there does not appear to be any feature which strikes the native imagination, and the Somaliland term " Tahf " applies to telegraphy " wired " and " wireless " alike.

In deference to the opinions of a particular friend of mine, who has been trying to humbug the native for as many years as I have spent months in trying to enlighten him—whose opinions I might add materially differ from anything and everything that has ever been written or said by any recognised authority on the subject—I will not attempt to trace the ancestry of the Somali. Sufficient for the present is the fact that he inhabits, graces or disgraces by his presence, the little known part of Africa whose littoral extends from French Somaliland eastwards along the southern shores of the Gulf of Aden to Italian Somaliland. He is rather a handsome ebony-skinned gentleman with features much more after the European type



General View of Aden.

Natives carrying an extension pole for the Berbera Station.

than those possessed by the majority of the sons of Ham. He is as proud as Lucifer, and his expression "Every Somali his own Sultan" should be ample justification for this statement. To see the gentleman in charge of the tennis boys of the Berbera Club swagger off duty in his white *tobe*, with his silver-headed ebony walking-stick thrust through his elbows and gracefully resting on his shoulders—practise this position, O ye Gilbertian readers!—is a veritable object lesson in gentlemanly outdoor deportment.

Not less genteel are the many ladies of the bazaar, who in spotless raiment and with ineffably graceful carriage haggle and barter over the fraction of a farthing with the Arab or Indian shopkeeper. When not under the direct surveillance of their lords and masters, the glad, glad eye is often lavishly flashed at the official who is fortunate enough, or unfortunate enough—according to his temperament—to be anywhere in the immediate neighbourhood. More interesting to the susceptible male heart is the picture of a string of burden camels being led by some dusky "gabad" (maiden) towards the open desert, what time her male relatives are lazily cleaning their teeth with a twig from a certain bush always used for the purpose. More often than not the human portion of a caravan carries its sandals swinging from its hands, but as to whether this method of treating footwear is the outcome of economy or comfort I am afraid I must refer the reader to my particular friend mentioned above.

A certain portion of the trading section of the Somali people travels quite considerably, Aden and the ports of the Red Sea and the Persian Gulf, as well as the more distant coast of British East Africa, receiving a fair share of attention. As a consequence electricity in its different manifestations is not entirely unknown to this section of the community, but as a matter of fact amusing incidents do occasionally arise on account of the ignorance of the great majority. I shall not forget in a hurry—and I feel convinced that the subject of my experiment will remember sufficiently well not to repeat his experience except under compulsion—the awe with which I was regarded by a native boatman, whom I invited to touch the sparking plug of a small detachable two-stroke petrol motor with which I had temporarily decorated the stern of his rickety craft. After a little persuasion I induced him to make a further essay, using a large spanner instead of his finger. The first lesson was not sufficient, but after receiving a second shock, in spite of the protecting spanner, and after almost precipitating the two of us into the sharkinfested waters of the harbour, nothing on earth would induce him to have any more dealings with the spirit-haunted machine. He did not appear to be quite sure whether Sheitan himself was in the machine, or whether I was the Evil One in person, but it must be admitted in his favour that he wished me to try on the same game with some of his friends who were loitering about the little jetty on our landing. On obtaining permission to explain matters to his friends, he proceeded with great gusto to enumerate the many delights consequent on contact with the sparking plug, but certainly appeared convinced that I was not exerting my Satanic powers and not playing the game when no result was forthcoming when his friends gingerly touched the now stationary engine.

Naturally, an electric shock, more than anything else connected with wireless telegraphy or electric lighting, creates the greatest impression, and even the educated native requires a practical demonstration before he acquires the slightest respect for high tension current. During the last few years a number of peons engaged as linesmen have become accustomed to slight shocks—mainly due to atmospheric causes—when erecting land lines. Of course, the substitution of wireless stations for land line offices and the policy of coastal concentration led to the rolling up of existing land lines, but during the last few months a new line has been erected into the interior. During the erection of this line, which on account of the dry nature of the country is capable of transmitting messages even when hundreds of yards of uninsulated wire may be lying on the ground, the linesmen were much surprised to receive more powerful shocks than before. When trying to demonstrate that the shocks were harmless I found that they were due to currents induced by the Berbera wireless station when transmitting, and that messages could be read by the sense of touch.

At one of the coast towns where a small wireless station was erected to take the place of a land line office the plain aerial system was adopted as being sufficiently powerful and economical. The original land line operators, who were Somali products of a French Catholic Mission which existed at one time in the country, took over the new station and successfully operated it within twelve hours of its completion. The only difficulties experienced were the adjustment of the spark and the manipulation of the hearer transmitting key. In justice to the European operator, however, it must be mentioned that the old land line was worked on the vibrator system, on which method reception is by means of the telephone headpiece, which reproduces signals of a type practically identical with those received on the Marconi wireless receiver. Further, the Somali operator could not, of course, have passed the qualifying examination for the Postmaster-General's certificate, but the

Steamer Point and Post Office Pier, Aden.

incident is mentioned as showing the remarkable aptitude shown by the Somali for tackling innovations. The housing of the instruments in a small wooden office was responsible for the leading in insulator occupying a rather low position. Although warned that contact with the insulator would have unpleasant consequences, the truth of the warning had to be driven home by actual experience. On seeing the operator in charge, who had carelessly touched the insulator with his head whilst transmitting—he insisted on standing up for so doing instead of using his instrument seated in the usual way—frantically holding his head with one hand and clutching the door jamb for support with the other, I was unable to refrain from laughter, and this gave rise to the worst case of disrespect encountered during my stay in the country. The poor fellow, with hair curlier than ever, and showing the whites of his eyes in a manner calculated to drive the cleverest Moore & Burgess corner-man into suicide, declared, " It all right you laugh, sir, but your head not fly in pieces all over the office."

"Elephant's Back"—near Gold Mohur Valley.

It has not often been the case hitherto that the introduction of wireless telegraphy into a country precedes that of electric lighting.

In the case of Somaliland, however, the employment of a mechanic to look after the small generating plant at Berbera led to the introduction of lighting plant in that town. A small 15 h.p. high-speed Gardner oil engine is used to supply the necessary driving power to a 9 kw. dynamo, which is utilised for charging up a 480 amp. howr. accumulator battery, the current from this battery being used by the lights and fans of Government House, the hospital, post office, club and bungalows of the European officials. Already various merchants of the Bazaar have asked for the supply of electric light, but the capacity of the plant precludes any possibility of their wishes being fulfilled for the present.

A description of the wireless stations at present under the control of the Protectorate has already appeared in THE WIRELESS WORLD (see issue No. 1 of April, 1913, pp. 7–13), but for the benefit of the more recent subscribers to this interesting monthly it may be as well to state that in addition to the 1½-kw. installations erected at Aden and Berbera in 1910 a third ½-kw. P.A. station has since been built at Bulhar, some 40 miles west of Berbera, for communication between the two latter ports. The Bulhar station does not deal with ship traffic.

It is anticipated that other stations will be erected in the near future, and on account of the interesting and difficult nature of the country the operations in connection with this work should form subject matter for a further interesting and illustrated article on Wireless in Darkest Africa.

The special utility of wireless telegraphy for opening up the difficult Hinterland of countries like Somaliland is admirably described in the account of " Wireless Telegraphy in the Italian African Colonies," contained in No. 12 of Vol. 1 (March, 1914). These regions have proved almost inaccessible even to the intrepid officers of the Italian Navy, but as soon as an expedition could be fitted out with field wireless apparatus, maintaining constant communications with land stations, the problem was solved and Italian peaceful penetration secured.

The cosmopolitan town of Aden forms the point of communication with the outside world. It is a city containing a very miscellaneous crowd of about 45,000 inhabitants, and forms the starting-point from which Europeans make their way into this land of unsophistication, as well as the goal of all returning travellers on their way home. Aden-Berbera have been fully dealt with in THE WIRELESS WORLD, No. 1 of Vol. 1 (April, 1913).

A PROGRESSIVE CAREER

A short biographical sketch of Mr. S. Fenn, late Traffic Manager of the Western Union Telegraph Company.

THE recent retirement of Mr. S. Fenn, of whom we have the pleasure of reproducing a photograph herewith, has suggested to us that a few words concerning his career may be welcomed by our readers. Mr. Fenn at the time of his withdrawal from business held the position of Traffic Manager of the Western Union Telegraph Company, with which the Marconi Company works very closely.

The subject of our illustration gives yet another example of a man who has attained his position by hard work and sheer merit. He joined the London District Telegraph Company in 1866 as a messenger, and a few months later entered the service of the Electric and International Telegraph Company, also as a messenger. In 1868 he obtained his first appointment as operator with the Great Western Railway Company, remaining with them for two years, being stationed at Paddington and Southall stations for different periods. At the time of the transfer of telegraphs to the State in 1870 Mr. Fenn joined the Postal Telegraphs. A part of his service with the Government was spent in the Press division and at the special wire office of the *Scotsman* in Fleet Street.

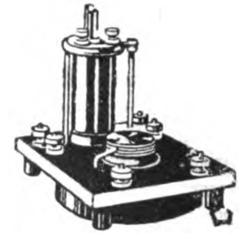
He was one of the first to join the Direct United States Cable Company at its inception in 1874, and was one of four to be first sent abroad to that Company's station at Torbay, Nova Scotia. Whilst serving in Canada, Mr. Fenn rose from the position of junior operator to that of superintendent. In 1910 the then manager of the Direct United States Cable Company died suddenly and Mr. Fenn was summoned to London by the Board of Directors and appointed Manager of the company.

Upon the amalgamation of the Anglo-Western Union and the Direct United States Companies under the title of the Western Union Telegraph Company, he was appointed Traffic Manager, and served in this position for nearly three years, retiring on July 31st last, having attained the age of sixty years.

Mr. Fenn's telegraphic experience extends over a period of fifty years, and altogether he forms an interesting example of "*Palmam qui meruit ferat.*"

Mr. S. Fenn.

The ENGINEERS Note Book



[Under this heading we propose to publish each month communications from our readers dealing with general engineering matters of various kinds in their application to wireless telegraphy, and we would welcome criticisms, remarks and questions relating to the matter published under this heading. We do not hold ourselves responsible for the opinions and statements of our contributors.]

Porcelain High Tension Insulators.

IN a modern wireless telegraph station insulation of the apparatus is naturally of paramount importance, particularly in those parts of the installation which are traversed by high-frequency currents. So much is required of a good insulator that the number of substances that can be used for this purpose is strictly limited, whilst for the high-tension portions of the apparatus which are subjected to great mechanical strain—aerial insulators, for instance—the number of suitable materials can almost be counted on the fingers of one hand.

Amongst these last specially prepared porcelain is one of the most useful, possessing as it does not only a high insulation resistance but high disruptive strength, excellent non-hygroscopic qualities, and ability to withstand corrosive action by the atmosphere and sea-spray. For the benefit of wireless engineers and others concerned with its use we give below a few notes regarding the manufacture of special porcelain used for insulating purposes, in the hope that they may prove of interest.

At the outset it will be as well if we consider what is required of a good porcelain insulator. Firstly, it must be mechanically strong in compression and tension. Secondly, it should be tough, not brittle or fragile. Thirdly, it should be non-porous. Fourthly, it should be without appreciable cracks or flaws. Fifthly, it should have a fair uniform dielectric strength. Sixthly, it should have a permanent glaze free from cracks and roughness. We are not concerned here with the design of insulators; this will be dealt with in a subsequent issue. The reader should bear in mind the above requirements when reading the notes which follow.

The three main ingredients of electrical porcelain are feldspar, clay and silica. Both china clay and ball clay are used, the ball clay being added to the china clay for the purpose of giving the necessary plasticity. China clay itself is not sufficiently plastic for the manufacturer's requirements, as after the raw porcelain is dry it must retain sufficient coherence not only to hold itself together but also the ground-up particles of feldspar and flint.

The silicious constituent of the porcelain consists of powdered flint, quartz, sand or other similar substance, and feldspar is added to provide a flux. The greater the proportion of feldspar the lower is the temperature at which the porcelain will vitrify. The feldspar by its action on the silica dissolves it and forms a kind of glass, which in combination with the clay cools into a solid vitreous mass.

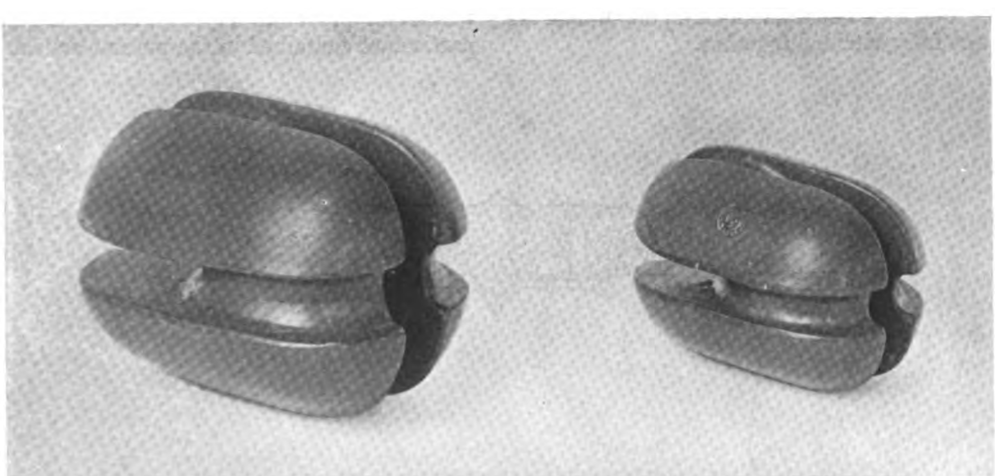
The greatest care is necessary in selecting the various ingredients, for any admixture of metallic impurities may cause a breakdown of the insulator at a much lower voltage than that it is required to withstand. Particular difficulty is experienced with the clay which has to be selected with exceptional care. The methods of refining the clay depend upon the nature of the deposits, but can be stated generally to consist of mixing the crude clay with water and allowing the impurities to settle. The comparatively light clay remains some time in suspension, whilst the sand and other impurities are precipitated with fair rapidity. The water containing the clay in suspension is run off and the clay allowed to settle, after which it is dried and prepared for shipment.

At the porcelain factory the various constituents are ground into an impalpable powder, and after being weighed are thrown into a tank. There they are thoroughly mixed with water so as to form a liquid of the consistency of cream, this liquid being technically known as "slip." After a thorough churning the "slip" is pumped off into filter presses and most of the water expelled under considerable pressure. The resultant cakes of raw porcelain are next hammered with large mallets and then sliced up and thrown into a "pug-mill," which consists of a cylindrical receptacle about five feet high, containing a set of revolving screw blades resembling the propeller of a boat. These blades cut through the plastic mass, squeezing out the air and forcing the material downwards. At the bottom of the receptacle an opening is provided through which the material is squirted, and as it exudes from the orifice it is cut into cylindrical pieces by means of fine wire. The object of the pug-mill is to ensure a thorough mixing of the component parts. It is sometimes necessary to pass the raw porcelain through this machine a second time.

Having been thoroughly mixed in the pug-mill, the plastic mass is next shaped roughly to the form it is intended finally to take. The degree of plasticity at this stage of manufacture is of considerable importance, for the rough "blank" must be sufficiently firm to keep its shape whilst the preliminary air drying is taking place. It must also be strong enough when fairly dry to be packed in the kiln, and in many cases sufficiently firm to be turned in a lathe.

As soon as the blanks are sufficiently air-dried the glaze has to be applied. In this portion of the process the handling of electrical porcelain differs essentially from that of ordinary pottery. In the manufacture of earthenware the glaze is applied after firing, and the process may consist of applying various substances to the red-hot material. In the case of electrical porcelain the glaze is not a different substance, but merely a similar porcelain with a higher proportion of feldspar, and therefore a lower fusing point. The glaze is applied to the surface by dipping the objects to be glazed into a tank containing the glaze material in suspension. The dry surface of the porcelain thus absorbs some of the liquid, and its surface retains a thin coating of the suspended matter. The blanks are then allowed to dry a second time, and fired. During firing the glaze melts and forms an impervious coating over the surface.

The firing process consists in placing the air-dried blanks in rough yellowish earthenware dishes known as saggers. The saggers are generally of cylindrical form, and, of course, have a much higher melting point than the porcelain they have to contain. It should be noted in passing that the blanks are not glazed where they come into contact with the saggers, for if they were the result would be that after firing the blanks would be firmly attached to the saggers by a cement of glaze.



Porcelain Compression Insulators.

In the kiln the saggers are stacked one on top of the other in tall columns, space being left between the columns for the heat to circulate. The usual kiln is bottle shaped, and the furnaces for heating it are arranged round the base. After the fires are started the temperature is very gradually increased, until after a number of hours a maximum temperature of 1,310 to 1,360 degrees centigrade is reached. This is maintained for a number of hours, and then the kiln is allowed to cool even more gradually than it was heated. The whole process occupies several days, depending on the size of the kiln. When all is cool the kiln is opened, the saggers unstacked and the porcelain parts taken out and examined for flaws. Those which on visual inspection seem perfect are passed on for the elaborate electrical tests to which all electrical porcelain is subjected before issuing from the works.

It is the aim of all manufacturers of such porcelain to avoid making the product porous. Porous porcelain will absorb moisture, sometimes in considerable quantity, and as a result its insulation value will be greatly decreased. Porosity may result if the proportion of flux is too small, but, on the other hand, if too much flux is included the porcelain will be over-vitrified and brittle. Only very careful selection of materials and accurate proportioning of parts will avoid the difficulty.

A second aim of the manufacturer is to obtain homogeneity of structure. Unless the raw porcelain is perfectly homogeneous on leaving the pug-mill it will tend to develop flaws through unequal drying, and separation into laminations and local spots which are not fully vitrified together.

Great care is also required in the process of air drying. If a number of articles composed of raw porcelain are set to dry in a room where the temperature and atmospheric conditions are not satisfactory, it is likely that too rapid drying may occur and the objects become subjected to severe internal mechanical strains. Still another critical stage occurs in the kiln at the commencement of firing. At a temperature of 400 to 500 degrees centigrade the water of composition of the clay is thrown off and a considerable decrease in weight occurs. It is evident that the removal of a considerable amount of water from the clay in a comparatively short time must be accompanied by no small internal change in the green porcelain, and great care has to be exercised to prevent too rapid a rise in temperature, which may cause the objects to be warped and puffed up. If air-dried porcelain is placed directly into a hot electric furnace it will be reduced to a powder.

Vitrification, like every other stage in the preparation of the porcelain, is attended by certain risks. It may briefly be stated to depend not only on the temperature to which the porcelain is subjected but also to the duration of the high temperature.

In a further article we hope to deal with some points in the design and testing of porcelain insulators. Readers who are interested in the subject are recommended to obtain the Proceedings of the American Institute of Electrical Engineers for May, 1915, where a lengthy and exhaustive paper by Mr. E. E. F. Creighton is reproduced, and which has provided us with many of the particulars contained in the present article.

Administrative Notes.

HOLLAND.

THE following is communicated by the Netherlands authorities regarding meteorological radio-telegrams from Scheveningen, and emphasises one of the varied uses to which wireless telegraphy is put :—

"On and after July 1st the station "of Scheveningen Harbour will send at "11.15 a.m. and p.m. (Greenwich time) a "meteorological radio-telegram in Dutch "and French, followed by a storm signal "whenever necessary, and also a notice to "mariners in Dutch and English."

The meteorological radio-telegram will be preceded by the letters KNMI, and will consist of four sets of two groups of five figures each for the stations Helder, Flushing, Gris Nez, and The Hague ; and, further, of four sets of two groups wherein one group will have five and the other group will have four figures each for the stations Yarmouth, Shields, Skudnaes, and Sylt, according to the scheme BBBWW SHTT(G). In this scheme BBB stands for the atmospheric pressure in tenths of a millimeter, omitting the 700, WW indicate the direction, and S the force of the wind ; H gives the condition of the sky and weather ; TT the temperature in centigrade degrees, 50 being added to temperatures below 0° C ; G indicates the condition of the sea, all being according to the scales given below.

Following the above will come, if deemed important, first, the storm signal, *e.g.*, warning signal, signal of shifting south-east storm ; second, the notice to mariners preceded by the letters NBAZ, *e.g.*, wreck, mouth Hook of Holland.

The scales according to which the above information is reported are as follows :—

Every observation that is missing for each station is replaced by an appropriate number of X's.

Examples of meteorological radio-telegrams from the first and the fifth of the eight sets of two groups KMNI are 69010–21541 and 57316 – 4405 ; their translations follow :

HELDER.	YARMOUTH.
Barometer, 769.0 mm.	Barometer, 757.3 mm.
Wind direction, E.S.E.	Wind direction, south.
Wind force, very light.	Wind force, moderate.
Sky, slightly cloudy.	Sky, overcast.
Temperature, 4° C.	Temperature, 5° C.
Sea, very fine.	

Wind.				Conditions of sky and weather.		Condition of Sea.	
Direction.		Force.					
WW.	Significance.	S.	Significance.	H.	Significance.	G.	Significance.
00	Calm	0	Calm	0	Clear	0	Smooth.
02	N.N.E., etc. ...	1	Almost calm ...	1	Slightly cloudy (¼)	1	Very fine.
06	E.N.E., etc. ...	2	Very light ...	2	Cloudy (½) ...	2	Fine.
08	E., etc.	3	Light	3	Very cloudy (¾)...	3	Slightly rough.
12	S.E., etc.	4	Moderate... ...	4	Wholly overcast...	4	Rough.
16	S., etc.	5	Rather high ...	5	Rain	5	Swell.
20	S.W., etc.	6	High	6	Snow	6	Heavy swell.
24	W., etc.	7	Very high ...	7	Mist	7	Heavy sea.
28	N.W., etc.... ...	8	Violent	8	Fog	8	Very heavy.
32	N., etc.	9	Storm	9	Storm	9	Violent.

Wireless Telegraphy in the War

A résumé of the work which is being accomplished both on land and sea.

THE recent sinking by a British submarine of the Turkish battleship *Hairredin Barbarossa* again calls attention to the Turkish Fleet, which, never a large one, is rapidly approaching the stage of non-existence. Purchased from Germany in the summer of 1910, this recently torpedoed battleship was of about 10,000 tons displacement, mounting six 11-in. guns and fitted with modern equipment. Our illustration shows the Turkish wireless operating staff on board, and the apparatus standing on the table in front of them consists on the one side of Marconi instruments and on the other side of Telefunken. It is to be supposed that, in view of the grabbing of all power in Turkey by the Teutonic candidates for world domination, only the Telefunken apparatus now remains. The Turks make quite good operators of a mechanical kind, and the practice which they had during the Balkan War increased their efficiency in a marked degree. British operators on ships trading in the Mediterranean during the Balkan struggle well remember the clear ringing spark which characterised the Constantinople station calls when working with Adrianople and the Turkish Fleet in the Dardanelles.

* * *

Dispatch-Rider Relf Gurney, son of a Hereford Alderman, in a recent letter home, describes very vividly the way in which wireless aids the fighting man right at the front.

"I'm sitting in a hole," he writes, "with the wireless operator and the telephonist. The wireless man removes his cigarette from his lips, carefully puts it out, places it behind his ear, and bends over his instrument. He then starts to scribble on his message pad.

"I lean over, and read the words 'Just leaving. Shall be with you in four minutes.' The telephonist transmits the message to the gun, and almost immediately a white speck appears on the sky, and the drone of a powerful engine is heard. The operators adjust their instruments for the last time, and fit their earpieces more firmly on their heads.

Wireless Staff on the "Hairredin Barbarossa."

"'Prepare for action,' writes the wireless man. The message is duly transmitted, and I stuff cotton-wool into my ears. 'He will get it in a minute,' mutters the telephonist; and, sure enough, as he speaks, a huge white ball of smoke appears to the left of our machine.

"The flying man makes a graceful detour with his machine, and then takes up his original course once more. The wireless man stiffens again, stoops, and writes; this time, a jumble of figures and numbers, or so it appears to me, and, as they are transmitted, the huge barrel of the gun moves slowly, and at length comes to rest. The gun team stand clear, the lanyard is pulled, and the gun runs back 'midst a huge cloud of dirty smoke. It is immediately followed by a deafening roar, whilst the projectile is heard screaming away over the enemy's lines.

"While the gun is being re-sighted for a second shot, we in the 'dug-out' anxiously await the wireless message from the skies, telling us the effect of the shot. 'Fifty yards short,' says the operator. 'Fifty yards short,' repeats the telephonist. With great care, the gun-sighting is corrected, and again a shell is sent hurtling towards the target. The anxious wait follows; our wireless man taps impatiently with his pencil; I light a cigarette to while away the seconds. 'Good!' the operator exclaims, 'direct hit; fire six more.' Thus he writes down the message from our air craft. And, as the gun is again re-sighted, its smoking muzzle seems to smile at the sheer pleasure of the gunners at their wonderful work."

* * *

We print an excellent photograph of Senatore Marconi in his Italian uniform, perhaps one of the neatest and most artistic of any active service uniform in the world. At a period of national crisis, such as that which is being shared with Great Britain by Italy, the possession of a man like Guglielmo Marconi constitutes a national asset of no mean importance, of which the King and people of Italy are well aware, and in this case, at all events, we have a contradiction of the popular proverb, "A prophet is without honour in his own country."

* * *

A long and interesting account was recently published by our contemporary the *Southport Visitor* dealing with life on an armed merchantman. Lieutenant Boothroyd, who tells the story, was called out as

Senatore Marconi.

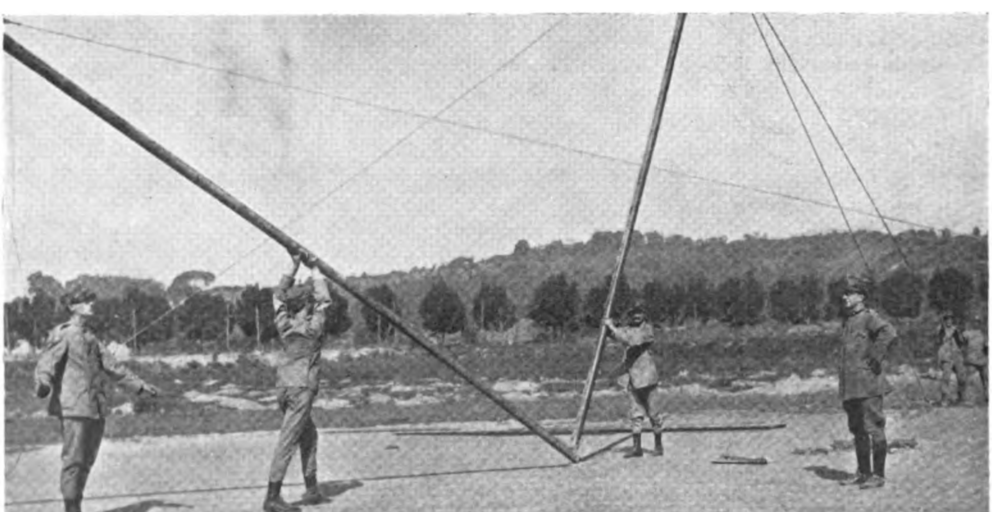
a reservist at the beginning of the war, and has only just recently been allowed home on leave. As might have been expected his account was full of the utility of wireless. These cruisers practically rely not only for their information, but for their actual directions from headquarters, on their wireless equipment. The sinking of the *Kaiser Wilhelm der Grosse*, the depredations of the *Konigsberg*, etc., were all reported through this medium. The destruction of the German wireless at Swakopmund is referred to as one of the most important factors telling in favour of the British for hundreds of miles radius, whilst his account plainly indicates that the powerful inland wireless station at Windhoek operated and influenced proceedings far out at sea, until its activities were destroyed by the British Boer Army under General Botha.

* * *

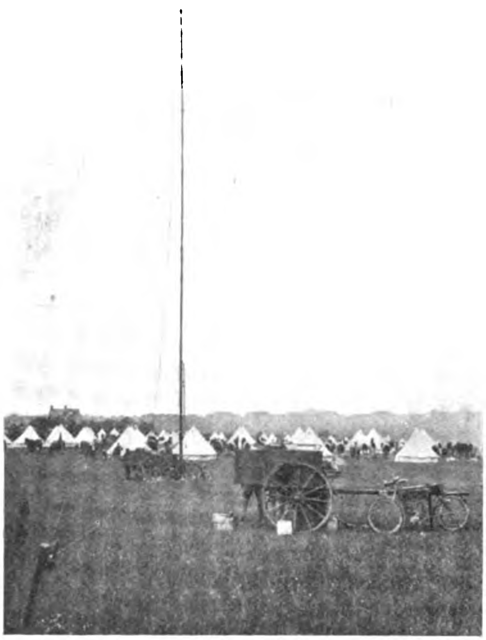
Our illustration shows a picture of the Italian Army radio-telegraphic engineer in the course of erecting one of the wireless stations which now form an inseparable part of operations in the field. The army led by General Cadorna is particularly well equipped in this respect, and the Italian field telegraphists are second to none in smartness of erection and working.

Lt.-Gen. Cadorna.

The interest taken in wireless operations starts nowadays at a very early age, and we find that the press which specially caters for youth contains articles of wireless. A



Italian Army Field Set.



Royal Engineers' Field Set.

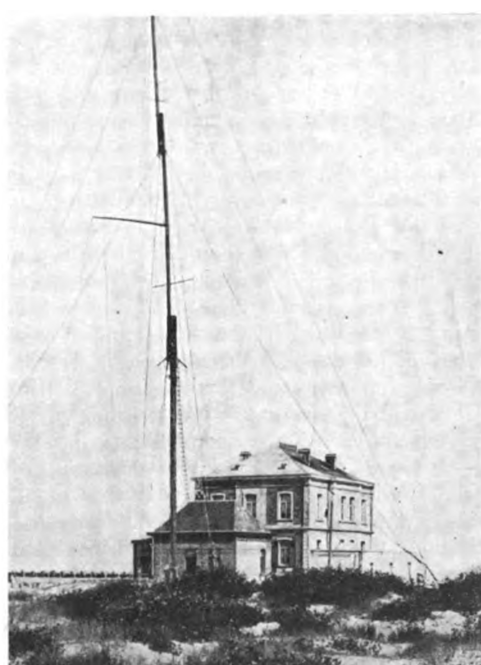
very informative and well written account is given in the *Boy's Own Paper* current issue, from the pen of Mr. Raymond Raife. The field wireless which is being so freely used by all sides in this terrible world-conflict figures prominently in the article, which should give lads a very adequate conception of its scope and utility. The work of the Royal Engineers (whose field wireless installation figures in our illustration) is graphically described by means of an extract from a letter written at the front by one actually engaged in the operation, whilst the various graphic episodes of the war, like the " God save the King " message sent out by Admiral Sturdee, the destruction of the *Emden*, etc., are narrated in a way likely to appeal to the heart of every English boy.

* * *

Mr. Bonar Law recently emphasised in detail the same moral as that more briefly emphasised by Mr. Godfrey Isaacs—namely, that from a national point of view the importance of wireless far exceeds that of its cable rivals; not only is it infinitely superior from the point of view of economy, as valuable from the point of view of efficiency, but its superiority from the point of view of vulnerability has been demonstrated not by words but by the stern logic of actual experience.

* * *

The slice of Belgian territory still remaining under the jurisdiction of King Albert is small in extent, but its activities have adjusted themselves in inverse proportion. Nieuport, whose wireless station forms the subject of our illustration, consists of two parts, Nieuport Bains and Nieuport Ville, the former being situated on the coast and the latter about two miles from the sea. The history of the mast in our illustration is somewhat eventful as masts go. It was originally erected at La Panne, but at the time when experiments were being made with regard to wireless messages to the Belgian mail-packet boats the mast was removed from La Panne and erected at Nieuport Bains. Its distance from Ostend is but twelve miles, and the station lies sufficiently close to the German lines to form a target for their artillery. There has been, therefore, some uncertainty as to whether it would not be well to take down the mast for the second time.



Nieuport Wireless Station.

NOTES OF THE MONTH

THE Press has recently contained some references to the connection between X-ray outfits and that of wireless telegraphy. Wireless telegraphy uses very large induction coils, and X-ray operators also use very large coils, far bigger even than for wireless intsallations. Hence there comes the difficulty: "Shall the Postmaster-General confiscate all the coils?" He has the right to remove every part of a wireless apparatus, but where will his officials end their labours? Of course, no one imagines for a moment that there will be a raid on the huge induction coils that do the X-ray work in our great hospitals, but what about the little installations of the country doctors, who have endeavoured to help their patients by having their consulting rooms up to date? The power of the "coil" possessed by a private practitioner may be very small when compared with that used in a town or city hospital, but it represents something he has paid for and would be very sorry to part with.

The Postmaster-General is doubtless worried enough, but there are already complaints about the way his instructions are being carried out. The British constable may be the best in the world, but it is no part of his duty to distinguish between an X-ray apparatus and a wireless installation. It would be a comparatively simple matter to register each X-ray operator in the country —as there are not so many of them after all. But until this registration is carried out all attempts to cut out private wireless installations will either be futile or harmful. They will be futile so long as they leave a single X-ray apparatus in a house inhabited by an enemy, and they will be harmful if the X-ray diagnosis and X-ray heating is taken out of the hands of medical practitioners.

An X-ray installation, although having nothing to do with wireless telegraphy, could be turned into a wireless station by a clever operator in about ten minutes. Should every doctor who has an X-ray outfit surrender it to the Government? It seems so.

* * *

Among the eminent gentlemen who have been asked to sit on the Committee presided over by Lord Fisher of Kilverstone, we note Sir Oliver Lodge, F.R.S., the Principal of Birmingham University and an authority on electricity, wireless telegraphy and mechanics; Mr. W. Duddell, F.R.S., a leading authority on electricity and wireless telegraphy, whose portrait and biography appeared in our April, 1915, issue; and Sir William Crookes, O.M., F.R.S., LL.D., who has interested himself fairly considerably in radio-telegraphy. These gentlemen are members of the Inventions Board, which was established to assist the Admiralty in co-ordinating and encouraging scientific efforts in relation to the requirements of the naval service during the war.

* * *

The Archbishop of York, who recently paid a pastoral visit to the Grand Fleet, strangely enough makes no mention of the pastors serving permanently with the Fleet. The duties of this individual are manifold. We do not hold a brief for him, but from what can be gathered it appears that he is very hard worked and very inadequately paid. Apart from his spiritual functions, which we maintain should receive his first consideration, he is expected to undertake all sorts of general work which apparently cannot be imposed on a layman. These include the censoring of letters and parcels, acting as schoolmaster and instructor, fulfilling the office of sea-lawyer, and coding and decoding wireless messages. Although we think that because a man happens to be a priest it should not be assumed that he should do no material work; yet we certainly feel that, to take the example which interests ourselves (that of coding and decoding wireless messages) he should be excused. After all, naval telegraphists are appointed for that special work.

* * *

In its issue of July 31st the *Nation* publishes a letter from Sir Laurence Gomme, who queries whether "the Welsh Fairies" once upon a time knew the secret of wireless telegraphy. Of course, it is very open to question whether there were any fairies at all, but for the sake of argument let us assume that such creatures once existed. Sir Laurence writes:

"A great deal of so-called magic was "the result of a comprehension of natural "phenomena which we are slowly dis-"covering by the operations of science. ". . . But direct proofs are not readily "forthcoming. I have collected some of "these possible proofs, but I do not think "any of them are quite so remarkable as "the following passages from the Mabinogion "Welsh traditions of the tenth century, "which seem to point unmistakably to the "operation of wireless telegraphy:

"'1. Three plagues fell on the island of "'Britain. . . . The first was a certain "'race that came, and was called the "'Coranians; and so great was their "'knowledge that there was no discourse "'upon the face of the island, however low "'it might be spoken, but what if the wind "'met it, it was known to them.

"'2. The two brothers Lludd and "'Llevelys took counsel together to dis-"'course on the matter otherwise than thus, "'in order that the wind might not catch "'their words nor the Coranians know what "'they might say. Then Llevelys caused "'a long horn to be made of brass, and "'through this horn they discoursed. But "'whatsoever words they spoke through "'this horn one to the other, neither of "'them could hear any other but harsh and "'hostile words. And when Llevelys saw "'this, and that there was a demon thwart-"'ing them and disturbing through this "'horn, he caused wine to be put therein "'to wash it. And through the virtue of "'the wine the demon was driven out of "'the horn. . . .'

"These passages occur in 'the story of "'Lludd and Llevelys,' and they seem suf-"ficiently curious to warrant a request for "some criticism of my suggestion from the "technical science side. Sir John Rhys "kindly tells me that the translation from "the Welsh text is quite accurate. He has "alluded to these passages in his 'Celtic "'Folklore,' vol. 1, pp. 195-6, where he "draws attention to an account of Welsh "fairies, printed in 1813, in which it is stated "that 'the fairies knew whatever was "'spoken in the air without the houses, not "'so much what was spoken in the houses.'"

These assertions are certainly very remarkable, although we feel inclined to believe that they are due to those mysterious influences from the realms of legend. Anyhow, we give them to our readers for what they may be worth.

* * *

The following appeared in a recent issue of the *Times*:—

"Lord R. Cecil, in answer to a question in "the House of Commons with regard to the "neutrality of the Colombian Government "and the question of the wireless telegraph "station at Cartagena, said His Majesty's "Government were convinced that the "measures taken by the Colombian Govern-"ment to control the use of wireless tele-"graphy in Colombia would, if effectively "and adequately carried out, be sufficient "to prevent the abuse of this means of "communication in the interest of our "enemies. The Government of Bogota had, "moreover, caused a preliminary inspection "by a neutral wireless telegraph operator "of the station of Cartagena, in order to "ensure the efficient local execution of their "instructions; and they had further stated "that a competent neutral would be invited "to inspect this station and report upon the "adequacy of the measures taken, so that no "doubt might remain that their instructions "had been effectively carried out by the "local authorities."

Maritime Wireless Telegraphy

OUR readers will recollect the account of a fire which occurred on board the s.s. *Benalla* off the south-east coast of Africa, towards the latter part of July last. This ship had 800 emigrants aboard when the fire was discovered, and consequently the aid of wireless telegraphy was sought. The operator of this ship sent out the distress signal, and in response thereto the *Otaki* went to her assistance. It transpired that the cargo in No. 1 hold was ablaze. The *Otaki* was 150 miles off when she picked up the wireless call, and immediately changed her course. The fire was eventually "got under" and both ships arrived safely in port. The *Benalla* belongs to the Peninsular and Oriental Steam Navigation Co., and is a vessel of 11,118 tons gross, built in 1913.

* * *

How useful Senatore Marconi's invention is in such vast wastes of ocean as the Pacific was recently demonstrated in connection with the loss of the British cable ship *Strathcona*. This ship belonged to Auckland, New Zealand, and was wrecked in the South Pacific near the Fiji Islands. The crew took to the boats, and the cable layer *Iris*, which was in company with the doomed vessel, essayed to rescue the survivors. It was here that wireless telegraphy was brought into use. The *Iris* found one boat load, and was able to keep the islanders at Suva (Fiji) closely in touch with her doings and the result of her attempts.

* * *

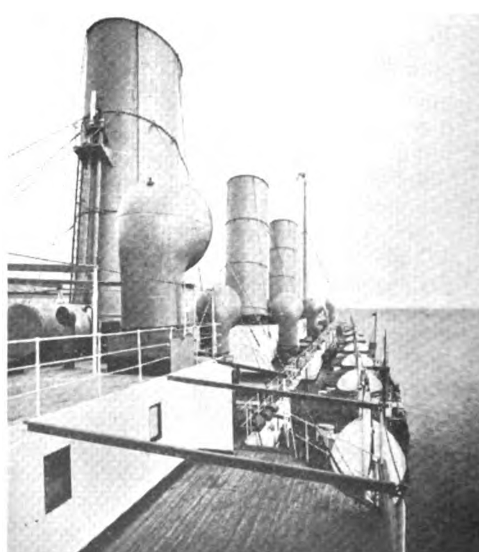
Some months ago we recorded an instance of how medical aid was requisitioned by wireless at a Mexican-Atlantic port. In the instance which we recount now a Tampa doctor diagnosed the sickness of a sailor on board a tug. The sailor complained of a pain in his left arm, which began to swell, and a high fever developed. All sorts of suggestions were made for relieving the man, but no rules could be found in the first-aid book. As a last resort the wireless operator sent a wireless message, and the doctor sent the following prescription:

"Make saturated solution boric acid in "water. Wrap arm from shoulder to "hand. Keep it soaked in hot solution. "Get man ashore as quickly as possible. Is "blood poison. If boric acid unobtainable, "make solution one five-thousandth bi-"chloride mercury in water."

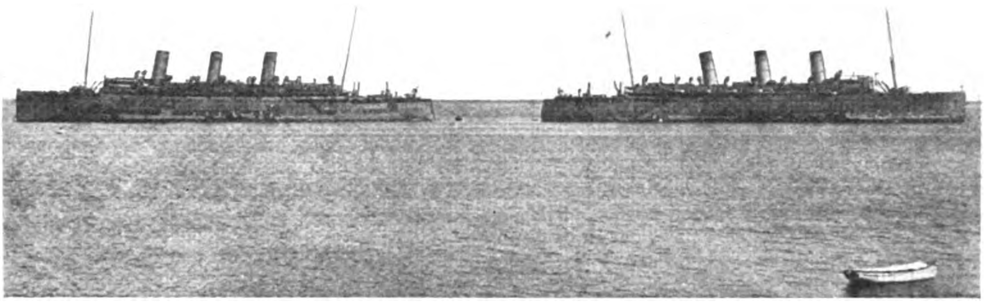
Unfortunately these medicines were not available on board, and so the ship immediately made for the nearest port. The operator kept in wireless touch with the shore, and a tug was despatched to meet the steamer. The man was landed, and, although he had been in a position of extreme danger, the tide turned in his favour, and he eventually became completely cured.

* * *

Seldom indeed are the magnificent vessels belonging to the Canadian Pacific Railway, which ply between Canada and Japan, to be seen on this side of the Atlantic, but war



Deck of "Empress of Asia."



Ss. "Empress of Asia" and "Empress of Russia."

upsets all arrangements, including the itineraries of steamship companies. It is due to this fact that the *Empress of Asia* and the *Empress of Russia* have been ploughing the waves of regions not their own, engaged in duties which it has been found necessary to allocate to them, and therefore the hopes and appreciation of travellers must be deferred until peace once more reigns over the blood-stained fields of Europe. These magnificent vessels feature an innovation for large passenger steamers. This is the "cruiser stern," and our photograph above well illustrates it, especially that of the vessel on the right. These steamers are fitted with the standard $1\frac{1}{2}$ kw. set. Our small illustration (see previous page) shews the deck of the *Empress of Asia.* Unfortunately, the Marconi cabin is not visible.

* * *

We have just received a copy of the *Musen Dempo Shimbun* (the Pacific Wireless Daily News). This interesting little journal is published on board Japanese steamers, and is of the same nature and category as the wireless ocean newspapers published on board a number of the larger steamers having European ports as their home terminal points. The general scheme of these newspapers is that of supplying passengers on board the modern ocean greyhounds with the latest and most up-to-date news of the world's happenings whilst they are temporarily "lost" on the ocean. The journals are filled with interesting matter ashore, but several pages in the centre are left blank, and it is on these that the news received by wireless telegraphy is printed.

The Norwegian Salvage Company has just had delivered to it the new large salvage steamer *Salvator*. She will be stationed for some time at Ecort near Archangel in the White Sea. She is in every respect well equipped for the work likely to be required of her. Strong winches are situated on the fore-deck and one of smaller capacity aft, together with powerful salvage pumps capable of dealing with an aggregate of 4,000 tons of water per hour, and she is capable of travelling at a speed of about twelve knots. Her fittings comprise a wireless telegraphic installation having an actual radius of 250 miles, which will no doubt be of great use to her in her work.

* * *

An unique feature of the expedition undertaken by Sir Ernest Shackleton to cross the Antarctic Continent is the arrangement made for a service of news messages to be despatched by the Port Stanley (Falkland Islands) station. This is made possible by the loan by the Marconi Company to the expedition of a complete installation for the reception and transmission of messages, and by the action of the Falkland Islands Government in arranging the service clear of all charges.

It can easily be imagined the source of pleasure this will be to the expedition, who are now wintering somewhere in the vicinity of the Weddell Sea. The installation is in charge of Mr. R. Jones, physicist attached to the party, who is to transfer the set to a shore station in the South. A directional aerial is to be erected towards Port Stanley. Naturally the service will

The "Endurance."

not be extensive, a short message being despatched broadcast at 2 a.m. on the first and fifteenth day in each month. The arrangements were made by letter, and before a reply could be sent to Sir Ernest the expedition had sailed from Buenos Aires. Otherwise a weekly service would have been arranged. Unfortunately, the *Endurance* did not call at Port Stanley as originally arranged, but proceeded instead *viâ* South Georgia. This was owing to the naval situation then prevailing in the southern waters.

Apart from this use of the installation, much valuable work will be carried out in the observation of wireless phenomena in the South. Probably the Port Stanley station will be greatly observed, being one of the most southerly stations in the world, and at the same time the nearest to the base of the expedition. The distance is roughly 1,100 miles.

Another great advantage will be the observation of time signals emitted by the Argentine Government station at New Year Island every Saturday night at midnight G.M.T. This will enable the observers to define accurately their position, and in consequence be able to chart the coast with far greater precision than has hitherto been possible with chronometers, owing to their unknown ratings in extreme cold.

No endeavour is to be made to communicate with Port Stanley, as the power supply is not considered sufficient to cover the distance, but perhaps under favourable conditions it will be possible, owing to the great range of comparatively small stations in the Far South, and also the remarkably good receiving practice at Port Stanley.

It is to be deplored that more complete arrangements were not made, with the view of obtaining a definite programme, as with a greater mutual understanding much could be done in the way of direct communication if it is at all possible. As things stand, it is doubtful if the observers know what range of wave-lengths are available at Port Stanley, and it is, of course, almost impossible for them to pick up one of the longer waves, as the chances are all against their being on watch on a particular wave at a time when that wave is in use. Also it is impossible for the operators at Port Stanley to know if the signals are being received at any particular time.

Consequently the service is not as full as it might have been, and is being carried out on a wave-length of 600 metres.

The terrible calamity which recently appalled the minds of the civilised world exceeds in its magnitude the loss of life in other nautical disasters. The facts were given in the press at the time, but it might be well here to recall the outstanding features of this terrible accident. The ss. *Eastland* had just taken aboard a huge crowd of 2,500 " picnicers," employees with their wives and families of a large electrical company in Chicago, when she capsized. Several accounts of the cause of the disaster are given, and many theories advanced as to why the vessel turned turtle. Some say that the water-ballast had been pumped from the hold as the passengers went aboard in order that more of the latter might be carried, others that the vessel stuck in the mud and failed to free herself when the engines were started, thus causing her to list, and that the large crowd on board increased this tendency so that she could not right herself. It was also learned for the first time that the *Eastland* had given evidence of " crankiness " on at least one other occasion and had nearly capsized. It is useless, of course, to speculate; suffice it to say that this hideous accident caused the deaths of a large number of innocent pleasure-seekers. Every known life-saving appliance, including wireless telegraphy, was installed on board this ship; she was lying alongside the land, moored to a quay, and yet all this was of no avail. Her wireless installation was fitted by the Marconi Wireless Telegraph Company, of America, her call signal letters were " W F M "; and she was operated by that company. She was built in 1903, and possessed a gross tonnage of 1,961 tons.

* * *

Yet another instance of medical aid being requisitioned by radio-telegraphy has arisen. The captain of the steamship *Bradford*, which arrived at Philadelphia, Pa., from Tuxpan, Mexico, reports that when his ship was two days out a seaman was taken ill. The vessel carried no doctor, and the wireless operator swept the sea in search of one; a British warship answered. The symptoms of the man's illness were given to the ship's doctor by wireless, and he diagnosed the case as pneumonia, prescribing accordingly. So satisfactory were the measures taken that the ship's officers were able to sustain life for some days. The patient, however, eventually succumbed.

* * *

As instancing a further use of wireless telegraphy on the high seas we may cite the following:

A wireless message was recently received at the Browhead signal station belonging to Lloyd's that the British schooner *Gypsum Queen*, from Halifax, Nova Scotia, for Preston, lumber laden, was abandoned on July 31st. That ship is now a derelict, being tossed hither and thither at the mercy and will of the wind and sea, and constitutes a very real danger to navigation. The position of the spot where she was abandoned may now be flashed by those self-same wireless waves to all ships in the actual neighbourhood or likely to pass the *locale*.

* * *

Two fine new steamers have recently been fitted with wireless telegraphy, and have been placed in commission for service on the Pacific coast between San Francisco and Astoria, Oregon. They are named respectively the *Great Northern* and *Northern Pacific*, and have the distinction of being the largest turbine-driven steamers so far constructed in the United States. Their designed speed is 23 knots, and they possess accommodation for 856 passengers, and capacity for 2,185 tons deadweight of cargo. Under favourable circumstances they make the voyage between the two terminal points in 25 to 26 hours, thus equalling the time now required for travelling by the overland route from Portland, Oregon, to San Francisco. The wireless cabin is situated on the boat deck and is contiguous to the officers' quarters. Altogether they are graceful ships and should prove very comfortable.

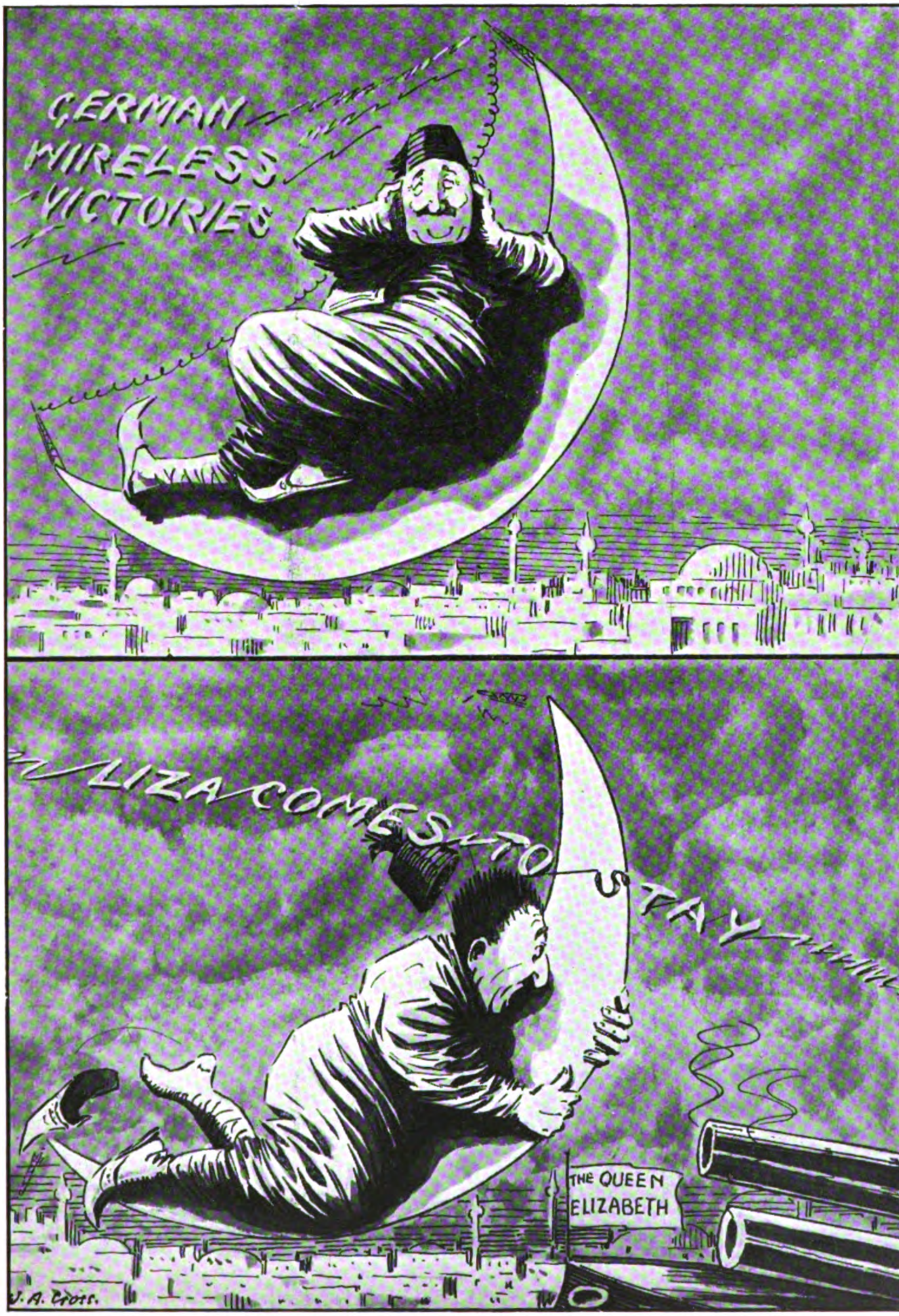
Instructional Articles and the Examination

THE Thirteenth Instructional Article, published in the last issue, marks, as will be noted, the close of this valuable series. It was originally intended that immediately upon the cessation of the articles an examination should be conducted and prizes given to the successful students. The outbreak of war, however, materially altered the outlook. Our readers will remember that in April, 1914, when announcing the series, we indicated that the examination would be open to members of the Territorial Force, Cadet Corps, Boys' Brigades, Church Lads' Brigades, Boy Scouts, etc., and also to general readers. Now, after twelve months of war, a large number of those who commenced to study the articles have joined His Majesty's Forces, and are therefore unable to devote time to the subject. For this reason we feel that by holding an examination at the present moment we should exclude a number of our most ardent readers, and so, after mature consideration, it has been decided to postpone the examination until the conclusion of the war.

In order to sustain our readers' interest, and to enable those who intend to enter for the examination to continue their studies on suitable lines, we have arranged to conduct a third series of Instructional Articles dealing with the "Mathematics of Wireless Telegraphy." These articles, the first of which appears in this issue, are designed to assist those of our readers who have not devoted much time to mathematical study, to understand better books and articles which deal with wireless telegraphy from this point of view.

CARTOON OF THE MONTH

TEUTON WIRELESS IN TURKEY.



No. 1.—What are the wild (wireless) waves saying?
No. 2.—"Liza comes to stay"!

The Destruction of the "Königsberg."

An Episode in the Life of a Wireless Operator

WE have received the following account of the destruction of the "Königsberg" from the wireless operators on s.s. "Trent."

" After a slow but necessary voyage, we " arrived at Mafia Island, off German " East Africa, on June 2nd, having brought " out the two British monitors, H.M.S. " *Severn* and *Mersey*, which did such " brilliant work last year on the Belgian " coast.

" It will be remembered that the German " commerce raider *Königsberg* took refuge " in the Rufigi River, German East Africa, " about six miles from the mouth.

" Her hiding-place was discovered by " H.M.S. *Chatham* in October last, but on " account of her great draught this ship " was unable to proceed up the river. She " withdrew, after sinking a collier at the " mouth, thus preventing the *Königsberg* " from escaping into the open sea. She " could, however, be still used in con- " junction with the German land forces.

" The monitors had the advantage of " drawing very little water—only 6½ ft.—

Up the River Rufigi.

Village scene near the River Rufigi.

"which enabled them to get closer to the "*Königsberg*, whereas the *Chatham* could "not. It may here be mentioned that "the *Königsberg's* wireless was working "a few days before the action.

"The operations commenced on July 6th. "The *Trent* was used as a temporary "hospital ship, and, of course, anchored "in a safe position while the operations "were in progress. The monitors entered "the river, H.M.S. *Severn* leading. They "were met by a hot fire from the shore "batteries; the return fire was, however, "hotter, and eventually they took up "positions to bombard the *Königsberg*.

"The winding nature of the river, coupled "with the thickly wooded surroundings, "rendered range finding difficult. An aero-"plane was therefore used to denote fall "of shot, which by a certain signal made "by wireless to the monitors enabled them "to get over this difficulty.

"The German method of range finding "was accomplished by means of a 'look-out' "tower, which was undoubtedly in com-"munication with the *Königsberg*. The "monitors fired at this tower, destroyed "it, and moved their positions. The "enemy's shot continued to fall at the "place they had just vacated. It was now "getting dark, and orders were given to retire.

"On Sunday, July 11th, another attempt "was made, resulting in the complete "destruction of the *Königsberg*. A loud "explosion was heard which was either "the result of the monitors' fire or the "Germans purposely blowing it up them-"selves, which, however, remains to be "proved. A wireless message was inter-"cepted, stating that the *Königsberg* was "completely destroyed.

"During the operations an aeroplane "was hit, and fell to the ground. It is "interesting to note that the aeroplane's "wireless operator was transmitting as "the machine was falling. The monitors "added further honours to 'Britain's "'First Line,' and also avenged the fate "of the *Pegasus*, thus bringing their day's "work to a successful issue."

The Influence of Atmospheric Ionisation on the Propagation of Electro-Magnetic Waves

By H. M. DOWSETT.

IN last month's WIRELESS WORLD the writer gave a rough sketch of the electrical conditions prevailing in the earth's atmosphere, which showed that the air in bulk possesses more the qualities of a leaky dielectric than of a perfect insulator.

In consequence of this it has been generally recognised that electro-magnetic waves transmitted through the atmosphere must suffer attenuation due to absorption, and certain other possible results on speed and direction of propagation have been subjects of general discussion during the last few years.

But all the effects of atmospheric ionisation on transmission have not yet been studied.

The writer proposes in the present article to refer to some of these neglected effects, which suggest on examination that they may play an important part in electro-magnetic transmission.

To begin with, it is admitted that there must be a difference in the velocity of the waves through the earth's crust and through the air, due to the difference in dielectric constant of the two mediums. But because the air in contact with the surface of the earth is ionised, one would expect a certain speeding up of the waves through the earth's crust at the expense of the energy of the waves through the surface air, in very much the same way as the speed of an electrical operation along a submarine tele graph cable is increased by lowering the insulation resistance of its covering.

This result in its turn would tend to reduce the intensity and alter the phase of the Sommerfeld surface waves, whose existence is due to the difference in speed between the air and earth waves.

Also, as at every earthed aerial receiving station, the tendency is to change the whole of the earth wave energy by means of ground plates or wires into a surface wave so that it can be used in the aerial-earth circuit—an ionised ground atmosphere at the receiving station, by reducing the surface wave, will therefore tend to reduce the strength of received signals.

To proceed further. The air in the lower atmosphere—exclusive of charged clouds which affect strictly local conditions—is not only ionised, it is polarised, so that it conducts best in a definite direction. The potential gradient is normal to the earth, so that the air conducts better normal to the earth than parallel to it. How this is likely to affect transmission is roughly illustrated in Fig. 1.

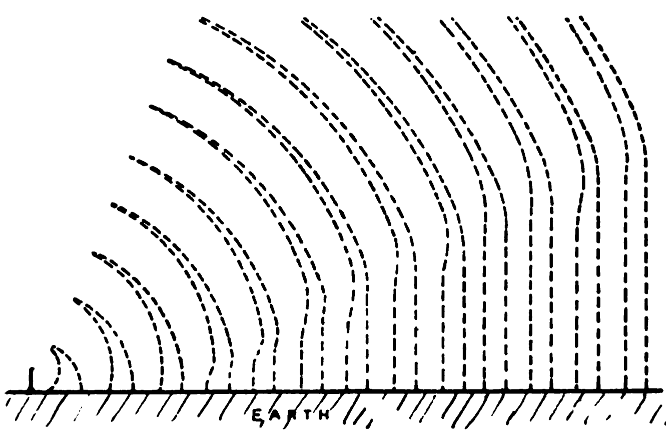


Fig. 1.—Effect on lower part of wave of potential gradient normal to the earth's su·face.

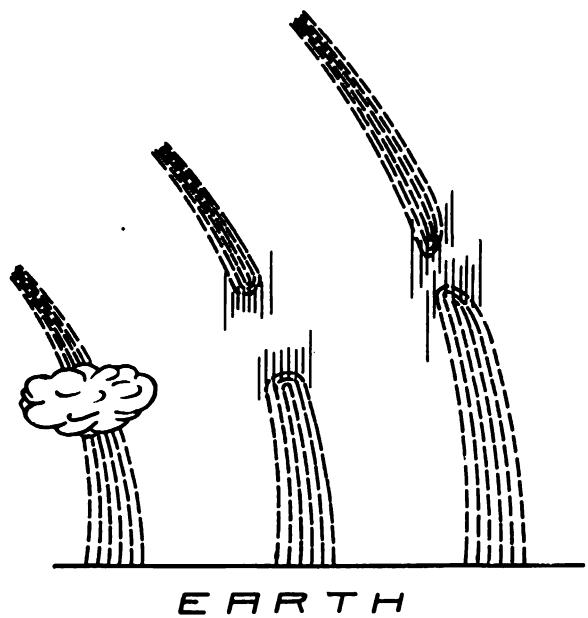


Fig. 2.—Potential gradient assisting the repair of a wave.

The wave front at ground level, being parallel to the line of potential gradient, will add a small potential difference to that already existing, which will tend to set up additional minute currents normal to the surface of the earth spreading both up and down the lines of potential gradient, and this deflected wave energy will reduce the effective velocity of the foot of the wave so that the wave-front will gradually lose its spherical character and become perpendicular to the earth for some distance up.

It is obvious that the less the wave-front is parallel to the lines of gradient the less will it be distorted in this way, and rays having a greater inclination to the earth than, say, 60 degrees may scarcely be affected.

The rectification of the wave-front will not take place at the transmitting station, as the wave intensity there will be great enough to swamp any effect of potential gradient, but as the wave front expands with increase of distance from the source, and the intensity in consequence diminishes, the relative value of the gradient will increase and so will the rectification.

The perpendicularity when once established will tend to maintain itself as the wave bends round the earth if the potential gradient and absorption generally is greater at the foot of the wave than some distance up, which actually appears to be the case. In fact, the top part of the wave may even obtain a bend forward as the distance travelled over the earth increases. If the ionisation of the lower atmosphere is continuous for some 12 miles up, the perpendicular front of the wave may extend well above the cloud region where most local absorption takes place.

Suppose that part of the wave loses energy in passing through a cloud. Then fresh energy will tend to flow into this region from the other parts of the wave not directly attenuated by the cloud until wave equilibrium is once more restored.

But it is clear that this flow will be considerably influenced by the direction of the potential gradient. The repair of the wave will be assisted if this direction is parallel to the wave-front—Fig. 2—and impeded if the wave-front and potential gradient are at right angles, Fig. 3—for in the last case the gradient will provide a grain of conductivity in the air which will tend to prevent the wave expanding back through it.

Fig. 3 actually shews in section a hole made through the top of a spherical wave. The growth of several such holes would finally lop off the top of the wave. It is possible this may often occur, and within ten miles of the transmitting station—short waves, owing to their smaller wave volume, suffering more in this respect than long waves.

Suppose absorption occurs near the ground, due, for instance, to a sudden rise and fall in earth level—a hill, or a ground fog of negatively charged air which will produce a somewhat similar effect—then there may be no

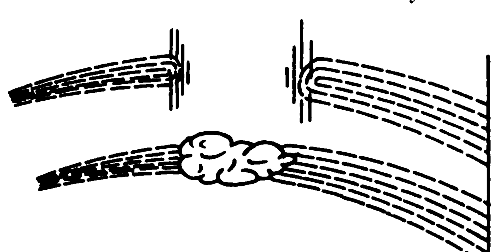


Fig. 3.—Potential gradient impeding the repair of a wave.

wave energy to work up from below after the obstruction has been passed, but there is still a supply available to work down from above by normal expansion—as every part of a wave can be regarded as a new centre of disturbance by creeping round the obstacle —and also by leakage currents down the lines of potential gradient until the wave is once more in touch with the earth and travelling with wave-front normal to it.

Next to be considered is the influence on wave propagation of ionisation in the region known as the permanently ionised layer.

As at this level there is no vertical temperature gradient and therefore no wind, the other forces at work are better able to make their presence felt. It is reasonable to suppose that this region, like the lower atmosphere, has a potential gradient normal to the earth, but the free gaseous ions are subject to another influence besides electrical stress—that of the earth's magnetic field.

Positive and negative molecular ions will not be much affected by the magnetic field, but electrons will be strongly affected, and their movement will probably constitute the principal gaseous movement at this level.

The electrons will be made to follow paths at right angles to the magnetic lines of force. They will move from west to east round the earth, describing spirals round the lines of force—Fig. 4—also round the earth and to and from the poles always west to east—Fig. 5—and again to and from the poles by spirals along the magnetic lines without going round the earth, Fig. 6. This last variation of electron movement is not of immediate interest to us, as it will occur principally in the outer atmosphere. The electron movements at the beginning of the permanently ionised layer—that part which comes first in contact with earth-generated electro-magnetic waves—will be mainly those illustrated in Fig. 4 and Fig. 5, which together give the resultant effect of a

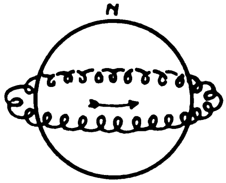


Fig. 4.

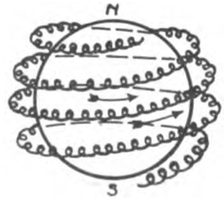


Fig. 5.

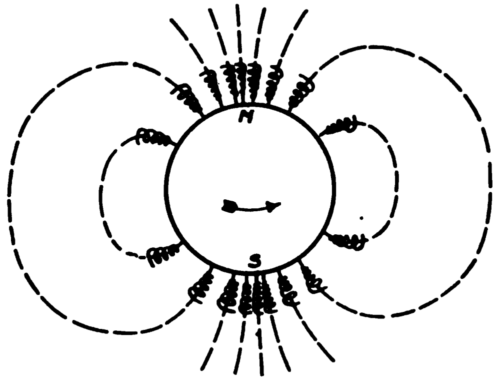


Fig. 6.—Section of earth's magnetic field shewing paths of election through the outer atmosphere.

spheroidal shell of electron currents enclosing the earth and rotating in the same direction. Consider the effect of this shell on an electro-magnetic wave. In the first place, the principal part of the wave-front to reach it will be the almost horizontal part which has escaped the rectifying process of the vertical potential gradient in the lower atmosphere. If this is parallel to the electron currents—that is, if it has a wave-front east and west —it will influence these currents, it will be more or less absorbed by them, and no doubt some of the wave energy will be reflected.

The absorbed wave energy will run along this conducting grain in the atmosphere, —Fig. 7—in much the same way as it behaves near the earth, and will thus complete the perpendicular rectification of the wave-front travelling east and west, which the curvature of the electron shell will also help to maintain.

As regards reflection, this must depend on the degree of conductivity and also on the sharpness of change in conductivity the wave meets with on entering this layer, conditions which will determine the depth of penetration before the wave is completely absorbed. The writer doubts whether the normal reflection from this layer is of sufficient importance to affect very much wave propagation round the earth.

Absorption by this layer, on the other hand, must be of importance, as energy flows in where it is used up, and the wave in the lower atmosphere must become weakened in consequence.

Consider now the wave-front north and south. As this is at right angles to the

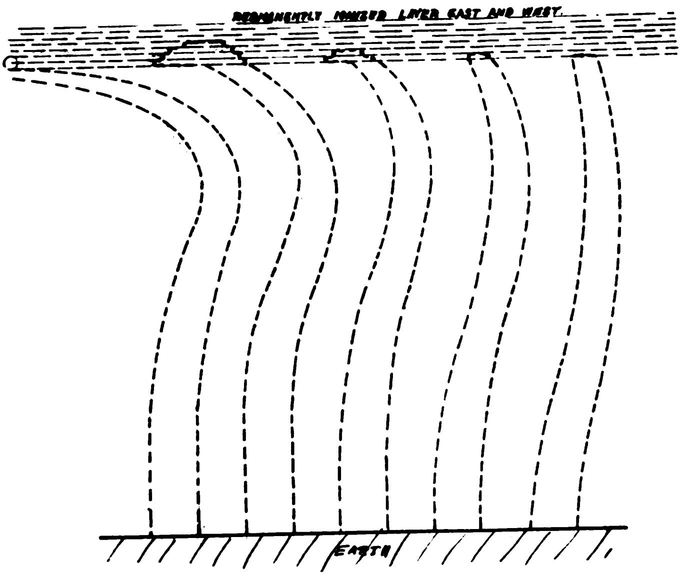


Fig. 7.—The absorbing and rectifying effect of the permanent ionised layer on waves travelling East and West.

electron currents and also at right angles to the potential gradient, it will tend to pass through the layer and continue to expand upwards with a minimum of absorption and reflection. In consequence, this part of the wave will not need to tap the wave energy in the lower atmosphere to the same extent as the part travelling east and west. The wave taken as a whole below the permanently ionised layer will tend to restore its own homogeneity, but the total result must leave it stronger north and south than east and west.

We may also note that, should any wave energy emerge through the electron shell it would be polarised north and south. The night conditions for wave propagation are thus summarised above. In the daytime the "diurnal layer" introduces new conditions. When the ultra violet rays of sunlight first affect the atmosphere a wave of ionisation runs down from the outer to the inner layers, splitting up the neutral molecules into positive and negative ions, growing weaker as it advances downwards, and finally ending when the whole of the ultra violet light has been absorbed. At the front of its advance the medium will be in active erratic gaseous commotion capable of absorbing wave energy and reflecting it, but in a state of disturbance which would make it difficult for an electromagnetic wave to permeate through it. It will be least permeable when ionisation is beginning and is, therefore, most active, and also when the ionised condition is disappearing, and much more permeable at the final lower limit of the diurnal layer where the last of the ultra violet light energy has spent itself. Above this lower skin the diurnal ions, under the impulse of the potential gradient, will gradually assume more orderly movement, the positive ions moving up and the negative ions moving down. How will the diurnal layer affect transmission?

First we may note that the ions will screen the electron shell of the permanent layer, and so will stop its polarising effect on the waves. If there is any difference, therefore, in transmission north and south from transmission east and west, during daylight, it cannot be put down to this cause.

During the processes of ionisation and deionisation at sunrise and sunset, the waves will be subject to considerable reflection, which may result in a considerable strengthening of signals, but in the mid-period of full daylight, when there is little reflection from the indistinct boundary of the layer, and much more permeability, the wave energy will enter the layer and dissipate itself in the potential gradient currents, which, being parallel to the wave-front normal to the earth, will exert a strong weakening influence on the lower part of the waves by causing their energy to feed up into the diurnal layer to replace the energy absorbed. If these potential gradient currents are stronger than those just above the earth's surface, the top of the wave may again be bent back, thus increasing the radiation upwards and therefore away from the earth, Fig. 8. In this manner can one explain the weaker signals of full daylight.

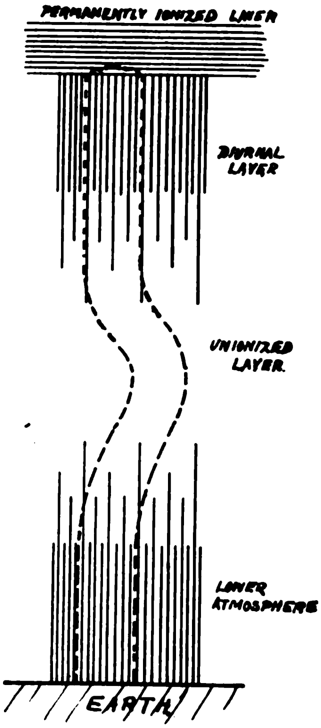


Fig. 8.—The effect of the diurnal layer on shape of wave.

Atmospheric ionisation therefore appears to be able to provide a satisfactory explanation of the principal effects of wireless transmission without it being necessary to introduce the wave acceleration theory of Dr. Eccles.

SENSELESS.

HE was a wireless operator,
She was a thoughtless maid,
Out on the grassless lawn together,
Under the treeless shade,
Playing a game of netless tennis,
This with a bounceless ball,
When from their dineless middle regions
Echoed a soundless call.

Then through the pathless walk they ambled,
Each with a stepless gait,
Into the flyless room for dining,
Each to a foodless plate ;
Each with a smileless face then settled
Down in a seatless seat,
" Ah, what a tasteless taste ! " he muttered
" Oh for a biteless eat ! "

First 'twas a meatless meal they ordered,
Topped with a crustless pie ;
Next o'er an iceless ice they dallied,
Each with a blinkless eye. . . .
Ah, what an endless end I'm reaching—
End of this wordless drool—
He paid the check with a centless dollar
Earned in the Marconi School.

(From *The Wireless Age.*)

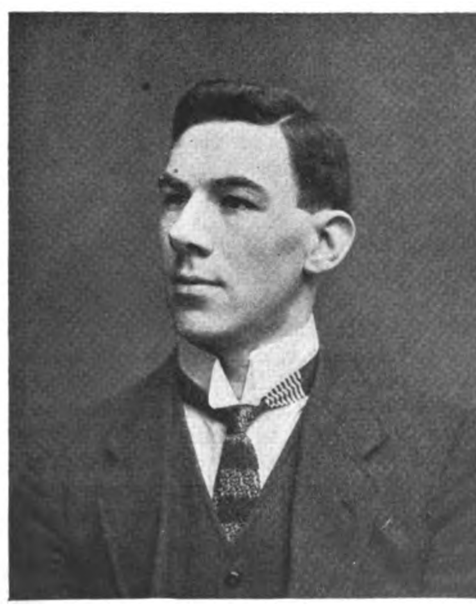
Doings of Operators

Operator Healy.

WE have often referred to the brave deeds daily performed by wireless operators in the course of their duty. In a previous number we also published a little poem entitled "The Merchant Service Man." To this latter our thoughts immediately turned on hearing of the sinking of the ss. *Jacona*, a merchant vessel owned by Messrs. Cairns, Noble and Co., and of some 3,000 tons. There seems little heroism in sitting at the key in a small wireless cabin on board a merchant steamer quietly ploughing its way through the water, but it must be remembered that at any moment a periscope of some German submarine may appear in the vicinity. Should this happen, much needs to be done in a little time, for by skilful navigation and prompt call for assistance the pirate foe may be eluded. That an almost uncanny cleverness is daily shown by the brave commanders and officers of the British mercantile marine in "dodging" the semi-submerged craft is grudgingly admitted by the Germans, for did not the famous Captain Perseus state recently that the results of their efforts with a submarine blockade were "only modest." The wireless operator on the *Jacona* was Mr. Maurice Healy, a comparatively recent recruit to the Marconi Company's operating staff. Mr. Healy hails from Ireland, having been born at Earlville, Aghinagh, co. Cork. After an education at Rusheen, Ballyvogane, and Macroom, he entered for wireless training at a school in Cork, and in February of this year crossed to London and joined the Marconi Company. After a short finishing course in the Company's London school he was appointed to the staff and joined the *Jacona*, on which ship he remained until the event above referred to. It is much to be feared that Mr. Healy, who was still quite young, has lost his life in the wreck, for at the time of writing he is among the missing and little hope is entertained. We take this opportunity of expressing, on behalf of our readers, the deep sympathy that is felt for the parents of Mr. Healy in their time of trouble.

* * *

On the 13th August, and the day that the confirmatory news came through regarding the sinking of the Turkish battleship *Hairredin Barbarossa*, a brief announcement



Warrant Telegraphist Lovett.

from the Admiralty gave the information that H.M. auxiliary cruiser *India*, whilst on patrol duty in the North Sea, had been torpedoed by a German submarine. Twenty-two officers and one hundred and nineteen men were at the same time reported saved.

Three wireless telegraphists were carried by the *India*, which in peace time was well known to Eastern travellers as a large P. & O. liner. The three were warrant telegraphists, R.N.R.: Frederick John Lovett, John Leonard Revell, and Andre Simon Read Akerman. Messrs. Revell and Akerman were fortunately saved, but Lovett is reported missing, and it is to be feared that he has lost his life in the service of his King and country.

Warrant Telegraphist Frederick John Lovett, who was twenty-six years of age, was born at Southwark Park, and educated at Keetons Road Higher Grade School, Bermondsey, the Boutcher School, and at King's College, London. He joined the Marconi Company three years ago and served successively on the ss. *Cestrian*, *Milford Hall*, *Arabia*, and *Egypt*. On behalf of our readers we offer to Mr. Lovett's parents our deepest and most sincere sympathy in their great bereavement.

Warrant Telegraphist Revell.

Warrant Telegraphist J. L. Revell, who, as above stated, is among the saved, was born at Clacton, Essex twenty-two years ago. He went to school in his native town, and later erected an amateur station with which he gained some experience. In July, 1913, he joined the Marconi Company as learner in the London School, and two months later received his appointment to the operating staff. Warrant Telegraphist Revell, prior to the war, served on board the ss. *Danube*, *Minnehaha*, *Dunluce Castle*, *Geelong*, *Highland Scot*, and *Normannia*. We congratulate him upon his lucky escape.

Warrant Telegraphist A. S. R. Akerman, who is twenty-one years of age, although born at Bordeaux, is a British subject and makes his home at Hayes, Kent. After an education at St. Dunstan's College and Margate College he trained for wireless telegraphy, and entered the service of the late United Wireless Telegraph Company, which, it will be remembered, was absorbed by the Marconi Company after the famous law case for patent infringement. He has served on board the ss. *Tagus*, *City of London* and *La Negra*, having made on this last a large number of trips. He also is to be congratulated on his fortunate escape.

* * *

The quiet, yet magnificent, work that is daily being performed by wireless telegraphists in both the Naval and Mercantile Services is perhaps not fully realised by the "man in the street." It requires some practical acquaintance with actual working conditions to picture in one's mind the wireless man intently listening through long watches, day and night, for signals which may change the ship from a quiet and peaceful vessel slowly swinging at anchor with the waves gently lapping at her side to the throbbing ship of war, thrusting her nose through the blue-green water, each gunner at his post and eager to fire the first shot at an enemy target—signals which a moment's inattention might lose entirely, signals which may bring succour to some quiet ocean tramp but five minutes ago

Warrant Telegraphist Lemon.

plugging her way along the Channel, but now cramming on every pound of steam and nearly bursting her old boilers in the effort to save her crew and cargo from the pirate enemy—signals, in short, which may set in motion almost any train of events that may be thought of in connection with the great ocean highway.

Now and then, of course, some passenger vessel buffeted by the elements, or perhaps with fire eaten into her holds, may use her wireless to gather help from all quarters in her great extremity. Then the journalistic searchlight throws its beam upon the wireless men, who blink in its glare and sometimes tell their story. The value of wireless in ocean disasters is thereupon discussed for a day or two, and then the flitting public attention moves off to other fields. Five tense minutes at the instruments are often sufficient to gain what is required in the perils of a wreck; five long months at the instruments on a war vessel may be needed to achieve even a little in times of peril for a nation. Who shall say which of the two cases may mean the most?

After the war, and round a winter fireside, much truth will filter out. Not the least interesting of the stories to be told will be those which tell of great deeds quietly performed.

Here and there we find a decoration awarded to mark some special case. Unlike Germany, Great Britain has never awarded decorations indiscriminately; when they *are* awarded it is for real merit. It is for meritorious work on the high seas that the Distinguished Service Cross has been awarded to Samuel Lemon, of H.M. patrol ship *Alsatian.* On behalf of the readers of this magazine, we herewith offer him our heartiest congratulations.

A native of Fleetwood, Lancashire, Samuel Lemon is but twenty-three years of age. Like many operators, he came to wireless from the railway telegraph work, having entered the services of the London and North-Western Railway as a boy. In April, 1911, he joined the Marconi Co.'s school at Liverpool, and soon after made his first trip to sea on the Allan liner *Virginian.* From this ship he passed to the *Teutonic,* and later to a number of other vessels trading on the North and South Atlantic. For some time prior to the outbreak of war he was serving on the *Alsatian,* so that by now he must be very well acquainted with her.

Warrant Telegraphist Lemon's award is the more noteworthy in that it is the first D.S.C. to be awarded to a warrant officer of the Royal Naval Reserve, with the exception of two awards to skippers of mine-sweepers for gallantry in the course of their duties. Wireless telegraphists are therefore very proud of their confrère, and we hope his example will stimulate many others to put forth their utmost efforts for the welfare of their country.

Wireless in the Newspapers

A Jocular Jockeying of some Contemporaries.

By E. BLAKE.

SOME months ago there appeared in this journal an article entitled "Wireless in Fiction." It was an attempt to demonstrate that the ideas about wireless held by the guinea-grinders who jig the puppets on the story magazine stage are turgid with ignorance, and that the gaudy paint with which these writers try to hide their lack of exact knowledge is only too easily licked off. Nevertheless, a writer of fiction is under no obligation to "draw it mild"; so that when Montmorency casts the aerial into the sea ("as quick as thought Montmorency seized the aerial and threw it," etc.) and electrocutes by wireless the villain who is in the act of marooning the long-suffering maiden, we can pass on to weightier matters, murmuring "Great is fiction if it have a sale"—to parody the Latin phrase found at the end of the dictionary. We can examine, for example, what the newspapers say about wireless—a really serious and important investigation. By this it is not implied that newspaper men in contradistinction to the fictioneers are obliged or even expected to adhere to the truth. Such obligation would limit their output, their usefulness, and (shame upon us readers!) their circulation. No, their stuff is supposed to contain, at least, a nucleus of the truth; just enough to license the mass of speculation, "fine writing" and journalese which covers it.

At this game the American reporter stands alone, pre-eminent, unbeatable. I once had the grave misfortune to arrive in New York. During the voyage something interesting had happened about which I knew as much as most people, plus. . . . So at 2 a.m. a reporter entered my cabin, armed with a fountain pen and a mouthful of what looked like golden teeth. He wore a check suit which could have smitten a Chicago baseball crowd dumb. The following commercial dialogue took place:

Reporter: "Saay, what about it?"
Myself: "How much?"
Reporter: "Aw, fer nixes. No dollars this trip."
Myself: "Nothing doing. Mind the step."

The interview then ended and he left the Presence Chamber. Next day I found that he had written me up to the extent of three-quarters of a column, giving a description of my personal appearance, my views on America, my opinions relative to the voyage incident, my favourite occupation and my ideas concerning the state of the green wax-insect trade on the Lower Yang-tse. . . .

What the newspaper men do not know about wireless would fill volumes. What they write about it would fill the Editor's waste-paper basket. In fact, it is safe to say that the story-writers owe many of their quaint wireless fictions to the sharp-nosed men of shorthand who "do" the shipwrecks from the point where "all was calm and bright" to where "the ill-fated vessel with its human freight plunged sullenly beneath the waves."

Let it be supposed that a disaster has occurred, and the *Pommonia* has sullenly plunged. What happens is this: The special correspondent of *Spillikin's Weekly* rushes to Queenstown and espies a wretched survivor wambling wetly along the quay, clad in one pyjama-leg and a cork jacket, his stokehold awash with a quart and a half of best guaranteed Irish Sea. This poor creature, who is vainly endeavouring to recall the words of the Hymn of Hate, or wondering whether it is possible to get Scotch whiskey in Ireland, is button-holed (or

"Saay, what about it?"

pyjama-legged) by the man with the note book, and asked for his account of the tragedy. Naturally, the result as it appears in print is after the manner of the following:

"Mr. Charles P. Schnitzelbaumer, an American peanut dealer, hailing from Snooper's Butte, Pa., who is one of the survivors of the ill-fated *Pommonia*, said he was standing on the second-class saloon companion—or it may have been near the bar—when the explosion occurred. He noticed Mr. Justus K. Schoebheimer standing near, calmly helping the women into the boats. He himself was hurled some distance by the force of the explosion, and told Mr. Julius Brown, the famous chameleon-fancier, that he thought they had been torpedoed. He saw the torpedo coming, and thinks it must have struck the ship. The Marconi operators had by this time luckily succeeded in calling for assistance. He distinctly heard the senior operator say 'Sausages and Onions, Sixpence,' and his companion laughed. Both were wet through, and their coolness was amazing. Soon after the explosion the dynamos burst with a loud report and the Marconi operators had to work the wireless batteries from their emergency switches. He would suggest that in future ships should carry spare lighting mains; the wireless could then be run on to these when the dynamos blew up. Mr. Schnitzelbaumer also said he thought that in time of danger the overhead cables might be coiled round the masts, as by so doing the risk of breakage would be minimised. He further said that there was no panic on board, and that he saw the captain distributing cigars amongst the coal-trimmers and nuts to the children. One lady coolly stepped up to a piano and struck a few notes. He could not say which notes as it was only a second-saloon piano. He then fell overboard. He is certain the vessel was attacked by a hostile submarine, as the whole affair was a complete surprise to all on board."

In one newspaper it was stated that soon after the *Lusitania* was torpedoed a passenger went to the wireless cabin where "the Marconi operators were getting ready to send out the distress signals." What were they doing? One imagines them putting on clean collars and brushing their hair. Or perhaps they were rolling up their shirt-sleeves, moistening the palms of their hands, and praying for a successful call. The impression conveyed is one of strenuous, unhurrying labour amongst whizzing machinery in an inferno of sparks; whereas, at the most, all that needed doing was the screwing up of a few terminals and the closing of a switch.

Recently there appeared in a well-known journal edited by one who is seldom caught napping, a letter from a ship's officer, in which it was stated that owing to the majority of British vessels carrying the Marconi system of wireless they are unable to pick up messages from German stations. This is a grave defect of the Marconi system which I trust will be remedied at once. Either the German electromagnetic waves must be naturalised or British antennæ must be attuned to German Kultur.

Dealing with Mr. Marconi's connection with the Italian wireless service, another paper has it on record that he has instituted "the transatlantic wireless service between —— and ——," both places being on the Mediterranean seaboard. Just fancy a station powerful enough to carry westwards across the Atlantic, the American continent, the Pacific Ocean, Asia and a large slice of Europe! And all in order to reach an aerial not so very far to the eastward. A directional aerial should be useful in this case; or they might shift the station right about face, thus avoiding the long Atlantic trip.

The commercial advent of wireless is perhaps the biggest stroke of luck which has fallen to the newspapers within living memory, always excepting the War and Bombardier Wells. Given a fair mastery of the more lurid adjectives, a knowledge of Fleet Street flapdoodle about "the wizardry of science," and a few blurred photographs of any old ship—and they can do almost anything with wireless. One is tempted to believe that the Editors gathered together and said one to another, "Times are slack. Not a decent murder for months, and novel reviewing is becoming overdone. But here is a thing about which nobody knows anything, and which looks extraordinarily rummy. Let us work it up and excite the imagination of the proletarii. What we do not know we can guess at, and then fill up with chunks from 'The Boy's Own Book of Wonders.'"

So wireless was boomed from the viewpoint of romance and mystery. Myopic little hack-writers invented the wireless hero and made the operator's life at sea a misery by investing his cabin with a glamour which would be worth thousands were it applied to the right place—namely,

"The public have regarded the wireless cabin as a cross between a sorcery shop and a firework factory."

"D-do you hear words?"

a Bond Street palmist's den. Until recently the public have regarded the wireless cabin as a cross between a sorcery shop and a firework factory. Yet beside the mystery which surrounds the wine trade wireless is as simple as plain sewing. In any case, its mysteries are high and holy, being revealed only to the elect. The newspaper reporter who, having peeped into a wirelesss cabin, goes off into wordy paroxysms about the sparks (that wretched obsession of the lay mind), what does he know of the true mysteries—of the Spark who would not, of the Insulator who didn't, of the Condenser-plate who was not so much a dielectric as a circuit-breaker, of Terminals that Pass in the Night, and of the Mysterious Mr. X.?

The lady passenger who wants to send a message to Hoxton when the ship is halfway between the Cocos Islands and Colombo, and says, "D-do you hear words, or does a bell ring?" is more sinned against than sinning, for she has only been guilty of sitting at the feet of the Special Correspondent of *Spillikin's Weekly*, who wrote those articles on "The Conquest of Time and Space," with the help of two invaluable aids to science, "The Electromagnetic Theory of Light," by Clerk Maxwell, and "Half-hours with Electricity," by the author of "Pastime with Pithballs," etc.

And the inventions which are reported! Wireless installations which will see through walls, up chimneys, into pork-pies and round corners! Scarcely a month passes but what Mr. Marconi, or Edison or Tesla is said to have produced a machine which will peel onions, smoke twopenny cigars, correct inebriated coal-heavers, pay the legal fare to taxi-men, or tell lies about "a cheque next week" to landladies—all at a safe distance—by wireless.

"It's wonderful what they do think of nowadays," remarked Pharaoh as he idly thumbed a few slabs of the *Egyptian Daily Era*. "Here are these Israelites making bricks without wire."

A "DOG" IN WIRELESS.

THE *Scarborough Pictorial* recently contained an interesting illustrated page entitled "A Canine Coastguard." It appears that the Scarborough wireless station has a faithful watchdog named "Bob," of whose intelligence the men in whose service he is are justifiably proud. The Government premises, more so now than ever, are forbidden ground to the ordinary civilian, and this fact "Bob" realises as much as anyone. In one of the pictures illustrating the page of our contemporary, "Bob" is seen with receivers affixed to his ears, and his paw poised on the operating key. His conception of the idea he was intended to convey while the photograph was being taken is indeed remarkable. Not until he heard the camera "click" did "Bob" remove his paw from the instrument. Of the other pictures of him his ladder-climbing exhibition is also unusual. "Bob" can negotiate the rungs with sureness and safely, a feat not very easy for a dog. Such entertaining, faithful and serviceable companions as "Bob" contribute in no small measure to the more cheerful performance of the "wireless" men's duties. "Bob" is the proud possessor of an Iron Cross, which he wears round his neck. It was conferred on him for "extinguished" gallantry on the morning of the bombardment, when, unable to defend himself, he retreated to the Racecourse!

A Book that Marks an Epoch

Professor Fleming's latest contribution to Wireless Literature.

TIME flies! Nineteen years have passed since Senatore Marconi, then but a young man, packed up his primitive wireless apparatus and came to the hospitable shores where so much of his life-work has been done. Nineteen years is not so very long as history goes, yet in that time much has been achieved. Nineteen years ago no heavier-than-air flying machines had ever crossed the skies, and even automobiles were in the earliest experimental stage. It is hard for us to-day to realise that when the first announcements of Senatore Marconi's invention appeared in the Press thousands of otherwise well-informed people laughed at the idea, whilst scientists by the score gave vent to weighty opinions regarding the impossibility of commercial wireless communication. Even those, and they were few, who believed that the young Italian had something practical to demonstrate shrugged their shoulders when mention was made of possible commercial telegraphy by the new means.

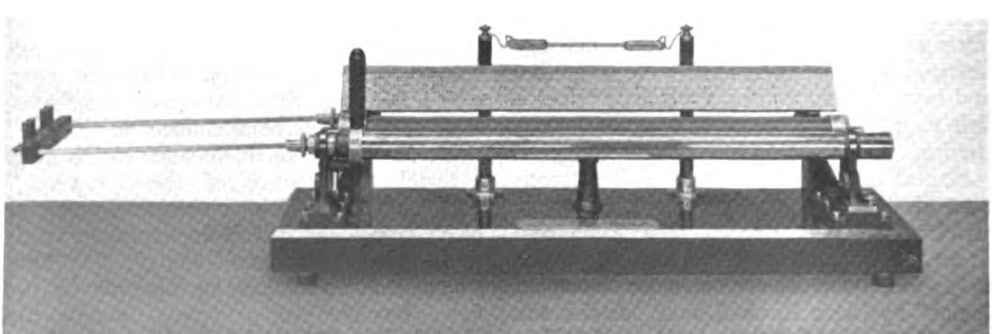
Nineteen years ago Senatore Marconi and his little group of helpers had no easy task before them. Of "wireless" theory practically nothing was known. Apparatus had to be evolved by trial and experiment, not from theoretical deductions. It had not even been discovered that the height of the aerial had an important bearing on the distance of communication.

Now, in 1915, matters are on a totally different footing. These years of experiment and study have been so fruitful that radiotelegraphic theory is by now well advanced, multitudinous formulæ enabling the worker to achieve results with a minimum of labour.

One of the first scientists to place whole-hearted faith in the young Italian inventor was Dr. J. A. Fleming. For many years prior to 1896 he had been closely connected with advanced electrical work, and was therefore of great assistance in designing much of the power plant required in the early stations.

But it is chiefly by his monumental treatise *The Principles of Electric Wave Telegraphy and Telephony* that Dr. Fleming is best known in the world of wireless telegraphy. We can safely say that this volume is on the bookshelf of practically every serious student of the science, and is in every way truly a standard work.

A new book on wireless telegraphy from the pen of such an eminent expert will, we are sure, be welcomed enthusiastically in



many quarters. We have before us as we write a copy of ***The Wireless Telegraphist's Pocket Book of Notes, Formulæ and Calculations***, Dr. Fleming's latest contribution to the subject, and the book which suggested to us the thoughts upon which we have just dwelt. Although it is modestly entitled a "Wireless Telegraphist's" Pocket Book, its scope is really much broader. Wireless telegraphists, wireless engineers, engineers whose work but rarely touches radiotelegraphy, tutors, technical students—in fact, all who are concerned with the application of electricity, will find the little volume not only of interest, but of constant value as a book of reference. Information often needed, and which, prior to the publication of this book, was only to be found by searching through a number of volumes, is now obtainable for the first time in compact form. To indicate but slightly the value of the little volume, let us place ourselves in the position of a serious wireless student, and see how Dr. Fleming ministers to our needs.

Mathematics, of course, plays an important part in the study of radiotelegraphy, particularly in the more advanced stages. Chapter I., entitled "Mathematical Notes," will serve to provide our student with the necessary "tools." Many who have had a thorough training in this subject will find the chapter of great value for polishing up knowledge which has become "rusty." Chapter II. will often be referred to for definitions and information on units, dimensions, and systems of measurement. Unless these be clearly understood no real progress can be made by a young student. What, for instance, is the use of the wireless amateur knowing that 746 watts make one horse-power when he is not clear in his mind about the watt itself? Chapter III. —one of the most valuable in the book as far as wireless engineers are concerned—deals in masterly style with high-frequency resistance and inductance measurement. The difference between high-frequency resistance and steady resistance, the calculation of high-frequency resistance of wires, self and mutual inductance with its calculation and measurement—these are subjects of the greatest importance, and the numerous formulæ provided will be found of the greatest use. Further chapters, the contents of which are so valuable that we are sorry not to have space to enumerate them more fully here, treat of high-frequency current and voltage measurements, capacity measurement and predetermination, methods of measuring wave-lengths and decrement, and numerous other vital subjects.

The much-discussed electric radiation from aerials has a full chapter to itself, and is considered from many standpoints. Here will be found much practical information on the determination of aerial resistance, radiation resistance and other work which comes the way of both wireless engineers and advanced amateurs. The practical man, amateur and professional, will welcome the concise particulars in Chapter IX. regarding transmitters and transmitting circuits. Arc transmitters, the Goldschmidt high-frequency alternator, and other interesting apparatus, all receive treatment. A feature of particular interest is the "Energy Balance Sheet" on page 221, showing losses in particular parts of an experimental installation. No less than twenty-two pages of the book are devoted to receiving circuits and detectors, the formulæ to be used in their calculation, and descriptions of receivers of every type. That the information is right up to date is evident from the inclusion of the Goldschmidt tone wheel, a detector for continuous oscillations which has a number of points of interest.

Wireless operators will welcome the practical information on the maintenance of apparatus in Chapter XI., and all interested in radio-telegraphy will find much help from the excellent glossary of terms which appears in the same chapter. Had we more space at our disposal, we could indicate numerous other valuable features, but in conclusion we must not omit to mention the sixty pages of mathematical and physical tables, which alone are sufficiently valuable to warrant the appearance of the volume on the bookshelf of every "wireless man," whether he be professional or amateur.

The Wireless Student's Friend

A new and revised edition of Hawkhead's "Handbook."

WHEN, not so very long ago, the first edition of *The Handbook of Technical Instruction for Wireless Telegraphists* appeared on the market, the reception which it was afforded gave little room for doubt that such a book had long been needed. Written by a practical man essentially for practical men, it had no superfluous matter, no padding to bring the book up to a reasonable size, and, above all, no lengthy mathematical proofs of matters which can only interest the advanced theorist. In short, from cover to cover there was little else but what was necessary to the acquirement of proficiency as a practical operator.

New books are seldom entirely free from error and omission, particularly in cases where, as in Hawkhead's book, new ground has to be broken. Then, again, progress is made in all subjects, in wireless telegraphy particularly. These considerations are some which have led the publishers of the well-known "Handbook" to arrange for a new and revised edition, and the resulting volume will be available to our readers by the time this magazine is in their hands.

Unfortunately, it was impossible to arrange for the original author to undertake the revision, for Mr. Hawkhead is now Superintendent of Telegraphs in the distant protectorate of British Somaliland. In passing, we may mention that an article from Mr. Hawkhead's pen will be found on page 365 of this issue. The work of revision and amplification has, therefore, been undertaken by Mr. H. M. Dowsett, whose interesting and instructive articles on the "Physical and Electrical State of the Atmosphere" appear in the August and present numbers. That the reviser has carried out his task in a most excellent manner is at once evident on perusing the new volume before us.

Profiting by the many kind criticisms in the technical press and in numerous letters of appreciation, the opportunity has been taken of re-writing a number of portions of the book, and of amplifying the matter where necessary. No less than 88 diagrams have been re-drawn and 19 new ones added, whilst the other illustrations have been added to by the introduction of no less than 28 new photographs. Particular attention is drawn to the chapters dealing with the various transmitting installations, these chapters being considerably enlarged and augmented by much new matter. The disc discharger apparatus is particularly well treated.

Crystal detectors, the opposed valve and crystal receiver, for eliminating atmospherics, and numerous other matters, are either treated for the first time, or else brought thoroughly in line with current practice. The chapters dealing with the practical side of wireless are also thoroughly modernised. Altogether, we can safely say that nothing of any importance has been omitted, and the Handbook becomes by the revision even more indispensable than before to the practical student.

SHARE MARKET REPORT.

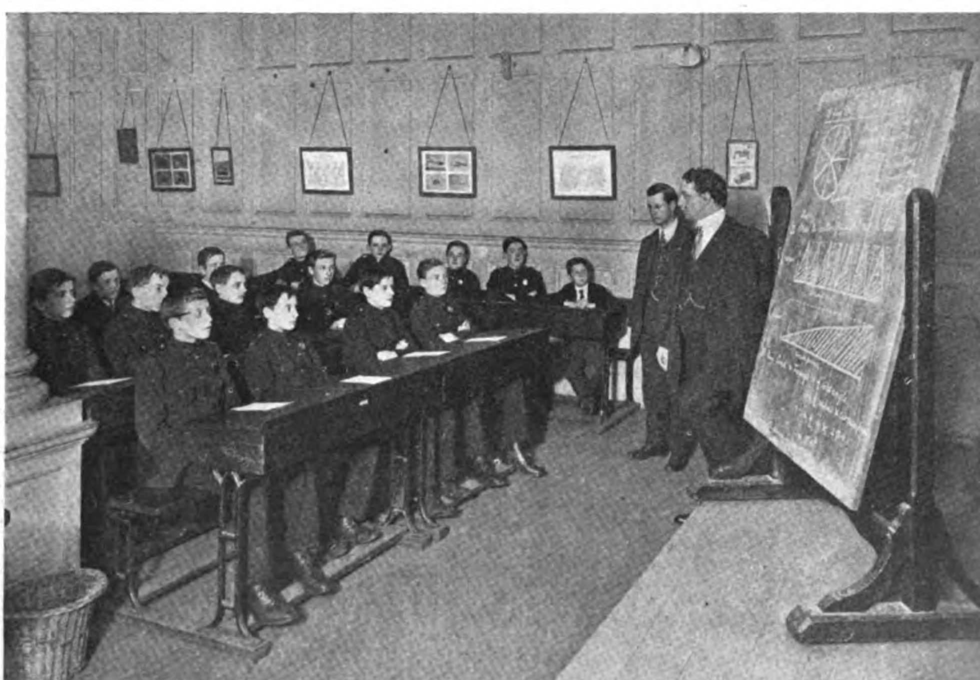
London, August 17th, 1915.

The market in the various Marconi issues has been very active since the publication of the Annual Report of Marconi's Wireless Telegraph Company, Ltd. There has been considerable buying for investment, and the prices show a decided improvement. Marconi Ordinary, £1 18s. 9d.; Preference, £1 15s.; Canadian Marconi, 6s. 6d.; American, 18s. 9d.; Spanish Trust, 5s. 9d.; Marconi International Marine, £1 5s.

The Future Welfare of the Messenger Boy

A few notes concerning an innovation at Marconi House.

IT has been frequently said that a messenger is engaged in a *cul-de-sac* in commercial life. But the Marconi Company have done a great deal to demonstrate that this is far from being an actuality. The messenger boy in an ordinary commercial house fares badly, and the unfortunate fact exists that many a lad who has outgrown his duties finds himself thrown on to the street at an age when, in the ordinary course, he should have begun to "feel his feet." The Marconi Company, having the welfare of their staff at heart, decided to obviate this unhappy position, and made arrangements with the London County Council for a trained instructor to attend at Marconi House and give lessons in English, Commercial Arithmetic, and Shorthand during the very important years of a lad's life—*i.e.*, from 14 to 16 (see photograph). The classes possess a distinct advantage in that they are held on the Company's premises, and, as attendance during the day time is obligatory, real educational progress is to be expected. Account is taken of the periodical reports on the attendance and progress of the lads when vacancies for commercial and telegraph clerks arise in the various departments of the Company's service. The Company desires to attract intelligent and industrious boys into their employ, and, by providing facilities for continuing their education, to give them opportunities to equip themselves for positions of greater responsibility.



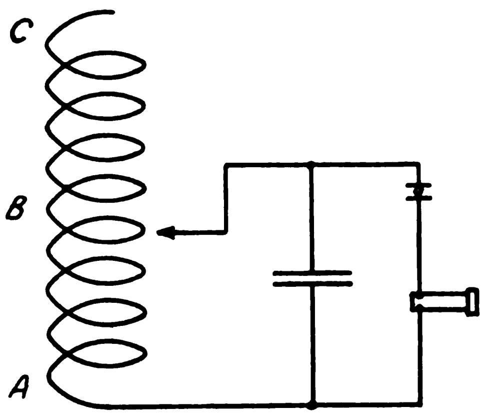
QUESTIONS AND ANSWERS

Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study to the Editor, THE WIRELESS WORLD, *Marconi House, Strand, London, W.C. Such questions must be accompanied by the name and address of the writer, otherwise they will remain unanswered: and it must be clearly understood that owing to the Defence of the Realm Act we are totally unable to answer any questions on the construction of apparatus during the present emergency.*

F. S. T. (Birmingham).—We are obliged by your pointing out the error. The statement *re* damped and undamped waves at the foot of page 58 in the April number should read "be made to reach an accuracy of within 2 per cent. We are very glad to hear you like Mr. Martin's articles.

J. P. (Rijswijk, Holland).—Fifteen thousand ohm telephones are rather costly instruments compared with those of lower resistance. You would, however, get better results with them than with telephones of lower resistance in the case of the electrolytic detector.

E. R. (Vendee).—Many thanks for your letter and the table which you have calculated. Whilst we cannot publish this at the present, we shall no doubt be able to make use of it after the war, and have therefore placed it on file. With regard to your questions, the auxiliary voltage necessary to bring a carborundum crystal to its most sensitive state depends on the particular specimen with which one is dealing. It is usually in the neighbourhood of two volts. The Fleming valve requires a voltage somewhat higher than this, and the electrolytic detector a lower voltage. Question 2.—In all secondary circuits which are designed for use with potentially operated detectors such as carborundum, the Fleming valve, etc., the inductance should be made as large as is possible with the particular wave-length that it is desired to receive. When a condenser is shunted across the secondary for tuning purposes, this should be kept very small, or the object of having a large inductance—to get the greatest possible e.m.f. impressed on the detector—will be largely defeated. On the other hand, with the magnetic detector, which is current-operated, the aim should be to have the maximum *current* in the secondary, and this can well be achieved by using a small inductance and large condenser. Question 3.—The self-capacity of an inductance coil depends on many factors, amongst these being the dielectric value of the material forming the insulating covering of the wire and the spacing of the turns. We are not aware of any simple method of calculating the self-capacity of such a coil. The effect on wave-length of the capacity of the telephones and crystal depends on the design of the circuit. In your fig. 1 there would be less effect than in fig. 2, but in neither case would much difference be noticed. Question 4.—We scarcely understand your fourth question. The primary of the jigger is designed to provide a magnetic field which will affect the secondary. The greater the current, the stronger the field will become. There is no object in having a high potential in the primary. Question 5.—The idle portion of a tuning inductance not only adds useless capacity, but has a detrimental effect in absorbing energy, particularly on some wave-lengths. For instance, in the diagram reproduced, the whole inductance A-C has a natural period of oscillation, which we will suppose for the moment to correspond to a wave-length of 300 metres. The inductance A-B, together with the condenser, will also have a certain frequency of oscillation. If now this latter frequency chances to be the same as that of the whole inductance A-C, only a part of the energy will be available for the detector, the remainder being wasted in the inductance A-C. In modern receivers where it is desired to have a large variable inductance in the detector circuit, means are adopted for cutting out the inductance not in use, either by breaking the inductance



A-C at B, or by providing separate sections of inductance which can be added or taken away as required.

H. L. (Longsight, Manchester).—(1) See reply to E.R. on this page. (2) In the Marconi high resistance crystal receivers the value of the inductance in the detector circuit is kept as high as possible. A "billi" condenser of very small capacity is shunted across the inductance so that a certain range of wave-lengths can be obtained. If, for instance, the value of inductance is such that with the billi condenser set at zero the wave-length obtainable is 250 metres, the maximum value of this condenser will give a wave-length of about 750 metres. To obtain greater wave-lengths extra inductance is added. In reply to the second part of your Question 2, the shorter wave would probably be obtainable, but it should not be forgotten that the crystal itself has a certain capacity.

R. R. H. (Woburn Sands) finds difficulty in understanding several points regarding the S. G. Brown relay and the note with reference to it which appeared in this column recently. He says, "You say the relay does not work by virtue of any variation in resistance of a *contact*, but by alteration in the resistance of a microscopic *gap*. If there is a *gap*, how can 1½ volts pass—*i.e.*, if there is no current flowing how can it indicate in *H* winding, as I suppose it is by the flow of the current being arrested or otherwise that operates the telephones?" He also asks six other questions, which are too long to reproduce here, but with some of which we will endeavour to deal.

Firstly, our correspondent has not clearly understood our previous explanation. If he will read it again carefully he will see that we explained that with the microscopic gap the current *continues to flow.* There is really a minute spark at the gap the whole time that the relay is working, and it is the idea of varying the length of this spark which constitutes the novel feature of the instrument. Further, the current is not *made and broken*, but *varied.* In reply to another question, the current in the winding *K* varies in accordance with that in the winding *H*, but is, of course, much stronger If there are sixty little alternations of current per second in winding *H*, there will be sixty bigger alterations of current in winding K. This means that the *note* heard in the telephones is of exactly the same tone as would be heard without the relay, if the received current were sufficiently strong. R. R. H. in other parts of his letter says the points of interruption are *carbon* not platinum, which leads us to believe that he is confusing this type of relay with another also invented by Mr. S. G. Brown, in which carbon contacts are used. In the relay with which we have been dealing the points are, as stated previously, of platinum. In conclusion, we think that most of our correspondent's trouble is due to the fact that he has not realised the difference between this relay and one which operates by virtue of alteration in resistance of a contact.

We have received from W. A. (Liverpool) the following query arising out of the Instructional Articles which have appeared in our pages. The query is printed in full for the information of those of our readers who are interested in inductance calculations.

"If we take a length of wire 640 π centimetres long and "wind it 20 turns per cm. on different formers so as to "get coils of varying ratio $\frac{l}{d}$ say with a length and diameter "of

"2 and 16, 4 and 8, 8 and 4, $10\frac{2}{3}$ and 3 "respectively, and then from the given table take the "values of inductances, tabulate them, and then take a "length of wire 360 π cm. long and wind it to produce "coils whose l and d are respectively 2 and 9, 3 and 6, 4 "and $4\frac{1}{2}$, and again take the inductances from table, the "following is the result:

$\frac{l}{d}$	$\frac{1}{8}$	$\frac{1}{2}$	2	$3\frac{5}{9}$
1	2	4	8	$10\frac{2}{3}$
D	16	8	4	3
Inductance	478·2	531·5	413·1	337·4 *

* From inductance of coil $l=32$ $d=9$ divided by 27.

$\frac{l}{d}$	$\cdot\dot{2}$	$\cdot\dot{5}$	$\cdot\dot{8}$
1	2	3	4
D	9	6	$4\frac{1}{2}$
Inductance	218	224·1	211·875 †

† From inductance of $l=8$, $D=9$, divided by 8.

"The maximum inductance in each case is obtained "somewhere about the ratio $l = \cdot 5$.

"If in the formula mentioned in paragraph 754 ($L=\pi^2 d^2 n^2 l K$), the complete table of the factor K were given, "the determination of the position would be a very easy "matter.

"Inductance $= \pi^2 d^2 n^2 l K$

$$= \frac{\pi^2 d^2 n^2 l^2 K}{l} \text{ length of wire } \pi d n l,$$

"so that inductance $= \frac{K\,(\text{length of wire})^2}{l}$

$$= \frac{K}{\sqrt{\frac{l}{d}}} \times (\text{length of wire})^2 \times \sqrt{\frac{d}{l}}$$

$$= \frac{K}{\sqrt{\frac{l}{d}}} \times \frac{(\text{length of wire})^2}{\sqrt{Dl}}$$

"For a given length of wire, Dl is a constant, so that "$\sqrt{Dl}$ is a constant also. The maximum inductance for "a given length of wire wound the same number of turns "per centimetre will therefore be obtained when the "proportions of a coil are such that the ratio $\frac{K}{\sqrt{\frac{l}{d}}}$ is at its "maximum value. If, from the table of inductances any "given value of inductance in cms. is divided by $\pi^2 d^2 n^2 l$ of "the particular coil to which it corresponds, the result wil "be the factor 'K' for that ratio of $\frac{l}{d}$. Taking the values "below 'K' is found to be as follows:

$\frac{l}{d}$	K	$\frac{l}{d}$	K
2/5 = ·4	·4717	4/8 = ·5	·5257
5/12 = ·416	·481627	5/9 = $\cdot\dot{5}$	·55125
3/7 = ·4287	·48851	9/16 = ·5625	·55244
7/16 = ·4375	·49374	4/7 = ·57143	·55795
4/9 = $\cdot\dot{4}$	·497385		

"The following values of 'K' are taken from a large "curve drawn from above values to show the variation "of 'K' with $\frac{l}{d}$ and in the third column the ratio $\frac{K^2}{\frac{l}{d}}$ is "shown worked out for each value.

$$\frac{K^2}{\frac{l}{d}} \left(\text{the square of } \frac{K}{\sqrt{\frac{l}{d}}}\right)$$

"has been taken, as it is a more convenient ratio to work "out and the square of a quantity will reach its maximum "at the same time as the quantity.

$\frac{l}{d}$	K	$\frac{K^2}{\frac{l}{d}}$
·4	·4717	·55625
·42	·4839	·55754
·428	·4887	·558
·43	·4897	·55769
·44	·4951	·5571
·45	·5005	·556667
·47	·5104	·55427
·5	·5253	·55188

"It would appear, therefore, that the maximum inductance is obtained from a given length of wire (with "turns per centimetre equal) when the length of coil is "about ·428 of its diameter. Is this correct?

"$\frac{l}{d}$ = about 3 was given in Vol. 2, Jan.

"$\frac{l}{d}$ = 4 was given in Vol. 2, March."

Answer.—The fact that the inductance of a given length of wire is a maximum when it is wound into a coil with a diameter about $2\frac{1}{2}$ times its length is well known, but although I have consulted several well-known text books on the subject, I have been unable to find any reference to it. Working on the lines adopted in the enquiry, but using the more exact figures to be found in the works quoted in the "Instructional Article," *paragraph* 754, the following are obtained:

$\frac{d}{l}$	$\frac{l}{d}$	K	$\frac{K^2}{\frac{l}{d}}$
2·3	·43478	·491782	·556254
2·4	·41667	·481591	·556632
2·5	·40000	·471865	·556642
2·6	·38462	·462573	·556332

from which it is seen that the coil of maximum inductance has a ratio $\frac{l}{d}$ between ·4 and ·417.

The above result is only true for a coil for which the inductance given by the formula is correct—*i.e.*, for which the correcting term mentioned in paragraph 755 is negligible. It is as well in designing a receiver to arrange for the coils to have a ratio of the above order, although if the gauge of wire required to give the proper number of turns is small, it is worth while making some calculations to see whether a larger wire wound into a longer coil would give less resistance in the circuit, which, of course, is the principal point at which to aim.

Instructional Article

The following series, of which the article below forms the first part, is designed to provide wireless telegraphists, amateurs, and technical students generally, with clear and precise instruction in technical mathematics, in order that they may be enabled to read and understand the more advanced technical articles which appear from time to time.

Our New Instructional Articles.

IN the August issue of our magazine we took the opportunity of emphasising the need for theoretical study on the part of those who, through lack of opportunity for practical work, are likely to allow their hobby to be forgotten. We have also received from various sources communications which indicate that many of our readers are handicapped in theoretical study by a lack of suitable mathematical knowledge. In view of this, and because those of our readers who have diligently studied the previous instructional articles are now in a position to benefit by a little more advanced fare, we have arranged to publish monthly the following series of MATHEMATICAL INSTRUCTIONAL ARTICLES. Although these articles will perhaps not be quite so interesting at the outset as those which we have previously published, yet their importance should not be underestimated, for by their aid students will be introduced to broad fields of interest which previously have been barred to them. The ability to read and benefit from the more advanced technical articles which appear from time to time will, we are sure, be much appreciated by many who at present can only glance over them and pass them by.

The preparation of the series has been placed in the hands of an expert wireless engineer who is daily occupied in research and other work of an advanced nature, and therefore in the position to know exactly what is required in such a series. Logarithms, the Slide Rule, Trigonometry, and many other subjects will be clearly dealt with, and, provided the series is carefully studied, we can promise to all who take up the new work a considerable and lasting benefit.

I.—Logarithms.

It will often occur, in the course of wireless work, that we have several quantities to be multiplied together and divided into each other, quantities which may each consist of half-a-dozen or more figures. Operations of this description, tedious as they are when carried out by ordinary or contracted arithmetical methods, may be very easily performed by means of logarithms.

To explain what a logarithm is, we will take a few very simple examples. We know that $100=10^2$. Now 2 is called the logarithm of 100 to the base 10, as 10 has to be multiplied by itself "2 times" in order to obtain 100. This can be written "$2=\log_{10} 100$"; but as 10 is used as the base in the case of ordinary or "common" logarithms we omit the suffix 10, and simply write $\log 100=2$.

Now $100{,}000=10^5$

therefore $\log 100{,}000=5$.

$100=10^2$

therefore $\log 100=2$.

$10=10^1$

therefore $\log 10=1$.

$0{\cdot}01=\frac{1}{100}=10^{-2}$

therefore $\log 0{\cdot}01=-2$ or $\bar{2}$.

$0{\cdot}00001=\frac{1}{100000}=10^{-5}$

therefore $\log 0{\cdot}00001=-5$ or $\bar{5}$.

and so on.

We see from this that the logarithms of all numbers from 10 to 99·99999 will have a logarithm of something between 1 and 2. That is, any number consisting of two figures in front of the decimal point has a logarithm of "one decimal something." Similarly, any number consisting of six figures before the decimal point has a logarithm of "five decimal something"; any number consisting of a decimal point followed by three noughts and then some

LOGARITHMS.

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
49	6902	6911	6920	6928	6937	6946	6955	6964	6972	6981	1	2	3	4	4	5	6	7	8
50	6990	6998	7007	7016	7024	7033	7042	7050	7059	7067	1	2	3	3	4	5	6	7	8
51	7076	7084	7093	7101	7110	7118	7126	7135	7143	7152	1	2	3	3	4	5	6	7	8
52	7160	7168	7177	7185	7193	7202	7210	7218	7226	7235	1	2	2	3	4	5	6	7	7

other figures will have a logarithm of "minus four decimal something," and so on.

Thus we see that log 50 will be equal to "one decimal something." All would be plain sailing if the "something" was 5, so that log 50=1·50, and in the case of 20 the "something" was 2, so that log 20=1·20, and so on; but, unfortunately, things are not arranged quite so conveniently for us. If we look up books on mathematics we shall find that the calculation of logs is quite a formidable business, and is a matter necessitating a knowledge of mathematics beyond the scope of these articles. Luckily, however various kind gentlemen have gone to a lot of trouble to calculate for us the logarithms of all numbers from 1 to 99,999 and even beyond that, tabulating their results in a convenient form.

Above is a portion of a table of "Four-Figure Logarithms."

Looking opposite 50 and in the column headed 0, we find the figures 6990. This is the *decimal* part of log 50, which we want, or log 50=1·6990. If we look opposite 51 and in the column headed 3, we see that the decimal part of log 51·3 is 7101, or log 51·3=1·7101. If we add to this the figure 6 found in the same horizontal row, but in the small column on the right headed 7, we shall get log 51·37=1·7101+·0006=1·7107. Thus we can find from our tables the logarithm of any number we wish, though we must remember that these particular tables are limited to the first four significant figures. For instance, if we require the log of 794·285 we can only find the log of the nearest four-figure value —*i.e.*, log 794·3=2·9000.

The whole number portion of a logarithm is called the index or characteristic, and the decimal portion the mantissa.

It is most important to remember that the values given in the log tables are the *decimal portions only*; the characteristic must in every case be supplied separately, and its value depends entirely on the position of the decimal point in the original number.

We have just found that log 51·3=1·7101, therefore

log 51300=4·7101
log 513·0=2·7101
log 5·13=0·7101
log 0·513=$\bar{1}$·7101
log 0·00513=$\bar{3}$·7101, and so forth.

It will be noticed that in the first three cases the characteristic is one less than the number of figures and in the last two cases that the value of the characteristic is negative, and is greater by one than the number of noughts following the decimal point in the given number.

We can, of course, use our log tables to perform the reverse operation, that of finding a number which has a given value for its log. This, however, will be found on trial to be rather inconvenient, and so we generally find, in company with log tables, another set of tables, headed "Antilogarithms." For instance, we have found that the value of log 51·37 is 1·7107. If we look up the mantissa ·7107 in our antilog tables in exactly the same way as we looked up our log we shall find the figures 5137. These figures give, to four significant figures, the number whose log is ·7107. Now, just as when looking up our log we put 1 as characteristic *because* the number was 51·37, so in this case we put down the figures as 51·37 *because* we had 1 as characteristic. It will also be noticed that, on looking up the antilogs of 3·7101 and 1·6990 we get 5130 and 50 respectively, the numbers we started with originally.

Now that we can, with a little care, find the log or antilog of any number it is time to explain how we can use them for calculations. For the purpose of this explanation we will construct the simplest possible tables of logs and antilogs :

ANTILOGARITHMS.

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
·69	4898	4909	4920	4932	4943	4955	4966	4977	4989	5000	1	2	3	5	6	7	8	9	10
·70	5012	5023	5035	5047	5058	5070	5082	5093	5105	5117	1	2	4	5	6	7	8	9	11
·71	5129	5140	5152	5164	5176	5188	5200	5212	5224	5236	1	2	4	5	6	7	8	10	11
·72	5248	5260	5272	5284	5297	5309	5321	5333	5346	5358	1	2	4	5	6	7	9	10	11

LOGARITHMS.

0·001	$\bar{3}$
0·01	$\bar{2}$
0·10	1
1·0	0
10·0	1
100·0	2
1,000·0	3
10,000·0	4
100,000·0	5

ANTILOGARITHMS.

3	0·001
$\bar{2}$	0·01
$\bar{1}$	0·10
0	1·0
1	10·0
2	100·0
3	1,000·0
4	10,000·0
5	100,000·0

Now $10\times 1{,}000=10{,}000$

Also log 10 + log 1,000 = 1 + 3 = 4, and antilog 4 = 10,000.

Similarly $100{,}000\times 0·001\times 10=1{,}000$, and log 100,000 + log 0·001 + log 10 = $5+\bar{3}+1=3$, and antilog 3 = 1,000.

Thus we can multiply numbers by adding their logs and taking the antilog of the sum. The method depends, of course, on the principle that

$$10^a\times 10^b\times 10^c\times 10^d=10^{(a+b+c+d)},$$

where a, b, c, d, etc., are the logarithms of the various numbers we wish to multiply together.

EXAMPLE I.

Find the product of $17·62\times 0·972\times 0·00076$.

Log 17·62 = 1·2460 = 1 + ·2460
Log 972·0 = 2·9877 = 2 + ·9877
Log 0·00076 = $\bar{4}$·8808 = $\bar{4}$ + ·8808

Adding .... $\bar{1}+2·1145=1·1145$

Antilog 1·1145 = 13·02.—*Ans.*

Note that when adding the logs the characteristics are treated separately from the mantissæ, and that the mantissæ are *always positive*; these points are of great importance.

EXAMPLE II.

Multiply 37·62 by 0·000859.

Log 37·62 = 1·5754 = 1 + 0·5754
Log 0·000859 = $\bar{4}$·9340 = $\bar{4}$ + 0·9340

Adding $\bar{3}+1·5094=\bar{2}·5094$

This must be taken as $\bar{2}+0·5094$, and so the result is greater than antilog $\bar{2}$, and less than antilog $\bar{1}$—*i.e.*, it lies in value between 0·01 and 0·10. Looking up ·5094 in our antilog tables we see that the answer is 0·03231.

The LIBRARY TABLE

"THE INSPECTOR AND THE TROUBLEMAN." By Stanley R. Edwards and A. E. Dobbs. Chicago: Telephony Publishing Company. London: S. Rentell & Co., Ltd. 4s. 6d. net.

The troubles of telephone electricians are many, and although books on telephony are numerous, it is frequently a difficult matter to get practical men to learn from any experience but their own. A man who has been out all day tracing line troubles is not often inclined to spend his evenings in studying books, particularly if they are at all "dry." For this reason a volume which contains practical information presented, not merely in a lucid fashion, but also in an interesting way, should make a special appeal to many.

The book under review can well be placed in this category, consisting as it does of a series of imaginary dialogues between practical telephone men engaged in working a telephone system in a small town. Originating in the United States, the volume is naturally full of Americanisms, some of a very "advanced" nature, but after a few pages one becomes used to them, and they certainly do not detract from the clarity of the explanations.

The purpose of the authors is to deal in an elementary but thoroughly practical manner with the problems which are encountered in magneto exchanges. This they can well be said to have accomplished. Spread about the book there is also a great deal of valuable information on the theory of telephone work in general, and clear diagrams are given when it is thought they are needed. Altogether it is a handy and well-written book, which should be of great help to telephone linesmen and many others concerned with the practical problems of transmitting speech by wire.

* * *

THE WORLD-WIDE ATLAS OF MODERN GEOGRAPHY. With an introduction by Dr. J. Scott Keltie, Edinburgh and London, 1915. W. & A. K. Johnston, Ltd. 7s. 6d.

War constitutes perhaps a better instructor in political and physical geography than all the text-books which have ever been published on that subject. The holocaust which is now devastating half Europe has created a demand for up-to-date Atlases, such as that under review. The publishers have deemed it advisable under present circumstances to present to the public a revised edition (the eighth) of their well-known standard atlas, which has been found so useful to those who want really accurate maps. The excellent introduction on geographical discoveries and territorial changes from the beginning of the nineteenth century, written specially by Dr. Keltie, the secretary to the Royal Geographical Society, has been considerably amplified, and includes the re-arrangement of territory subsequent to the war between the Balkan allies in 1912–13, which resulted in the

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almost complete abolition of the Ottoman Empire from Europe. The maps, generally (of which there are 128 plates), are beyond reproach, although, whilst in the map of the Balkan States the territorial changes above referred to are shewn, yet in the map of Europe, which is printed in the beginning of the volume, this re-arrangement is not indicated—the Turkish Empire being represented as stretching from the Black Sea in the east to the Adriatic Sea in the west. A very comprehensive index, running into 98 pages, is added, together with frontispieces of the flags and time of all nations, and plans of cities. In view of the increasing number of radio stations all over the world, a copy of this atlas should be in the hands of everyone interested in the science of Wireless Telegraphy.

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"ELECTRICITY." By W. H. McCormick. London, 1915. T. C. & E. C. Jack. Price 3s. 6d.

The aim of this book appears to be to satisfy the demand that Science should be placed before the general public in popular form. A real need exists nowadays that the "man in the street" should be acquainted with, at any rate, the less technical side of the sciences, and in order to place him *au courant* with progress in the scientific world the excellent plan was conceived of putting these "popular" books on the market. Mr. McCormick begins by going to the root of the whole thing. He devotes his first chapter to tracing the history of electricity, and shews that although the science is of comparatively recent date, electricity itself has existed from the beginning of the world. He points out that probably man's first acquaintance with it was through the natural phenomenon, known to all the world as a thunderstorm. The author discourses on the fundamental uses of the Leyden jar and shews that the electrical capacity of even a small jar is surprisingly great. He also speaks of electricity in its relation to the atmosphere, and shews how the latter is charged with the former in varying degrees. This part of the book might almost be considered a preamble, and the author now plunges seriously into his subject by describing firstly the various pieces of electrical apparatus, and secondly the different uses to which the power is put. The harnessing of electrical current and its deviation into the channels of usefulness are strongly emphasized. The use of electricity in locomotion has become so regular a feature in the lives of most of us that we are apt to look upon it as a mere commonplace. In reality the application of the electric current to the tramcar or the train represents a degree of skill of the highest order. This is only an example, but Mr. McCormick shows how electricity has been employed for lighting, heating, for working clocks, bells and lifts, for electro-plating and electro-typing. In medicine the special boon which it represents is exemplified in the Röntgen Rays apparatus. In the realm of electricity represented by the telegraph and telephone special opportunities have manifested themselves. Were it not for electricity the marvels of wireless telegraphy and its life-saving efforts would never have been known to mankind. The author devotes two special chapters to wireless, the first of which he opens by saying, "Wireless telegraphy is probably the most remarkable and at the same time the most interesting of all the varied applications of electricity." He describes in some detail the apparatus and its workings which produce the etheric waves, and reproduces several diagrams and photographs. In his second wireless chapter he explains the practical application of wireless telegraphy, and enumerates several of the more important radio-telegraph stations of the world. Altogether the book is well written, the subject has been pleasingly handled, and we commend it to those who desire more than a passing acquaintance with that most wonderful of all sciences, Electricity.

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"ALSACE AND LORRAINE." By Ruth Putnam. New York and London, 1915. G. P. Putnam's Sons. 5s. net.

Miss Putnam's own words in her preface make a good introduction to our review of her excellent book. "The war of 1914," she says, "exciting interest in past problems as well as in a stormy present, has turned the attention of the general public to the make-up of European nations." Comparatively speaking, how few in number are those who really take an interest in the study of the history of states other than their own. This may be gauged from the appalling ignorance generally exhibited by the Englishman in connection with anything outside his own country. But the sad thing about it is that he is conscious of this ignorance, and has no shame in excusing and attributing it to his insular position. It is a recognised fact that the Englishman (or woman) is probably the worst linguist of all the civilised peoples. There may be a shred of justification in this excuse, but surely it behoves every individual to leave no stone unturned to acquaint himself at least with a rudimentary knowledge of things extra-British. Miss Putnam's book should therefore make a particular appeal at this juncture. The knowledge that the average "man in the street" possesses concerning Alsace and Lorraine is that they are two provinces stolen from the French by Germany at the close of the Franco-Prussian war of 1870–1. The author traces the history of both provinces from the earliest times and gives detailed accounts of the trials and worries which beset the inhabitants. To those interested in wireless telegraphy this book should make a peculiar appeal. Metz, the strong German fortress, is situate within the confines of Lorraine, and it is here that the Germans have established a high-power wireless installation. In this connection it may be of interest to remark that it is said it is only by sufferance of this big apparatus at Metz that the French frontier wireless telegraph stations at Verdun and other places are allowed to work. In fine, the book is well worth reading, and the author has apparently lavished no small amount of care on its production. We trust that it will receive the hearty reception which it deserves.

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"THE SPECTROSCOPY OF THE EXTREME ULTRA-VIOLET." By Theodore Lyman, Ph.D. Longmans, Green & Co. 5s. net.

From the distant period when Newton first performed his classic experiments with a prism and a sunbeam filtering through a shutter in a darkened room, the science of spectroscopy has exercised a powerful fascination over physicists of all nations. For some time after Newton's investigations there was so much to occupy attention in the spectrum normally visible to the eye that very little consideration was given to what might lie in the regions immediately beyond the visible red and violet. Then gradually, as the science developed, research was undertaken in this direction, with the result that we now have an ever-growing store of knowledge regarding these regions which are known respectively as the infra-red and the ultra-violet.

It is with this latter part of the spectrum that Dr. Lyman deals in the book before us. Principally the volume treats of a certain part of the ultra-violet spectrum known as the "Schumann" region, in honour of the great scientist who first revealed its presence. The limit of violet light observable with the ordinary form of spectroscope appears to the normal eye in the neighbourhood of wave-length 4,000 (Angstrom Units). Comparatively early in the history of spectroscopy Ritter showed that chemically active rays existed beyond the visible violet limit; and later Becquerel, by means of a Daguerreotype plate, succeeded in tracing the spectrum down to about wave-length 3,400. Later investigators, substituting quartz for glass in the prisms, and introducing other improvements, were able to reach a wave-length of 1,850, and finally Schumann, with fluorite in place of quartz, succeeded in photographing the spectrum as far as wave-length 1,200. Dr. Lyman, in the introduction to his book, deals briefly but nevertheless in an interesting manner with the history of ultra-violet research. Chapter I. has for its subject Photometers, and treats, among other things, of the special photographic plates which are needful in spectroscopic work. Subsequent chapters are devoted to the consideration of the Absorption of Solids and Gases, Apparatus and Methods of Investigation, Emission Spectra, and Photo-Electric and Photo-Abiotic phenomena.

Many readers will be interested in the short account of Schumann's life which appears on pages 29 and 30. Schumann was more than forty before he gave up commercial life, and devoted himself entirely to scientific work. Practically his whole life from this time forward was occupied in spectrum analysis, and our knowledge of the extreme ultra-violet is chiefly due to his researches.

In the concluding pages of the book are printed a number of valuable tables, a bibliography, a list of Schumann's published papers and an appendix dealing with the manufacture of special dry plates for ultra-violet work. Both the student of spectroscopy and those members of the scientific public whose work has not led them to specialise in this particular branch of physics, will find this monograph of considerable value and interest.

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" PRINCIPLES OF FLIGHT." By Algernon E. Berriman. London: Offices of *Flight*. 2s. net.

The rapid and astonishing development within the last few years of machines for navigating the air, together with the important part these are playing in the prosecution of the war, are causes which may well stimulate the curiosity of the général public regarding the principles upon which such machines are based. Most of us, when we see an aeroplane cleaving its way across the sky, are desirous of knowing "how it works," and it can safely be said that an afternoon at Hendon or any of the other aerodromes is rendered much more enjoyable by at least some knowledge of the main principles of flight.

Mr. Algernon E. Berriman, an expert, who, as former technical editor of a well-known aeronautical journal, is eminently qualified to write on the subject, in the volume before us describes in a readily comprehensible manner the principles and working of flying machines, both heavier and lighter than air. The first few pages are perhaps the most interesting in the whole book, for they give a short history of flying from the time when Leonardo da Vinci conceived the idea of attaching wings to the human body, down to the period when the Wright brothers emerged from their obscurity and showed themselves veritable masters of the science and art of aerial navigation.

After a brief chapter on lighter-than-air machines, the writer devotes the remainder of the book to the consideration in detail of a modern aeroplane—a British-built Deperdussin monoplane being taken as typical.

In addition to clear line drawings interspersed in the text, sheet diagrams which open out much larger than the book itself assists the reader to understand the explanations given.

Constructional details are largely dealt with, but there are also chapters dealing with the angle of incidence, the cambered wing, resistance (not the electrical variety), propellers and stability. Careful study of these is essential to a proper realisation of the problems of aviation. A final, but highly interesting and important chapter treats of petrol engines, particularly the "Gnome," the popularity of which in the world of aviation is at present outrivalled by no other. Here, too, excellent sectional diagrams are given.

For those who wish to commence the study of aeronautics and for the general public who desire to grasp the main principles of aviation we can strongly recommend this book. By its modest price (2s. net) it is brought within reach of practically everybody, and we are convinced that it will appeal to a very large public.

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" ARITHMETIC OF ALTERNATING CURRENTS." By Ellis H. Crapper, B.Eng.M.I.M.E. London: Whittaker & Co. 1915. 2s. 6d. net.

The study of alternating currents is one in which the student can proceed but a very short distance without the aid of mathematics, and the practical electrician may also be severely handicapped if he lacks the necessary knowledge regarding the quantitative relationships between the various factors of the A.C. Circuit. This little book is intended to serve as a companion to the many text-books on alternating current theory, and will be found of use to many of our readers. Of particular value are the numerous worked examples by the aid of which the student can obtain a clear insight into the methods of solving the problems. Suitable exercises are also provided, together with their answers.

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" THE TEACHING OF ELECTRIC LIGHT SWITCHING." (Third Edition.) London: A. P. Lundberg & Sons. Post Free.

This little pamphlet, already well-known in electrical circles, has now reached its third and enlarged edition. As its title implies, it deals with instruction in electric light switching—a very important and much neglected subject—and will be found of great use to heads of electrical engineering departments, lecturers on electric lighting, etc. Messrs. Lundberg will be pleased to forward the pamphlet post free to all who are concerned with such instruction.

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"MONTHLY WEATHER REVIEW." Vol. 43, No. 4. April, 1915. Government Printing Office, Washington, U.S.A.

We have received from the Weather Bureau of the U.S. Department of Agriculture a copy of the April issue of the above. It contains contributions of the research work of the Weather Bureau, and deals with climatic, aerologic, meteorologic and seismologic conditions generally in the United States, whilst several tables, diagrams, and charts are appended.

THE BRITISH ASSOCIATION.

THIS association has just compiled and issued the programme of its meeting which will take place at Manchester from September 7th to 11th, under the presidency of Professor Arthur Schuster. In consequence of the war, and as has been already announced, the meeting will confine itself wholly to the technical side, the usual social arrangements having been eliminated.

The sectional meetings have been arranged as usual, Section G (Engineering) having for its President Dr. H. S. Hele Shaw, F.R.S. The following are the electrical papers to be read in this section: "The Heating of Iron when Magnetised at Very High Frequencies," by N. W. McLachlan; "Some Experiments to Determine whether there exists Mutual Induction between Masses," by Professor Miles Walker; "The Eddy Current Losses in the End Plates of Large Turbo-Generators," by Professor Miles Walker; "Electric Oscillations in Coupled Circuits—a Class of Particular Cases," by Dr. W. H. Eccles and Mr. A. J. Makower; "The Capacity of Aerials of the Umbrella Type," by Professor G. W. O. Howe; "The Calculation of the Effect of Masts and Buildings on the Capacity of Aerials," by Professor G. W. O. Howe.

A number of matters in other sections may also be mentioned. In Section B (Chemistry) there will be a discussion on "Smoke Prevention," and in Section L (Educational Science) a discussion will take place on "Education and Industry." A report of the Committee on Industrial Fatigue, to be presented to Section F (Economic Science and Statistics), may also produce some points of interest, whilst a discussion in the same section on the production of industrial harmony will attract attention having regard to recent happenings in the labour world.

AN APPRECIATION.

SOME time ago we received the following letter from an Ecuadorian reader, but, owing to pressure of space caused by the insertion of interesting matter dealing with the war, we were compelled to withhold its publication until the present moment. We trust that all our readers derive as much pleasure and instruction from the perusal of our pages as does our friend in far-off Guayaquil.

"DEAR SIRS,—I duly received and have "been punctually receiving the important "magazine WIRELESS WORLD during the "past year, which is highly instructive "and meritorious. It is a treasure, and a "source of wireless instruction; its lessons "in 'marconigraphy' are so clear and "comprehensible on account of the excellent "drawings, and I have found data which "I have not seen in many modern text-"books which I possess. Your magazine "is the guide to the student, as well as to "the expert operator. As long as I live "if I can I shall be a continuous subscriber "to THE WIRELESS WORLD.

"(Sgd.) RICARDO MORAN PEREIRA."

Foreign and Colonial Notes

Brazil.

The offices of Marconi's Wireless Telegraph Co., Ltd., in Rio de Janeiro have been removed to 37, Rua Visconde de Inhauma, immediately opposite the headquarters of the Ministry of Marine and quite close to the offices of the Royal Mail Steam Packet Company.

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China.

During the last few months a number of wireless telegraph stations have been established on the Chinese coast. It is expected that they will be of great value to shipping in that neighbourhood. New stations have been opened at Canton, Wusung (near Shanghai), Foochow and Hankow. The general range of these stations is about 700 nautical miles. The power of the old station at Hong-Kong is to be increased to the same range.

* * *

Japan.

Long distance wireless telegraphy is slowly but surely spreading its feelers over all the globe. Communication by this means has just been established between Funabashi, Japan, and Honolulu, in the Hawaiian Islands, a distance of about 4,000 miles.

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Portugal.

Three wireless installations fully equipped with Morse apparatus have been found in different parts of Lisbon. One wireless station was discovered on the fourth floor of a house in the town. Five arrests were made of persons, who confessed to having erected three other stations in different localities of Lisbon. They were apprehended by order of the Government. Further information goes to show that the Germans are at the bottom of the matter.

Sweden.

The exactions of the British censorship during the war have unfortunately raised difficulties for the authorities in neutral countries. If they wish to communicate with other neutral countries they must avoid the cable passing through British territory. This is particularly emphasised in the case of the Scandinavian kingdoms. A Swedish Committee has just been formed to discuss the erection of a wireless station at Karlsborg, Sweden, for direct communication between Sweden and America, thus escaping the censorship of their communications by the British. The Chairman of the Committee is the general manager of the Swedish State Telegraph Company.

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United States.

It is very interesting to note the latest experiments to be undertaken by the Weather Bureau of the United States. They contemplate the sending of the weather forecasts by wireless telegraphy at a speed slow enough to accommodate the majority of amateur operators.

* * *

We are indebted to our American contemporary, *The Wireless Age*, for the following paragraph:

"How the news of the outbreak of the European war reached the Russian naval officer, Vilkitsky, an Arctic explorer in Behring Strait, is told in a newspaper dispatch from Petrograd. Vilkitsky, who has been heard of by wireless, left Vladivostok, planning to attempt the Arctic passage from east to west. He was not aware that hostilities between the Allies and Germany had begun and obtained the information from a wireless source somewhere in Behring Strait."

Marconi's Wireless Telegraph Co., Ltd.

Account of General Meeting.

THE Eighteenth Ordinary General Meeting of Marconi's Wireless Telegraph Company, Ltd., was held on July 26th, 1915, at the Whitehall Rooms, Hotel Metropole, W.C., Senatore G. Marconi, G.C.V.O., LL.D., D.Sc., Chairman of the Company, presiding.

The Secretary, Mr. Henry W. Allen, having read the notice calling the meeting and the Auditors' Report,

The Chairman, who was warmly received, said:

I propose, with your approval, to take the Report as read. I have little doubt that the Statement of Accounts which has been submitted to you will be regarded in all the circumstances as satisfactory.

If you will refer to the Balance Sheet you will find on the Debit side, Capital remains practically unchanged, Bills Payable show a slight increase, and Sundry Creditors somewhat less than the figures of the preceding year.

The Reserve Account now carries with it the Share Premium Account which, as we have advised you, we have transferred. On the credit side the Cash at Bankers and in hand requires no explanation, while the amount to the credit of Temporary Investments and Loans against securities represents monies for which we had no immediate need, and which therefore have been lent against or invested in first class securities earning a better interest than could be obtained by placing the money on deposit at our bank.

Sundry Debtors shows an increase approaching £250,000 over the figure of the preceding year; practically the whole of this increase was in respect of Government work, and nearly the whole of it has since been received.

The amounts invested in Freehold and Leasehold Properties do not call for any special comment. They have been reduced by sums set aside for depreciation, according to our custom.

Shares in Associated Companies, as stated in the Report, shows an increase of some £60,000, the greater part of which is represented by an increase in our holding in the Russian Company, by reason of the growth of their business and the increase of the capital of which we took our proportion. The par value of our total shareholding is now close on 2½ million sterling, but the figure appearing to the credit in the Balance Sheet represents, as usual, the actual cost to the Company.

Turning to the Profit and Loss Account, there is little which calls for comment; on the Debit side, there is the substantial balance amounting to £232,716 8s. 11d. Profit carried to Balance Sheet. This figure shows a marked increase over the profit of the preceding year, proportionate, of course, to the increase in contracts, sales, and trading account.

I do not think that the figures need any further explanation; but, as I have already said, I am satisfied that you will regard them in all the circumstances as highly satisfactory. They exclude, however, as you have been told in the Report, any remuneration from the Government for the use of the Company's high-power stations since the beginning of the war, and numerous other services which the Company has rendered. As no basis for remuneration has yet been settled, we have thought it better to make no estimate of this amount, but have left the whole item to be dealt with in the accounts of the current year. All that I can be permitted to tell you is that the amount of work which has been done and the services rendered are considerable, and we have very little doubt that the remuneration which will be awarded the Company in due course will be proportionate to the value of the services rendered and the work done.

We all realise that we are passing through most exceptional and serious times, and everybody, I am sure, will appreciate that the outbreak of hostilities at the beginning of August of last year must have caused very considerable disturbance to a world-wide business such as ours.

As was to be expected, wireless telegraph apparatus was promptly declared contraband of war, and for the time being, therefore, our work in many parts of the world practically came to a standstill. Some of our negotiations had to be completely abandoned and many others deferred. Our programme has consequently undergone complete dislocation, and it is quite impossible at the present moment to say to what extent, or in what way, it will be affected eventually. We can only bide our time and await events.

On the other hand, our factory has been kept very fully occupied in carrying out the very important orders which we have received both from home and abroad in consequence of the war. The greater part of this work, however, will figure in the accounts of the present year.

Very naturally the businesses of our associated Companies in some cases have also been very much disturbed.

The American Company have been deprived of the use of their Transatlantic Station owing to the stations on this side being required for other purposes. It is hoped, however, that in due course they will receive fair compensation. Their high-power stations, however, of San Francisco and Hawaii have been completed, and a telegraphic service is being conducted very satisfactorily. We are daily awaiting information with regard to the opening of the service through to Japan. Arrangements have been made with the Japanese Government for the conduct of a commercial telegraph service, which they contemplated to inaugurate ere this.

The Canadian Company has continued to make progress, but the changes which we informed you last year were contemplated have not yet been able to be carried out owing to the war.

The Argentine Company have had to defer for the present work upon their high-power station.

The Belgian Company continues to conduct its business from our office in Marconi House under the direction of the English Directors of that Company, Mr. Godfrey Isaacs and Captain Sankey. The business is progressing satisfactorily, but it has been quite impossible to make up any balance sheet.

The French Company has continued to do a satisfactory business, and has paid for 1914 a dividend similar to that of 1913.

The Marconi International Marine Communication Company, Ltd., has continued to show satisfactory progress, although it has not been altogether free from loss directly arising from the state of war.

Our Russian Company had a very good year, and has paid a dividend of 15 per cent. as compared with 6 per cent. for 1913. They have a considerable amount of work in hand, and are doing a very satisfactory business.

The Spanish Company's negotiations with the Spanish Government, to which reference was made last year, were not facilitated by the outbreak of war. They have, however, continued to make progress, and we are now advised that they are assured of an early and satisfactory termination.

The development of the Automatic Telephone Company has not made much commercial progress in consequence, of course, of the war. The name of the Company has been changed to that of " The Relay Automatic Telephone Company," as the Swedish name under which it traded was liable to be mistaken, which would not have been to its advantage.

We have signed an important contract with the Italian Government, which we contemplate will be put into operation in the early future.

With regard to the Imperial chain: you will remember that in their Report of last year the Directors informed you that they were permitted to make but slow progress with the erection of the six high-power stations for which they had contracted with His Majesty's Postmaster-General, and the Company's interests were being seriously prejudiced thereby. Within a few days of our General Meeting war was declared, and at the end of the year the Postmaster-General informed the Company that, owing to the altered circumstances resulting from the war, the Government had decided not to proceed with the Imperial wireless chain. We were further informed that the governing factors in determining the Imperial Scheme would be better met by means other than the construction of stations of the character and in the situations contemplated by the contract for the Imperial chain, and that the amounts disbursed by the Company in respect of the contract would be refunded to us.

Subsequently, in February, negotiations were entered into with His Majesty's Government for the erection of certain stations on conditions differing from those contained in the original scheme. Negotiations are proceeding on a basis which, if agreed to, would represent to the Company a reasonable equivalent of the terms of the 1913 contract. Nothing, however, has yet been definitely decided.

Since I last addressed you there have been some important developments in the art of wireless telegraphy, and we have applied for several new patents. It would be inadvisable, however, for me to give any further information upon this subject at present.

I should like to be able to give you a full account of the very important part which your Company has played since the outbreak of war; but, unfortunately, this would not be permitted me, nor would it be in the interests of anybody for me to attempt to do so at the present moment. All I am able to say is that the Company has received more than one letter of appreciation from the Lords Commissioners of the Admiralty in respect of the work they and members of their staff have done. It will interest you to know that from our Companies some 1,100 men are employed in the forces on active service or on special duties, apart from the very large number at the Head Office and Works who have been requested to remain at their posts, where by so doing they could render great service to the country.

On behalf of my co-Directors and myself I wish again to place on record our high appreciation of the services rendered to your Company, and I might also say to the British nation and her Allies, by our Managing Director, Mr. Godfrey Isaacs. He has continued untiring in his work and activities, and it would be difficult to overestimate the value of his services. As I said last time I had the honour of addressing you, I believe it to be an indisputable fact that it is very largely due to him that wireless telegraphy has become, and has remained, a great British industry—I might also say a great British enterprise—of perhaps greater value to the nation during war-time than in peace.

You will perhaps remember that I said last year: "The value of wireless telegraphy may one day be put to a great practical and critical test; then, perhaps, there will be a true appreciation of the greatness of the work." I have full confidence that when the war is over, and the facts can be made public, the appreciation to which I referred will not be lacking.

I have now to move: "That the Report of the Directors, together with the annexed Statement of the Company's Accounts at December 31st, 1914, duly audited, be received, approved, and adopted." I will call upon Mr. Godfrey Isaacs to second the motion.

The Managing Director (Mr. Godfrey C. Isaacs), who was warmly received, said: "Ladies and Gentlemen,—In rising to second the resolution I had not contemplated much to add to what our Chairman has already told you; but, in view of his last remarks, I must, in the first place, thank him very sincerely indeed for the terms in which he has expressed himself of the work which I have done for the Company, and I propose, in the circumstances, to take advantage of this opportunity of telling you something about the Company and the competition which it has experienced—circumstances which at no other period has it ever been possible for me to speak about. I want to remind you that I joined the Company, at Mr. Marconi's personal invitation, on January 25th, 1910. At that time the Company had an issued capital of £547,299. It had practically no cash resources whatsoever, and it had no credit. It had been extremely difficult to find money in this country for wireless telegraphy. Mr. Marconi had personally made great efforts to find the necessary money to conduct the business of the Company, and he only succeeded by going to Italy and obtaining there a substantial subscription to the Preference issue which was at that time made. But for that fact—but for his being able to obtain that money in Italy—there is little doubt, I think, that the Marconi Company would have then come to an end.

When I joined in 1910 Mr. Marconi personally lent to the Company the sum of £12,000, and he then proceeded to Canada upon the Company's business. Within a very few weeks of his absence I had to draw a cheque on my own banking account to pay the salaries which were due on the Saturday morning for the preceding month. To-day, ladies and gentlemen, we have a capital issued of somewhere approaching one and a half millions sterling, and I think you have but to refer to the Balance Sheet to be satisfied that we are in a very sound financial position, and that our Balance Sheet is a very sound Balance Sheet, and that our assets are very sound assets. We have to-day nearly one million sterling to the credit of our General Reserve Account, and we have very large assets in the shape of cash, Realisable First-Class Securities, Freehold Property, Leasehold Property (and in speaking of Leasehold Property I would like to tell you that although it appears in the Balance Sheet at cost, less depreciation, we could dispose of it to-day—and we have had more than one offer for it—at a very handsome profit); and we have, in addition, a large number of shares in our Associated Companies, most of which have to-day a very substantial value, and all of which we hope in the future will have a very big value. Now, ladies and gentlemen, I want to tell you something of the reasons why the business did not prosper in the first years. I think it is advisable—I think it is desirable—that you should have an insight into the history of this Company, which heretofore has of necessity, for reasons which you will all understand, been a closed book. Very soon after Mr. Marconi provided the Company with this very valuable invention, the methods obtaining abroad were adopted with regard to this science, and the very valuable patents which were then this Company's property, and the property of this Company alone, were imitated in Germany, and with the great ability of the German people, and their great foresight, a big German Company was created. This German Company was created by the German Government. It had for its direction the most, or some of the most, eminent and able commercial men in Germany—men who were then the Directors of some of the biggest commercial industries of that country.

It had, further, the great advantage of the financial aid of some of the principal German banks, and it had, finally, a very large subsidy from the German Government. Now, ladies and gentlemen, that was the opposition Company against which the Marconi Company for many years, up to the time when I joined it, and subsequently, had to contend. Mr. Marconi personally, with the aid of his Managers, had for many years succeeded—and, in my opinion, marvellously—in maintaining something of the position of the English Company, notwithstanding this very powerful opposition of the German Company; and I think that it was very largely due to the magnificent support given to the Company—and, perhaps, it would be more correct to say to Mr. Marconi personally—by the Italian Government, notwithstanding the fact that they were the ally of the German Company's Government, that the Marconi Wireless Telegraph Company was able to continue in existence. The German Company, no doubt, under the direction, to a large extent, of the German Government, proceeded to create powerful agencies in pretty well every country in the world, and they made great headway. With the exception of Italy, France, and this country, they had, I think, obtained the preponderating position in this industry in practically every part of the world, and that was the position which I found in 1910. Wherever one went, whatever negotiations one had with a foreign Government, one was always in competition with the powerful German agency; but that was not all. We had not only to contend with the German agents, but we had also to contend with the German Ambassadors, and we eventually found that our position was so impossible under such conditions that I returned from a journey abroad and made an immediate appeal to Sir Edward Grey, and placed these facts before him; and from that time forward I obtained the support of the British Ministers abroad in our different negotiations with foreign Governments, and from that time also we commenced to make substantial progress until we reached the preponderating position in the industry throughout the world.

It is easy to understand that to a company like this German Company, which had the support of the German Government and conducted the greater part of its business under the direction of the German Government—always with the aim of obtaining the contracts or concessions for the construction of wireless telegraph stations in foreign countries, having in view the importance which they one day would play, and with the prospect where a German station was built that German hands would work that station—it mattered little or nothing to the German Company, with the German Government behind it, at what price, or in what conditions, it entered into contracts for the construction of those stations. In those circumstances, I think you will agree that it was not easy for the Marconi Company to maintain its own. Within three months of my joining the Company it was evident to all of us that the future of our Company lay in the commercial wireless telegraph service round the world, and we adopted the policy of creating such a commercial telegraph service; and one of our first acts in April, 1910, was to apply to the British Government for the right to erect high-power stations in all the British Possessions, we stating at the time that we had determined to create this telegraph service—that we had determined to create that service on British soil, if possible, but that we had made up our minds that the stations were to be built and the service created. Unfortunately, the Government did not see its way to grant us that right, although we had asked for no money. We had merely proposed that we should, at our own expense, build these stations and work a commercial service in peace time, and in case of war hand over the whole of the stations to the Government for Government purposes. It is regrettable that we were not enabled in 1910, when we made that proposal, to proceed with our programme. Out of it was born the Imperial chain.

As you will remember, when that was mentioned in Parliament it received most hostile criticism, on the ground that it was alleged that the Company was receiving terms far too favourable to it. Immediately the matter was mentioned the German Government resolved to build a chain of wireless stations in all German colonies. The matter was not discussed in Parliament. The stations were immediately proceeded with, and they were built. I am informed—and I think I am correctly informed—that the price which the German Government paid for each of those stations was three times the price which we had asked of the British Government. Besides that price, which provided for a very handsome profit, there was a subsidy which represented in amount far more than we ever contemplated we would get in any year from the royalty which we were to receive upon the Imperial stations, and that subsidy was to be paid, not for eighteen years, but for twenty-five years. Those stations, ladies and gentlemen, were built, and, I believe, cost the German Government two millions sterling. In the light of what has subsequently happened you will probably say that it was a very bad investment, but you would be mistaken.

You will remember that this country declared war on Germany at 12 o'clock midnight on the 4th August last. At 5 o'clock in the afternoon of August 4th last Germany sent out a message to all its wireless stations, which passed that message on from one to another, and each station sent it out to sea, covering a radius of something like 2,000 miles or more, to this effect: "War declared upon England; make as quickly as you can for a neutral port." By that message, which occupied but a few minutes, Germany contrived to save the greater part of its mercantile marine. If it had but saved one of its big ships, the *Vaterland*, or any one of that class, it would have paid for the whole cost of its wireless stations. We all know that it did a great deal more than that, and that it did a great deal more than sending this message to its mercantile marine, but I do not think I am permitted to go further, or to tell you any more than what I have told you already with regard to the saving of the mercantile marine.

Ladies and gentlemen, I have given you this information because, as I said before, I think it right that you should understand a little of what the Marconi Company has had to contend with in endeavouring to maintain its position in the world in this industry, and I have also given it to you because I want you to understand —or, perhaps, better understand—the reasons for the conservative policy which the Board has determined upon at this time. We contemplate that when this war is over, in consequence of the very big value which wireless telegraphy has proved itself to be during this war, there will be a very considerable business to be done with a great many foreign countries. But, ladies and gentlemen, we are mindful that when that time comes it is possible that, owing to the financial stress which may reign for a period, many foreign Governments would defer entering into the engagements which they otherwise, in my opinion, would be only too willing to do, if we were not able to some extent, and for some little period, to finance the work which we may undertake for them. I do not know what is likely to be the position of our competitors when the war is over. I do not know whether they will have the same facilities financially, or in other respects; but, in any case, we do not propose to take any chances.

We contemplate so harbouring our resources that when the time comes we shall be able to undertake the business which will be offered to us, and we shall be able to undertake it far more profitably by reason of our having the means at our disposal to give such temporary assistance in carrying out the work as will be required. Further, we must recognise that it may be possible that we may be called upon for some financial assistance for a period to some of our Associated Companies, and there is no doubt that the Mother Company will have to be prepared to be their bankers in case of need. In these circumstances we feel sure you will agree with us that we are adopting a far wiser policy in paying a smaller dividend and in making all the provision which we contemplate the future may require from us. In giving you the account which I have done of the work which the Company has had to do in maintaining its position in the world in this industry I want to add one thing. I never could possibly have succeeded in the work I have done had it not been for the loyal support and help I have had from Mr. Marconi personally, and from every single member of my Board, and very particularly from our Manager (Mr. Bradfield) and our Assistant Manager and Secretary (Mr. Allen). I cannot exaggerate the immense help they have been to me throughout all these five years of work. I must also refer to our staff of engineers —to our Head Engineer (Mr. Gray), to our Mr. Vyvyan, and to a number of others that I cannot name now, who have all done magnificent work for the Company, and have shown a loyalty which I do not think has ever been surpassed anywhere. Ladies and gentlemen, I am quite sure that it must have given you all a great deal of satisfaction to see Mr. Marconi, who has been able to return for a few days to this country, to preside over us. In his work in Italy as an officer supervising all matters electrical for the Army and Navy I am sorry to say that he has been nearer to Austrian and German shells than I like to think about, but I am very glad, at all events, that we see him safely home, none the worse for his experiences.

Ladies and gentlemen, I also want to tell you that although he has been employed in the capacity which I have just named for his own country, he has, nevertheless, been able to give to us during all that time all the direction and all the assistance, and has been able to watch over this Company's affairs, and to work in the interests of this Company, just the same as he has always done. There is only one thing more I want to mention before I sit down—I ought to have told you sooner—that the five Balance Sheets of this Company published since 1910 show a net profit of close upon one million sterling, and I think, in face of the difficult conditions under which we have had to work, that is not a bad result. It only remains for me now to second the Resolution which has been proposed by the Chairman.

The Chairman: I think we are all grateful to Mr. Godfrey Isaacs for the very clear and interesting history which he has given us of what this Company has done, what it has had to contend with, and the difficulties which it has encountered in the past. I think we are all very glad that he has been able to give us this *résumé* of the history of the Company. I am very grateful indeed to him for what he said in regard to myself personally, and I thoroughly endorse everything he has said with regard to the Staff of this Company. I will now ask any Shareholder who has any question to ask upon the Balance Sheet and Report to please do so now.

A Shareholder: Mr. Chairman, may I ask whether in the item appearing in the Profit and Loss Account, under the heading of "Profit for the year as per Account, £232,716 8s. 11d.," is included the dividends received from the Associated Companies in respect of our holdings?

The Chairman: Yes, certainly.

Mr. Lanham: Mr. Chairman, before you put the Resolution to the Meeting, as nobody seems to be inclined to say a few words, I would like to do so. Last year we had, if anything, perhaps a little too much talking; but to-day we have had a very momentous speech, which in a few minutes will be on its way to our Colonies and elsewhere throughout the world. It is a speech which has been most illuminating to us all as to the methods which our British industries have to contend with. I just wish to say a word or two, from the point of view of a small Ordinary Shareholder, of appreciation on behalf of the whole of the Shareholders present to-day, and nothing by way of any cantankerous talk. When I came here I had two pleasant surprises. The last I heard of our gallant Chairman was that he was on his way across the Atlantic. I do not know whether it was inside one of the boilers of the ship, or something of that sort; but it is a great pleasure to us all, sir, to see you here looking not much the worse for that experience. Then, in the second place, I do not think any of us will regret the time we have spent here to-day by the pleasure afforded us not only from our Shareholding point of view, but from the pleasure which we have received in the intellectual speech which we have had from Mr. Godfrey Isaacs. This is the first time I have been with him. I was not with him last year, but then, like a great many other Shareholders, I did not know; but I think, sir, in the course of a few minutes, probably with the assistance of this very wireless telegraphy which we here represent, that speech, as I say, will be filling others with the same admiration and interest with which it has filled us here in London. As regards the Balance Sheet, I should only like one little bit of information. We have an asset which, it appears, no one knows anything about—that is to say, as to what its ultimate value will be—namely, what we have to receive from the British Government. Now this must, I should say, be a somewhat large amount. I do not know whether, so far, anything has been received on account, but it is one of those things which I think places our Directors in perhaps a rather invidious position as regards we poor ordinary provincial Shareholders, because there will come a time when negotiations will be begun in regard to what this amount will be. If it is a large sum it will be a very useful thing to know in the nick of time. And I think, sir, that you should, if possible, give us the amount. All these things have been known in the past. I wish I had known as much in February, 1914, as I know to-day. I am speaking, to a certain extent, as a Stock Exchange man, and I have known that inside knowledge is rather useful. I think, therefore, if you could give us some slight idea of what the eventual payment will amount to——whether it be thousands or millions—we shall then, to some extent, be all in the same boat. Personally, I will hand over to anyone to-day one thousand times the amount of profit I make out of my shares if they will pay me one-half my losses. That wants thinking about. In conclusion, I am sorry to have detained you; but I feel that this has been an exceedingly interesting meeting, and although there has not been quite so much fun this year, as I may say we had last year, it is intensely more satisfactory.

Mr. Jordan: May I ask a question of Mr. Isaacs? If our Government had given one-half the support to the development of wireless telegraphy which the German Government gave to its subjects, should we be likely to have lost the *Good Hope* and the other vessels which were sent to the bottom by German ships?

Alderman J. Ford (Cork): Before you answer that question, I would like to make one remark following upon what my friend here said. I would suggest that when this money is paid to the Company, it will be communicated at once to the Shareholders—that it will not be allowed to hang fire. I really think that some expression of opinion should come from this meeting that when the negotiations come to a close, the Shareholders should be informed of what has transpired. Up to the present we have had nothing but kicks and cuffs from the Government, and I really think that now is the time for reparation on their part, to do the handsome, and when they are about it to consider what money has been lost by the Shareholders in the past.

Mr. Godfrey Isaacs: In reply to Mr. Jordan's question, I am afraid, sir, that I must not give you any answer. I do not think that, personally, I could with any assurance do so, and if I could, I do not think I would. With regard to the second question put by Mr. Ford, I cannot form any estimate at the present moment of the sum which the Company will receive, because the services which the Company is rendering to the Government, and for which we have received remuneration, still continue. As regards publishing the sum which we may receive, directly the matter may be settled, if it be possible, it shall be done—it shall be done immediately. With regard to the question of the information getting through to some before it gets to others, to the advantage of some, so far as the Company is concerned, we do our very utmost to prevent any information going out of the office until it is sent out by circular to the Shareholders; but in a business like ours, where we have to do with a great many people, I want everybody to bear in mind, before he allows himself to listen to wild charges thrown at the Company and its officials, that there is a very large number of persons, not in the Marconi Office, who know what is going on, and who, perhaps, know sooner what is going to happen than the Marconi officials themselves.

The Resolution was then put to the meeting, and carried unanimously.

The Chairman moved, Capt. Sankey seconded, and the Resolution was unanimously approved, "That a dividend of 10 per cent., equal to 2s. per share, less income tax, upon the 1,222,688 Ordinary Shares numbered 1 to 500,000, and 750,001 to 1,472,688, be and the same is hereby declared for the year ended December 31st, 1914; that the said dividend be payable on August 31st, 1915, to the Shareholders now registered on the Books of the Company, and to holders of Share Warrants to Bearer."

Mr. Godfrey Isaacs moved, Mr. Alfonso Marconi seconded, and the Resolution was unanimously approved, "That the retiring Directors, Mr. Henry S. Saunders and Mr. Samuel Geoghegan, be re-elected Directors of the Company." Mr. Isaacs said: I have already told you, ladies and gentlemen, that I have always received the most loyal support from all my Directors, and all my Directors have been on the Board longer than I have. I feel, therefore, that you will not hesitate to re-elect them.

The Chairman then remarked: Before I go on to the next Resolution I wish to say a word or two with regard to the Directors generally. We have suffered a very great loss by the death of General Albert Thys, who was for many years connected with the International Company, with the Belgian Company, and then with our English Company. He helped us very efficiently and very devotedly all through our difficulties in the past. I must also mention the death of Major Flood Page, which occurred some months ago. He was also one of the Directors who assisted this Company, and assisted me through all the difficult times in the past. I think he was a Director of the Company for over twelve years. Speaking personally, and for my co-Directors on this Board, we feel the loss of these two gentlemen very deeply. I will now ask a Shareholder if he will please move the reappointment of the Auditors?

Mr. Foat moved, Alderman Ford seconded, and the Resolution was carried unanimously, "That Messieurs Cooper Bros. & Co. be re-elected Auditors for the ensuing year, and that their remuneration for auditing the Accounts to December 31st, 1914, be 500 guineas."

The Chairman: I now have to propose the following Resolution:—

"That the Articles of Association of the Company be altered in the following manner:—

"(a) By cancelling the second, third and "fourth lines of Article 78 commencing, 'If "'without the sanction,' and ending with "'Departmental Manager.'

"(b) By inserting after Article 78 a new "Article to be numbered 78A, to the following "effect:—

"'78A. A Director may hold any other "'office under the Company in conjunction "'with the office of Director, and on such "'terms as to remuneration and otherwise as "'may be determined by the Directors.'

"(c) By cancelling Article 110 and substituting "the following Article therefor, namely:—

"'110. Notwithstanding anything in these "'Articles contained the Directors may from "'time to time out of accrued or accruing "'profits pay to the members such interim "'dividends as in their judgment the position "'of the Company justifies, and for this "'purpose any payment to Preference Share- "'holders in or towards satisfaction of any "'fixed preferential dividend for the time "'being payable on their Shares shall be "'deemed to be an interim dividend.'"

I will ask Mr. Godfrey Isaacs to second the Resolution and to explain it.

Mr. Godfrey Isaacs: I rise to second the Resolution. I would like to explain, with regard to the first part of the Resolution, that we are suffering something of an anomaly in our Articles of Association at the present moment. I think you can easily understand what is the object of the proposal. I need not give any better instance than that of our Chairman, Mr. Marconi. Mr. Marconi is our Chairman, and he is also our Scientific Adviser; but, strictly speaking, under the Articles as they at present exist, he has no right to hold the position of Scientific Adviser, and for such a reason naturally it is desirable that this Article be immediately changed. With regard to the second Article, it is merely a case of facilitating the payment of interim dividends whenever we find it desirable to do so. I do not know that any further explanation is required, and I beg to second the Resolution.

The Resolution was unanimously adopted.

The Chairman: I would remind the Shareholders that the confirmatory meeting will be held at Marconi House, Strand, on Wednesday, August 18th, 1915, at 11 a.m. I think that concludes all our business, and I have to thank you very much for your attendance and for the support which you have given us.

Alderman Ford: I think we would be wanting in our duty if we did not propose a vote of thanks to the Chairman and his colleagues. I think it would be a grave dereliction of duty on our part if we did not convey to the Chairman our hearty expression of our pleasure at seeing him here to-day in our midst, and also for the very able manner in which he has discharged his duties as Chairman of this meeting. Last year there was a certain amount of friction; but to-day we are all a happy family. We are all one, and I hope next year, when our meeting comes round again, we will all be in equally good form, and that our Chairman will be in as robust health as he is to-day. I think the least we can do is to express to him our deep debt of gratitude for the manner in which he has conducted our proceedings here to-day.

The Resolution was carried with acclamation.

The Chairman: I thank you very much. I am very grateful indeed for the support which you have given us, and for the kind things you said about myself, Mr. Godfrey Isaacs, and the Board generally.

The proceedings then terminated.

Russian Company of Wireless Telegraphs and Telephones.

THE Annual General Meeting of the Russian Company of Wireless Telegraphs and Telephones (Russian Marconi Company), was held in Petrograd on June 13th, Vice-Admiral Bostrem, Chairman of the Board, presiding. The directors' report and accounts for the year ending December 31st, 1914, record a largely increased turnover in the business of the Company, mainly due to orders received from the Russian Government. The Company declared a dividend in respect of the year 1914 at the rate of 15 per cent., which was payable on July 13th. The retiring directors, Messrs. Godfrey C. Isaacs and P. I. Balinsky, were re-elected, and the meeting passed a vote of thanks to Messrs. Balinsky and L. M. Eisenstein and the staff for their work in connection with the affairs of the Company

Institute of Radio Engineers.

Notice of Meeting.

ON Thursday and Friday afternoons, September 16th and 17th next, joint meetings of the Institute of Radio Engineers and the American Institute of Electrical Engineers will be held at the Native Sons of the Golden West Hall, Panama-Pacific Exposition Grounds, San Francisco. Two papers for the Radio Engineers will be presented, one on each day. Thursday afternoon Prof. Harris J. Ryan will read the results of investigations on the "Sustained Radio Frequency High Voltage Discharge," by Mr. Roland G. Marx and himself, taking up the flame and brush types of discharge obtained from conductors when a powerful arc generator is used to apply voltages up to 50,000 at frequencies as high as 200,000 cycles per second. On Friday Mr. Robert H. Marriott will read a paper on, "Radio Development in the United States," giving special attention to Pacific Coast conditions.

PERSONAL PARAGRAPHS.

Mrs. Greenaway, the mother of F. Greenaway, who worked for Marconi's Wireless Telegraph Co., Ltd., for about six years, and who will no doubt be well remembered, has received from his captain and adjutant a letter, of which the following is a copy, describing the good work her son has done at the Front. This will no doubt be interesting and pleasing not only to all who remember him, but also to readers of THE WIRELESS WORLD.

"*June 5th*, 1915.

"To MRS. GREENAWAY,—I am writing this note in connection with your son, who is on the staff of the brigade to which I am adjutant. So much is done in this war which deserves more than the brave man who did it ever receives that I think it is everyone's duty to bring to light the acts (that otherwise may pass unnoticed) which help to bring this war to a successful conclusion. I, therefore, write to tell you of your son's good work under very dangerous and unnerving conditions of which I am sure you will be glad to hear. I did not witness the deeds of pluck personally, as I was not with your son, but a special memorandum has been received about him. At the time to which I refer he was doing duty of linesman at artillery headquarters, which meant that he was responsible for the maintenance of the telephonic communications between that place and his brigade headquarters. The telephone line ran over a zone constantly swept by very heavy shell fire, which meant the frequent cutting of your son's line. He had consequently to go out each time to repair it, and the General sent a special letter to say that he wished to very warmly commend your son's pluck, grit and promptness in going out under very heavy shell fire to do his duty, not once, but frequently. I am sure your son's behaviour and example are an example of what is required for success in the Army. I feel sure, too, a mother is always glad to hear of her son's bravery, and that is why I have written.

"Everyone cannot get a prize, but it is to be hoped in the future occasion will arise which will bring him some tangible recognition of his good work.

"(Signed) Capt. & Adjt. ROBERTSON,
"118th How. Brigade."

* * *

Hearty congratulations to Lieutenant Hake, who was gazetted on July 21st last. Lieutenant G. E. Hake joined the Marconi Company in September, 1911, as learner in the London School, and early in the following year was appointed to the operating staff, subsequently taking service on board a number of vessels. After some time at sea he was promoted to the inspecting staff, and later received an appointment as instructor in the London School. Lieutenant Hake, who previous to joining the Marconi Company had served some years in the Army, at the commencement of the war rejoined the Forces as corporal in the Northumberland Fusiliers. After a short period in England he was drafted to the Front and saw some of the most sanguinary fighting in the early days of the conflict. On November 1st last Lieutenant Hake received a head wound from a flying splinter of shrapnel, and returned to England for treatment. Upon recovery he received a transfer to the Wireless Section of the Royal Engineers, where, of course, his experience in commercial wireless telegraphy stood him in good stead, and on the date mentioned above received his commission.

* * *

Many of our readers among the operating staff of the Marconi International Marine Communication Co., Ltd., will recognise in the photograph below George Dewdney, who for more than a year was attached to the staff of the Marconi House school as boy assistant. Dewdney, who was an active member of Major Masterman's Own Stockwell Scouts, spent most of his spare time when at Marconi House in studying signalling and wireless telegraphy, the latter in both theory and practice. At the outbreak of war, through the influence of Major Masterman, he became attached to the Welsh Regiment as Boy Scout, and a little later was proud to join the regiment as private. By his skill and good conduct he soon marked himself out for promotion, with the result that on March 10th he was raised to the rank of lance-corporal. Further promotion has since been awarded him, and he

Corporal Dewdney.

now proudly serves his King and country as Corporal Dewdney, Signalling Instructor. We take the opportunity of heartily congratulating Corporal Dewdney on his splendid progress, and are sure that many other boys of 16 (for Dewdney is just that age) will be inspired by his fine example.

* * *

We learn from Manchester that Mr. John Welsh, who was at one time employed as a wireless operator at the Marconi station in Honolulu, and Miss Gerta Neilson were recently married as the result of a romance which began on the ill-fated voyage of the *Lusitania*. The acquaintance, which started early in the voyage, soon ripened into friendship, and before the "hunnish" attack they became engaged. When the vessel sank they were rescued together. Both lost all their savings in the wreck.

* * *

We are pleased to make mention in these columns of the marriage of Sapper Fred Archer, a member of the Essex Fortress Engineers stationed at Landguard Fort, Felixstowe. Before the war broke out he was employed at the Marconi Works at Chelmsford, and from the employees there the happy couple received as a present a dinner service, a tea service, and a set of cutlery. His wife was Miss Kitty Carlton, of Chelmsford, and the ceremony took place at St. John's Church, Moulsham, the bride being given away by her father. We wish them every happiness in their future life.

Lieutenant McEwen.

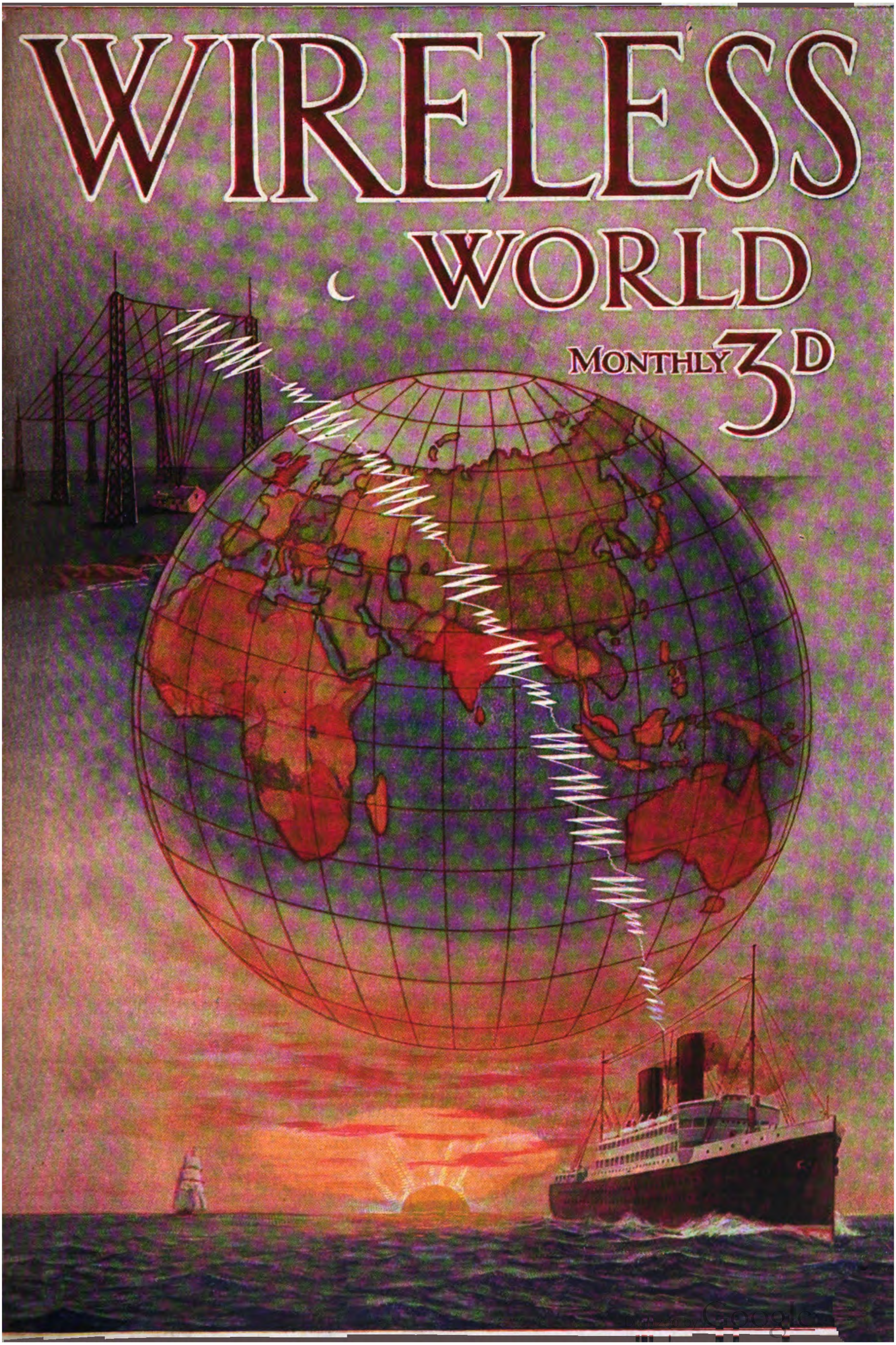
The many friends of Lieut. McEwen, the secretary of Senatore Marconi at his London office before the war, will be very gratified to learn that his name was mentioned in the last despatch sent by Sir John French to the Secretary of State for War. Lieut. McEwen offered his services to the Intelligence Branch of His Majesty's Army, and his deeds well merit their honourable mention. We hasten to convey to him the hearty congratulations of our many readers and ourselves.

* * *

It is with pleasure that we learn of the marriage on July 13th last, at Errismore Church, Ballyconneely, Clifden, Ireland, by the Rev. Thomas Nee, M.A., by special licence, of Mr. W. G. Groves, a member of the operating staff at the Clifden station, to Miss Elsie E. Tear, the youngest daughter of Mr. Richard Tear, of Hampstead, London. We take this opportunity of wishing them all happiness in their new sphere of life.

* * *

Mr. E. J. Nally, the general manager of the Marconi Wireless Telegraph Company of America, accompanied by Mr. G. S. De Sousa, traffic manager, and Mr. E. B. Pillsbury, general superintendent, has returned from an inspection of the Marconi property in the states of New Jersey and Massachusetts, including the station on the Island of Nantucket.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MONTHLY 3D

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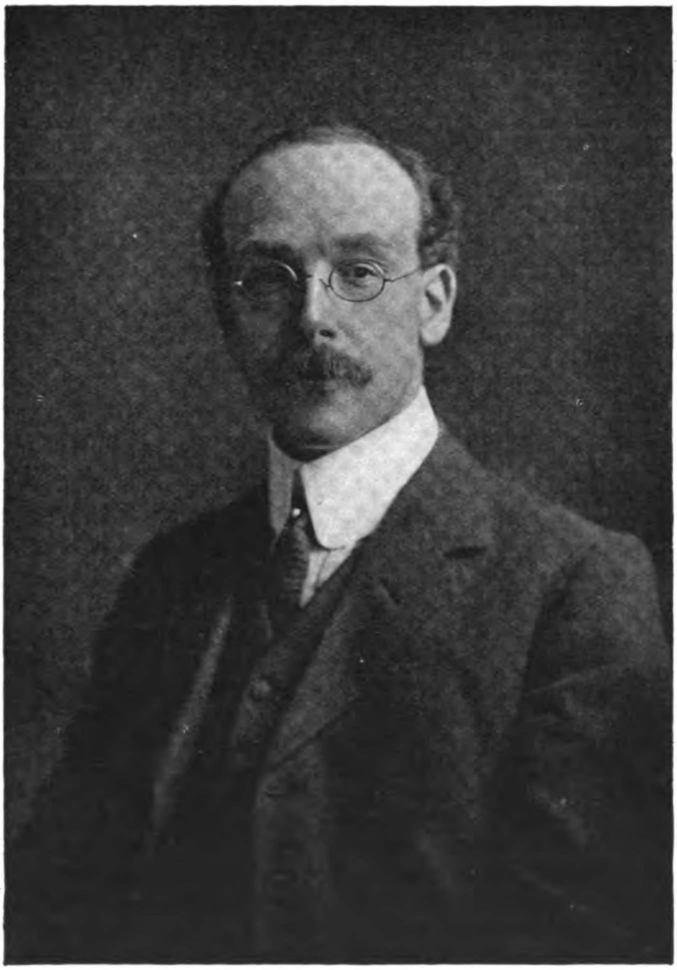
NEWS BY WIRELESS

The Overpowering Supremacy of Radio-Telegraphy

ASSOCIATION of ideas is responsible for a good many sub-conscious assumptions. It is not many generations ago since the words " I saw it in print " settled at once the authenticity of a statement. In a sense every item of recent information not intended for exclusive possession may be classified as " news." Actually, when we speak of news, we mean such items as appear, or would fitly find their place, in the public newspapers. Just as other things are affected by the medium through which they are passed, so, also, has the character of the news appearing in public periodicals been modified by the medium of its transmission. In the earlier days of newspapers, reliance had perforce to be placed upon the medium either of the postal service or of special emissaries. It is difficult for us to realise that Englishmen at the time of the Crimean War had to rely for their accounts of the gallant deeds and sufferings of British troops upon the written despatches *posted* by Russell and the other great war correspondents of that period. " Wired telegraphy " practically killed the " News Letter," and profoundly affected not only the time elapsing between occurrence and narration, but also the manner in which the stories were told. Nowadays we have come to consider recency of occurrence as the very essence of a news item. Judged by this standard " Wireless News " is quite an easy victor. Messages sent in this way are transmitted at the rate of 186,400 miles per second, the same rate of speed as that of light—in other words, practically instantaneously. It therefore only becomes a matter of organisation to render radio-telegraphy *facile princeps* in this field of activity. But, from the view of the Press, there is the further consideration of £ s. d., and it must be with some sinking of heart that newspaper proprietors read the recent announcement in the forecast of the next Budget prophesying that the Chancellor of the Exchequer is likely to increase the special land line rates charged for press telegrams. In the matter of cost, radio-telegraphy enjoys the same advantage as it does in that of speed. As if the two advantages of *speed* and *economy* were not sufficient in themselves, there is added to them the additional important factor of *mobility of stations*. A land station is tied to its wire; a wireless station may operate on a train or motor running at full speed, or on ships at sea. It is this latter factor which enables many of the great steamship lines to publish newspapers regularly on board their vessels when thousands of miles from land. Ocean newspapers are even yet in their infancy, but their's is a lusty babyhood, and we are constantly meeting with examples in all sorts of unexpected places. The only recorded instance of the sinking of a British troopship is the disaster which befell the *Royal Edward* in the Ægean Sea. From the narrative recently published, we learn that during the course of the voyaging of this transport, two or three of the men on board made themselves responsible for the publication of an interesting little newspaper called *The " Royal Edward " News*. This, we are informed, contained not merely a regular budget of war news picked up by wireless, but also a number of personal items dealing with the experiences of soldiers on board in their former campaigns.



PROFESSOR G. W. O. HOWE,
D.Sc., Whit.Sch., M.I.E.E.

Personalities in the Wireless World

PROFESSOR GEORGE WILLIAM OSBORN HOWE, D.Sc., Whit.Sch., M.I.E.E.

THE eminent figure in the world of Electricity, a photograph of whom we have pleasure in reproducing on the opposite page, was born at Charlton in Kent on December 4th, 1875. His connection with things electrical has been of life-long duration, as he entered the Woolwich works of Messrs. Siemens & Co., Ltd., at the tender age of 14, and, after serving an apprenticeship of five years in their shops, was transferred to the cable department, where he spent two years.

Whilst at Woolwich he attended the evening courses at the Polytechnic, obtaining a Whitworth Exhibition in 1896 and a Senior County Scholarship in 1897. He then withdrew from the service of Messrs. Siemens & Co., Ltd., and attended Armstrong College, Newcastle-on-Tyne, for three years. This college forms the science and engineering section of Durham University, where he obtained the degree of Bachelor of Science, and the Senior Pemberton Scholarship, whilst in the year 1900 he headed the list of Whitworth Scholars. Desiring greater scope, he proceeded to Charlottenburg, in Germany, where he stayed two years in the works of Messrs. Siemens & Halske, designing and testing alternating current machinery.

After this he returned to that firm's Woolwich branch, and spent a year in the designing department, leaving in 1903 to take charge of the electrical engineering department at the Hull Municipal Technical School. In 1905 he received the appointment of Lecturer at the Central Technical College, South Kensington, and became Assistant Professor of Electrical Engineering in 1909. This college now forms the engineering section of the Imperial College of Science and Technology, and is part of London University, in which Professor Howe is a member of the Boards of Studies in Electrical Engineering and Mining and Metallurgy, and also of the Board of Examiners in Electrical Engineering. Professor Howe's valuable knowledge of electrical science is much coveted, and his services are often requisitioned. He is a member of the Institute of Electrical Engineers, and of the Council of the Physical Society, and, what will appeal particularly to our readers, a vice-president of the Wireless Society of London, a member of the Radio-Telegraphic Research Committee of the British Association, and a member of the British Committee of the International Radio-Telegraphic Commission.

Professor Howe holds the position of secretary to the engineering section of the British Association, in whose service he visited Australia in 1914, reading papers and giving lectures on subjects connected with wireless telegraphy at Melbourne, Sydney, and Brisbane. During his sojourn in the "Land of the Southern Cross" the honorary degree of Doctor of Science was conferred on him by the University of Adelaide. It may be remarked here that the subject of our illustration is also a D.Sc. of Durham University.

Professor Howe is a writer on electrical matters, of no mean repute, and he has published many articles dealing with the various aspects of radio-telegraphy in the technical journals of Great Britain and several foreign countries. Our readers will recollect that some of these papers have appeared from time to time in the MARCONIGRAPH and WIRELESS WORLD. Professor Howe has read a number of papers before British societies, and his services in the advancement of electrical science have been legion.

The Capacity of Aerials of the Umbrella Type.

By Professor G. W. O. HOWE, D.Sc., M.I.E.E., Imperial College of Science and Technology, South Kensington.

Paper read before the British Association at Manchester, September 10th, 1915.

THE author has recently published * a method of calculating rapidly the approximate capacity of aerials of various types. Although not rigorously correct, the accuracy obtained is more than sufficient for all the purposes of radio-telegraphy, and in most cases will be found to agree with the measured capacity within the errors of observation. In addition to describing the method in general, curves and formulæ were given so that the capacity of aerials of standard types could be determined in a few minutes. The umbrella type, however, was not specially considered, and it has been suggested to the author that the usefulness of the original paper would be considerably increased if curves and formulæ could be given for aerials of this type.

The method is briefly as follows: the whole aerial is assumed to have a uniformly distributed charge, and the average potential taken over the whole aerial under this fictitious condition is then calculated. The assumption is then made that if the total charge, while remaining unchanged in amount, be allowed to have its own natural distribution, it will assume a uniform potential approximately equal to

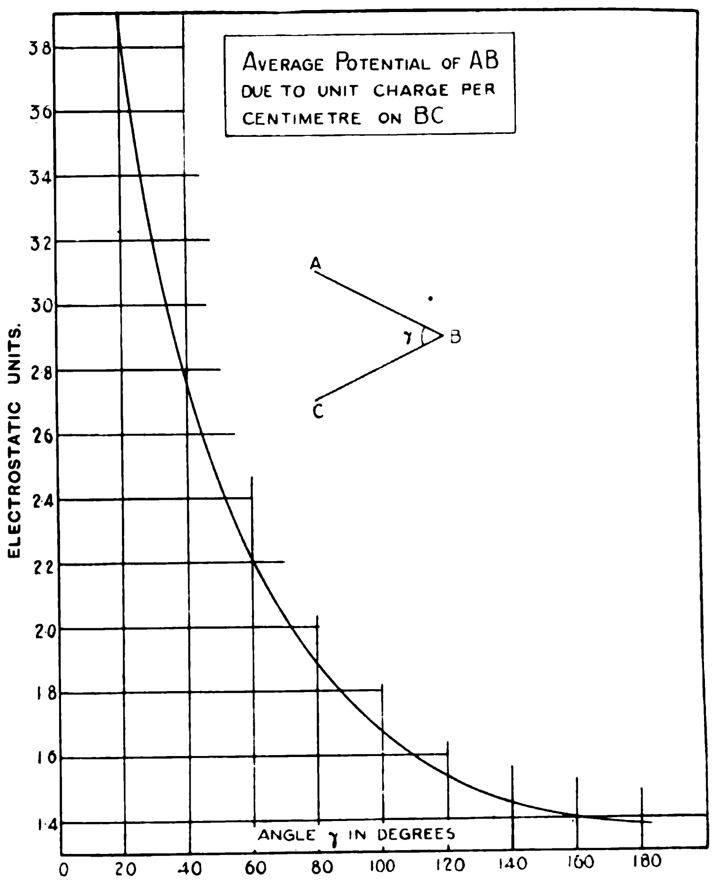


Fig. 1.

* British Association, Sydney, 1914. *Electrician*, August 28th, 1914. WIRELESS WORLD, February, 1915.

this average potential. The proximity of the earth is taken into account by assuming that the image of the aerial in the earth is uniformly charged with electricity of opposite sign, and calculating its effect on the average potential of the actual aerial.

The umbrella type of aerial consists of a vertical wire with a number of radial ribs sloping downwards from the top towards the earth. Both the vertical and sloping elements may consist of single wires or may be made up of a number of wires suitably spaced. We shall consider in the first place the simple case of a single vertical wire and n ribs each of a single wire. The "single wire" may, of course, and usually will, consist of a number of wires stranded together. Let the angle between the vertical and the ribs be α.

The average potential of each rib is made up of five components:

(1) Due to its own charge;
(2) Due to the charges on the other ribs.
(3) Due to the charge on the vertical wire.
(4) Due to the image of the ribs.
(5) Due to the image of the vertical wire.

In the same way the average potential of the vertical wire is made up of four components:

(6) Due to its own charge.
(7) Due to the charges on the ribs.
(8) Due to its own image.
(9) Due to the image of the ribs.

Our object is to plot curves from which each of these components may be written down at once for any given aerial.

All the nine component potentials can be found from curves given in the original paper, with the exception of the second, third, and seventh. With regard to the second, the average potential of any rib due to unit charge per centimetre of length on any other rib could be found from Fig. 28 in the original paper if the angle between them did not exceed 52 degrees. Since the angle will usually be larger than this, it will be necessary to extend the curve for angles up to 180 degrees, but before doing this it will be convenient to find the angles between various ribs for various values of n and of α. If there are n ribs the angle between any two adjacent ribs may be called θ_{12}, while that between any rib and the next but one

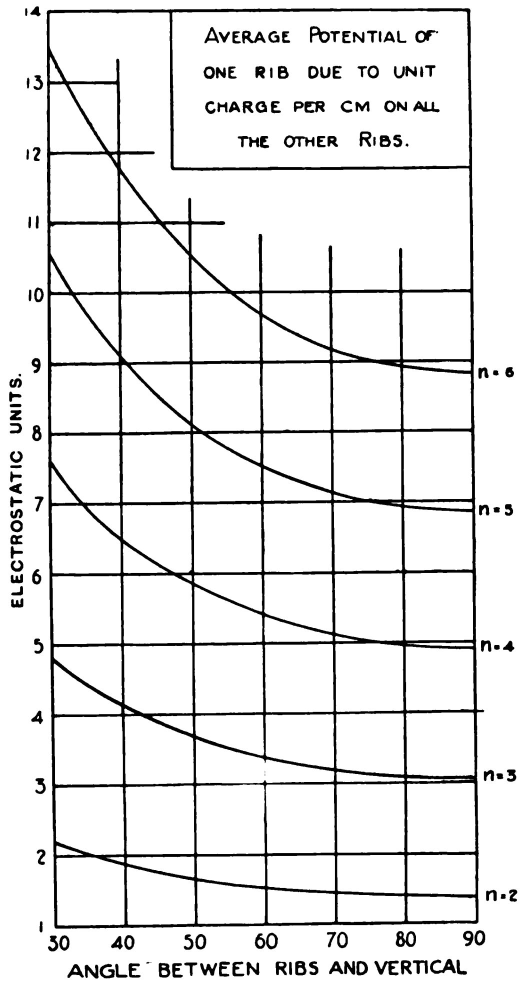


Fig. 2.

may be called θ_{13}, and so on. The values of θ are given in Table I.

TABLE I.
Angles between Ribs.

Angle with vertical α	$n=2$ θ	$n=3$ θ	$n=4$ θ_{12}	$n=4$ θ_{13}	$n=5$ θ_{12}	$n=5$ θ_{13}	$n=6$ θ_{12}	$n=6$ θ_{13}	$n=6$ θ_{14}
90	180	120	90	180	72	144	60	120	180
75	150	113·4	86·2	150	69·2	133·3	57·8	113·4	150
60	120	97.2	75·6	120	61	111	51·2	97·2	120
45	90	75·5	60	90	49	84·5	41·4	75·5	90
30	60	51·2	41·4	60	34·2	56·7	28·95	51·2	60

We have previously * shown that when two wires of equal length meet at an angle

* *The Electrician*, Vol. LXXIII., p. 909.

γ, the average potential of one of them due to unit charge per centimetre on the other is given by the formula :

$$V_{av.} = 2 \log_e \left(1 + \sqrt{1 + (\operatorname{cosec} \gamma + \operatorname{cotan} \gamma)^2}\right)$$

This has been worked out for values of γ up to 180 degrees, and the results are plotted in Fig. 1. By means of this curve and Table I. the potential of the rib can be found due to each of the other ribs, and by adding these together the total potential due to all the other ribs is obtained.

This is given in Table II., and plotted in Fig. 2.

TABLE II.

Average potential of one rib due to all other ribs with uniform charge of one unit per centimetre.

Angle with vertical α	$n=2$	$n=3$	$n=4$	$n=5$	$n=6$
90	1·385	3·06	4·905	6·86	8·835
75	1·42	3·13	5·02	7·01	9·03
60	1·53	3·38	5·41	7·52	9·69
45	1·76	3·88	6·15	8·55	11·10
30	2·195	4·78	7·585	10·53	13·475

To find the potential of the rib due to the charge on the vertical wire, or *vice versa*, we have the last formula on p. 908 (*loc. cit.*)—viz. :

$$V_{av.} = \sinh^{-1}\beta + \sinh^{-1}\left(\frac{1-\alpha'}{\alpha'}\beta\right) + \frac{\cos\gamma}{\alpha'}\left\{\sinh^{-1}\left(\frac{\alpha'(1+\beta^2)}{\beta} - \beta\right) + \sinh^{-1}\beta\right\}$$

which may also be written :

$$V_{av.} = \sinh^{-1}\frac{\alpha'}{\sqrt{m^2-\alpha'^2}} + \sinh^{-1}\frac{1-\alpha'}{\sqrt{m^2-\alpha'^2}} + \frac{1}{m}\left\{\sinh^{-1}\frac{m^2-\alpha'}{\sqrt{m^2-\alpha'^2}} + \sinh^{-1}\frac{\alpha'}{\sqrt{m^2-\alpha'^2}}\right\}$$

where γ is the angle between the two wires.

" $m = \dfrac{\text{length of uncharged wire}}{\text{length of charged wire}}$.

" $\beta = \operatorname{cotan}\ \gamma$.

and $\alpha' = m.\cos\gamma$ (*see* Fig. 27, *loc. cit.*)

The values given by this equation have been worked out for a number of cases and are plotted in Figs. 3 and 4.

We shall now illustrate the use of these curves by calculating the capacity of two aerials of the umbrella type, one a simple portable aerial and the other a larger and more complicated type. Fig. 5 shows the principal dimensions of an aerial with six ribs, each making an angle of 66 degrees with the vertical. Both vertical wire and ribs have a diameter of 3 mm. We assume a uniform charge of unit quantity per centimetre of wire.

(1) Potential of a rib due to its own charge (*see* Fig. 3 in original paper)	19·2
(2) Potential of a rib due to all other ribs (*see* Fig. 2 in this paper)...	9·35
(3) Potential of a rib due to vertical wire (m=30/26 ; *see* Fig. 4 in this paper)	1·95
(4) Potential of a rib due to image of ribs (charge= —18000 ; distance about 42·5 metres) ...	—4·2
(5) Potential of a rib due to image of vertical wire (charge= —2600 ; mean distance about 36 metres)	—0·7
Total potential of a rib ... =	25·6
(6) Potential of vertical wire due to its own charge (*see* Fig. 3 in original paper)	19·0
(7) Potential of vertical wire due to the six ribs (m=26/30 ; *see* Fig. 4 in this paper)	13·5
(8) Potential due to its own image (*see* Fig. 21 *et seq.* in original paper)	—1·0
(9) Potential due to image of the six ribs (charge= —18000 ; distance about 35·5 metres) ...	—5·1
Total potential of vertical wire ... ... =	26·4

We have, therefore, 180 metres of wire at an average potential of 25·6 and 26 metres at an average potential of 26·4, making a total of 206 metres at an average potential of 25·7. The capacity is therefore :

$$\frac{20600}{25\cdot 7} = 802 \text{ cms.} = 0\cdot 89 \text{ milli-microfarad.}$$

With regard to the last component potential of —5·1, it may be pointed out that, instead of finding it in the approximate manner there indicated from the charge and the average distance as estimated from Fig. 5, it can be calculated accurately by means of the curve in Fig. 4. If the vertical wire were 52 metres long—*i.e.*, twice its actual length, its average potential due to

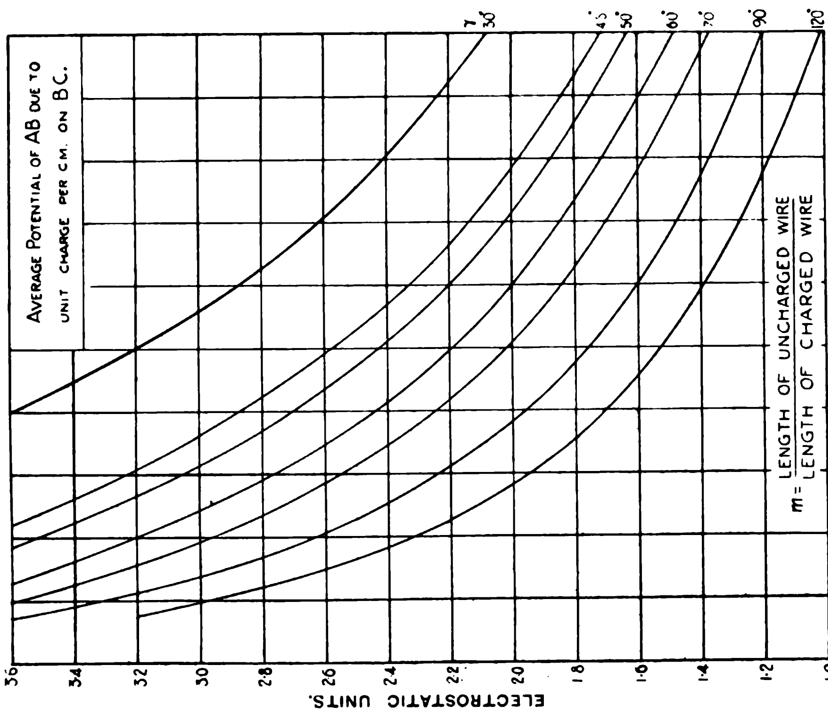

AVERAGE POTENTIAL OF AB DUE TO UNIT CHARGE PER CM. ON BC.
m = LENGTH OF UNCHARGED WIRE / LENGTH OF CHARGED WIRE
ELECTROSTATIC UNITS.
γ 30° 45° 50° 60° 70° 90° 120°
0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0
3.6 3.4 3.2 3.0 2.8 2.6 2.4 2.2 2.0 1.8 1.6 1.4 1.2 1.0

Fig. 4.

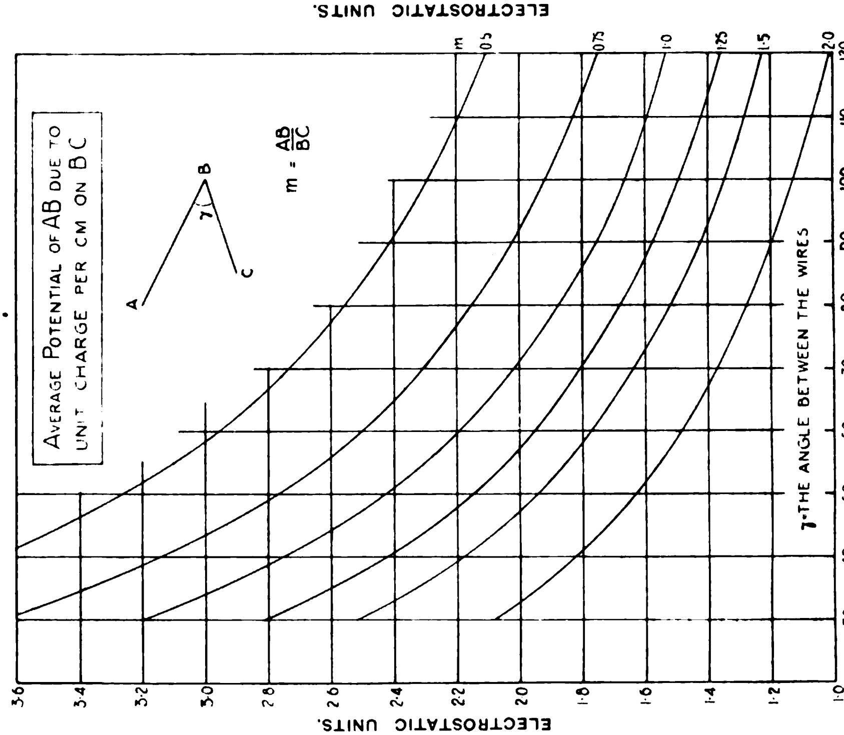

AVERAGE POTENTIAL OF AB DUE TO UNIT CHARGE PER CM ON BC
A
B
C
γ
m = AB/BC
γ = THE ANGLE BETWEEN THE WIRES
ELECTROSTATIC UNITS.
m 0.5 0.75 1.0 1.25 1.5 2.0
20 30 40 50 60 70 80 90 100 110 120
3.6 3.4 3.2 3.0 2.8 2.6 2.4 2.2 2.0 1.8 1.6 1.4 1.2 1.0

Fig. 3.

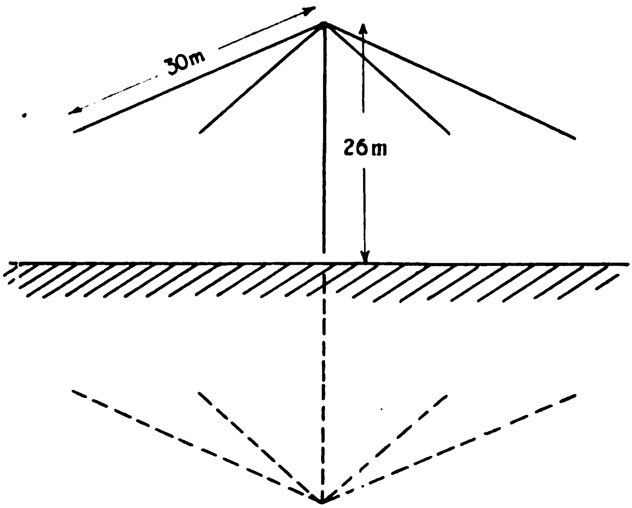


Fig. 5.

the six ribs would be $6\times1{\cdot}55=9{\cdot}3$, since m would then be 52/30. Since the average potential of the actual vertical wire due to the six ribs is 13·5, that of the other half of the 52 metres, remote from the ribs, must be $2\times9{\cdot}3-13{\cdot}5=5{\cdot}1$. Hence this will be the potential of the vertical wire due to the image of the ribs.

As a second example, we shall calculate the capacity of the antenna shown in Fig. 6; it has five ribs each consisting of four wires situated at the corners of a square of two metres side, the angle between the ribs and the vertical being 60 degrees. To make the calculation more general we shall assume that the ribs consist of 10 mm. wire, while the vertical wire has a diameter of 20 mm. We shall assume that the whole aerial is charged to a uniform surface density, the ribs having unit charge per cm. of length and the vertical wire two units per centimetre. The image is equally but oppositely charged.

(1) Potential of four-wire rib due to its own charge (*see below*) ... 36·0

(2) Potential of rib due to all other ribs ($4\times7{\cdot}5$; *see* Fig. 2) 30·0

(3) Potential of rib due to vertical wire ($2\times2{\cdot}37$; *see* Fig. 4; $m=60/70$) ... 4·7

(4) Potential of rib due to image of ribs (charge $=-20\times6000$; distance $=115$ metres) ... ... —10·4

(5) Potential of rib due to image of vertical wire (charge $=-2\times7000$; distance $=92{\cdot}5$ metres) ... —1·5

Total potential of rib ... = 58·8

(6) Potential of vertical wire due to its own charge (2×17; *see* Fig. 3 in original paper) ... ... 34·0

(7) Potential of vertical wire due to the ribs ($5\times4\times2{\cdot}025$; *see* Fig. 4; $m=70/60$) ... ... 40·5

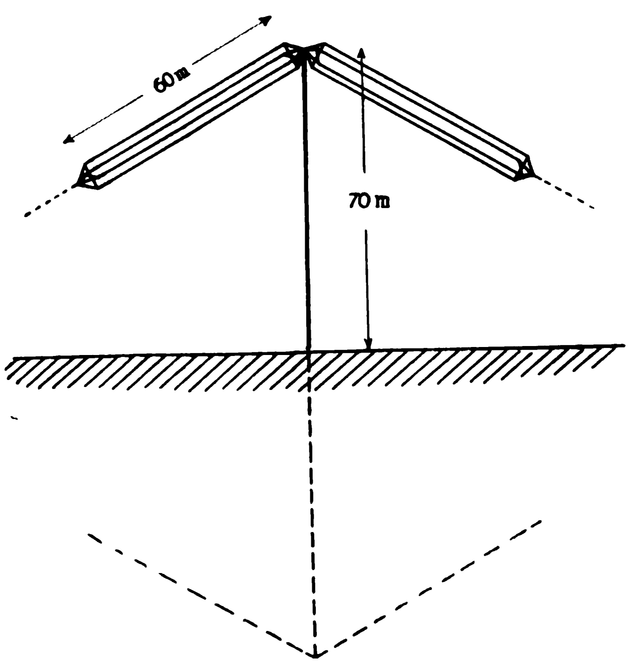


Fig. 6.

(8) Potential due to its own image (*see* Fig. 21 *et seq.* in original paper) ... ... —2·0
(9) Potential due to image of ribs (charge= -20×6000 ; distance =95 metres) ... ... —12·7

Total potential of vertical wire ... ... = 59·8

With regard to the first item, the capacity of four-wire box type aerials was investigated in the original paper (*see* Figs. 16 and 17), and it was shown that the average potential is

$$2\left(\log_e \frac{l}{r} + Y\right),$$

where Y depends on the ratio of the length l to the distance d between adjacent wires. In our case this ratio is 30, and Y is found from Fig. 17 to be 8·6. Hence :

$$2\left(\log_e \frac{l}{r} + Y\right) = 2\left(\log_e \frac{6000}{0{\cdot}5} + 8{\cdot}6\right) = 36.$$

This can also be found directly from Fig. 18 by noting that the average potential of any number n of parallel wires is equal to

$$\frac{33{\cdot}9\, n}{\text{micro-microfarads per foot}}$$

which, in the present case, gives :

$$\frac{33{\cdot}9 \times 4}{3{\cdot}75} = 36.$$

The last item of —12·7 can also be calculated accurately, as explained in the previous example. The other items will present no difficulty.

Summing up, we have on the ribs a charge of 120,000 units at a potential of 58·8, and on the vertical wire a charge of 14,000 units at a potential of 59·8, giving a total of 134,000 units at an average potential of 59. The capacity is therefore

$$\frac{134000}{59} = 2270 \text{ cms.} = 2{\cdot}53 \text{ milli-microfarads.}$$

It will be noticed that with the uniform distribution of charge which we have assumed the average potentials of the ribs and vertical wire are nearly equal—viz., 25·6 and 26·4 in the first example and 58·8 and 59·8 in the second. This shows that in the actual condition of uniform potential the charges will be distributed between the vertical wire and the ribs very nearly as we have assumed.

Tests on actual aerials have shown that the values of the capacity as calculated by this method agree with the measured values within the errors of observation and of estimation as to the allowance to be made for connecting wires, etc.

An Appreciation.

IN our September number we published an article by Mr. Bertram Hoyle entitled "The Influence of Temperature and Pressure on the Sensitivity of the Carborundum Crystal Detector." That such an article would be welcomed we had no doubt, and were therefore pleased to find in the columns of the *Manchester Guardian* the following appreciation of it :

"It is a curious circumstance, and one "that is quite contrary to the present trend "of progress in most branches of engineering, "that the wireless coherer has been virtually "superseded by a device whose method of "action remains to be investigated long "after its suitability has been established. "Although the crystal detector has for most "practical purpose swept everything before "it, and despite the fact that many com"petent people have carried out investi"gations with regard to it, no clear theory "has yet been formulated as to its precise "action. The September number of THE "WIRELESS WORLD contains an important "article in this connection by Mr. Bertram "Hoyle under the title of 'The Influence "'of Temperature and Pressure on the "'Sensitivity of the Carborundum Crystal "'Detector.' On account of its calcu"lations and tabulated results the article "necessarily looks a little formidable to the "reader who wants strictly 'popular "'science,' but really Mr. Hoyle is as lucid "in his treatment as he has been uncon"ventional in research and systematic in "recording his results. . . . Amongst the "younger wireless investigators Mr. Hoyle, "who carries on his work at the Man"chester School of Technology, has been "conspicuously persevering. Those who "heard Professor Marchant's paper on 'The "'Strength of Wireless Signals' before the "Institution of Electrical Engineers at "Liverpool last winter will remember that "Mr. Hoyle only made any effective con"tribution to the discussion on that "occasion."

Digest of Wireless Literature

ABSTRACTS OF IMPORTANT ORIGINAL ARTICLES DEALING WITH WIRELESS TELEGRAPHY AND COMMUNICATIONS READ BEFORE SCIENTIFIC SOCIETIES.

THE HISTORY OF SIGNALLING.

In the *Engineering Gazette* for July 14th an interesting article appears entitled "Naval Progress in a Lifetime," in which the history of signalling is ably reviewed. The writer remarks that it is hardly too much to say that naval signalling has shown greater progress during the past ten years than throughout the past ten centuries. Wireless Telegraphy is now regarded as such a matter of course that its recent introduction is almost forgotten. Flags, lamps and semaphores have still their uses however, and it would almost seem as if after some two thousand years of development the old system only reached its highest pitch of perfection to be superseded.

One Aeneas Tacitus would seem to have been the inventor of a flag system of signalling, as he devised a method by which words could be transmitted by means of flags, but it was very elaborate and slow. At the same time the germ of the heliograph came to life, shields arranged in a stipulated manner sending words by flashes of sunlight reflected from them. In the Middle Ages ships communicated by a primitive use of flags by day and lanterns by night, and when cannon were invented they were also pressed into service. When square-rigged ships came into being someone hit on the ingenious idea of signalling by means of raising and lowering the sail, so many times denoting a word or letter. Elizabeth and her advisers seem to have drawn up some code of signals which, we are told, was first used by the expedition against Cadiz, but means of communication between ships was primitive and slow. Some progress was made towards the end of the seventeenth century, when Admiral Penn and the Duke of York (James II.) arranged some sort of a system, most of the credit belonging to the former, though it is frequently given to James. But the development of signalling at sea was very slow, though the adoption of balls and cones hoisted in various positions led to some improvement and more certainty, coloured lights being used at night.

It was during the naval wars of the eighteenth century that the necessity of a reliable and quick means of signalling became so apparent, and several officers turned their attention to the matter in the hope of solving the problem. Two famous admirals took up the question, and, presumably because they were both practical seamen and knew what was required, both of them evolved a similar system. One method was invented by Hood's secretary, M'Arthur, and the other by Lord Howe, and the best features of both were combined to form one system. For the first time several flags were hoisted together, their combinations giving the message, whereas before this time they were displayed in different parts of the ship according to their meaning. Twelve flags were used which singly or in combination, says a correspondent of the *Globe*, stood for common naval manœuvres such as "Engage the Enemy," "Anchor," "Chase the Enemy," "Make all sail." Numbers could also be signalled, while the use of inverted and reversed flags had other meanings. M'Arthur also invented a system of night signalling by means of lights.

Then there was the semaphore, which still has its uses, though wireless has practically superseded it. The late Admiral Colomb brought out in 1867 a system of night-flashing signals which alone made it possible to handle modern fleets in the dark, but an attempt to use mast-head semaphores by outlining the arms with electric lamps was not very successful. Collapsible drums have also been used in conjunction with the Morse alphabet, and now the wireless telephone is being perfected.

* * *

THE PRODUCTION OF METAL COATINGS BY SPRAYING.

In a paper recently presented at the New York section of the American Society of Mechanical Engineers Mr. John Calder described the "Schoop" process for depositing electro-positive metals on iron and steel. This process, which is the latest of its kind, also permits the depositing of many other metals and alloys on coherent bodies, whether metallic or not. To the wireless engineer the process is of value in that amongst other things it enables him to deposit with great ease a highly conducting copper coating on glass for making condensers.

The author first dealt with the other metal-depositing processes, including tinning, galvanising, sherardising and plating, pointing out the defects and limitations which are inherent in these methods. Plating, he said, furnishes a continuous thin metallic web around iron or steel objects submitted to it, providing the shape and size of the article are suitable. It is necessarily limited to small objects. The adhesion of the plated coating is slight, and its continuity is essential for service. The tinned or galvanised coating adheres, due to chemical affinity for clean iron, but its irregularity gives much trouble. The dry zinc galvanising, known as sherardising, gives a better result, but is limited to the application of one metal under heat conditions, which confine it largely to black work and to objects the distortion of which is of no consequence.

The Schoop process takes its name from M. U. Schoop, an engineer of Zurich, who, in collaboration with other inventors, made the metal spray an effective coating agent. In the Schoop process the coating metal adheres to the object chiefly by mechanical union. The metal is discharged in hot, impalpable particles moving with high velocity, and these, when directed upon a prepared object, penetrate the pores of the latter while the spray is still plastic. The coating thus dovetails itself into the superficial pores of the object and does so in the presence of reducing gas which prevents oxidation at the junction of the metals.

Mr. Calder next outlined the history of metal spraying, and pointed out that the progress of invention in this direction has been chiefly towards making the metallic particles as small and as hot as possible, thereby avoiding oxidation, and reducing the pressure of air used and the cost of the gases employed.

Prior to inventing his present apparatus, Schoop had constructed other forms, which, however, were characterised by certain defects. For example, one of his inventions, which sprayed liquid metal, involved a large non-portable reservoir of hot metal weighing with the auxiliary parts over a ton. The latest of Schoop's inventions, the "pistol," weighs less than four pounds.

The principle of the "pistol" consists in feeding a fine wire of the metal to be deposited into a reducing flame at such a constant speed that the position of the end of the wire remains stationary, the melting rate being exactly equal to the rate of feed. Under such conditions the wire end melts a drop at a time, and each drop at the instant of formation is struck a violent blow by an air-blast. In other words, the "pistol" is a machine gun which automatically manufactures its ammunition from a reel of wire and bombards the object to be plated with plastic projectiles of extremely small size. The resulting fog or spray of fine metallic particles into which the drops are divided takes the form of a diverging cone with a core of reducing gas in which the particles are entrained, and a surrounding sheath of air which is rapidly expanding and cooling. Any suitably prepared object placed in the path of this metallic spray is plated through impact without undue elevation of temperature

The spray established is essentially a metal plating air-brush, the diameter of which 5 in. from the pistol end is about 2 in. Objects to be plated are operated upon by pointing the pistol normally to the surface to be coated at any moment at about 5 in. distance and traversing the pistol across the surface with a regular motion. A single coating is 0·001 in. thick. The operator's vision easily guides him in distinguishing between the coated and uncoated portions, and also between a first and second coat. Carbon in all its resistance forms can be freely sprayed with copper, and that metal can be applied in minimum quantity to any piece or portion of a piece of apparatus. The most recent electrical application is the construction of condensers, especially for wireless service. The Schoop pistol will spray an adherent coat of copper on ordinary sand-blasted window glass. Two-thousandths of an inch is sufficient to produce a highly efficient and cheap plate much superior to rolled tinfoil coverings or galvanic deposits of copper on glass. Lead sprayed on glass also furnishes a very cheap and effective condenser plate. The time taken to cover one square foot of surface with the copper spray is one minute ten seconds, and the approximate cost three-halfpence.

* * *

PROGRESS IN HIGH FREQUENCY ALTERNATORS.

A recent issue of the *Electrical Review* contains an illuminating contribution on the above subject, in which the history and principles of high frequency machines are briefly dealt with. The impossibility of securing from arc or spark a train of radio-telegraphic waves of that degree of uniformity desirable in wireless telegraphy, and imperative in wireless telephony, has directed, says the writer, a vast amount of attention towards the discovery of a means of generating very high frequency currents by dynamo-electric machinery. It is impracticable to attain any suitable frequency by adhering to standard alternator design; pole pitch, air-gap, and winding space become impracticably small, and insulation and iron loss difficulties insuperable. No radical progress was made for twenty years after Tesla built his 1 K.V.A. 5,000 cycle machine in 1889. It is true that Alexanderson completed in 1909 a 2 K.V.A., 100,000 cycle alternator, but even this machine, the fruit of five years' labour, gave inadequate power, though it generated currents of the right order of frequency. To combine extra high frequency with reasonable power output it was necessary to employ new principles.

After mentioning the Dolezalek alternator and the Bethenod machines, the author says that resonating particular harmonics of a magnetic field affords one means of obtaining high frequency currents, but the difficulty is to secure sufficient amplitude in high frequency harmonics. The principle which has given the best results so far is that of "cascading" machines or windings, so as to superpose on mechanical rotation the rotation of high frequency magnetic fields. Jarvis Patten proposed in 1894 to use n cascaded single-phase alternators in conjunction with suitable resonating circuits to produce current of n times the frequency of a single machine. Ten years later Latour showed how squirrel-cage machines could be used in this connection, but it was not until 1907 that Goldschmidt effected a radical improvement by utilising a single machine for several successive frequency conversions. The Bethenod and Goldschmidt machines are next compared with interesting results.

M. Bethenod has given his opinion that industrial alternators of acceptable efficiency could now be built for outputs of 100 to 150 kilowatts at 10,000 to 40,000 cycles, running at a peripheral rotor velocity of from 24,000 to 30,000 ft. per minute, but that, since the difficulty and cost of construction increase rapidly with frequency even in the above range, the industrial success of high frequency alternators, as applied to wireless telegraphy and telephony, depends on the adoption of long wave-lengths—probably several tens of kilometres. So far as one can see, the accuracy of this conclusion must be admitted, but the writer well remembers how, a few years ago, one who ranks undoubtedly among the greatest experts of radio-telegraphy "proved" on paper that alternators exceeding a few watts capacity could not be built on the Goldschmidt principle. Moreover, the proof was, at that time, convincing, and its subsequent refutation was only another demonstration of the need for caution in placing limitations on the development of radio-telegraphy in general and high frequency alternators in particular.

A New Link

Further Progress in the World Chain of Wireless.

A YEAR or two ago the world was startled by the realisation that a state of extreme diplomatic tension prevailed between the United States of North America and Japan. To-day, happily, that tension does not exist. In its place there has arisen a desire among the two peoples for closer intercourse and commercial co-operation. Although many leagues of ocean separate the two nations, yet they are neighbours, as the jurisdiction of no other authority thrusts itself between them. Although the two continents are separated by so many miles, topographically a great similarity exists between them. The western part of the United States is a mountainous and broken district freely interspersed with ravines and fertile valleys in which are cultivated large quantities of useful produce. Japan is one of the most mountainous countries in the world. Its plains and valleys, with their foliage surpassing in richness that of no other extra-tropical region, its arcadian hill-slopes and forest-clad heights, its Alpine peaks towering in weird grandeur above clefts in the mountain range noisy with waterfalls, its lines of foam-fringed headlands, give it a claim to be considered one of the fairest portions of the earth. The commercial development of Japan has been remarkably progressive, and exemplifies the keen businesslike qualities so characteristic of the Japanese. Their very willingness to open up their country to outside trade has probably contributed in no small measure to the success of their efforts. In 1899, principally through the intervention of Britain, the irritating foreign jurisprudence rights over the treaty ports were abolished. Foreigners enjoy equal rights with natives except that they cannot own real estate unless as partners of associations under Japanese law. Such, then, is the country between which and the United States closer commercial relations have been established. This inauguration was in the form of direct wireless telegraphic communication across the wide expanse of

Honolulu Harbour.

Honolulu Wireless Station.

the Pacific Ocean, with but one "stepping stone." Honolulu formed the intermediary. This town is situated on the southern side of the mountainous island of Oahu, one of the Hawaiian Archipelago. Ruggedness and picturesqueness form its chief geographical features. These characteristics are aptly illustrated by the photograph which we reproduce here, and which was taken on board a steamer entering the harbour. In the distance may be seen the bold rocky outline of the mountain chain which culminates in Mount Kaula, 4,060 feet high. The Sandwich Islands are separated from other lands by a broad expanse and great depth of sea, and consequently their natural history has many special features of its own. The unique position of these islands in mid-Atlantic is of vast importance, as they act as a "halfway house" for that huge waste of waters. It is said that the islands were discovered by Gaetano in 1542; they were re-discovered by Captain Cook in the year 1778. From 1779 until 1898 the isles formed a kingdom, although in the early years of this period each island possessed its own king. Subsequently, however, the separate kingdoms were welded into one, and King Kamehameha I. became ruler of the united islands. He died in 1819, and the next reign is famous for the abolition of idolatry simultaneously throughout all the islands. It was on the chief island of Hawaii that Captain Cook met his death at the hands of the natives in the year 1779. Since 1900 the Sandwich Islands have formed part of the colonial possessions of the United States, and our progressive cousins were not slow in appreciating the advantages possessed by their newly acquired territory.

Over twelve months ago the giant wireless stations at San Francisco, California, and Honolulu commenced to communicate with one another, and since have handled a large amount of traffic daily. Communication between the United States and Japan by wireless was the next step contemplated, and, as announced in the September number of THE WIRELESS WORLD, is now an accomplished fact. Crowded as the newspapers are with news of every kind regarding the war, it is not surprising that the importance of this achievement was to a large extent overlooked by the general public. A few moments' consideration will convince the thinking man that wireless communication between these places must rank as one of the greatest achievements in radio-telegraphy.

A message sent by wireless from the Pacific Coast of America to Japan goes first to

Honolulu—over the waters of the Pacific Ocean for more than two thousand miles. At Honolulu it is retransmitted to the Japanese station at Funabashi, which is no less than 3,355 miles from the Sandwich Islands, and thence to its destination by the Japanese land lines. It will help our readers to realise the immense distance traversed by the wireless signals in crossing this last expanse of waters if we consider that this distance is some hundreds of miles greater than that between Berlin and New York.

The Funabashi station is situated some ten miles from Tokio, and is owned by the Japanese Government. The operators are Japanese, too, and we can well imagine their intense interest and excitement when the first signals came through from the distant Pacific Islands.

It was on July 27th that Mr. E. J. Nally, the Vice-President and General Manager of the Marconi Wireless Telegraph Co. of America, received from Japan the first wireless telegram, which read as follows:

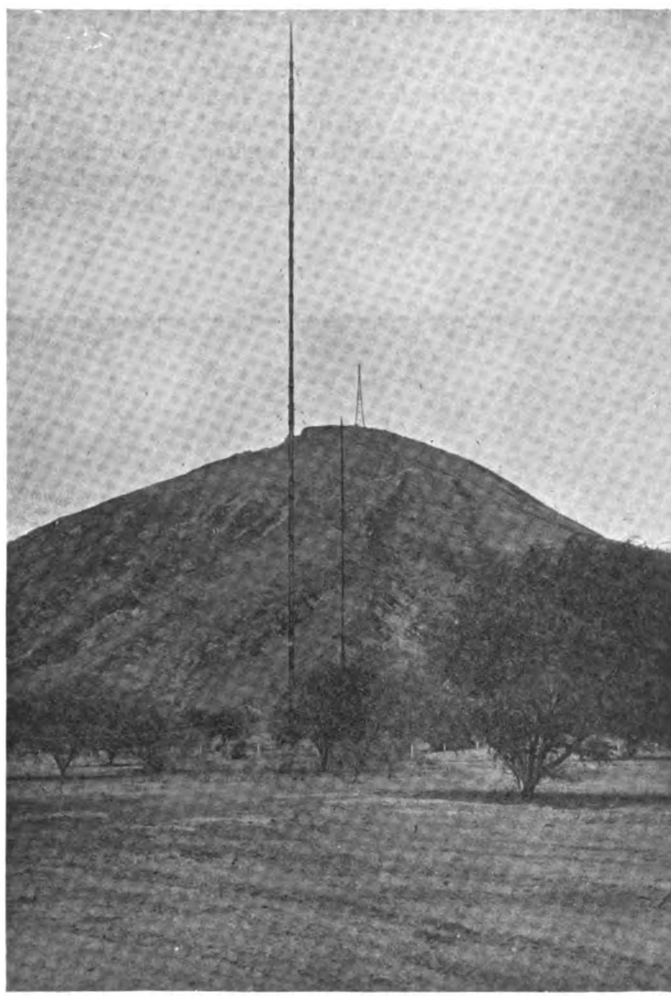
"Following from Tokio "to Mr. and Mrs. Nally:

"Availing myself of "this opportunity I have "the honour to offer you "my sincere congratula-"tions upon this first com-"munication. Signed, Jiro "Tanaka, Director-Gene-"ral Ministry Communica-"tions."

To which he immediately replied:

"Mrs. Nally joins me "in congratulations and "thanks for the first "wireless communication "between Japan and "America, and also in the "fervent wish that this "most wonderful of all in-"ventions will still further "bind the two countries "in peace and pro-"gress."

These communications were followed by a long series of tests for the purpose of perfecting the service and making the multitudinous adjustments which are necessary in establishing a service such as this. It should be remembered that it is always the aim of the Marconi Co. to make their services thoroughly commercial and continuous, and therefore much preliminary work has to be performed. Long messages in both directions dealt with the arrangements for the tests, which were carried out through all hours of the day and night, and proved most successful. Not only could the Japanese station read the Honolulu



Honolulu Station—Some of the Masts.

signals easily, and the Honolulu station those of Funabashi, but the San Francisco station was on many occasions able to read every word that was being transmitted both from Japan and Honolulu. As an example of the successful results obtained, we may give the following extracts from the "log" of San Francisco of signals overheard:

Funabashi to Honolulu: "Are you not "disturbed by statics? Much statics here. "How is statics there?"

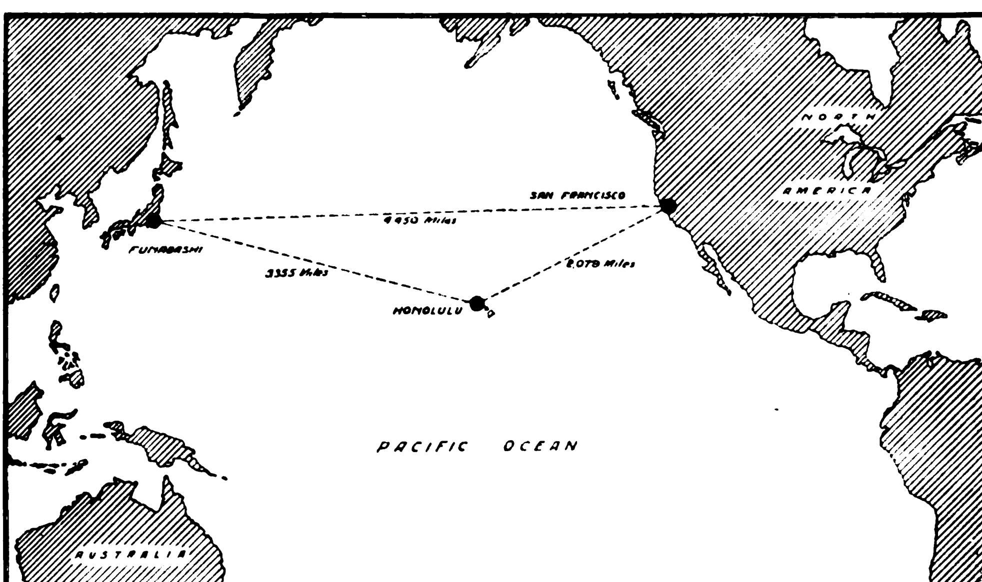
Honolulu to Funabashi: "Static mode- "rate, but your signals loud copy you on "typewriter we are not bothered just now "it's fine. K."

Funabashi to Honolulu: "OK. that's "good min. please and by till call you. See "you later."

From Funabashi to San Francisco is nearly 4,500 miles, or practically as far as from London to Cape Town, or Rio de Janeiro! And surely there is an element of humour in the Japanese operator at Funabashi telling the American at Honolulu—some thousands of miles away—that he will see him soon!

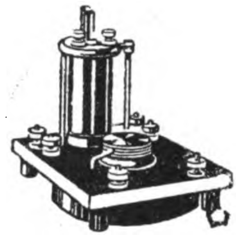
Mention of "static" (the American term for atmospherics) in the above extract reminds us that this is one of the greatest difficulties to be overcome in Pacific long-distance communication. An important series of experiments is now being carried out at San Francisco with a view to reducing still more the trouble caused in this way, although much has been done by providing the stations with installations of very high power. For instance, both San Francisco and Honolulu have 300 kilowatt transmitters, with aerials supported on thirteen steel masts four hundred feet high.

It can safely be prophesied that before many years are past wireless communication will be possible the whole way round the earth. It is not many years since the first radio-telegram was sent across the Channel; and if in the short period which has elapsed since then trans-Pacific communication is an accomplished fact, what may we expect fifty years from now?



The New Link.

The ENGINEERS Note Book



[Under this heading we propose to publish each month communications from our readers dealing with general engineering matters of various kinds in their application to wireless telegraphy, and we would welcome criticisms, remarks and questions relating to the matter published under this heading. We do not hold ourselves responsible for the opinions and statements of our contributors.]

A Useful Formula for Calculating the Strain in Mast Stays.

IT is well known that a wire suspended between two points will form the curve of a catenary. Accordingly the curve formed by a stay of a Marconi mast is part of a catenary.

The equation of a catenary in the convenient system of co-ordinates is the following:

$$y = \frac{m}{2}\left(e^{\frac{x}{m}} + e^{-\frac{x}{m}}\right) \quad . \quad . \quad (1)$$

where y and x are the co-ordinates and m is a constant.

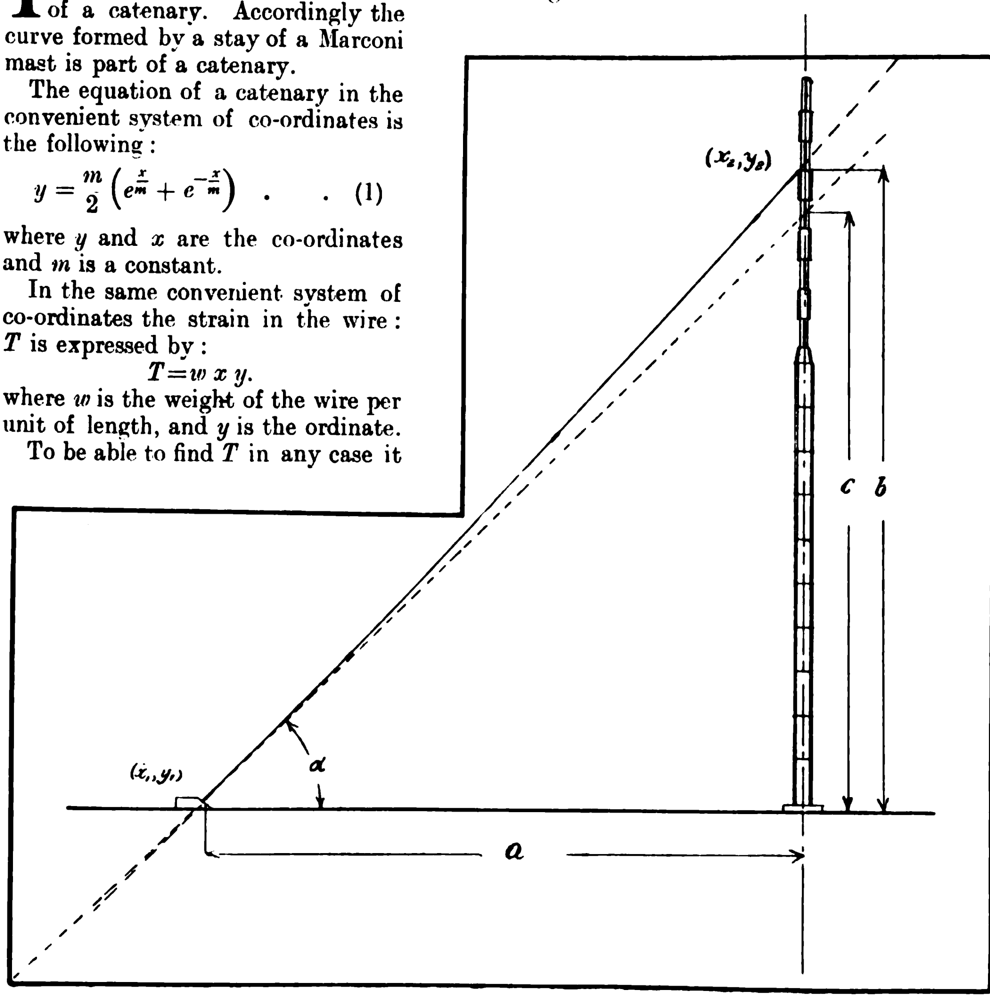
In the same convenient system of co-ordinates the strain in the wire: T is expressed by:

$$T = w\,x\,y.$$

where w is the weight of the wire per unit of length, and y is the ordinate.

To be able to find T in any case it is necessary to know certain dimensions of the mast; these dimensions are the following:

(1) w=the weight of the wire per unit of length.



(2) a=the distance from the anchor to the mast centre.

(3) b=the height of the mast from the ground to the attachment of the stay.

(4) The piece $(c-b)$.

This piece is very easy to measure on the Marconi type of mast. If standing at the anchor you look along the stay the direction of the line of sight will be the tangent to the lower portion of the stay, and you will be able to see the point of the mast where this tangent crosses the mast. In other words, you will be able to estimate the length (in number of sections and fractions) of the mast which you can see above this point to the point of attachment of the stay.

Calling the point of attachment of the stay to the anchor (x_1, y_1), and the point of attachment to the mast (x_2, y_2), we imagine the catenary formed by the stay as being laid out in the convenient system of co-ordinates.

Accordingly we have:

$$x_2-x_1=a.$$
$$y_2-y_1=b.$$
$$\frac{dy_1}{dx_1}=\frac{c}{a}=\text{tang } \alpha.$$

The equation of the catenary being:

$$y=\frac{m}{2}\times\left(e^{\frac{x}{m}}+e^{-\frac{x}{m}}\right) \quad . \quad . \quad (\text{I.}),$$

the first differential is:

$$\frac{dy}{dx}=\frac{1}{2}\times\left(e^{\frac{x}{m}}-e^{-\frac{x}{m}}\right) \quad . \quad . \quad (\text{II.}).$$

From (I.) we get:

$$y_2-y_1=b=\frac{m}{2}\left(e^{\frac{x_2}{m}}+e^{-\frac{x_2}{m}}-e^{\frac{x_1}{m}}-e^{-\frac{x_1}{m}}\right);$$

$$b=\frac{m}{2}\left(e^{\frac{x_1+a}{m}}+e^{-\frac{x_1+a}{m}}-e^{\frac{x_1}{m}}-e^{-\frac{x_1}{m}}\right);$$

$$b=\frac{m}{2}\left(e^{\frac{x_1}{m}}\times e^{\frac{a}{m}}+e^{-\frac{x_1}{m}}\times e^{-\frac{a}{m}}-e^{\frac{x_1}{m}}-e^{-\frac{x_1}{m}}\right);$$

$$b=\frac{m}{2}\left(e^{\frac{x_1}{m}}\left(e^{\frac{a}{m}}-1\right)+e^{-\frac{x_1}{m}}\left(e^{-\frac{a}{m}}-1\right)\right); \quad (\text{III.}).$$

It is to be remembered now that the expansion of e^z is:

$$e^z=1+\frac{z}{1}+\frac{z^2}{1\times2}+\frac{z^3}{1\times2\times3}+\ .\ .\ .$$

and therefore:

$$e^{\frac{a}{m}}=1+\frac{a}{m}+\frac{\left(\frac{a}{m}\right)^2}{1\times2}+\frac{\left(\frac{a}{m}\right)^3}{1\times2\times3}+\ .\ .\ .$$

As $\frac{a}{m}$ is a fraction the value of which is not greater than $\frac{1}{5}$ (this is easy to prove), the fault committed in throwing away the terms of larger order than the second is negligible.

$$\left(\frac{\left(\frac{a}{m}\right)^3}{1\times2\times3}<\frac{1}{750}\right).$$

We are therefore perfectly right in terminating the series thus:

$$e^{\frac{a}{m}}=1+\frac{a}{m}+\frac{a^2}{2m^2}$$
$$e^{-\frac{a}{m}}=1-\frac{a}{m}+\frac{a^2}{2m^2}$$

Substituting these in (III.) we get:

$$b=\frac{m}{2}\left(e^{\frac{x_1}{m}}\left(\frac{a}{m}+\frac{a^2}{2m^2}\right)+e^{-\frac{x_1}{m}}\left(-\frac{a}{m}+\frac{a^2}{2m^2}\right)\right);$$

$$b=\frac{m}{2}\left(\frac{a}{m}\left(e^{\frac{x_1}{m}}-e^{-\frac{x_1}{m}}\right)+\frac{a^2}{2m^2}\left(e^{\frac{x_1}{m}}+e^{-\frac{x_1}{m}}\right)\right);$$

$$b=a\times\frac{1}{2}\times\left(e^{\frac{x_1}{m}}-e^{-\frac{x_1}{m}}\right)+a^2\times\frac{1}{2\times2\times m}\left(e^{\frac{x_1}{m}}+e^{-\frac{x_1}{m}}\right). \quad . \quad . \quad (\text{IV.}).$$

From (II.) we have:

$$\frac{dy_1}{dx_1}=tg\alpha=\frac{1}{2}\left(e^{\frac{x_1}{m}}-e^{-\frac{x_1}{m}}\right) \quad . \quad . \quad (\text{V.}).$$

$$tg^2\alpha=\frac{1}{4}\left(e^{\frac{2x_1}{m}}+e^{-\frac{2x_1}{m}}-2\right).$$

$$tg^2\alpha+1=\frac{1}{4}\left(e^{\frac{2x_1}{m}}+e^{-\frac{2x_1}{m}}+2\right).$$

$$\sqrt{tg^2\alpha+1}=\frac{1}{2}\left(e^{\frac{x_1}{m}}+e^{-\frac{x_1}{m}}\right)=\frac{y_1}{m}=\frac{T_1}{w}\times\frac{1}{m}.$$

$$m=\frac{T_1}{w}\times\frac{1}{\sqrt{tg^2\alpha+1}}.$$

$$\frac{1}{2m}\times\left(e^{\frac{x_1}{m}}+e^{-\frac{x_1}{m}}\right)=\frac{w}{T_1}\times\sqrt{tg^2\alpha+1}$$

$$\times\sqrt{tg^2\alpha+1}=\frac{w}{T_1}(tg^2\alpha+1) \quad (\text{VI.}).$$

Substituting (V.) and (VI.) in (IV.) we get:

$$b=atg\alpha+\frac{a^2w}{2T_1}(tg^2\alpha+1).$$

But $atg\alpha=c$.
therefore:

$$b=c+\frac{a^2w}{2T_1}\left(\frac{c^2}{a^2}+1\right).$$

or:

$$T_1=w\frac{a^2+c^2}{2(b-c)}.$$

If w is lbs. per foot, and a, b and c are measured in feet, T_1 is found in lbs.

If w is in kg. per meter, and a, b and c are measured in meters, T_1 is found in kg.

Example :—In a 400 feet mast $a=200$ feet, $b=215$ feet, and c is found to be 200 feet. The stay is made of 3-inch steel wire rope with weigh 9 lbs. per fathom, or 1·5 lbs. per foot. The stress in the stay is :

$$T_1 = 1\cdot5\,\frac{200^2+200^2}{2\times(215-200)} = 1\cdot5\,\frac{80{,}000}{30}$$
$$= 4{,}000 \text{ lbs.}$$

WIRELESS AT NEW YORK'S FIRE STATION.

THE praises of the United States as the home of initiative have been loudly sung. The uses nowadays to which Americans turn all sorts of inventions appear very marked, particularly in connection with things electrical. The one topic which is of absorbing interest to the majority of our readers—to wit, radio-telegraphy, has received its whole share of attention by our cousins in the States. It is not intended here to give a eulogy of their deeds, but be it remembered that it is to a large extent due to their love of initiative that we owe many of our modern realities, whether regarded from the point of view of business or pleasure. The mysteries of sound-reproduction by means of gramophone discs and phonograph cylinders were first brought into play on the other side of the Atlantic. The ordinary-wired telephone was first adapted for commercial use within those shores. The use of electricity as a means of locomotion received its greatest impetus at the hands of progressive Americans, and the unlimited use to which wireless telegraphy might be put has not been overlooked by our friends. Our picture illustrates one of the uses of Senatore Marconi's invention, and shews the wireless instrument at the fire station in New York. The old wired alarm bells, with their constant liability to breakdown at the crucial moment, have been superseded by this greatest invention of modern days. And this is only more or less in the nature of a trial! The different modes of employment of radio-telegraphy steadily increase. Slowly but surely the genius of Marconi is spreading its tentacles into fields hitherto untouched, and its possibilities seem limitless.

Wireless Installation at New York Fire Station.

The application of wireless telegraphy to such uses is not new, for as far back as 1908 a fire station at Streatham, London, was fitted with a wireless installation. This was done experimentally, but at that time the results did not justify the general equipping of fire stations throughout the land.

WIRELESS INSTALLATION FOR ABERDEEN SERVICE.

According to the *Aberdeen Free Press*, Mr. Esslemont, M.P., has received a letter from the Postmaster-General stating that he hopes the new wireless station near Stonehaven will be completed and in use about the end of September. It is hoped that as the result telegraphic isolation of Aberdeen will now be a thing of the past.

The above statement is significant in that it proves that the Government is fully alive to the uses of wireless telegraphy as a stand-by in case of breakdown of the wire telegraph. In several other parts of the country wireless can be used in this manner. A year or two ago the cable between Land's End and the Scilly Isles broke down, and wireless was brought into use to effect communication, with excellent results.

Administrative Notes.

Alaska.

We are advised that the Marconi wireless service between Astoria and Alaskan points was opened for public traffic on August 7th last. Radio-telegrams are now accepted for Ketchikan, Juneau, Wrangle, Petersburg, Cordova, Sitka, Douglas and Treadwell.

* * *

Austria-Hungary.

The Royal Imperial Ambassador of Austria-Hungary has communicated to the Minister of State in Spain :—

"My Government has just instructed "me to advise the Direccion General de "Correos y Telegrafos in Madrid that :—

"'1. From now on, for technical and "'military reasons, radiograms from private "'parties DESTINED for Spain *via* Pola—"'Barcelona will not be accepted (this "'regulation does not refer to messages "'from private parties which ARRIVE at "'Pola coming from Spain).

"'2. Telegraphic communication with the "'central provinces of the Austro-Hun-"'garian Monarchy near to the field of "'operations of war is entirely suppressed.

"'The above is for the information of all "'stations and telegraph employees, as, "'whereas the service from Spain for "'Austria *via* Barcelona-Pola is still "'accepted, it is convenient to advise "'senders of messages that they cannot "'receive replies from those with whom they "'communicate.'"

* * *

Japan.

It is announced that a public wireless telegraph service is available between Japan and foreign countries, *viâ* Ochiishi, on the east coast of Hokkaido, and Petropavlovsk, in Kamchatka. Public messages are accepted at any post-office in Japan for despatch to Petropavlovsk at 48 sen (1s.) per word.

* * *

United States.

The superintendent of the United States Naval Radio Service, announces the completion of the Commercial Traffic Regulations of that service. These books may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D.C., at 25 cents per copy.

* * *

Our American contemporary, *The Wireless Age*, prints the following note in its August issue with regard to Ice Patrol Service :

"The U.S. Coast Guard cutters *Seneca* "and *Miami* have been detailed to carry "on the International Ice Observation "and Ice Patrol Service provided for by "the International Convention for the "Safety of Life at Sea, London, 1913–14.

"The object of the Ice Patrol Service "is to locate the icebergs and field ice "nearest to the trans-Atlantic steamship "lane. It will be the duty of patrol "vessels to determine the southerly, easterly, "and westerly limits of the ice, and to keep "in touch with these fields as they move "to the southward, in order that radio "messages may be sent out daily, giving "the whereabouts of the ice that may "be in the immediate vicinity of the "regular trans-Atlantic steamer lane.

"The *Miami* on April 16th relieved the "*Seneca*, which had been performing Ice "Observation and Ice Patrol Service since "February 15th, 1915, and during the "months of April, May and June, and as "much longer as necessary, these two "vessels will alternate on patrol, making "alternate cruises of about fifteen days in "the ice region; the fifteen days to be "exclusive of time occupied in going to "and from Halifax. The movements of "the vessels will be so regulated that on "the fifteenth day after reaching the ice "region the vessel on patrol will be relieved "by the second vessel if possible, at which "time the first vessel will proceed to "Halifax, replenish her coal supply, and "return in time to relieve the other vessel "at the end of the latter's fifteen-day "cruise.

"Having located the ice the patrol "vessel will send daily the following wireless "messages in 75th meridian time:

"(*a*) At 6 p.m. (75th meridian time) "ice information will be sent broadcast "for the benefit of vessels, using 600-"metre wave-length. This message will "be sent three times with an interval of "two minutes between each.

"(*b*) At 6.15 p.m. (75th meridian time) "the same information will be sent "broadcast three times in similar manner, "using 300-metre wave-length.

"(*c*) At 4 a.m. (75th meridian time) a "radiogram will be sent to the Branch "Hydrographic Office, New York City, "through the nearest land radio station, "defining the ice danger zone, its southern "limits, or other definite ice news.

"(*d*) Ice information will be given at "any time to any ship with which the "patrol vessel can communicate.

"Ice information will be given in as "plain concise English as practicable, and "will state in the following order:

"(*a*) Ice (berg or field).
"(*b*) Date.
"(*c*) Time (75th meridian time).
"(*d*) Latitude.
"(*e*) Longitude.
"(*f*) Other data as may be necessary.

"While on this duty the patrol vessel "will endeavour by means of daily radio "messages to keep ships at sea advised "of the limits of the ice fields."

* * *

West Indies.

The Marconi Wireless Telegraph Company (Limited) announce that telegrams can now be accepted at their offices and be exchanged between the United Kingdom of Great Britain and Ireland and Bermuda, Turks Island, Jamaica, Antigua, St. Kitts, Dominica, St. Lucia, St. Vincent, Barbados, Grenada, Tobago, Trinidad, and British Guiana at 2s. 2d. per word for ordinary full rate messages and at 1s. 1d. per word for deferred messages in plain language. The rates for Bahamas-Nassau for the same classes of telegrams are respectively 2s. 2d. and 1s. 0½d. per word. A service at deferred rates is not at present recognised by the islands of Porto Rico, St. Croix, and St. Thomas, but the rates to these islands for ordinary telegrams have also been reduced to 2s. 9d. per word. The above rates are in all cases cheaper than those charged by other companies by 4d. and 2d. per word, and they will be notified by the General Post Office to all provincial offices in the next Post Office Circular.

A READY RESPONSE.

An interesting indication of the promptitude with which assistance came to the torpedoed Allan liner *Hesperian* after she had sent out the wireless S.O.S. signal was afforded on the arrival at Liverpool recently of the American liner *Philadelphia*. The latter vessel picked up the *Hesperian's* cry for aid when sixty miles away. The *Hesperian's* message stated that she was sinking, and gave particulars of the latitude and longitude. Capt. Mills, of the *Philadelphia*, immediately caused a message to be sent in response stating that his vessel would proceed to the rescue. Scarcely, however, had the ship's course been set for this purpose than another wireless was received from the *Hesperian*, stating that the *Philadelphia's* good offices would not be necessary as a British patrol boat had arrived at the scene of disaster, and all the aid needed was already at hand. Thus it would appear that material help was furnished to the stricken liner with a celerity almost rivalling that of wireless telegraphy itself.

SHARE MARKET REPORT.

LONDON, *September 17th*, 1915.

The market in the various Marconi issues has not been very active during the last month. There has been some investment buying, but prices are inclined to droop.

Marconi Ordinary, $1\frac{29}{32}$; Marconi Preference, $1\frac{3}{4}$; Canadian Marconi, 5s. 9d.; American Marconi, 16s.; Spanish & General Wireless Trust, 5s. 6d.; International Marine, $1\frac{3}{16}$.

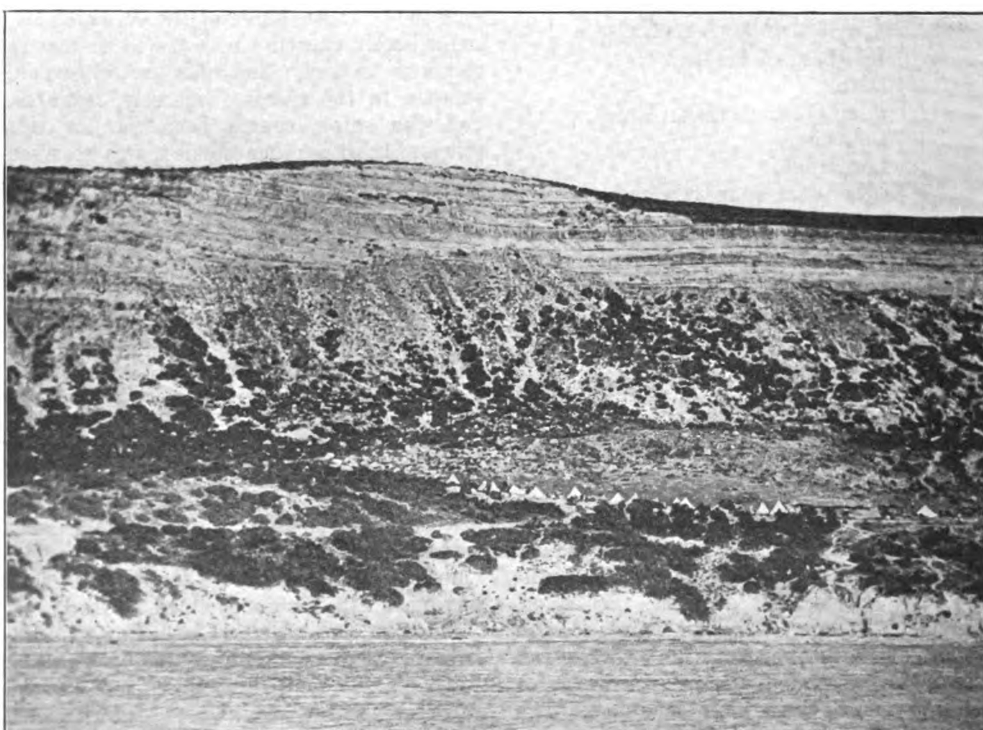
In the Gallipoli Peninsula.

An Interesting Letter from a Member of the Staff of the Marconi Company.

The following letter has been received by the Marconi Company from Petty Officer L. Sanderson, at present stationed for wireless duty at a naval wireless telegraph station on the Gallipoli Peninsula :

" I thought perhaps it might interest you " to know how and where some of your old " staff are working. C. S. Gordon is on this " station with me. When we arrived out " here, at the end of April, we were to join " H.M.S. *Ark Royal*—the seaplane ship— " for observation duty. Our hopes, how- " ever, were disappointed, as we were sent " from one of the battleships ashore to this " station on the Gallipoli Peninsula, and " here we have remained, and expect to " remain until the finish of this campaign.

" Times have been very exciting, and " working wireless here is not quite the same " as sitting in a comfortable Marconi room " on board ship ! Our instruments are in a " dug-out on a hill side facing the sea, our " living ' room ' is next door. We are using " a ½-kw. pack set, excepting that the engine " and generator are mounted on a bedplate " instead of on the usual pack-saddle frame. " It has been about the best working set " it has been my fortune to use ; we have " had no trouble at all, except very minor " forms, since we landed. Our main trouble



Military Encampment at the Dardanelles

European Coast of the Dardanelles.

"is broken shafts; we broke the original "steel shaft and have since had to manu- "facture our own from wood, which, needless "to relate, do not last very long. We have "been under a continual shell fire all the "time—shells varying in size from 18 "pounder to 11 inch (probably from the "*Goeben*). It is a more or less common "occurrence to have our aerial shot away; "in that case we do not stop outside to make "neat splices, but tie knots in the wire and "rush for cover again. The last time it hap- "pened a piece of shell made a hole right "through the base of the mast and cut two "stays. The mast is still standing how- "ever. We also had a new reel of aerial "wire cut up into small pieces! There are "four operators besides myself. I do not "keep a watch, as I have to generally "superintend the working of the station. "When I get any spare time, which is not "often, I take a trip to the trenches and "fire a few shots at sandbags—all I could "see of the Turkish position excepting "dead Turks. My last voyage with the "Marconi Company was coming home with "the Australian troops. I have met them "all here since and renewed many friend- "ships.

"Our airmen here are very active; one "or two are always above us. The other "evening there were five up together. We "had a very exciting episode a few days ago. "A German aeroplane was flying towards "us when one of our machines was seen "approaching from the south. The "Deutscher at once made off, but our man "followed. The last we saw of them, as "they disappeared over the ridge, was the "German being rapidly overhauled; un- "fortunately we did not see the finish. Our "airmen have certainly established a big "supremacy here.

"The general opinion is that this cam- "paign will be over soon now. I hope it "will. I shall be very glad when the whole "thing is over. I am looking forward to "coming back to Marconi House and "renewing all the old and pleasant asso- "ciations.

"Big things are happening here now, "which, of course, the censor will not allow "me to write about. But from all appear- "ances it certainly looks as if the Turks were "getting very fed up. Many prisoners "have been brought in lately, and they look "very ragged and weary, but they have "fought a good fight, although they are "never able to get the upper hand.

"I would like to send you some photo- "graphs of the station, but regulations do "not permit of them being sent away.

"We hear occasionally of the good work "being done by Marconi men in different "capacities, and we shall have many things "to yarn about when we all meet again."

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Wireless Telegraphy in the War

A résumé of the work which is being accomplished both on land and sea.

OUR illustration of the Ok Meidan wireless station, situated in the environs of Constantinople, between two and three miles outside the city, gives a very fair idea of the general outside appearance of an installation, which was dealt with in some detail in the October, 1914, issue of THE WIRELESS WORLD, page 456. Located on high ground, it consists of wild heath land. The visitor who arrives from the Turkish capital is liable to find himself seriously troubled by clouds of dust. The installation is a powerful one, the aerials being capable of developing a continuous 20-kw. transmission. It was erected prior to the Balkan War, and played an important part during the siege of Adrianople, maintaining communication between the Turkish Government and the beleaguered garrison. In the present war there can be little doubt that it is in constant communication with the great German station at Berlin, and we may feel pretty certain that it is by the agency of these 250 ft. masts that all those "Arabian Night" fictions which the German Government add to their own wireless bulletins come through.

The following extract from an article in a recent number of the *United Empire*, upon "The Aeroplane and War," is of interest.

Speaking of the R.F.C., the writer says:

"What they did want was opportunity "and efficiency—more machines and better "machines; opportunities to perfect them-"selves in their work, to try for possible "developments. Take wireless telegraphy, "for example. Experiments had been made "in Italy and elsewhere, the matter dis-"cussed, apparatus designed and, to some "extent, tested before 1913. Apparently "English officialdom regarded it as a harm-"less crank, beloved of two or three indi-"viduals. However, they were permitted "to try. Last summer they tried, tested, "perfected as much as might be with avail-"able resources, encouraged by their own "conviction of the value of the work. Ger-"many, be it noted, has no similar achieve-"ment to record. All her big dirigibles, "however, are fitted with wireless, and "moreover can carry a wireless operator "who need not be an aviator. . . ."

The above statement hints at an infinity of energy and organisation since the out-

Ok Meidan, Constantinople, Wireless Station.

break of war, of which no doubt we shall hear more at an opportune moment.

* * *

We read in the *Sydney Sun* (Australia) that the invention of apparatus for controlling a submarine, or aerial torpedo, by wireless is the invention of a Mr. Alban Roberts, and that when the patent was first introduced it was controlled by a Sydney syndicate. As, however, the applications for patents were lodged in Germany before the war broke out, our contemporary appears to consider it not unlikely that, if the idea has been applied to Zeppelins, the Germans must have stolen the invention for their own purposes.

* * *

Our illustration of the s.y. *Mahroussa* recalls the fact that the ex-Khedive of Egypt has "sold his kingdom" not "for a Mass," as did our own Stuart Dynasty, but for the indulgence of a piece of personal spite against England. His private yacht *Mahroussa* was lying at Constantinople at the time when war broke out between Turkey and the Allies. The wireless apparatus on board, which consisted of a Marconi 5-kw. installation of the battle-ship type, was removed by the Turks and utilised ashore. It may be remarked that the power used for this apparatus was provided by a large battery of accumulators, which also served to light the ship when in port. A triple-screw steamer, fitted with Parsons turbines, she is the fourth largest private yacht in the world, her tonnage being 4,500. She did excellent work in connection with the Egyptian "Red Crescent" Mission all through the Balkan War.

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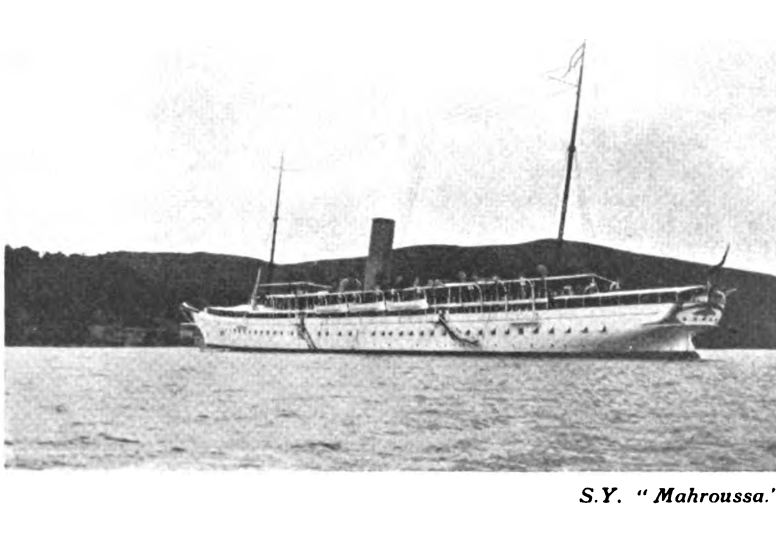
If only German methods were not quite so clumsy, some of the German ideas, which are quite good, would work out in a more artistically satisfactory manner. But as a rule the clumsiness of the means employed gives the show away.



S.Y. "Mahroussa."

An interesting example is furnished by the attempt of the German authorities to influence foreign opinion through the insertion of imaginary items in the "news from "Berlin sent through the wireless stations "of the German Government." It will be remembered that on July 10th, just after the German reply to the United States' note about the *Lusitania* had been received, the German wireless stations radiated the following message :—

"Political, and even naval, circles are "beginning to get tired of the daily editorials "of the *Deutsche Tageszeitung* against a "German-American understanding on the "submarine question. The attitude of the "*Tageszeitung* is considered sufficient proof "that such an understanding is desirable."

Count Reventlow, who is responsible for the *Tageszeitung*, appears to have been at a loss to trace the message ascribed to him. Nothing of the kind had really appeared in the *Tageszeitung*, and the editorial staff of that paper, including their distinguished inspirer Count Reventlow, had to discover it through the medium of the British Press.

* * *

British submarines have recently been making matters a little too lively in the

In the Bosphorus.

Sea of Marmora and off the coast line of Con stantinople for the fancy of the Turks. The ferry-boats, of which we publish an illustration, ply to and fro on the Bosphorus, and provide in peace time an extensively patronised service along the coast at very moderate rates, so low indeed that it is possible to travel from Constantinople to the Black Sea for the equivalent of a shilling. Owing to the fact that these steamers are unprovided with wireless apparatus they are totally incapable of receiving notice of the presence of hostile submarines, and a certain number of them already have been sent to the bottom. So risky do the Turks consider a voyage in them to be that we understand passengers refuse to go on board unless provided with life-belts. The boats, some of them constructed in England and some in France, form quite commodious steamers, built in two decks.

* * *

We sometimes see it stated in British as well as German newspapers that " the future " of the operations elsewhere will be settled " on the battlefields of Flanders," but will it? We can understand the reason for hoping so from the enemy point of view, but with the supremacy of the British Fleet still unshaken another solution is perfectly possible. Our illustration of a pack wireless station of the Indian Army operating " somewhere up Euphrates " recalls to our minds an important British expedition from the point of view of locality, though not from that of the size of the forces employed. An Anglo-Indian Expeditionary Force has for some months past been progressing up the Euphrates from the end of the Persian Gulf. It is excellently organised and equipped, and well provided with " wireless ears." The figure standing on the left side of the photograph is Sergeant Blundell, who has already distinguished himself in the present war.

The news, as far as it has been published, takes us up to the end of July, when the Turkish forces were defeated near Nasiryeh. This is by no means the first important expedition conducted by Englishmen in this part of the world. In 1835 a party

Pack Wireless Station.

of engineers, sappers, miners, and artillerymen started down the Euphrates River under the command of Captain F. R. Chesney and proved the practicability of this route by which the passage from England to Karachi, the nearest port of British India, could be effected by the transit of 1,000 miles less than that occupied *via* Suez. A railway concession was obtained from the Turkish Government, but the project failed, *on account of the overwhelming British influence which would thus be secured over this part of the world.* Political jealousies were aroused and Lord Palmerston gave way. Perhaps Great Britain may reconquer in war what she gave up in peace, so that the rich valley of the Euphrates may yet constitute a most important channel of communication between the Mother Country and her Indian Empire.

* * *

At a time when a "certain section of the Press" has called forth the condemnation of the Trades Union Congress for endeavouring to take advantage of the present war to fasten some form of military service on Englishmen the *Spectator* brings out a timely article on "Education and War," pointing out that despite its many drawbacks military service may if properly conducted prove of considerable educative value to the youth of the country engaged in it. They refer to an article in *The Daily News*, published by Mr. H. W. Nevinson, who some years ago went so far as to call the army "the poor man's university." Certainly, "in the Royal Engineers, besides "gaining some knowledge of *wireless telegraphy*, land surveying and signalling, the "recruit may make acquaintance with the "newest instruments from mining and blasting and the management of explosives in "general." It is far from our wish to trench on controversial subjects, but this side of the question is not unworthy of some attention.

* * *

In the course of an article dated from Rotterdam from the pen of Mr. James Dunn, reference was recently made to the aerial torpedo invented by a Swedish officer and sold to Krupps. Germany's finished weapon appears to be an important development of the Swedish invention and "resembles" a miniature airship fitted with propellers driven by electricity and controlled from a Zeppelin by wireless. The German aerial torpedo can theoretically remain in the air for three hours, and can be controlled from a distance of two miles. It is provided with two propellers, and two lifting screws are automatically started at the moment of discharge.

In shape this torpedo of the air, which is about seven feet long, resembles the submarine weapon. It is composed of two cases, the outer of thin chrome nickel and the inner of material similar to that used in Zeppelins. About a sixth of the space at the rear is occupied by an electric accumulator at the bottom and an electric motor generator secured to the top. The machinery is controlled by Hertzian waves acting on the Telefunken system of wireless, and it is claimed that up to a distance of two miles the air torpedo can be steered at will.

* * *

The air torpedo is inflated with water gas and compressed gas, but as it is heavier than the air, two lifting screws work under the body to keep the torpedo in the air, while the motive power is supplied by two propellers. Both screws and propellers are connected with the same shaft, which runs through the body of the torpedo.

* * *

Mr. Godfrey Isaacs' fine speech at the Whitehall Rooms on July 26th must have opened the eyes not only of the shareholders of the Marconi Company, but the wider circle of British newspaper readers, as to the value of the German wireless chain, which has been recently broken up. A full report of the speech was printed in our September issue. But there is one point upon which it might be worth while to enlarge a little here. Mr. Isaacs, after stating that on good authority the German Government was supposed to have spent about two million sterling in their wireless construction, proceeded to point out what an excellent investment that expenditure proved. It snatched scores of million pounds' worth of prizes away from the British Navy. Neutral ports all along the great routes of commerce are stuffed with German shipping interned to evade the strong arm of the British Navy. A journey down the South American coast is an object lesson in itself. We have pointed out in these columns that this wireless organisation of theirs rendered possible the predatory careers of the *Emden, Karlsruhe, Königsberg,* and their consorts, besides accounting for our enemy's sole naval success, that off the Chilian coast against the gallant British Admiral Craddock.

The speech of the Secretary of State for the Colonies (Mr. Bonar Law), in his statement in the House on the occasion of his report on the Colonial Vote, devoted a large part of his speech to driving home the same moral as did Mr. Isaacs. He paid no small tribute to the far-sighted expenditure of German money on wireless, when he declared that with regard to their Colonial wireless stations that "it was of the utmost importance that by some means or other, we should either obtain possession of these stations or destroy them." The vulnerability of the cables as compared with the wireless stations has been most strikingly exemplified. The former were cut within a few hours of the declaration of war, the latter have to be reduced piecemeal, and although approaching completion that object has not even yet been altogether attained. New Zealand struck the first blow, and on the last day of August entered into possession of the German wireless station Samoa. The Australian forces followed suit and after some fighting took possession of the German colonies of New Guinea, Bismarck Archipelago and the Solomon Islands, together with their wireless equipment. In Togoland the British and French worked together. Here some very stiff fighting took place before the great wireless station, which formed the objective of the whole expedition, had been destroyed by the Germans to prevent it falling into our hands. After this the Colony surrendered and is now being administered by the Allies. In the Kameruns the success of the Allies has not been so unqualified, but although at present only partial the end is not only certain but approximate. The magnificent campaign conducted in so skilful and successful a manner by General Botha is fresh in the minds of us all. Here again the main objective was Windhoek with its giant wireless equipment. The capture of this important radio-telegraphic station and city decided the fate of the Colony and was closely followed by the surrender of the German forces. The history of this campaign against German wireless and the Colonies which sheltered it forms one of the most interesting and illuminating contributions to the understanding of the war and Britain's position relative to Germany which has been published since the outbreak of hostilities.

* * *

The occasion of Senatore Marconi's visit to London resulted in several interesting press interviews. The representative of one of our weekly contemporaries appears to have put a series of questions ranging over a very wide field. It appears to be the fashion nowadays to exaggerate the achievements of our German enemies, particularly in a certain section of the press, which called down upon themselves the rebuke of the Prime Minister on this very point, just previous to the rising of Parliament for the summer recess. The interviewer in question in calling Senatore Marconi's attention to the "wonderful wireless station in German South West-Africa, practically built at a cost of a quarter of a million pounds, by means of which the Colony was able to speak direct to Berlin" drew from the great inventor the remark that this achievement hardly represented anything very remarkable in view of the development of radio-telegraphy at the present day. Senatore Marconi's reply included the observation that "it has been found quite possible to communicate by wireless direct from Buenos Aires to England, which, if I am not mistaken, is further than from German South-West Africa to Berlin." This achievement is a work of the English Marconi Company, and the Chief's temperate reminder formed an excellent rebuke to the representative of a journal which has recently constituted itself one of the "admirers of all countries but their own."

* * *

Of course, the old suggestion about the possibility of exploding the enemies' shells by means of wireless turned up, like a hardy perennial. "Personally," said the great inventor, "I do not see how this can be done. I do not say that it could not be done, but if I were asked to do it, I should answer 'Not at present.'" The subject of the rapprochement between England and Italy which may be expected after the war, gave rise to the expression of some well-founded expectations of business to be done in the future. In the past Italy has taken a great quantity of manufactured articles from Germany, but after the end of the present struggle, this trade ought to go largely to England and result in the building up of a most important commercial intercourse between the two great nations, always friendly and now Allies.

* * *

In a recent issue we gave a story of how the "treasure ship" *Kronprinzessin Cecilie* escaped the British cruisers at the end of July last year. The distinguished writer who employs the pseudonym of "Americanus" contributed a remarkable article to a recent number of the *Spectator*, in which he does us the honour of quoting the account we published, and adducing from it fresh damning evidence of German duplicity. He points out that the wireless message to which she owed her salvation signified, when decoded, that war had broken out with England, France and Russia *four days before the event actually occurred*. In other words, war had not broken out; and "Germany was then nominally at peace "with the world and through diplomatic "agencies was vigorously asserting the "sincerity of her alleged mediatory efforts "to preserve peace."

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The Note to United States recently transmitted by Sir Edward Grey contains a very masterly defence of the British sea blockade determining. The Americans have been insisting upon the well established contention that a blockade must be a reality before neutral countries will submit to be governed by its laws. The British despatch points out that a modern blockade does not require a close ring of warships before the ports it is intended to invest. The great speed of up-to-date warships gives them a wider range, which is immensely added to by *their control of wireless telegraphy*. The situation itself is a novel one and must, therefore, be judged by novel standards, due regard, of course, being made to the principles involved in the ancient rules.

* * *

The aircraft men form the "eyes" of an army, and the wireless sections form its "ears." Just as the Flying Corps are being trained at Marconi House, London, in the wireless branch of their service, so the Royal Engineers are having their wireless sections trained at different points in Great Britain. Our illustration depicts the corps of the Royal Engineers, who are at present undergoing instruction in wireless telegraphy at Glasgow. Here they are being

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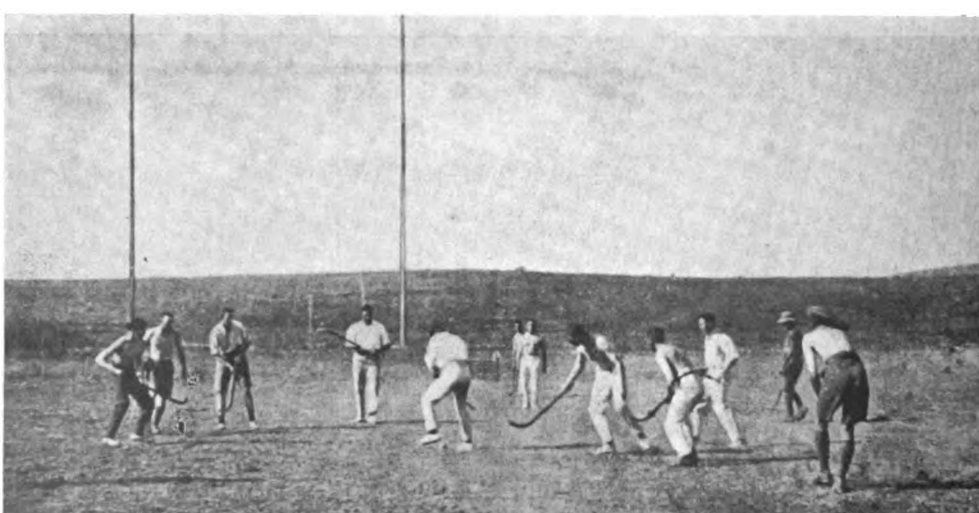
Royal Engineers Wireless Corps.

trained for service in any of the many regions in which the British Army is now operating, and few of us blessed with any imagination can look upon these gallant young sons of the Empire unmoved by the reflection that many of them are likely to suffer in life or limb in various parts of the world before Great Britain and her Allies have been able to curb the lust for power of the Pinchbeck Potentate of Potsdam.

* * *

As far as land operations are concerned, the greatest activities for the moment displayed by the British centre round the Gallipoli Peninsula. Here the game of war is being played in a most strenuous style by the British Imperial and Colonial forces. We print in the present issue an account of what is going on from the pen of the wireless operator in charge of the station at Anzac, which gives a very fair idea of what conditions are like in this part of the world-wide operations of war. Our illustration shows a different scene. The wireless masts are looking down upon, not trenches and bomb shelters, but a team of hockey players engaged in friendly, not deadly, combat upon the sandy soil which, varied by craggy hills, forms the Gallipoli Peninsula.

In our last (September) issue we published on page 373 a portrait of Senatore Marconi in his Italian uniform, and the *Daily Chronicle* has recently printed an interview with him concerning his war experiences with the Italian Army. Italy, it would appear, is probably the best equipped country in the world in the most modern of the weapons of war, and Senatore Marconi's services have naturally been utilised more particularly in this branch of his country's service. In the course of his interview he gave a graphic little description of the character of the mountain fighting experienced by the Italian Army, now, for the first time after many bitter years, entering the unredeemed provinces so long retained by their traditional foes. "The posts that "marked the former frontiers between the "two countries," said the great Italian, "bore the word *Italia* inscribed on one side "and *Austria* on the other. There was "tremendous excitement in the ranks one "day when an Italian soldier rooted up a "post and triumphantly carted it off— "between rows of cheering compatriots— "for about ten miles further on towards the "Austrian lines. I have sometimes seen on "other posts the name *Austria* obliterated "so as to enable *Italia* to be triumphantly "inserted on top."



Marconi Posts as Hockey Bases in Gullipoli.

British Association Meeting

Three Papers on Wireless

IN Section G (Engineering) of the British Association on Friday, September 10th, three papers relating to wireless telegraphy were read.

The first was by Dr. W. Eccles, and Mr. A. J. Makower on " Electric Oscillations in Coupled Circuits—a Class of Particular Cases." The paper was of a highly mathematical character, and Dr. Eccles apologised for presenting it to the Engineering Section of the Association. He pointed out, however, that the paper gave several formulæ not to be found in text books, and he felt that these would be of assistance to designers of wireless telegraph installations. The investigations which formed the subject of the paper arose during an examination of the methods of coupling that might give rise to single frequency oscillations.

PROFESSOR GISBERT KAPP, who was in the Chair, remarked that the author had judged the mentality of his audience rather too highly. He confessed that the subject was beyond him.

PROFESSOR G. W. O. HOWE said he was very interested in the paper, but it was not one that could be discussed very well on account of its very mathematical nature without losing oneself and losing everybody else in the process. He had done some work on similar lines himself and on one or two occasions had written articles criticising adversely the French system of getting a single wave known as " System 'à onde unique' of the Société Française Radio Electrique." When he first heard of this paper, he was not sure whether Dr. Eccles was going to say that he had made a " howler," and he was very relieved to find that it was quite impossible to make a single circuit. Recently also he himself had written a paper on similar lines, of coupling by means of condensers in special cases as well as of inductance, and working out in a simple manner the equivalent couple in the two cases. In the special cases as represented in the paper where the circuits were joined and coupled by a condenser, there was a simple way of finding out the frequency of oscillation and the equivalent coupling. The method he had adopted in the paper which he had recently written was one which would appeal to the usual elementary student.

PROFESSOR E. W. MARCHANT said it was difficult to discuss a paper of this nature at first sight, but the results in it would be of very great value in connection with it in the design of wireless telegraph stations.

DR. ECCLES briefly replied.

The second paper was by Professor G. W. O. Howe on " The Capacity of Aerials of the Umbrella Type " (see pp. 426-431). In a paper read before the British Association at Sydney last year the author developed a method of calculating the capacity of radiotelegraphic antennæ. In addition to describing the method in general, curves and formulæ were given so that the capacity of aerials of standard types could be determined in a few minutes. The umbrella type, however, was not specially considered, and it has since been suggested to the author that the usefulness of the paper would be considerably increased if curves and formulæ could be given for aerials of this type. The method is briefly as follows: The whole aerial is assumed to have a uniformly distributed charge, and the average potential of the whole aerial under this fictitious condition is then calculated. It is assumed that if the total charge, while remaining unchanged in quantity, be allowed to have its own natural distribution, it will assume a uniform potential approximately equal to this fictitious average potential. The proximity of the earth is taken into account by the method of images. Tables and curves are given for aerials with from two to six ribs and for various angles between the ribs and the vertical. With these curves and those given in the original paper each of the nine component potentials of any given aerial of the umbrella type can be read off and the resultant average potential determined. The method is then applied to two practical examples, one a simple aerial with six single-wire ribs and the other a more complicated case in which each of the five ribs consists of a four-wire cage, the size of the wire being different from that used for the central vertical wire. Tests on actual aerials have shown that the value of the capacity as calculated by the author's method agrees with the measured values within the errors of observation and of estimation as to the allowance to be made for connecting wires, etc.

In answer to a few questions, Professor Howe said that the thing which had surprised him was the accuracy of the rough assumption in the paper. He had expected to get large discrepancies.

The final paper was by Professor E. W. Marchant, and was entitled "A Note on Earth Resistance." This was a short paper and we give it below.

If an earth plate in the form of a hemisphere is embedded in a homogeneous medium, with a flat bounding surface, the flat face of the hemisphere coinciding with the flat surface, it may easily be shown that the resistance between this surface and a very distant surface also of hemispherical form is $= p/2\pi^{a}{}_{2}$, where p is the specific resistance of the material, and a is the radius of the hemispherical earth plate. This may be written $= (p2\pi a^2)\ a.\ p/2\pi a^2 =$ specific resistance. / Area of hemispherical earth plate.

a is the length of the uniform bar with area $2\pi a^2$, which could have the same resistance as the earth. "a" may be called the "Equivalent length of the earth resistance," which in this case is equal to the radius of the hemisphere. For other forms of earth than the sphere this equivalent length of earth may be determined. The earth resistance of an earth plate will depend almost entirely on the specific resistance of the material immediately surrounding the earth plate, and, if its value is known, the resistance of the earth at any place may be determined, if the specific resistance of the soil in the neighbourhood of the earth plate is found. In connection with the wireless station at Liverpool some experiments have been made recently on the resistance to earth of three different types of earth plate. The earth most used was the water pipe system of the building; in addition to this an earth was formed by fourteen 2-in. cast-iron pipes pointed and driven about 1 ft. into the ground, which, in Liverpool, is a good yellow sandstone; a third earth was formed by a copper plate 1 ft. 6 in. wide and 4 ft. 6 in. long, buried vertically at a depth at the lower edge of 6 ft. below ground. To this was riveted two copper strips laid at a depth of 6 ft., each 1 in. wide, and 40 ft. long. In both cases described the earth was made by burying the plates direct in the wet sandstone, without a surrounding volume of coke such as is usually recommended. If good conducting material were used to surround the plate it would, of course, considerably reduce the "effective length" of the earth resistance. The specific resistance of the sandstone, when excavated from the soil and firmly pressed into a wooden box with copper plates at opposite faces, was 375 ohms per foot cube, the percentage of moisture in the sand being 10 per cent. By measuring between these earths in succession and by assuming that the earth resistance of each was some definite quantity, the resistance of each of the three can be estimated. The earth resistance was measured first between A and B with A positive, then with A negative, and so on, and the earth resistances were calculated on the assumption that the earth currents flowed from A to B, from B to C, and from C to A.

Calculating from the measurement so made, the following results were obtained:

	ohms.
Earth resistance of copper plate and strip	6·1
Earth resistance of iron pipes ...	42
,, ,, ,, water pipes ...	3

Assuming that the current flowed the other way, the earth resistances were:

	ohms.
Earth resistance of copper plate and strip	7·1
Earth resistance of iron pipes ...	40
,, ,, ,, water pipes ...	2·7

The water pipe earth has very much the lowest resistance as might have been expected from the large area of water pipe embedded in the soil. In comparing the two earths formed by the iron pipes and the copper plate, it was calculated that the area of surface exposed to the soil was 5·8 sq. ft. in the case of the iron pipes and about 27 sq. ft. in the case of the copper plate. The equivalent length of earth as defined above may be easily calculated from the above data :

	ft.
For the copper plate earth the mean equivalent length is	0·51
For the iron pipes the mean equivalent length is	0·63

It is impossible to estimate the equivalent length of the water-pipe earth, since the area of surface of the water pipes exposed to the ground is unknown, and in any case the calculation of the equivalent length for such a complicated network would have no practicable value. The earth resistance of these plates has not been measured over a very long interval of time, the greatest difference in earth resistance found, so far, is for the copper plate which is buried in ground exposed to rain. After a very dry spell of weather the earth resistance was found to be about 6 per cent. greater than it was after the usual rainy conditions had prevailed for some weeks. The reason for the smaller equivalent length of the copper plate earth is its form, the long copper strip giving contact to a large area of soil, whereas the pointed iron pipes were close together. The determination of the equivalent length of earth for various forms of earth plates provides a simple means of comparing their effectiveness.

PROFESSOR G. W. HOWE said that although Professor Marchant was not aware of it this paper was also an appendix to his own paper in Australia. There was one point which required making a little clearer. The equivalent length in an arrangement of embedded wires in the earth was merely a geometrical thing which could be calculated, depending merely on the dimensions. It did not depend on the specific resistance—*i.e.*, the nature of the earth. It was a geometrical constant depending upon the dimensions which could be calculated approximately quite sufficiently accurately for all practical purposes. With two plates, one positive and one negative, and an insulating medium there were electrostatic lines from one to the other, and, depending upon dimensions, that arrangement had a certain capacity. If, however, these two plates were embedded in a conducting medium these lines were not electrostatic lines, but lines of flow of current, and depending upon the dimensions for a given specific resistance one obtained certain resistance. The same formulæ that gave capacity gave resistance, and if they calculated the capacity they could say straight away what was the resistance of that arrangement. Given the specific resistance of the medium in which it was embedded, it was possible to calculate the resistance if they could calculate the capacity. The surface of the earth might at first sight appear troublesome, but this could be allowed for by a modification of the method of images. He had applied this method to his formulæ in his Australian paper and the results agreed approximately with those given by Professor Marchant. Professor Marchant's results were absolutely at the mercy of specific resistance. His (Professor Howe's) paper on the subject would shortly be published.

DR. W. H. ECCLES said that in calculations of earth resistance in wireless telegraphy it was necessary to be specially careful to remember that the effective resistance varies with the frequency. It varied up to 300 or 400 per cent.

PROFESSOR HOWE said that he had intended to draw attention to that point, which was mentioned in his forthcoming paper. Low frequency or static measurement of earth resistance had to be used very carefully in wireless telegraphy.

MR. J. FRITH asked how Professor Marchant measured his earth resistance. Continuous current was not a reliable method of measuring earth resistance. A far more reliable method was alternating current using a bridge and telephone.

PROFESSOR KAPP said that one was always under the impression that the earth offered very little resistance—*i.e.*, if it was really a moist earth. Was there not such a thing as contact resistance between the plate and the earth ? For instance, the first ¼ in. contact between the plate and the earth must have a different resistance to the middle of the plate. Had that fact been observed and how was it accounted for ?

PROFESSOR MARCHANT said the main object he had in writing the paper was to attempt to establish some sort of standard by which the effectiveness of different forms of earth plate could be measured. He agreed with Dr. Eccles that the difference of resistance and difference of wave-length was of very great importance in wireless telegraphy. He understood, however, that the form of the earth plate did not make much difference.

DR. ECCLES, interposing, said that if the earth plate had about one-half or one-third copper in the antennæ it could not be very much improved upon.

PROFESSOR MARCHANT, replying to Mr. Frith's point, said that he measured with direct-current. Professor Kapp's question as to contact resistance was rather difficult to answer. He did not see how in these tests they could determine whether it was contact resistance or ordinary resistance. On the surface of iron pipes there would be scale or rust which would increase the resistance. He did not think there would be anything much on the copper plates, and thought the results showed that the main factor in the measurement was the resistance of the material.

PATENT RECORD

The following patents have been applied for since our June issue :

(JULY, AUGUST, SEPTEMBER. 1915.)

10272. July 14th. Alban J. Roberts. Amplification of wireless signals. (*Complete.*)

10373. July 16th. Thomas W. Stratford-Andrews. Detector for wireless signalling. (*Provisional.*)

10449. July 19th. Genison & Co., Ltd., F. J. Spencer and W. J. Keily. Machines employed in the manufacture of boots and shoes, and electrical means for obtaining and imparting high-frequency oscillations or vibrations applicable to such machines and for other purposes. (*Provisional.*)

10667. July 22nd. Arthur H. Morse and The Indo-European Telegraph Co., Ltd. Electric alarm or calling devices used in receiving apparatus and more particularly in wireless receiving apparatus. (*Complete.*)

10672. July 22nd. Lewis C. Stewart and J. J. Little. Wireless type-printing and telegraph systems. (*Provisional.*)

10769. July 24th. Sterling Telephone and Electric Co., Ltd., and Thomas D. Ward-Miller. Crystal detector, particularly for wireless signalling. (*Provisional.*)

10983. July 29th. Paul M. Rainey. Isochronising and synchronising systems in multiplex telegraphy. (Convention application August 18th, 1914, United States.) (*Complete.*)

11157. July 31st. Jacob Longman. Wireless telegraph. (*Provisional.*)

11158. July 31st. Jacob Longman. Telephonic receiving apparatus. (*Provisional.*)

11161. August 3rd. Thomas F. Wall. Method of generating high-frequency electric currents. (*Provisional.*)

11443. August 9th. Gaston V. A. G. Mathieu. Spark gaps for wireless telegraphy. (*Complete.*)

11555. August 10th. Fred K. Vreeland. Production of undamped or sustained electric oscillations. (*Complete.*)

11831. August 16th. Marconi's Wireless Telegraph Co., Ltd., and S. O. E. Trost. Transmitters for wireless telephony. (*Provisional.*)

12201. August 24th. Arthur H. Morse and The Indo-European Telegraph Co., Ltd. Electric alarm or calling devices used in telegraph, and more particularly wireless telegraph, receiving apparatus. (*Provisional.*)

12564. September 1st. British Thomson-Houston Co. (*General Electric Company, United States.*) Wireless signalling systems. (*Provisional.*)

NOTES OF THE MONTH

FROM the Antipodes through the medium of the public press—in this instance the *Sydney Sun*—comes news of an invention which (if only it were true) would revolutionise the face of the earth. Under the heading of " Bullroarers versus " Ultra-Violet Rays " our contemporary contrasts the methods of old time rain-makers with that of the oldest modern exponent of the art: " The rain-maker in " our modern invention does not need to " wear a head-dress of feathers and paint " false ribs on his body with pipeclay; nor " does he need a cannon or a cauldron like " later members of the profession. All he " does is to sit in front of a switchboard, " ascertain by 'phone or wireless where the " rain is wanted and how much, push in a " few plugs and touch some buttons. Then " it's time for the populace to rush for " the shops where they sell umbrellas for " 2s. 11d."

Rain in Australia by wireless! If only it were true.

* * *

Under the heading of " Marconi and Commerce," with the sub-title of " Cheaper than Cables," the Liverpool Journal of Commerce *in its issue of August* 16*th published the following article, which we reproduce below. It constitutes a really valuable independent testimony to the indebtedness of the commercial world to the system of wireless communication invented and organised by Senatore Marconi.*

" The Marconi system of wireless tele- " graphy is steadily and largely extending " its field of operation, and nobody can deny " that, apart from its great scientific, strate- " gic, and marine activities, the company " is building up a vast commercial system. " Had the war not occurred, other new " services would have been at the disposal " of the public, but, on the other hand, let " it be remembered that the important " services rendered to Government, country " and empire have been of so vast and " valuable a nature that a leaning towards " wireless is only to be expected, as evidenced " by the growth of business. Of the Trans- " atlantic service—Canada, the United " States, Honolulu, the West Indies, etc., " can now be reached more cheaply and as " easily and effectively by wireless as by " cable, and when it is taken into considera- " tion that the rates to New York, Montreal, " and, in fact, all places in the 1s. zone of the " cable companies in North America are 8d. " per word, there is the additional substan- " tial attraction of a 33 per cent. saving on " the cable bill of commercial concerns and " private senders, no mean consideration at " the present time. The Marconi Company " has opened an office in the heart of the " City, at No. 1, Fenchurch Street, where " speedy transmission and delivery of all " messages are effected, and it is probable " that when the war is over a considerable " extension of such offices will take place, " and that active competition will be offered " in provincial centres. In the meantime " messages are, of course, accepted at all " postal telegraph offices.

" The American associate of the Marconi " Company is about to open up a commercial " service to Japan, etc., at considerably " reduced charges, and although no doubt " the commercial community is grateful to " any live company prevailing against " powerful interests and reducing rates, it " must be remembered that this cannot " be done without the support of the public, " and, it may be added, it is to their interest "to do so. Cable companies have already "had to bring down their rates to the level "of those charged by the wireless, or create "special services, but whatever the method "the credit therefor is due to wireless.

"Cable telegraphy has, of course, been in "existence for about 65 years, and when "commercial wireless can look back on "this span of years who can say what it will "achieve, not only in the direction of saving "to the public, but also in consolidation and "union of the many countries and people "who constitute the British Empire."

* * *

Towards the end of August last the submarine cable between the south-east of Mull and Oban broke. Before it was repaired the only means of communication with the island was by means of wireless telegraphy, the islands of Mull, Coll, and Tiree being otherwise isolated. The usefulness of the wireless system is clearly seen at such a time. Telegraphic messages from Mull on reaching Lochboisdale by wireless are transmitted to Stornoway, and thence by cable to Glasgow and other points. The work, which is especially heavy at present owing to the restricted steamer service on the west coat, is being got through with little or no delay, on account of an increased staff being employed at the two wireless stations.

* * *

Manifold are the uses to which the science of wireless telegraphy is put, but perhaps one of the most curious is that recently exemplified in the case of Galveston, Texas. So severe has been the weather that the town was completely isolated by the seas which swept round it.

Wireless telegraphy was employed to enable the inhabitants to keep in touch with the outside world.

* * *

Referring to Captain W. H. G. Bullard, whose biography we had the pleasure of publishing last month, it is interesting to know that he is an author, having prepared a handbook for naval electricians, which has undergone three revisions and enlargements, and is now published in two volumes. It is the standing text-book at the United States Naval Academy for the use of midshipmen in their electrical course.

* * *

Perhaps one of the most interesting of the happenings during September was the visit of Mr. Frederick Palmer, a well-known American Press representative, to the British Fleet. The article which he wrote, describing his adventures, made public for the first time a number of facts interesting to those who pay for the upkeep of the Fleet, but who had not been allowed to know anything about it until the American visitor issued his account. Perhaps the most pregnant paragraph from a wireless point of view, occurs in the description of Admiral Jellicoe, the Commander, at the age of 57, of the mightiest battle fleet the world has ever seen. "Stepping into a small room, where "telegraph keys clicked and *compact wireless* "*apparatus was hidden behind armour*, we "saw one focus of communication which "brings Sir John word of any submarine "sighted or of any movement in all the "seas around the British Isles and carries "the Commander-in-Chief's orders far and "near."

The immense concentration of power in the Admiral's hands indicated in the passage we have quoted is mainly the work of radiotelegraphy. Without it this great Fleet, whose auxiliaries, outside of the regular service on duty, amount to 2,300 vessels, would be split into a number of separate units keeping in touch as best they could. Thanks to the power of wireless the most distant unit in the Fleet is as completely under Sir John Jellicoe's hand as if he could hail it by megaphone from his quarter-deck.

Maritime Wireless Telegraphy

IN connection with the sinking of the American s.s. *Denver*, an account of which appeared in our May issue, we hear that the United States Secretary of Commerce has sent a letter to the captain of the Atlantic transport steamer *Manhattan* conveying an expression of appreciation to himself, officers, and crew of their courage in rescuing the crew of the sinking steamer. During a terrible storm the *Denver* sent out an urgent wireless call for help, and the *Manhattan* left her course and arrived in time to take off the passengers and crew, numbering altogether fifty-six. The captain of the *Manhattan* will receive from the American State Department material acknowledgment as provided for by the laws of the United States. It is interesting to notice that the White Star Line's *Megantic*, which recently escaped being torpedoed by a German submarine, and the American Line's *St. Louis* also responded to the wireless call.

* * *

There has just been built for the United States Navy a new type of vessel to serve as "mother ship" to the fleet of torpedo-boat destroyers. She is the destroyer tender *Melville*, and is a vessel of 400 feet in length, about 54 feet beam, with a depth of 36½ feet and a draught of 20 feet. She has been designed and equipped to perform the duties of a supply depot, repair ship, and escort to the destroyers. Plenty of provision has been made for the stowage of stores, fuel and ammunition with which to replenish the supply of the vessels of the flotilla. Large machine and general repair shops are fitted with the necessary machinery with which to effect the general repairs to the destroyers, thus keeping them in good order and obviating the necessity of returning to dockyard for minor repairs. She is armed and fitted with two powerful searchlights and has acbommodation for a full complement of 357 officers and men. It is inconceivable that such a ship should lack a wireless telegraphic installation, and this evidently was the opinion of the authorities, for she has been fitted with a standard ship set which will without doubt prove of immense interest in her work.

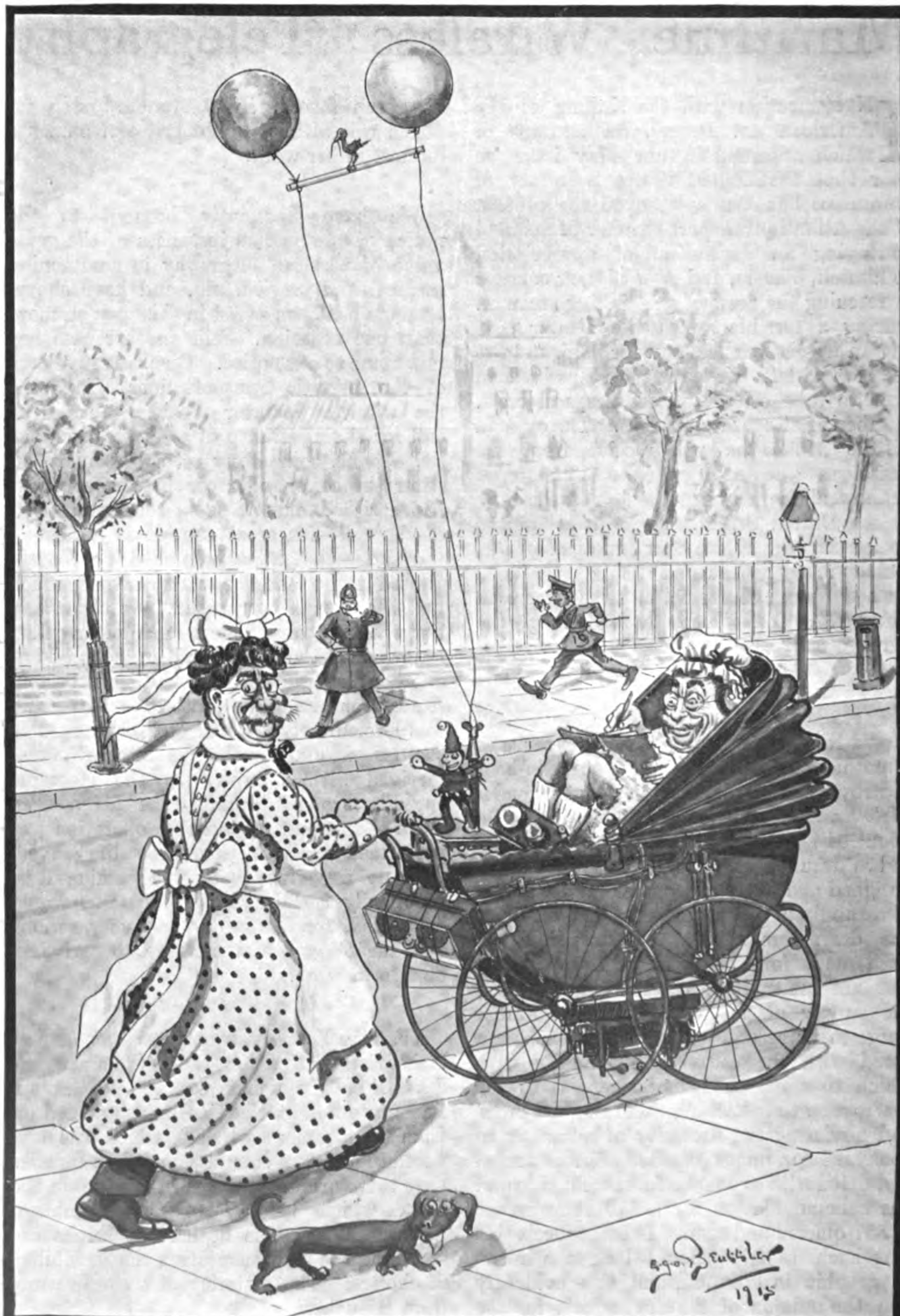
* * *

We have frequently brought to the notice of our readers instances of the great value of wireless telegraphy in summoning medical and surgical aid, and have shown how life has been saved in this way on more than one occasion. Still another case has now come to our notice. On a recent voyage of the Atlantic transport liner *Minnehaha* the wireless operator received an urgent call for the assistance of a doctor from the s.s. *Georgic*, some sixty or eighty miles off. After the commander of the former vessel had satisfied himself as to the genuineness of the call—for great caution is needed in war-time—the *Minnehaha* had her course altered and made for a rendezvous which had been quickly arranged. So accurately had the two commanders made their calculations that the ships came in sight of one another almost exactly to the time expected. A boat containing the doctor and a stretcher was immediately lowered and dispatched to the *Georgic*, and the chief engineer, who had received serious injury to the stomach, speedily brought back to the *Minnehaha*. With the utmost dispatch an operation was performed and the patient's life saved. Had no assistance been forthcoming it is practically certain that the patient would have died, for the injury was very serious and the *Georgic* was not due to arrive in port for a week.

* * *

The *New York World* declares that the first intimation of illness on board the s.s. *President Lincoln*, which is one of the German liners interned at New York, was picked up from the steamer's wireless, which was supposed to be out of commission. It transpires that there are thirty cases of disease on the boat, which belongs to the Hamburg-America Line. The health authorities are watching the ship, suspecting the possibility of cholera. The majority of those ill came from Kiauchau.

CARTOON OF THE MONTH



Another Wireless Spy in Our Midst.

The Calculation of Inductances

By S. LOWEY.

THE writer has been for some time trying to find some easy method for the calculation of, or comparison of, inductances of solenoids. With this object in view an experimental determination of relative inductances of sections of a solenoid was carried out.

The publication of the *Year-Book of Wireless Telegraphy*, with Dr. Cohen's formula for inductance printed correctly, led him to compare results obtained by using various formulæ and to try to devise some method of calculation applicable either to short or long solenoids or even to coils of only one or two turns.

The results obtained were so closely in keeping with the results obtained experimentally, that he has written this article in the belief (judging by the substance of many queries in the technical press) that he is only one among many who have been earnestly endeavouring to reconcile results from various formulæ with practical experiment. The process may be dry and tedious to many, but the final result—*i.e.*, the two diagrams—should be of interest to any amateur who takes any interest in the mathematical side of the science of wireless telegraphy.

The following formulæ will be made use of, and they are lettered (*a*), (*b*) and (*c*) for convenience of future reference :

(*a*) $L=l\,(\pi.D.N)^2$

when $\begin{cases} D = \text{Diameter in centimetres.} \\ N = \text{Turns per centimetre length.} \\ L = \text{Inductance in C.G.S. units.} \\ l = \text{Length in cms.} \end{cases}$

DR. COHEN'S FORMULA.

Inductance of a Single Layer Solenoid.

(*b*) $L=4\pi^2N^2\left(\dfrac{2a^4+a^2l^2}{\sqrt{4a^2+l^2}}-\dfrac{8a^3}{3\pi}\right)$

when $\begin{cases} l = \text{Length in cms.} \\ N = \text{Turns per cm.} \\ L = \text{Inductance in cms.} \\ a = \text{Radius in cms.} \end{cases}$

DR. FLEMING'S FORMULA.

Inductance of Single Ring Coil.

(*c*) $L=2l\,(2{\cdot}303\,\text{Log}_{10}\dfrac{4l}{d}-2{\cdot}45)$

when $\begin{cases} l = \text{Length of wire.} \\ d = \text{Diameter of wire.} \\ L = \text{Inductance in cms.} \end{cases}$

Formulæ (*b*) and (*c*) are taken from the *Year-Book.*

Formula (*a*) is obtained by dividing the magnetising force set up by unit current by the magnetic reluctance of the core of solenoid, and multiplying by the number of turns in solenoid.

It does not take into account the magnetic reluctance of the outside path surrounding solenoid, and is correct, therefore, only for a solenoid of infinite length, or one whose core forms a closed magnetic circuit.

The reluctance of the outside path of a solenoid of given diameter increases as the length diminishes.

It is necessary, therefore, in the case of short solenoids, to allow for this reluctance in calculations of inductance.

Formula (*b*) makes allowance for this, but it is rather a lengthy process to apply it to a number of cases.

If formula (*b*) is divided by formula (*a*) a factor is obtained, by which results given by formula (*a*) may be multiplied to give the same results as if formula (*b*) had been applied directly.

Formula (*a*) may be written

$$l\,(2a.\pi.N)^2=4\pi^2N^2\,(a^2l)$$

if in terms of radius (*a*) instead of diameter (*D*).

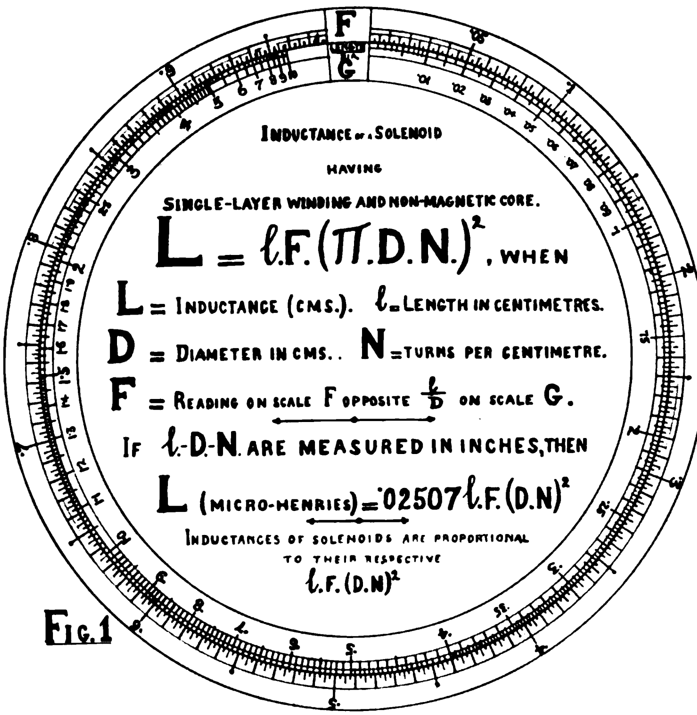


FIG. 1

$$\frac{\text{Formula } (b)}{\text{Formula } (a)} = \frac{4\pi^2N^2\left(\frac{2a^4+a^2l^2}{\sqrt{4a^2+l^2}} - \frac{8a^3}{3\pi}\right)}{4\pi^2N^2\,(a^2l)}$$

$$= \frac{2a^4+a^2l^2}{a^2l\sqrt{4a^2+l^2}} - \frac{8a^3}{3a^2l.\pi}$$

$$= \frac{2a^2+l^2}{l\sqrt{4a^2+l^2}} - \frac{8a}{3l.\pi}.$$

If solenoid is one diameter long—*i.e.*, $l=2a$, this expression becomes

$$\frac{2a^2+(2a)^2}{2a\sqrt{4a^2+(2a)^2}} - \frac{8a}{3.2a.\pi} = \frac{6a^2}{2a^2\sqrt{8}} - \frac{4}{3\pi}$$

$$= \frac{3}{\sqrt{8}} - \frac{4}{3\pi} = 1{\cdot}06 - {\cdot}424 = {\cdot}636.$$

The inductance of a solenoid 1 diameter long $= {\cdot}636l\,(\pi.D.N)^2$.

The result is the same as if formula (*b*) (Dr. Cohen's) had been used.

If different values of l for different lengths of solenoids are substituted, say, $l=3a$, etc., a table of factors can be made ranging from $F={\cdot}9293$ for a solenoid 6 diameters long to $F={\cdot}495$ for solenoid half a diameter long.

For lengths less than half a diameter formula (*b*) does not appear to apply, as the factors begin to increase when the length is less than ·6 of radius.

Formula (*c*) is now made use of. Instead of regarding it as a single turn of wire of length l and diameter d, consider it as a short solenoid of diameter D and length l. The length of wire is then equal to $\pi.D.$ and the diameter of wire = length of solenoid.

Formula (*c*) then becomes

$$L = 2\pi D\left(2{\cdot}303\log_{10}\frac{4\pi D}{l} - 2{\cdot}45\right).$$

But two different solenoids having equal lengths and equal diameters have inductances proportional to the square of their respective turns. Number of turns = turns per cm. length × length in cms.

$$= Nl$$

$$(\text{Turns})^2 = (Nl)^2.$$

The formula may be altered

$$L = 2\pi D\,(Nl)^2\left(2{\cdot}303\log_{10}\frac{4\pi D}{l} - 2{\cdot}45\right).$$

If this is divided by formula (*a*) the factor for short solenoids is obtained.

$$\frac{2\pi Dl^2n^2\left(2{\cdot}303\log_{10}\frac{4\pi D}{l} - 2{\cdot}45\right)}{l\,(\pi.D.N)^2}$$

$$= \frac{2l}{\pi.D.}\left(2{\cdot}303\log_{10}\frac{4\pi D}{l} - 2{\cdot}45\right)$$

$$= {\cdot}636\,\frac{l}{D}\left(2{\cdot}303\log_{10}\frac{4\pi D}{l} - 2{\cdot}45\right).$$

For a solenoid $\frac{1}{10}$th diameter long—*i.e.*, $D=10l.$, the factor would be

$${\cdot}636 \times \tfrac{1}{10}\left(2{\cdot}303\log_{10}\frac{4\pi\times 10}{1} - 2{\cdot}45\right)$$

$$= {\cdot}0636\,(2{\cdot}303\log_{10}125{\cdot}6 - 2{\cdot}45)$$

$$= {\cdot}1517.$$

Further factors for solenoids having different ratios $\frac{l}{D}$ may be worked out, and the results combined with those previously obtained to plot out a curve showing how the value of the factor (F) varies with the ratio $\frac{l}{D}$.

Unless curves are on a large scale they are inconvenient for accurate reference. The values of F could be plotted out on one scale opposite to corresponding values of $\frac{l}{D}$ on another scale, when numerical values of F could be read off more easily. These scales could either be straight or circular. Such a circular scale is shown in Fig. 1. Values of F are read off opposite ratio $\frac{l}{D}$ of solenoid whose inductance is being calculated.

L (in cms.) $= lF\ (\pi.D.N)^2$

L (in microhenries) $= \cdot 001\ l.F.\ (\pi.D.N)^2$

If l, D and N are measured in inches, then

L (in cms.) $= 25\cdot 07\ l.F.\ (D.N)^2$

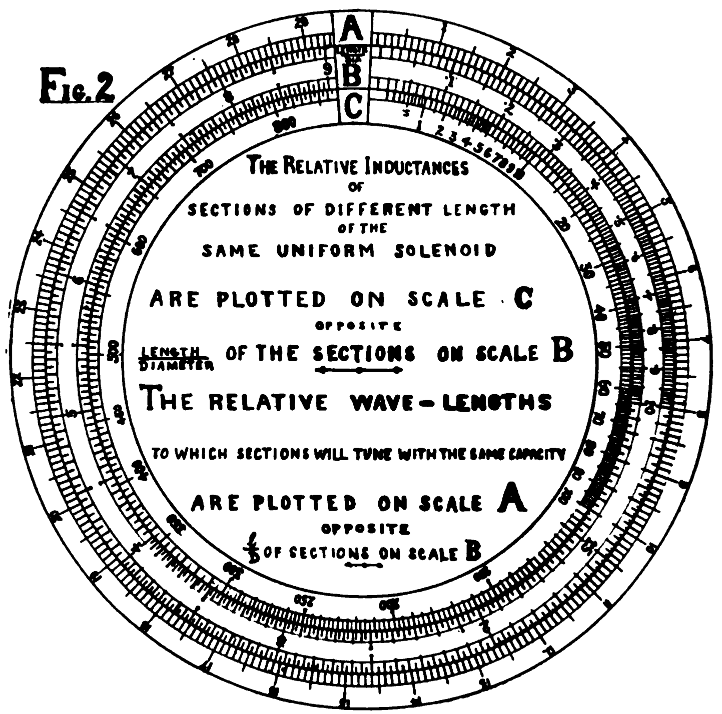
L (in microhenries) $= \cdot 02507\ l.F.\ (D.N)^2$

The inductances of any two solenoids are proportional to their respective $l.F.D^2.N^2$, and the wave-lengths to which they will tune with the same capacity are proportional to their respective $D.N\sqrt{l.F}$.

If different length sections of the same uniform solenoid are being dealt with (D and N therefore being equal in each case) the inductances are proportional to the respective $l.F.$, and the wave-lengths are proportional to the respective $\sqrt{l.F}$.

In Fig. 2, Scale B is the ratio $\frac{l}{D}$ for different sections of the same solenoid. Readings on Scale A are proportional to wave-lengths, and on Scale C to the inductances of these sections.

FIG. 2



The actual values to which these scales are marked are:—

(A) Scale.—Reading (opposite a given $\frac{l}{D}$ on scale B) $= 10\sqrt{\frac{l.F}{D}}$.

(C) Scale.—Reading (opposite a given $\frac{l}{D}$ on scale B) $= \frac{100\ l.F}{D}$.

EXAMPLES OF USE.

If 4 in. length of a tuning inductance 8 in. diameter has an inductance of 4,000 microhenries, what is the inductance of 12 in. length ?

The two ratios $\frac{l}{D}$ are $\frac{4}{8} = \cdot 5$, and $\frac{12}{8} = 1\cdot 5$ respectively.

The two numbers on Scale C opposite to these numbers on Scale B are 24·3 and 110. The required inductance is therefore $\frac{110}{24\cdot 3} \times 4{,}000 = 18{,}107$ microhenries.

If 7 in. of a coil $5\frac{1}{2}$ in. diameter tunes to 2,000 metres, what length of the same coil will tune to 600 metres ? Neglect the inductance of aerial. $\frac{l}{D} = 1{\cdot}273$. This number on Scale B has opposite to it on Scale A the number 9·35.

$9{\cdot}35 \times \frac{600 \text{ metres}}{2{,}000 \text{ metres}} = 2{\cdot}805$. This number on Scale A is opposite to ·245 on Scale B. This number is the $\frac{l}{D}$ required. As $D = 5\frac{1}{2}$ in., $l = {\cdot}245 \times 5{\cdot}5 = 1{\cdot}347$ in.

If it is desired to construct a tuning coil having an inductance of 10,000 microhenries, and the winding space available is 10 in. diameter and 6 in. long, how many turns per inch will be necessary?

Formula given in text $L = {\cdot}02507\, lF\, (D.N)$.

$\frac{l}{D} = \frac{6 \text{ in.}}{10 \text{ in.}} = {\cdot}6$. From scale, value of F for this value $\frac{l}{D}$ is ·523.

Then $10{,}000 = {\cdot}02507 \times 6 \times {\cdot}523 \times 10^2 \times N^2$.

$$N^2 = \frac{10{,}000}{{\cdot}02507 \times 6 \times {\cdot}523 \times 10^2}$$

$$N^2 = \frac{10{,}000}{7{\cdot}867} = 1{,}271{\cdot}1$$

$$N = 35{\cdot}6 \text{ turns per in.}$$

If on a coil 4 in. diameter having 40 turns per inch, a length of 6 in. tunes a particular station, what length will be required on a coil 6 in. diameter, 30 turns per inch, to tune same station?

Formula in text:—Inductances are proportional to respective.

$$l.F\ (D.N)^2.$$

For first coil this is $6 \times {\cdot}733\ (4 \times 40)^2$

For second coil it is $l.F\ (6 \times 30)^2$

These two values of inductance are to be equal, therefore:—

$$l.F = \frac{6 \times {\cdot}733 \times 160^2}{(6 \times 30)^2} = \frac{20{\cdot}85}{6} = 3{\cdot}47$$

$\frac{100\, l.F}{D}$ would be 57·9, as $D = 6$ in.

This number on Scale C is opposite ·935 on Scale B. This is the required $\frac{l}{D}$; but

$$D = 6 \text{ in.},$$

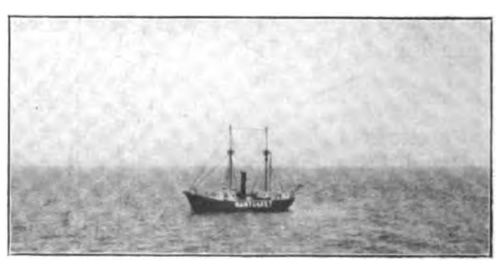
$$\text{so } l = {\cdot}935 \times 6 \text{ in.} = 5{\cdot}61 \text{ in.}$$

It will be at once seen the variety of uses to which these scales can be put. Positions may be marked off on a tuning inductance for different wave-lengths, providing the position for one definite wave-length (preferably a high one) is known, by using Scales A and B, or the inductance of the whole coil may be calculated by scales in Fig. 1, and then, by applying Scales B and C of Fig. 2, the coil may be marked off in definite values of inductance.

A SOLITARY OUTPOST.

A Visit to a Nantucket Lightship.

THE island of Nantucket forms the easternmost of a group of islands lying off the south-east coast of Massachusetts, and is one of the danger spots of the Atlantic seaboard of the United States of North America. On the north shore is situated Nantucket town, possessing a nearly landlocked harbour and a population of about 3,000 inhabitants. In times past it formed the seat of an important whaling industry, but its claims to fame now rest almost solely on its attractions as a summer resort for the workers of the large cities on the neighbouring main lines. The trend of the coast lends itself admirably to the formation of shoals which constitute a dangerous menace to the mariner. To minimise this danger as far as possible the Commissioners of Navigation of the United States have established a light vessel, of which we are able to reproduce a photograph. We are extremely fortunate in having obtained this as fog surrounds the little ship for the greater part of each year. It possesses an electric lantern containing a light which occults every fifteen seconds, and situated on the foremast. It is a steam lightship, and is anchored in thirty fathoms of water, having been placed there in 1909. The height of the lantern above sea level is 50 feet, and the light is visible for thirteen miles. We are indebted to Mr. W. Condon for the photograph.



Nantucket Lightship.

Doings of Operators

WHILST we were going to press last month the news came through that the British transport *Royal Edward*, bound for the Gallipoli peninsula, had been torpedoed by an enemy submarine with the loss of some hundreds of lives. The *Royal Edward*, a large steamer which prior to the war was well known to travellers to and from Canada, was built in 1908 for the Egyptian Mail Steamship Company, and for a short period traded between Alexandria and Marseilles under the name of the s.s. *Cairo*. The company owning her soon went into liquidation, however, and after a while she was bought by the Canadian Northern Steamship Company and re-christened the *Royal Edward*.

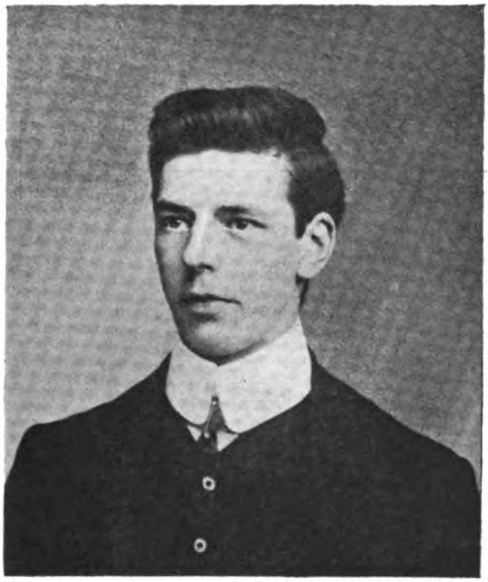
On her last ill-fated trip she had on board two wireless operators, Edward Walter Dyer and John Keir, both of whom were luckily saved. Mr. Dyer, who was born at Stratford, Essex, is twenty-one years old, and served some time as a telephone exchange operator on the Great Eastern Railway. Having a desire to become a wireless operator, he availed himself of the facilities offered by the Marconi Company's evening classes, and after a period of training joined the staff of the Marconi Company in January, 1914. His first appointment was to the s.s. *Corinthian*, and later Mr. Dyer served on board the s.s. *Mount Temple*, *Obuasi*, *Grampian*, *Matina* and *Waipara*. In the middle of this year he was appointed to the s.s. *Royal Edward*.

Operator Dyer.

Operator Keir.

Mr. Keir, who is twenty years of age, is a native of Blair Atholl, in Perthshire, and has but comparatively recently taken to the profession of wireless operating. After training for wireless telegraphy at an institution in Scotland he joined the Marconi Company's London school in January of this year, and in the following month was appointed to the staff. Prior to joining the *Royal Edward* Mr. Keir served on board the s.s. *Anglo-Mexican*.

Whilst both Mr. Keir and Mr. Dyer were saved, it is to be regretted that neither escaped unscathed. Mr. Dyer is at the time of writing still in hospital at Alexandria,



Operator Caldwell.

suffering from severe injuries incurred whilst in the water. Such were the injuries to his legs that one has had to be amputated. We sincerely trust that his recovery may be rapid. Mr. Keir was more fortunate, and has arrived home with no worse hurt than bruised ribs, caused by his being crushed between two collapsible boats which had been washed off the decks. He has at present to avoid much exertion, and is now on leave at his quiet home in Scotland, where we hope he will benefit considerably by the rest.

* * *

Concerning the iniquity of the Germans in sinking the defenceless liner *Arabic* we could write much, but considerations of space forbid us to deal with little save her wireless service and the men who so well performed it. How the great liner bound for New York was torpedoed without warning most of our readers well know, and the story of the magnificent rescue work has already been told.

Two wireless operators were carried on board, Messrs. John Caldwell and James Leonard Batchelor. Caldwell was in charge, and had sailed before on the ship; Batchelor had only just joined. Caldwell, who is a native of Wishaw, is twenty-eight years of age, and prior to taking up wireless had served in the Post Office as sorting clerk and telegraphist. He has been in the Marconi Company's service for five years and has carried out wireless duties on so many ships that we have no room to catalogue them here. Amongst them we may mention the s.s. *Mantua*, *Grampian*, *Cameronia*, and *Adriatic*. Mr. Batchelor, the junior operator, is twenty-two years old, and makes his home in Kennington. Before he took to wireless as a profession, he held the position of call-boy at the Playhouse Theatre. We have no doubt that when watching the changing scenes upon that stage he had little thought that he himself would come into the spotlight as a star actor on a much larger stage with the world as an audience. It was in his spare time that he studied wireless telegraphy, and after training in the Marconi Company's London school, he joined the operating staff in June, 1914. His first ship was the s.s. *Tunisian*, of the Allan Line, and afterwards he took duty on the s.s. *Lackawanna*, *Indore*, and then the *Arabic*.

On the morning of the disaster both men were in the wireless cabin, having just relieved one another for breakfast, when with a deep dull thud the torpedo exploded and threw up a great mass of water which

Operator Batchelor.

darkened the cabin. In spite of damage to the apparatus, the "SOS" call was sent, and both men, quite cool, made their report to the commander. Receiving their orders to leave the ship, they made their way to the boats and managed to get away in safety. We have before referred to the "long arm of coincidence" in these columns, and here again we find an instance of it. No sooner had Batchelor settled into the boat when he found himself with Mr. Kenneth Douglas, the well-known actor, who has many times appeared at the "Playhouse," the very theatre where Batchelor worked so long.

After drifting about for some time, the boats were found by a steamer which had been sent out from Queenstown to pick them up, and all the survivors were treated with the greatest kindness. At Queenstown, where they arrived before long, further aid was rendered, and both wireless men were able to return home in comfort. They have our congratulations and those of all their colleagues on their fortunate escape.

* * *

About the time that the pirates committed the *Arabic* outrage, a smaller steamer, the s.s. *Baron Erskine*, suffered the same fate. She carried but one operator, Mr. William Clifford Brock, of Manchester. Mr. Brock, who is twenty-six years of age in December next, joined the Marconi school in London at the commencement of the war, and was appointed soon after to the s.s. *Adriatic*, on which vessel he made three trips. From the *Adriatic* he was transferred to the s.s. *Highland Laird*, and thence to the *Baron Erskine*. Mr. Brock sustained no injury whatever in the wreck, and is none the worst for his exciting experiences.

Operator Robert Jones.

Operator Brock.

* * *

Amongst the survivors of the *Arabic* was Mr. J. E. Usher, of Nemoure Road, Acton, a young wireless operator, who had set out to join his ship on Government Service at San Francisco. Mr. Usher lost everything in the wreck, including his new official uniform, and returned home only with the clothes he was wearing at the time of the disaster.

* * *

On Saturday, September 4th, whilst the United States were still congratulating themselves upon what was described as President Wilson's "victory for diplomacy" in obtaining from Germany a promise not to sink any further liners without warning, the large Allan liner *Hesperian*, outward bound from Liverpool, was torpedoed by a German submarine. As usual, the wireless apparatus was used in calling assistance, and fortunately few lives were lost. The two operators on the *Hesperian* by a strange coincidence were both named Jones and both hailed from Liverpool. Mr. Humphrey

Operator Humphrey Jones

Jones, the senior operator, is twenty-seven years of age, and after leaving school was employed in clerical work for some time. In 1912 he commenced training for wireless telegraphy at a private training institution in Liverpool, and in April, 1913, joined the Marconi Company's London School. After a short finishing course Mr. Jones was appointed to the staff and made his first trip to sea on the ss. *Monmouthshire.* He afterwards took duty on the ss. *La Blanca, Hydaspes, Junin,* and a number of other vessels, and was making his first voyage on the ss. *Hesperian* when that vessel was torpedoed.

Mr. Robert Jones, second operator, is but a year younger than his namesake, and before joining the Marconi Company had served as electrician with the Mersey Docks and Harbour Board. His appointment with the Company dates from June, 1914, and he has already had experience on the ss. *Antillian, Michigan, City of Madras* and *Cymric.* Previous to the ill-fated trip on which the *Hesperian* was lost he had made two voyages on that ship, and so was well acquainted with the vessel. We are pleased to inform our readers that both men were saved and are none the worse for their experience.

Official Recognition of Wireless Operator's Heroism

On page 297 of our August issue we drew attention to the magnificent bravery of the Captain and officers of the s.s. *Anglo-Californian,* pointing out at the same time how wireless telegraphy was able to summon aid to the bombarded vessel. The Marconi Company have recently received from Messrs. Lawther, Latta and Co., Managers of the Nitrate Producers' Steamship Company, Ltd., the owners of the s.s. *Anglo-Californian,* a letter, from which we extract the following :—

" We have pleasure to advise you that " the Lords Commissioners of the Admiralty " have had before them a report from the " Vice-Admiral, Queenstown, on the subject " of the attack on the above steamer by a " German submarine, and consider the " conduct of the officers and crew of the " vessel deserving of the highest praise. " Further, the Lords Commissioners desire " to present a gold watch with a suitable " inscription to Mr. J. F. Rea, Chief Marconi " Operator, for his devotion to duty in " remaining at his post in the wireless " telegraphy office during the engage- " ment."

We offer on behalf of our readers our heartiest congratulations to Mr. Rea, whose magnificent conduct will stand out prominently in the records of wireless telegraphy in the present war.

Professor Sparkington Gapp on Munitions

By P. W. HARRIS.

" . . . And you will interview Professor Gapp," said the Editor, " on the subject of Munitions."

" On the subject of what ? " I asked, somewhat surprised.

" On the subject of Munitions ! " repeated the Editor. " Munitions! pinhead, Munitions! Don't you know what Munitions are ? Mu——"

" Oh, yes, I understand ! " I exclaimed, anxious to retain my dignity. " But what have munitions to do with wireless ? "

" That's for you to find out," replied my chief. " Do you think we pay you thirty-one and sixpence a week to ask idiotic questions ? "

I had framed quite a neat reply and delivered about half of it when I suddenly found myself outside the door. It is useless to argue with people of this type, so I let Jenkins, the office-boy, brush me down—a favour which he much appreciated. Then, finding nothing was torn, I left the building, explained my pedigree and family business to three hundred and forty-nine recruiting sergeants, and finally arrived at Charing Cross. Speaking of Charing Cross reminds me of the Government posters enjoining thrift, which prompted me to say " Season " in the Underground and save threepence. I certainly agree with all this publicity.

" Those are my ohming pigeons."

Professor Gapp lives in a large mansion at Kensington, a little place near London. The mansion stands by itself and is insulated from the road by a spacious garden, in which many world-famous experiments have been carried out. (See WIRELESS WORLD, July, 1915.) As I walked up the drive towards the front door I could not avoid meditating on the immense value to the nation of such a great scientist as Sparkington Gapp.

" Pleased to see you again, young man ; pleased to see you," said the great man, as I was ushered into his private room. " I presume you have come on behalf of your excellent magazine ? You wish for an interview perhaps ? "

Delighted with the famous expert's urbanity, I thanked him and said that his surmise was correct. I explained that the readers of THE WIRELESS WORLD, brimming with patriotism and anxious to learn of every new method of defeating the Hunnish foe, were impatiently waiting to hear of the new discoveries which it was rumoured had been made in his laboratory. Would he favour me with a few words on the subject of Munitions ?

" With great pleasure," replied the Professor. " My whole time is now devoted to their study and manufacture. I have even roofed in a part of my garden to form

"An interruption was caused."

workshops. Will you come through with me?"

With beating heart I accompanied my venerable companion through several luxurious apartments into what had once been the famous wireless garden. Alas! Its erstwhile beauty had vanished and there remained but a small plot of ground surrounded by glazed buildings, from which issued the subdued humming of many machines. In the midst of the plot there rose a tall pole surmounted by what appeared to be a dove-cote. Grey birds winged great circles about the pole and occasionally settled on the ground. I asked the Professor what purpose they served.

"Those are my Ohming pigeons," graciously replied my guide. "I find them very useful as general scavengers for picking up strays, wireworms, atmospherics, and other insects. They are very tame, as you will observe, and subsist on odd bits of carbon and other *pièces de résistance.* I lost one the other day," continued the Professor, with a tear in his eye, "It was trying to pick flies out of a spark-gap and came to an abrupt conclusion."

Touched by this display of human feeling in one so far above it, I changed the conversation by asking whether the birds were British or foreign.

"Well, as a matter of fact, they are Chinese," replied Professor Gapp; "but they are breeding here and rapidly learning Pigeon English."

We had by this time reached the door of the largest building, and the Professor, stepping forward, motioned me to enter, which I did with some trepidation.

"What is taking place here?" I asked.

"These men are all making parts of my new weapon, the 'Wireless Paralyser.' I may mention without divulging too much of Lord Kitchener's future plans, that the Wireless Paralyser is destined to change the whole aspect of trench warfare. It consists," continued my guide, taking in his hand what appeared to be the body of a gigantic aluminium grasshopper, "of a metallic casing with six legs, each of which is worked by a ratchet mechanism. The interior of the case contains the wireless control, a poison-gas generator, and a composite gramophone record. The method of operation is as follows: first the Paralyser is fired from the British lines by a special mortar, and a moment after alights on the parapet of the enemy trench. The gramophone mechanism then automatically comes into operation and shouts with a pronounced Scotch accent, 'Here we are! Here we are! Here we are again!!' By means of a delicate relay at the words 'are' and at the final word 'again' the whole machine jumps forward six feet, exuding poison gas meanwhile. Thus: 'Here we are!'—six-foot jump; 'Here we are!'—another six-foot jump, 'Here we are again!'—final six-foot jump. A touch on the wireless key in the British trenches changes the tune to Tipperary, whereupon the jumps take place at the words 'Tipperary,' 'Go,' 'Tipperary' 'Know,' 'Piccadilly,' etc. The object of the poison gas is to prevent the Germans approaching the instrument; but no German is sufficiently brave to come anywhere near it, and hundreds have been found completely paralysed with fright. It is this latter fact which has suggested the name of the invention."

I had barely commenced the expression of my profound admiration of this marvellous engine of warfare when an interruption was caused by a Paralyser getting loose and chasing a workman. A shiver of horror went through my frame as the poor mechanic, white with terror, ran hither and thither endeavouring to avoid the gigantic pounces and monotonous chanting of the glistening mechanical insect. However, after five crowded minutes the Paralyser came into violent contact with a steam-hammer and burst with a blood-curdling shriek. As we crawled from beneath a table the Professor remarked that it was a warm day. I agreed.

We next proceeded to a smaller building, cool and quiet, where a number of men were stirring some dark substances in a large vat. Other workmen were packing the mixture into shell-cases.

"This is the room devoted to the manufacture of my new high explosive 'wirelessite,'" said the great scientist. "It is an explosive of exceptional power. As soon as the shell bursts, all Germans within half a mile are set in a state of violent oscillation. Their arms wave about, their collars rush up and down their necks, and the contents of their pockets shoot out in all directions. Statistics compiled from results so far obtained show that most deaths are caused by the men's boots knocking their heads off."

"How and where do you test this explosive?" I queried in tones of admiration.

"At present we are testing it in this garden on Germans we buy from the nearest internment camp," was the reply. "We pay sixpence a dozen for ordinary Germans and eightpence for large ones. It is rather a high figure, but we don't use many large ones as they make such a mess."

I commiserated with the Professor and remarked on the red tape which surrounded all official dealings. In Germany they would—at least, not exactly—well, anyway, they would be cheaper.

"I have a number of other inventions in course of manufacture," the scientist continued; "but time will scarcely permit me to deal with them now. I must, however, mention the 'Radio-Irritator.' It has been said that this is a war of artillery, but I maintain that it is a war of nerves, and the side which gets 'jumpy' first is sure to lose. The British so far have refused to get into this condition, but the Germans since Karlsruhe have grown daily more and more so. To hasten the end I have invented the Irritator, which, fired from long-range guns, attaches itself by attraction to enemy wireless aerials and causes the operators to hear nothing but fiendish laughter in the telephones. The details of the invention I must at present keep secret, but I can say that one of the biggest German wireless stations has been shut down because the operators daren't put the 'phones on without disconnecting the aerial. Half of them have been removed to the Potsdam Asylum already.

"Wonderful, wonderful!" I exclaimed, looking at my watch. "A thousand thanks for explaining all these things to me. Our readers will be intensely interested."

"It is nothing," modestly replied the Professor; "I am only too pleased to be of some service to them. But before you go, won't you have a glass of my wireless Whisky?"

"Wireless Whisky!" I exclaimed. "What is that?"

"Oh, it differs from the ordinary kind in sending you into continuous waves," courteously explained the great genius, reaching for a syphon. "Do you like it damped or undamped?"

"Damped, please," I answered. "Thank you, that's enough! Good luck to wireless research!!"

"Cheer Oh!" answered Professor Gapp, draining his glass.

QUESTIONS AND ANSWERS

Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study to the Editor, THE WIRELESS WORLD, *Marconi House, Strand, London, W.C. Such questions must be accompanied by the name and address of the writer, otherwise they will remain unanswered: and it must be clearly understood that owing to the Defence of the Realm Act we are totally unable to answer any questions on the construction of apparatus during the present emergency.*

J. E. (Bergen).—As you are not a British subject, you would stand very little chance of obtaining an appointment such as you mention during the war. What your prospects may be after the war we cannot say; but if you will communicate with us when peace is restored, stating in full the qualifications you possess, we will give you all the advice that we can.

J. K. H. (Plymouth) and a number of other correspondents address queries which the present restrictions will not permit us to deal with.

W. L. C. (Wandsworth Common).—The alternating current district would be much preferable, as there one could use a transformer connected to the mains. We cannot say what restrictions will be in force after the war. In answer to your second question, you do not give us enough details of your accumulator to enable us to give you much help. It would seem that the capacity has been reduced. Are any of the plates covered with sulphate? Is the acid of the right specific gravity? We would suggest that you take the accumulator round to the people who made the repairs and explain your trouble to them.

J. F. L. (Wortley).—We cannot publish details of the nature you desire whilst the present restrictions are in force.

R. H. B. (Whetstone).—Automatic recording apparatus is not used on board ship, as there is at present no great need for it. There is no advantage in first recording signals of ordinary speed and then transcribing them on a form, for it is much quicker to write them down immediately on the form for delivery. On land stations which have to handle a large amount of traffic, such as the large Marconi trans-ocean stations, the position is different, and both transmission and reception are sometimes automatic and at a much higher speed than is possible with hand working. In cases where high speed transmission is used, considerable time is saved by automatic working, as several operators at the same time can be writing up the recorded signals or punching strip for the automatic transmitter, whilst one man supervises the instruments. Thus five men can be punching strip at 20 words per minute and the transmitter operated at a hundred words per minute, and in the same way the receiver may be taking signals at this speed and five men be transcribing at twenty words a minute. The trouble with most recording devices is that they make no distinction between atmospheric noises and the signals it is desired to receive. The Marconi Company has for a long time used phonographs with records running at high speed for reception, and these can be run at a much lower speed for transcription. The experienced transcribing operators can easily distinguish between the pure musical sounds of the signals and the rough sounds of atmospherics. There is a big opening for a recorder of the same order of sensitivity as the telephone receiver and which will record signals but not atmospherics.

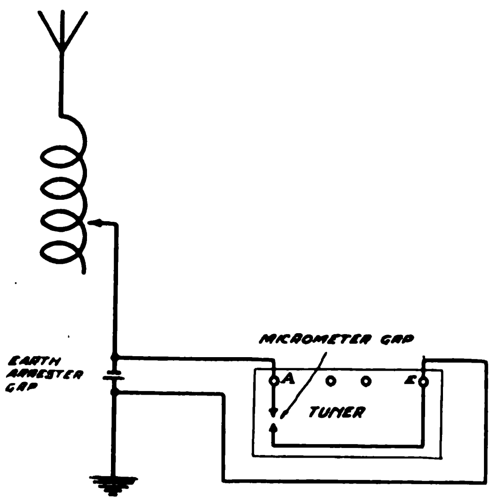
W. G. (Klondike, Canada).—We are very glad to hear from friends in such distant and sparsely populated parts of the world. The difficulties of erecting and working wireless in such districts as that in which you live we fully appreciate. Unfortunately we cannot deal at the present time with the question you ask, as the publication of matter of a constructional nature is not considered advisable. In field stations for military use counterpoises are sometimes made with strips of wire netting covering the ground underneath the aerial. The pieces of netting have, of course, to be well connected electrically, and there is no need for buried plates.

A. H. (Margate) writes to us concerning the use of a parallel condenser in the receiving antenna, and the inefficiency of this arrangement for obtaining long waves compared with the use of inductance only. It is a common practice to make use of a variable condenser in parallel with a part or all of the aerial inductance of an inductively coupled receiver for the purpose of increasing the wavelength to which the aerial is tuned. The method is convenient and obviates the necessity for a large amount of inductance, but, as our correspondent points out, the efficiency is reduced. Dr. Louis W. Austin, in a paper presented before the Institute of Radio Engineers at New York in March of last year, gave tables which showed that with an aerial capacity of 0·0007 microids and a wavelength of 2,000 metres, the substitution of parallel capacity for part of the inductance, in such a way as to keep the wave length the same, gave a regular diminution in efficiency as the value of the shunted capacity increased. As an example, taking the extreme figures of the table, with no capacity in parallel with an aerial inductance of 1,330 mhys., a deflection of 230 units on the galvanometer was given, whereas with a capacity of ·002 mf. in shunt with 480 mhys. there was a deflection of only 105 units. Another table of reading with a wave-length of 3,000 metres and a much larger antenna (0·002 mf. capacity) showed the same decrease of efficiency with a parallel capacity, but more capacity could be used in this case without materially decreasing the intensity of received signals. A number of other sets of observations were carried out, and in all cases the results were substantially the same.

C. A. B. (Funchal, Madeira).—We cannot reply to your first question, as the arrangements in all coast stations during war time are secret. In answer to the second question, you would certainly improve matters by taking the step you mention. Question 3, D.C.C. wire is better than enamelled, as although this latter allows many turns to be wound in a small space, it is not used where high efficiency is desired, as there is too much capacity between the turns.

"AMATEUR" (Dundee) writes: (1) "Does the guard lamp in the D.C. side glow brighter if the brushes on the commutator are lifted? (Marconi 1½ kw. set). In Marchant's book of instruction he states, under the heading 'faults': 'If the break (most probably due to the lifting of brushes on commutator) is in the armature circuit, it will be indicated by the guard lamp on the D.C. side of the converter glowing brightly, because the full voltage of the direct current supply is now across the terminals.'" (2) "Does sparking take place, when transmitting, at the micrometer spark gap, as well as at the earth arrester spark gap?"

Answer.—In reply to the first question, the statement is correct that the guard lamp glows brighter if the D.C. brushes are lifted, but it is not wise, particularly in examinations, when the candidate is usually flurried, to attempt to judge by any increased glow whether the brushes are lifted or not. In any case, the increase in brightness is not very pronounced, and it is very easy to examine the brush connections. Question 2 gives us an opportunity of explaining a point which has given trouble to both students and professional operators. Our correspondent asks whether sparking takes place at both the arrester and micrometer gap. The reply to this is that everything depends on the adjustment of these gaps. If our readers will refer to the diagram reproduced here, they will see that the micrometer gap is in *parallel* with the earth arrester gap. This being so, if the two gaps are approximately of the same size, sparking will take place across both, although the inductance of the leads to the tuner will choke some of the current. If the micrometer gap is opened wide, no sparking will take place there, which is not a result to be aimed at, for in that case a great strain is put upon the condensers and windings. The micrometer gap should in all cases be set to have as small



a gap as possible without risk of the points touching. In some installations there will be no sparking even with this minute gap, for the leads will act as a protecting choke, but in most cases there will be a little.

C. L. (Karachi) writes: "(1) Is it as necessary to have low-frequency resonance with an asynchronous as well as with a synchronous rotary gap? If so, in the case of an alternator 200 and an asynchronous rotary gap of 1,000-spark frequency, should 'n' read 200 or 500? (2) In a telephone transformer is it as necessary to have the resistance of the secondary winding equal to the 'phones, as the primary winding equal to the resistance of a detector? My point is this: Phones 120 ohms. If secondary is wound with 500 turns with, say, 22 S.W.G. to a resistance of 120 ohms, and if it is then rewound with 500 turns 13 S.W.G., the ampère turns will be more under the same conditions of magnetic coupling, owing to less total resistance, and it would seem that signals would be stronger! It is understood that 120 ohms of this latter wire might give a stronger magnetic coupling, but the question is: from an efficiency point of view, does the number of turns of a secondary winding (step-down) influence *best effects* as well as the balanced resistances? The point is in reference to one of the Marconi large telephone transformers in a 30 kw. station."

Answers.—In reply to question (1), low frequency resonance is not so important with an asynchronous as with a synchronous rotary gap, but it is of some value. "N" in the case quoted would be 200. Question 2.—To obtain best results, the telephone transformer and the telephones must be designed to suit both each other and the circuit with which they are to be used. In this connection the inductances are of more importance than the resistances, and the problem is complicated by the fact that it is usual to connect condensers for the purpose of obtaining resonance in the circuits. These also have to be taken into account. The signals obtained by using a higher resistance secondary of the same number of turns would be weaker than with the normal winding, since there would be greater internal loss. If a larger number of turns of wire of lower resistance were used the ratio of transformation would be reduced, but whether this would give better results depends upon the efficiency of the instruments and the relative inductances, etc. The problem could be worked out mathematically if sufficient data were available on these points. Perhaps some of our readers have done work on these lines. We shall be very pleased to open our columns to correspondence on the subject.

G. A. J. (Bushire).—When a transformer is used to charge a circuit which gives one spark per half-cycle of the alternator, the voltage to which the condenser is charged may rise to $\frac{\pi}{2}$ times the value of the maximum voltage given by the transformer when working on a non-inductive load. The maximum volts $=\sqrt{2}$ R.M.S. volts. The above voltage is realised when the spark occurs at the peak of the voltage wave, and the complete low-frequency circuit is tuned to the alternator frequency.

In answer to your second question, choke coils for protecting the transformer need not be calculated. They must have a sufficient number of turns to choke high-frequency currents, and must not in themselves resonate to the frequency of the oscillating circuit. They are usually made by trial and experiment. In the case of the design of low-frequency iron core inductances, we must consider the whole question of low-frequency resonance. The formula for resonance of a single circuit is

$$4\pi^2 n^2 LC=1,$$

where "n" = frequency per second and L and C henrys and farads. The alternator and transformer primary and the condenser and transformer secondary form two circuits interlinked by the mutual inductance of the transformer. In this case the circuit may be treated as a single one by referring to either side of the transformer an equivalent to the resistance inductance and capacity of the complete circuit of the other side of the transformer. If we refer these quantities to the high voltage side of the transformer we must add to the actual resistance, inductance and capacity in the circuit quantities T^2R and T^2L, where R and L are actual resistance and inductance of the low voltage side and T the ratio of transformation of the transformer.

Conversely, we add $\frac{1}{T^2}R^1$ and $\frac{1}{T^2}L^1$ and T^2C^1 * to the low voltage side if we refer the quantities to this. Thus for a transformer for a value 100/1000 volts, if the primary circuit has a resistance of ·01 ohm we must add $\cdot01\times\left(\frac{1000}{100}\right)^2=1$ ohm to the high voltage side, and for inductance of, say, ·004 henry we add $\cdot004\times100=\cdot4$ henry to the resistance and inductance of the high voltage side. These values are inserted in the formula.

It will now be seen that the L.F.I.C.I. has to be wound to have an inductance to suit the circuit, and should be made variable to allow of the necessary changes. The best spark is obtained when the low-frequency circuit is slightly off resonance.

* Not $\frac{1}{T^2}C$.

Instructional Article

The following series, of which the article below forms the second part, is designed to provide wireless telegraphists, amateurs, and technical students generally, with clear and precise instruction in technical mathematics, in order that they may be enabled to read and understand the more advanced technical articles which appear from time to time.

5. Division by Logarithms.

TAKING a very simple example, we will divide 1728 by 16, in which case 1728 is called the dividend and 16 the divisor. We can express this operation in the form of a fraction $\frac{1728}{16}$.

Now we know that if we have any fraction $\frac{a}{b}$ we can write it as $a \times \frac{1}{b} = a \times (b^{-1}) = ab^{-1}$.

Similarly $\frac{1728}{16} = 1728 \times (16)^{-1}$.

From log tables we find that

$$\log 1728 = 3{\cdot}2375$$
$$\text{and } \log 16 = 1{\cdot}2041$$

Therefore

$$\frac{1728}{16} = \frac{10^{3\cdot2375}}{10^{1\cdot2041}} = 10^{3\cdot2375} \times 10^{-(1\cdot2041)}$$

We have now turned our division into a multiplication, with the important difference that we have *changed the sign of the log of the divisor.* As in the case of any other multiplication, the next operation is to add the logarithms. But changing the sign of one quantity and then adding it to another quantity is the same as subtracting the former from the latter quantity, and so we arrive at the rule for dividing with logarithms:

Subtract the log of the divisor from the log of the dividend, and take the antilog of the remainder.

In this case $\log 1728 = 3 + {\cdot}2375$
$\log 16 = 1 + {\cdot}2041$
$\text{Subtracting} = 2 + {\cdot}0334 = 2{\cdot}0334$

$\text{Antilog } 2{\cdot}0334 = 108{\cdot}0.$ *Ans.*

EXAMPLE.

Divide 0·0297 by 67·84

From tables $\log 0{\cdot}0297 = \bar{2} + {\cdot}4728$
and $\log 67{\cdot}84 = 1 + {\cdot}8315$

In order to be able to subtract the mantissæ, add 1 to the mantissa of log 0·0297, at the same time adding 1 to its characteristic in order to leave the whole logarithm the same as before.

Then $\log 0{\cdot}0297 = \bar{3} + 1{\cdot}4728$
$\log 67{\cdot}84 = 1 + 0{\cdot}8315$
$\text{Subtracting} = \bar{4} + 0{\cdot}6413 = \bar{4}{\cdot}6413$

$\text{Antilog } \bar{4}{\cdot}6413 = 0{\cdot}0004378.$ *Ans.*

6. Powers and Roots by Logarithms.

Logarithms are very useful when dealing with the powers and roots of quantities. Suppose, for example, we wanted to find the value of $(79)^7$, the seventh power of 79.

We can, of course, multiply seven 79's together, but such an operation is obviously long and tedious. If we use logarithms, then, instead of $79 \times 79 \times 79 \times 79 \times 79 \times 79 \times 79$,

we have $\log 79 + \log 79 + \log 79 + \log 79 + \log 79 + \log 79 + \log 79 = 7 \times \log 79$,

the antilog of which product will give us our answer.

$$\text{Log } 79 = 1{\cdot}8976$$
$$7 \times \log 79 = 7 \times 1{\cdot}8976$$
$$= 13{\cdot}2832$$

Antilog $13{\cdot}2832 = 19{,}200{,}000{,}000{,}000$, a result correct to the first four figures. This would generally be written as 1920×10^{10}.

This can be done in any case where we wish to find the power of a number, and so we arrive at the rule—*to find the power of any number, multiply the log of the number by the index of the power required, and take the antilog of the product.*

This method is applicable to working out roots, for the seventh root of 79, for example, written as $\sqrt[7]{79}$, is the same as the "one-seventh power" of 79, or $(79)^{\frac{1}{7}}$.

Treating it in this way, as before we multiply log 79 by $\frac{1}{7}$—*i.e.*, divide it by 7, and take the antilog of the quotient.

In this particular case log 79 = 1·8976
Dividing by 7 = 0·2711 (approx.)
Antilog 0·2711 = 1·866

Thus, to find the root of any number, divide the log of the number by the index of the root required, and take the antilog of the quotient.

EXAMPLE.

To evaluate $\sqrt[9]{0\cdot06723}$

Log 0·06723 = $\bar{2}$·8276 = $\bar{2}$ + 0·8276.

Before dividing this logarithm by 9, we add 7 to the characteristic, and add 7 to the mantissa.

Then log 0·06723 = $\bar{9}$ + 7·8276. This operation has not changed the net value of the logarithm, but the characteristic is now exactly divisible by 9.

Dividing by 9, we get $\bar{1}$ + 0·8697
= $\bar{1}$·8697

Antilog $\bar{1}$·8697 = 0·7408. *Ans.*

7. It will sometimes occur that we have to find both the power and the root of a number at the same time; as, for instance, in evaluating such an expression as $\sqrt[5]{9^6}$.

Now, $\sqrt[5]{9^6} = (9^6)^{\frac{1}{5}} = 9^{6\times\frac{1}{5}} = 9^{\frac{6}{5}}$, and so all we do is to find the "six-fifths power" of 9.

Log 9 = 0·9542

$\frac{6}{5} \times 0\cdot9542 = \frac{5\cdot7252}{5} = 1\cdot1450$ (approx.).

Antilog 1·1450 = 13·96. *Ans.*

EXAMPLE.

Given that an aerial has a capacity of 0·00057 mfds. and oscillates with a wave-length of 213 metres: find its inductance.

From previous instructional articles we know that $\lambda = 1885\sqrt{LC}$ where

λ = wave-length in metres = 213
C = capacity in mfds. = 0·00057
and L = inductance in mhys.

By squaring $\lambda^2 = (1885)^2 (LC)$

$$L = \frac{\lambda^2}{(1885)^2}\frac{1}{C} = \left(\frac{\lambda}{1885}\right)^2 \frac{1}{C}$$

$$= \left(\frac{213}{1885}\right)^2 \frac{1}{0\cdot00057}.$$

Log 213 = 2·3284
Log 1885 = 3·2754

Subtracting = $\bar{1}$·0530 = log $\left(\frac{213}{1885}\right)$

Multiplying by 2 = $\bar{2}$·1060 = log $\left(\frac{213}{1885}\right)^2$
= $\bar{3}$ + 1·1060
Log 0·00057 = $\bar{4}$ + 0·7559
Subtracting = 1 + 0·3501 = 1·3503
Antilog 1·3503 = 22·41
Ans. = 22·41 mhys.

8. Principle of the Slide-rule.

The slide-rule is an instrument which carries out mechanically the operations of adding and subtracting logarithms required for multiplication and division respectively.

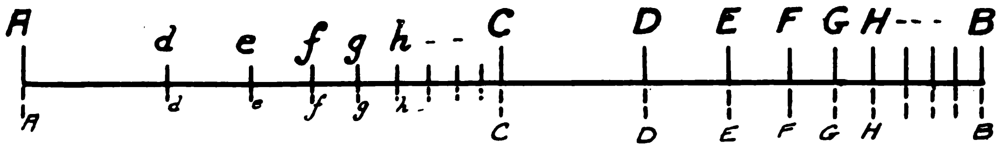


Fig. 1.

Let us take a straight line *AB*, say, 4 inches long (Fig. 1), and agree that its length shall represent the log. of 100—*i.e.*, 2. Thus our scale is

4 inches = 2 logarithm units,
or 2 inches = 1 unit log.

Along *AB* mark off *AC* = 2 inches.
= 1 unit log.
= log 10.

Similarly mark the points *D*, *E*, *F*, *G*, etc., so that *AD* = 2·6020 inches.
= 1·3010 log units.
= log 20.
AE = log 30.
AF = log 40.
AG = log 50, and so on.

The point *A*, being at zero distance along *AB*, represents log 1, which is zero.

In a similar manner we can plot the points *d*, *e*, *f*, *g*, etc., so that

Ad = log 2,
Ae = log 3,
Af = log 4, and so on.

If also we prepare a similar scale (shown dotted in Fig. 1), so arranged that we can slide it alongside the first scale, we shall be enabled to perform additions and sub-

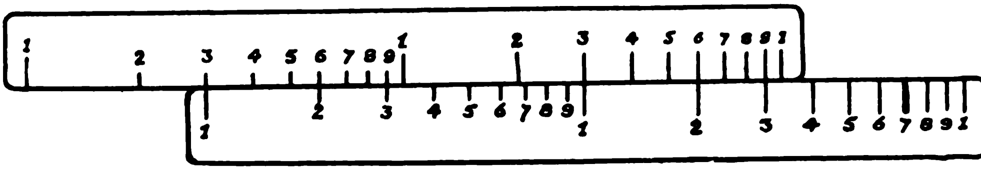


Fig. 2.

tractions of lengths of scale corresponding to any logarithms we wish.

9. In Fig. 2 the scales are shown marked, as in an actual slide-rule, with the numbers the values of whose logarithms have determined the calibration of the scales. The scales have also been displaced so that the 1 of the lower scale comes opposite the 3 of the upper scale.

It will be seen that the distance 1–3 on the top scale added to the distance 1–2 on the bottom scale equals the distance 1–6 on the top scale. This is only to be expected, as 1–3 represents log 3, 1–2 represents log 2 *to the same scale*, and log 3 + log 2 = log 6 (represented by the distance 1-6) because $3 \times 2 = 6$.

With a fully calibrated slide-rule we should read off on the top scale:

9 opposite 3 on the bottom scale,
12 ,, 4 ,, ,,
15 ,, 5 ,, ,,

and so on.

Again, if from the distance 1–6 on the top scale we subtract the distance 1–2 on the bottom scale, we have remaining a distance 1–3 on the top scale. In this case we have log 6—log 2 = log 3 (for $6 \div 2 = 3$).

Thus, to multiply two quantities together, slide the lower scale along until its left-hand end (or right-hand end if more convenient) is opposite the value, on the fixed scale, of one of the quantities; then, looking along the sliding scale for the value of the second quantity, read off the result on the fixed scale at this point.

To divide, find the value of the dividend on the fixed scale; move the slider along until the value of the divisor on the sliding scale coincides with the value of the dividend on the fixed scale; read off the result on the fixed scale opposite one end of the sliding scale.

10. Fig. 3 shows a simple form of slide-rule as used in practice. The "cursor" is a clip which slides along the rule, and carries a glass window on which is engraved a fine line at right angles to the separating line of the scales. This is used for marking any special value on the rule while the slider is being moved for the purpose of a multiplication or a division.

The lower pair of scales (*C* and *D*) consist of the left-hand half of the *A* and *B* scales plotted to twice the size. These scales will give rather more accurate results than scales *A* and *B* on account of their greater size, and consequently more numerous and more open divisions.

The *C* and *D* scales are also very useful for obtaining squares and square roots.

If we put the cursor in any position along the rule, the reading on scale *A* is the square of that on scale *D*, and conversely the reading on scale *D* is the square root of the reading on scale *A*. The reason for this is easily seen. If we take any distance, say, 1–9, equal to log 9, along scale *A* and mark

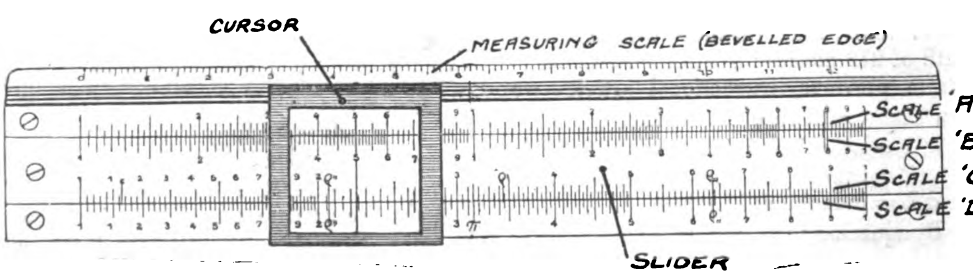


Fig. 3.

off the same distance along scale *D* (from the left-hand end), we get a distance which, on that scale, is only equal to $\frac{1}{2}$ log 9—*i.e.*, a distance equal to log $\sqrt{9}$ or log 3.

When taking square roots we must bear in mind the fact that one distance 1–9 on scale *A* equals log 9, and the other distance 1–9 equals log 90, both being measured from the extreme left-hand end. Thus, to find the square root of 9 or 9,00 or 9,00,00 or 0·09, etc., we must put the cursor over the 9 nearer the left-hand end; and for the square root of 90 or 90,00 or 0·90, etc., we must put it over the 9 nearer the right-hand end. Similarly, of course, with any other number. This is because, when taking square roots, the actual figures in the result are unaltered if the original number is multiplied or divided by any *even* power of ten (*e.g.*, by $10^2=100$, or by $10^6=1{,}000{,}000$), but the value is quite different if the original number be multiplied by an *odd* power of ten (*e.g.*, by $10^1=10$, or by $10^5=100{,}000$). Thus

$$\left.\begin{aligned}\sqrt{900} &= \phantom{\sqrt{9}} = 30 \\ \text{and } \sqrt{900 \div 10^2} &= \sqrt{9} = 3\end{aligned}\right\}\text{same figures,}$$

$$\text{but } \sqrt{900 \div 10^3} = \sqrt{0{\cdot}9} = 0{\cdot}95 \text{ (nearly),}$$

a quite different value.

It is therefore advisable, as in all slide-rule operations, to work out the result very approximately by ordinary methods as a check on the values obtained from the rule.

Full instructions for the use of a slide-rule will be found in the book of instructions supplied with the instrument.

11. Naperian Logarithms.

This system of logarithms is used in all theoretical and in some practical work, and has for its base the value :

$$1+\frac{1}{1}+\frac{1}{1\times 2}+\frac{1}{1\times 2\times 3}+\frac{1}{1\times 2\times 3\times 4}+\ \ldots\ = 2{\cdot}7183\ \ldots\ \text{(approx.)}$$

This value is sometimes written as *e*, and so we write, for " the Naperian logarithm of 7 "—$\log_e 7$.

It is obvious that the Naperian log of any number is greater than its common log, because the smaller base *e* (2·7183) will have to be multiplied up a greater number of times (that is, to a greater power) than will the larger base 10, in order to be equal to the given number.

For the present it is sufficient to know that ordinary logs multiplied by 2·3026 give Naperian logs, and Naperian logs multiplied by 0·4343 give common logs.

AN AMATEUR AND SAYVILLE

Thrilling Story in next month's " Wireless World "

As many of our readers know, it was an amateur wireless experimenter who recorded the signals of the German Wireless Station at Sayville, and proved that the station was being used to transmit unneutral messages to Germany. Mr. C. E. Apgar, the amateur in question, has written a full account of how he trapped the Germans, and this, together with photographs, will be reproduced in the November issue of our magazine.

"MODERN INVENTIONS." Romance and Reality Series. By V. E. Johnson, M.A. London: T. C. & E. C. Jack. 1915. 3s. 6d.

In his introduction the author strikes a new note by suggesting that had it not been for the research, invention, and discovery of our ancestors we should not now be in possession of many of the things which we accept as commonplace. This is a fresh idea, and the attention of the reader is merited from the new standpoint. The writer takes us successively into the realms of cinematography; he initiates us into the mysteries of the submarine, airship, aeroplane and hydroplane, flying boats, motors, high speed railways, television, electroculture, radiography, radium, and devotes a whole chapter each to the subjects of wireless telegraphy and wireless telephony. He discourses on various systems of wireless telegraphy, classifying them under the three heads of conduction, induction, and radiation. As the last-named is all-paramount and appears likely to continue so, it is that with which he deals. All our readers will, of course, recognise that it is to this category that the Marconi system belongs. Mr. Johnson gives a brief history of the events which led up to the discovery of wireless, and gives an account and some illustrations of an amateur wireless station. He touches on "directiveness," that is, being able to send by the ether waves in the direction in which it is desired to telegraph. He explains the particular apparatus used for this purpose. The author discourses on what might be termed the extravagances of wireless, such as the control of boats, either from another boat or from the shore, the ignition of explosives from a distance, the control of railway trains, and so on. He also deals very fully with the application of wireless telegraphy to aircraft and emphasises the special difficulties in connection with the reception of messages in the case of aeroplanes. These are noise and vibration, and he gives suggestions for the amelioration of the troubles. The chapter on wireless telephony is short but interesting. He explains what is meant by damped and undamped waves, speaks of the apparatus for sending and receiving, and gives a dissertation on the advantages to be gained from the use of wireless telephony. Altogether, the book has been thoughtfully written, and we commend it to the attention of those of our readers who desire more than a passing acquaintance with modern inventions.

* * *

"AEROPLANES AND DIRIGIBLES OF WAR." By Frederick A. Talbot. London: William Heinemann. 1915. 3s. 6d. net.

The rapid strides made by aviation during the last ten years has engaged the attention even of the most *blasé*. The science—for such it is—of aeronautics has made rapid strides, especially in things military. The author is concerned solely with aircraft from this point of view, and traces the history from the first attempts by the use of the captive balloon to the present day, when the skies of the battlefield are speckled with the aircraft of the opposing armies. One of the first instances of the use of aircraft in war time was during the Franco-Prussian War of 1870–1, when certain persons escaped by balloon from Paris whilst that city was being besieged. The author devotes a chapter to the rise of Germany to military airship supremacy, and traces the evolution of the Zeppelin airship. He deals with scouting from the air, bomb-dropping, and the uses of armoured aeroplanes, and contributes a chapter on the management of anti-aircraft guns. Of course, the importance of the application of wireless telegraphy to aircraft has not been overlooked, although he remarks that it is utilised only to a very limited extent. This is due to two causes, one of a technical, and the other of a strategical character. In the first place there is the weight of the necessary installation, and in the second place there is the noise of the motor, which is apt to render difficult the reception of wireless signals, although various means of overcoming this difficulty have been suggested. This argument, of course, does not hold to such an extent in connection with dirigibles. Altogether, the book is very well written, and should certainly find a place on the bookshelves of those who are interested in the application of wireless telegraphy to aircraft.

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"A B C OF ELECTRICITY." By William H. Meadowcroft. New York and London: Harper & Brothers. 2s. net.

This little book, which is of American origin, claims to fill the need for a text-book "which shall explain, in simple language, to young people of, say, from fourteen years and upward, a general outline of the science of electricity, as well as the groundwork of those electrical inventions which are to-day of such vast commercial importance." The reader is confronted, on opening the book, with a statement by Thos. A. Edison that he has read the MS. and found the statements therein correct. With a "guarantee" of this nature the reader might feel perfectly safe in accepting the statements made, but it should be pointed out that the methods referred to are largely American, and should not be taken to apply in all cases to England. For instance, on page 30 we find the following: "We show below the alphabet in these dots, dashes and spaces, and these are the ones now used in sending *all* telegraphic messages" (the italics are ours). The code reproduced is the American Morse, and no mention is made of the Continental code, which is used exclusively in European countries, and in fact practically everywhere but the United States. Further, the code is badly reproduced, and very little difference is shown in the length of dots and dashes: for example, the letter "F," consisting of a dot, a dash and a dot, might easily be taken for three dots. In the chapter on wireless telegraphy the author has seen fit to make no mention of Senatore Marconi's name, which is perhaps a little unkind, seeing what the world owes to that inventor; and the information given is not very helpful. After speaking of induction coils with large brass balls, coherers, and Morse registers, the writer says: "In many of the systems the electric pulsations are generated by a dynamo-machine instead of batteries." This statement is likely to convey the impression that some systems utilise batteries exclusively and others dynamos; in actual practice both are used in most systems. However, these are not very vital points, and altogether the volume can be said to serve its purpose very well.

* * *

"OUR COUNTRY'S INDUSTRIAL HISTORY." By William J. Claxton. London: George G. Harrap & Co. 1915. 1s. 6d.

To explain the scope of this book we cannot do better than quote a few words from its preface. The author says:—

"In this book I have endeavoured to give "a simple and logical outline of the industrial history of this country, from the days "before the Roman occupation up to the "present day, which has seen the development of such inventions as wireless telegraphy and the aeroplane."

The book should prove of interest to the class of reader for whom it is intended, and altogether the writer appears to have spent a good deal of time in getting together the information, particularly the matter from which the blocks were made. A short account of the invention of Senatore Marconi is given, and illustrations of the Glace Bay stations and the wireless apparatus on board the ill-fated *Lusitania* are reproduced. Wireless telegraphy indeed holds first position in the recent inventions of the world, and the author has not failed to realise that it has contributed its quota to our country's industrial history.

* * *

"THE ENGINEER AFLOAT: HIS TRAINING, WORK AND PAY." By Frank Butterworth, A.M.I.Mech.E. London: The Technical Publishing Company, Ltd. 1s. 6d.

The sea-going engineer, whether he be serving amongst the glittering machinery of a first-class liner or in the grimy engine-room of an ocean tramp, lives a life which has a distinct charm and many advantages compared with that of his shore confrère. Prospects of promotion are good, the interests of travel are not to be despised, and, even should he not wish to remain at sea all his life, the marine engineer can have no better training for a position as engineer-in-charge ashore than a few years with steam on the ocean.

For young men who wish seriously to consider the question of taking up this profession the little book under review will furnish as complete and valuable information as could possibly be required. The author, who, by the way, holds an "extra chief's ticket," and therefore is no amateur, possesses the ability—all too rare—of expressing what he knows both clearly and in an interesting manner. Full particulars are given concerning the requirements of the B. O. T. Examinations, and each stage of the engineer's career from workshop to engineer superintendent is considered from every standpoint.

Apart from the technical information given, there is to be found much sound common sense in relation to the outfit, duties of junior engineers, management of firemen, and general care of the engine-room. Many junior engineers who have been through the "shops" and are just commencing their sea life might well purchase this little book, and would obtain much help therefrom.

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"THE PANAMA CANAL." By Bakenhus, Knapp and Johnson, with maps and illustrations. London: Chapman & Hall, Ltd. 1915. 10s. 6d. net.

We are not generally inclined to appreciate those authors who make apologies for their work. The apology offered for the book under review is that, although a great deal has been published on the Panama Canal, "it is this very wealth of literature which makes another book desirable." The book is well written, and much care and attention appear to have been lavished on its production. There are some excellent illustrations, and a section of the book is devoted to the Panama Canal in International Law. The design and construction of the canal and locks are described, and mention is made of the thousand and one accessories necessitated in attempting so great an undertaking. A brief historical survey is given, and a chapter on sanitation, costs, etc., is appended, whilst a dissertation on the commercial importance of the canal closes the work. Cross-section diagrams of the canal at various points are reproduced, and maps of sections of the canal are attached. Altogether the work forms a fitting monument to the energy and devotion of the authors.

* * *

"CONSTANT VOLTAGE TRANSMISSION." By H. B. Dwight, B.Sc. New York: John Wiley & Sons, Inc. London: Chapman and Hall, Ltd. 5s. 6d.

The author considers the subject of constant voltage transmission from all standpoints, and gives a number of formulæ so that the reader can make his own calculations. Although, of course, the main appeal of this book will be to electrical engineers in countries like America, where numerous power lines are erected, yet there are a sufficient number of such installations in this country to make this volume of interest to many readers on this side of the Atlantic. A number of photographic illustrations and curves help to elucidate the text.

Foreign and Colonial Notes

Argentina.

The following is a translation of an article in the *Revista Telegrafica*, of Buenos Aires, of July 20th, 1915.

"WIRELESS TELEGRAPHY AND SHIP "STATIONS.

"It being judicially established that any "inhabitant of the country can put up "an aerial and establish a wireless station "at his residence without the authorities "being able legally to prohibit him from so "doing so long as no law has been passed "restricting or abolishing this right, we "consider as a logical consequence that the "wireless stations installed on board ships "of the mercantile marine should work "freely without any restriction, especially "when it be taken into account that these "latter stations are fulfilling a public need, "for which reason the law makes their "installation obligatory on every ship "intended to carry over 30 passengers.

"We have, in these columns, always "supported the view that coercive measures "tending to absolutely prohibit all un-"authorised private stations should be "adopted, as we believed, and we still "believe, that they are a danger to the "social, commercial and political safety of "the country, and besides—as we then "stated—their tolerance amounts to the "sanctioning the right of violation of the "secrecy of traffic.

"We should approve, with similar en-"thusiasm, any initiative having for its "object the legalisation of such prohibition, "but meantime we must respect the law "which is contrary to our modes of thinking.

"And further, if the law allows the right "of private parties to have and to use "wireless stations, the capacity and range "of which are free from all control by the "authorities, seeing that no authority has "the right to inspect them, why have ship "stations to be subject to regulations "imposed by the law?

"Why should navigators be deprived of "the right of communicating during a "voyage with their families, their friends, "or from attending to their business? Why "should the steamship companies, who have "to pay for the upkeep of these stations, be "deprived of the receipts which their "service brings them in, and which are "legally authorised and controlled, and "subject to the payment of taxes?"

* * *

Australasia.

At the 12th Annual Meeting of the Associated Chambers of Commerce of the Commonwealth of Australia, held at Hobart, Tasmania, on the 15th, 16th and 17th of March of this year, Mr. L. M. Bond, of the Brisbane Chamber of Commerce, moved that the Associated Chambers of Commerce recommend that wireless stations be established at Tulagi (Solomon Islands) and other British Islands in the Pacific. This suggestion was made in view of the fact that the trade between these islands and Australia is increasing and that trade should be encouraged to flow towards Australia. As it is, communication with the Solomon Islands is obtainable by wireless only when the steamer *Kulanbangra* is in the group. The Government has agreed to pay a third of the cost and expense of maintenance. As exemplifying the appreciation of wireless telegraphy by the Colonies it is interesting to note that in response to a request that the town of Cairns should be included in the list of places where wireless apparatus should be established, Mr. Bond said, "I am agreeable to that because I take "it that the more wireless stations we have "the better." Mr. Robison Chapman, of the Hobart Chamber of Commerce, supported the resolution, and said, "It is "most important that wireless stations "should be established in the Pacific islands. "We have seen," he said, "during the war "how very necessary they are. They are "necessary from a commercial point of "view, and also for defence reasons in "linking up the Empire." The resolution was then carried.

Canada.

A debate on navigation in Hudson Bay was recently held in the Canadian House of Commons, and Mr. J. D. Hazen, Minister of Marine, announced that the first wireless station would be erected on Hudson Strait. It will be able to work with the stations at Port Nelson and Le Bas. In answer to a question Mr. Hazen replied that it would be necessary to build and equip more than one wireless station on the Strait in order that the ice conditions might be known.

* * *

Japan.

Some time ago the Department of Communications in Japan established a wireless telephone system between Toba (Shima province) and the island of Ishijima. This communication having rendered great service, it has been decided to establish similar telephones in five other ports, the range in each case being from 40 to 50 miles.

* * *

Oceania.

A Commonwealth scheme of wireless telegraphy includes three high-power stations for long-distance communication, and seventeen low-power stations, at such intervals round the coast as to allow inter-communication from ship to shore. The high-power stations at Sydney and Perth are open for traffic, and preliminary arrangements have been made for the erection of a third power-station at Darwin, capable of communicating with Singapore. The following low-power stations, with the exception of Roebourne and Wyndham, are now in operation: Victoria-Melbourne; Queensland-Brisbane, Rockhampton, Cooktown, Thursday Island, and Townsville; South Australia-Adelaide and Mount Gambier; Western Australia-Geraldton, Roebourne, Broome, Wyndham, and Esperance; Tasmania-Hobart and Flinders' Island; Northern Territory-Darwin; and Papua-Port Moresby. It is intended to increase the number of stations to thirty-two.

* * *

United States.

A despatch has been received from San Antonio, Texas, that the United States Government wireless station, under the control of the Army at Brownsville, in that State, has been increased to nearly double its former capacity, and is now able to communicate with vessels at sea 800 miles from the station. A large portion of the military messages from the border patrol along the lower Rio Grande to the Army Department at Fort Sam Houston is handled by the station.

* * *

Point Isbell, Texas, on the Rio Grande, is to have a wireless station. The United States collier *Jason* arrived at Galveston recently, and discharged a complete 5 kw. wireless set, including masts, which will be re-shipped to the former point. It is understood that the Navy is going to erect a station to communicate with the battleships off Tampico and Vera Cruz.

* * *

The growth of the radio-telegraphic service in the United States has necessitated the appointment of superintendents in the various districts. We learn from the States that Lieut.-Commander E. H. Todd has been appointed Pacific Coast superintendent in so far as wireless telegraphy is concerned. His headquarters will be at the naval training station on Yerba Buena Island. Lieut.-Commander Todd has been in the Navy since 1906, enlisting from Illinois, whilst for the past two years he has commanded the torpedo "Flotilla" of the Pacific fleet.

* * *

The Telegraph Championship Tournament, which was held on August 27th and 28th at the Panama-Pacific International Exposition at San Francisco, comprised nine events in all. The fifth event consisted of a special "wireless" contest, divided into classes "A" and "B." Competitors in Class "A" were required to send twenty ordinary wireless messages, and those in Class "B" to receive twenty ordinary wireless messages. A regulation pair of head telephones was used for receiving, the signals being made on a high-frequency buzzer. We hope to announce the result of the competition shortly.

PERSONAL PARAGRAPHS.

W. A. B. Kirwan Ward commenced his business career in London as an apprentice in the National Telephone Company in August, 1907. During his apprenticeship he studied all branches of telephony, the maintenance and construction of exchanges and the laying and upkeep of overhead and underground lines. He also thoroughly acquainted himself with accountancy. On the completion of his apprenticeship he took up outside construction work in 1910, but resigned in 1912 and joined the Constantinople Telephone Company, where he remained until October, 1913. He joined the Relay Automatic Telephone Company (then called the Betulander Automatic Telephone Company) in November, 1913, and was for some time employed in London and in France in connection with the installation erected in the Bois de Boulogne. On the outbreak of war he was called up to serve with his company, in which he held the rank of 2nd Lieutenant, and about six weeks ago was ordered to proceed to Alexandria with a view to joining the Mediterranean Force in the Dardanelles.

Sec. Lieut. W. A. B. K. Ward.

The news of his death from wounds came as a great shock to his many friends. He was very popular with the staff with whom he served, and will be remembered by some of the Marconi staff as the representative of the Relay Company in the competition for the Tennis Challenge Cup.

* * *

It is always pleasing to us to hear of heroic deeds and sacrifices rendered to their country by members of the Navy or Army, and we are particularly gratified to learn that wireless telegraphists find their place in the mention of those who deserve it. In this connection we learn that Lieut.-Commander James F. Sommerville, Fleet Wireless Telegraph Officer, is mentioned in Vice-Admiral J. M. de Robeck's despatch on naval matters in the Dardanelles. He "performed good service in organising, with the military, the intercommunication between the allied fleets and armies." We congratulate Lieut.-Commander Sommerville on his receipt of this honourable mention.

* * *

In last month's issue we were pleased to make mention of the promotion of Lieut. Hake to commissioned rank. By his courtesy we are enabled to publish a photograph, which will, no doubt, prove of interest to our readers and also to his many friends.

Sec.-Lieut. E. G. Hake.

It is with deep regret that we have to record the death from diabetes of Operator Charles Frederick Mackenzie, at the hospital at Wellington, New

Operator Mackenzie.

F

Operator Pollard.

Zealand. Mr. Mackenzie, who was 25 years of age, was born at Leytonstone, Essex, and received his education at the same place. A few years ago he became interested in wireless telegraphy, and after a course in a training college, joined the Marconi Company's school in May, 1912. On appointment to the staff, he served on board the s.s. *Cameronia, Saturnia, Itapue, Nyanza, Highland Scot*, and *Tainui*, and whilst serving on this last, was taken ill. We tender the sincerest sympathy to the late gentleman's parents in their sad bereavement.

* * *

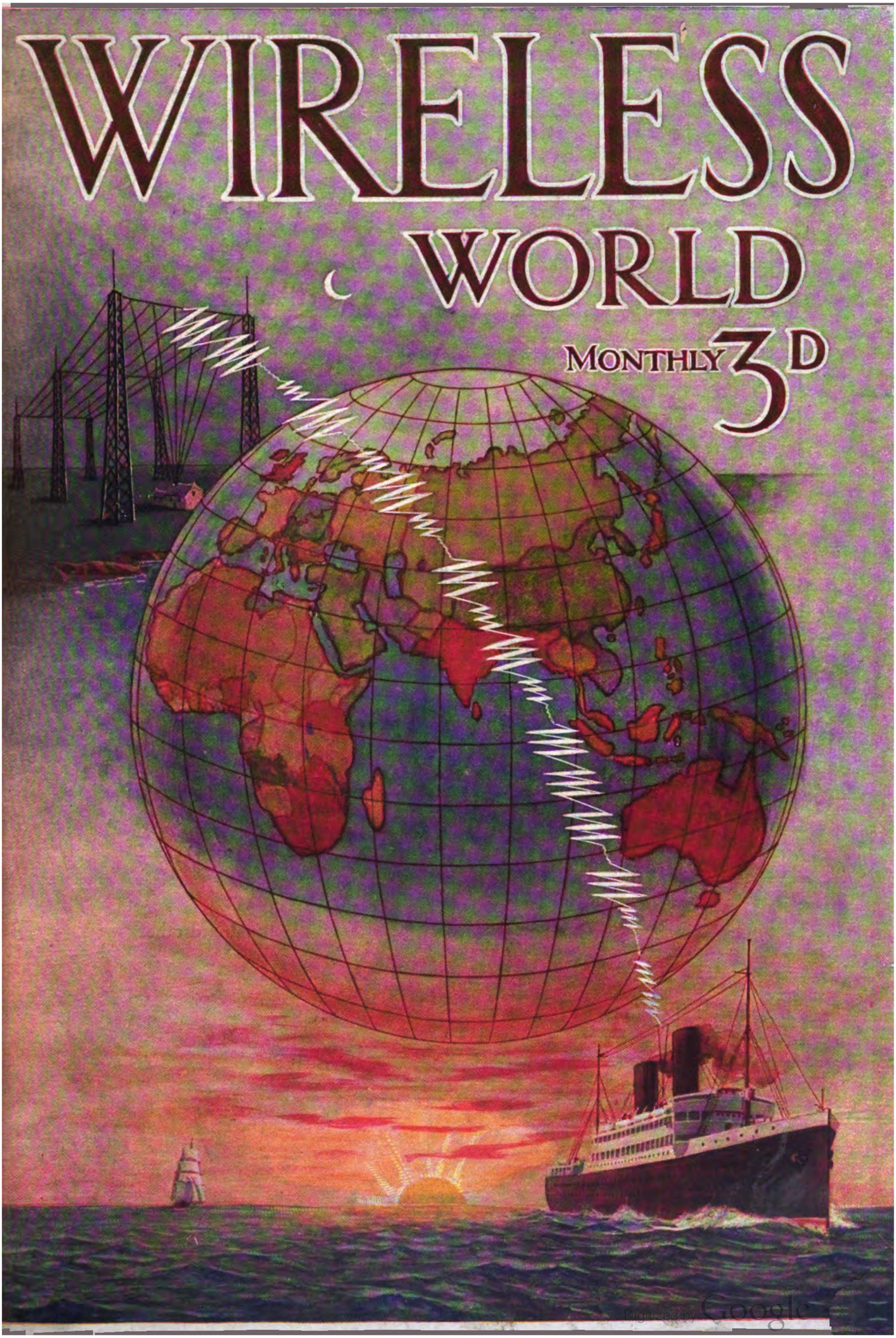
It is with much regret that we have to record the death of Mr. Frederick George Pollard, of the Marconi Company's operating staff. Mr. Pollard, whose home was at Lewisham, for some time served in the South-Eastern and Chatham Railway Company as telegraphist. In 1913 he joined the Marconi Company's London School, and after a few months' training received his appointment to the staff. Mr. Pollard served at sea on the s.s. *Reva*, and afterwards on board the *Arlanza*. In August of last year he was taken ill and has since been on sick leave. Although he rallied at times, he never really recovered, and passed away on August 6th.

Operator F. W. Page.

We tender to the late gentleman's parents our sincerest sympathy in their sad bereavement.

* * *

It is our painful duty to inform our readers of the death from dysentery of Operator Frank William Page, of H.M. Hospital Ship *Sicilia*. Mr. Page, who was 21 years of age, came from Walthamstow, at which place he received his education. Prior to joining the Marconi Company he was employed in a clerical capacity, and during his spare time studied at the Marconi Company's Evening Classes. Just a year ago he was appointed to the staff, and almost immediately joined the Hospital Ship *Sicilia*, on which vessel he remained until the end. His loss was deeply felt by all on board. The funeral took place in the Red Sea on August 24th. We take this opportunity of offering our deepest sympathy to the late gentleman's relatives in their terrible bereavement.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THE WIRELESS WORLD

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SPECIAL DOUBLE NUMBER

A Wireless Innovation for Christmastide

WITH the "lights out" order in full swing and hours of darkness ever increasing, a large majority of our readers are certain to be turning their thoughts towards the comforts of the home fireside. Wireless amateurs have had to submit, for patriotic reasons, to a curtailment of their hobby in the suspension of all those experiments which really form one of the most interesting sections of the pursuit. For the same reasons we have ourselves been obliged to eliminate some of our regular features and modify others which specifically refer to experimentation and practical work.

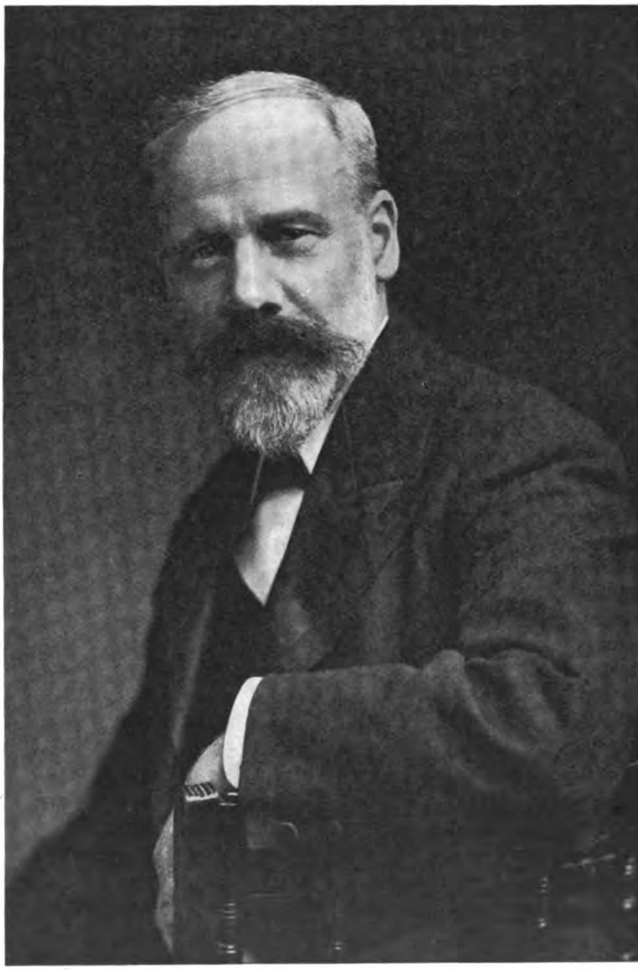
With the view of compensating our readers for the omission of many items from our bill-of-fare which would have been very agreeable to their palate had we been able to "serve" them, we have prepared a Christmas Double Number after a fashion which has never been before attempted. Whilst all the regular features will remain, the introduction of a number of original articles, Christmas stories and special scientific papers will considerably augment the interest which an abundance of appreciative comments shows us to be well maintained by our ordinary numbers.

A notable feature will consist of a brightly written story covering the twenty years (more or less) which have elapsed since Senatore Marconi landed with his little black box on the shores of England.

Turning to the side of fiction, it is not an easy matter to combine first-class literary workmanship and correct wireless technology. We are glad to say that we have been able to secure both of these by enlisting the services of Mr. William le Queux, whose writings and attainments are too well known to need laudation here. We may remind any readers who may chance to have forgotten the fact, that Mr. William le Queux before the commencement of the war possessed a well-equipped wireless installation of his own, besides holding the Postmaster-General's certificate of proficiency in radio-telegraphy.

It would be impossible here to enumerate the many miscellaneous features of the Double Number. Our advertising pages contain a synopsis of its contents and we have no hesitation in stating that WIRELESS WORLD readers could find no more acceptable Christmas momento for transmission to their friends.

One feature of the issue will make a practically world-wide appeal. Readers would be surprised if they knew the number of applications that have been received by us for an adequate delineation of Senatore Marconi. The photogravure which will form our presentation plate has been pronounced by those intimately acquainted with the great Italian inventor to be one of the most successful portraits of the many taken by the Dover Street Studios. Not only sober scientists who know the debt of gratitude which the world owes to this distinguished son of Italy, but every schoolboy, scout or student will welcome the pictorial representation of the man whose name stands for the new science, which owes the major part of its development to him.



SIR WILLIAM SLINGO

Personalities in the Wireless World

SIR WILLIAM SLINGO

SIR WILLIAM SLINGO, upon whom His Majesty the King has recently bestowed the honour of Knighthood, was born in London on May 25th, 1855, and commenced his career as a telegraph clerk in 1870. He has always taken a deep and active interest in radiotelegraphy. In 1876 he founded the Telegraphic School of Science at the General Post Office, and he remained Principal of this school until 1898. He was for a number of years head of the Electrical Department at the People's Palace, now known as the East London Technical College, and took a leading part in the formation of the City and Guilds of London Institute. While employed in the Central Telegraph Office he became Consulting Engineer to the Drapers' Company and other bodies. On the closing of the Telegraphists' School of Science, Sir William's services were transferred to the Engineering Department of the Post Office with the rank of First Class Technical Officer. In this capacity he had charge of various classes of work, including the establishment of Hughes Duplex working between London and the Continent, and designed the system for protecting telegraph and telephone plant from fire and the system of secondary battery working now in extensive use in the United Kingdom. At the close of 1903 Sir William was promoted to the position of Superintending Engineer of the North Wales District, with headquarters at Liverpool, where exceptional calls were made upon his technical and administrative abilities. In September, 1910, he returned to London to carry out the responsible duties appertaining to the supervision of the work involved in the preparation of the inventory and valuation of the National Telephone Company's plant. In January, 1911, he was appointed Assistant Engineer-in-Chief, and in March, 1912, he was further advanced to the position of Engineer-in-Chief, in succession to Major O'Meara, C.M.G., R.E.

In the year 1913 Sir William's activities included work in connection with the Holt Parliamentary Committee on Post Office servants' wages and conditions of employment. He was also engaged on the scheme for providing an underground railway in London for the transmission of mails, and the laying of the Anglo-Irish loaded telephone cable.

In 1914 Sir William served on no fewer than six important Government Committees, including the Committee on State Research in Wireless Telegraphy, the Imperial Wireless Committee, the Committee on High Speed Telegraphy, the Telephone Finance Committee and the Electric Mains Explosions Committee.

Since the outbreak of war in August, 1914, the duties of the Engineer-in-Chief have naturally been of a responsible character in connection with the provision and maintenance of communication services. The importance of wireless work in this time of national emergency will be realised, and it is interesting to note that within two or three days of the outbreak of war 2,916 licensed and about 800 unlicensed wireless stations were closed under Sir William Slingo's directions.

Sir William Slingo has a world-wide reputation as an author. He was joint author, with Mr. A. Brooker, of *Electrical Engineering*, which is still a standard work. It was first published in 1890, and has since then run through many editions, each edition numbering several thousand copies. Sir William was for some time editor of *Knowledge*, a widely-circulating scientific weekly, and he has contributed extensively to the technical and lay Press.

British Association and Radiotelegraphic Investigations

REPORT OF THE COMMITTEE, CONSISTING OF SIR OLIVER LODGE (*Chairman*), DR. W. H. ECCLES (*Secretary*), MR. SIDNEY G. BROWN, DR. C. CHREE, PROFESSOR A. S. EDDINGTON, DR. ERSKINE-MURRAY, PROFESSORS J. A. FLEMING, G. W. O. HOWE, H. M. MACDONALD, AND J. W. NICHOLSON, SIR HENRY NORMAN, CAPTAIN H. R. SANKEY, PROFESSOR A. SCHUSTER, SIR NAPIER SHAW, AND PROFESSORS S. P. THOMPSON, AND H. H. TURNER.

Effect of the War on the Work of the Committee.

THE war has had a very direct effect on radiotelegraphic investigations. About the beginning of August, 1914, private wireless telegraph stations throughout the Empire nearly all stopped collecting statistics, while naval and other Government stations stopped all merely scientific observing. The radiotelegraphic stations in Russia, Germany, and neighbouring countries doubtless discontinued the filling up of our forms as soon as mobilisation began. A few stations in India, Australia, Canada, the West Indies, and the United States are, however, still at work. In the last-named country about thirty stations are making observations.

The Committee's programme for the collection of statistics three days a week in all parts of the English-speaking world, and in a few other countries, was planned to embrace one complete round of the seasons. The fact that the programme has been interrupted after only three months of work diminishes greatly the scientific value of such statistics as have been collected. It also implies considerable financial loss. A large batch of forms was distributed to our Navy in July; in clearing for action these forms would probably be wasted. The German edition was distributed in June. The Russian edition also was probably distributed before the outbreak of war.

The extensive scheme of special observations projected for the occasion of the solar eclipse failed almost completely in the countries in which the eclipse was visible. A small amount of work was done in Norway and Sweden. All the necessary forms had been printed, and some had been circulated, before the war started. The financial loss to the Committee in this respect exceeds a hundred pounds.

The day-by-day statistics collected in the period April to July have been partially analysed. The conclusions drawn from these observations are described below. Apart from any scientific value they possess they yield information which will guide the Committee, when the time comes, to further attacks on the problems concerned. A similar thought may be set down as consolation for the eclipse failure.

ANALYSIS OF RECORDS OF STRAYS.

Diurnal Variations.

The principal and most universal fact is that the strays heard in the dark hours are much more numerous and louder than those heard during daylight. If curves be drawn showing the amount of disturbance to telegraphic work from hour to hour, two types of curve stand out; one in which the changes from day to night and night to day conditions are somewhat abrupt, and another in which the changes are much more gradual. The former curves might be called "trough-shaped," the latter "U-shaped." The former type is met with at sea and on islands at a considerable distance from the mainland, the other on the mainland, especially in the tropics. The lowest point of the U or of the trough usually falls a little after midday, and the highest point of the convex part of the curve occurs a little after midnight, in nearly all stations north of the Equator. The only exception to this rule is found in some records from Lagos, Nigeria, where the curve showing the intensity of disturbance is lowest about seven in the morning and rises during the daylight hours. Unless local weather conditions are producing great disturbance, the change from night to day conditions and *vice versa* in stations north of the Equator lags behind the sunrise and the sunset. At some stations south of the Equator—*e.g.*, Cocos Island, the opposite rule seems to be usual. These regular and universal diurnal variations have an average magnitude which is represented on the arbitrary scale used in the forms by figures like 2 in the day and 5 at night in tropical latitudes, or 0·3 in the day and 3 at night in temperate latitudes. These figures are greatly affected by local meteorological conditions, which in fact frequently overwhelm all the statements set forth above.

Periods of Excessive Disturbance.

Occasionally the radiotelegraphic work at a station is rendered almost or quite impossible for a period, by strays of vigour and number greatly exceeding the average. These occurrences are for brevity called " X storms," the term " X " being an alternative designation for " stray " or " atmospheric." When an X storm happens in the day and lasts more than an hour or two, it may completely alter the character of the curve of that day's disturbances and even make the day portion of the curve higher than the night portion. An analysis of the records has shown that X storms occur within the same two or three days over very wide areas. Occasionally X storms are reported almost simultaneously at places several hundred miles apart, but more usually the X storms occurring at such distances are separated by several hours. Some of the European, American, and Canadian X storms have been compared with the meteorological records and charts for the two continents. The comparison has shown very plainly that periods of severe strays coincide with periods of low barometer, high wind velocity, rapid change of temperature, great rainfall, and, especially, rapid barometer fluctuations. In low latitudes the barometer fluctuations during violent X storms can usually be followed on any ordinary instrument. The worst X storm in the European records was accompanied by the rapid movement of a low-pressure system in a north-easterly direction. In twenty-four hours the eye of the cyclone moved from a point south-west of Lisbon to the North Sea, and in another twenty-four hours into the Gulf of Bothnia. The worst X storm in the American records was also accompanied by the exceptionally rapid movement eastward from the Pacific of a cyclonic depression with steep pressure gradients. A report from a Californian station of the Marconi Wireless Telegraph Company of America on this latter occasion states that the barometer was fluctuating between 29·44 and 29·52 inches very rapidly, the variations being accompanied by gusts of wind which attained the velocity of 70 miles per hour. The disturbance produced in the telephones by the strays amounted to a roar. On this occasion, between 1 p.m. and night, the strays rapidly diminished as the wind fell and the barometer rose. These meteorological conditions are precisely those that accompany or precede thunderstorms and line squalls; and, in fact, the records of the Meteorological Offices, and of the observers reporting to the Committee, all lead to the conclusion that X storms are often associated with thunderstorms at places not very far distant. Sometimes all the symptoms of thunder weather except thunder and lightning may be present in a locality and a heavy X storm be recorded—*e.g.*, Mr. P. H. Burns, Superintendent of Telegraphs in the Bahamas, reports that he has often been experiencing an X storm when a sudden shift of wind to the north-west (wind velocity about twenty miles per hour) has taken place and been followed by heavy rain, a calm, low temperature, lessened humidity, and a total disappearance of strays—all without thunder or lightning. To some extent these are symptoms of the passage of a small secondary or V depression such as might not be recorded on synoptic charts.

It is well known that the unstable atmospheric conditions bringing thunder weather sometimes move at a relatively slow rate from place to place, and may have their movements traced by the ordinary methods of meteorology. The analysis of the radiotelegraphic records shows that such convective weather can be anticipated several days in advance. This is particularly well borne out by some of the Malta records when taken together with some abstracts of the meteorological conditions kindly supplied by Dr. T. Agius, in charge of the Observatory at Valetta:

Strays bad	All Aug. 22nd and 23rd, 1914	Greatest rainfall of month Aug. 24th.
" "	Nights of Sept. 22nd and 23rd and day of 24th	" " " Sept. 25th.
" "	All Oct. 6th and 7th	" " " Oct. 9th.
" "	All day Nov. 12th	" " " Nov 13th.
" "	Dec. 26th and 27th	Greatest fall in temperature, lowest barometer Dec. 28th.
" "	Jan. 20th, 1915	Greatest rainfall Jan. 21st.
" "	May 27th and 28th, 1915	" " May 31st.

A report received from the wireless telegraph station of the Government of Australia situated at Esperance states that during the day-time rain is preceded in at least 80 per cent. of cases by intermittent disturbances. Strays of varying strengths may be heard from 6 a.m. to sunset for one or more consecutive days prior to rain. The following instances may be quoted:

Feb. 13th, 1915	Strays strength	2A from 6 a.m. to 6 p.m.
Feb. 14th, 1915	" "	3A from 6 a.m. to 10 a.m. and 4A from then till 5 p.m.
Feb. 15th, 1915	" "	3A from 6 a.m. to 1 p.m. and 3C from 1 p.m. to 7 p.m.

On February 15th, 16th, 17th, and 18th, 167 points of rain were recorded, of which only 3 points fell on the 15th. On February 23rd, 1915, strays were of strength 3A from 6 a.m. to 6 p.m. On February 24th 129 points of rain fell.

This conclusion is borne out in other ways by some of the records forwarded to the Committee. There is evidence that north-west winds on our Atlantic coasts, especially in the winter, are associated with strong strays at Irish stations and at sea. The atmospheric convection produced by the land may be sufficient to account for this. Mr. R. Ricci, of the Marconi Co., who has made reports on two trips round the world, during which he made especially careful daily observations, states that in mid-ocean strays are, as a rule, very few and feeble both in the day and in the night; but that when the edge of a mountainous continent is approached strong, and even continuous, strays are normal. In this something must depend on the direction of the prevailing wind relative to the land—a matter that will be inquired into later.

It may be mentioned here as very significant that the months of the greatest X storms in the Mediterranean are shown by the records to be September and October, the months of cyclonic weather.

As a whole the statistics show that there appear to be two kinds of X storm occurring in the day-time: (1) Those produced by convective conditions in the atmosphere within, perhaps, a hundred miles of the station, which may be termed local X storms; (2) Those originating at a distance. Regarding the first class, they may occur almost simultaneously over a whole continent, but this is only because convective conditions happen to be ruling all over that area. Stations not too far outside the boundary of such a region also receive many strays, but apparently their distance must be limited to within 200 miles of the disturbed regions. In general, we may conclude that the observation of strays in the daytime constitutes a method of feeling the fringe of a region of convective weather, and so anticipating thunder and rain a day or two in advance. Of course, this ability to prophesy the advent of thunder weather is well known and is as old as wireless telegraphy itself; but hitherto it has been thought that the electric discharges at a great distance were responsible for the strays heard at the station attempting to prophesy. The present analysis indicates, rather, that, at any rate in the daytime, the strays are frequently due to very local discharges, often too weak to give noticeable lightning or thunder, but definitely indicative of an approaching period of instability in the atmosphere.

The second kind of X storm is not of strictly local origin, but is sometimes traceable in the stray observations made hourly at the Malta station of the Eastern Telegraph Co., and the Sierra Leone station of the African Direct Telegraph Co. There is evidence that on certain occasions the same cause is affecting both stations, though they are separated by 2,500 miles, mostly across mountain and desert.

As regards disturbances observed at night-time, these are also frequently very local and due to convective weather, but there is probably a greater proportion of non-local storms than appears in the day records. In this connection may be noted a report from Australian stations that the worst and most continuous type of disturbance (apart from local thunderstorms) occurs on calm nights when the sky is blue and starry.

As a contrast to the prevalence of strays during convective weather may be instanced the fact, reported by Lieut. E. R. Macpherson from Sierra Leone, that a very dry wind which blows periodically for several days on the West Coast of Africa causes an almost complete cessation of strays immediately it starts, and allows of their resumption immediately it stops. On the other hand, the monsoon period on the same coast is one marked by great X storms..

Correlation of Records at Distant Stations.

The daily records of strays received at the above-mentioned stations in Malta and Sierra Leone have been examined carefully for the period August, 1914, to May, 1915, inclusive. This period has been treated in four sections of two and a half months each. It will be sufficient to give the following figures, which refer to the night hours 10 p.m. to 2 a.m., Greenwich mean time :

Mean M.	14·13	14·24	12·85	13·70
Probable error	±·64	±·67	±·57	±·53
Mean S. L.	28·68	19·90	14·87	26·31
Probable error	±·69	±·78	±·68	±·68
Standard Deviation, M.	8·34	8·66	7·28	6·78
,, ,, S. L.	8·94	10·17	8·77	8·79
Correlation Coefficient	0·18	0·36	0·14	−0·25
Probable error	±·075	±·067	±·075	±·073

M. indicates Malta ; S. L. indicates Sierra Leone.

Graphic Records.

Many observers have made for the Committee precise observations of individual strays by making, on lines graduated to represent time, marks corresponding to each stray as heard in the telephones, the zero of time being fixed by aid of radiotelegraphic time signals within range of the observer. Comparison of the records made in the British Isles has shown that on an average night many of the strong strays are heard by all the observers, and on days free from X storms the same remark applies. Coincidences have also been noticed between pairs of American stations not too widely separated. The analysis for very distant stations has not yet been carried out except for a very few in Europe. For example, in the month of June, 1914, coincidences have been traced in the strays heard at Southampton and Dresden, Gibraltar and Dresden Guildford and Malta. A proper investigation of the meteorological conditions accompanying or determining the periods when strays are heard simultaneously at places very wide apart has not yet been made.

Auroral Displays and Strays.

By the kindness of General Geo. P. Scriven, Chief Signal Officer of the United States Army, the Committee have been able to obtain reports from Officers in the Wireless Telegraph stations of Alaska concerning the presence or absence of any connection between auroral displays and disturbances due to natural electric waves or atmospheric discharges. At six stations special observations have been made during the later months of the past winter. Various types of aurora were watched, but nearly all the observers reported that the appearance or disappearance of auroræ caused no unusual disturbances. The best months for such observations in Alaska would, it is stated, be October and November. The systematic work had not then been started, but one telegraphist reports that during this period of more brilliant display the only thing noticed in the radiotelegraphic apparatus was a trifle more electrical disturbance than occurred when there was no aurora.

The 27-day Period of Magnetic Variations.

Such of the radiotelegraphic records as were suitable for the purpose have been analysed with a view to detecting a 27-day period in the cases: days with many strays, nights with many strays, nights with few strays. No trace of this period or of any nearly equal period has as yet been found, but the matter cannot be regarded as settled till more numerous and more continuous records are available.

The Committee desire to express their cordial thanks for the help extended to them by the Government Departments, companies, and private individuals named below. The list refers to those whose co-operation has been of importance in the matters described in the preceding pages, and does not include the names of those who have helped in other investigations. The assistance of the latter will be duly acknowledged in future Reports.

The British Admiralty and Post Office; the Colonial Office; the Governments of Australia, Canada, and New Zealand; the War Department and the Navy Department of the United States of America; and the Telegraph Department of the Dutch East Indies; the Marconi Companies in England, Canada, and the United States and the Marconi International Marine Communication Co.; the Eastern Telegraph, Eastern Extension, and African Direct Telegraph Companies; H. Barkhausen, W. G. Cady, E. T. Cottingham, D. O. Davies, E. H. Dixon, E. D. Evens, J. P. Fennelly, A. Gorham, F. Kilbitz, J. R. Lamming, L. H. Lomas, F. A. Love, E. R. Macpherson, T. J. Matthews, W. E. Nicoll, F. E. Norris, R. Ricci, D. Rintoul, C. Ross, A. Hoyt Taylor.

A Little Problem

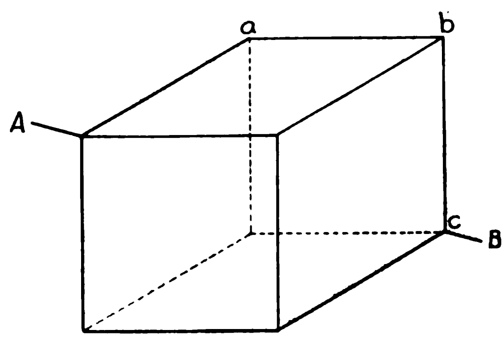
THE following letter has been received from a correspondent, and the query contained in it would in the ordinary course have been dealt with in the "Questions and Answers" column. As, however, the problem in question is one of great interest, it has occurred to us that it would be a pity to publish the answer at the same time as the question, and we therefore publish the problem alone in this issue, reserving the answer for the December number. Our correspondent has been answered through the post.

"The following may be of interest to "readers of THE WIRELESS WORLD. The "question was set to an advanced class of "electrical engineers in a well-known college "in Liverpool, and successfully baffled the "great majority of the students, as so far "it has done me. I have arrived at several "different results (by different methods), "each apparently correct, but, as one only "can be the correct answer, I should be "very interested in the orthodox manner "of setting about such a problem, which, "on the face of it, looks so simple. Here it "is:—

"Consider the cube to be constructed of "a series of wires representing the edges— "i.e., a to b = one wire, b to c is another, etc. "Each has a resistance of 1 ohm. What is "the total resistance A to B?

"It might also be interesting to know "how to set about the question if, instead "of being constructed of a series of wires, it "were made of sheet metal, each side being "1 ohm resistance. Of course, direct cur- "rent is employed in each case."

Amateurs who think they know all about Ohm's Law and its application will perhaps be interested to work out the total resistance.



Digest of Wireless Literature

ABSTRACTS OF IMPORTANT ORIGINAL ARTICLES DEALING WITH WIRELESS TELEGRAPHY AND COMMUNICATIONS READ BEFORE SCIENTIFIC SOCIETIES.

THE WIRELESS DIRECTION-FINDER.

In a recent issue of the *Electrician* Dr. E. Bellini contributes an interesting article entitled "Some Details of the Direction-finder." Commencing with a simple description of the Bellini-Tosi Radiogoniometer, the writer says that at the beginning of 1912 the Marconi Company took over the enterprise of the direction-finder and the apparatus was subjected to some modification. Previous to this the wave-length used had generally been 100 metres, but the Marconi Company thought that this wave-length presented difficulties from the commercial point of view. First, it was necessary to instal "radiophares," which would necessitate an expense in installation and in handling that most States would not accept; secondly, it was necessary to instal on board of the ships, for their reciprocal direction finding, sending stations radiating the same wave of 100 metres, whence there would be supplementary charges for the shipping companies.

The Marconi Company estimated that it would be more convenient to give to the syntonising devices of the direction-finder such an amplitude that the commercial waves of 300 and 600 metres could be received. So all the existing shore and ship stations became immediately available for the use of the direction-finder and no special transmitting stations either on the coast or on the ships, except in special cases, were required. In these exceptional cases the "radiophares" could conveniently radiate a wave-length of 450 metres.

Arising from the adoption of the wave-lengths above referred to, certain modifications were made in the aerials. All the direction-finder aerial installation on board was reduced to four wires suspended from a special porcelain insulator and stretched so as to form the edges of a pyramid with a square base.

The tuning appliances had also to be changed, and a condenser was inserted in the base of each triangle. The chief difficulty of this condenser syntonisation was found in the construction of the two condensers. These must practically have the same capacity, especially in the case of feebly damped waves. If the two condensers are not equal, the phases of the currents in the two aerials and connected fixed coils do not coincide, and the ratio of their intensities is not what it should be. Hence, inside the fixed coils an elliptical rotating field is obtained, instead of an alternating field of constant direction. The reception takes place, more or less, for every position of the exploring coil; the determination of the direction of the sending station is, therefore, uncertain, and the errors can consequently be large. The condensers must be acted upon at the same time, by turning only one handle. Good results were obtained by using condensers of the plane sliding plate type. Dr. Bellini next deals with the coupling of the circuits and the important influence this has upon the exactness of the bearings given by the direction-finder. This influence was small in the case of open-top aerials, but with closed-top aerials the influence of coupling is much more important. The construction of the direction-finder was, therefore, modified in its dimensions so as to give good results for all the waves and for all aerials met with in practice.

In the ship installations of the direction-finder it is sometimes difficult to find room for the aerials and radiogoniometer. It would, therefore, be convenient to be able to place the radiogoniometer far from the aerial if necessary. Experiments were made to ascertain if this were possible. From results obtained it was found that the radiogoniometer must be placed as close as possible to the aerial installation; and in any case the connecting wires have to be placed at the edges of a square-based prism of about 50 cm. side.

It has been remarked since the first installations that the bearings given by the direction-finder installed in land stations were generally more exact than those given by the same apparatus placed on board ship. A first cause of error was found in the ordinary aerial, the oscillations of which acted as a secondary source of oscillations. It is sufficient, however, to disconnect this aerial from the earth during the observations at the direction-finder to suppress this cause of error. But other causes remained which were difficult to ascertain, as it was necessary to make methodical experiments upon ships manœuvring only in view of these experiments. As this was difficult to obtain, a long time elapsed before positive results were obtained. The writer then deals with the experiments just mentioned and the influence of the metallic masses of the ship, showing how it was found possible to eliminate the effects of this. The article concludes with a table showing a number of excellent results obtained on board the Wilson Line steamer *Eskimo*, making the service between Hull and Christiania.

* * *

AN AERO-RADIO SYSTEM FOR AMERICAN DEFENCE.

Mr. John Hays Hammond, Junior, in a recent issue of the American publication *Flying*, outlined a proposal for a new system of coastal defence in America, in which aeroplane patrols, in conjunction with wireless stations, would keep a keen look along the coast. It would be a matter of years, not months, says Mr. Hammond, before the United States could increase its military organisation to a point where it would be equal to the standard of a possible enemy. Even with all the money which that nation had available, time is the thing which counts in the first phases of modern war. In proportion to what would have to be done, time is so short that all the dollars on earth could not increase the speed of manufacture of necessary arms to supply the imminent demand. Mr. Hammond's idea is to apply radio-systems to aeroplanes and establish aero-scouting districts along the United States seaboard in such a way as to provide an invaluable unit of defence. It must be borne in mind that the coast line in question is so extensive, and the American Navy at present of such small size and comparatively slow speed, that it is essential to develop scouting facilities of extraordinary efficiency. With a scout system such as Mr. Hammond outlines, land forces could co-operate with the fleet in preventing landing operations on the part of the enemy. Aerial information would be the only sort by which the intent of the enemy's manœuvres and the ultimate objective could be ascertained.

In the plan put forward there are forty-four areas which cover the whole coast of the country. In each of these it is proposed to erect a wireless station connected by land lines with the other stations. Each of the aero-scouts will be equipped with a radio transmitter of sixty miles daylight range. It will not have receiving apparatus, as the noise of the motor and propeller would be too great to permit the operator to hear. While aloft each of the scouts would be in constant communication with the central radio station, which in turn is connected with the existing land system by telephone or telegraph. Scouts covering such an extended front would be able to discover and report upon the movements of the enemy's ships, their number and disposition and their strategical formation. Then, equipped with such valuable information, it would be comparatively easy to concentrate our forces at decisive points to meet the invader.

Aeroplanes cost approximately £1,500 apiece, so that forty-four would cost roughly £66,000. Radio transmitters and receivers at £40 apiece would mean a total of £1,760. The receiving stations and aeroplane sheds, costing £120 each would total £5,280. The receiving aerials and masts at £50 make a sum of £2,200, and then there is a final sum of £4,460. This makes a grand total of expenditure of £79,700.

To man the system properly it would require three shifts of aviators, or 132 men, and 40 telegraphists. With a system such as that outlined it would be possible in time of war for Washington to know every hour and a half the exact conditions along the entire coast-line.

IRON LOSSES AT HIGH FREQUENCIES.

Among the papers read at the recent British Association meeting was one by Mr. N. W. McLachlan, B.Sc.Eng., entitled "The Heating of Iron when Magnetised at very High Frequencies." The paper described experiments illustrating the heat produced when iron is magnetised by very high frequency alternating currents, *e.g.*, 2×10^5 to 5×10^5 periods per second.

The magnetising current was obtained by using a Poulsen arc generator connected across the town mains (240 volts). In order to demonstrate the extent of the losses, a magnetic heater or boiler, consisting of a solenoid wound on a glass tube containing water and a number of iron strips or wires, was inserted in the shunt circuit of the generator. A short time after the shunt circuit was closed the water began to boil.

An experiment was also arranged to show the variation in permeability of iron with variation in temperature. A ring of Lohys (mild steel) was insulated with asbestos and wound with a number of turns of copper wire. This was connected in the shunt circuit of the generator. By passing a large current through the windings of the ring, thereby obtaining a strong magnetising force, the magnetisation losses were such that a rapid rise in temperature was produced, causing the iron to attain a bright red heat. The variation in permeability corresponding to the rise in temperature may be followed by observing the current in the shunt circuit and the voltage across the terminals of the ring.

In the discussion following the reading of the paper, Professor Gisbert Kapp drew attention to the fact that the losses observed were extremely high compared with what was encountered at ordinary frequencies. It had long been a puzzle to those familiar with ordinary alternating current work as to how it was possible, in view of hysteresis and skin effects, to use in wireless work frequencies of a quarter of a million or so in circuits containing iron. They were often told by wireless engineers that the usual rules did not apply at high frequencies, but apparently from the author's figures this was incorrect. Professor Howe said that the discrepancy pointed out by Professor Kapp arose because the formula quoted by the author gave simply the skin losses. As the frequency rose the flux was, in fact, more and more confined to the skin, so that less and less iron was really involved in the phenomenon.

Professor Perry said that the formulæ used with low frequency currents were derived from one deduced by Sir J. J. Thomson. The complete formulæ contained a factor e^x, which in the case of low frequencies, could be replaced by a first approximation, but the exponential had to be retained when the frequency was high.

* * *

WIRELESS RECEIVING STATIONS.

Part 46 of the *Harmsworth Self-Educator* contains a long article on Wireless Receiving Stations from the pen of Mr. Thorne Baker. After touching on resonance and tuning, the writer deals with receiving circuits in general, and gives simple diagrams of various forms of circuit in use. Speaking of detectors, Mr. Baker says that the currents which have to be detected are exceedingly small, in some cases amounting to small fractions of a micro-ampere (one millionth of an ampere). Minute as these currents are, they appear to be capable of producing heat; in fact, the micro-ammeters used to measure the currents received are often dependent on the heating of a fine wire. The coherer receiver is then mentioned, and is followed by a description of the Marconi magnetic detector. The crystal, electrolytic and valve detectors are in turn considered, and brief descriptions are given of the Einthoven galvanometer, the Orling relay and the Brown relay. Speaking of this last, the writer says that by its means it is possible so greatly to magnify the sounds in the telephone receiver that the receiver can be placed on a table or hung on a wall, and the signals will be audible anywhere in the room.

The measurement of waves and wavemeters next occupy the reader's attention, and the use of long wave-lengths for long distance communication is briefly considered. Paragraphs follow dealing with portable sets, wireless in airships and aeroplanes, wireless in submarines, and the wireless compass, and an interesting little note is given regarding transmission of wireless signals without aerials.

In the Rubber Region of South America

Wireless Telegraphy in Bolivia

By "GRINGO"

IF reference be made to a map of South America one may perhaps find marked approximately in Long. 66° W. Lat. 11° S. on the Rio Beni the town of Riberalta, having a population of about 2,500, where has lately been established one of the wireless stations contracted for by Marconi's Wireless Telegraph Co., Ltd., for the Bolivian Government. As might be presumed, the journey from England to Riberalta is long and tedious, to say nothing of expensive. Leaving Liverpool on 1st July in one of the Booth Line steamships and calling at Havre, Vigo, Leixões (for Oporto), Lisbon, and Madeira, we arrived on the 19th July at Pará, where a number of passengers disembarked, and cargo, consisting of bags of salt, casks of wine and cases of onions, was discharged. We cleared from Pará in the afternoon of 22nd July, and all those who were making their first acquaintance with the Amazon looked forward to an interesting time to Manaos, but I think after twenty-four hours everyone on board with the exception of the captain, officers and pilots, had lost all interest in the scenery, which consisted in mile after mile of forest, with an occasional hut built up on piles along the banks. In the morning of 26th July we arrived at Manaos, the ship's destination, 5,600 odd miles from Liverpool, where passengers prepared to leave, get their luggage through the customs, and hunt up hotels or friends. After attending to our baggage and getting settled in an hotel, the next question was to find out the most convenient river steamer wherein to continue our journey to Porto Velho on the Rio Madeira; we were advised there would be one up from Pará on 2nd or 3rd August. Accordingly we held ourselves in readiness to proceed by it, but on making further inquiries on the 2nd we were told this steamer had met with an accident on the way, but perhaps to-morrow we could leave; we called again at steamer office next day, and received a similar reply; finally another boat was put into commission, and we were notified to be on board by the night of the 7th, and after a sleepless night amidst the din of loading we got under way following morning. After being accustomed to English hours for meals, the times on these river steamers are rather disconcerting at first, as coffee is served 6 till 7 a.m., lunch 10.30 a.m., dinner 4.30 p.m., and tea or coffee again 8 p.m., and it is advisable for anyone with a good appetite not to be misled during the course of the two principal meals into laying down his knife and fork to look at anything of interest on the river bank behind him; if you must look round keep a grip on knife and fork, otherwise the plate is immediately snapped up by the attendants and carried away; there is evidently some ulterior motive here, as it is against their nature to hurry over anything else. There is no unseemly haste about the progress of steamers and launches on the Amazon and its tributaries, because it does not pay, for this reason: it is not every day that those who live at scattered intervals along the banks have an opportunity of conversing with those from the more populous centres, consequently when a steamer calls at one of these places and they have cargo for shipment they expect the *commandante* to come ashore and have a yarn and drink, or else the solitary ones come aboard the steamer for like purpose, all of which goes a long way towards the ship getting the business of the freight. During these stops, mosquitoes and other fly pests get busy with the passengers and *vice versa*; whilst the boat is in motion the mosquitoes are not such a nuisance owing to the slight breeze created by move-

Porto Velho.

ment. On the morning of the 15th August we arrived at Porto Velho, and left the steamer without any feelings of regret. Porto Velho, on the Rio Madeira, is a terminus of the Madeira-Mamoré Railway to which it owes its origin ; it consists of a fine locomotive repair shop, well designed mosquito-proof offices and quarters for the staff, a good hospital and a high power Marconi station communicating with Manaos and other places in the Acre region of Brazil, and now also with Riberalta in Bolivia. The other terminus of the line is at present at Guayaramerin, 364 kilometres distant in a south-westerly direction. During the construction of this line, which took about four years to build and was opened in 1912, the loss of life was enormous owing to malaria, black-water fever, beri-beri and various other tropical diseases, as testified by the official statistics and the groups of graves at frequent intervals alongside the track ; quinine is still kept on the tables at meal time in the messes.

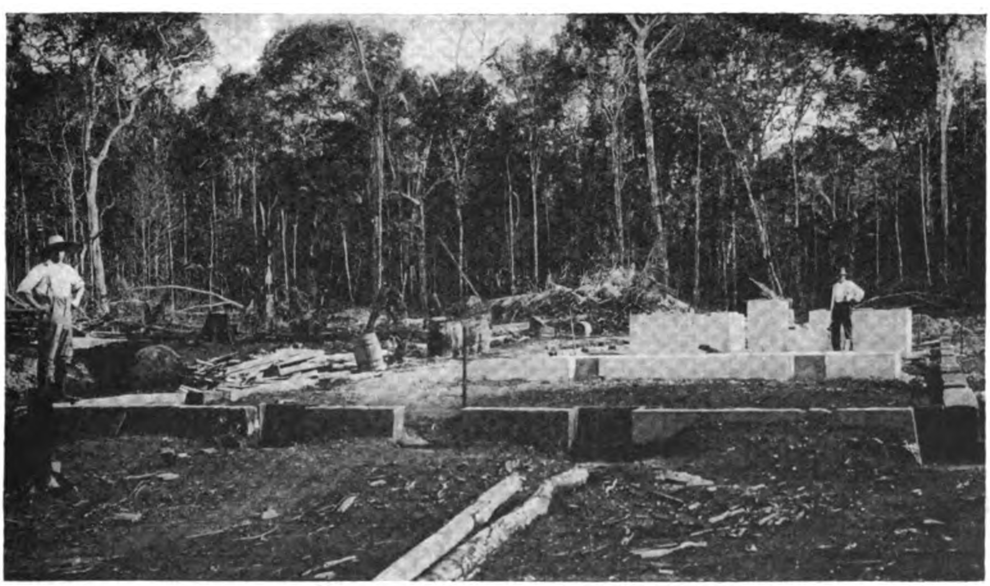
After a delay in Porto Velho of twelve days, we took train at 8.20 a.m. on the 27th August, reaching Abuná (137 miles) same evening at 5.30, where the train stops for the night In the ordinary course we should have proceeded next morning, but owing to some further delay did not leave till 7.45 a.m. on the 30th, arriving at Villa Murtinho (58 miles from Abuná) 12.40 p.m. Villa Murtinho is situated at the junction of the rivers Beni and Mamoré, which together form the Madeira river, and here passengers for the Beni leave the train. After lunch we crossed the Mamoré to Villa Bella on the Bolivian side, a small town of 300 odd inhabitants, possessing a customs house and offices of several commercial houses engaged in the rubber business. We were informed we should have to stay here overnight, so set about finding a place to put up in. The hotel accommodation in Villa Bella is not exactly palatial, but the ants, beetles and rats seemed to find it to their satisfaction—it at least affords cover from the rain if one selects a good part in the roof below which to sling a hammock or set a camp bed. The room we occupied was in a block of huts constructed of tree bark nailed to uprights and roofed with a thatch of palm leaves and having an earth floor covered with bark—in places. There were no sanitary arrangements whatever, no furniture, and the rate was, with three very inferior meals, 10 *bolivianos* (16s. 8d.) per head per day. The

Natives in a Canoe.

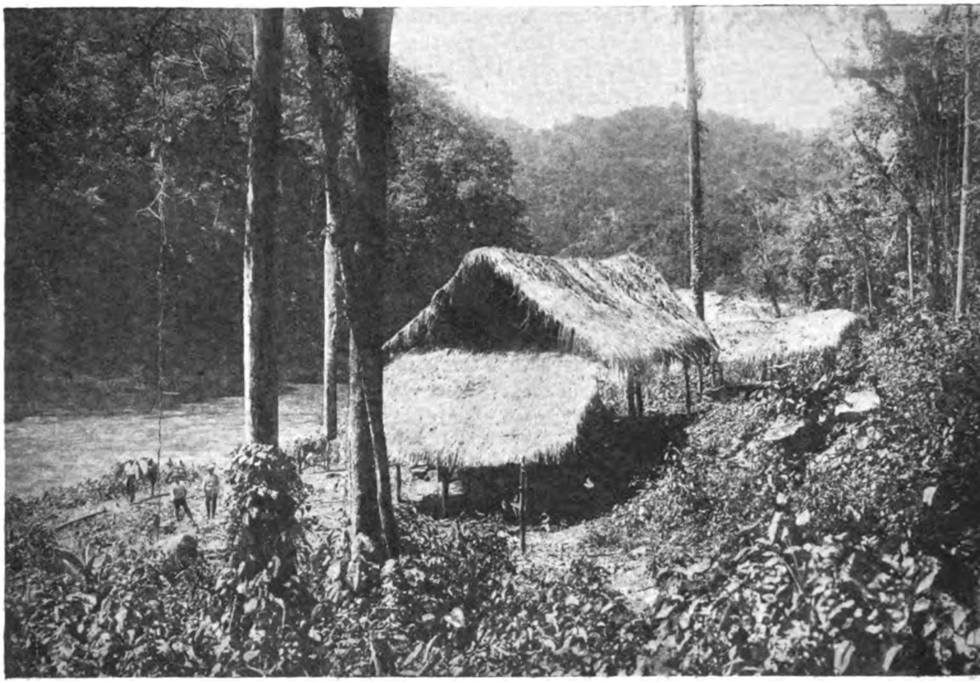
walls of these huts were of the "open ventilated" type (cracks in the bark varying in width up to ¾ inch) and the natives in the street and next room took full advantage of the fact to watch us settle down; had they understood English they might have picked up some useful additions to their vocabulary. Owing to someone in the next room moaning throughout the night in the throes of fever our first night's sleep was not a success, neither was that of the following night on account of our neighbours having got hold of a guitar and some alcohol. During the afternoon of the 2nd September we left in a motor *batelone* (large cumbersome boat) for Cachuela Esperanza, about 30 miles up the Beni, arriving there 6 p.m., where we had to get out and walk about 700 metres round the rapids to a steam launch on upper side. Next day the crew were busy loading mast sections on the launch and a *batelone*; when the *commandante* thought he had sufficient sections in the hold he ordered the hatch covers to be put on, but the engineer of the launch thought the hold would take more, the *commandante* thought not, so they proceeded to bet on it one bottle of whisky (13s. 4d.) for every other section that could be stowed in hold—the upshot was the engineer was three bottles of whisky to the good, and we left for Riberalta that evening, 80 odd miles up river, and also that night made our first acquaintance with *charque*. *Charque* is meat cut into layers, dried in the sun and lashed with a strip of thong into bundles; we had seen these bundles pitched off the train at various camps along the line on to the dust, where they were walked on and spat on, and upon making inquiries as to what they were we were told we would find out later on. The greater part of the following day was spent in cutting and loading firewood, and in a hopeless endeavour to escape the attentions of flies; these flies came on duty at sunrise, and the place where they had bitten was marked by a small blood blister which itched for hours, the mark remaining two or three days. At dusk the flies "handed over" to the mosquitoes, and the only way to get peace was to retire to bed under a net. There was one particularly dirty member of the crew of the launch whose hands were covered with sores: this turned out to be the cook. I discovered this when I saw him mixing up the dough to

A Rubber Gatherer.

make bread. In the afternoon of 5th September we arrived at Riberalta, 6,610 miles from Liverpool, having taken 67 days for the journey. Riberalta stands in a clearing on a level piece of ground about 60 or 70 feet above low river level; the town is laid out in 100 metre square blocks with streets 15 and 20 metres wide, the houses being built of adobe or split bamboo or bark and roofed with tiles, corrugated iron or palm thatch. It is (or was) the seat of the *Delegacion Nacional de Territorie de Colonias*, the *Delegado* being the President's representative in the region; there is also a garrison, power-driven *Delegacion* workshop, steam sawmill, brickworks, ice-making plant, and a mixed population comprised of Spaniards, French, Italians, Germans, Swiss, Greeks, Turks, Japs, Chinese, Chilians, Danes, Peruvians, Colombians, Brazilians, Barbadians and one Englishman, whilst there are Spanish, French, and German Consuls. The imports include all kinds of merchandise, but the sole exports at present are rubber and caoutchouc, and there is a North American syndicate negotiating with a view to taking up the exportation of cedar, which is very abundant on the Beni, though whether this can be done profitably is questionable owing to excessive freights on rail and river. There are seven firms having offices and stores in Riberalta, and rubber lands in the region, two of these being Bolivian houses, four German, and one with head office in Paris; there are no English concerns. The gathering and preparation of the rubber latex is rather a laborious process, as it is all done by hand and the trees are scattered about in the forest, not in plantations as in the East. It is accomplished in the following way:—the labourer sets out with a number of small cans and an axe with which to make incisions in the trees, and at the lowest point of these incisions he fixes one of the small cans into which the latex drains; after some time he returns and collects these tins and proceeds to coagulate the latex as follows: a fire is made on the ground, using a certain kind of nut as fuel, and over the fire is placed a cone-shaped sheet iron funnel with an opening in the apex through which the smoke and heat issue, and over this opening a stick is supported horizontally and free to rotate, and on this stick some of the latex is poured and coagulated by the smoke and heat, layer after layer being laid on till the ball is of the required size, some of these weighing 150 lbs., though they vary a lot. The making of these balls is not continuous, however, from the first layer to the last, as time has to be allowed between layers to give the moisture a chance to dry out; fresh



Early Work on the Station.



Typical South American Jungle Scenery.

rubber sent from Riberalta loses 4 per cent. in weight sometimes by the time it reaches Pará. Rubber is used in the district to make boots, tobacco pouches and rainproof ponchos; to make boots a block of wood is cut out to the shape of the foot and the latex coagulated on it as above; for ponchos a very light cotton cloth is used and served with a layer or two of rubber, or better still caoutchouc; this makes a light waterproof coat which folds into a small space. The following figures will give an idea of cost of various articles in Riberalta, though prices of some of these fluctuated from time to time: 1 lb. tin jam, 5s. 10d.; tin condensed milk, 2s. 6d.; sparklet syphon (2s. 6d. size), £1 9s. 2d.; 1 lb. tin biscuits, 5s.; whisky, per bottle, 13s. 4d. to 20s.; British and German beer, per bottle, 10s.; ginger ale, 4s. 2d.; five gallon tin gasoline, £2 18s. 4d.; five gallon tin kerosine, £1 8s. 4d. to £2 16s. 8d.; nails, 5s. per lb., etc.

To show what a boon to Riberalta and the region generally the new Marconi station is, it is only necessary to mention the following facts with regard to telegraphic communication. Before the wireless service was established, out of five cables received from London the following delays between Porto Velho and Riberalta occurred, 13, 8, 13, 12 and 16 days respectively, whereas now cables from London will be received in Riberalta the day after despatch, provided the traffic is not too heavy. Mails from England average about 52 days for the journey if directed *via* Pará and Manaos, but if not so marked they go *via* La Paz, taking about 90 days. Letters from La Paz, the capital of Bolivia, 480 odd miles as the crow flies, seemed to require 50 days, and from Yacuiba in the south of Bolivia 72 days appeared to be the average time. The Marconi station is situated on a cleared piece of land some 5½ hectares in extent on the outskirts of the town, about ten minutes' walk from the *Plaza* and *Delegacion* offices. The building itself, measuring 46 feet by 34 feet with a 6 feet 8 inches verandah all round, is constructed of cedar, double-walled, resting on a brick foundation; drawings were made out for a skeleton framework in sections, the individual members of these sections being cut to requisite lengths at the sawmill, carted to site, pieced together there, and erected and made fast to the brick foundation and then securely bolted together; the inside and outside of sections were then sheeted with tongued and grooved planks, having a space between walls of 4 inches. There are six rooms, viz., engine, transmitting, and receiving rooms, store, engineer's office and public office. The prime mover is a 4 cylinder petrol engine driving the alternator-exciter-disc combination by means of a belt passing through a slot in the dividing wall to the transmitting room. Reception is obtained by either crystal, valve, or magnetic detector. The aerial system, consisting of a long and a short wave aerial, is supported by four 250 feet steel sectional masts, the masts being planted at the corners of a rectangle 800 feet by 200 feet. The earth system is composed of a metal strip laid in a trench running underneath the station from side to side, and to the ends of this strip are connected wires radiating to a semicircle of buried zinc plates. Before this network was fenced round a good deal of annoyance was caused by cattle stampeding across the wires and wrenching them off the strip connection, also when excavating mast foundations cattle were a nuisance, as on several occasions they fell into the holes during the night. The method employed to get them out was by means of planks put into the holes at an angle from the surface, a noose was then put round the beast's horns and the animal thrown on its side on the planks and hauled up. For the erection of the masts the workers were composed of Spaniards, British, West Indians, Bolivians and Brazilians, and of these the Spaniards proved the most satisfactory.

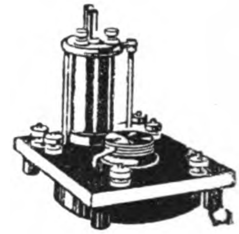
As there was no stone in Riberalta for making concrete for mast and anchor foundations this had to be brought either from Cachuela Esperanze, 80 miles down river, or from Rurrenabaque, 500 miles up river; fortunately we obtained the necessary permission to remove rock from Cachuela on the condition that it was done without blasting; from the date of arrival of the first load till the arrival of the last was three months. Had it been necessary to go to Rurrenabaque, the time occupied would probably have been nine or ten months. Sand was obtained from the opposite bank of Rio Beni before the river rose, as in the rainy season the sand is submerged; this year the Beni rose some 40 feet above its dry season level. The rainy season commences in November and continues till the latter end of March, and during each day of this period heavy rain may be reckoned on, which detracts somewhat from the pleasure of outdoor work. The day temperature throughout the year is fairly equable, seldom rising above 92° F. in the shade and generally falling a few degrees at night; during the dry season, however, "*Surs*," or cold south winds, occur at intervals, lasting two or three days, when the temperature will drop 30° F. or so in little over an hour sometimes, and comparatively speaking the cold is intense.

Besides rubber and caoutchouc, there are many other commodities of commercial value in this region, such as coffee, sugar, cacao, coca (from which cocaine is extracted), vanilla, cascarilla (from which quinine is obtained), cotton, and so on, but owing to scarcity of labour and high freights these are not developed to any extent. When these defects are remedied the region should enjoy greater prosperity than even that of the days of the rubber boom.

[*Travelling in Bolivia is at present excessively uncomfortable and fraught with a certain amount of danger, so that the article from the pen of our contributor should prove of more than usual interest to lovers of exploration and those who are fascinated by reading the experiences of people whose business calls them to this little known and rarely visited region.*—ED.]

On the Rio Beni.

The ENGINEERS Note Book



[Under this heading we propose to publish each month communications from our readers dealing with general engineering matters of various kinds in their application to wireless telegraphy, and we would welcome criticisms, remarks and questions relating to the matter published under this heading. We do not hold ourselves responsible for the opinions and statements of our contributors.]

Porcelain Insulators. (II.)

IN the September issue we dealt with the manufacture of porcelain insulators and showed the care that is necessary in selecting and combining the various ingredients. Equal care has to be given to the design. A well-known American expert recently said that the modern electrical porcelain involves more attention to the form of the parts than the most fastidious Greek ever gave his. If in the ancient Greek art the curves were poor, it displeased some of the cultivated eyes—that was all. If in modern electrical porcelain the curves are poor, thousands of people are deprived of light and power.

The testing of insulators after their manufacture is also of paramount importance. The expert to whom we have referred above—Mr. E. E. F. Creighton—recently delivered a paper to the American Institute of Electrical Engineers in which he gave details of a large number of tests of porcelain insulators carried out by means of a high-frequency oscillator. This consisted of a combination of a 60-cycle transformer, a condenser, a spark-gap and an oscillation transformer. Most interesting and instructive results were obtained, many of which will enable the manufacturers to see exactly where the fault lies and how it might be avoided in future. We may instance a test for faults in the skirts of suspension insulators which in many cases gave punctures which traversed a distance nearly twice as great as the thickness of the porcelain. The samples were shown to a porcelain manufacturer, who immediately set the cause of the trouble to the improper use of the tool used in forming the thread on the inner surface of the porcelain. It is probable that the fault could be attributed to insufficient plasticity, which may in turn be due to lack of water, lack of enough ball clay, or to too large particles of flint. It is easy to conceive of the more plastic clay being squeezed out from under the tool, leaving the material directly under the tool of a different consistency from the rest of the body of the porcelain. From this difference in body, weaknesses may be caused either in the rate of drying or in the vitrification due to the improper proportioning of the ingredients in this locality.

Our readers will be well acquainted with the fact that with very high voltages a conductor may often be surrounded with a bluish-violet glow, or "corona." The growth of this corona around the electrodes and on different parts of the insulator has been successfully used as a basis of design. The oscillator with its high frequency is well adapted to bring out the characteristics of design by this method. From some points of view the ideal design of an insulator would be one producing no corona until the arc-over voltage of the insulator was reached. From the practical point of view the laboratory test, unless made under the same conditions as are found in the operation of the insulator, does not necessarily give the best design. For example, if an insulator is to be designed for a very dusty country or where soot and smoke will be deposited on the surface of the porcelain, the conditions call for extra long surfaces for creepage. If an insulator in a clean condition is tested in the laboratory for the appearance of corona, the corona will appear at a comparatively small fraction of the arc-over voltage. Yet, if this insulator is thoroughly coated with a semi-conductor, as would occur in practice, it is quite probable that the apparently faulty design would be far better than one with shorter skirts which in the laboratory tests in a clean condition gives a higher percentage of voltage for the appearance of corona. In brief, one must take into account the use of the insulator and reproduce the operating conditions as far as possible.

Under certain conditions it has been found practicable repeatedly to puncture and weld up the puncture holes in porcelain. There seem to be certain requirements in order successfully to weld up the holes. The best results were obtained by Mr. Cermak in the tests of large porcelain cups which were made up of several different kinds of clay, but all fired at the same time. These cups were partially filled with water, which acted as one electrode, and the other electrode was a wire wrapped around the outside. The punctures noted never took place directly under the wire and therefore no copper vapour was carried directly into the puncture hole. Since the other electrode was water, no metallic vapour could be obtained from this source. The punctured spots in this porcelain appeared as a small bead of clear glass, which actually had greater dielectric strength than the porcelain elsewhere, as no welded punctures were repunctured by a second application of potential.

Comparative tests were also carried out with pieces of porcelain and glass. During these tests a curious feature of the porcelain was remarked. It was found that an increase in the thickness of porcelain from 0·4 in. to three times as much, or 1·2 in., gave an increase in puncture potential from only 74 kilovolts to 91 kilovolts, which is 13 per cent. Three hundred per cent. increase in thickness gives 13 per cent. increase in puncture potential. Although this general condition of increasing the thickness without increasing the puncture potential is known, the small percentage of gain from an increase in thickness may be new to many.

When a puncture has occurred in an insulator, it is often necessary to break up the insulator for the purpose of finding what path the puncture has taken. The following technique has been used to advantage in the examination of the porcelain, and in most cases has indicated the nature of the fault. In many cases the cause of the fault has been traced to a particular condition of manufacture which needs to be improved. In beginning the tests of a piece of porcelain, the first step is to determine the presence of accidental flaws so far as possible.

Soaking in Eosin stain or aniline violet dissolved in alcohol, under vacuum, allows the penetration of the stain into the open air pockets and laminations. A dark stain may be used for this purpose. The stain is then washed off the surface of the insulator. Frequently the cracks will be shown up by the streaks where the stain has soaked into them, and will not wash off. The insulator is then dried and punctured under oil. It is removed from the oil and the oil is washed out with gasoline or some other solvent of oil. The insulator is then thoroughly dried at a temperature above one hundred degrees. It is then immersed in red aniline stain (alcohol solution) and placed under a vacuum. The red stain will penetrate most of the holes and cracks that are opened up by the punctures. In removing the insulator from the stain, it is wiped off and washed off and dried, to prevent discoloration later in handling the broken pieces. The porcelain is then broken up. The original cracks are shown by the dark stain with a layer of red stain on top and the developed cracks are shown by the red stain alone. In some cases it is found difficult or impossible to remove the oil from a crack, and this oil will be found on the surface of the crack as an indicator that the crack was produced by the discharge. Any surface of a broken piece which shows neither stain nor oil, it is natural to infer, is produced by the mechanical strains of the hammer or vise. The alcohol solutions are far more penetrating than solutions in water, such as ink.

A "TALL ORDER."

Extract from a letter to the Editor:

"Please could you send to the above "name and address full particulars of the "wireless system. . . . If you could I "should be only too pleased to receive "them and let you know the results."

Administrative Notes

New Zealand.

Amended radio-telegraphic regulations provide that radio-telegrams to or from ships trading exclusively between ports on the coast of the Dominion of New Zealand, while such ships are voyaging between the Ports of Lyttelton and Wellington, from or to any telegraph-office in the Dominion of New Zealand shall be charged at the rate of 2½d. a word, with a minimum charge of 1s. 3d. for each radio-telegram, equal to a message of six words.

Arrangements have been made to telephone free of charge to the addressee any radio-telegram the address of which includes a telephone number.

* * *

Twenty-seven ship stations are registered in New Zealand and regulations for controlling the use of wireless on British and foreign ships, not registered in New Zealand, while they are in territorial waters were gazetted on the 16th July, 1914, and are now in force.

* * *

Oceania.

We have been advised that since January 1st, 1915, New Caledonia and Tonga have subscribed to the International Radio-telegraph Convention, signed at London on July 5th, 1912.

* * *

South Africa.

A further convenience for mariners is reported from South Africa. We understand that the Union Government wireless station at Slangkop will transmit wireless time signals daily. The signals are sent at 11 o'clock at night, South African time (9 p.m. G.M.T.).

* * *

Sweden.

The *Times* of 10th September last contained the following paragraph :

"The Swedish Government recently asked "the German Government that commercial "telegrams emanating from Sweden might "be sent by wireless telegraphy from Nauen "to New York. This the German Government has assented to, but on condition "that the telegrams be important and that "they do not exceed 25 words in length. "This arrangement is looked upon in "Sweden as extremely important, as it "affords a quicker service than that *via* "Serbia and at the same time avoids the "British cable censorship."

* * *

United States.

We are informed that the Sagaponack station (call letters "WSK") has been temporarily discontinued, and until further notice traffic will be dealt with by the coast stations at Seagate ("WSE") and Siasconset ("WSC") in place of the Sagaponack station.

* * *

The September number of the *Wireless Age* contains the following paragraphs :—

"It is pointed out in a dispatch from "Washington that the opening of the new "United States naval wireless station at "Darien, on the Canal zone, does not add to "the facilities for the transmission of "commercial messages. The new station "will be used exclusively for Government "business. Primarily, it will be used as a "means of directing operations of various "kinds on the Canal zone, and keeping in "communication with ships at sea, but it "will also be used freely by the Department "of Commerce for the sending of its official "messages.

"Out of a total of forty-seven naval radio "stations now in use in various parts of the "United States or its possessions, twenty-"one, it is declared, are open to commercial "messages, the others being reserved strictly "for official business. In the Canal zone "there are two stations—at Balboa and at "Colon—which receive commercial messages, "so that the new station need not enter that "field in order to accommodate the public, "as the facilities are already ample.

"Plans have been made for radio com-"munication between San Francisco and "Manila by way of Honolulu. The section "to Honolulu will not be in operation until "a year from this time."

Correspondence

"The Calculation of Inductances."

To the Editor of THE WIRELESS WORLD.

SIR,—The article on "The Calculation of Inductances," by Mr. Lowey, in your October issue, is of great interest.

Unlike the capacity of a condenser, the self (and mutual) inductances of coils such as are used in wireless circuits can be calculated to a high degree of accuracy by the use of appropriate formulæ. There are a large number of formulæ now available for every conceivable case, but the majority of them, including even the most convenient and easy to work with, are not known as widely as they might be to those who are interested in these matters.

In the case of the capacity of a condenser the formulæ available are not of great accuracy for most of the forms of condensers which are in general use where a dielectric other than air is used, the variability of the dielectric constant for different specimens renders difficult an accurate predetermination of the capacity.

In the case of a coil the inductance depends principally on its geometrical form and can be predetermined with great accuracy, which is an important point for some purposes. The representation of the inductance by a chart or scale such as that described by Mr. Lowey in his article is extremely useful, since it avoids the use of tedious calculations and, therefore, facilitates the process of selecting the most suitable sizes of former and wire for the purpose in view.

Unfortunately the value of Mr. Lowey's chart, which must have entailed considerable work to construct, is somewhat reduced by its inaccuracy, which is apparently due to the fact that Dr. Cohen's formula, on which it is based, is not a suitable one to use for the purpose.

The formula in its original form is intended for the inductance of a multi-layer coil, and the form quoted in *The Year Book of Wireless Telegraphy* has apparently been obtained by eliminating the terms which depend on the number of layers.

In *Formulæ for Mutual and Self Inductance*, bulletin of the Bureau of Standards, U.S.A., Vol. 8, No. 1, the formula is given as an approximate one with an accuracy of a half of one per cent. for $L=2D$.

A much more convenient one to use is that of Professor Nagaoka $L=l(\pi DN)^2 K$ in which the factor F worked out by Mr. Lowey is given directly. A table of the values of this factor to six places of decimals with first and second differences will be found in the pamphlet quoted.

From this it is seen, for example, that the inductance of a solenoid with length equal to its diameter is ·6884 and not ·636 times $l(\pi DN)^2$ as given in the article.

In addressing this letter to you I am prompted not so much with a view to criticism of Mr. Lowey's article but because it shows how useful an exchange of information on subjects like this may be, since it must often happen that one person has access to more extensive or more reliable information than another, and the great labour which has been expended in the derivation of formulæ such as those here mentioned deserves that the results should be made known as widely as possible to all those who are interested.

This exchange of information and ideas can best be carried out in the columns of a journal such as THE WIRELESS WORLD, which is devoted to the subject.

In the matter of practical construction of apparatus a great deal has already appeared, but as regards theoretical points much more might be done. The amateur, who constructs a wireless receiver with the aid of a ginger beer stopper and some empty tins, is never backward in sending a description and photo of it for insertion.

It is to be hoped that in future his ideas or queries on matters of theory will be forwarded for publication with the same assurance, or will receive enlargement from the work of those who do communicate the results of their work, in this direction, to your columns.

I am, Sir,

Yours faithfully,

"FORMULÆ."

Wireless Telegraphy in the War

A résumé of the work which is being accomplished both on land and sea.

OUR contemporary the *Morning Post* recently issued the following communication from their correspondent in Christiania:

"A business man residing here has within "the last few days received messages sent "by wireless telegraphy from America to "Germany and thence in the ordinary way "to Christiania. I learn that there are two "wireless routes between America and Ger-"many—namely, between Tuckerton (New "Jersey) and Eilwese, near Hanover, and "between Sayville (Long Island) and Nauen, "near Berlin. No official information has "been issued to the effect that wireless mes-"sages will be transmitted from America to "Scandinavian countries by way of Ger-"many; and certainly no messages are "accepted for transmission by wireless in "the opposite direction."

The whole situation would appear to have arisen through the fact that the wired lines connecting the Scandinavian countries with America are under British control. The British censors seem to have delayed, and in some cases even to have stopped altogether, business communications thus coming under their control. A certain number of complaints were received by the Norwegian and Swedish Governments, and a meeting was held to consider the situation. The German Government heard of this convention, and put before it an offer to receive the various business telegrams in Germany and transmit them by their long-distance wireless stations to America. The experiment was tried; but the Germans in their turn seem to have tampered with messages, with the result that (we understand) the arrangement completely broke down. This is only one of many instances from which neutral countries are bound to suffer to some extent when their powerful neighbours are in conflict.

* * *

An interesting point confirming the utility of wireless stations in Germany has recently appeared in the report issued by Vice-Admiral Patty, concerning the operations of the young Australian Navy at the beginning of the war. In the course of August of last year the gallant Admiral was endeavouring to get into touch with the *Scharnhorst* and the *Gneisenau* with the object, of course, of destroying them. He formed an elaborate campaign for getting them at Simpsonshaven. But the German wireless station at Rabaul communicated the movements of the British Fleet to the enemy and frustrated Admiral Patty's manœuvre. When we remember that those two ships destroyed the British Pacific Squadron off the Chilian coast a couple of months later, it will be recognised that this German wireless station fully justified, by this one act, the whole expenditure involved in its erection and maintenance.

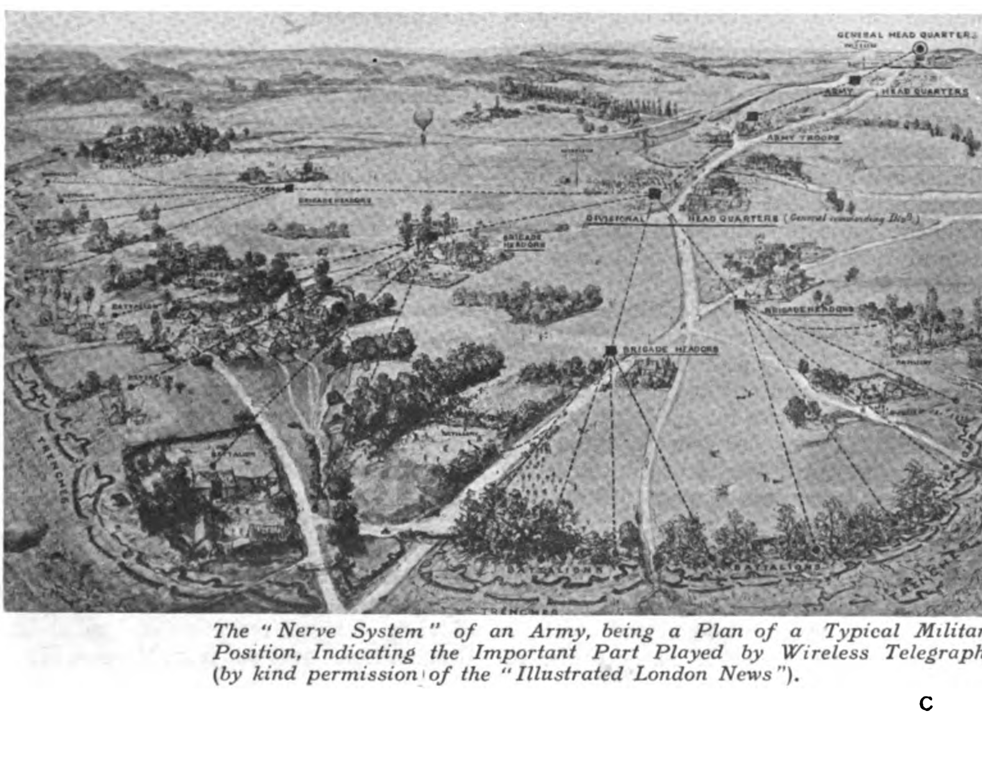
* * *

The wireless stations in Africa captured from the Germans are likely to prove by no means the least valuable of the booty taken. The right flank of General Botha's advance northward, commanded by Colonel Myburgh, crowned their efforts by the capture of Tsumeb. The town and garrisons surrendered on demand, and the entire German battery with its full complement of officers and men fell into the British hands. The enormous supplies taken at this town included 5,000 cases of rum and new equipment for 10,000 men. The Germans destroyed their cartridges, but their *wireless apparatus* was so little damaged that it was possible to communicate the same day with the Slangkop Station at Cape Town. When we remember that one of the principal defects in opening up vast tracks of undeveloped country consists of lack of means of communication, the value in the future of those powerful and well equipped stations can hardly be exaggerated.

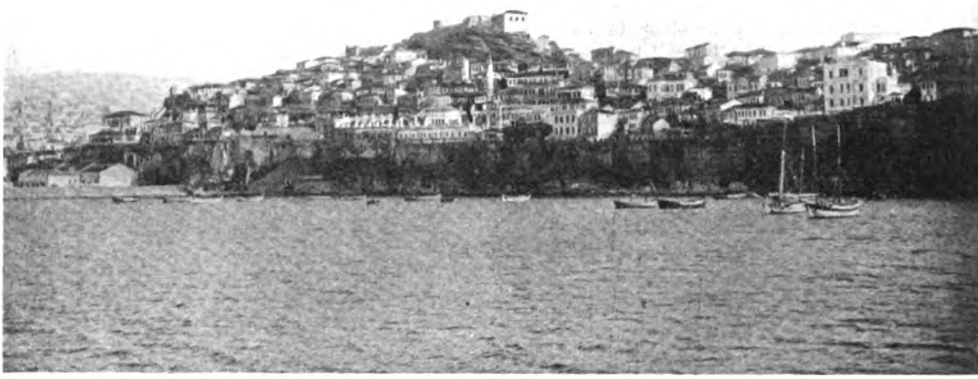
Our illustration of a typical plan of military operations (which is reproduced by kind permission of the *Illustrated London News*) will serve to indicate the way in which operations of a modern army in the field are assisted by wireless telegraphy. Series of dots represent the main threads of the spider's web formed by the lines of inter-communication between the General Headquarters and the various units. Messages are passed between all parts of the war area by various means of communication —by wireless, by ordinary telegraphic and telephonic lines, by messengers on motor-cycles, or mounted dispatch-riders. All means are employed; but, under the intense concentration of artillery fire which characterises the present-day battle, the only one which can be looked upon as absolutely reliable is wireless. Over and over again it has been found in certain sections almost impossible for orderlies or dispatch-riders to cross a fire-swept zone, whilst telegraphic and telephonic wires are smashed by high explosives almost as soon as they are laid. Only the invisible æther waves remain unaffected, and it is for this reason that more and more on the field of battle, as well as at sea, the reliance of the higher command is leaning towards wireless. As far as aerial reconnaissance is concerned, it is the only form of communication available under *all atmospheric conditions*, and the vast increase in France's aerial fleet, to which we refer below, has necessitated, in the course of this war, the taking over by the French military authorities of the training of their own wireless aeronauts.

* * *

Count Reventlow's letter to the *New York World* on the subject of the German Fleet, its lack of achievements, and the reasons for it, naturally makes great play with the exploits of the *Emden*. We have many times pointed out that the successes won by this raiding cruiser were due to the help of wireless; but it is interesting to learn that our view has been confirmed by the deliberate statement of Captain von Mueller himself. A Mr. Haumann, recently released from four months' internment in Australia, on arriving at Fremantle, gave an interview to a representative of the *Western Australian*. This is well worth reading, if only for the anecdotes told to Mr. Haumann by Captain Mueller instancing the different ways in which wireless had enabled



The "Nerve System" of an Army, being a Plan of a Typical Military Position, Indicating the Important Part Played by Wireless Telegraphy (by kind permission of the "Illustrated London News").



Kavalla, which, like Salonika, Forms an Excellent Landing Place for Troops.

him, not only to "play up" his pursuers, but to catch his prizes.

* * *

The most striking feature of the European war which has occurred during the past month consists of the sudden establishment of the Balkan war in the forefront of military operations. From the point of view of the Allies, the principal happening of importance consists of the landing of the British and French troops at Salonika, and we accordingly feel that our readers will appreciate the views reproduced in these pages. Two of them (pages 510 and 511) show the wireless station there taken from different points of view, and it is certain that both permanent land stations and wireless field equipment will play as fully an important part in the forthcoming struggle of Serbia for existence as they have done in other parts of the world. Of our other views, that on page 509 shows a typical street scene in the town, whilst the illustration on page 512 gives a very fair idea of the port itself, the latest scene of operations for the French and British fleets. Our illustration on this page represents Kavalla, the only other port on the Macedonian coast equipped with a wireless station, which is likely to be of service to the Allies in the forthcoming struggle against Bulgaria. Lying under the protection of the island of Thasos, this port is largely immune from the heavy winter gales which severely handicap the navigation of this coast.

* * *

Amongst the many novelties introduced during the course of this wonderful war, for the first time there figures largely in the Press, not only of Great Britain but of the whole world, a number of miscellaneous items generally denominated as "Wireless News." Although by no means confined to news from Germany, but regularly including items from France, Italy, Russia, America, etc., the greatest prominence has been given by the newspaper Press to the "German Wireless." The reason for this is that Germany, whose cables were cut within a few hours of the declaration of war, has had to rely ever since for direct communication with the outside world upon her wireless stations, so that *news direct from Germany is only available by wireless*. The value of direct as against indirect communication is highly valued by the Press. From the point of view of speed reception and reliability, German items sent out from Marconi House have to all intents and purposes no rivals to contend with. The war has, therefore, seen initiated the news service of the "Wireless Press," received at all hours of day and night by radiotelegraphy and subscribed to by every newspaper of importance in London. Its services are continually extending, even under war conditions, and are certain of an immense development and many ramifications after the re-establishment of peace.

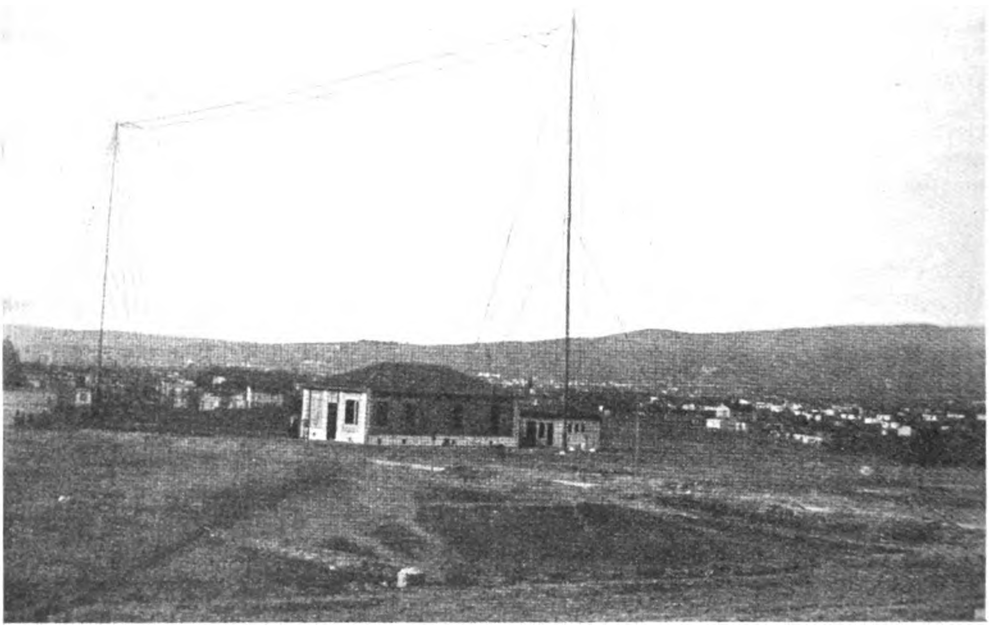
*   *   *

An interesting account of operations in the Dardanelles appeared in the recent issue of the *Aberdeen Journal*, extracted from a letter written by Mr. E. K. Ogilvie, *wireless operator on one of His Majesty's ships.* Amongst a series of pen pictures drawn by the gallant young operator the following will be found especially interesting to our readers: "Our people know where to draw the line. "There was a tower on a hill, apparently a "mosque or shrine, close beside a defended "village. In spite of the fact that shells "from our ships destroyed everything in "and around the place the tower remained "an object lesson to Germany on principles "of 'right and wrong.'"

*   *   *

Few points in the conduct of the present war are more interesting and instructive than the ingenuity which is being devoted to devising novel methods of breaking down the enemy's resistance. The accounts which have recently been allowed to appear in the daily papers dealing with the new aerial fleets of France emphasise the rapid development of this branch of our Allies' military activities. The spread of the wings of these aerial dreadnoughts is 70 feet, and the body will comfortably hold 12 men, although the normal crew will only number 6. The average speed is about 80 miles an hour, and in stability, rapidity, carrying

Salonika: A Typical Street Scene.



Aerial and General View of Wireless Station at Salonika.

power and endurance these new machines are vastly superior to the German zeppelins. The smaller biplanes which, driven at a speed of 100 miles an hour, act the part of "destroyer" auxiliaries to these dreadnoughts of the air, indicate that real fleets cruising as composite units are now possible, and when we come to consider that the whole science of military aviation is the result of 6 years' growth, we shall realise the rapidity of progress made. Of course, it is hardly necessary nowadays to point out that these new organisations have only been brought within the field of "practical politics" by the advent and development of wireless telegraphy, whose experts have had their ingenuity kept continually on the *qui vive* to respond to the fresh demand made by the new conditions under which their science is called upon to work.

* * *

Mr. Allan Baddeley contributes a very interesting paper to a recent issue of the *Fortnightly Review* dealing with the Navy past and present. He draws a very fascinating picture of old time single ship cruising in distant and tropical seas. The essence of the attractiveness of these conditions is contained in the little sentence *there was no harassing wireless*. Upon this depended all the peace of mind engendered in the captain and his officers. "Remoteness from direct authority, the charm of the roving life amidst the genial ports, the hospitality universally extended to the sailor in his wanderings, all tended to induce a state of acquiescence in routine, an eminently human refusal to bother about the possibility of war." Wireless has altered all this, every ship now is in immediate connection with the officer commanding the Fleet or Squadron, he himself remains directly in touch with headquarters. The result is that the British Navy of to-day is an almost perfect machine, whose magnificent qualities have recently aroused a pæan of admiration amongst the French visitors accorded the privilege permitted to no Englishman.

* * *

In our September issue we published an account from the wireless operator of the *Trent* describing the final destruction of the

Königsberg. A further account is given in a letter by Chief Paymaster Charles Spedding of the *Laconia.* He states that "the "bottling up business was all bunkum; the "ship had the choice of five rivers or rather "river mouths to come down, and in order "to get at her it was necessary to run the "gauntlet of a miniature Dardanelles." His description is a very graphic one, and one weird feature in connection with the German vessel's final destruction consisted of the fact that neither the *Königsberg* nor the ships bombarding her could see the object at which they were firing; all had to be done by direction either from aircraft or observation posts. His description of the gallantry of the occupants of the British aeroplanes and the way in which they controlled the British gun fire by wireless is well worth reading:—

"During the second day of action an "incident occurred which calls forth one's "admiration of the pluck and presence of "mind of Flight-Commander Cull and "Wireless Expert Arnold, who were in the "aeroplane that the Germans brought down. "When it was seen that there was something "wrong with the plane, the spotting correc-"tions still continued, and the last message "read as follows: 'Carry on, you are "'hitting her every time forward. We have "'been hit. Coming down on water. Send "'a boat.' A few seconds later the aero-"plane (a land machine) crashed into the "water throwing Arnold out. Cull ex-"tricated himself with great difficulty under "water a minute and a half after she struck. "He had a very narrow escape indeed. "Had these two officers not put the guns on "to the *Königsberg* in time a different ending "of the whole action might have resulted."

* * *

It is not often that a wireless station is "frozen out" for lack of news, yet such appears to have been the case with a German wireless station established at Gross Bay, situated in the Polar regions. The Christiania correspondent of *France de Demains* states that a German settlement had been located here since 1908, when Count Zeppelin established an airship station at Spitzbergen; its object was to exploit the copper deposits of this region, despite the prior British claims supported by the Government. News travels slowly, and we have only just heard that in October, 1914, a British vessel took refuge in Gross Bay from an autumn tempest. The wireless station had not been working for some time on account of bad weather, and the men in charge, who had no idea that war was declared, saluted the cruiser by hoisting the German flag. The glee of the British sailor in having something tangible to "go for" can easily be imagined. The ubiquity of these German wireless stations is quite marvellous, and we are constantly hearing of their presence in all sorts of unexpected quarters. Perhaps if Mr. Savage Landor were once again to make his adventurous way through Tibet he would find German wireless stations on the "roof of the world."

* * *

The *Indian Pioneer Mail* gives some interesting details of the fall of the German post of Bukoba in East Africa, where the enemy had built strong forts, a powerful wireless station and other erections. The enemy put up a stout fight, and the British frontiersmen, under the command of Lieutenant-Colonel D. P. Driscoll, D.S.O., had hard work to make their way up a steep ascent through dense plantations. Eventually, the British worked themselves into a strong attacking position and rushed the fortifications.

* * *

The British nation has recently been profoundly touched by the kind sympathy displayed by the Danish authorities and

Salonika: The Wireless Station Building.

The Water Front at Salonika.

people on the occasion of the Germans' dastardly attack upon a British submarine grounded and helpless on the neutral shores of Denmark. It is, therefore, with some peculiar gratification that we learned recently of the preservation of a Danish crew, victims to German submarine piracy, through the means of wireless. The Danish schooner *Jason*, of Svendborg, had been torpedoed, and the seamen on board her were in danger of perishing when a wireless call at 11 p.m. was received from a neighbouring lightship by some vessels near by, which proceeded to the scene of the disaster and rescued them all.

* * *

The *New York World* was made responsible for the recent exposure of the German intrigues connected with the Sayville station. Their revelations, however, extended considerably beyond this one item. It is alleged on their authority that the Telefunken Wireless Company, acting under instructions from the German Foreign Office, endeavoured to instal for the American Government stations in the Philippine Islands located on positions mapped out by the German Foreign Office. Moreover, according to our enterprising American contemporary, Herr Bredow, General Manager of the Telefunken Company, attempted in 1913 to gain complete control of the wireless plants of South and Central America working in connection with Sayville. Evidence adduced also tends to show that Germany in 1911 made strenuous efforts to obtain permanent land stations in the neighbourhood of Nicaragua with a view to the great utility which would be possessed by them in the event of the Panama Canal being fortified. We would refer our readers for full details as to the methods pursued in the United States by the unscrupulous Teuton to the absorbing article commencing on page 515 of this issue.

* * *

The deliberation with which the great German war plot, which we are now engaged in crushing, was systematically prepared and laboured for many years, has already been made abundantly clear. But additional evidence is continually being brought to light, and we have a fresh exemplification in the discovery of a secret wireless plant in the island of Bréhat, one of the lesser known islets off the French coast, an installation connected with a well-laid plot against our Gallic Ally.

A certain apparently guileless, venerable, and bespectacled German professor visited this pretty little island on the pretence of scientific research, and purchased an old mill on an eminence commanding an extensive view of the tiny Archipelago. Here have been discovered unmistakable preparations for establishing a wireless station, and the details of a daring project for the invasion of France from the sea operating from this point have since come to light. With Great Britain neutral, the French Fleet was to have been "suitably accounted for," and a large number of transports were to convey thither two army corps from Bremen and Hamburg. Thus was to have been established an island stronghold, forming an organised centre for Germans rejoining the Colours from the United States and South America, and it was estimated that a German army of about 200,000 men would, within a short time after the outbreak of hostilities, be operating from this point in Brittany, thus taking the French armies in the rear. Of course this was one of the plots which was frustrated immediately it was made evident that the standard of Great Britain was being unfurled against the encroachments of the modern Huns.

* * *

An interesting account of an interview with the captain of a British transport has recently come through from Montreal. Whilst engaged in transporting troops to the Dardanelles one day in the late spring of this year, a wireless call for assistance was received from a sister transport which was being attacked by an enemy torpedo boat. Captain Edward Thomas asked for wireless instructions, and in view of the fact that he himself had troops on Board, was promptly ordered to "clear out!" In the meantime the enemy torpedo boat found that the wireless of the helpless vessel they were attacking had summoned British destroyers from about 12 miles away. For over 40 miles the enemy was able to keep away from the British ships of war, but eventually he was obliged to beach his boat on an island in such haste that when the British pursuers arrived they found the engines still running. This isle of refuge was only a square mile in area, so that the exciting man-hunt which ensued on the arrival of the British was speedily and completely successful. The gallant captain closed his interview with the Canadian reporter with a reference to the remarkably effective co-operation of the Fleet with the landing forces in the Dardanelles, and with expressions of admiration of the marvellous shooting made by the gunners of the *Queen Elizabeth*.

* * *

Our illustration below depicts a sight which is now common on every battlefield—namely, the erection of the wireless masts as part of the great nerve system whose centre is the General Headquarters and whose ramifications are dealt with on p. 507 of this issue.

NOTES OF THE MONTH

THE Northampton Polytechnic Institute, of St. John Street, London, E.C., has favoured us with a copy of their recently issued "Announcements" for the session 1915–16, in which we notice that there are day and evening courses in various subjects. These include engineering (civil, mechanical and electrical), whilst this subject is further subdivided under the headings automobile work, aeronautics and radio-telegraphy. We are informed that in the electrical engineering department various transformers and motors of special types have been added, and a Tirrell regulator and a Mercury Arc rectifier installed. The instrument equipment has also been extended.

* * *

The following paragraph, taken from the tenth annual report of the Meteorological Committee to the Lords Commissioners of His Majesty's Treasury, for the year ended March 31st, 1915, may be of interest to our readers :—

"During the first seven months of the "year the arrangements for the collection "of information by wireless from Atlantic "liners were carried out on lines indicated "in previous reports. The number of mes-"sages received was well maintained. A "further improvement in the direction of "avoiding delay in transmission can be put "on record. The percentage of morning "reports which reached the office in time "for inclusion in the current issue of the "Daily Weather Report increased to 9·4 "per cent., as compared with 7 per cent. "for 1913 and 5 per cent. for 1912."

* * *

Mr. Godfrey Isaacs, Managing Director of the Marconi Wireless Telegraph Co., made the interesting statement recently to the London News Agency that had it not been for the war we should now have been telephoning by wireless to New York.

He was approached on the subject, he said, as the outcome of the successful experiments of the United States Navy Department in telephoning by wireless from Arlington, Virginia, to Mare Island, California, a distance of 2,500 miles. "Our "experiments," he added, "have been "interrupted by the war, as our stations are "now used for Government work. But we "have carried our experiments far enough to "know that undoubtedly after the war "we shall be able to talk to New York."

"Senatore Marconi has been experiment-"ing with Wireless Telephony for a long "time. There is nothing new in being able "to telephone by wireless over a long dis-"tance. The great point is to make it a "practical proposition. It is to that end "that Senatore Marconi's experiments have "been directed, and to make it more "efficient and turn it to practical commercial "account."

* * *

For the first time in the history of the automobile it has been demonstrated that a car can be started from a distance by means of wireless. This was proved recently when the motor of a model 83 Overland was started every five minutes by a wireless impulse from the Overland headquarters five miles away. A complete wireless outfit consisting of motor generator, transformers, relays and other details was installed in the show windows of the Overland depôt. This was connected with an aerial on the roof of the building, and by stepping up the alternating current from 110 volts to 16,000 volts the apparatus made it possible to send messages 300 miles. The Overland car on exhibition five miles away was fitted up with the necessary receiving and other apparatus.

The Quenching of Sayville

THE CLOSE OF A SORDID STORY

By Special Permission of the "Wireless Age"

WITH the control of the German-owned Sayville wireless station now in the hands of the United States Government and its operation governed by American naval officers, details of the acts which led to the seizure reported in the August issue are rapidly coming to light. Accusations of neutrality violation have followed thick and fast and people hitherto respected by their neighbours have been placed in the limelight of suspicion. Even the sinking of the *Lusitania* has been connected with the operations of the station and the country has been stirred from end to end by disclosures made in unexpected quarters. That the principal evidence upon which the seizure was made was supplied by an amateur makes the story just that much more dramatic to our readers, and bears out an oft-repeated contention that the amateur is a valuable member of the community and entitled to serious consideration.

The story properly begins back in the early part of July, when the first rumble of suspicion came from Washington officials and found its way into the newspapers. It had been repeatedly hinted in certain quarters that the Government might refuse to issue a new licence for the new and more powerful equipment then being installed at Sayville. Persistent rumours of messages of a military character sent under cover of ordinary commercial dispatches in plain English and German caused the situation to be viewed from an angle more serious than that which concerned the right of the Government to refuse to grant the new licence on the ground that no belligerent nation or its agents has the right to establish a wireless station in a neutral country after war has been declared. Some of the messages filed had been rejected by the naval censors on the ground that they were too obviously not what they pretended to be. For example, orders from America to buy cotton in Germany impressed the censors as entirely unworthy of being intended to be taken at their face value by those to whom they were addressed. Other commercial orders, or pretended commercial orders, that could not in the nature of things be executed in Germany on account of the present commercial isolation of that country were rejected also. Certain messages to persons in America to execute orders for goods that could not be shipped to German ports or would be useless in Germany in this time of war, if it were possible to get them into German territory, shared the same fate.

The fear was expressed that through apparently harmless messages the Sayville station might be used to communicate military information to German submarines. In answer, Dr. Karl G. Frank, of the Atlantic Communication Company, which owns the station, said he did not consider this intimation worthy of serious consideration, for what it claimed was a physical impossibility. "In the first place," he said, "the wave-length used at Sayville is eight or ten thousand metres, whereas the wireless equipment of submarines would produce a very much shorter wave-length." When this statement appeared wireless men called attention to the fact that information sent first to Nauen could easily be re-transmitted to the submersibles through one of the several types of equipment installed at Nauen.

And so the situation stood when, on July 9th, the United States Government announced that in the future the plant would be conducted by American naval officers in the interests of its proprietors. The official memorandum from the Secretary of Commerce stated that the new licence had been refused because it had been learned that the Atlantic Communication Company is owned by the Telefunken Company of Germany, the controlling interest in which is owned by powerful German electrical concerns. Dr. Frank was identified as the New York representative of these controlling companies and Prof. J. Zenneck, who had been conducting so-called experiments at Sayville, was known to be a captain of marines in the German army and had been during the present war in the trenches in Belgium. The opinion of the department as stated was: "To grant a licence for a new station, erected since the war began, with German apparatus, avowedly under German ownership and control, communicating avowedly with stations known to be under the control of the Imperial German Government . . . would be an unneutral act."

The seizure of the station was characterised a "precautionary measure" and rested as such in the public mind for ten days. Then, on a Sunday morning, New Yorkers were startled by reading in their newspapers what was announced by the *World*, "the real reasons" for taking over Sayville. Investigation by the Secret Service, the account said, had established a definite probability that unneutral uses were being made of the station, the exact nature and extent of these uses remaining an official secret.

Great was the astonishment of readers when they learned that, in the course of the investigation by the Secret Service, phonographic records were taken by Charles E. Apgar, owner of a wireless experimental station at Westfield, N.J., for fourteen successive nights of every message, every signal, sent out from Sayville. These "canned" messages established the truth about Sayville. They showed exactly what had been transmitted; their comparison with the messages as they were submitted for approval to the censor showed the impotence of anything but Government operation.

By specific statute provision the contents of messages sent by wireless must be held inviolate. It can be said, however, that the "canning" of the messages sent from Sayville from June 7th to 21st inclusive showed these significant things:

That striking variations from the customary methods of sending were recorded, the possibility of system in these variations being made apparent.

That in the repeating of messages and in the sending of "message checks" there were similar variations from customary practice, with a similar possibility of system.

That these variations, undetected by the Government operators at Arlington and Fire Island, who "listened in" nightly on Sayville, were made unmistakable by the phonograph.

That the mechanical transmission of messages could be interrupted at any time and repetitions or interpolations of words by key could be easily effected.

That the possibilities for such codes as acrostics and "time spacing" were great under the circumstances, and that no censorship could prevent their use.

In long-distance transmission what is known as a Wheatstone tape machine is used. This punches out the dots and dashes on a strip of paper, the sending itself being mechanical. By the closing of a switch, however, it is possible to cut in on such transmission and to send by key, as, for instance, when it is necessary to repeat a word. To repeat mechanically it is necessary to stop sending and move the tape back until the perforations symbolising the desired word are reached.

The phonograph records showed that such repetitions as this were frequently made with so little loss of time that they must have been done by key. In the same way it would be possible, furthermore, to add a word or two, or even a sentence, in the middle or at the end of a message with no record to show for it.

The usual custom in long-distance sending is to repeat each word. For example, a message beginning: "Pr. 3. W. 16 to" (name and address), etc., would be sent thus: "Pr. 3 Pr. 3., W. 16. W. 16, to to," etc.

In the "canning" of the Sayville messages it was found that this custom was frequently varied. Sometimes a message would start: "Pr. Pr. 3. Pr. 3." Sometimes a word would be repeated twice instead of once. Sometimes there would be still other variations in sending that became apparent in the faithful reproduction of the phonograph.

An operator taking down the message by ear could easily miss the possible significance of these variations. With his attention centred on getting the meaning, he would regard the repetition as being intended merely to make the symbol clear.

Numerous instances appeared where the messages were not always repeated in the order of their sending. Messages Nos. 73, 74, 75 and 76 would be sent, then Nos. 78, 79, 80, and so on. After a score or more of messages had been repeated, No. 77 would appear. Sometimes the missing message would come after only two or three others had been repeated. On one occasion 48 had been sent again before it appeared.

Another nightly custom that offered similar opportunities, apparently, was in the "message checks." These are reports back to the Nauen station of the messages, by number, "received complete" the night before. These reports would read, for example: "Received complete 191 till 196, 199 till 210," etc. What had happened to messages Nos. 197 and 198 would not appear, and there seemed a possibility of coding in that.

Each night, also, after the transmission was at an end, there was always "talk" of how the signals had come in, of static conditions of the night, between what hours signals had been strongest, and matters of that sort.

When Dr. Frank, of the Atlantic Communication Company, read the revelations published by the *World* he gave out an interview which quoted him as saying:

"That Mr. Apgar can record messages "sent out by wireless on a phonograph "cylinder is hardly worth discussing. That "is physically impossible. I have never "heard of its being done. If Mr. Apgar "has accomplished it, he should get his "idea patented and perhaps we will buy it."

Dr. Frank thereby indicated that he was not acquainted with articles appearing in wireless magazines. On several occasions during the past year reference has been made to the dictaphone receivers installed by the American Marconi Company in its new trans-oceanic stations. A number of these records have been in use for some time in the Marconi School in New York for code practice and others have been used in the New York trans-oceanic offices to acquaint former cable operators with fast trans-oceanic wireless work.

Among wireless men the dictaphone, or phonographic wax cylinder, method of recording is known as a development that made possible the reception of signals at a speed greater than the most expert operator could achieve.

Dr. Frank's declaration was read with amused interest by Charles E. Apgar. By way of reply he produced a letter, written under date of February 5th, 1914, on stationery of the Atlantic Communication Company, of which Dr. Frank was then, as now, secretary and treasurer. The letter read:

"Mr. Charles E. Apgar, No. 549 Carleton
"Road, Westfield, N.J.:

"Dear Sir: Your letter of the 30th ult. "addressed to Mr. A. F. Seelig has come "to hand and we have noted its contents "with interest. In answer we beg to say "that we have no objection to your re- "ceiving our Sayville press in the way you "have done so far. We can, however, not "allow you to publish what you receive, "neither private messages nor press. It "would interest us to receive one or two "of the phonographic records you have "taken, and we would be much obliged if "you would favour us with the same.

"Yours very truly,
"ATLANTIC COMMUNICATION COMPANY,
"Operating Department,
"H. Boehme."

On the letter Mr. Apgar had written this memorandum:

"Monday, Feb. 9th, 1914."

"Delivered personally to Mr. Boehme "two phonographic records of Sayville "(W S L) sending, dated Nov. 3rd, '13, "and Nov. 12th, '13, for test of results."

"I think," said Mr. Apgar, "that ought "to show Dr. Frank it is his own fault if "he never heard of making phonographic "records of wireless messages. This letter "was written eighteen months ago. The "records that were delivered at that time "were made three months earlier, and, in- "cidentally, in the course of the second "month of my experiments in recording "messages. You can see my experience "with Sayville 'sending' began a long, "long time before I did my work for the "Government."

How I Cornered Sayville

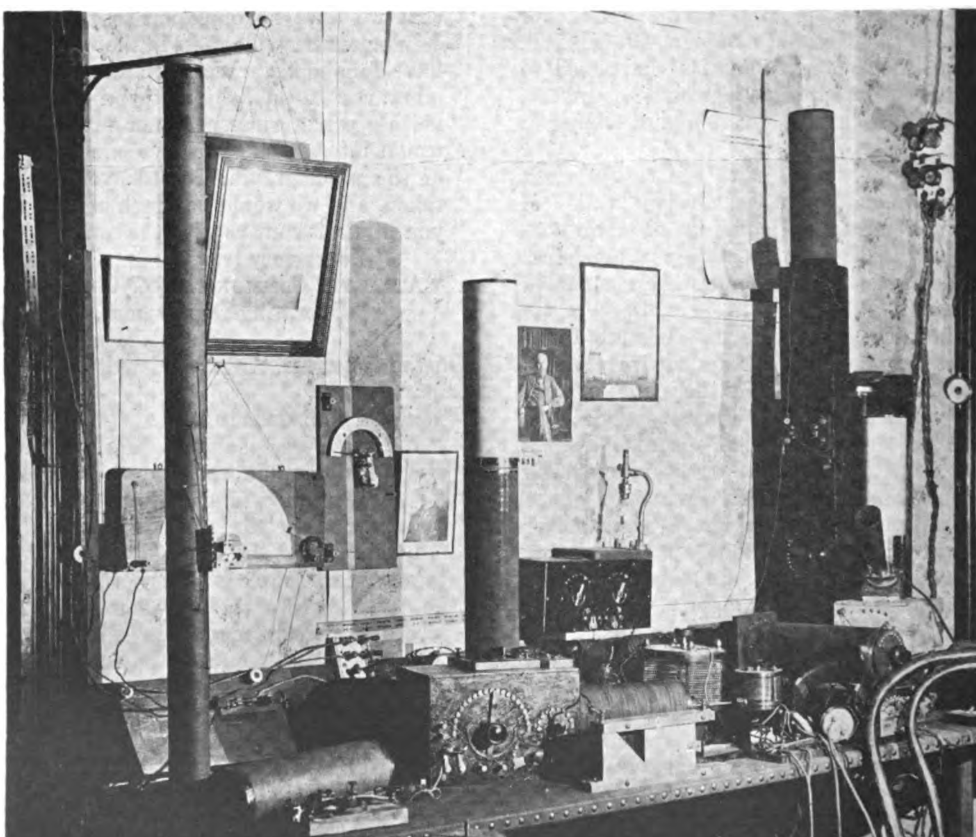
By CHAS E. APGAR

By Special Permission of the "Wireless Age"

THERE is comparatively little I can add to what has been so well set down by this magazine's Editor. My part in the Secret Service work has been told and the circumstances which led to my employment faithfully related; what, then, will probably interest my fellow readers most are a few of the details connected with making the records and a description of my equipment.

First, let me deal with the attempts to discredit the use of the records:

It has been stated in several New York papers that as the phonographic records did not reach Washington till after the Sayville station had been taken over by the Government, they did not play any important part in securing certain desired information. Replying to this, I will say that the records were made each night, between 11 p.m. and 2 a.m. The next morning I immediately transcribed the recorded messages and delivered them personally to Chief Flynn in New York, or sent them to him in Washington; hence they were filed with the Secret Service a very few hours after being sent out by Sayville, which enabled practically immediate comparison with the censored messages, as well as with those received by other wireless operators of the

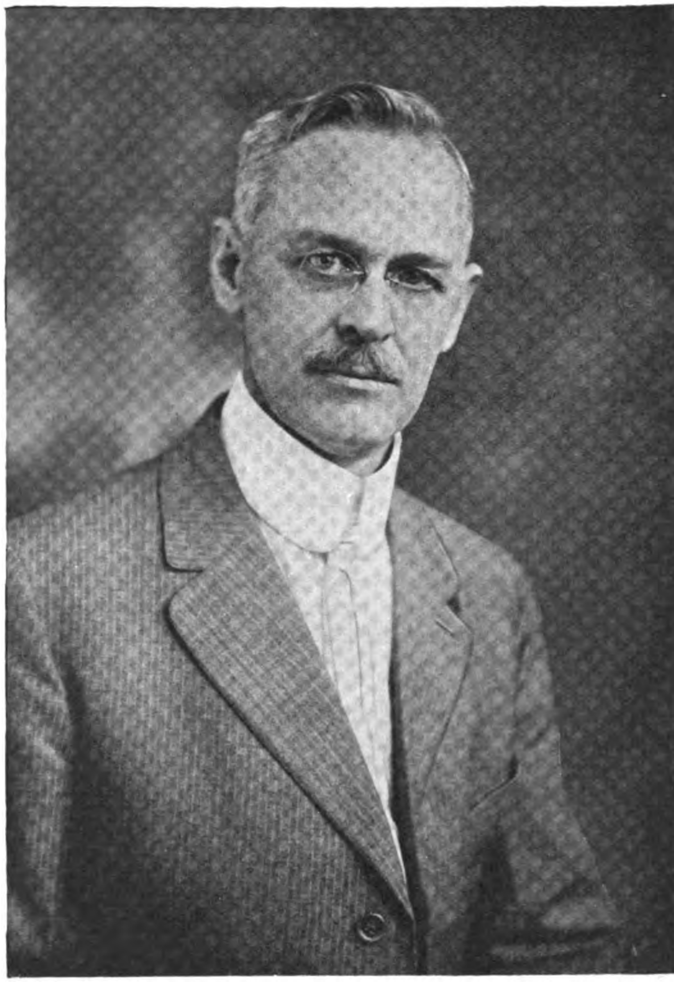


Mr. Apgar's Station.

Government who were "listening in," presumably at Arlington and elsewhere.

Just bef.re this special work began L. R. Krumm, Chief Radio Inspector of the port of New York, visited my station and after many hours of actual experience with the receiving instrument pronounced the station of the highest efficiency. Many phonographic records were demonstrated to him; hence when Chief Flynn of the Secret Service consulted him concerning the best method to get Sayville undeniably on record, he requested me to call at his office "on an important matter."

I was immediately introduced to the head of the Secret Service in New York, who told me to "get busy." Needless to state, perhaps, it was some pleasure at least to aid in taking the "Say" out of Sayville.



Mr. Charles E. Apgar.

When I was asked to execute this commission, or whatever you want to call it, no time was allowed for extended preparation. The interview was held at eleven in the morning and I was instructed to begin work the same evening. Scouring New York for "blanks" meant some tall hustling, but before sundown I had secured a number sufficient for a night or two. Subsequently during the period of action it became necessary for me to go several times in person to the Edison Company at Orange to replenish my supply of wax cylinders.

In regard to the operation, Sayville was never very generous with her 11 p.m. test signal Vs, and it meant working fast to utilise these in securing perfect tuning. There were several circuits to be looked after, their various condensers, inductances, batteries—everything, had to be practically in perfect harmony the instant Sayville began sending. That not a single message was missed and hundreds were recorded is evidence that every instrument and device of my home-made set did its duty fully and promptly; which is to me, of course, very gratifying.

To avoid the loss of a single word, which seemed likely in substituting a new blank for the record just filled, two phonograph machines were used. When the record on one machine was filled it was only necessary to switch the amplifone receiver from one machine to the other. The filled record was then replaced by a fresh blank and everything put in readiness for the next switch-over. This method made practicable a continuous record without loss of a signal.

The cylinders were consecutively numbered and when the work was finished a complete tabulation by message numbers was made. This was supplemented by a tabulation which revealed instantly on which cylinder any particular message could be found.

Of course, during the two weeks I recorded considerable static along with the message signals; other irregularities, too, were registered, particularly Sayville's many "breaks," due to poor spark. These breaks and the usual tuning-up signals all appear clearly on the cylinders. The phonographic record reveals some significant things; for example, when a break occurred in the middle of a long German word, three attempts were made to get through with this word before the message was continued. I was not a little interested to discover that "tape" sending could take care of such unusual interruptions.

Now as to my equipment.

There is nothing about it which might be termed remarkable; but unquestionably it is efficient for an amateur plant. The photograph of my station tells the whole story, the hook-up being the simplest form of the Armstrong circuit. Referring to the photograph which is reproduced at the foot of p. 518 and clearly indicates the general features, the equipment is quickly described. The vertical and horizontal inductances to the left of the photograph are primary loading; vertical inductance in centre on loose-coupler, secondary loading; vertical and horizontal inductances to right, boxed and open, are in the wing circuit. The slide condenser in the foreground is connected to grid of audion valve detector; the small variable rotary condenser across secondary and loading of loose-coupler; the other variable rotary condenser across receiving phones. The loud-speaking phone is in the amplifying circuit—on battery box to the right. When the records were made the amplifying circuit receiver, without the horn, was placed directly over the phonograph's recorder. The box containing the wireless receiver and amplifier, also transmitter, does not happen to show in the photograph.

Excepting the regular receiving phones and the valve detector, all my instruments are home-made. The set without "loading" will easily tune to 4,000 metre wave-lengths and over; with loading, 10,000 metre wave-lengths are secured.

I have two aerials, a short one on the house, 55 feet long, four wires spaced 2 feet apart, and a long aerial in the trees measuring about 600 feet, four wires fan shape, starting 10 feet apart and graduating down to 18 inches, suspended at an average height of 50 feet; both of these aerials are well below the tree-tops.

THE SAN FRANCISCO TELEGRAPH TOURNAMENT.

UNDER the heading Foreign and Colonial Notes in our October Number we mentioned the Telegraph Championship Tournament which was held on August 27th and 28th at the International Exposition at San Francisco. We are now able to give the result. On August 27th the call for the first wireless tournament was sounded at Moose Hall, San Francisco. The cream of the competing bodies of wireless operators on the Pacific Coast took their seats on the official stage. Mr. J. L. McKinnon, representing the Federal Telegraph Company, won the toss for the choice of first transmission, making a speed of 31¼ words per minute. Mr. A. E. Gerhard, the Marconi representative, was on the receiving end. The same messages were retransmitted by Mr. Gerhard at a speed of 32½ words per minute with Mr. McKinnon on the receiving end. Through an unaccountable error the same messages transmitted by Mr. McKinnon were given to Mr. Gerhard for transmission. This retransmission no doubt proved a decided advantage to Mr. McKinnon in receiving, as all the messages had previously been transmitted by him. On completion of the contest the judges reported the Marconi entry far superior in both transmission and reception. The officiating judges were United States Radio Inspector in charge at San Francisco, United States Radio Engineer at Washington, and the Engineer in Charge of the Electrical Department of the Postal Telegraph Company at San Francisco.

Maritime Wireless Telegraphy

YET another lamentable disaster has happened to the Portuguese Navy, a disaster which has resulted in the loss of the cruiser *Republica*, which but a short time ago sailed from the arsenal, where she had been laid up for three years undergoing important repairs. The officer who had command of this ship is a distinguished sailor, one of the most experienced in the Navy, and the wreck appears to have been due to the thick mist which prevailed along the coast.

The *Republica*, which was steaming north, ran ashore between Cape Roca and Peniche in Portugal, 15 miles from Lamparoeira Point, opposite the Conceica Fort.

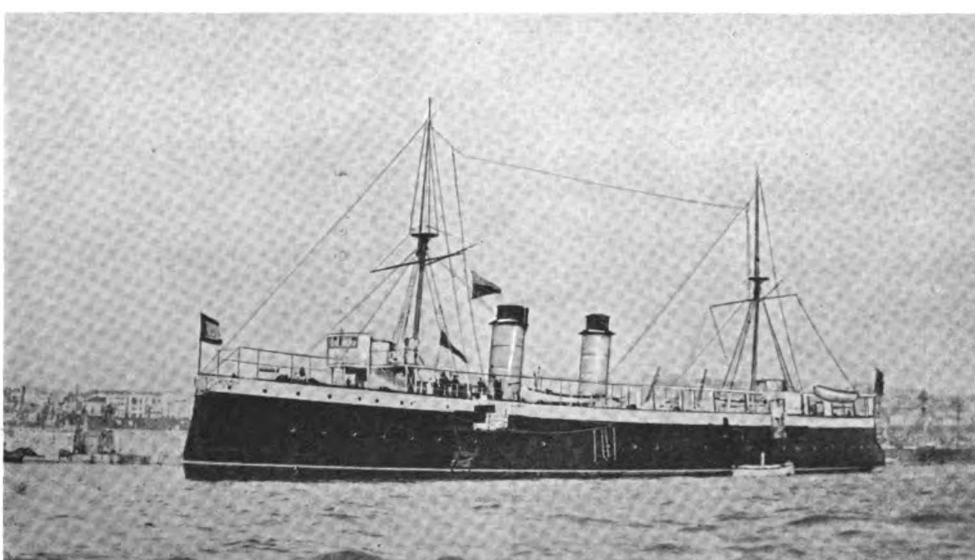
The steamer *San Miguel*, homeward bound from the Azores, was advised of the wreck by wireless, and immediately set out to search for the *Republica*. The former vessel was on her way from Madeira to Lisbon and was then about 20 miles distant from the bar. She sent a message to the *Republica* asking what help was needed. The Commander of the cruiser replied that he required a large kedger and a towing cable. Immediately the whole of the crew of the *San Miguel* started preparing what was needed. The *Republica* was on the rocks with her bow to the west with the sea rising and breaking from amidships to the stern.

The *San Miguel* finally came alongside at 8.30 p.m. Her captain regretted that he had been unable to save the cruiser in spite of the efforts and willingness of the crew and officers of his ship, which rapidly got ready to afford all help.

Mr. Antonio Viveiro Reis, the Wireless Operator aboard the *San Miguel*, remained nearly 10 hours at his post.

* * *

It was extremely fortunate for the schooner *Emma F. Angell* that the s.s. *Bermudian* happened to pass near her last August, when the former vessel was caught in a storm off Fire Island and battered by the seas and gale until she was compelled to fly distress signals. The United States Coast Guard



Portuguese Cruiser "Republica."

Service steamship *Seneca* had previously set out in search of the distressed vessel but was unable to locate her. Wireless telegraphy, however, relieved the situation. On the arrival of the *Bermudian* this ship was able to communicate to the *Seneca* by wireless the position of the *Emma F. Angell* (which was not fitted with wireless). When the *Seneca* came alongside the storm-swept craft, the pumps of the latter were just keeping her afloat. She was taken in tow and was brought to a safe anchor inside Sandy Hook.

* * *

A wireless telegraphic message was recently received from the Captain of the steamer *Koningin Emma*, one of the newest and finest boats of the Netherland Steamship Co., reporting that she had struck a mine in the North Sea. Luckily there was time for the wireless operator on board to advise the wireless station at Scheveningen, and several vessels went to the assistance of the stricken boat. All the passengers and baggage were saved, whilst the ship herself was taken in tow, but she eventually sank. The *Koningin Emma* was a steel twin screw steamer, 9,181 tons, and was on a voyage from Java to Holland.

* * *

By wireless telegraph recently a report reached Halifax, Nova Scotia, that the steamer *Sant Anna* was on fire as the result of two explosions and required assistance; the position was given as on the western side of the Atlantic, and the nearest land would be Cape Race on the coast of Newfoundland, 450 miles away. The steamer *Ancona* arrived eight hours after the fire started, and took aboard 105 of the passengers. The *Sant Anna* is a liner of 9,350 tons belonging to the Compagnie Générale Transatlantique, and was on her way from the Mediterranean to New York. She is a four deck steamer, and was built in 1910.

* * *

The *Athinai*, outward bound from New York to Piræus, the port of Athens, recently scattered broadcast a wireless call for help. She was on fire. The *Tuscania* received the distress signal and in due course arrived to succour the stricken vessel. The crew on the *Athinai* were in a worn-out state. A fight for more than twenty-four hours had told on them. There were no chemical fire extinguishers or other up-to-date appliances on board. The English seamen (from the *Tuscania*), however, brought a smoke helmet, with air pumps, tubes and telephonic attachments, as since the war began all British vessels have been prepared for emergencies. Once again wireless telegraphy has demonstrated its utility in saving life. There is not the shadow of a doubt but that the 408 survivors of the Greek steamer would have lost their lives had it not been for the promptitude of the *Tuscania's* commander in answering the call for help. The last seen of the *Athinai* was when she was afire from stem to stern and listing heavily to starboard. Her sea cocks were open and her holds fast filling with water.

* * *

We hear from New York that the ships of the Standard Oil Company are replacing their German "Telefunken" wireless apparatus with fresh installations supplied by the Marconi Wireless Telegraph Company of America.

The installing of the apparatus upon the twenty-two "Standard Oil and New Jersey" ships has already begun, and the new vessels to be fitted out include the following:—*The Ardmore, Baton Rouge, Bayway, Bradford, Brindilla, Caddo, Corning, Cushing, Dayton, De Soto, Moreni, Motano, Muskegee, Petrolite, Pioneer, Polarine, Princeton, Somerset, Matinicock, Standard, Communipaw*, and *Glenpool.*

In addition to the above, other lines are now under contract to rent from the Marconi Company, including a number of coastwise vessels, besides lines on the Pacific Coast and on the Great Lakes. The arrangement is that the Marconi Company supplies the equipment, assumes responsibility for the correct working of the apparatus, trains and employs operators, and relieves the shipping company of all concern with the transmission. Many of the agreements just signed with the steamship lines run for a number of years, and the new development is regarded as the most important in American marine wireless affairs since the Marconi Co. acquired the United Wireless Telegraph business in 1912.

Wireless in the Courts.

NEWCASTLE and district seems to be the most active centre of police court activity with regard to the illegal possession of wireless apparatus.

Clifton Gosman, an apprentice fitter working at Gateshead, was charged at the Newcastle Police Court recently with having had in his possession, without the written permission of the Postmaster-General, certain apparatus intended to be used as a component part of an installation for the receiving of messages by wireless telegraphy, contrary to the Defence of the Realm Act. According to the evidence for the prosecution, there was no suggestion that there was any wireless installation on the defendant's premises, nor was it suggested that there had been any attempt to set such up. Defendant had called voluntarily at the detective office and handed over minor articles to the police. The deputy town clerk, who conducted the prosecution, stated that although there was no aggravating feature about the case, at the same time it was an inherently grave one. Members of the public who had still wireless apparatus in their possession should at once communicate with the postal authorities in order that they might put themselves in a proper position with regard to the matter. The penalty for not complying with the present regulations was £100 or six months' imprisonment without the option of a fine. Defendant pleaded that he had not read the regulations and he did not know that parts of the apparatus had to be reported. When the detective visited his house it was covered with dust, showing that it had not been used for some time. In imposing a penalty of 20s., in default 13 days' imprisonment, the Chairman said now that so many cases had been before the court and that so much publicity had been given to them, those brought before the Bench in future would be treated in a different way from the present case.

* * *

At the Gateshead Court recently a young man named Frederick Askew was fined £1 for being in possession of a wireless telegraph apparatus. When a detective called at the house, the accused produced the parts in his possession from an overcoat pocket and stated that a friend of his had the other portions of the set which they had bought between them for 25s. An assistant engineer from the Post Office said that the other parts of the instrument would be capable of receiving (but not transmitting) messages from a long distance. The Mayor warned the young man that he had rendered himself liable to a fine of £100.

* * *

A more serious case was dealt with at the Blyth Police Court when a labourer, William Thompson, was sentenced to the maximum penalty of six months' imprisonment in the second division for having in his possession a wireless apparatus capable of receiving and transmitting messages. Sergeant Ormston gave evidence of having found the apparatus in Thompson's house, and described the room in which he found it as more like an electrical engineer's shop than that of an ordinary house. Mr. Henry Dunthorpe, a post office expert, said that the apparatus could transmit messages over a radius of five miles under favourable circumstances. Under ordinary circumstances it would have a radius of about two miles. To do this the apparatus would require an aerial, and he found among the things handed to the police material from which an aerial could be made. The defendant stated that he made electrical experiments a hobby, but that he was not using the apparatus as a wireless telegraph instrument. The major part was used in developing the idea of steering ships at sea from the shore. He was experimenting on this subject with a model yacht on Ridley Park Lake. Defendant's solicitor contended that Thompson had no motive prejudicial to the interests of the State and, whilst a technical offence had been committed, the case did not call for a very severe penalty. He thought the Bench would agree that the defendant, who was an Englishman, had no desire to be a traitor to his country and that he did not keep the instrument for any wrong motive. The Chairman said the Bench, in considering the case, could not forget the man's extraordinary ability, and were of opinion that these gifts must be of grave danger and menace to the State if used in the wrong direction. Therefore the Bench had decided to inflict the maximum penalty.

A charge against Thompson of stealing 26 lb. of brass for use in his electrical experiments was then preferred, and for this offence he was sentenced to one month's imprisonment, also in the second division, the two terms of punishment to run concurrently.

* * *

Castle Eden, in county Durham, has evidently developed a taste for "limelight." In a recent issue of THE WIRELESS WORLD a report appeared of a prosecution for the possession of a wireless apparatus contrary to the provisions of the Defence of the Realm Act. The culprit *then* was a school teacher; the culprit *now* is a school teacher. George Robert Lindhay, aged 54, was brought before the magistrates charged with having wireless apparatus in his possession without the permission of the Postmaster-General. Defendant stated that he possessed the small apparatus in question, which he had been in the habit of using during the past ten years to teach the principles of wireless to his scholars. A police-constable visited the school, and the apparatus was handed over to him. It could not receive messages, but was able to transmit them to a certain extent. One of the engineers gave evidence to the effect that as the apparatus stood it was practically useless for receiving messages from any modern station. It could transmit, he said, but the range would be extremely limited. After hearing the evidence, the Chairman said that the Bench was not satisfied that the summons had been taken out against the right party, and under the circumstances they dismissed the case. He ordered, however, that the apparatus be left in the care of the police, and hoped that other instruments kept in similar conditions would be brought in at once.

* * *

At Prahran, Victoria, Matthew Henry Read, a mechanic in the Postal Department, was charged with having in his possession apparatus capable of being used for tapping wireless telegraphic messages. In commenting on the case the Chairman said that he thought defendant did not intend to aid the enemy, but nevertheless these illicit practices must cease. The defendant was fined £20 and £4 4s. costs.

* * *

People still do not seem to realise the gravity of defying the official regulations during this time of crisis. Orders have been given that no person shall use or possess a wireless telegraphic apparatus or component part or parts thereof capable of being used for transmitting or receiving wireless signals. Yet we learn that on August 5th last, over a year after the war had started, R. Evans was charged at Sydney, Australia, with having in his possession apparatus capable of being used for tapping wireless messages. The magistrate on imposing the sentence commented on the seriousness of refusing to abide by official regulations. He fined the defendant £50 or in default sentenced him to six months' imprisonment. It is indeed strange that when the nation is engaged in a war as desperate as any in which we have previously taken up arms, people are still found wanting in ordinary common sense. They well deserve the punishments meted out to them.

IMPORTANT NOTICE.

Newspapers for Neutral Countries.

BY a recent order newspapers may no longer be posted to addresses in neutral countries by private persons. It is explained that this step has been taken to prevent the use of newspapers as a code for conveying information to the enemy. The authorities will, however, permit newspapers to go through the mails if sent from the offices of the publishers, or their agents. As the WIRELESS WORLD falls within the category of this prohibition the publishers (at Marconi House, Strand, London, W.C.) will be pleased to forward the magazine post free to any neutral country at the rate of 5s. per annum or for shorter periods at a pro-rata charge.

CARTOON OF THE MONTH

"WIRELESS OPERATORS MUST NOT SWEAR."

United States Official Regulations.

The Calculation of Mutual Inductance

By W. H. NOTTAGE, B.Sc.

In the design of a radio-telegraphic receiver of the inductively-coupled circuit type an estimate of the maximum and minimum coupling which can be obtained from a given arrangement of the coils is very useful.

There are many formulas by which the mutual inductance, on which the coupling depends, can be calculated to any desired degree of accuracy, but in most cases the calculations required are very lengthy, and therefore are seldom undertaken

If we confine our attention to the single-layer coils which are alone used for the inductances of receivers, and only require an accuracy within 1 per cent., or, at most, that given by four-figure logarithm tables, the following method will be found applicable to all cases and easily carried out.

The mutual inductance of two coils is given approximately by the formula

$$M = n_1 \, n_2 \, M_0$$

where n_1 n_2 are the total number of turns of wire on the two respective coils, and M_0 is the mutual inductance between two single circles of the same diameters as the coils, and situated at the same distance apart as the middle turns of the two coils.

In order to calculate M_0 there are a large number of formulas available, the best one to use in any given case depending on whether the circles are near together or far apart.

A convenient formula for many cases is

$$M = 16\pi^2 \sqrt{Aa} \, q^{3/2} \, (1 + e)$$

where A and a are the radii of the two circles, and d the axial distance between them :

$$q = \frac{l}{2} + 2\left(\frac{l}{2}\right)^5 + 15\left(\frac{l}{2}\right)^9$$

$$l = \frac{1 - \sqrt{k^1}}{1 + \sqrt{k^1}} \quad k^1 = \frac{r_2}{r_1} = \frac{\sqrt{(A - a) + d^2}}{\sqrt{(A + a) + d^2}}$$

$$e = 3q^4 - 4q^6 + 9q^8 - 12q^{10}$$

If the dimensions be expressed in centimetres the inductance will be in centimetres.

The above formula is due to Prof. Nagaoka, and calculations made by it are made less tedious by a table which has been prepared by him giving the differences between q and $\frac{l}{2}$, and also the value of $1+e$ for certain values of q. The tables are too long to reproduce here, but will be found in the "Formulas for Calculation of Mutual and Self-inductance," by Rosa & Grover, Bulletin of the Bureau of Standards, U.S.A. Vol. 8, No. 1.

It will be noticed, however, that for a given value of $\frac{r_2}{r_1}$, which is the ratio between the least and greatest distance between the two circles, the value of the expression $q^{3/2}(1+e)$ is a constant and independent of the actual dimensions of the circles.

In order to facilitate the calculation of mutual inductance the writer has worked out the values of this constant for various ratios of $\frac{r_2}{r_1}$, making use, however, of other similar formulas, to be found in the article quoted, where they are more convenient.

These values are reproduced here :

k^1 or $\frac{r_2}{r_1}$	γ	k^1 or $\frac{r_2}{r_1}$	γ	k^1 or $\frac{r_2}{r_1}$	γ
·01	50·3	·16	15·8	·50	3·97
·02	41·5	·18	14·5	·55	3·19
·03	36·7	·20	13·3	·60	2·53
·04	32·8	·22	12·2	·65	1·96
·05	30·0	·24	11·2	·70	1·48
·06	27·7	·26	10·4	·75	1·05
·07	25·9	·28	9·55	·80	·735
·08	24·2	·30	8·82	·85	·457
·09	22·5	·34	7·55	·90	·239
·10	21·2	·38	6·46	·95	·092
·12	19·3	·40	5·96	1·00	·0
·14	17·5	·45	4·88		

The inductance of two circles is given by $M = \sqrt{Aa}\,\gamma$ where A and a are the radii of the circles in centimetres and the inductance is in centimetres. To bring the inductance to microhenries divide by 1,000.

The value of $\frac{r_2}{r_1}$ can either be obtained from the formula

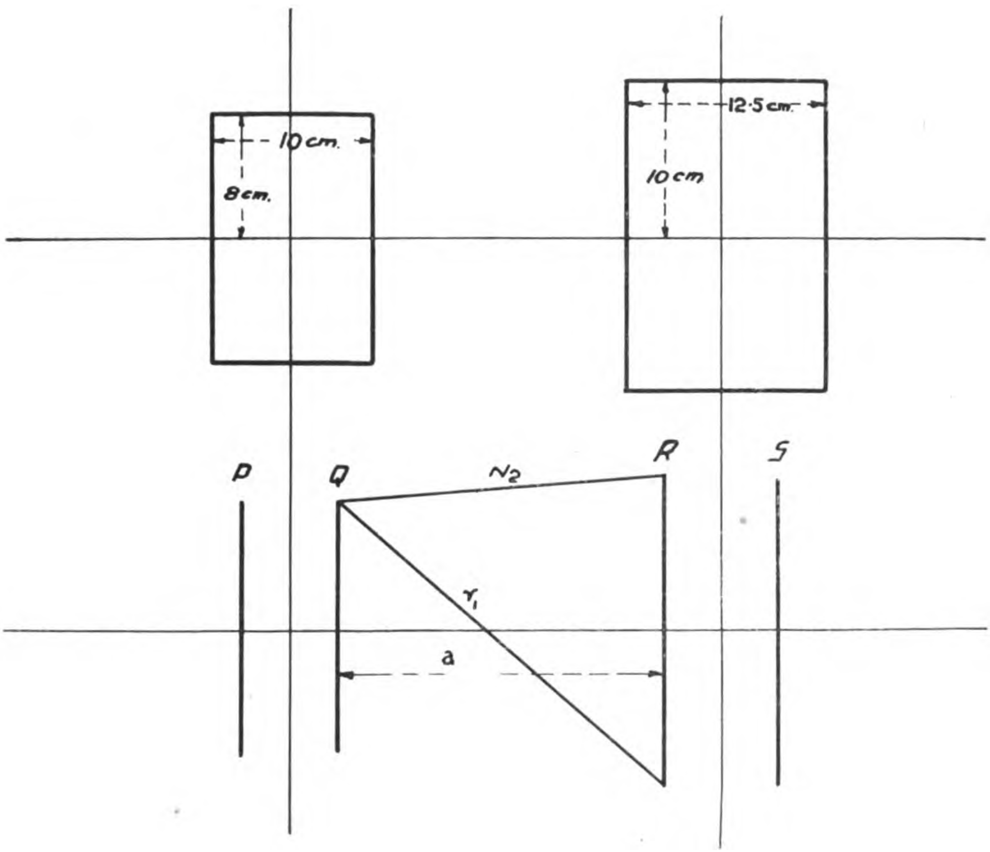
$$\frac{r_2}{r_1} = \frac{\sqrt{(A - a)^2 + d^2}}{\sqrt{(A + a)^2 + d^2}}$$

or can be measured on a diagram drawn to scale (see figure).

It can be shown that any single layer coil of breadth b can be replaced for purposes of this calculation by two equivalent circles at a distance apart, $2g$

$$\text{where } g^2 = \frac{b^2}{12} \text{ or } g = \cdot 2887\, b.$$

These circles are equidistant from the middle turn of the coil—that is, they are each at a distance g from it.



The mutual inductance of two coils can now be obtained by first calculating the mutual inductance between two circles of the same radius at a distance apart, equal to that of the middle turns of the coils, and multiplying by $n_1\ n_2$

$$M = M_0,\ n_1\ n_2.$$

Where the two coils are far apart this will give a correct value, but if the coils are close the following calculation should be made.

Having obtained the positions of the circles, which may be called P and Q for one coil and R and S for the other, work out by the formula already given the following:

Mutual inductance between P and R,
P and S,
Q and R,
Q and S.

Take the mean of the above and multiply

by n_1 n_2, to give the mutual inductance of the two coils.

As an example we will calculate the mutual inductance between the following coils, both being wound with 20 turns per cm., as shown in the diagram.

1st Coil:
Radius $= A = 10$ cm.
Breadth $= b_1 = 12{\cdot}5$ cm.
No. of turns $= n_1 = 250$.

Distance between equivalent circles P and Q and the middle turn of coil:

$$= g_1 = {\cdot}2887\ b_1 = 3{\cdot}60 \text{ cm.}$$

2nd Coil:
Radius $= a = 8$ cm.
Breadth $= b_2 = 10$ cm.
No. of turns $= n_2 = 200$.

$$\cdot 2887\ b_2 = g_2 = 2{\cdot}9 \text{ cm.}$$

Distance between centres of coils:

$$= d = 27{\cdot}5 \text{ cm.}$$

From the above
Distance between:
P and $R = 26{\cdot}8$ cm.
P and $S = 34{\cdot}0$ cm.
Q and $R = 21{\cdot}0$ cm.
Q and $S = 28{\cdot}2$ cm.

The values of $k^1 = \frac{r_2}{r_1}$ for these four circles may be either calculated from the formula given above or obtained from measurements on a scale-drawing.

For Q and R we have

$$k^1 = \frac{r_2}{r_1} = \frac{\sqrt{(10-8)^2 + (21)^2}}{\sqrt{(10+8)^2 + (21)^2}} = \frac{\sqrt{445}}{\sqrt{765}}$$
$$= {\cdot}762.$$

Similarly for P and R, $k^1 = {\cdot}833$.
,, ,, P and S, $k^1 = {\cdot}885$.
,, ,, Q and S, $k^1 = {\cdot}845$.

From the table the following values of γ are obtained:

For circles P and R $\gamma = {\cdot}55$.
,, P and S $\gamma = {\cdot}304$.
,, Q and R $\gamma = {\cdot}97$.
,, Q and S $\gamma = {\cdot}485$.

The mean value of the above $= {\cdot}577$ whence the mutual inductance between the coils is

$$\cdot 577 \times \sqrt{10} \times 8 \times 200 \times 250.$$
$$= 258{,}000 \text{ centimetres.}$$
or 258 microhenries.

If the mutual inductance had been calculated for two circles at the centres of the coil instead of for the four equivalent circles we should obtain:

$$\frac{r_2}{r_1} = \frac{\sqrt{(10-8)^2 + (27{\cdot}5)^2}}{\sqrt{(10+8)^2 + (27{\cdot}5)^2}}$$
$$= {\cdot}84, \text{ for which } \gamma = {\cdot}513.$$

The mutual inductance given by this value would be 11·25 per cent. too small.

The coupling between the coils can now be calculated.

Inductance of 1st coil:
= 8 times inductance of a coil 10 cm. diameter 6·25 cm. long
$= 1433 \times 8 = 11460$ mhy. approximately.

Inductance of 2nd coil:
=5857 mhys.

(see table on page 124 in the May, 1915, number of THE WIRELESS WORLD).

The coupling is

$$\frac{M}{\sqrt{L_1, L_2}} = \frac{258}{\sqrt{5857 \times 11460}}$$
$$= 0315 \text{ or } 3{\cdot}15 \text{ per cent.}$$

ARCHÆOLOGICAL RESEARCH.

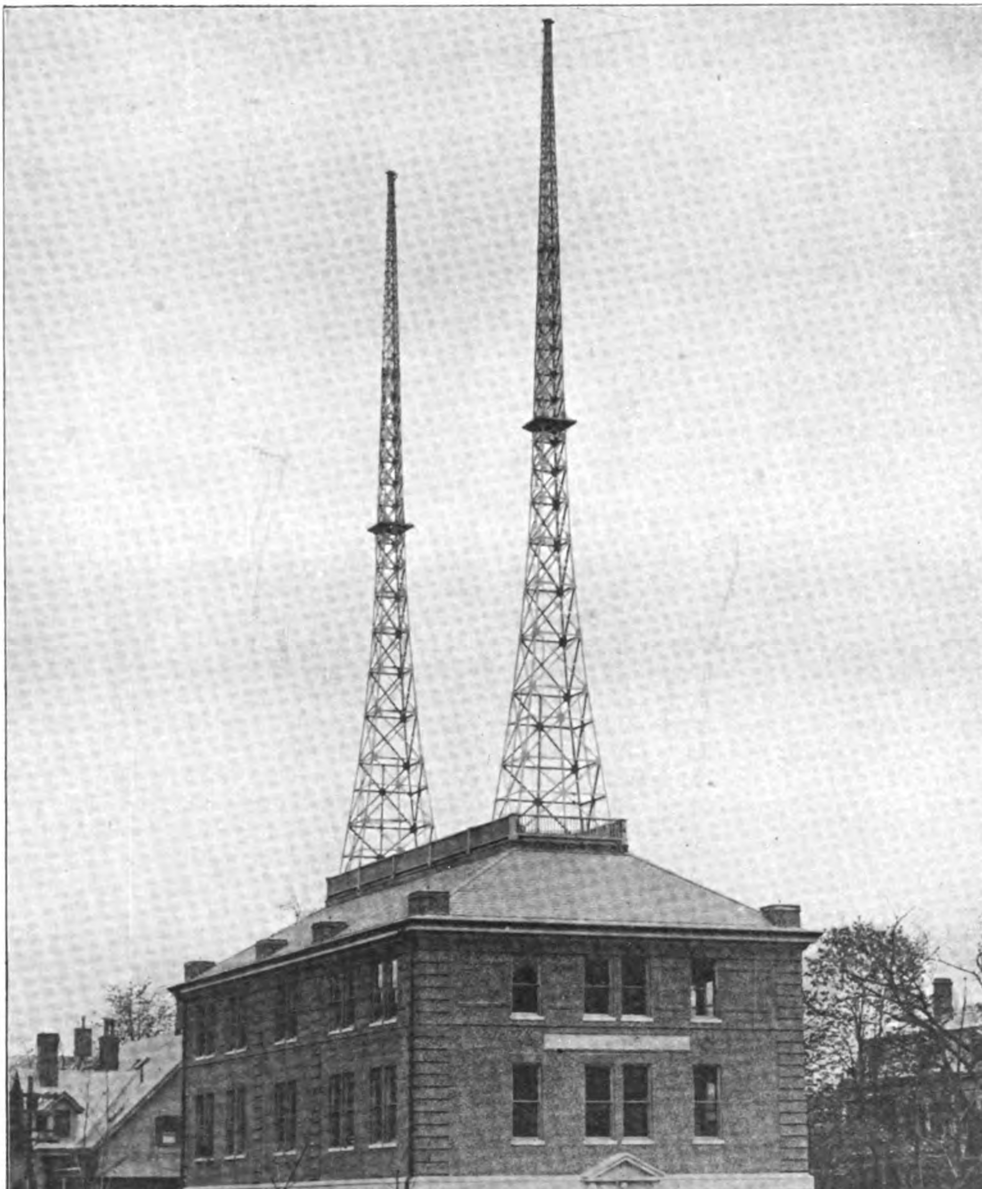
THE GREEK: "They have found iron wires at Athens in excavation among ancient ruins, proving that the ancient Greeks understood telegraphy."

THE EGYPTIAN: "But at Cairo it is more remarkable. They have made excavations and found nothing!"

THE GREEK: "Found nothing! What does that prove?"

THE EGYPTIAN: "Why, that the ancient Egyptians understood wireless telegraphy!"
—From *Le Rire*.

HARVARD UNIVERSITY



New Craft High Tension Laboratory, showing Steel Wireless Towers.

Doings of Operators

THE extremely interesting letter which we published in the October issue from Petty Officer L. T. N. Sanderson has received such a favourable reception from our readers that we think a few notes concerning the gentleman in question will not be amiss in this column.

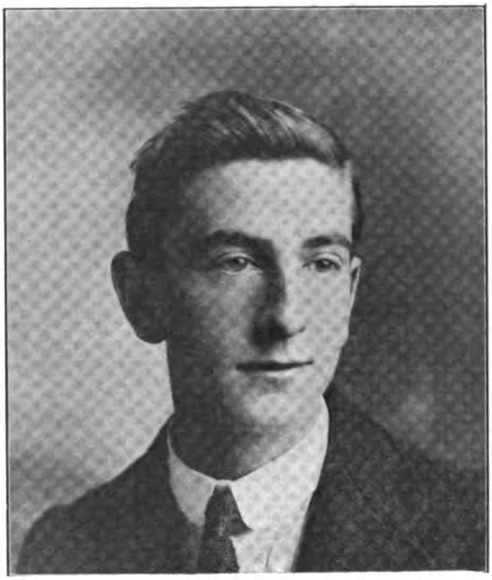
Mr. Sanderson, who was born at Wandsworth twenty-eight years ago, makes his home when in England at South Norwood, not far from London. His school days were spent at Beddington, a pretty spot in Surrey, and upon reaching an age when the question of a career arose, he entered the services of the Commercial Cable Company. It was not long, however, before the fascination of "wireless" seized upon him, and in June, 1910, Mr. Sanderson entered the Marconi Company's Liverpool School, from which he was appointed to the operating staff shortly afterwards. During the last five years he has served on board a large number of liners, most of his trips being to the South and East. At the beginning of this year Mr. Sanderson, with a number of his fellow-operators, was selected for special war duty, and, as he has related in his letter, proceeded to the Dardanelles for duty on the Peninsula. No doubt by the time this paragraph appears he will have been through many further exciting adventures, which we hope he will record at a convenient opportunity.

Petty Officer L. T. N. Sanderson.

* * *

In these times so much attention is concentrated on naval and military affairs that an "ordinary" wreck is liable to be overlooked. In the case of the *Highland Warrior*, which was wrecked recently off the coast of Spain, there are a number of features of particular interest to wireless men, and as the operator, Mr. Leonard C. Fox, had an exciting time, we give below a short account.

The *Highland Warrior*, a well-known Nelson liner engaged in the South American trade, encountered early in October, when in the neighbourhood of Corunna, a dense fog, which made an accurate determination of her position impossible. In the early hours of the morning of the third, just when everything seemed calm and quiet and the wireless operator was busily engaged in transcribing Press, a crash and a violent shock woke everyone to the grim reality of a disaster. So violent was the blow that Mr. Fox, who a moment before had been sitting quietly at the instrument table, was thrown right out of the cabin against the rail. As nothing but this rail guarded the upper deck from the well of the ship, Mr. Fox had a narrow escape from death. The order to send the "S.O.S." call was of course immediately given, and brought instant response from a number of stations within range. In spite of the fog and the difficulty of making known the exact location of the *Highland Warrior*, but few hours elapsed before aid arrived, and all passengers were removed to safety. One rather unusual instance of the value of wireless may be quoted in connection with the arrival of the first rescue ship. The anxious watchers on the wrecked vessel suddenly observed a steamer looming through the fog and apparently coming to their rescue. Great was the dismay when the vessel made no attempt to stop, but was



Operator L. C. Fox.

about to pass by. Rockets were sent up, and detonators fired, all with no effect; even although it was known that this was the vessel that had announced by wireless that she was coming to the rescue. A rapid exchange of wireless signals brought to light the curious fact that although the rescuing vessel could clearly be seen from the wreck, yet she herself could neither see the rockets nor hear the explosive signals. She was promptly directed by wireless, and in a short while had arrived on the scene and taken off all the passengers and done all that was required of her.

Mr. Fox, who is twenty-four years of age, is now back in England none the worse for his exciting adventure. His services with the Marconi Company date from 1912, when he joined the London School after having had Post Office experience. Amongst the vessels on which Mr. Fox has served may be mentioned the *Calabria*, *Paparoa*, *Chantala*, and *Kashgar*.

* * *

It is with the deepest regret that we have to record the death of Operator Frank Avory, as the result of an accident. Mr. Avory was senior operator of the ss. *Chaudiere*, belonging to the Royal Mail Steam Packet Company, and together with several of the officers and engineers was bathing from the ship's side when at anchor in St. Kitts. Mr. Avory unfortunately dived into the water simultaneously with another officer and collided with him. Apparently stunned, he appeared to recover, but later in the evening the pains became more severe, and a sleeping draught was administered. By the next morning Mr. Avory seemed much better, but after a few hours he dropped into a state of unconsciousness, from which he never recovered. Everything possible was done, and the ship was headed with all speed for Bermuda, in order that an operation might be performed, and all arrangements were made by wireless; but before that port could be reached Mr. Avory had passed away.

The funeral took place on Friday afternoon, September 17th, in Pembroke Cemetery, Bermuda, all officers and engineers off duty attending. The late gentleman was a native of Peckham, and joined the Marconi Company in 1912. Prior to joining the ss. *Chaudiere* he served on the ss. *Tyrolia*, and had been senior operator of the *Chaudiere* for nearly eighteen months at the time of the accident. We offer our deepest sympathy to the relatives of Mr. Avory in their terrible bereavement.

The Late Operator F. Avory.

QUESTIONS AND ANSWERS

Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study to the Editor, THE WIRELESS WORLD, *Marconi House, Strand, London, W.C. Such questions must be accompanied by the name and address of the writer, otherwise they will remain unanswered: and it must be clearly understood that owing to the Defence of the Realm Act we are totally unable to answer any questions on the construction of apparatus during the present emergency.*

D. M. P. (Farnham Royal).—The number of Joules stored in a condenser is given by the formula:—

$$J = \frac{1}{2}CV^2.$$

G. E. G. (Aldeburgh-on-Sea).—Before we can recommend a book to you on the subject you mention, we need to have some idea of your knowledge of the subject. Wireless engineering comprises so much that it cannot be said that any book deals fully with it. Before a student can become a wireless engineer he must have a good theoretical and practical knowledge of electrical engineering, and in addition must be acquainted with the theory of wireless telegraphy. If you will write and inform us to what extent you are acquainted with these things, we may be able to help you. Meanwhile, we would suggest that you study Dr. Fleming's "Pocket Book," which you will find advertised in this number. It contains much that it is essential to know as a wireless engineer. Question 2.—As far as wireless telegraphy itself is concerned, we do not think there is anything nearer than London.

F. J. B. (Henfield, Sussex).—In a receiver using the electrolytic detector, the current passing through the telephones is in some measure proportional to the amplitude of the received waves. Question 2.—The answer to this depends upon what you would call a "comparatively small antenna," also upon the sensitivity of the ammeter. Speaking generally, the answer is "Yes." Question 3.—We do not think you quite understand the principle of the electrolytic detector, or you would not ask this and the following question. The purpose of the local battery is to polarise the electrodes of the detector, and the voltage applied has to be carefully adjusted by means of a potentiometer or series resistance. There is but one adjustment with each detector which will give the best result. If the voltage is too low the detector will be insensitive, and if it is too high there will be a roaring sound in the telephones. The particular voltage which gives the best result depends on the design of the detector.

W. R. L. (Bridgend, Glam.) writes: "In a wireless transmitting apparatus 'guard lamps' are used to prevent high frequency currents from getting back into the low-frequency circuit and damaging the windings of the converter. I can quite understand the action of the guard lamps, but fail to see how high-frequency currents can get back at all. I would point out that it can hardly be due to inductance (as has been explained to me), since the circuits are of such a highly different frequency."

Answer.—Our correspondent starts off with an erroneous statement. The guard lamps are not used to prevent high-frequency currents getting back into the low-frequency circuit—that is the duty of the air-core chokes—but to prevent any high-frequency currents which might happen to get back into the low-frequency circuit from penetrating the windings of the converter. However, that is not exactly the point. High-frequency currents may slip into the low-frequency circuit by many ways, only a few of which we can indicate here. As an example, we may instance a case which came under the personal observation of the writer. Owing to the proximity of some wires, a high-frequency current from the aerial sparked across the receiving leads, through the magnetic detector, down the telephone short-circuiting leads, and then sparked across to the key. The trouble took some minutes to trace, as may be imagined. Again, in the case of a transmitter with a disc discharger, faulty insulation of the disc may cause a leak of high-frequency current into the low-frequency circuit. Moisture or dirt on the air-core chokes may cause sparking-over of high-frequency currents into the transformer, and a breakdown of the insulation, followed by leakage into the low-tension circuit.

"ARCHIMEDES" (St. Vincent, Cape Verde Is.).—We think you have misunderstood the equation. If C and L are in mfds. and mhys. respectively, CL must be divided by 10^{15} to give the result that would be obtained with C and L in absolute units. Have another look at it!

G. R. (Dordrecht, Holland).—(1) "Wireless Telegraphy," by A. B. Rolfe-Martin, obtainable from the Wireless Press, Ltd. (2) From Marconi's Wireless Telegraph Co., Ltd. Such valves require carefully designed receivers, and unless an amateur be experienced, he is not likely to get the best results from them. (3) The distance that can be transmitted by a given spark-coil depends upon the aerial, the wave-length used, the receiving aerial, and the sensitivity of the receiving instruments.

C. B. P. M. (Delft, Holland).—Many thanks for your letter. We are only too pleased to be of assistance. With regard to your first query about the inductance and capacity of your aerial, there is a very much simpler way of working this out. If you will turn to page 734 of the February, 1915, issue of THE WIRELESS WORLD, you will find particulars. Once you have calculated the L and C of your aerial, you can turn to the Instructional Articles on the Receiver. These will tell you how to calculate the inductance of your tuning coils, and you can then calculate what inductance you must add or subtract to obtain any particular wave-length. With regard to your second question, we do not quite understand what you mean. Fibre and ebonite insulation is better than wood coated with shellac varnish. Bad insulation both decreases the strength of signals and prevents sharp tuning. Question 3.—The Perikon detector is not a very high-resistance detector, and you should get fair results with a 400 ohm. headpiece, but higher resistance telephones would be better. We are afraid we have not space here to deal with telephone transformers. Question 4.—With regard to the position of the telephones this depends on the particular scheme of connections. There is generally not much to choose either way. Question 5.—Your scheme of connections is a very good one. Write to us again if the above information is not sufficient.

R. T. (Service T.S.F. Militaire Belge).—We regret that we have no curve available which shows what you require. In the case of a plain aerial, the spark resistance depends not only on the length of the gap, but on the quantity of electricity conveyed across it, and to some extent on the material of which the electrodes are composed. The amount of electricity which passes across the gap depends on the capacity of the aerial and the voltage to which it is charged. If the size of the spark-gap be made too large, the insulation of the antenna is endangered, and there will be large losses through brush discharges. A given gap will break down at a lower voltage with pointed electrodes than with spherical electrodes, and easier with small spheres than with large ones. It has been proved that, with an increasing spark length, the resistance of the spark between iron balls increases rapidly when compared with that between brass or zinc balls. A number of gaps in series will break down easier than a single gap of a length equal to the sum of the series gaps. The total resistance of the series of gaps will also be less than that of the single gap.

Instructional Article

NEW SERIES (No. 3)

The following series, of which the article below forms the third part, is designed to provide wireless telegraphists, amateurs, and technical students generally, with clear and precise instruction in technical mathematics, in order that they may be enabled to read and understand the more advanced technical articles which appear from time to time.

Algebra.

FACTORISATION.

12. The simplest case of factorisation is when we have an expression, each term of which is divisible by a common factor. For example, in the expression $3x^3-9x^2+6x$, we can divide each of the three terms by $3x$, thus getting the factors $3x\ (x^2-3x+2)$.

We shall find, by what follows, that the second of these factors can be again split up into the two factors $(x-2)\ (x-1)$, and so we get as the final factors $3x\ (x-2)\ (x-1)$.

13. In multiplying $(x+a)$ by $(x+b)$, we proceed as follows :—

$$\begin{array}{l} x+a \\ \underline{x+b} \\ x^2+ax \\ \quad\ \ bx+ab \\ \hline x^2+ax+bx+ab \\ =x^2+(a+b)x+ab \end{array}$$

We see from this that the product of two such simple factors, each consisting of "x plus something" is a three term, or trinomial expression consisting of (x^2) plus (an x term) plus (a third term not containing x). Also, the coefficient of x^2 is 1 ; the coefficient of x is the *sum* of the two "somethings" ; and the third term is the *product* of the two "somethings."

Looking at it from the other point of view—namely, that the factors of $x^2+(a+b)x+ab$ are $(x+a)\ (x+b)$, we find the rule that the factors of any expression of the form x^2+px+q are $(x+a)\ (x+b)$, such that $(a+b)=p$ and $ab=q$.

Applying this to the expression x^2-3x+2 in §12, we see that we can split it up into two factors $(x+a)\ (x+b)$ *if* we can find values of a and b such that $a+b=-3$ and $ab=+2$. Such values are obviously -2 and -1, as $(-2)+(-1)=-3$ and $(-2)\times(-1)=+2$

Thus x^2-3x+2 can be split up into the two factors : $[x+(-2)]\ [x+(-1)]$
$=(x-2)\ (x-1)$

14. The matter is rather more complicated when the coefficient of x is not unity, as for example in the expression $6x^2+11x-10$. In this case we might have a pair of factors $(6x+a)\ (x+b)$, or we might have a pair $(3x+c)\ (2x+d)$, as with either of these pairs we should get the $6x^2$ on multiplying them together.

The only other guide we have at present is the fact that the term *not* containing x is -10. Now this term results from the multiplication of the two terms a and b (or c and d), and so we know that $a\times b$ (or $c\times d$) equals -10. Thus a and b (or c and d) might be (±5) and (∓2) or (±10) and (∓1), the decisive point which finally picks out the correct factors being the fact that the coefficient of x must be $+11$.

Thus the possible factors are those in the following list :—

$(6x+10)\ (x-1)$	$+4x$		$(3x+10)\ (2x-1)$	$+17x$
$(6x-10)\ (x+1)$	$-4x$		$(3x-10)\ (2x+1)$	$-17x$
$(6x+1)\ (x-10)$	$-59x$		$(3x+1)\ (2x-10)$	$-28x$
$(6x-1)\ (x+10)$	$+59x$		$(3x-1)\ (2x+10)$	$+28x$
$(6x+5)\ (x-2)$	$-7x$	or	$(3x+5)\ (2x-2)$	$+4x$
$(6x-5)\ (x+2)$	$+7x$		$(3x-5)\ (2x+2)$	$-4x$
$(6x+2)\ (x-5)$	$-28x$		$(3x+2)\ (2x-5)$	$-11x$
$(6x-2)\ (x+5)$	$+28x$		$(3x-2)\ (2x+5)$	$+11x$

Any of these pairs of factors, when multiplied together, will give us the $6x^2$ term, and also the -10 term, and what we have to do is to pick out that particular pair which will also give us the term $+11x$. Considering the first pair of factors $(6x+10)\ (x-1)$ we see that when these are multiplied out we shall get one x term when multiplying $6x$ by -1, and another when multiplying $+10$ by x, and the sum of these two products (in this case $-6x+10x=+4x$) is the x term in the final product.

The column to the right of the factors gives this x term for each pair of factors, and we see that the pair which gives us the $+11x$ we are wanting is $(3x-2)\,(2x+5)$.

Thus the factors of $6x^2+11x-10$ are $(3x-2)\,(2x+5)$.

An expression such as we have just factorised, in which there is no higher power of x than x^2 can be factorised as follows :—

Factorise the x^2 term, and also the term which does not contain x. Then fit these factors together in pairs until a pair is found which will give, on multiplication, the x term of the given expression. If two such factors can be found, then they are the factors of the given expression.

15. In conjunction with this subject, it will be useful to note the following standard factors :—

$$a^2+2ab+b^2=(a+b)^2$$
$$a^2-2ab+b^2=(a-b)^2$$
$$a^2-b^2=(a+b)\ (a-b)$$
$$a^3+b^3=(a+b)\ (a^2-ab+b^2)$$
$$a^3-b^3=(a-b)\ (a^2+ab+b^2)$$

PROGRESSIONS OR SERIES.

Arithmetical Progression.

16. A series of terms, each of which differs from the next by a common difference is called an Arithmetical Progression, written for short as A.P. For example :—

$3+5\frac{1}{2}+8+10\frac{1}{2}+13+15\frac{1}{2}+\ .\ .\ .$ is an A.P. in which the first term is 3 and the common difference is $2\frac{1}{2}$.

For the purpose of deriving some formulæ which can be applied to any A.P. we will take a series having a first term a and a common difference d :—

$$a+(a+d)+(a+2d)+(a+3d)+\ .\ .\ .$$

Now the 1st term $=a+0\times d$
,, ,, 2nd ,, $=a+1\times d$
,, ,, 3rd ,, $=a+2\times d$
,, ,, 4th ,, $=a+3\times d$, and so on.

It will be noticed that in each case the coefficient of d is less by 1 than the number of the term, and so—

The nth term is $a+(n-1)d$ where n has any value we wish.

17. Fig. 4 represents the first seven terms of this series ; XY represents the first term a, and the distances yz, $y'z'$, $y''z''$, etc., represent the values d, $2d$, $3d$ . . . etc. X'Y' represents the last term $a+6d$.

It is obvious that the average length of these seven lines can not only be obtained

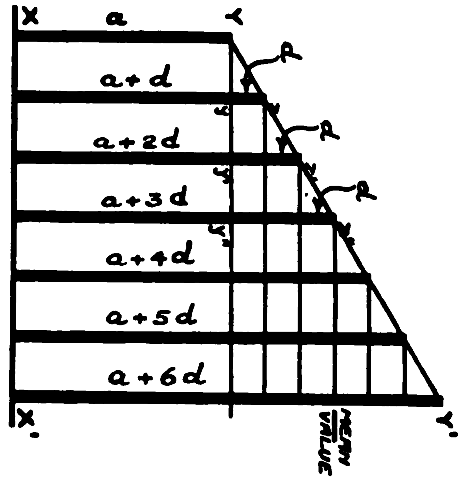


Fig. 4.

by adding up the lengths of all seven lines and dividing by 7, but it can also be found from the mean of the first and last lines—*i.e.*,

$$\frac{XY+X'Y'}{2}=\frac{a+(a+6d)}{2}=\frac{2a+6d}{2}=a+3d.$$

Thus the mean value of the terms of such a series *in which the terms increase regularly* is equal to the mean of the first and last terms, or $\frac{(\text{first term}+\text{last term})}{2}$.

Expressing this in our chosen notation, we see that the mean value of n terms of an A.P. equals

$$\frac{(1\text{st term}+n\text{th term})}{2}=\frac{a+\{a+(n-1)d\}}{2}$$
$$=\frac{2a+(n-1)d}{2}.$$

Now the sum of any number of terms of *any* series *must* equal the mean value of the terms multiplied by the number of terms there are in the series, and so the sum of n terms of an A.P. equals

$$S_n=\frac{2a+(n-1)d}{2}\times n$$
$$=\frac{n}{2}\{2a+(n-1)d\}$$

or
$$S_n=\frac{n}{2}(a+l)$$

where l is the last term of the series we are summing.

EXAMPLE.

The first term of an A.P. is 1·7 and the seventh term is $-0{\cdot}7$. Find the common difference and the sum of the first nine terms.

We are here told that $a=1{\cdot}7$ and that $l=-0{\cdot}7$ when $n=7$.

Thus

$$l=a+(n-1)\,d$$
$$-0{\cdot}7=1{\cdot}7+(7-1)d=1{\cdot}7+6d$$

Therefore

$$6d=-0{\cdot}7-1{\cdot}7=-2{\cdot}4$$

or
$$d=\frac{-2{\cdot}4}{6}=-0{\cdot}4. \quad \textit{Ans.}$$

The series must therefore be

$$1{\cdot}7+1{\cdot}3+0{\cdot}9+0{\cdot}5+0{\cdot}1-0{\cdot}3-0{\cdot}7-1{\cdot}1-1{\cdot}5-\ldots$$

The ninth term is $a+8d=1{\cdot}7+8\times(-0{\cdot}4)$
$$=1{\cdot}7-3{\cdot}2$$
$$=-1{\cdot}5$$

Now the sum of the first nine terms

$$=S_9=\frac{n}{2}(a+l)$$
$$=\frac{9}{2}(1{\cdot}7-1{\cdot}5)=\frac{9}{2}\times 0{\cdot}2$$
$$S_9=0{\cdot}9. \quad \textit{Ans.}$$

Otherwise

$$S_9=\frac{n}{2}\{2a+(n-1)d\}$$
$$\frac{9}{2}\{(2\times 1{\cdot}7)+8(-0{\cdot}4)\}$$
$$=\frac{9}{2}(3{\cdot}4-3{\cdot}2)=\frac{9}{2}\times{\cdot}2$$
$$S_9=0{\cdot}9. \quad \textit{As before.}$$

EXAMPLE.

Find the sum of the first 73 natural numbers:

We have here to sum $1+2+3+4+\ldots$ to 73 terms, so that $a=1$, $d=1$, $n=73$, and $l=73$.

Therefore

$$S_{73}=\frac{n}{2}(a+l)$$
$$=\frac{73}{2}(1+73)=\frac{73}{2}\times 74$$
$$=\frac{73}{2}\times 37$$
$$S_{73}=2701. \quad \textit{Ans.}$$

GEOMETRICAL PROGRESSION.

18. In Geometrical Progression [written for short as G.P.], instead of neighbouring terms having a common *difference d*, they have a common *ratio r*; that is, each term multiplied by a common ratio gives the next term.

For instance, the series $2+4+8+16+32+64+\ldots$ is a G.P. in which the first term is 2, and the common ratio is 2.

Just as, in the case of A.P., we took the series $a+(a+d)+(a+2d)+\ldots$ for the purpose of finding general formulæ applicable to all A.P.'s, so in the case of G.P. we take the series $a+ar+ar^2+ar^3+\ldots$ in order to find some general formulæ applicable to all G.P.'s.

Note that the second term is ar^1
,, third ,, ar^2
,, fourth ,, ar^3

and so the index of r is in every case less by 1 than the number of the term.

Thus the nth term$=l=ar^{n-1}$.

19. To find the sum of a number of terms of a G.P. is not quite as simple as it was for an A.P. Take, for example, a series of five terms, $1+3+9+27+81$, in which $a=1$ and $r=3$.

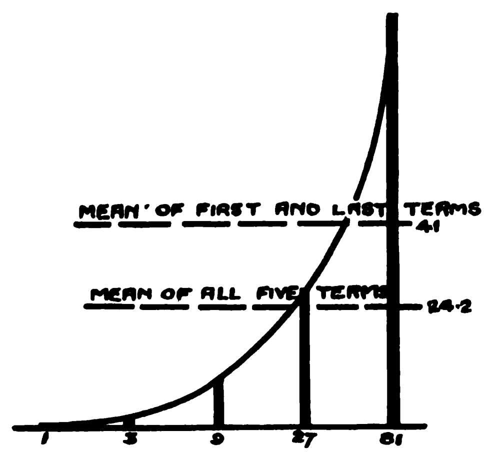


Fig. 5.

Drawing a diagram as before (Fig. 5), we see that the value of successive terms increases more and more rapidly the farther we continue the series. The mean value of the first five terms is

$$\frac{1+3+9+27+81}{5}=\frac{121}{5}=24{\cdot}2,$$

whereas the mean of the first and last terms is

$$\frac{1+81}{2}=\frac{82}{2}=41.$$

Thus to find the sum of a G.P. we cannot

$$S_n = a + ar + ar^2 + ar^3 + \ldots\ldots ar^{n-2} + ar^{n-1}.$$

From this

$$r \times S_n = \quad ar + ar^2 + ar^3 + ar^4 + \ldots ar^{n-2} + ar^{n-1} + ar^n$$

On multiplying each term by r.

take the mean of the first and last terms and multiply by the number of terms, as we did for an A.P., but we must find some other method.

We will find the sum of the first n terms of our general series $a + ar + ar^2 + \ldots$ We have seen that the nth term is ar^{n-1}, and so the $(n-1)$th term is ar^{n-2}, and so on (*see above*).

Subtracting $S_n - rS_n = a - ar^n = a(1 - r^n)$, all the intermediate terms cancelling out,

or $\quad S_n\ (1-r) = a.(1-r^n)$

$$S_n = \frac{a(1-r^n)}{1-r}$$

If we had carried out the above subtraction the other way round—that is, subtracted S_n from rS_n—we should have got

$$rS_n - S_n = ar^n - a$$

$$S_n(r-1) = a(r^n - 1) \text{ or } S_n = \frac{a(r^n-1)}{r-1}$$

To show that these two formulæ will give the same result we will apply each of them to finding the sum of the first five terms of the series $1+3+9+27+81+ \ldots$ in which $a=1$, $r=3$, and $n=5$.

$$S_n = \frac{a(1-r^n)}{1-r} = \frac{1(1-3^5)}{1-3} = \frac{1(1-243)}{-2} = \frac{-242}{-2} = 121 \qquad S_n = \frac{a(r^n-1)}{r-1} = \frac{1(3^5-1)}{3-1} = \frac{1(243-1)}{3-1} = \frac{242}{2} = 121$$

The only choice between the two formulæ

$$S_n = \frac{a(r^n-1)}{r-1} \text{ and } S_n = \frac{a(1-r^n)}{1-r}$$

is one of convenience. It will be found that if r is less than 1, the $(1-r^n)$ form is the more convenient of the two, and *vice versa*.

EXAMPLE.

The fifth term of a G.P. is 8, and the seventh term is 2. Find the sum of the first 10 terms.

To do this we must first find the first term a and the common ratio r.

The 5th term $= ar^4 = 8$
and ,, 7th ,, $= ar^6 = 2.$

Dividing the 7th term by the 5th

$$\frac{ar^6}{ar^4} = r^2 = \frac{2}{8} = \frac{1}{4}.$$

Therefore $r = \sqrt{\frac{1}{4}} = \frac{1}{2}.$

Now $ar^4 = 8$ and substituting in this the value $r = \frac{1}{2}$ which we have just found we get $a(\frac{1}{2})4 = 8$

$$a \times \frac{1}{16} = 8$$

$$a = 8 \times 16 = 128$$

Sum of 10 terms

$$= S_{10} = \frac{a(1-r^n)}{1-r} = \frac{128\,\{1-(\frac{1}{2})^{10}\}}{1-\frac{1}{2}} = \frac{128(1-\frac{1}{1024})}{1-\frac{1}{2}} = \frac{128 \times \frac{1023}{1024}}{\frac{1}{2}} = 128 \times \frac{1023}{1024} \times 2$$

which cancels out to

$$\frac{1023}{4} = 255\tfrac{3}{4}. \quad \textit{Ans.}$$

20. *Summation to Infinity.*—If we have any A.P., say $2+4+6+8+ \ldots$, we see that the sum of an infinite number of terms (called "the sum to infinity") is infinitely great; the more terms we add the greater will be the final sum, and as, to sum to infinity, we keep on adding terms for ever, we shall get an infinitely great result for the summation. In other words, the sum to infinity *is* infinity, written as ∞. If the common difference had been negative, the sum to infinity would have been *minus* infinity instead of *plus* infinity.

In the case of a G.P. in which the common ratio r is greater than 1, either positive or negative, the sum to infinity is again infinitely great. If, however, the common ratio is less than 1, the terms get smaller as we proceed, and we shall find that the sum of the terms will gradually approach a certain definite *limit* as more and more terms are taken.

Consider, for example, the series $4+2+1+\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\ldots$ where $a=4$ and $r=\frac{1}{2}$.

The sum of the first 3 terms is 7,
" 4 " $7\frac{1}{2}$,
" 5 " $7\frac{3}{4}$,
" 6 " $7\frac{7}{8}$,

and we see that the value of the sum is gradually approaching 8, though if we go on adding terms for an hour or two we shall never quite get to 8.

Returning to our original expression for the sum of a G.P.

$$S_n=\frac{a(1-r^n)}{1-r},$$

we can obtain from it an expression giving the sum to infinity, or S_∞, for the case when r is less than 1.

Inside the bracket in the top line we have r^n, which is in this case r^∞. Now if we keep on multiplying a fraction by itself, it becomes smaller and smaller each time; for example, $\frac{1}{2}$ becomes $\frac{1}{4}, \frac{1}{8}, \frac{1}{16}, \frac{1}{32}, \frac{1}{64}\ldots$ after successive multiplications. If we keep on multiplying thus an infinite number of times—that is, if we kept on for ever—we should eventually arrive at a result *infinitely small*, which we say is 0. Thus, if r is less than 1, $r^\infty=0$.

But $S_\infty=\frac{a(1-r^\infty)}{1-r}=\frac{a(1-0)}{1-r}=\frac{a}{1-r}$.

EXAMPLE.

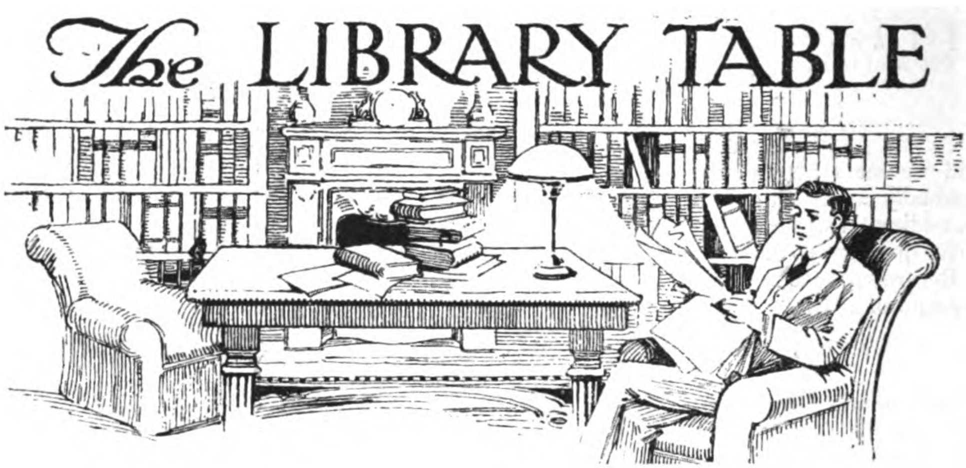
Find the sum to infinity of $0{\cdot}7\dot{5}\dot{6}$. This decimal can be written as 0·756565656 . . . and so

$$S_\infty=0{\cdot}7+0{\cdot}056+0{\cdot}00056+0{\cdot}0000056+\ldots$$
$$=\frac{7}{10}+\frac{56}{1000}+\frac{56}{100000}+\frac{56}{10000000}+\ldots$$
$$=\frac{7}{10}+\left\{\begin{array}{l}\text{sum to infinity of a series whose}\\ \text{first term } a=\frac{56}{1000} \text{ and whose}\\ \text{common ratio } r=\frac{1}{100}\end{array}\right\}$$
$$=\frac{7}{10}+\left\{\frac{a}{1-r}\right\}$$
$$=\frac{7}{10}+\left(\frac{\frac{56}{1000}}{1-\frac{1}{100}}\right)$$
$$=\frac{7}{10}+\left(\frac{\frac{56}{1000}}{\frac{99}{100}}\right)$$
$$=\frac{7}{10}+\left(\frac{56}{1000}\times\frac{100}{99}\right)$$
$$=\frac{7}{10}+\frac{56}{990}=\frac{693+56}{990}$$
$$=\frac{749}{990}. \quad \textit{Ans.}$$

This result agrees with the fraction obtained by means of the ordinary arithmetical rule for turning a mixed decimal into a fraction. This arithmetical rule is:—"subtract the non-recurring figures from the whole decimal, and place the number so obtained over as many nines as there are recurring figures, followed by as many noughts as there are non-recurring figures in the decimal." Thus:—756 minus 7 equals 749 and the bottom line of the fraction will have two nines followed by one nought or 990. Thus we get $\frac{749}{990}$

In our last issue (on p. 483) we published an obituary notice of Sec. Lieut. W. A. B. K. Ward, together with the only portrait at our

disposal at that time. We have since received the above photograph, taken just prior to his decease.



"**The Aeroplane: A Concise Scientific Study.**" By A. Fage, A.R.C.Sc. London: Charles Griffin & Co., Ltd. 6s. net.

This volume, which forms one of Griffin's Aeronautical Series, is, as its sub-title indicates, a scientific work rather than an addition to the already numerous class of "popular" treatises. The important part played by aeroplanes in the present war, and the resulting great increase in their output, has turned the attention of many skilled engineers towards the study of aeronautics, and the appearance of Mr. Fage's book will be welcomed in many quarters.

As the author points out in the preface, the fundamental principles of mechanics are unalterable, although the many interpretations and practical applications of such laws are the fruit of scientific labour. The new science of aviation, which has necessitated a fuller understanding of the dynamics of the air, must now be regarded as a branch of engineering, although each step forward into the realm of aeronautical research seems but to reveal an ever-increasing unexplored region. Commencing with a consideration of winds, wind velocity, and similar objects, the book goes on to deal with streamline bodies and struts, the principles, design, and structure of wings, the general construction of aeroplanes, and many other points. Equilibrium and stability each have chapters devoted to their consideration, and the propeller is very carefully treated. A final chapter is given to aeronautical engines.

Although this book is primarily for those who have at least some acquaintance with engineering, there are many parts which afford much interest to the lay reader, particularly in Chapter 4, where the general construction is considered. The volume is well illustrated with photographs and diagrams.

* * *

"**Brazil** (1913)." By J. C. Oakenfull. Frome, Somerset: Butler & Tanner. 7s. 6d. net.

The commercial resources and possibilities of the great South American continent have engaged the attention of Europeans very considerably of late years. We have before us a very useful handbook dealing particularly with the trade of this continent. Chapters appear on the administration, the history, and the climate, whilst the book is lavishly furnished with maps and plans of cities. What will specially appeal to those interested in radio-telegraphy is a chapter with a sub-section headed "Wireless Telegraphy," which contains a list of the principal wireless stations in Brazil, together with the radius of each and stations with which each can communicate.

* * *

"**Alternating Current Work.**" By W. Perren Maycock, M.I.E.E. London: Whittaker & Co. 6s. net.

The author of this book is well known as a lucid writer on electrical subjects, and the new volume from his pen will further add to the reputation he has acquired in this respect. Although a sound knowledge of the principles of alternating current work is required by every wireless engineer, and should be possessed by the serious wireless amateur, it is to be regretted that few of the latter have given much attention to the subject. There is perhaps some excuse for the average amateur who avoids the study of alternating currents, for most of the books dealing with them are full of mathematics and appear, on the surface at least, to be very difficult and " dry."

Professor Maycock is to be congratulated on producing a book in which mathematics have been introduced only where absolutely essential. What mathematics do appear are very simple and should be easily understood by the great majority of our readers. To quote the author's words: " The Calculus " has not been allowed to show its fearsome " face within these pages, and the very little " trigonometry that has been used is briefly " explained."

A special feature of the book is the use of mechanical analogies in explaining such matters as inductance, capacity, resistance, and combinations of these. For class instruction models constructed as described will be found invaluable. A further welcome feature are the questions set at convenient intervals throughout the volume, and these will be found of great assistance to the home student.

The treatment of all matters, even the most difficult, is throughout the book very clear and interesting. Whilst theory is fully considered, practical matters have not been overlooked, and illustrations of modern alternators, transformers, motors, etc., are interspersed where necessary. Numerous well-drawn diagrams are also provided. We can strongly recommend this book to all who desire to take up the study of alternating currents.

* * *

" THE WONDERLAND OF EGYPT." By Percy R. Salmon, F.R.P.S. London: The Religious Tract Society. 2s. 6d.

Ever since the occupation of Egypt by the British in 1882, when Sir Garnet Wolseley's army defeated Arabi Pasha and restored the authority of the Khedive, the interest of Britain has been more or less centred on that " Land of the Pharaohs." As is so ably explained in the prefatory note at the beginning of the book, " At first " the intention of the British was simply " to restore the power of the Khedive, to " give his Highness friendly advice, and " withdraw the British troops as quickly " as possible. . . . Few people can really " understand our position in the country, as " it was so singular. Egypt appeared to " be ours, but it was not." We are all quite familiar with the dramatic announcement which was made in December, 1914, to the effect that the Khedive had left Egypt for Constantinople, and that the British had decided unreservedly to take over the administration of the country. Henceforth Egypt became a British Protectorate under a new ruler called the Sultan, and a new flag. The book before us is very well written, and illustrated with some good drawings and coloured pictures. A short account of the hieroglyphics is given, together with a chapter on tomb and papyrus pictures. The book contains a good deal of interest to Egyptologists, and the development of the country by the proposed erection of wireless telegraph stations should make an appeal to all those concerned with the art of radio-telegraphy.

* * *

" AERO ENGINES." By G. A. Burls, M.Inst.C.E. London: Chas. Griffin & Co., Ltd. 8s. 6d. net.

The general public does not perhaps fully realise what aviation owes to modern improvements in the internal combustion engine. For years no success could be achieved in artificial flight through lack of an engine with both high power and light weight, and it was not until the invention by Daimler of the small high-speed petrol engine that any real advance was made. It is interesting to consider that the early stationary petrol engines weighed upwards of 1,000 lb. per b.h.p., whereas a modern aeroplane engine weighs something in the neighbourhood of 2¾ lb. per b.h.p. This fact will indicate the enormous advance which has been made of recent years.

Mr. Burls, in this volume, which is also one of Griffin's Aeronautical Series, treats exhaustively of aeronautical engines of all types. The book is excellently illustrated with photographs, diagrams, and folding plates, and will no doubt appeal to a wide circle of readers interested in aviation.

* * *

"THE BOOK OF FRANCE" (1915). Edited by Winifred Stephens. London: Macmillan & Co.; and Paris: Edouard Champion. 5s. net.

The object of the "Book of France" is fourfold. Primarily it is intended to raise money in aid of the invaded Departments of France. But it is also hoped that the book will serve to show what perhaps is not enough realised in this country—namely, the sorrows France is suffering and the services she is rendering to the cause of civilisation. The book should also afford a memento of the cruellest war humanity has ever known, and an example of high literary and artistic excellence. For it contains contributions from the pen, the pencil, and the brush of French authors and artists of the first eminence.

The book is further intended to bind even yet more closely together the allied countries of France and England, for with the humility of true courtesy English writers no less eminent than their French confrères have consented to render into English the French contributions to this book. The French originals and the English versions appear side by side.

The invaded districts of France have suffered no less than Belgium from the appalling cruelty and wantonness of the brutal German soldiers. Proceeds from the sale of this book will go to a fund which is intended in some measure to ameliorate the sufferings of those unfortunate enough to live in the districts which have experienced the fury of the Hun. We trust our readers will not forget our obligation to France, and especially the ties of friendship which now so happily exist between the two nations, and will purchase a copy of the book, thus adding their quota to the relief of suffering and distress.

* * *

"ELEMENTARY PRACTICAL MAGNETISM AND ELECTRICITY." By J. C. Kirkman, B.Sc. London: George G. Harrap & Co. 1s. 6d. net.

This little book is designed for use by students in the laboratory, as a guide to practical work. Theory is dealt with only so far as it concerns the particular experiments described, as it is presumed that the reader is either attending classes for theoretical instruction, or else possesses the needful knowledge. The author lays emphasis on the need for accuracy in performing the experiments and also on the advisability of making clear and concise records of work done. The experiments described are arranged in the order found most suitable in the author's own classes, and the later experiments presuppose a knowledge gained in the earlier part of the book. Each chapter is prefixed by a list of the apparatus required, and appendices contain additional information on the experiments, together with some useful tables. The book should be very helpful to teachers and students in the coming autumn and winter technical classes.

* * *

"SEA, LAND, AND AIR STRATEGY." By Col. Sir George Aston, K.C.B. 1914. London: John Murray. 10s. 6d. net.

The issue of this book last year was most opportune, coming as it did when half Europe was engaged in deadly warfare. Its primary object appears to be that of a comparison between the relative value of sea strategy, land strategy, and air strategy. Many of our readers will recall the famous dictum of Von der Goltz quoted on the title-page of the book: "Who-"ever writes on strategy and tactics ought "not in his theory to neglect the point of "view of his own people. He should give "us national strategy and national tactics." Col. Aston's experience has been wide, for he has spent thirty-five years of his life both with the Fleet and with the Army, so that he holds probably a unique position, which permits him to treat his subject from both points of view. His chapters on air strategy are largely speculative, because, of course, they were written before the outbreak of the present war, which has thrown so much light on the usefulness of aeronautics in war time. Altogether the book forms a monument to the energy and devotion of its author, and should be read by all who are interested with strategical progress and tactics.

Foreign and Colonial Notes

China.

The expansion of China through Western civilisation and influence increases annually. There has recently been inaugurated at Hong Kong a wireless telegraph service for communication with ships and coast stations within the radius of 500 to 700 miles in daytime and over 1,300 miles at night. The Post Office department of the colonial government is in charge of the services, and the Post Office at Hong Kong deals with the local business.

* * *

Cocos Island.

It is understood that the wireless station at Cocos Island which was destroyed by the German raiding cruiser *Emden* is again in full working order.

* * *

Haiti.

Despatches reporting the revolutionary troubles in Cap Haiten, Haiti, contain information to the effect that a wireless station has been erected on the roof of the American Legation in that city.

* * *

India.

Dr. Filippo de Filippi, the Italian explorer, recently lectured at Bombay before the Royal Geographical Society on his expedition to the Karakorum and Central Asia in 1913–14. The subject is most entrancing, and great interest was shown by the audience. He proceeded further in his task than other well-known explorers of the Central Asian district—Sir Francis Younghusband, Dr. and Mrs. Workman and the Duke of the Abruzzi. It is interesting to record that Dr. Filippi related how he determined longitude by means of wireless time signals transmitted from Lahore.

* * *

New Zealand.

In the Postmaster-General's letter presenting the annual report of the Post and Telegraph Department for the year 1914 to both Houses of the General Assembly of New Zealand the following paragraph appears to call for notice :—

"The radio-telegraph system, although "suffering from loss of ordinary business, "has proved its usefulness in connection "with matters affected by the war, and, "among other things, has proved of great "utility in communicating with our Forces "in Samoa."

The Postmaster-General reports that the two high-power and the three low-power stations of the Dominion have continued to work satisfactorily.

Observations are still being made at New Zealand stations of atmospheric electrical disturbances which interfere with the reception of signals, and the data collected are being communicated to the British Association for the Advancement of Science.

It is interesting to note that on the initiative of the British Post Office arrangements have been concluded by which the certificates of competency, signifying that the holders are competent to act as wireless operators on vessels, issued by any of the self-governing countries of the British Empire shall be recognised throughout the Empire.

* * *

A few weeks ago a wireless operator in New Zealand distinctly heard the two Western Australian stations at Broome and Perth (approximately 3,000 miles from Wellington) testing, but as the staff of the office where these signals were heard were inclined to doubt the genuineness of this, the operator wrote to the station at Broome quoting particulars of what had been heard, and received a letter in reply giving a complete confirmation. Considering that the signals would have to traverse the whole of the continent, including desert, and that they would have been subjected to diffusion, diffraction, absorption, and so on, this record is remarkable.

* * *

United States.

The superior jury of the Panama-Pacific International Exposition has awarded the following medals to the Bureau of Navigation: Radio apparatus, medal of honour; educational demonstration of methods and apparatus for enforcement of the Federal radio law, silver medal.

* * *

In a recent issue the *Electrical World* of New York prints the following paragraphs:—

"The radio station at Arlington, Va., just "across from Washington, D.C., is now "working with the new high-powered "station at Darien, Canal Zone.

"The radio station, which has recently "been put into operation, has three masts "900 ft. apart, each mast being 600 ft. high. "The Arlington station has two masts 450 ft. "high each and one mast 600 ft. high. "The Darien equipment is of the 100-kw. "continuous-oscillation type of apparatus. "The station is situated at the edge of "Gatun Lake, on three little island knolls, "and the foundations and lower part of the "works were constructed before the water "was let into the lakes, a good electrical "'ground' being thus obtained. Comfort- "able quarters for the crew of twenty men "have been erected near the station, twenty "men being detailed there.

"The Darien station is working also with "the two small stations on the Isthmus, one "at Colon and one at Balboa, and when the "high-powered station now being built at "Hawaii is completed Darien will work with "that office, Hawaii in turn communicating "with the Philippines."

* * *

The following is an account as published by our American contemporary the *Wireless Age* of the Tesla/Marconi action now proceeding in the United States:—

"In a suit brought in the United States "District Court in New York City by the "Nikola Tesla Company against the Marconi "Wireless Telegraph Company of America "to have the Marconi tuning patent adjudged "void, as interfering with two of the Tesla "patents, Judge Hand on August 10 "rendered a decision on a motion made by "the Tesla Company to strike out certain "allegations in the answer of the Marconi "Company. He refused to strike out the "allegations in the Marconi answer alleging "the invalidity of the Tesla patents. He "decided that these allegations are good "defenses of the suit, and should, therefore, "remain in the answer.

"Judge Hand, however, decided that as "the allegations in the answer relating to "Judge Veeder's decision sustaining the "validity of the Marconi tuning patent over "the Tesla patents in the suit against the "National Electric Signalling Company is a "legal precedent and can be presented on "the argument in relation to the issues, and "as it was not alleged that the Tesla "Company was in privity with the National "Company, or had control over that suit, "that allegation should not be set up in the "answer.

"The suit of the Tesla Company against "the Marconi Company is a new develop- "ment in the latter's claim to ownership of "all basic patent rights in the transmission "of wireless messages. In a number of "other wireless patent suits against com- "panies and individuals the Marconi Com- "pany is the plaintiff, and, though a defen- "dant in this latest litigation, Edward J. "Nally, vice-president and general manager "of the Marconi Company, believes that the "suit will serve as one of the mediums "through which the Marconi Company "hopes to establish the broad claim of its "right to all basic wireless patents.

"The dispute over patent rights between "the Marconi Company and Mr. Tesla began "in August, 1914, when the Marconi "Company sued Fritz Lowenstein, a German "engineer, alleging that certain wireless "apparatus sold by him to the United States "Navy was made in violation of the Marconi "patent 763, 772. It was announced then "that Tesla would testify for Mr. Lowen- "stein, alleging that the Lowenstein devices "were developed from Tesla patents 645, "576 and 649, 621, which were granted prior "to the Marconi patent.

"In the present suit, Mr. Tesla bases his "action on the allegation that his two patents "were granted in 1900, and that the Marconi "patent was not granted until 1904. The "bill of complaint asks for a decree adjudging "the Marconi patent null and void, and as- "serts that the Marconi patent covers the "inventions and combinations of appa- "ratus described and claimed in the Tesla "patents.

"The answer of the Marconi Company "denies that the Marconi patent covers the

" inventions or combination of apparatus " described in the Tesla patents, and also " denies that it is guilty of any infringement. " The company asserts that its patent was " granted to Guglielmo Marconi on the proof " of independent invention by Mr. Marconi " not in any way due to or based on any " invention of Mr. Tesla.

" Mr. Nally said that he had no reason to " fear the Tesla suit.

" 'The Marconi Company has a right to its " patent,' he said, 'and can establish that " right in the courts. Many individuals and " companies have infringed the Marconi " patents, and others have attempted to " disprove the originality of our inventions, " but when our present litigation shall have " gone through the courts, I am confident " that the leadership of the Marconi Com- " pany in the invention and development " of wireless communication will be estab- " lished.' "

* * *

It is understood that the Navy Department is planning the construction of a new high-power wireless station on Puget Sound. The plant will possess towers 400 feet high. It has not yet been decided where the station will actually be erected, but it is probable that Keyport, near Bremerton, Washington, will finally be fixed upon.

* * *

We understand that since September 1st no new business except Government messages has been, or will be, received at the Tuckerton wireless station until further notice. It was suggested that telegrams for Germany be despatched from Sayville. It is significantly stated that the reason for this order is that atmospheric conditions were poor.

* * *

The *Telegraph and Telephone Age* recently contained the following paragraph :—

" The Carnegie Institute of Technology, " Pittsburg, Pa., is installing a powerful " radio plant in the tower of Machinery " Hall. It will have a very wide operating " range, embracing Honolulu and Eastern " Germany. The station is being installed " for the use of the student radio club, an " organisation of electrical students. The " equipment of the new station consists of a " 10-kilowatt motor-generator set of the " latest type, and an audion detector."

Since the opening of the Panama Canal the wireless stations erected by the United States Government have more than justified their existence. We read in the *Panama Canal Record* that the naval stations at Colon and at Balboa, which were constructed especially for communication with vessels using the Canal or going to its terminal ports, are performing increasingly effective services in facilitating Canal operations. It transpires that more than one half the number of vessels passing through the Canal or arriving at its terminal ports are equipped with wireless apparatus, although only about a quarter of the number of those so equipped have advised the authorities of their approach. The Colon station now deals with about 2,300 messages per month and the Balboa station with about 400, practically all of which comprise messages to or from ships. Of these about one sixth are handled as part of the Canal work for which no charges are made. It is interesting to note that the radii of communication of the stations have extended to as far as 1,500 miles under favourable conditions. The Colon station, amongst its other duties, sends out a news bulletin, a weather forecast and any information relating to navigation.

* * *

High winds were the cause of an accident to a new steel wireless tower at Medford, Mass. It was erected for service at Tufts College, and was blown down across the tracks of the southern division of the Boston and Maine railroad, immediately in front of the White Mountain express, which was approaching at a speed of 40 miles an hour. The tower derailed the former trucks of the locomotive and was literally torn to pieces. Other portions fell across electric light, power, telephone, and tramway wires. The tower was 310 feet high and had nearly been completed when the accident occurred. It was mounted on a reinforced concrete foundation and measured 3 feet 6 inches square, being guyed at 100 foot intervals by three-strand steel wires, the size at the two lower points of attachment being five-eighths of an inch and at the top guying point three-quarters of an inch. About 500 yards of overhead lines were torn down when the tower fell, and fragments of the tower were carried 263 feet by the locomotive.

Amalgamated Wireless (Australasia) Limited

THE half-yearly ordinary general meeting of the Company was held at Sydney on August 31st last, to receive the report and balance sheet of the Directors of the Company for the half-year ended June 30th, 1915, Mr. H. R. Denison, managing director, presiding.

The Directors' report states that trading for the period has naturally been seriously interfered with by the war, and profits from this department have, in consequence, suffered somewhat severely.

The ships' message traffic, particularly referred to in the report of the Directors in March last (see page 203 WIRELESS WORLD, June, 1915), has shown a slight improvement, but is still subject to the peculiar disabilities therein referred to.

The subsidy ships now operated by the Company have been increased by five during the period under review, the total number now standing at eighty-five.

The Directors have had under consideration for some time the extension of the manufacturing plant for the complete manufacture in Australia of wireless telegraph apparatus. This object has been successfully achieved and the Company is now manufacturing the majority of its requirements.

The Directors have maintained a policy of rendering assistance to the Defence Authorities in every possible manner. On the eve of the declaration of war the Company's entire marine and shore organisations, together with factory and training schools, were placed unreservedly at the disposal of the Government. This was acknowledged by a letter from the Prime Minister, in which he stated: "I am to express the Government's high appreciation of your patriotic and generous action."

Positions are kept vacant without loss of seniority for all permanent employees on active service. Over 80 trained men have already been supplied by the Company to the Defence Authorities in Australia, New Zealand and England. Appreciatory letters have been received from the Defence Authorities and from shipowners for assistance rendered by the Company and its officers since the outbreak of war.

The net profit standing at the credit of Profit and Loss Account amounts to £6,001 14s. 7d., from which the Directors propose to recommend the distribution of a dividend of 3½ per cent. for the half-year on the capital of the Company, absorbing £4,900, thus making the full dividend for the past year at the rate of 6 per cent. per annum. This leaves a balance of £1,101 14s. 7d. to be carried forward to next account.

PATENT RECORD.

12630. September 2nd. Arthur H. Morse & the Indo-European Telegraph Co., Ltd. Selective calling devices for use in electric telegraphy. (*Provisional.*)

12882. September 8th. Marconi's Wireless Telegraph Co., Ltd., & George M. Wright. Production of continuous oscillations. (*Provisional.*)

13129. September 14th. Werner Otto. Arrangement for producing short uni-directed high-tension current impulses. (*Complete.*)

13614 and 13615. September 24th. Arthur H. Morse & the Indo-European Telegraph Co., Ltd., Selective devices. (*Provisional.*) Supply of electric energy to wireless telegraphy installations. (*Provisional.*)

13899. September 30th. Murray F. Sueter, R. M. Groves & Basil Binyon. Apparatus for use in wireless telegraphy and the like. (*Provisional.*)

SHARE MARKET REPORT.

LONDON, *October 19th*, 1915.

Business during the last month has been very small in the various Marconi issues. The price of the Ordinary Shares remains unchanged. Canadians are rather easier and Americans have improved on buying from America. Spanish are lower. Marine have improved slightly. There is no special feature to report.

Prices: Marconi (English), Ordinary, £1 18s. 1½d., Preference, £1 15s.; Canadian, 5s. 3d.; American, 17s. 6d.; International Marine, £1 4s. 6d. Spanish and General Wireless Trust, 3s. 6d.

PERSONAL PARAGRAPHS.

Mr. J. G. Robb, who has been connected with the Louisburg, Canada, Station during the past two years in the Engineering Department, has left for his home in England, where he will take up a similar position in the service of the English Marconi Company.

On the evening before his departure, Mr. Johnstone, Officer-in-Charge of the Traffic Department, on behalf of the officers and members of his staff, made Mr. Robb a presentation. The gift was a handsome and costly travelling bag containing pipes, smokes, etc. An address was made by Mr. Johnstone, to which Mr. Robb feelingly replied.

* * *

Our sincere felicitations to Mr. and Mrs. Frederick Atkin on the occasion of their wedding, which took place on the 2nd October last. Mr. Atkin, who is an assistant in the Secretary's Department of the Marconi Company, was married at St. Etheldreda's Church, Fulham, to Miss E. M. Brown of that suburb. The Directors and officials of the Marconi Company showed their goodwill and appreciation of Mr. Atkin's services by presenting him with a handsome canteen of cutlery. We wish them all happiness in their future estate.

* * *

Our readers, with us, will be sorry to hear of the death of Lance-Corporal Baker, Bandsman and Medical Officer's Orderly, No. 1796, D Company, 5th Essex Battalion, which took place in the Dardanelles. No further information as to the nature of his death has come to hand. He was a joiner in the carpenter's shop at the Chelmsford Works of the Marconi Company and a Labour member of the Town Council. He was also an energetic member of the Chelmsford Works Orchestra. We take this opportunity of offering our sincere condolences to his relatives.

* * *

George Foot, of H.M.S. *Impregnable*, has been successful in passing the preliminary naval examination for wireless telegraphy, obtaining the highest number of points of any boy competing. One hundred and twenty-seven lads sat, and only 29 passed. In the final examination on August 4th he succeeded in obtaining sixth place among 27 boys, 15 of whom passed. He is now expected to be transferred to H.M.S. *Vernon* (torpedo school, Portsmouth) for mechanical instruction. We very heartily congratulate the lad on his success, and wish him a very successful career in the Navy.

* * *

We regret to record the death of Warrant Telegraphist Ernest Arthur Sutton, who, according to an *Electrical Review* report, lost his life in the sinking of H.M. Trawler *City of London* in the North Sea on September 14th. Mr. Sutton, who was born at Marlow, Bucks, was enrolled in the Marconi Company's Liverpool School in June, 1910, and in the following month was appointed to the Operating Staff. He left the wireless service shortly afterwards, and took up a position in the General Electric Company, Ltd., of London, where he became assistant manager of one of the departments. After the outbreak of war he offered his services to the Admiralty, and at the time of his death was nominated for further promotion.

* * *

The *Ceylon Observer*, of September 3rd last, printed an account of a farewell function at the Colombo Wireless Station. It appears that Mr. F. T. Hubert had received another appointment, and together with his wife was leaving the district. Gaiety was the keynote on that occasion. The full C.E.V. Wireless Section with Sergeant J. R. Stapleton, O.C. Wireless Station, was present. A band discoursed music whilst refreshments were served *ad libitum*. Major David Rockwood said that Mr. Hubert's work had been highly appreciated, and he wished him all success in the new station. Mr. Hubert suitably replied, and the proceedings closed with the singing of the National Anthem.

* * *

The many friends of Sergt. E. J. Rowland, of the 1/6 Essex Regiment, "A" Company, 161st Brigade, 54th Division, Mediterranean Expeditionary Force, will be sorry to hear that he has been admitted to hospital at Alexandria, suffering from exhaustion and debility. From a letter received by the Marconi Company, it is gathered that he had been in the Gallipoli Peninsula for only about ten days, two of which were spent actually in the firing line. He reports that he had one "close shave," a bullet striking the back of his helmet and just grazing his left ear. He says not only have they the Turks to combat, but they have enemies in the climate and water.

Second Lieut. Powell.

F

We are informed that Mr. Stanley W. T. Powell, lately a member of the Transfer Department of the Marconi Company, who belonged to the London Scottish Territorials at the outbreak of the war, has obtained his commission as a Second Lieutenant in the Royal Garrison Artillery. Mr. Powell went to France with the London Scottish last autumn, and was invalided home in November last as the result of an injury to his eye caused by the bursting of a shell. We offer our sincere congratulations to Lieutenant Powell on his well-deserved promotion.

* * *

We think the following extract from a letter received by the Marconi Company from Private B. C. Collis, of the London Scottish, may prove of interest to our readers. Private Collis was formerly a member of the Accountants' Department of the Marconi Co. and writes:

"... . I was wounded in the thigh on Saturday "near Vermelles and Hulloch, when the Scottish "took part in the advance in that quarter. I am "going along quite well, although I am not allowed "to get out of bed yet as the bullet went right "through my thigh; luckily it did not touch the "bone or the artery."

We trust that Private Collis will make a speedy recovery to good health and hope that he will feel none the worse for his trying experience.

Private Collis.

We regret to announce that E. C. Aylett, who was formerly in the employ of the Marconi Company and served in the Machine Shop, has been shot through the nose and had several teeth displaced. He had been doing duty with the East Anglian R.A.M.C. in the Dardanelles when he received his wound. He is now at the Fifth Southern Town Hospital at Portsmouth, and we trust that he will make a speedy recovery.

We are pleased to make mention of the promotion of Mr. Steven B. Balcombe to the rank of Temporary 2nd Lieutenant as and from the 8th October, 1915. Mr. Balcombe was in the service of the Marconi Wireless Telegraph Co., Ltd., and we take this opportunity of offering him on behalf of our readers and ourselves our hearty congratulations on his new appointment.

Christmas Double Number

WIRELESS WORLD

[Photo by Dover Street Studios.

SENATORE MARCONI.

THE WIRELESS WORLD

Vol. 3.—No. 33. (New Series) December, 1915. Subscription 5/0 per annum post free. Price 6d. Post Free 10d.

[redacted]

WE have referred elsewhere and on other occasions to the fact that a very little amount of imagination would enable a thoughtful man to realise what a wonderful amount of disturbances must be going on in the æther caused by the radio waves transmitted under the stress of present conditions. Unfortunately, for the most part, during the last eighteen months, these messages have all, or nearly all, dealt with the subject of warfare and hatred. At this time of year, however, we may be certain that the æther will respond, probably in a vastly increased extent, to the pressure of waves which bear the messages started nearly 2,000 years ago, and which, despite temporary set-backs in the shape of wars and other calamities, are moving humanity, on the whole, steadily forward along the lines of progress towards Universal Love. It has for a good many years past been the habit of commanders of ships and their officers to pass along Christmas greetings to each other and to friends ashore, whilst these greetings are accompanied by all sorts of Christmas messages, which clients in increasing numbers, both afloat and ashore, entrust to this medium for transmission.

The part played by wireless so far has been to distribute military and naval orders and information and news relating to the efforts to carry into practical application rival gospels of hate. Every day sees an increase in its fields of activity, and the application of the principles of radio-telegraphy is constantly being met with in directions never heretofore contemplated. It is in this extension of *practical* applications that we find solace for the neglect of experimental work, which has perforce been for the last eighteen months reduced to a state of suspended animation.

Moreover, it is not for nothing that the new body of aeronauts, called into being for military purposes by His Britannic Majesty's Government, have received their training in wireless telegraphy. As you extend the number of ingenious human brains at work upon a given subject so will you increase the chances of progress for that subject. This war has had the effect of multiplying manifold the number of persons professionally engaged in the practice of radio work, and the full effect of this increase will only be evident when we reckon up our accounts after restoration of peace.

We wonder whether many of our readers have heard of the pseudonym sometimes bestowed upon wireless telegraphists in the naval service. They are called "Angels," and owe that title to the winged badge which they wear upon their right forearm. A little flight of fancy is permissible even for the gravest and the most matter-of-fact amongst us at this time. May we not connect this title and the vast future possibilities of wireless telegraphy together, as a kind of prophecy that the day will come when "Angels" cease to give out messages whose object is the furtherance of destruction and fulfil the task allotted to the angels who once sang "Peace on Earth" beside a certain cradle in Bethlehem?

A STORY OF DEVELOPMENT & PROGRESS

THE elderly man leaned back in his club chair and looked down into the street. A good dinner and a choice cigar assisted contemplation.

"A fine car, that!" he remarked, as a luxurious landaulette rolled by. "Not a sound, you notice; smooth running, speedy and comfortable. By Jove! Do you remember the first run we had in that old machine of Mackenzie's in—let me see, when was it? '96, I think."

"Yes, the beginning of 1896," replied the second clubman, smiling. "A fearful old bone-shaker, wasn't it? Eleven times we broke down in four miles. Ah, well! Improvements are always being made, and motors are being put to all kinds of uses. I see from the papers that motor-car wireless telegraph stations are being extensively used at the Front."

"Wireless on motor-cars," said the first man quietly, gazing into a cloud of blue smoke. "Wireless on motor-cars! Two things totally unknown in my boyhood. The novelty of motor-cars has long since passed. Wireless telegraphy is still looked upon as new, but I suppose that it, too, will soon be considered as nothing marvellous. Yet who thought of wireless telegraphy on motor-cars when we went for our first motor ride in '96?"

"I dare say Mr. Marconi and his assistants thought of it," replied the second man. "Wireless telegraphy is a good deal older than you seem to think. Do you know that Mr. Marconi came to England just at the time the old Locomotive Act was repealed, and motor-cars were first allowed to run—if they could!—without a man carrying a red flag in front?"

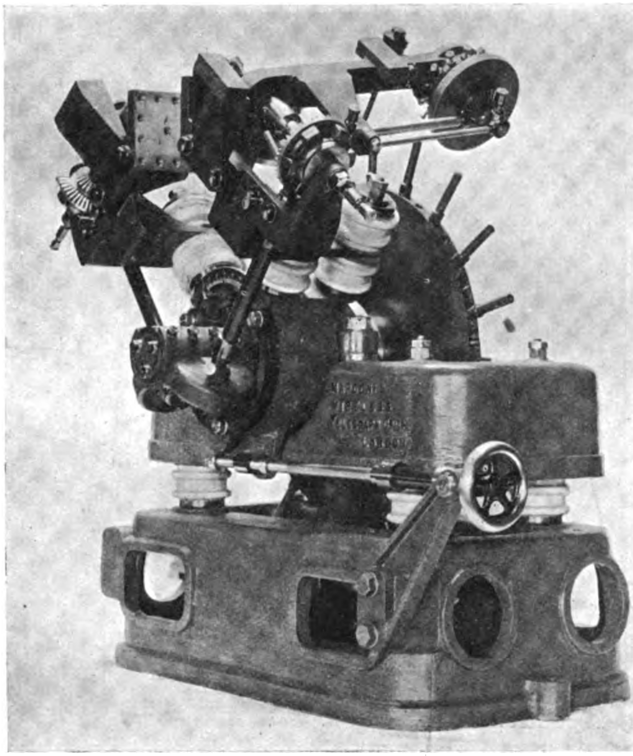
"No! Really? I had no idea he had been here as long as that. My word, how time flies! Now tell me, what did Mr. Marconi actually do when he first came to England?"

"Well, I don't know much about wireless myself, but there's a man from Marconi's in the club here, whom I know very well. I'll see if I can find him and introduce you."

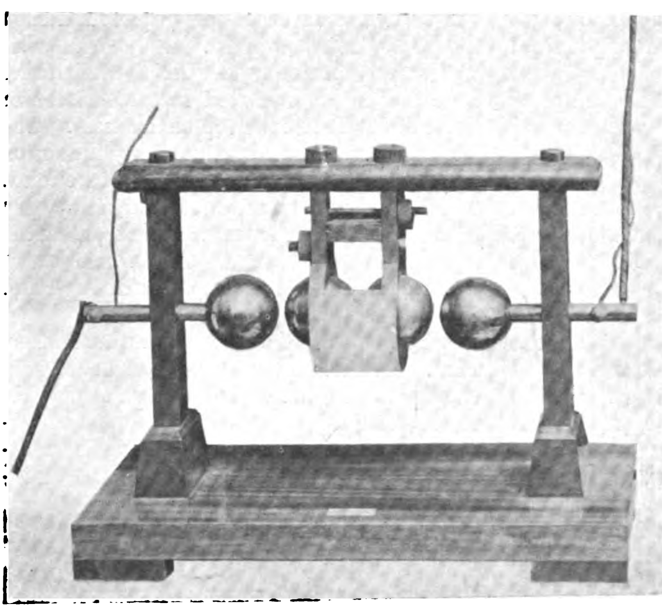
After a brief absence the second Clubman returned with the Man from Marconi's. The Elderly Man was forthwith introduced, and the three chose comfortable chairs by the Smoke Room fire, whilst a silent-footed attendant brought three glasses, a bottle and a syphon. Three columns of blue smoke now mingled in the air. After some small talk the Elderly Man turned to their newly-arrived companion.

"Major Smithson was just talking of the early days of wireless," he remarked. "I had no idea that Mr. Marconi had been with us so long. Those first days must have been extremely interesting!"

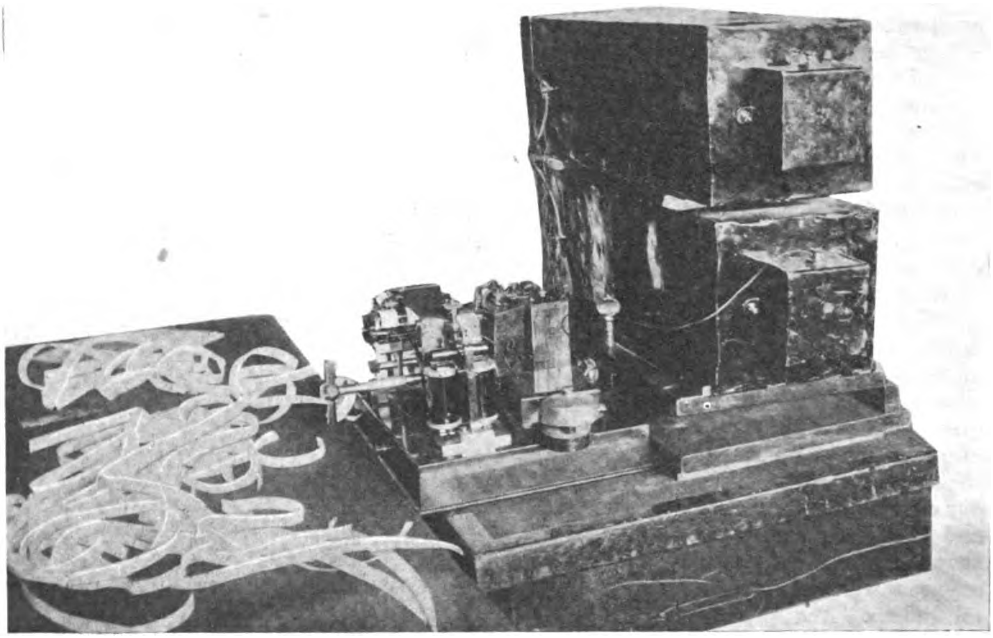
"Yes, they were certainly interesting!" answered the newcomer, with a far-off look in his eyes. "Interesting and also exciting. I remember the scepticism with which our claims were regarded, and the condescension shown by many men of science towards the youthful Italian. And then, as progress was made and the invention turned out to be really important, I recollect the petty jealousies of people who were angry because they had not themselves thought of it all before. But that was the unpleasant side. We had our happy hours in plenty, such as when first signals were transmitted over a mile or two on Salisbury Plain. When I think of the great wireless stations of to-day, with their giant steel masts and miles of aerial wire suspended hundreds of feet above the ground; their great boiler rooms, with stokers feeding the flames of roaring furnaces; the humming turbines and dynamos which produce the current, and the whirling discs with their dazzling blue-white sparks, I cannot help smiling at the old apparatus we used to carry about with us from place to place in wooden boxes.



Modern Rotary Discharger.



Early Form of Discharger.



Early Tape Recorder and Coherer Set.

We used flag poles or anything else of convenient height, to suspend our aerial wires then, but later, of course, we built special masts, and now, as you may know, we construct masts of any required height from sections of steel."

"When was the Marconi Company formed?" enquired the Elderly Man.

"The first Marconi Company came into existence under the name of the 'Wireless Telegraph and Signal Company, Limited,' in 1897," replied the Man from Marconi's. "Somewhat earlier in the year we had successfully transmitted signals across the Bristol Channel, up to a distance of about nine miles. A couple of months after the Company was formed Mr. Marconi managed to establish communication over a distance of 34 miles, which, of course, marked a big advance.

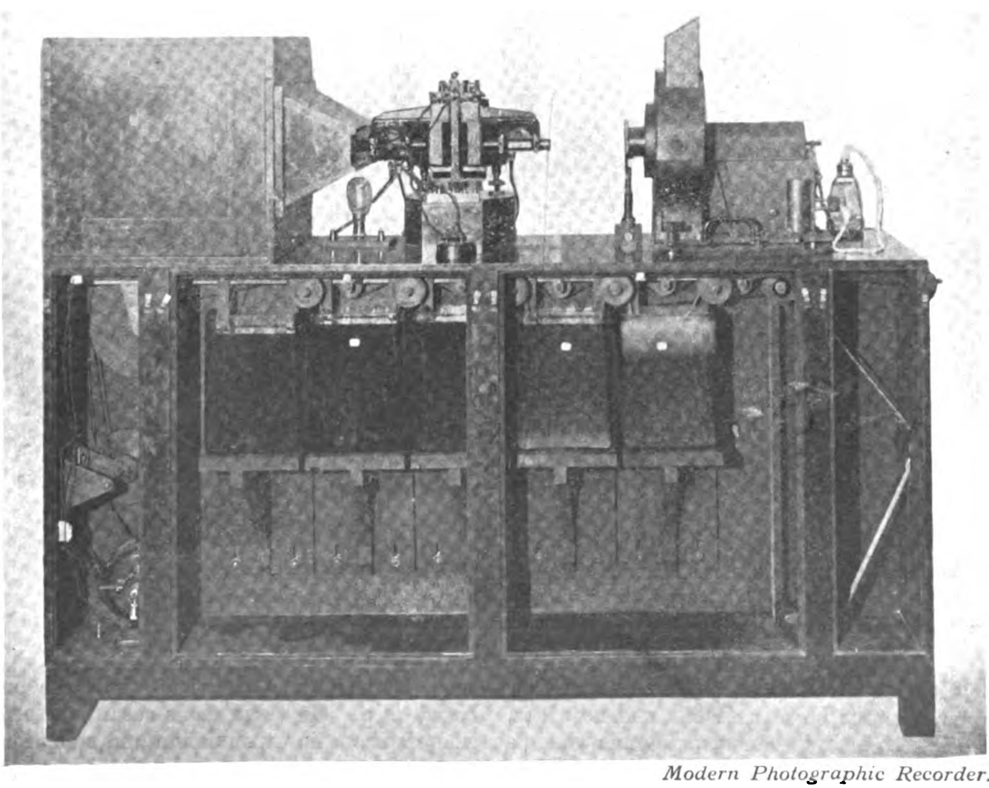
"The first big achievement was, of course, the transmission of messages across the English Channel. This happened in March, 1899, with apparatus fixed up at the South Foreland Lighthouse and Wimereux, near Boulogne."

"What apparatus did Mr. Marconi use in those days?"

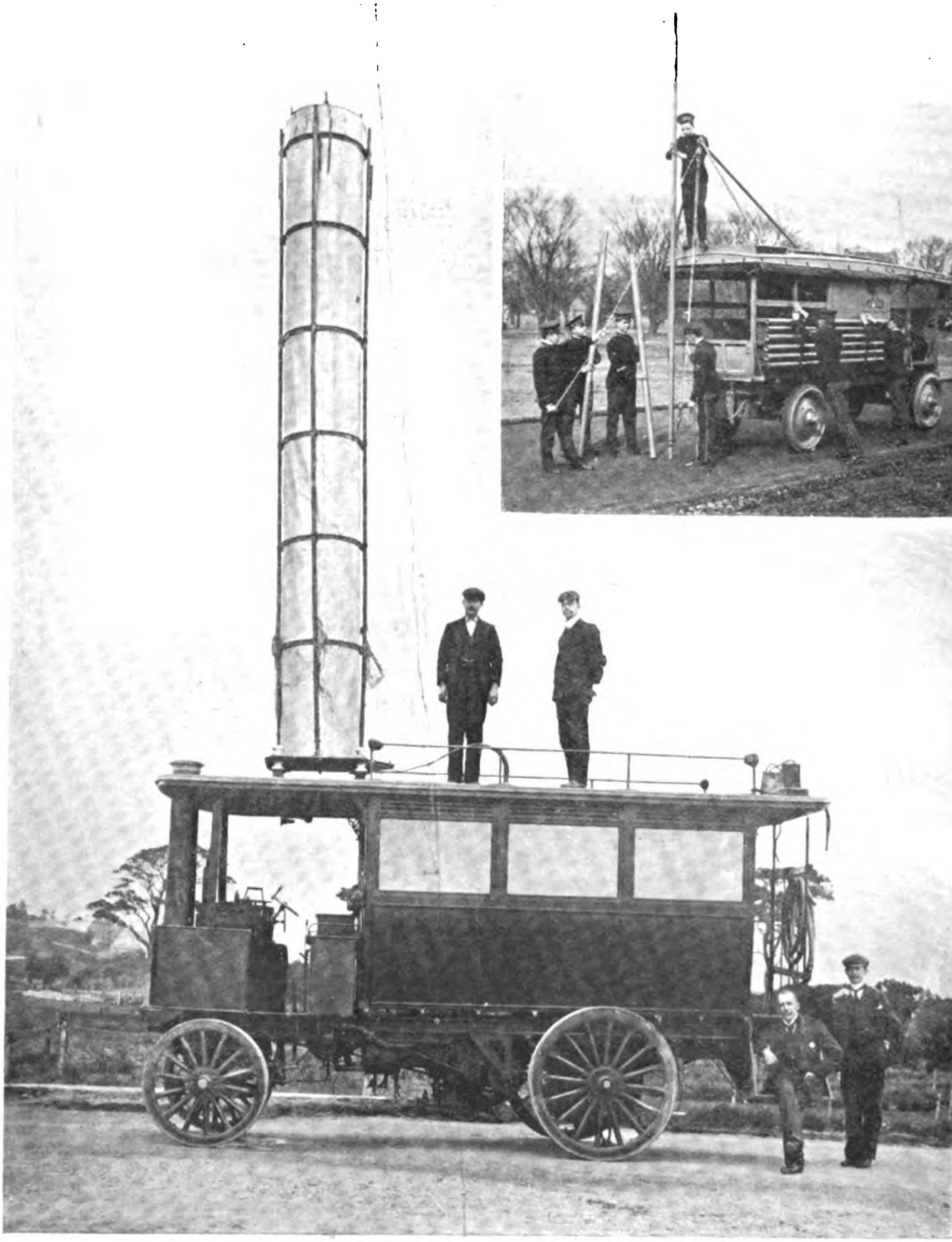
"Well, it was very simple compared with the elaborate mechanism to be found in a modern wireless station. The aerial wire was merely ordinary electric lighting cable attached to an insulated metal canister or sheet of netting at the top of the mast. The transmitter was nothing but a large induction coil with a make and break key in circuit. The receiver contained a coherer, relay, dry cells and a Morse Inker which recorded the signals on paper tape. The whole outfit would easily fit on an ordinary dining-room table."

"You speak of tape," said the Elderly Man. "The last time I was on board ship the Operator told me that it was not possible to record the signals satisfactorily. I understood that there was trouble from interference and something he called 'atmospherics.'"

"Well, as far as ordinary ship working goes his statement was correct," answered the Man from Marconi's. "The position with regard to recording is this. The early apparatus of which I have been speaking was, compared with the modern, very insensitive. In good conditions, when atmospheric electricity caused no false signals, the receiver yielded good readable messages in Morse characters on the tape. If there chanced to be atmospheric trouble, such as near or distant lightning flashes, or other similar electrical disturbances in the atmosphere, false signals mingled themselves with the true signals and the record became unreadable. Also, if another station happened to be working at the same time the two sets of signals would become inextricably mixed. The invention of tuned or synchronised apparatus by Mr. Marconi eliminated to a large extent this last trouble, and lessened the atmospheric bother, but there still remained a good deal to contend with after this. A little later much more sensitive receivers were invented, but these, unlike the coherers, were unable to give enough current to work the relay, and were used with telephone receivers, in which they gave a buzzing noise. As soon as telephonic reception came into use a great advantage showed itself. It was found that the operator could distinguish readily by sound between the noise caused by an atmospheric discharge and that given by a wireless station. In many cases, too, it was possible to pick out the station wanted from those which quite unintentionally were interfering. Again, the operator was able to write down the message word for word as it was received, and so no time was lost. When it was decided at an international conference that only two wave-lengths were to be used by commercial ship stations many of the advantages of tuning were lost, however, and while the operators had not much difficulty in mentally selecting the station they wished to hear owing to its having a slightly different sound, the jumbling of signals in recording apparatus quite precluded the use of tape.



Modern Photographic Recorder.



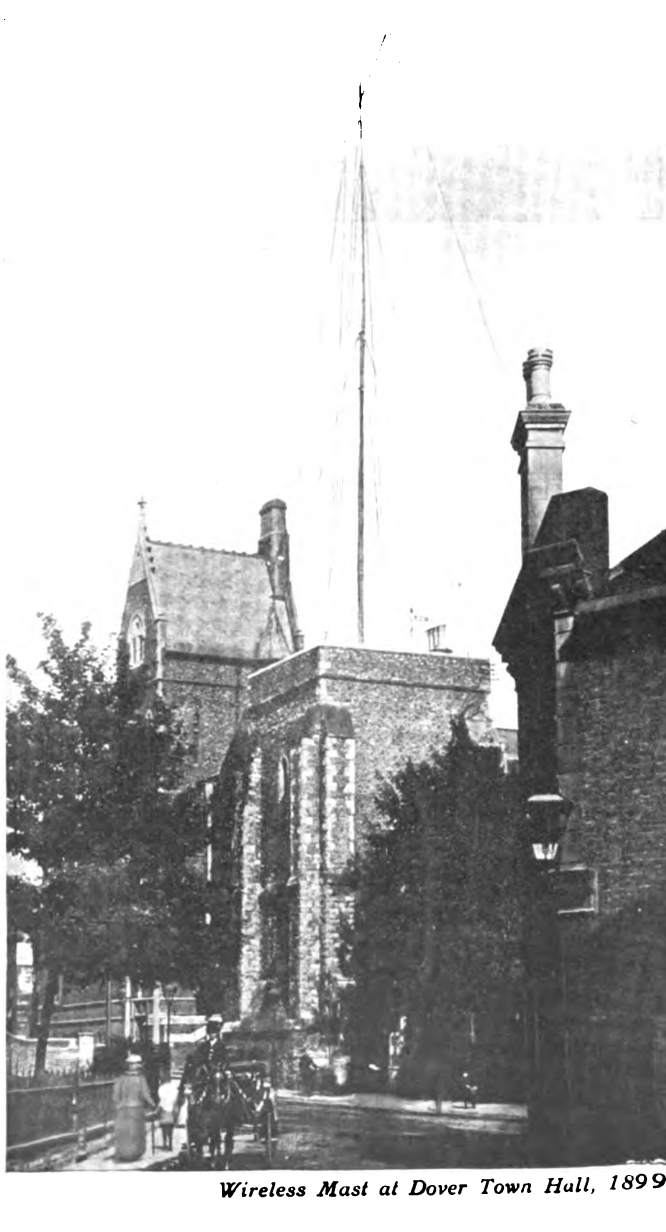
One of the First Motor-car Installations (Senatore Marconi standing at rear, with Dr. Fleming seated). Inset: Modern American Motor-car Station.

"During the last few years the receiving apparatus has been perfected, and now it is possible to record even weak signals when it is thought necessary, but the apparatus is very complicated and unsuited for use on board ship. On large trans-ocean stations where automatic transmission and reception are used, recording apparatus is frequently installed and is capable of receiving messages at a very high rate of speed—far higher than is possible without the use of automatic apparatus."

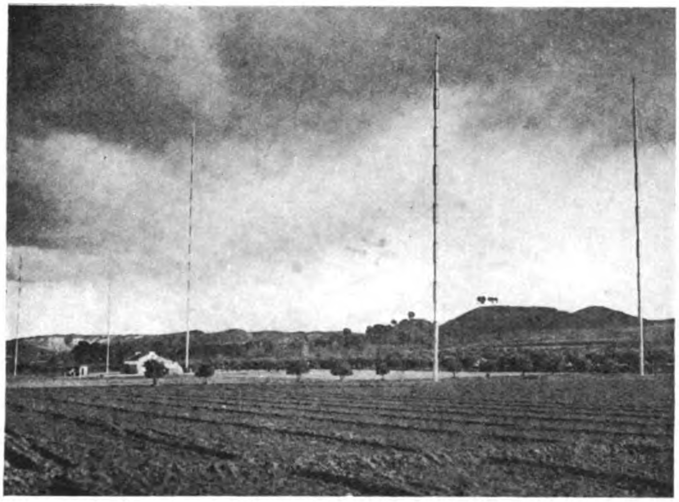
"Tell me, in what way does a modern short-distance wireless station differ from those first put up?"

"Well, perhaps the most important difference is that the transmitters and receivers are tuned; that is to say, a pair of stations working to one another on one adjustment will not interfere with another pair working on a different adjustment. A good example of the value of tuning is afforded by the working of the high-power station at Poldhu, which sends out the news each night to ships at sea. At the proper hour each operator who has to receive the news tunes up his apparatus to Poldhu's adjustment and can then hear nothing but that station, notwithstanding the fact that many other stations well within his range are working their ordinary traffic on a different adjustment.

"Then again, the modern station has apparatus which is far more sensitive; that is to say, with a given power at the transmitter, signals can be read over far greater distances now than in the early days. Efficiencies also have gone up all round, so that the wastage of power has been cut down very considerably. The coherer, with its complicated tapping mechanism, relay adjustments and the like, and the cumbrous Morse inker, have long since disappeared, to be replaced by a neat box with ebonite facing and top, studded with many terminals and handles. A pair of small telephone receivers fixed to a head-band are worn by the operator, his two hands thus being free for writing and adjustment of the instruments. The transmitting key on which he sends the dots and dashes is no longer an unwieldy piece of apparatus difficult and



Wireless Mast at Dover Town Hall, 1899.



Modern Steel Wireless Masts, Aranjuez.

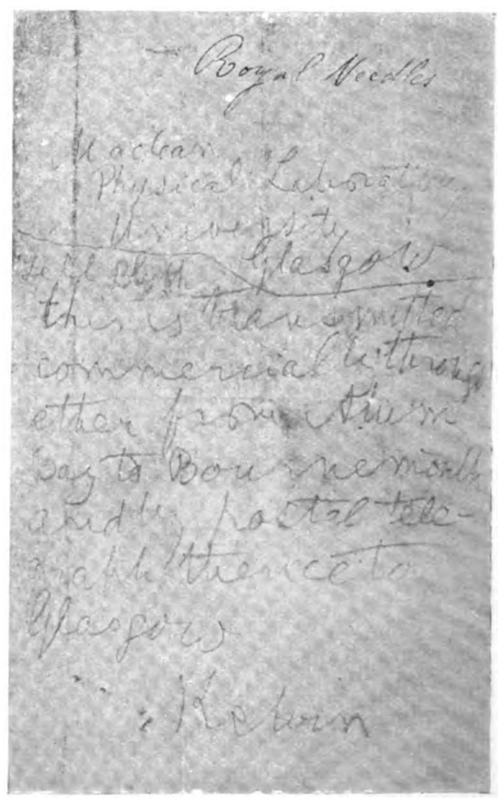
slow to manipulate, but is designed for speedy and comfortable working without risk of shock. Where large and dangerous currents have to be broken the operator's key works a relay key which handles the main working current. The transmitter is now no longer a large spark coil with a vibrating spring interrupter, but an alternating current machine with a transformer and a battery of condensers similar in principle to the old Leyden jar. The spark which used to deafen us and which at first occurred between the knobs of the induction coil, is now placed in a silencing box where it takes place between rotating studs and yields a note which resembles that of a flute, except no one but a giant could raise so much noise from a flute!"

"The Marconi staff must be pretty large now?"

"Yes, it can well be called that. In the operating side alone there are two or three thousand young men at work in different parts of the world, and the combined engineering staffs of the associated companies must reach a very high figure. At the works at Chelmsford there is also a large staff, whilst if we include all the clerical staffs there must be quite an army."

"When was the first wireless message sent? I don't mean the first tests and so on, but the first message that was accepted on a commercial basis."

"The late Lord Kelvin was the first man to send a paid wireless message. This telegram is still preserved by the Marconi Company and it was shown to me only the other day, together with one from Lord Tennyson to his son at college. These marconigrams were transmitted from a station erected at the Needles, Isle of Wight, to a similar station at Bournemouth, fourteen or fifteen miles away. This happened in June, 1898, and shortly afterwards a wireless installation was fitted up on the Royal Yacht *Osborne*. By means of this and another set of apparatus at Ladywood Cottage, Osborne, Queen Victoria was



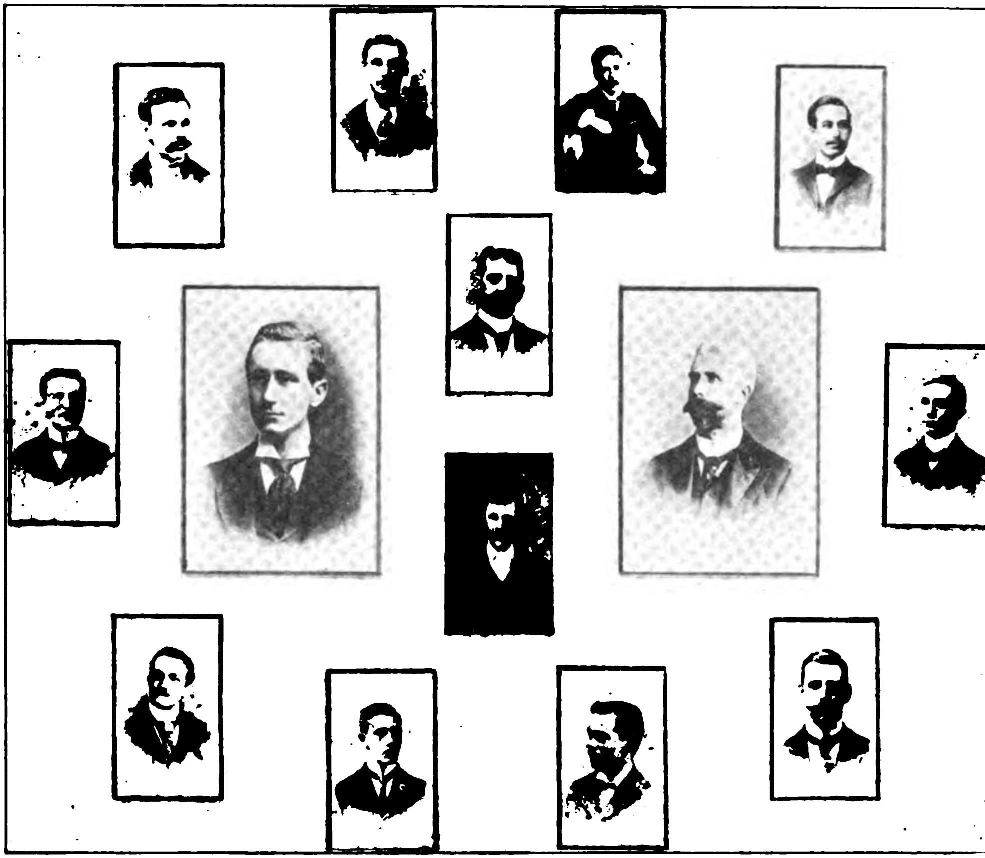
Royal Needles

Maclean
Physical Laboratory
University
Glasgow

this is transmitted commercial[illegible]
ether from Alum
Bay to Bournemouth
[illegible] postal tele-
graph thence to
Glasgow

Kelvin

The First Paid Wireless Message, sent by Lord Kelvin in 1898.



STAFF OF THE WIRELESS TELEGRAPH AND SIGNAL COMPANY, LTD., IN 1898.

Large portrait (left), Mr. (now Senatore) Marconi; large portrait (right), Col. H. Jameson Davis (first Managing Director); top row (left to right), Messrs. T. Bowden, A. A. Cahen, Dr. Erskine-Murray, Mr. Elliott; extreme left, Mr. G. L. Bullocke; extreme right, Mr. W. W. Bradfield; in centre (top), Mr. G. S. Kemp, (below) Mr. Glanville; bottom row (left to right), Messrs. H. W. Allen, C. E. Rickard, J. Cave, P. W. Paget.

kept in communication with the Prince of Wales—afterwards King Edward, you know —who was ill at the time."

"So wireless telegraphy in England has served under three sovereigns already— Queen Victoria, King Edward and King George? I'm sure many people do not realise the fact. Some of my financial friends in the City constantly make use of the Marconi Transatlantic Service and have expressed their high appreciation of it—in fact, several have stated that it is better than the Cable Service. This, with a saving of 4d. a word, comes as a consideration in modern business.

"Yes, the transatlantic business is growing very large. Of course it has taken years of painstaking and costly experiment to evolve the present commercial service. It is just fourteen years since Senatore Marconi crossed to Newfoundland with kites, balloons and other apparatus for the purpose of attempting to receive signals from the then new station at Poldhu. The assistants who had been left behind were instructed to send the letter 's' at short intervals until the programme was completed. You can easily imagine the excitement and suspense in Cornwall, where the Poldhu station lay miles from anywhere, and the assistants, fighting with sleep, kept

An Early Wireless Cabin on Board Ship.

sending the three dots which form the letter 's,' and the little building nestling at the foot of the ring of masts almost shook with the crash and roar of the blinding spark. And the tension was no less exhausting in Newfoundland, where Senatore Marconi and his little group of helpers struggled with the great kites which held aloft the tall wire forming the aerial. At last, after anxious waiting, the three dots were distinctly but faintly heard, and the Atlantic was bridged for the first time by the ether waves."

"But the transatlantic work is not now carried out between Cornwall and Newfoundland, is it ?"

"No. After the experiments were completed arrangements were made to build a large station in Nova Scotia, at Cape Breton Island. This station is known as "Glace Bay," and was built at the special request of the Canadian Government. Still later a special transatlantic station was constructed at Clifden, County Galway, and now these two stations are given up to this work alone. As soon as the war is over new stations at Carnarvon and New Jersey will be opened, thus giving direct communication between England and the United States."

"What is this I heard about wireless communication being best at night ? Someone told me that the big distances which can be traversed at night cannot be achieved in daytime. Is this so ?"

"It is true to some extent, but not entirely. Working on what we call short wavelengths, as ordinary ships do, much longer distances are sometimes, but by no means always, covered at night. Take, for instance, a ship which has a normal range of two hundred and fifty to three hundred miles. In certain conditions at night her range may reach two thousand miles, and quite frequently in southern waters, such as the Indian Ocean and South Pacific, ships will easily send and receive messages over a thousand miles during the dark hours. Strangely enough such conditions rarely prevail on the North Atlantic. No real explanation has been found for these "freak" communications, as they are called. When you come to deal with long wave-lengths, such as those used by the great trans-ocean stations, this difference between day and night ranges is not nearly so marked, and in fact daytime signals across the Atlantic between Ireland and Nova Scotia are frequently stronger than the night signals. There is certainly no truth in the statement sometimes made that all the transatlantic work is done at night."

Major Smithson, who had been enjoying his cigar and listening to the conversation without making much contribution to it, now took up the interrogation.

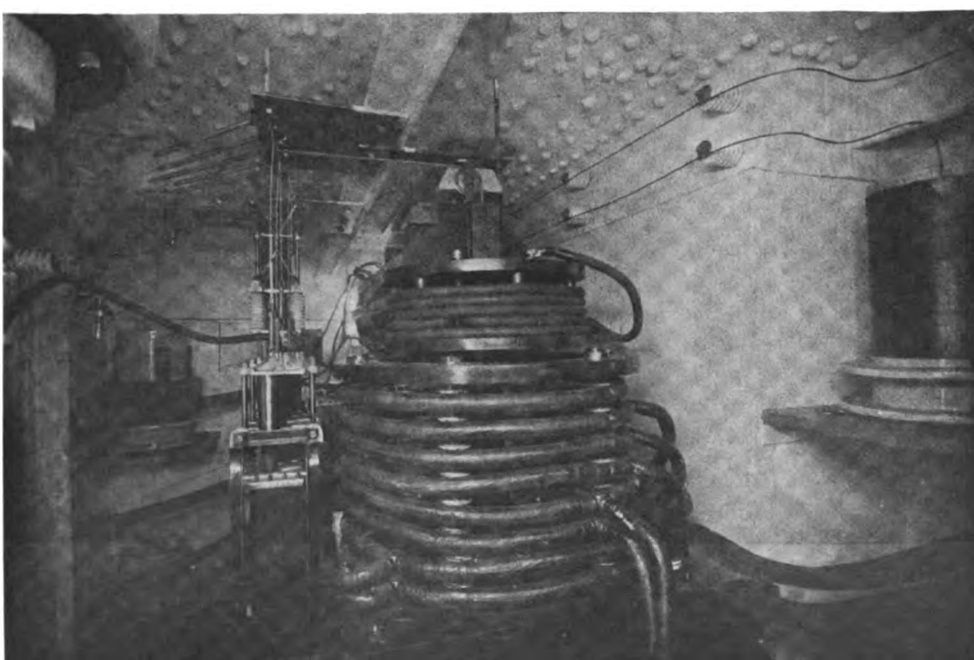
"It's very good of you to sit and let us question you in this way, but really it is so seldom one meets an expert that you must pardon the liberties we are taking. Now I'm interested in the military side of wireless, as you know. I see from the papers that extensive use is being made of wireless telegraphy on all the fronts. This is the first time that wireless has been used in actual warfare, isn't it?"

"Oh, no! In the Balkan imbroglio all the belligerents made good use of it on land and sea. The Italians in the Tripoli campaign found it very useful, and in the Russo-Japanese War some use was made of this form of communication. It may surprise you to hear that so far back as 1899 the War Office adopted Marconi apparatus for use in the field in South Africa, and six of the Marconi staff went out there with the apparatus. Satisfactory results were obtained, too, which is remarkable when we consider how young wireless was in those days!"

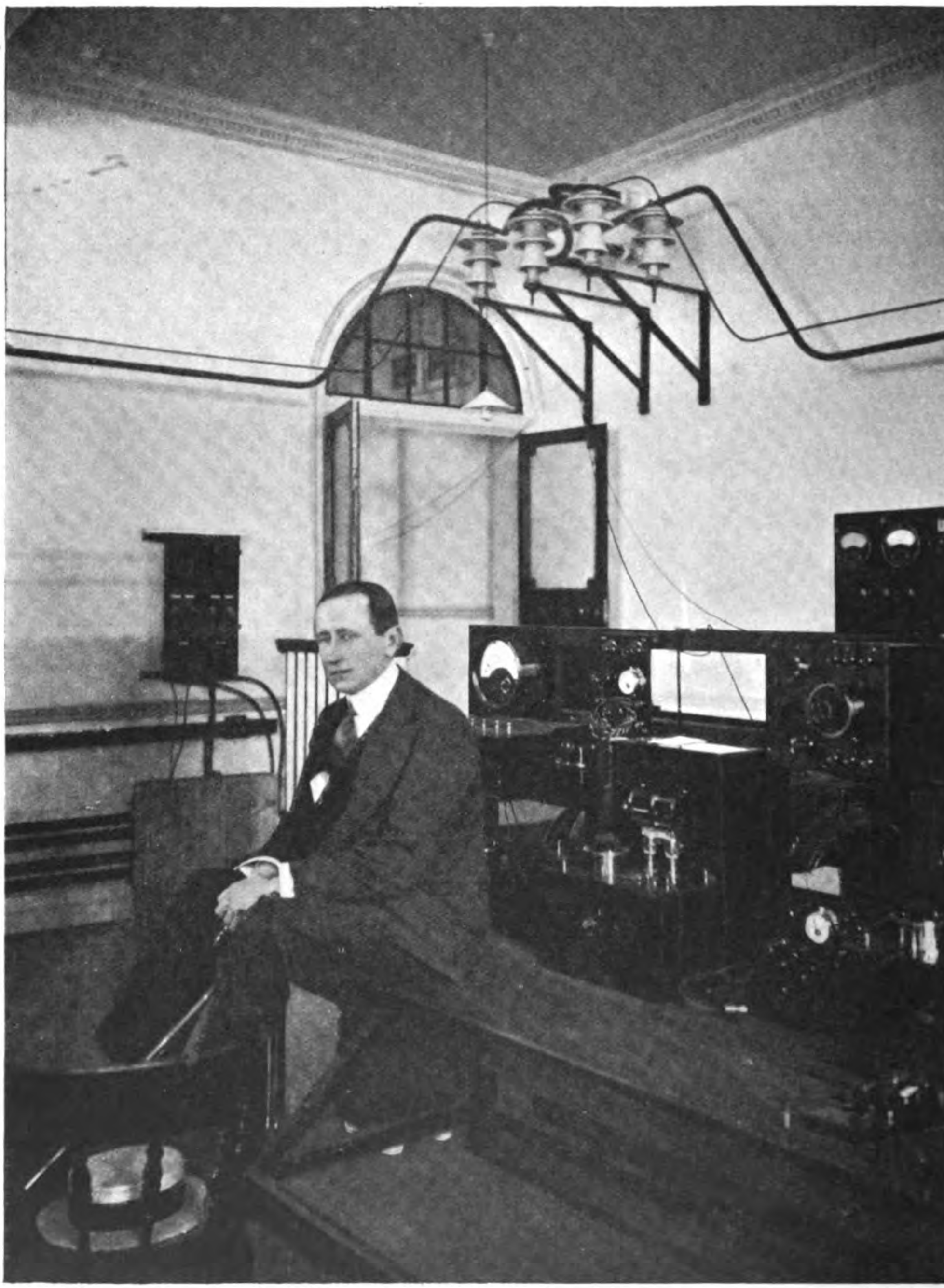
"That's one against you, old man!" said the Elderly Man to the Second Clubman. "You caught me in thebeginning over motor-cars and wireless, now you have been caught over field sets!"

"Oh, well, that's one each!" replied the Second Man, smiling. "I'm sure most of our fellows would be caught in the same way. It's very instructive to compare the old and the new in a science, even if the 'old' is but twenty years of age, eh?"

"Yes, one gets a much better perspective that way," replied the Man from Marconi's. "We speak of wireless being in its infancy, but perhaps we might better say 'in its boyhood,' for there are many young wireless operators who were born in the year that



Marconi Modern Transmitting Apparatus on a Spanish Battleship.



Senatore Marconi seated by 15 k.w. Installation.

Senatore Marconi came over here, and I suppose they would object to be called infants!"

"Suppose they would," said the Captain, and then the conversation drifted off into another channel.

The Measurement of Decrement

By W. H. NOTTAGE, B.Sc.

IF electric oscillations be set up in a suitable circuit by any means, such as the discharge of the condenser across a spark gap in the circuit or by induction from a second oscillating circuit, it is found that the amplitude of the oscillations continually diminishes until they at length cease, except where the source of the oscillations is *continuously* supplying fresh energy to the circuit, as in the case where a continuous wave producer is acting on it.

This decrease in the amplitude of the oscillations is due to the loss of energy in the circuit either through its ohmic resistance or by the transfer of some of the energy to another circuit by induction, or to the ether by radiation.

A knowledge of the rate of this decrease in the amplitude of oscillations, therefore, gives valuable information as to the losses in the circuit.

The curve of Fig. 1 represents the current wave form of a train of oscillations in a circuit, the ordinates K_1Q_1 K_2Q_2, etc., giving the maximum value of the amplitude for each half wave.

In a circuit which does not contain a spark gap—such as an aerial or a closed non-radiating oscillatory circuit—it can be shown, both by theory and actual experiment, that the logarithm of the ratio of the successive maximum values is a constant quantity, which is denoted by δ or d, and is termed the logarithmic decrement of the circuit.

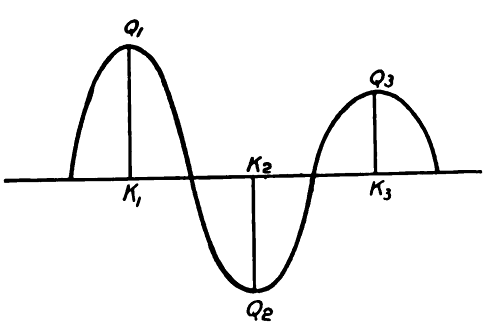


Fig. 1.

The logarithms are those termed natural, Napierian or hyperbolic logarithms, which occur in many mathematical functions and investigations, but it is to be noted that, since the natural logarithm of a number is 2·3026 times the common logarithm, the common logarithm of the ratio gives the same value of δ.

Thus—

$$\delta = \log_\epsilon \frac{K_1Q_1}{K_2Q_2} = 2{\cdot}3026 \log_{10} \frac{K_1Q_1}{K_2Q_2}.$$

This definition of the decrement is that used by British authors. Continental and American authors, however, define the decrement as the logarithm of the ratio of two successive maxima in the same direction—*i.e.*,

$$d = \log_\epsilon \frac{K_1Q_1}{K_3Q_3}$$

which gives a value twice that given by the formula quoted in the last paragraph. This fact must be kept in mind.

If we can measure the ratio of successive maximum amplitudes we obtain the logarithmic decrement of the oscillations in the circuit.

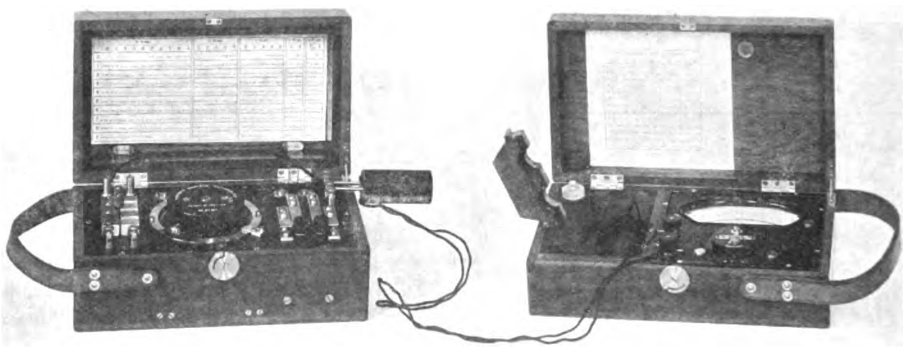
This, although possible in many cases, is not so convenient a way of determining decrement as the following method, which is almost universally used.

If a closed oscillatory circuit be brought near a circuit in which oscillations are taking place it will have oscillations induced in it, and the R.M.S. value of the current due to these oscillations may be measured by suitable instruments.

The strength of the induced current will vary with the coupling between the circuits, and the relative wave-lengths to which they are tuned.

If the measuring circuit be kept at a fixed distance and position with respect to the oscillating circuit, the coupling will be constant, and by varying its natural wave-length a curve may be plotted of the current induced in it for various wave-lengths.

It will be found that the maximum current is obtained when two circuits are



Marconi Long-wave Decremeter and Wavemeter.

adjusted to the same wave-length or are "in resonance."

From this curve the combined decrements of the oscillating and measuring circuits can be calculated by a method due to Bjerknes, the formula being

$$d_1 + d_2 = \pi x \sqrt{\frac{J_1^2}{J_m^2 - J_1^2}}$$

where

d_1 = decrement of the oscillating circuit.

d_2 = decrement of the measuring circuit.

J_m = current in the measuring circuit at resonance.

J_1 = current in the measuring circuit when tuned to another wave-length which does not differ more than 5 per cent. from that of the oscillations.

The quantity x is the value of the expression $\left(1 - \frac{n_1}{N_\gamma}\right)$ where N_γ is the frequency of the oscillations and also of the measuring circuit at resonance n_1 is the frequency to which the circuit is tuned when out of resonance.

The formula is only true when x is small —*i.e.*, not greater than ·04 or ·05: for this case, since the wave-length is inversely proportional to the frequency, we have

$$x = \left(1 - \frac{n_1}{N_\gamma}\right) = \left(1 - \frac{\lambda_\gamma}{\lambda_1}\right)$$

where λ_γ = wave-length at resonance and λ_1 = wave-length of circuit when out of tune.

If the decremeter circuit be tuned to these two frequencies or wave-lengths by a change in the inductance keeping the capacity constant, then

$$\text{since} \quad \lambda_\gamma = 1885\sqrt{L_\gamma C_\gamma}$$
$$\lambda_1 = 1885\sqrt{L_1 C_\gamma}$$
$$x = 1 - \frac{\sqrt{L_\gamma}}{\sqrt{L_1}}$$
$$= \sqrt{\frac{L_1 - L_\gamma}{L_1}}$$

which is approximately equal to $\frac{1}{2}\frac{L_1 - L_\gamma}{L_1}$ for the range of x for which the decrement formula is correct.

If a complete resonance curve be plotted the total decrement can be calculated, using a number of values for the difference in frequency or wave-length, and the mean taken; but in actual practice this method is found to be inconvenient, as it is very difficult to keep the oscillations at a constant intensity for a sufficient length of time to enable the complete curve to be plotted.

In the Marconi Decremeter the following method is used for taking sufficient readings to calculate a decrement quickly.

The instrument consists of an inductance coil, by which it may be coupled to the oscillating circuit, and a variable condenser by which its wave-length can be adjusted to that of the oscillations.

A small inductance is contained in the instrument and so connected that by means of a key it is cut out of the circuit when the key is depressed, being in circuit when the key is up. A change-over switch is provided so that these operations can be reversed.

The value of this inductance is such that on cutting it out of circuit the wave-length to which the decremeter is tuned is reduced by a known amount, about 4 per cent.

On reversing the switch and again tuning to the wave-length of the oscillations the decremeter wave-length is increased by 4 per cent. on depressing the key.

The currents for the resonance wave-length when the instrument is 4 per cent. out of tune can, therefore, be very quickly obtained and the decrement calculated from the above formula.

It is necessary to measure the decrement of the instrument in order that it may be deducted from the total value obtained.

For an instrument such as a decremeter the whole of the loss of energy (to which its decrement is due) is caused by the ohmic resistance of its coils with any measuring instrument such as a thermo-junction or sensitive hot wire ammeter used to measure the current. Any losses in the condenser will increase the decrement, but these are always small compared with those due to resistance.

The decrement of a circuit with a total resistance R is given by $d=\frac{R}{4nL}$, where the quantities are in absolute units and n the frequency of the oscillations and

$$d=\frac{8{\cdot}33\,R\,\lambda}{L}\times 10^{-4};$$

$$\text{or}\quad \frac{R\,\lambda}{1200\,L}$$

for resistance in ohms, inductance in micro-henries and wave-length in metres. The inductance of the coil can be measured and its value supplied with the instrument. The resistance is that for oscillations of the actual wave-length in use, which is always larger than, and sometimes several times, the continuous current value.

If a fine wire of such a diameter that its high frequency does not differ appreciably from its continuous current value be connected in the circuit, the latter may be measured and the decrement due to it calculated from the above formula. The total decrement of the circuit can be obtained exactly as in the first case, so that we have

$$d_1+d_2+d_3=\pi x\sqrt{\frac{J_4^2}{J_3^2-J_4^2}}$$

where d_3 = additional decrement due to resistance and J_3 is the current at resonance and J_4 the current at the other wave-length.

The value of d_2, the decrement of the decremeter, is calculated from

$$d_2=\frac{Y\,d_3}{\left(\frac{J_m}{J_3}\right)Z-Y}$$

where

$$Z=d_1+d_2$$
$$Y=d_1+d_2+d_3$$

and J_m, J_3 are the currents at resonance for the two cases.

For measuring the current in the decremeter circuit a sensitive thermo-junction and portable galvanometer may be used, but in one pattern of the Marconi Decremeter another method is used, which, although perhaps not so accurate, allows the decrement to be read directly on a scale. This method is as follows :—

In series with the main coil L_1 and detuning coils L_2, described above, another inductance, L_3 is connected. This consists of from 30 to 60 turns of bare wire, wound in an open spiral on a long ebonite former. A sliding contact is provided, the pointer of

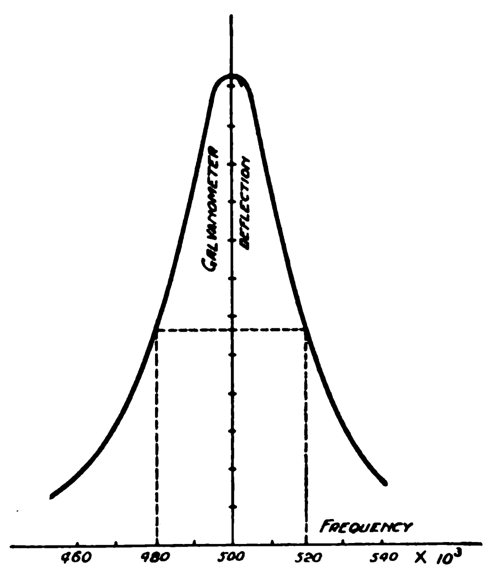


Fig. 2.

which moves over a graduated scale. An ordinary carborundum crystal and head telephones are used.

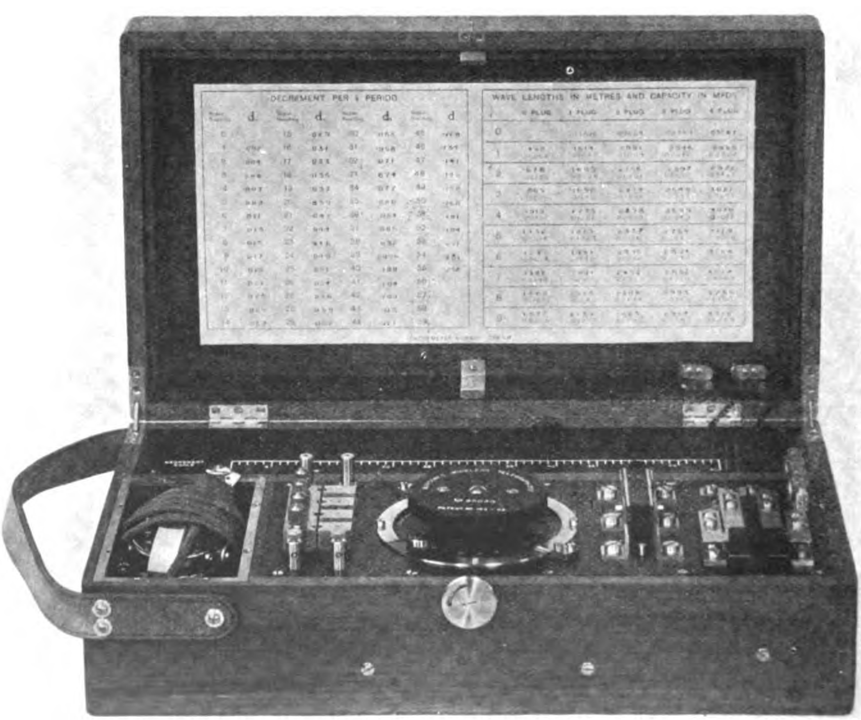
The instrument is first tuned up to the wave-length to be measured, just as a wave-meter. On now depressing a key provided, the instrument is thrown 4 per cent. out of tune, as previously described, and the carborundum crystal is tapped off the whole of the inductance. When the key is normal the crystal is tapped off a variable number of turns, according to the position of the sliding contact, which is moved till the sound in the telephones for these two cases is the same. When this is so the current through the crystal, and hence the voltage across the respective turns of inductance in the two cases, is the same. A table supplied with each instrument gives the value of the total decrement for each scale division.

Any wave-meter can be used as a decremeter if a thermo-junction or sensitive hot wire ammeter can be inserted in its circuit. The Fleming cymometer, for instance, is provided with a special fitting for this purpose.

In using a thermo-junction and galvanometer it must be noted that, since the galvanometer deflection is proportional to the heating effect of the current which passes through the heater of the junction, and this heating is proportional to the square of the current, the deflections of the galvanometer are proportional to the squares of the current in the measuring circuit, hence the ratio

$$\sqrt{\frac{J_1^2}{J_\gamma^2 - J_1^2}} = \sqrt{\frac{D}{D_\gamma - D}}$$

where D=deflection of galvanometer. Where other forms of hot-wire instruments are used, if especially intended for the purpose, the scales are frequently divided so as to read the squares of the current directly.



Marconi Direct-reading Portable Decremeter.

It can be seen from the formula

$$d_1+d_2=\pi x\sqrt{\frac{J_1^2}{J^2_{max.}-J_1^2}}$$

that if instead of keeping x or $\frac{\lambda_\gamma-\lambda_1}{\lambda_\gamma}$ constant, we keep the ratio $\frac{J_1^2}{J^2_{max.}}$ constant the sum of the decrements is proportional to x. If, for example, we make $J_1^2=\frac{1}{2}J^2_{max.}$ we obtain $d_1+d_2=\pi x$.

Hence, if instead of altering the wave-length by a fixed percentage we alter it by such an amount that the square of the current is half its value at resonance the decrement is proportional to π times the amount out of tune.

Keeping the inductance of the decremeter constant and varying the capacity, we have

$$\frac{n_1}{N_\gamma}=\frac{\sqrt{C_\gamma}}{\sqrt{C_1}}$$

where C_γ=capacity of the condenser at resonance and C_1 when out of tune.

Therefore

$$\left(J-\frac{n_1}{N_\gamma}\right)=\frac{\sqrt{C_\gamma}-\sqrt{C_\gamma}}{\sqrt{C_1}}$$

which is equal to $\frac{C_1-C_\gamma}{2C_1}$.

(See *The Wireless Telegraphist's Pocket Book*, page 182.)

Therefore if the capacity of the condenser is known for all points of its scale, the decrement can be determined by noting the scale readings for the maximum galvanometer deflection and for the point when the deflection is proportional to $\frac{1}{2}J^2_{max.}$

The decrement is then given by

$$d_1+d_2=\frac{\pi}{2}\frac{C_1-C_\gamma}{C_1}.$$

By making the condenser vanes of a special form, so that, instead of the capacity increasing by an equal amount for each scale division (as it does for the ordinary semicircular vane condenser), it increases by a constant percentage of the capacity at that point, then the decrement is proportional to the number of scale divisions of the condenser between the points which give $J^2_{max.}$ and $J_1^2=\frac{1}{2}J^2_{max.}$

This principle is used in the Kolster decremeter described in the *Bulletin* of the Bureau of Standards, U.S.A., vol. 11, No. 3.

As an example, we will calculate the value of the decrement of the resonance curve shown in Fig. 2.

The ordinates represent the deflections on a galvanometer in circuit with the thermo-junction of the decremeter, and are therefore proportional to the squares of the actual current in that instrument.

The wave-length at resonance is 600 metres, for which the frequency is 500,000. The deflection at resonance=12·3, and at a frequency of 480,000=5·7. Hence

$$d_1+d_2=\pi\left(1-\frac{480{,}000}{500{,}000}\right)\sqrt{\frac{5\cdot7}{12\cdot3-5\cdot7}}$$

$$=\pi\,(04)\sqrt{\frac{5\cdot7}{6\cdot6}}$$

which gives $d_1+d_2=\cdot117$.

To separate the decrement of the circuit from that of the decremeter we require to know the inductance of the latter, and also the amount by which the maximum deflection is reduced when a known resistance is inserted in the circuit.

Assume the inductance to be 50 microhenries and that the maximum galvanometer deflection is reduced from 12·3 to 8 when a resistance of 3 ohms is connected.

The extra decrement due to this resistance is given by

$$d=\frac{R\lambda}{1200\,L}=\frac{3\times600}{1200\times50}=\cdot03.$$

We can now calculate d_2 from the formula

$$d_2=\frac{Y\,d_3}{\left(\frac{J_m}{J_3}\right)^2Z-Y}$$

where $Y=d_1+d_2+d_3=\cdot117+\cdot03=\cdot147$

$$d_2=\frac{\cdot147\times\cdot03}{\frac{12\cdot3}{8}\times\cdot117-\cdot147}=\frac{\cdot00441}{\cdot180-\cdot147}$$

$$=\frac{\cdot00441}{\cdot033}=\cdot013.$$

Therefore $d_1=\cdot104$.

In addition to circuits of the type discussed in the previous paragraphs—*i.e.* circuits which do not contain a spark gap and in which oscillations of only one frequency are flowing—it is of course important to know the decrement of circuits which include spark gaps, and also of coupled circuits where the oscillations have the two coupled wave-lengths.

With regard to circuits which contain a spark gap, an important paper by Mr. J. S.

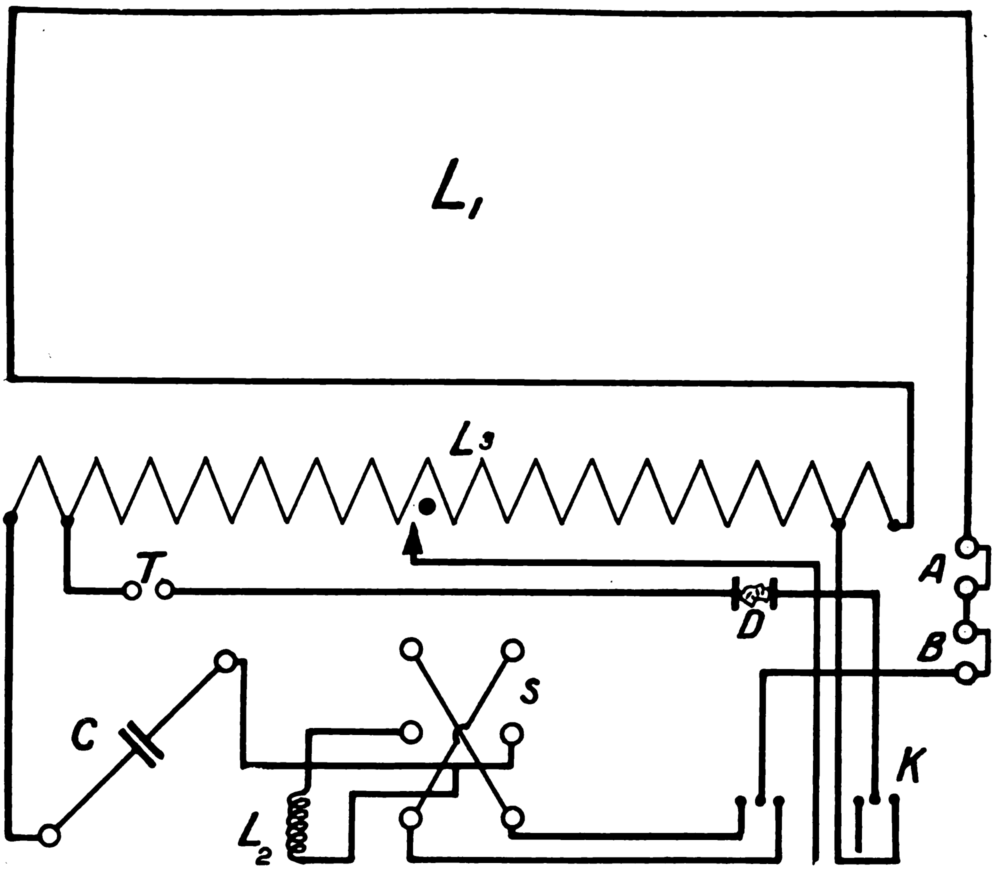


Fig. 3.

DIAGRAM OF CONNECTIONS OF THE MARCONI DECREMETER

L_1 = main inductance; L_2 = detuning inductance; C = condenser; S = change over switch; K = double pole key; A B = terminals for thermo-junction and resistance; L_3 = inductance with sliding contact; D = crystal; T = telephone terminals.

Stone will be found in the *Proceedings* of the Institute of Radio Engineers, vol. ii, No. 4, December 1914, where he points out that the initial resistance of the spark gap is large compared with the ohmic reistance of the conductors forming the circuit, or at least is comparable thereto.

The resistance of the spark is not constant, but increases as the current flowing across it decreases; and due to this the oscillations in the circuit have a decrement which does not follow the logarithmic law. In this case it is the difference between the successive maximum amplitudes which is constant —*i.e.* $J_1 - J_2$ = constant.

It is not, therefore, possible to obtain the theoretically correct value of the decrement of such circuits by the method described, but as there is no other convenient method available, it may be used for obtaining data by which such circuits may be compared among themselves.

For coupled circuits in which the two wave-lengths are so far apart that the resonance curve has two distinct peaks, the decrement for each of them may be calculated in the usual way. Where the two waves are close the distance between the peaks is smaller, and it will not be possible to obtain such accurate measurements as in the other cases. The actual decrement is also larger than that obtained by the usual calculation (see Fleming's *Principles of Electric Wave Telegraphy*, 2nd edition, page 291, which describes a method for obtaining the decrement of such circuits).

Digest of Wireless Literature

ABSTRACTS OF IMPORTANT ORIGINAL ARTICLES DEALING WITH WIRELESS TELEGRAPHY AND COMMUNICATIONS READ BEFORE SCIENTIFIC SOCIETIES.

SCIENCE AND THE WAR.

In an introductory lecture delivered at University College in October, Dr. Fleming gave many interesting particulars of the scientific aspect of the present conflict of nations. Turning to the application of science in the great war, said Dr. Fleming, we can mention four chief departments of it under the headings—Chemical, Mechanical, Electrical, and Physical, which cover such appliances as high explosives, aeroplanes, dirigibles, submarines, wireless telegraphy, and range-finders. The lecturer went on to say that he would not attempt to discuss the details of a fraction of all these applications, but just touch briefly on two departments which happened to occupy his own attention during the vacation—viz., range-finders and wireless telegraphy from aeroplanes. He then described the various methods of range-finding, and the principles on which they are based. Coming to wireless telegraphy in connection with aeroplanes and airships, Dr. Fleming said that this was another marvellous application of science to war. The difficulties connected with it are however considerable, and it has greater limitations than the uninitiated would suppose. In the case of aeroplanes, the first of these is the weight of apparatus. The military aeroplane is already loaded to its fullest extent. In addition to the pilot and observer and the bomb ammunition, it carries in nearly all cases some gun equipment. Hence any wireless apparatus must be made as light and compact as possible. A wireless transmitter of the so-called spark type involves three elements: (1) Some source of electro-motive force, such as a battery or dynamo; (2) an induction coil or transformer for creating a high electric potential or pressure; and (3) some form of condenser or Leyden jar which is charged and discharged across a spark-gap, thus creating rapid movements of electricity called electric oscillations. These oscillations are then caused to create others in a long wire called the aerial wire.

In the case of aeroplanes and airships, the source of electromotive force is generally a small dynamo or alternator which is coupled to the engine, and the voltage or pressure is raised to 30,000 volts or so by a small transformer sealed up in oil in a box. The condenser consists of metal plates, sandwiched between sheets of glass or ebonite, and the spark balls between which the spark passes are also enclosed. The weight of the whole apparatus has to be kept below 100 lb., and such apparatus has been designed having a weight of not more than 30 lbs. The French use a set weighing about 70 lbs. One of the difficulties is to dispose of the aerial wire conveniently and safely. It is sometimes made of aluminium and stretched on insulators carried by light supports on the wings, but the difficulty is to obtain in this way sufficient length. One plan adopted is to coil the wire on a reel, which the observer can uncoil and let it float out behind the aeroplane. The wire must be connected to the reel by a safety catch, so as to be released at once if it catches in trees or buildings. By this means an aerial wire of 100 feet in length can be employed. The observer has near his hand a key by which he controls the spark discharges, and so sets up in the aerial wire groups of electric oscillations which create electric waves in the ether and signal the message in Morse code.

In this manner there is not much difficulty in equipping aeroplanes with transmitters which will send messages 30 miles or so to a corresponding earth station. These latter are military portable motor-car or pack stations, the details of which were described in a lecture last year at University College, entitled "Wireless Telegraphy in War."

The receiving arrangements on aeroplanes comprise a head telephone, which is worn by the observer, associated with some simple form of detector, such as a carborundum crystal, aided by which the observer hears the signals sent to him in Morse code as long and short sounds in the telephone.

The noise of the aeroplane engine and that of the rush of air renders this method of aural reception a matter of great difficulty, especially as the messages must be sent in secret code, and the observer must therefore hear every letter distinctly if the message is to be intelligible. Great efforts have been made to devise methods of reception, which shall appeal to the eye by a visual signal rather than by the ear, but the exceedingly small electric currents set up in the aerial wire by the arriving waves make this a matter of extreme difficulty, and the problem has not yet been completely solved. There is then the difficulty caused by "jambing." If the signals from an aeroplane are picked up by a hostile station, this latter at once sends out powerful but unmeaning signals, the object of which is to blur and drown out the reception or sending of signals by this aeroplane. Moreover, the sending of wireless signals by an aeroplane reveals its presence to hostile earth stations before it can be seen by the eye. Hence wireless telegraphy may be a means of revealing the enemy's scouts, and it involves a certain kind of war in the ether as well as war in the air.

In the case of airships, there are other difficulties as well, and it is interesting to note that there are special difficulties in connection with Zeppelins. These aerial monsters are, as everyone knows, constructed with a framework of aluminium containing in its interior the eighteen or twenty balloons inflated with hydrogen. Now, as we rise upwards in the air, the electric potential increases rapidly, and if a conducting body at a height gives off water drops or products of combustion it is rapidly brought to the potential of the air at the place where it is. In the case of Zeppelins, this equalisation is no doubt brought about by the escape of products of combustion produced by the engines. When the conducting body is brought down suddenly to earth again there may be a great difference of potential between it and the objects on the earth. If it is a good conductor a spark may pass, and if it is, as in the case of a Zeppelin, a conducting body containing a highly inflammable gas, leakage of which cannot altogether be prevented, this spark may cause an explosion and destruction of the airship. Again, the violent electric oscillations created in all metal objects near powerful radiotelegraphic apparatus may cause sparks to jump between metal parts, and hence may inflame a hydrogen leak. It has, therefore, been recognised that there are special electrical difficulties in connection with the working of wireless on rigid airships with metal frames, and also in connection with the use of spark apparatus. However carefully the actual working spark is enclosed, there is always risk of induced sparks.

There is room, therefore, yet for much research and experimentation in connection with the use of wireless telegraphy on aeroplanes and airships, and the practical problems are by no means completely solved.

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AMERICAN WIRELESS EQUIPMENTS.

The October issue of the *Wireless Age* includes an article on the new American Marconi Standard Equipments, which is of much value to those who are interested in comparing American with British practice. One of the new sets described consists of a 2-kw. 500-cycle installation mounted on a panel, much space thus being saved on board small coasting vessels and the like, where cabin accommodation is at a premium. The complete set consists of a transmitting and receiving apparatus and various switches and appliances for manipulating the equipment. The transmitter has all of the regulating and manipulating appliances mounted on the front of the panel, so that they are easily accessible. Means are provided so that three wave-lengths—300 metres, 450 metres, and 600 metres—can be transmitted, the change of wave-length being accomplished by throwing a switch to the desired position. The control of the switch adjusts all circuits, so that the wave-length wanted can be transmitted immediately. This enables the operator to handle traffic with a minimum amount of interference when in congested zones.

On the front of the panel is mounted a watt meter, which indicates the amount of energy consumed at the terminals on the transformer; a radiation meter, which indicates the current flow in the aerial circuit; a motor field rheostat, which enables the speed of the motor generator to be varied; a generator field rheostat, which permits the variation of the generator voltage; an aerial inductance handle, which permits the variation of inductance in the aerial circuit and indicates the amount in turns; a wave-length switch, which permits the change of transmitted wave-lengths; a handle, which permits the variation of coupling between the closed and aerial circuits, and a low-power switch, which permits transmission at extremely low power in order to reduce interference to a minimum.

Beneath this panel is another panel which contains the quenched spark-gap. The latter panel is mounted on hinges so that it can be opened from either side for the purpose of removing and replacing the condenser jars. The quenched gap is cooled by an air blast delivered from the combined rotary gap and blower mounted on the end of the motor generator. Beneath the quenched gap is placed the starting panel, on which are mounted all the starting appliances, control switches, and protective devices. An automatic starter permits the motor to be started from a distant point by means of a single-pole switch. There are no fuses or other protective devices in the A.C. circuit, as the characteristics of the generator are such that it can be short-circuited without an abnormal flow of current. On the top of the generator are mounted the devices which protect the machine from the excessive potentials developed, due to the close proximity of the high-frequency circuits. An iron cover overspreads the protective devices and the machine terminals. The protective devices consist of six condensers, each of which has one terminal grounded on the motor-generator frame, the other terminals being connected to a terminal of the motor. The condensers have a capacity of such value that there can be no excessive rise of potential at the terminals of the motor generator. The armature shaft is extended at the generators end to permit the mounting of the rotary spark-gap. The latter is of the synchronous type, and has the same number of spark terminals as the generator has poles. The stationary spark terminals permit a discharge to take place between them and the terminals on the motor.

A convenient switch enables a rapid change to be made from the quenched to the rotary gap. When using the rotary a much looser coupling must be made between the closed and aerial circuits. The transformer, which is of the closed-core type, is enclosed in an iron case. The windings are completely immersed in transformer oil, which is solid at ordinary temperatures.

The elements of the high-frequency circuit are mounted at the back of the transmitting panel and supported on insulating rods. The inductance coils are of spiral form, and consist of an insulating slab having a spiral groove cut in one face. Into the spiral groove is fitted a strip of copper of the desired number of turns. This form of inductance has been found very convenient and economical from the standpoint of space. It also permits contact at any desired point on the spiral.

The receiver consists of a tuner with crystal detector. An antenna switch while in the receiving position throws the receiving circuits into operative condition, and at the same time opens the primary circuit of the transformer and generator field and stops the motor generator. When the switch is in the transmitting position the last-named circuits are closed, and the motor generator is started. The receiving circuits are automatically short-circuited in order to protect them from the transmitter.

Great care has been taken in designing the apparatus to provide a large factor of safety in order to do away with all causes of trouble. The equipment is complete in every detail, and only a very short time is required to install it on shipboard. In the majority of installations a storage battery is used so that the set may be operated independent of the ship's power.

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WIRELESS TELEGRAPHY IN THE DARK CONTINENT.

Mr. M. E. Pelgrims, in the *Popular Science Monthly* for October, writes an instructive article on wireless in the French Colonies of Central Africa. Near Lake Tchad, says the author, seven wireless stations are in daily use, operated by the French Government. In 1911 it was decided by the French Minister of Colonies, M. Messiny, to connect the military territory of Tchad with Ouadai.

As it was impossible to run wire lines between the two territories because of the dense vegetation, the wild animals, the high cost of the miles of wire required and, most important of all, incessant wars with the natives, wireless was chosen as the most practical means of communication. It was no easy task to install the radio stations. The engineers decided to erect six stations, from 125 to 200 miles apart, and scattered throughout the Tchad district. The stations were finally built at the following points: Nguigmi, Mao, Mussoro, Ati, Abeshr, Faya and Fort Lami. The first difficulties were encountered when the party, consisting of Captain Chaulard, head of the expedition, a captain of the Colonial Artillery and ex-chief of the radio service of Madagascar, a lieutenant and twenty-five men of the Signal Corps, were disembarked on the African coast and had to start on their difficult journey through the tropical forests. All the apparatus had to be carried on men's backs for hundreds of miles. Later on in the journey oxen and canoes were used on land and water to carry the materials and apparatus. The party had to be divided into two separate sections, one going by way of Lagos (Nigeria) and Zinder, and the other through French Congo, Oubanghi and Chari.

The stations to be installed consisted of two steel masts 90 feet high, a 5 h.p. kerosine motor, driving an alternator of one-thousand cycles frequency, ·05 mfd. condensers, and musical note spark-gap, and other pieces of apparatus, all of which were packed in steel waterproof boxes of about 155 lb. each. One night the tent of the party was flooded and upset, and on more than one occasion they were seriously annoyed by the wild animals of the jungles.

Then came the technical troubles. The sets were first tuned to a 1,500 metre wave-length, but the results were very poor, only 95 miles being covered. The wave-length was lengthened to 3,500 metres, and 10 feet more added to the masts. This resulted in increasing the range to a trifle over 400 miles. At the present time the Fort Lami station communicates regularly with Abeshr, a distance of about 300 miles. The constructors were also handicapped by the impossibility of securing a good ground connection at first. Finally, one of them conceived the idea of burying the steel boxes in which the apparatus had been packed, and connecting the ground wire to them. This proved to be an ideal ground, and the results were still more satisfactory.

The conquered wilderness soon avenged itself upon the invaders. The men were stricken by the malarial fevers, and the lieutenant and several of the men had to be sent back to France in order to save their lives. Captain Chaulard and the other engineers, however, stuck to their posts, and while the other men were helplessly ill, he, shaking with fever himself, kept in constant communication with the other stations. This self-sacrifice nearly cost him his life on two occasions, but his courage inspired the other men, and some time later they succeeded in establishing the seventh station 250 miles northward, thus connecting Borkoo with Ouadi. Later on, when he was able to communicate between Faya and Fort Lami, a distance of about 454 miles, the French Government decided to award him the decoration of the Legion of Honour in recognition of his services.

In this manner has the French Signal Corps invaded the darkest corners of Africa and established wireless stations which permit of communication with the outside world.

KITE-SUPPORTED AERIALS.

Further Experiments by the United States Army.

THE Signal Corps of the United States Army, in the course of their recent manœuvres, experimented with aerials formed by a string of kites, the heights of which attained an altitude of 6,600 ft. By utilising these instead of the ordinary mast aerials for their standard field radio-telegraphy set, they found they could increase the transmitting range from 25 miles to 150 miles. This method also resulted in great improvement in reception, and it is the intention of the authorities to institute further extensive tests. The data available at present point to the likelihood of increasing the range of the radio sets by this means from 6—16 times.

Wireless in the Far North

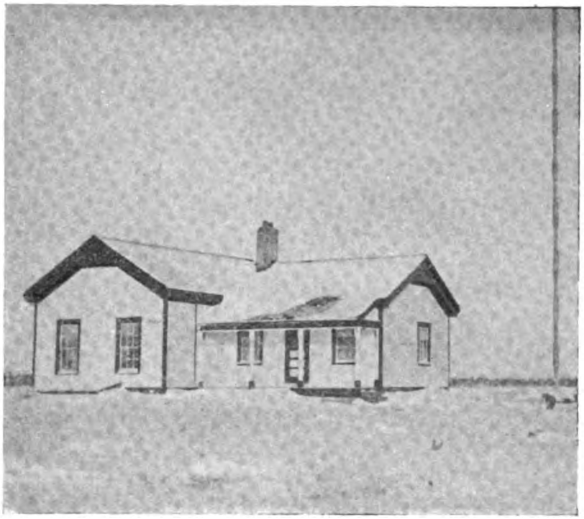
Seasonable Radio-telegraphic Notes

BY the time this number of our magazine reaches the hands of northern readers the countryside will once again be well within the grip of winter with its severe frosts, and it may be with a covering of snow upon the land. The attractions of the fireside will once more make their great appeal, and exercise outdoors will need to be vigorous if any measure of comfort is to exist. The wireless amateur in the warmth of his study will perhaps give a thought to his professional confrères, whose duties take them hither and thither across the oft-time storm-tossed wintry seas, and they on their part may think again of their brothers working at their instrument in land stations on bleak promontories and amid the snows and blizzards of the northern regions.

We need scarcely mention that the ubiquitous radio-telegraph has long since established itself as far north as any trader has yet cared to venture for regular business; indeed, wireless has already been used in regions where little has been achieved beyond circum-polar exploration. In the far south the Mawson expedition made good use of this means of communication, as most of our readers will remember. One of the most dramatic incidents of the whole journey was the founding of the isolated station on the wind-swept island of Macquarie. So great was the torment of the eternal silence to which the operator was subjected that after a period he had to be removed, his mental efficiency being greatly impaired.

On the western coast of North America, as far north as the bleak regions of Alaska, the wireless telegraph penetrated even so long ago as 1903, when the United States Signal Corps, under the direction of Captain Leonard D. Wildman, erected a pair of stations at the opposite sides of the Norton Sound, one at Nome and the other at St. Michael. This latter place is the terminus of the long wire telegraph which runs south

Unloading Stores.



Sault Ste. Marie Station.

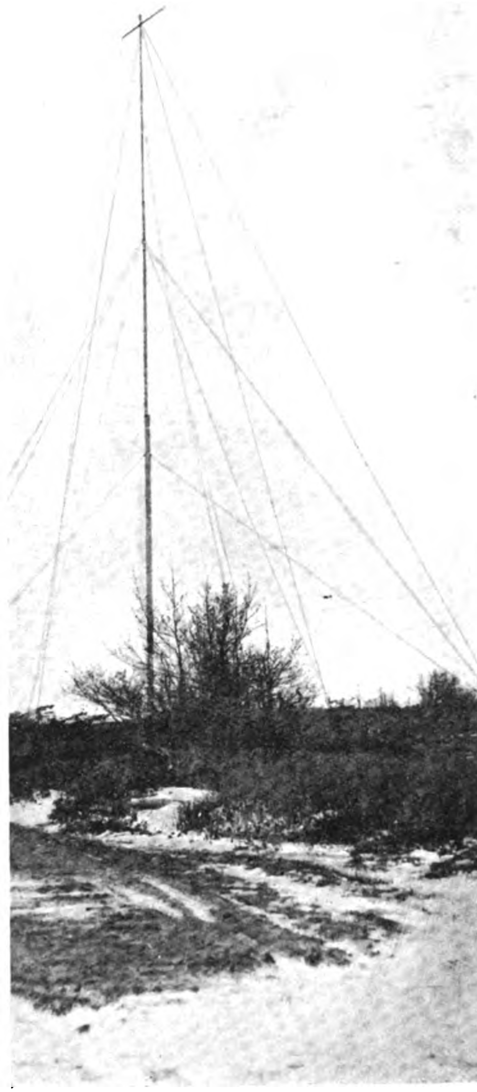
for 1,300 miles to Fort Liscum. It had been found impossible to span the Sound by a cable on account of the ice, whilst the frequent blizzards and storms which swept the coastline prevented the erection of the ordinary wire telegraph. A distance of 107 miles separated the two wireless stations, and the conditions under which the work of installation had to be carried out called forth all the skill and endurance that this pioneer party possessed. As soon as the difficulties had been mastered, wireless communication was established, and it is satisfactory to relate that in the annual report of the Chief Signal Officer of the U.S.R.B. for 1905 it is stated that on August 6, 1904, the wireless completed a year of uninterrupted service. During this time it had dealt without intermission with the entire telegraphic business of Nome and the Seward Peninsula—no mean achievement—for Nome itself is the most important centre in the north-western district of Alaska. Not only is it the most populated place in the whole of Alaska, but it also forms the centre of a large fishing and gold-mining district, with which the usual means of communication are only open during a very few months of the year. It may surprise many who are unacquainted with the commercial conditions prevailing in that part of the world to hear that more than one million words were sent during the year, many thousands being in code. Another district in which wireless has rendered yeoman service is Labrador, the north American Peninsula of the North American continent lying between Hudson Bay and the Gulf of St. Lawrence. It is said that it was given its name "Labrador" by a Portuguese navigator, Cortereal, who seems to have visited it in the year 1500, the name meaning "Labourers' Land." The Atlantic coast on which the many wireless stations are chiefly situated is wild and precipitous, entirely destitute of vegetation and pierced by many narrow fjords, bearing in this way a resemblance to the coast of Norway. The value of wireless in these regions will be readily understood when it is considered that the great wealth of Labrador is its fish. As many as 30,000 fishermen in search of cod, salmon, herrings and trout visit the magnificent fishing ground adjacent to its coast in the course of the season. The value of the fish taken during the year amounts to more than £1,000,000, and, as much depends

Battle Harbour from the Hill.

upon arriving at the right moment, wireless communication is of immense value to these toilers as they dredge the seas. We have already dealt in THE WIRELESS WORLD with the commercial value of wireless telegraphy to fishermen (see page 696 of the February issue), and we need scarcely remind our readers that the ability to advise the owners some hours in advance just what catch is to be brought to the market may enable the whole of the cargo to be disposed of at a far more favourable figure than if the ship had first to arrive in port and then perhaps precipitate an enormous catch upon an unexpecting market.

It is now some years since the first wireless stations were erected on the Labrador coast, and they possess an ever-increasing usefulness. It is only necessary to consult the wireless map of the world in *The Year Book of Wireless Telegraphy* to see that an unbroken chain of stations stretches from the Gulf of St. Lawrence to a very northerly point on the coast. Here, as in Alaska, many difficulties present themselves in the maintenance of the ordinary wire telegraph, which is liable at any moment to be swept away by the gales and blizzards which so frequently sweep across the land. The wireless stations thus take the place of wire telegraph as well as serve the fishing vessels which visit the adjacent waters. It should not be forgotten that in Labrador many trappers hunt the fur-bearing animals—bears, wolves, foxes, martens, otters, beavers, and several others—and accumulate during the season a large store of pelts, which in due time find their way to the furriers' luxurious establishments in London, Paris, New York and other centres. The trappers do their business through agents, and these in turn have other agents with whom they deal, so that a considerable amount of correspondence, mostly by telegraph, takes place in connection with this industry. Of course, out of the season there is no business either in the fishing or fur industry, and during this time the stations are closed down, a small steamer collecting the *personnel* along the coast.

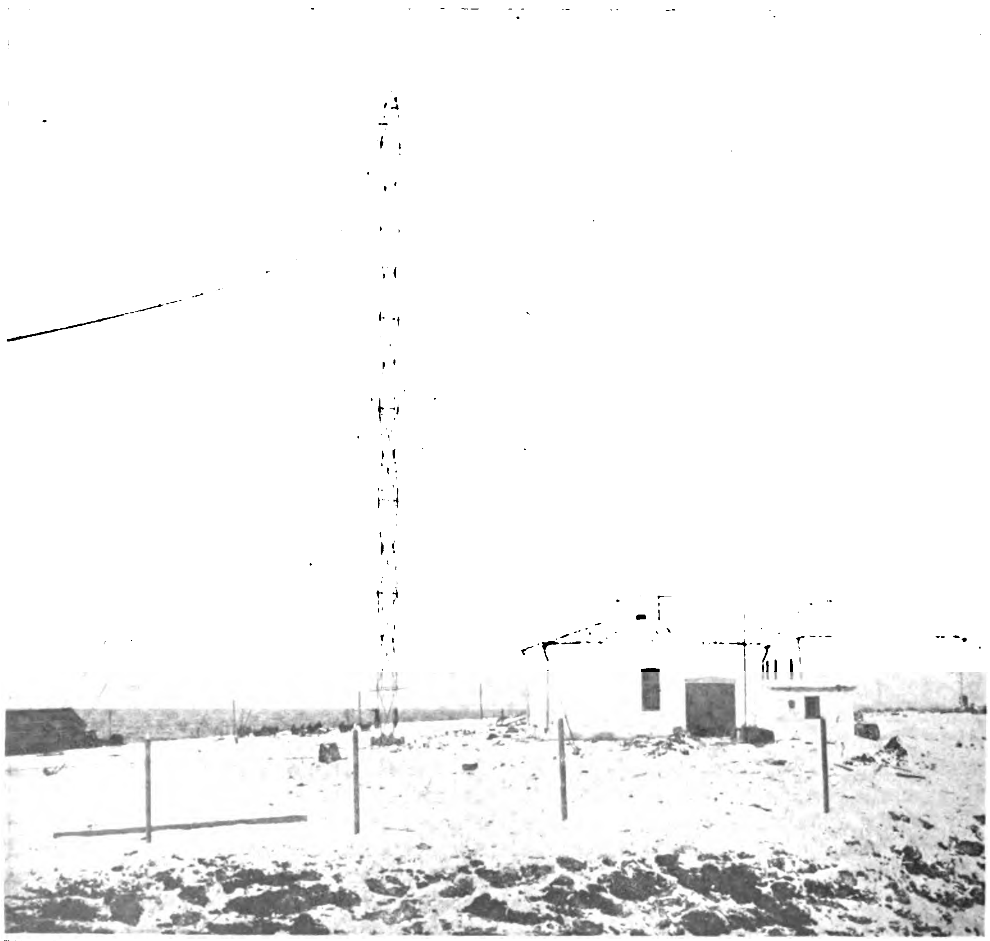
In dealing with wireless in Labrador we must not omit reference to the considerable sealing industry and the radio-telegraphic communication of which it makes so frequent use. This was dealt with in our magazine some time ago.



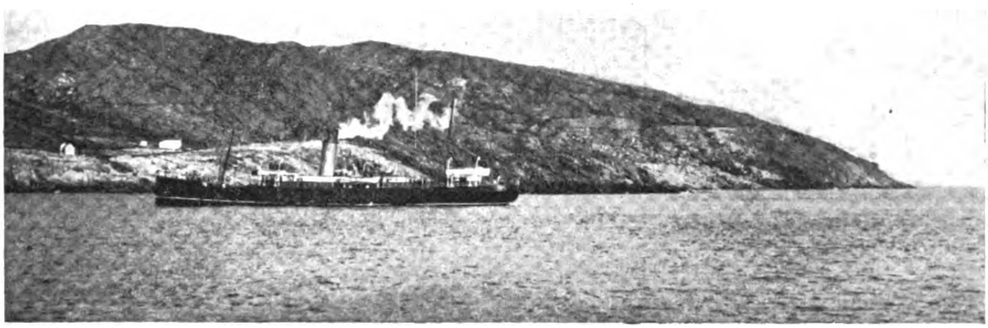
Cape Bear Station.

The vast expanse of northern territory which comes under the rule of the Czar of All the Russias, and which is associated in the minds of many of us with the stories of driving snow and utter solitude—Siberia—has more recently than Labrador adopted the new form of communication. Perhaps the Siberia of which we hear so much in stories of political exile is far too frequently depicted as a country wholly barren and snow-bound. It is only in the northern portions of this vast territory that such conditions exist; in the central and southern portions the richness and fertility of the soil support a vast colony of industrious farmers and graziers. It is this latter domain which the Trans-Siberian railway has tapped, and from which is drawn no inconsiderable portion of the world's grain supply. We can expect in the great era of regeneration which will follow the present conflict that a vast network of wireless stations will be erected throughout those fertile regions and, in fact, throughout the whole of Russia. For reasons both of economy and efficiency the radio-telegraph outrivals the old wire system, and is, of course, immune from the many local troubles, such as falling trees, gales, snow-drifts and the like, which play such havoc with the chain of telegraph poles supporting a fragile wire across great tracts of country.

In the northern regions wireless has already gained a firm hold, and a large station at Archangel transacts an ever-growing volume of traffic with the many ships which sail to and from that Arctic port. Other stations at Vaigatch, Yugorski-Char, and Mare Sale on the Kara Sea, take their share of business. Of the new wireless stations in northern Russia and Siberia which have been constructed owing to the exigencies of the war we are, of course, unable to say anything here, such matters being under the veil of secrecy, which now enshrouds all naval and military arrangements of the Allies. We need only say that



The Station at Cape Mare Sale, Siberia.



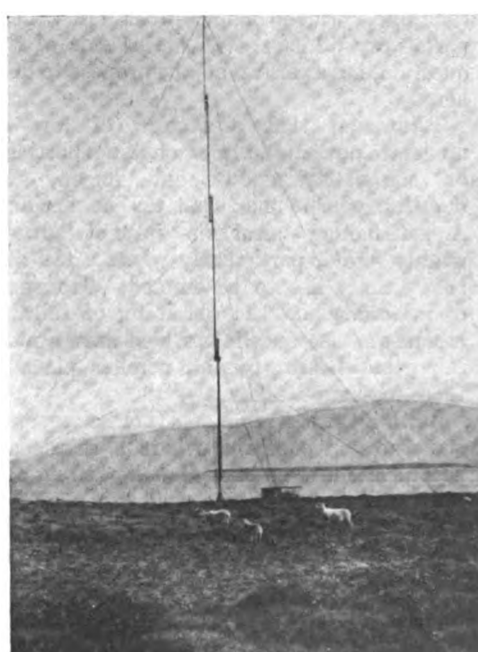
Supply Steamer at Belle Isle (white Marconi mast just left of steamer's after mast).

the Russian Government is fully alive to the value of the new means of communication, probably much to the discomfiture of the Germans.

Although not so far north as some of the stations of which we have made mention, the wireless station at Belle Isle, at the mouth of the St. Lawrence river, is subjected during a fair portion of the year to weather which may well claim to resemble that of the Arctic regions. A station was also erected some years ago at Reykjavik in Iceland, where conditions are sometimes very trying. Considering the quite appreciable volume of trade between this large island and Europe we can foresee radic-telegraphic developments in this district also. And now that practically every trading steamer finds its Marconi installation as essential to its proper navigation as many other fittings, and as these ships go ever further afield, wireless coast stations must in the very nature of things spring up on the shores of every navigable sea and channel throughout the world.

It is interesting to conjecture the uses that might be made of the Wireless Direction Finder in Polar exploration. The difficulties with which relief parties have to contend are known to every reader of books of travel in the Polar regions. To explain what we mean, let us imagine that the lost party has a wireless installation and is capable of sending out signals, although they are unaware—through loss of instruments, perhaps—of the location to which they have drifted. A search-party equipped with direction-finding apparatus would soon be able to reach the exact spot, as the radiogoniometer would indicate the line of march to be taken for the rescue.

And, just as Senatore Marconi's invention has thrust its tentacles even into steaming morasses and baking sands of Central Africa, so has it thrown its arm even across those frozen and glittering wastes where only recently the polar bear, the walrus and sea fowl reigned together undisturbed.



The Old Station at Reykjavik, Iceland.

The Troubles of a Snowbound Station.

AMONGST the many lesser-known problems of the radiotelegraph engineer is that of guarding against the injurious effects of extreme cold, ice, snow and sleet which prevail in extreme northern and southern climes. Already there have been erected a considerable number of stations in regions which are either snowbound throughout the whole year or else have such lengthy winters that similar conditions are the rule. Quite apart from the technical difficulties with which the engineer and operator must contend, there are questions of living accommodation, food, and the like, which make work in these parts very difficult. With this side of the question, however, we do not propose to deal here.

Presuming that a station of low or moderate power is to be erected in a partially or completely snow-bound region, the question of site has first to be decided. A satisfactory situation is not always readily found, particularly where a tall and heavy mast has to be erected. Transport of materials and the obtaining of suitable labour are also questions which have a most important bearing on all wireless plans in these ice-bound regions.

With regard to the masts themselves, such structures in countries where blizzards are prevalent must be exceptionally strong and well stayed. Extreme cold often causes metals to become brittle, so that wire stays, bolts, and other metal work have to be suitable for such conditions. Earth connections may present difficulties where the station is built on rocky soil, and under such circumstances it is usual to cut trenches in the rock in which the earth-wires are laid. It is interesting to note that ice and snow are themselves insulators, so that particular care must be taken where these substances cover the ground. A series of symmetrically arranged radiating wires is usually adopted where there is a considerable depth of snow or ice. These wires terminate in buried metal plates which form a ring round the station. Sometimes, in the case of small stations, wire netting is spread on the ground round about the mast, this acting as a balancing capacity for the aerial wires.

One of the most frequent troubles on a wireless station in cold regions is the collapse of the aerial system due to an accumulation of sleet or snow sufficiently heavy to break down the wires. The writer well remembers a voyage on an ice-breaking steamer when communication with the land was of the utmost importance. The only station with which communication could possibly be established had been warned to expect messages from the ice-breaker, and in fact had no other communication to expect for several weeks. Frequent calls elicited no reply, and as a result the ship was much inconvenienced. On arrival in port it was learned that the lonely operator, after living on a frozen island for some weeks without hearing a signal from any ship whatever, had awakened the morning that communication with the icebreaker was expected to find that his aerial, mast and all, had collapsed in a blizzard which had raged the night through. Several weeks elapsed before everything was in working order again.

In recent times most stations erected in districts where such trouble may be expected have their aerial leading-in wires so arranged that by changing over a switch the wires can be connected directly to the main power supply and a strong current passed through them. This current is sufficiently powerful to create an appreciable heat in the wires, with the result that any ice which may have accumulated immediately melts away and drops to the ground. Such an arrangement at the Punta Arenas station was described in THE WIRELESS WORLD for January, 1915 (p. 624).

Inside the station building there are many problems. The selection of a prime mover has to be undertaken in the light of local conditions. Steam is rarely used except on large stations; on smaller plants oil engines take the foremost place. A heavy oil engine connected to a dynamo either directly or by a belt provides the current for charging a battery of accumulators. As the wireless apparatus works off the accumulators, the engine is only run at intervals, and care has to be taken that it is protected from injury when starting up, particularly in cases where a lamp is used to start vaporisation. The sudden application of heat to icy cold metal may cause cracking and a consequent breakdown of the engine. The accumulators, containing as they do a liquid that will readily freeze, have to be arranged in a room where the temperature is not likely to drop below a safe figure, as a frozen accumulator would most likely burst its container.

In the transmitting room there is usually not much trouble to contend with, except, in very rare circumstances, the solidification of unsuitable oil in the condensers and transformer. In buildings artificially heated considerable moisture may accumulate on the walls and roof, and sometimes drip on to the apparatus with injurious effects on the insulation, resulting in "sparking-over" and similar annoyances. The leading-in insulator, if made of porcelain, may crack owing to the extreme cold outside and the warmth inside, this difference in temperature between the two ends of the insulator giving unequal expansion. It also frequently happens that the outside of the insulator will become coated thickly with snow and ice, but this is not harmful provided the temperature keeps low, for the reason given above—namely, that ice and snow are insulators. When a thaw sets in there may be considerable trouble from sparking-over, and sliding masses of snow from the roofs may carry away the projecting portions; but care and attention will prevent much of this.

As far as the aerial itself is concerned, insulation troubles do not often occur, for so long as a snow or ice-covered insulator remains frozen it will withstand very high voltages without breaking down. How perfect an insulation frozen snow affords may be judged from the fact that in Northern Canada a telephone line, made of bare copper wire, recently collapsed, and lay on the snow for a distance of eighteen or twenty miles without any noticeable effect on the conversation, which throughout this time was carried on uninterruptedly!

Whilst we have mentioned above the main problems which are encountered in wireless stations in the far north and south, yet there may be many others which must have occurred to those of our readers whose duties have taken them into these white lands. We, therefore, invite them to send us their experiences in this connection, so that we may publish them for the benefit of others.

Suspension of Operators' Certificates of Proficiency in Radiotelegraphy granted by the Postmaster-General.

IT has been officially suggested to us that, for the purpose of bringing home to operators the importance of adhering strictly to Government regulations, we should give prominence in the WIRELESS WORLD to the fact contained in the following communication received from the G.P.O.:

We have recently found it necessary to suspend the Certificate of Proficiency in Radiotelegraphy held by a wireless operator on board ship for the offence of carrying on a private conversation with an operator at a land station.

Operators are well aware of the necessity of adhering at all times to the Radiotelegraphic Regulations, and that any disregard renders them liable to penalties. But under existing circumstances the seriousness of the consequences involved in any breach of regulations is considerably enhanced. It is, therefore, hoped that the warning we are asked to convey will be taken to heart by all operators, most of whom, we believe, are numbered amongst our clientèle.

Administrative Notes

Argentina.

With reference to the notice in the *Board of Trade Journal* of February 18th last relative to regulations drawn up by the Argentine Ministry of Marine for the working of the wireless telegraph service of the Republic, the *Boletin Oficial* (Buenos Ayres) of 30th September contains a decree modifying those regulations as regards wireless installations on vessels registered under the Argentine flag.

The *Boletin* containing the text of the above-mentioned decree (in Spanish) may be consulted by United Kingdom shipowners interested at the Commercial Intelligence Branch of the Board of Trade, 73 Basinghall Street, London, E.C.

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Australia.

The Sydney *Daily Telegraph* of September 28th contained the following paragraph :—

" The transfer of officers of the wireless " branch of the Postmaster-General's De- " partment to the Navy Department, which " will in future have control of all radio- " telegraphic operations, is to be made on " October 1st."

* * *

Oceania.

The *Radio Service Bulletin*, Washington, of November last contained the following paragraph :

" The radio station now being built by " the French Government on Tahiti Island, " Society Islands, will be ready to receive " and transmit commercial messages before " the close of 1915.

" The temporary station, now in course of " erection, will be followed by a much more " powerful plant. The plans of the tem- " porary station contemplate a 10-kilowatt " installation of the type used by the French " Government with a wave length of 600 " meters. The towers, two in number, will " be 100 meters in height. The station " will be expected to reach Awanui, New " Zealand, Suva, Fiji, and the Samoan " Islands.

" Immediately upon the completion of " the temporary station, work will begin " on a permanent station of much greater " power. This permanent 300-kilowatt " station will be operated by a 500-horse " power gasoline engine, and will use a wave " length of 2,500 meters. There will be " eight towers, each 100 meters high, " erected in parallel rows of four towers. " The space between the towers will be 250 " meters, and 200 meters between parallels. " There will be two antennæ, one of 600 " meters wave length, and the other of " 2,500 meters.

" With the permanent station it is ex- " pected that communication will be es- " tablished with stations in Cochin-China, " South America, Honolulu, Hawaii, San " Francisco, Cal., Sydney, Australia, and " even in Martinique and Guadeloupe, " West Indies. All material used in the " construction of these stations is supplied " by the French Government and is shipped " from France.

" Call letters have not been assigned to " the station, and rates are not obtainable " at the present time."

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West Indies.

A wireless station has recently been erected at St. Lucia, and the rate for ships' telegrams has been fixed at tenpence per word. Messages may be sent from ships at sea by way of this wireless station and cabled to all parts of the world at rates obtainable on board.

MARTIAN RADIO-TELEGRAPHY.

A Contemporary's Brilliant Suggestion.

Now that we are able to telephone by wireless thousands of miles, why not turn our attention to communicating with the planet Mars by wireless telephony ?—*Telegraph and Telephone Age.*

For the Common Weal

The Efforts of members of the Belgian Marconi Company

BRITAIN has always nurtured friendly feelings for her small neighbour across the Channel. We speak of Belgium, that brave little country whose fair fields and pastures are sodden with the blood of her children. But a closer and a keener *rapprochement* will exist henceforth. Belgium promised, fruitless though it seemed, to preserve her integrity by all means at her disposal. Her word was her bond. So when the ruthless Hun descended with all his brutal barbarity, bludgeoning her old men and ravishing her maidens, there arose a mighty wave of indignation which traversed the kingdom from end to end, and found response in the hearts of everyone —from the King himself to his lowliest subject.

Although Belgium has a standing conscript army, and although her reserves for many years past were called out, yet these were not sufficient to stem the tide of invasion by the Prussian hordes, and many and many a volunteer was gratefully accepted by the Belgian military authorities.

Second Lieut. P. Thomson.

Second Lieut. G. Vincent.

Amongst those who were in Brussels on the outbreak of hostilities and who are now performing duty with the allied forces were several members of the staff of the Belgian Marconi Company, and we have pleasure in reproducing here photographs of a few of them. Second Lieut. G. Vincent is an engineer in the Belgian Company, and has been occupied with the Belgian Army. On the outbreak of war he immediately took service for his country as a simple private, and we congratulate him on his promotion to commissioned rank. Second Lieut. P. Thomson is a member of the Belgian Company's Traffic Department. When it was useless remaining in that country any longer Mr. Thomson proceeded to London and enlisted in the Sportsman's Battalion. His progress was rapid, and we now have to convey to him our best wishes on hearing

Lance-Corporal R. Newcomb.

that he has been allotted a commission in the Devonshire Regiment.

Lance-Corporal R. Newcomb was wireless officer in charge of the s.s. *Lapland* when war was declared, but being a member of the British Territorial Force, he volunteered for foreign service with the troops. He was recently wounded in action, and has just been home for a short rest. We trust that he will soon be restored to complete health.

Private V. J. N. Rigaux, who was previously in charge of the wireless installation on the Belgian Training Ship *L'Avenir*, had just returned from a short trip on the s.s. *Samland* when war began. He at once offered himself as a volunteer to the Belgian Army, and has been on active service for the last twelve months.

Private V. J. N. Rigaux.

Adjutant J. H. Spiritus is a member of the Traffic Department of the Belgian Company, and being on the reserve was called out at the beginning of hostilities in Belgium to rejoin his former regiment, the Royal Engineers. Since then he has been at the front doing excellent work, and for an act of great bravery has been decorated with the Order of Leopold. On the termination of the war we hope to be in a position to present to our readers an account of the individual acts of bravery which the rigours of the censorship prevent our doing now.

Adjutant J. H. Spiritus.

We take this opportunity of offering to these very gallant gentlemen our sincere felicitations, and trust that they may be spared to continue their good work in the cause of justice and liberty.

Being the Story of a Christmas Eve spent in Queer Company.

By WILLIAM LE QUEUX.

"THEN the whole affair is still a complete mystery—eh, Reggie?"

"Absolutely. I can see no daylight at all," was my reply.

Marjorie Harland, my well-beloved, placed her elbows upon the little *table-à-deux* at which we were seated at lunch in the upstairs room of the old-fashioned "Sun Inn" at Hitchin. She rested her pointed chin upon her hands, a habit of hers, and fixed her soft brown eyes upon mine in deep seriousness.

"You speak in a very hopeless tone, dear," she said. "Surely you don't intend to give up the puzzle?"

"Not in the least," I hastened to assure her. "You know me, Marjorie, by this time, I think. And you also know that when once I set myself to solve a problem I never relax my efforts unless I am compelled to acknowledge myself beaten. In this case—the extreme gravity of which you well know—I confess that I am completely baffled to-day. Yet I investigated another case equally mysterious, and have the satisfaction of knowing that the guilt has been fixed upon the culprit."

"I know, Reggie. Your success in the affair at Cleethorpes was simply astounding," my *fiancée* declared. "My complaint all along is that you would not allow me to assist you, until now."

"Quite so, dearest. Not because I did not believe in your capacity for keeping a secret, or your eagerness to act for the country's safety, but because—well, I hesitated to allow you to run any personal risk."

"I'm quite willing to share any risk with you," she declared, as she gazed straight across the flowers at me. "I have no fear whatsoever—so long as I can be of assistance to the country."

"You have already been, Marjorie," I answered calmly. "In this very difficult case—one which the authorities have unfortunately treated so lightly—you have been of the greatest assistance. Yet the problem is as far from solution as it ever was."

"And your leave will be up on the last day of the year," she sighed, "and you will go to sea again."

"I must," I said. "This long leave I've had is quite unusual, therefore I ought to think myself very lucky."

"Well—you had a narrow escape when the *Amblemore* went down."

"Yes, I did," I admitted with a smile, for, truth to tell, the Red Circle Liner *Amblemore*, of Liverpool, upon which I, Reginald Muir, had been first-class Marconi operator, had struck a mine thirty miles west of St. David's Head, and, though I had called instantly for assistance, she had gone down beneath us with a loss of one hundred and fourteen souls. We had been outward bound for the Mediterranean when, on the fourth of November, 1914, the disaster had happened. My own escape had

"Marjorie, my well-beloved."

been almost by a miracle, but that is another story. Indeed, there seems a special providence which watches over Marconi operators at sea.

Well, I had come ashore, and, finding myself with long leave, I at once went to London and joined Marjorie who, with her father and mother, lived out at Sydenham. Mr. Harland, who was a retired stockbroker, lived in a large detached house not far from the Crystal Palace, and kept a car, which Marjorie frequently drove, and sometimes in it she took me for a spin.

I arrived in London on November 6th, the day on which the spy, Carl Lody, was shot at the Tower. I read the fact in the paper, and it caused me deep thought, because of certain facts which had, quite accidentally, come within my knowledge.

Briefly they were as follow: About two years before, I had been on the Cunarder *Pandorania*, sailing between Liverpool and New York, when on one of our outward trips we carried, as saloon passengers, two Dutchmen named Klaassen and van Oordt. They were both men of considerable means, merchants of Utrecht, doing trade with America, as the radio-telegrams which during the voyage I sent and received for them plainly showed.

Both men spoke English extremely well for Dutchmen and, as they often sent messages, I frequently chatted with them in my cabin. It was in summer, and late one night I was on deck with a cigarette, prior to turning in—for we were then only thirty-six hours off Sandy Hook—when suddenly I overheard in the darkness two men conversing in low tones in Dutch. Next second I recognised the voices of Klaassen and his friend van Oordt. The former was of the stout, thick-set, stolid type of Hollander, while the other was a thin, lantern-jawed, deep-eyed man, who dressed in a somewhat exquisite manner, and wore rimless *pince-nez*.

I halted, and, holding my breath, listened to their conversation. As my father had been a British consular officer at Rotterdam, and all my youth had been spent in Holland, I knew the Dutch language about as well as my own, and as I listened I stood aghast.

Strange and amazing things were being whispered calmly in cold blood—a plot, it seemed, though by what I overheard I could not exactly decide what was intended. Certain high explosives were discussed, those which were the latest invention of scientific destruction, and van Oordt, who seemed to be an expert chemist, was explaining the relative force of certain compounds.

That conversation puzzled me so much that I mentioned it to the captain, and watch was kept upon the pair until their arrival in New York, when, of course, they went ashore—not, however, before we had informed the police. The latter seemed but little concerned, and as the Customs officers found nothing suspicious in their baggage they were not detained.

I had mentioned this to Marjorie and to Mr. Harland on my return to England, after which the matter had entirely passed out of my mind. I was appointed later on to another ship, and afterwards to a third, until at last, two years later, I found myself upon the ill-fated *Amblemore*.

But on the evening of our departure from Liverpool, at about six o'clock, it being quite dark at the time, I suddenly encountered among the bustling crowd on the promenade deck a thin, well-dressed man in a heavy overcoat and grey plush Tyrolese hat. As he passed beneath a lamp I fancied that his pale countenance was familiar. In a second I remembered those deep-set eyes and lantern jaws. It was the mysterious Dutchman van Oordt.

I turned back after him quickly and, following him through the crowd, saw him pass ashore with a number of friends of passengers who had been on board to take farewell. As I leaned over the rail I saw that when he had reached the shore he went quickly along the edge of the landing stage, where he stood beneath the lamp gazing up at the ship, his eager eyes as though in search of someone on board.

Apparently he did not see me, or if he did, he probably would not recognise me. Was his friend Klaassen on board, I wondered.

To my recollection there came vividly that strange conversation I had overheard in Dutch two years before, and, as at last we cast off, and slowly dropped down the Mersey, I stood watching the mysterious man in the grey plush hat. Examination of the passenger-lists an hour later did not reveal Klaassen's name, and, though I searched, I could find nobody in the least resembling him. Therefore I dismissed the matter from my mind as a merely curious meeting.

It was not until later on, in that heavy sea off St. David's Head, when in the darkness there was a sudden blood-red flash and a deafening roar as the vessel rose and then fell heavily back into the trough of the sea, that I again reflected.

"Klaassen. . . . the short, thick-set, stolid type of Hollander."

"Gad, Muir! We've struck a mine!" cried Bennett, my assistant, who had the phones on, and was at that moment in the act of taking in a message, while I had been putting some papers in order.

An instant later there was a second deafening and more terrible explosion, which seemed to tear the very vitals out of the vessel.

He sprang up in alarm, but in a moment I had my hand on the key calling for assistance and giving our call-letters and our whereabouts.

Meanwhile the vessel was already listing badly; shouts were heard everywhere, passengers, pale and scared, came up in their night attire, yet above all the terror and confusion could be heard the captain's voice calmly giving orders through his megaphone.

As long as I could I continued to send out the distress call, but at last the captain gave orders for all to save themselves as best they could. Next second I found myself in the sea, swimming away from the doomed ship lest I should be drawn under when she sank. And then—well, I have already told you the rest.

Two days later I was back in London with Marjorie, full of grave thoughts. Had the *Amblemore* really struck a mine: or had that mysterious Dutchman been on board with some evil purpose just before she sailed?

The newspapers were full of the disaster, and it now came out, for the first time, that we had been carrying a quantity of munitions and high explosives consigned to a Mediterranean port for the use of our Allies.

At Marjorie's suggestion I made a statement to the London manager of the Red Circle Line, but my story was, I saw, regarded as a highly improbable one, and I confess that I felt very indignant that notice was not taken of the grave suspicion resting upon the thin-faced Dutchman, for the company did not even trouble to communicate with Scotland Yard.

I was spending my leave in London with Marjorie, and we were enjoying ourselves together and looking forward to a pleasant Christmas, notwithstanding the general depression consequent upon the war, when, on the evening of November 10th, a curious thing happened.

Marjorie had come up from Sydenham, and we were about to enter a cinema in Oxford Street when there went in, just in front of us, a man wearing a grey Tyrolese hat which, in an instant, attracted my attention.

I hastened forward and glanced at him. My heart gave a bound. It was the mysterious van Oordt!

I saw him pay for a balcony seat, and after he had ascended the stairs I whispered the truth to Marjorie, who instantly grew excited and suggested that we should watch him.

This we did. For an hour we sat behind him in the half-darkened cinema, and when at last he put on his grey hat and again rose, we leisurely sauntered out after him.

He walked as far as the corner of Tottenham Court Road, where he hailed a taxi. In a moment we were in another, I having given the man orders—with a promise of double fare—to follow the cab in which the Dutchman was riding.

We followed him to the main-line station at Waterloo, where he passed the barrier and entered the Portsmouth train due to start in five minutes.

In a moment I had obtained for Marjorie a platform ticket from one of the slot-machines, telling her to follow him and watch into which compartment he entered, while I went and obtained two tickets for Portsmouth, not knowing, of course, at which station the Dutchman might alight. Then, when I rejoined my well-beloved, she indicated where he was, and we entered a compartment further to the front of the train.

From the guard we obtained the information that the train stopped first at Woking, then at Guildford, and afterwards at all stations to Portsmouth.

On arrival at Woking Marjorie drew up the blind, looked out and reported that he had not alighted. But at Guildford van Oordt got out, and when he had walked along the platform to the subway, we followed. Outside the station he halted, turned suddenly, and went to the parcel office. As I passed I heard him inquiring about a parcel, and then, when he had dis-

"As we cast off, and slowly dropped down the Mersey, I stood watching the mysterious man in the grey plush hat.'

appeared along the dark station-yard, I went up to the parcels clerk and asked what was known of the inquirer.

"Oh! That's Doctor Weiss, sir," replied the man.

"Does he live near here?"

"About a mile and a half away, sir—out near Shalford—a cottage called Bonner's Corner. He's a professor of languages."

"Has he lived there long?" I asked.

"About a year, I think."

And with this information we were content that evening, for it was growing late, and I had to see my *fiancée* back to Sydenham.

At least we knew where the man with the velour hat was residing.

Early next day I was again down at Guildford and, walking out on the Portsmouth road to a point near Shalford—perhaps a mile and a half from the town—I found a long, low-built, comforatble-looking cottage, which had recently been modernised, and which, upon its gate, bore the words "Bonner's Corner."

As I sauntered past, apparently taking no interest in my surroundings, I cast a covert glance into the garden, where I saw a man in blue serge strolling, smoking a briar pipe. I looked again. Yes, my eyes had not deceived me. It was none other than van Oordt's friend Klaassen!

I called at a little old-fashioned inn in the vicinity and ordered lunch. To the good woman who served me I told how I was in search of a country cottage, and asked if she knew of any to let around Shalford or Bramley.

"No, sir," was her reply, "I don't."

"I want something like a place I've just passed—it's called 'Bonner's Corner,' isn't it?"

"Oh, yes, sir. 'Bonner's Corner'—that's Mr. Meaken's. It was let furnished about a year ago, and Doctor Weiss has it now. He's a very nice gentleman, though he is a foreigner—Swiss, they say, like the friend who lives with him, Mr. Picot. They both come in here and chat sometimes."

"What is Mr. Picot?" I asked, knowing that she was referring to the man who, before the war, was known as Klaassen.

"I think he's something in the jewellery trade, in London. He's often away travelling, but Doctor Weiss is generally here, as he gives lessons in languages."

"To whom?"

"Well—to anybody who wants them," replied the stout, homely landlady. "He goes down into Guildford most days. I think he goes to one of the schools."

"I suppose he took over the servants when he rented the house, didn't he?"

"Oh, no. Mrs. Thornton, who was Mr. Meaken's housekeeper, was very sick about it. She told me how, when the doctor arrived, he brought his own housekeeper, Swiss like himself—a little dark-haired woman who is very short-sighted and wears spectacles. She's the only servant the two gentlemen have."

Then, in order to allay any suspicion that might be aroused in the good woman's mind, I began to talk of the war, and to gossip about trivialities.

It struck me as very curious that the two men should be living in that rural Surrey village under fresh names, for I could discern no reason for it. Since war had broken out we wireless operators had been taught to distrust both the *soi-disant* Dutch and Swiss as dangerous, and here was presented to me a very curious and puzzling problem, one which Marjorie was most eager and keen to assist in solving.

That dull, misty November day I spent around Shalford, the small scattered village about the winding Wey, situated in the hollow of the Surrey hills, through which both rail and road ran from London to the south coast. Three times I passed the dwelling-place of the pair who had, on that memorable voyage, been passengers with us to New York.

It was certainly quite a comfortable house, and as I stood in a hedge near by at five o'clock in the evening while the mist was rising, I watched a light in one of the windows, and distinctly saw van Oordt cross one of the ground-floor rooms.

When it grew quite dark I took tea in another local inn which I had noted, and then returned to my vigil until seven o'clock, after which I returned to Guildford and thence took train to Waterloo.

Next morning at eleven I met Marjorie at Charing Cross, and told her all that I had discovered.

"But surely it is very mysterious, Reggie!" she exclaimed. "What can those men be up to?"

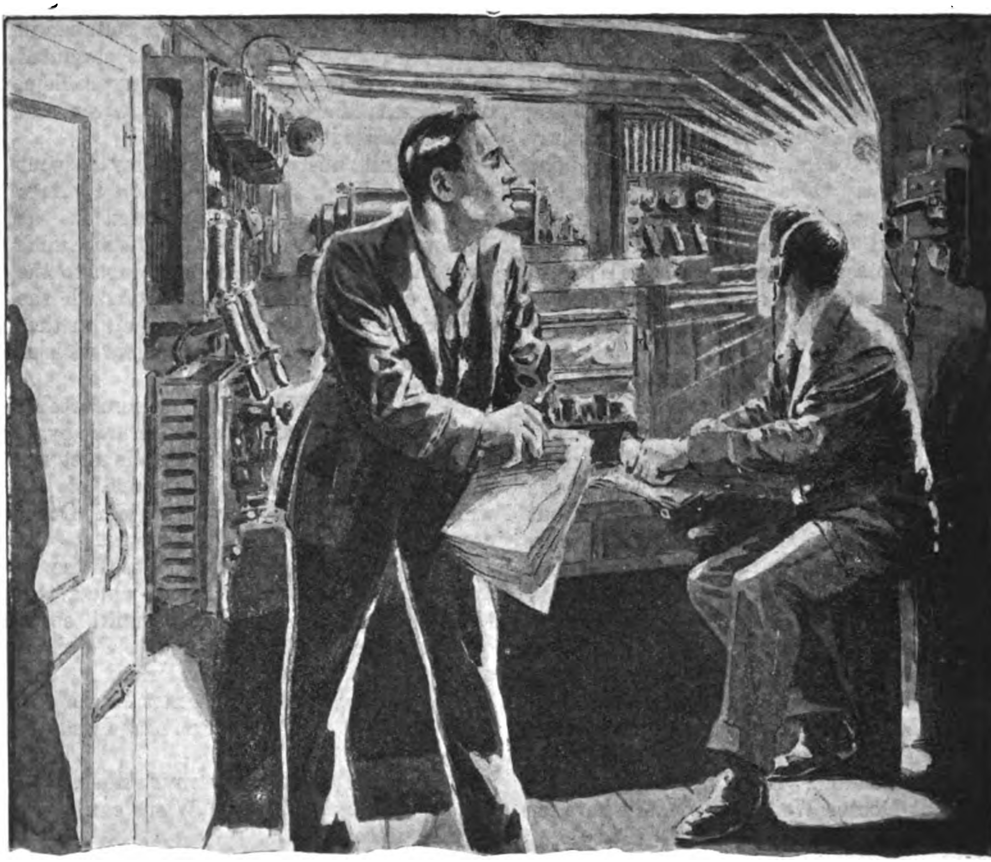
"Some devil's work, I believe," was my reply. "I recollect the end of the *Amblemore*, and the more I think over it the more certain I feel that the mysterious Dutchman had a hand in that disaster."

"Then you don't think the vessel struck a mine at all?"

"No. I certainly don't. There were no other mines at that spot. Mine-sweepers have been at work ever since, but not a single one has been found. I heard that when at the office the day before yesterday," was my reply.

Marjorie grew thoughtful, then, as we walked up St. Martin's Lane to the little Soho restaurant where we so often lunched, she suddenly turned to me, and said:—

"Look here, Reggie. You're home on leave till the end of the year. Why not watch these people? Let me help you. Hitherto you've been unkind, because I know that you are loth to trust a woman with a secret. But surely you know that, with me, any secret of yours is sacred!"



"A sudden blood-red flash and a deafening roar as the vessel rose and fell heavily back into the trough of the sea."

I turned and, on looking into her big, trustful eyes, I saw that honesty and truth were mirrored there.

"Very well, dearest," I replied, gripping her arm. "Yes, we will; you and I will act together and endeavour to solve the mystery."

Truth to tell, I had never seen her looking so smart and pretty as on that morning. Neat, yet daintily, dressed, with a short blue serge pleated costume, as was the *mode* of the moment, and slimly shod in black silk stockings, with patent leather shoes, her close-fitting hat admirably suiting her small features, and her white fox furs around her throat, she walked beside me laughing and chatting gaily, while I, on my part, strolled on full of the very acme of contentment.

Personally I dearly love a problem, and I had now approached this particular one with careful consideration, eliminating all chance of success, and only looking for possible failures—which is, after all, the proper spirit in which to seek success in any subterranean inquiry.

The November days passed. Each day I went down to Guildford, and on most days I walked out to Shalford to reconnoitre. One night I slept at the Lion Hotel in Guildford, and just after nine next morning waited at the railway station for the non-stop express to Waterloo.

As I had calculated, van Oordt, alias Doctor Weiss, arrived and entered a first-class compartment. I went into a third at some distance away, but on arrival at Waterloo I was near him, and, in addition, Marjorie, who had been awaiting me on the platform amid a crowd of men in khaki, followed me in all her loving enthusiasm.

Outside the station he entered a taxi, but not before crossing to the slope of the Loop Line, and in a moment we were both in another taxi, determined to follow him.

We did so, to the City first, where he called at a firm of stationers. Then he went to a bank in Newgate Street, and afterwards drove westward to a shop close to Oxford Circus, where he made some purchases. At noon he went to a house in Portman Square, the number of which we noted, and then to Prince's, where, in the vestibule, he met a well-dressed, middle-aged woman, with whom he lunched.

Marjorie lunched at another table, but alone. When we met later, at the corner of St. James's Street, she told me hurriedly how the Dutchman and his lady friend had grown most confidential, and while they were having their meal he had drawn some diagram or other on the back of a letter and had handed it to her.

At first the woman seemed puzzled, but a few seconds later her eyes had opened widely in astonishment, and she had held her breath as though in awe. It was as if he had put before her some proposition which had both astounded and terrified her.

The woman was certainly a foreigner: fair-haired, plump, and plainly dressed.

To me, it was a curious fact that Klaassen was never seen with his friend van Oordt. Time after time Marjorie urged me to go to the police and consult them, but I hesitated, well knowing the reluctance with which the authorities approached the question of the enemy alien. I preferred to make my own inquiries, because such inquiries were matters after my own heart. Every Marconi operator has had the detective spirit stirred within him since the war. And I was no exception.

The days passed—dark days for our dear old country. We made an air raid upon the Zeppelin factory at Friedrichshafen and nearly destroyed it; we bombarded Zeebrugge and destroyed the harbour works and locks, yet, on the other hand, the Turks were marching to the Suez Canal, and the *Bulwark* had been mysteriously blown up at Sheerness.

December was ushered in by the fall of Antwerp, and then came the daily up-and-down balance of the war, good news one morning and bad the next, intervals of brightness and of winter gloom as Christmas approached.

Marjorie was tireless in her vigil upon those two mysterious Dutchmen. From the Surrey County Constabulary I had learnt that the two men were registered as aliens, but being Swiss were therefore neutrals, and besides they being perfectly honest and open regarding their affairs, no suspicion whatever attached to them. Even the letters they had received from Berne had been opened in the postal Censor's office, but nothing in the least suspicious had been discovered.

In vain did I point out that I had known the pair as natives of Holland; in vain I declared that they could not be genuine Swiss subjects. Yet the official view was unshakeable and, after many inquiries, it was declared by the police that the two men living at "Bonner's Corner" were above suspicion.

It was in consequence of what I had been told at Whitehall that morning that I had declared to Marjorie, as we sat together at lunch at the old inn at Hitchin, that the problem was as far off solution as ever.

After my call in Whitehall my well-beloved had driven me in the car up the Great North Road for a spin, it being a bright, crisp morning, and at Hitchin we had decided to have our mid-day meal.

"It certainly is disheartening, Reggie," she declared. "Nobody believes you. They still declare that the *Amblemore* struck a mine, I suppose?"

"Of course. They never believe that the dear kind German could do any such cruel thing as to blow up a ship the cargo of which is munitions of war."

"That's just it, dear," Marjorie declared. "We're far too kind to the enemy. Therefore I don't wonder that, knowing what you do regarding those two mysterious Dutchmen, you are disheartened. But never mind, Reggie. Let's renew our efforts, and see whether we cannot get sufficient evidence to compel the authorities to take notice."

"I don't blame the police in the least," I declared. "If there is no suspicion, why should they act? It is the whole system which is at fault. But you're quite right, dearest, we will renew our efforts, and with your aid I hope that we may ultimately have success."

That same evening we were down in Surrey again, Marjorie having driven me in the car, which we left at St. Catherine's Mews, on the Portsmouth Road, beyond Guildford, and

"I did not know how near to death I had been at that second."

then, in the fading twilight, we walked together towards "Bonner's Corner." It was dark when we arrived there; hence we were able to take cover in the shadow of a high hedge close to the house, at a spot from which I had kept observation on several previous occasions.

The house was in total darkness, but we had not waited long before we heard a woman's footsteps, and into the gate passed a female figure, that of the spectacled Swiss housekeeper. She entered the house, and soon in two of the windows there showed lights.

Twice before, while I had watched, the woman had returned to the house at nearly the same hour; I therefore surmised that she had friends in the locality, and that the house was often left locked up between the hours of four and five-thirty. It was van Oordt's habit to return about six, while Klaassen's movements seemed to be much more erratic. Two or three other facts I had established only served to increase the mystery. One was that whenever the two men went to London together they posed as complete strangers to each other, travelling in separate compartments, making no sign of recognition, and leaving Waterloo separately. Klaassen usually carried a well-worn and rather heavy leather bag, of the kind used by jewellers' travellers. Once Marjorie had followed him for a whole day in London, but, though he visited the house in Portman Square which van Oordt had also visited, he never called upon any jeweller. Next day I met him at Waterloo by his usual train and kept observation on him.

From a stall in the Farringdon Road he purchased some second-hand pieces of ironmongery, though I could not get near enough to ascertain what they were until the woman who kept the stall had wrapped them in paper, and I could not stay behind to make inquiry, as I wished to keep track of his movements.

So the December days crept on, each bringing my leave nearer to its close. By watching constantly Marjorie discovered that both men were in the habit of receiving correspondence addressed to a small tobacconist's shop in the Kingsland Road, and that they took away parcels from there, and conveyed them down to Guildford.

Christmas was approaching. The shops were making a brave show of "Business as usual," yet for thousands of bereaved ones it was foredoomed to be a sad festival, the saddest in all the thousand years of Britain's history. Loving hearts do not heed a nation's sorrow; therefore, with Marjorie beside me in those few brief days before I should be compelled to go afloat again, to listen on the 'phones and scribble on the pads, to take in Poldhu and Paris, and listen to the high-pitched Telefunken lies, I remained supremely content, yet at the same time puzzled and perplexed.

It was Marjorie's influence, and that alone, which set me more thoroughly determined. On a dark, foggy day—December the eighteenth, to be exact—I went alone again down to Guildford in the afternoon, in order to put into execution a plan which I had had in my mind throughout the previous fortnight.

In the grey mist I walked out towards Shalford, and, having called upon my stout landlady at the inn, I obtained from her a corroborative statement of what I had obtained in another quarter—namely, that the Doctor's housekeeper was on very friendly terms with a woman in the village, and that almost daily she went to take tea with her, returning in time to light up for her master's homecoming.

The evening mist grew thicker as, on leaving the inn, I returned to "Bonner's Corner" to take observations. Armed with an electric torch, a revolver, and a short iron crowbar, I waited at my favourite spot beneath the hedge.

Of passers-by there were many—men going home from work on cycles, while near me was a letter-box in a wall to which people came, dropped in their letters, and flitted away again.

Darkness had fallen and, by the look of the house, nobody was in. Dare I risk it, and boldly investigate?

I reflected. But few days were now left to me in which to solve my problem. I remembered Marjorie's encouraging words—words of a true honest Englishwoman—and they decided me. In the gloom I crept forth and, getting through a thin hedge at the end of the garden, made my way stealthily, but fearlessly, towards the house.

My observations had led me to the knowledge that to most of the downstair rooms were casement windows, opening outwards.

To force a door would be to arouse suspicion when the housekeeper returned. Therefore I decided upon a window, one of a row of five facing the little ill-kept lawn.

Without a second's delay I approached it, inserted the forked end of my crow-bar and, with a single wrench, opened it. In less space than it takes to write, I climbed into the room, and, holding my torch pointing to the ground, made rapid investigation.

To my surprise I saw upon the floor a row of electric accumulators, all joined up with professional precision. The place was a kind of half sitting-room and half workshop, for on a wooden bench in a corner there lay a quantity of pieces of electrical instruments of all sorts, from coils of cheap electric bells and tangles of wires, to a Brown relay.

Sight of these caused me to pause. My suspicions were undoubtedly confirmed. To my surprise, I noticed that from the accumulators a lead ran beneath the door, and away to some unknown spot. In addition, a strong, pungent, but not really unpleasant, odour greeted my nostrils. It was of some acid, I believed, but, knowing little of chemistry, I, of course, failed to identify it.

My next thought was to pass out of the room in order to investigate further, but just as I was in the act of opening the door I heard the sharp click of a key in the latch of the front door and, at the same moment, a man's cough.

I had heard that cough before, and knew the comer to be van Oordt!

To be caught there would, I knew, spoil all my chances of success. Therefore, next instant I had climbed out of the window, closed it softly behind me, and escaped across the lawn into the road.

The latch of the window had been broken, but in such a manner that it would not arouse suspicion. I had examined it on entering and found it to be much worn, and as only the nut had been forced from the bolt, it would be thought that the nut had become dislodged by wear.

One fact caused me to reflect. If any secret operations were in progress in that house —such as the manufacture of explosives or of time-bombs—it seemed hardly feasible that the place would be left so entirely unguarded. I recollected, too, that row of accumulators, and wondered.

For two days I remained away. Then I revisited the place at the same hour, and, finding that the latch of the window had not been repaired, I easily entered the little room. Switching on my torch, I passed the accumulators and, opening the door, found myself in the long, narrow entrance-hall, in which were four closed doors, with a fifth at the extreme end.

I walked towards the end door, determining to examine the whole place thoroughly. The closed house reeked with the odour of some chemical—that same pungent smell that I had experienced before.

I had my fingers upon the door-handle of that end room, and was about to turn it and enter when, to my chagrin, I again heard a key in the front door and was compelled to fly and make my escape.

And none too early, either, as you will later see. I did not know how very near to death I had been at that second. Perhaps, for me, my ignorance was a fortunate fact.

At any rate, the knowledge that I had gained was sufficient to arouse at last the interest of the authorities at Whitehall, and I was at last given assistance in my investigations.

With three officers of the Special Department of Scotland Yard, and accompanied by Marjorie, we kept watch during the following days, when, on the morning of Christmas Eve, van Oordt left Guildford, carrying that brown bag usually carried by Klaassen. On arrival in London he crossed to Euston, and there bought a ticket for Liverpool.

He had, it seemed, set out upon another desperate mission, but this time he was closely shadowed.

We saw him go on board a certain vessel of the Red Circle Line which was about to leave for the Mediterranean, and followed him below among the bustling passengers and their friends. We watched him leave his bag at a spot which had evidently been prearranged with some fellow-conspirator—perhaps a labourer engaged in stowing away cargo—and then followed him as he moved off ashore again.

The bag was quickly seized, and the Dutchman as quickly arrested.

Examination of the bag revealed what I had all along suspected. Concealed within was a beautifully constructed piece of clockwork set to detonate a quantity of high explosive forty hours later, when the vessel got to sea.

"Ere we could realise what had happened the house was blown into the air."

We brought him up to London, in custody, and his temper was violent, as you may imagine, when he recognised in me the wireless operator who had sent his messages two years before.

"Bah!" he cried to me in defiance. Then he added in German, laughing grimly, "It will be you that will suffer—*you*! not me!"

At the time we did not understand the meaning of that remark. On that same night, when we arrived back in London, we at once went down to Guildford and, having surrounded "Bonner's Corner," one of the men approached, and knocked at the door.

The woman in spectacles appeared at it, but on the detective asking for Mr. Picot, she denied that he lived there.

"Oh, yes, he does," the officer declared. "Now, is he in—or not? Answer me quickly!"

His attitude alarmed the woman, whereupon she shouted down the passage, in German, "Be quick! *The police*!"

In a moment Klaassen appeared, white and alarmed, in his shirt-sleeves, but only for a second, as next instant he dashed down the passage to the room at the end.

He tore at the door and opened it, but as he did so there was a bright flash and, ere we could realise what had happened, the house was blown into the air, most of us being thrown down by the violent concussion.

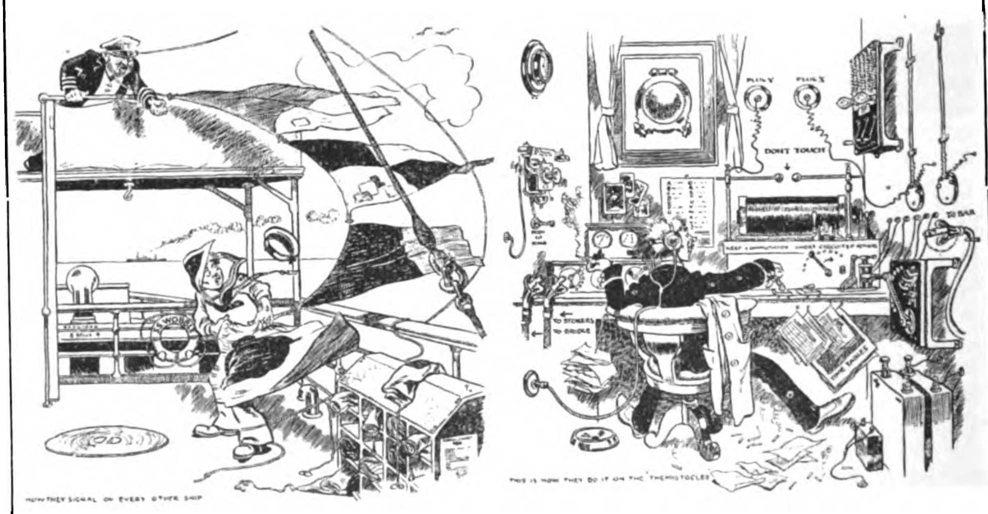
When we recovered from the shock we found that the place had been utterly demolished, and was on fire. Klaassen and the woman had both been blown to pieces, while the unfortunate detective standing at the door was lying stunned bleeding and unconscious.

Then, for the first time, as I gathered my senses, I realised how I had been twice within an ace of death, because—as van Oordt afterwards admitted at his trial by court-martial—the door of that room in which the secret operations were conducted was connected electrically with a bomb, so that anyone opening the door while the house was left unguarded would automatically explode it and blow himself to atoms.

No details of the affair, or of the trial of the Dutchman, were allowed to leak out, as the authorities—with very good reason—had no desire to alarm ocean-going travellers.

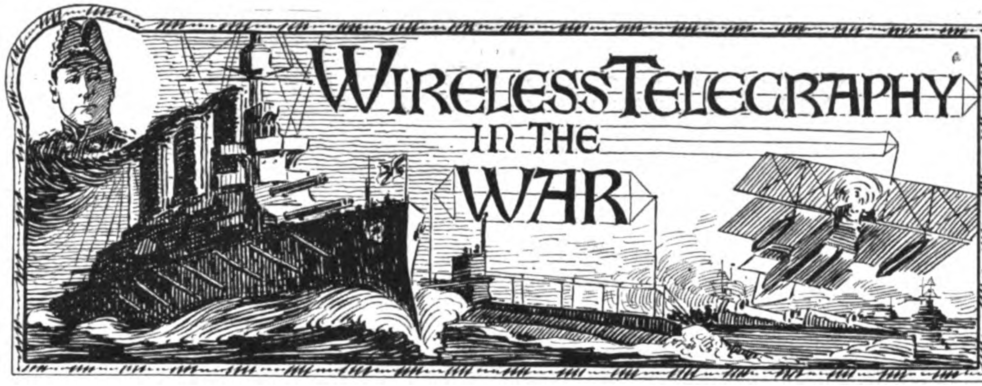
The fact that I had to be called as witness prolonged my leave for a further couple of months, greatly to Marjorie's joy, and in the end I had the satisfaction of being present at the Old Bailey, when, *in camera*, a sentence of penal servitude for life was passed upon the man with the grey plush hat.

THE END.



"How they signal on every other ship." *"How it is they do it on the 'Themistocles.'"*

(By special permission of Messrs. G. Thompson & Co., Ltd.)



ONE of the earliest effects of the war was to introduce such changes in the working of wireless telegraphy as caused many of our usual features perforce to disappear. One feature, however, which has been appearing since our September, 1914, issue, under the above heading, owes its original inception to the same cause. We believe that this feature is one which has been appreciated by our readers, and we have endeavoured to carry out the promise of our sub-title and make these pages a real *résumé* of the work which is being accomplished by radio-telegraphy both on land and sea. Our **head-piece** on this page gives the place of pride to the Fleet and Admiral Jellicoe, who, as we have pointed out in previous numbers at some length, is able *with the aid of wireless* to exercise complete control over the most distant units of his Fleet in a way that has never been possible for any of his predecessors in our glorious naval service.

* * *

Amongst the very numerous items of duties performed at sea by radio-telegraphy which have been chronicled in these pages, we might remind our readers of our exclusive description (compiled from the report of the wireless operator on board the auxiliary cruiser *Otranto*) of the only naval disaster in actual fighting which has befallen us. In these pages also have appeared notes concerning the great victory of Admiral Sturdee, by which that previous reverse was so gloriously avenged, notes which led up to a special article dealing with the subject. We have chronicled from the point of view of WIRELESS readers the various adventures of the *Emden* and her final destruction; we have described how radio-telegraphy contributed to the sealing up of the *Königsberg*, and ultimately directed the *coup de grâce* in the Refugi River; we have revealed the secret of how the German "Treasure Ship" was able through her wireless installation to escape the British cruisers scouring the Atlantic for her.

* * *

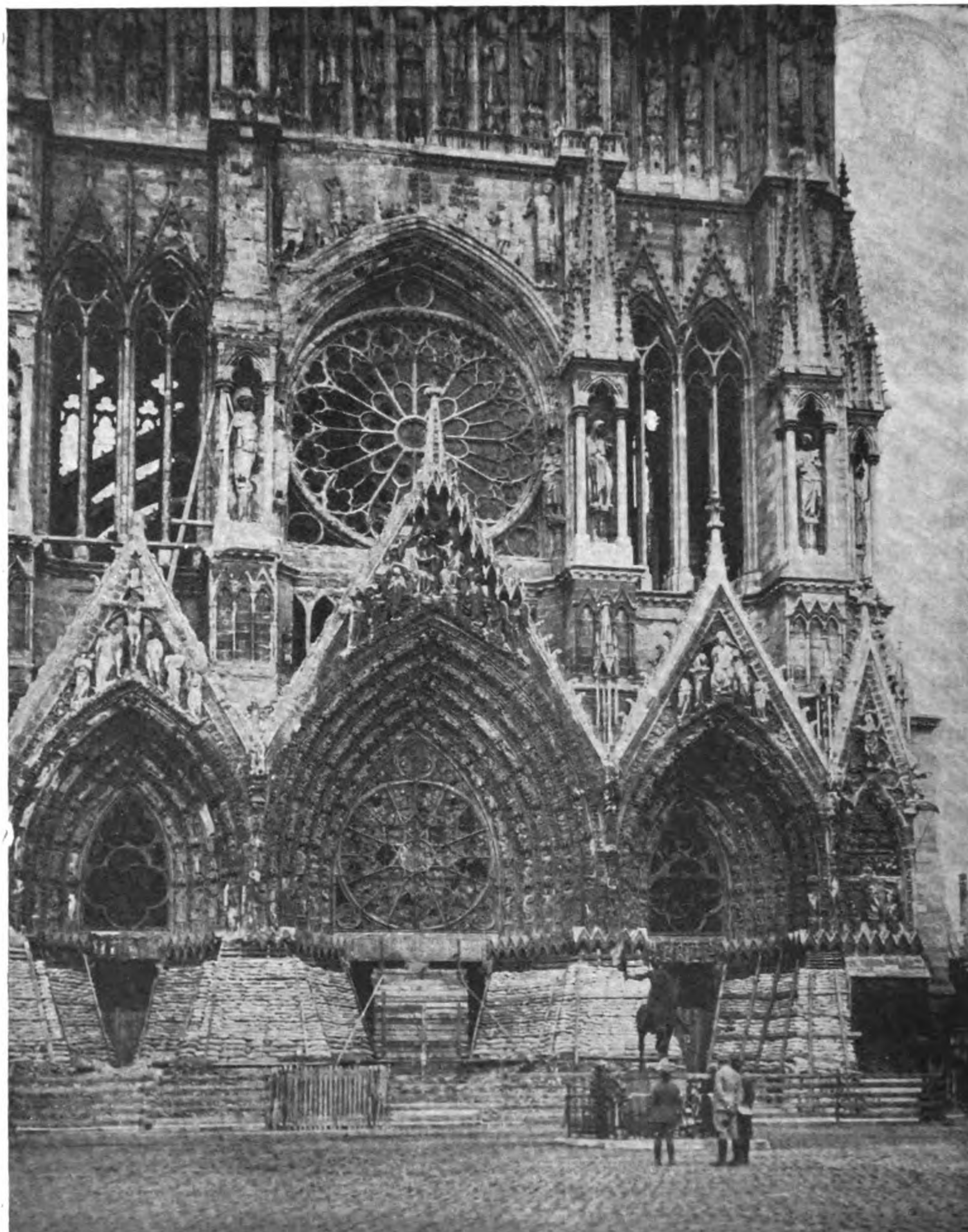
In our **tail-piece**, our artist has endeavoured to give an impressionist idea of the various accounts we have given describing the way in which wireless is playing its part on the field of battle, where it links up the various units in the fighting line, first to their divisional headquarters, and finally to the Commander-in-Chief himself.

* * *

Aviation has naturally received considerable attention in these columns, and we believe that our artist has not inaccurately indicated how these machines flying high above the enemy lines are able to communicate the intelligence gathered to the listening operators below.

* * *

The destruction of the German Wireless Chain has formed the subject of many an interesting paragraph in our successive issues as the news came in; whilst the series of happenings leading up to the closing of Sayville by the Americans have found a place in our series, and finally led up to a special article in which the subject was fully dealt with as a whole. It would be impossible to attempt an exhaustive enumeration; but we cannot close our mention of



Rheims Cathedral after Bombardment.

the general subject without referring to the interesting details of the wireless installations in Turkey and Greece, which formed some of the most recent and, at present, the most topical of our subjects.

* * *

One of the excuses put forward by the Germans for their scandalous act of vandalism in the wanton and deliberate destruction of Rheims Cathedral was that the French put a Wireless Installation on the top of the tower. The falsity of this statement was immediately exposed by the French Government, as well as the alternative statement of its having been used as an observation post by the French Military Authorities. It is sometimes said that hypocrisy is the tribute paid by evil-doers to virtue, and this is the best that can be said for this piece of unblushing mendacity. The remarkably fine photograph which we reproduce here possesses an added interest for WIRELESS WORLD readers, in that it is the work of the camera of Senatore Marconi, and that the exposure was personally made by him on the occasion of his recent visit to France. Nothing short of such incontrovertible evidence could make us realise the fiendish malignity with which the enemy has set to work to destroy a glorious achievement of pious antiquity, the heritage not only of France, the country in which it happens to be located, but of the whole civilised world.

* * *

All Englishmen have good reason for congratulating themselves that British men-of-war are so magnificently handled that, even under the severely trying ordeal of warfare at sea in every variety of weather conditions, they seldom stand in need of assistance from loss of life owing to wreckage. But when an unfortunate concatenation of circumstances lead to such mishaps as the loss of H.M.S. *Argyll*, the wireless installation which normally plays its less dramatic part in the daily routine of the ship proves itself here as elsewhere a sure help in need. The whole story, recently recounted in the daily press, emphasises not only the difficulties under which the units of our unseeing fleet are working, but also the magnificent spirit and discipline prevalent on board one and all of them, and the certainty with which wireless may be reckoned on even under such abnormal circumstances. The *Argyll* had been badly smashed on striking the ground, the night was extremely dark and stormy, and the sailors could plainly hear the crash of the riven metal as the heavy cruiser ground herself steadily to pieces on the rocks. Wireless messages speedily brought replies from one and another of her consorts, and at their hands the rescue was effected so skilfully that every man on board was saved. Here we have a case in which Wireless Telegraphy has to its credit the saving of not far off 1,000 skilled British sailors to go on performing their splendid work in the defence of our shores and the confusion of the enemy.

* * *

The following description of a wireless operator on a torpedo boat recently appeared in *The Yorkshire Post* special report of the activities of the British Fleet. These smaller craft are more continuously on duty than the big battleships, and the strain upon officers and crew is often very severe. It is to torpedo boats and destroyers that we largely owe the fact that the "German Submarine Blockade" has proved a source of ridicule instead of danger. And a large measure of the success of our torpedo boats and destroyers is due to Radio-Telegraphy.

"Only the wireless operator, a fresh-faced "young bluejacket, appears in uniform. "He is taking a brief respite from the wire-"less cabin, where he sits all day and all "night, the metal caps clamped over his "ears listening for the little noises which are "signals. They sound like the scratching "of a nail upon metal—short-long, long-"long-short, and so on. He transcribes "them into longhand as he listens, and at "the same time he can send a message with "his left hand. There are occasions when "he takes seventy hours duty on end, "without suffering distress, and when "they are done he cleans his instrument."

* * *

We presume that most of our readers will have read the various accounts of the different journalists, who recently visited the High Fleet, when they appeared in the daily papers, but there is one little item at the end of these impressionist sketches of British journalism which cannot fail to prove of interest to WIRELESS readers. As *The Yorkshire Post* correspondent left the *rendezvous* of the Fleet, and cast a backward glance in going, his eye naturally travelled to the flagship towering majestically against the curtain of lowering cloud. He watched the details of the picture fade gradually away, but the last feature of the admiral's headquarters at sea to disappear from his ken was what he describes as "the wireless "kites making symmetrical cobwebs on the "sky." This use of kite aerials is rather a reversion to earlier practice. Mr. Marconi used kites for his first trans-atlantic experiments, and they were frequently em-

An Outpost in Winter:—Wireless communication keeps the furthermost units in touch with the Headquarters Staff.

ployed in the first days of wireless telegraphy. But during recent years they have rather fallen into disuse, and it is interesting to learn that under war conditions these wireless kites have re-asserted their utility. It will be remembered that in our issue of June last (page 184) we printed an account of wireless kites said to have been used by the *Eitel Friedrich*. Capt. W. J. King when a prisoner on board the German corsair, noted the use of them, and stated that by means thereof the range of the German's wireless was extended, from 900 to 2,500 miles. There are no means of checking such figures; but the utilisation of kites on the British admiral's flagship seems to point to the fact that the additional mileage covered by the use of kites is being found of assistance in the British Navy.

* * *

Wireless amateurs in England are, after the fashion of most Englishmen, inclined to think themselves very hardly used and tyrannised over by the authorities. That there may have been individual cases of hardship no one doubts (least of all the authorities themselves); but if they desire genuine, unadulterated, honest, straightforward tyranny, we would commend wireless amateurs to the expert pundits of the Turkish Empire. In the current number of *The Near East* Mr. W. Gordon Campbell gives some indication of what radio amateurs had to experience even in the Capital City, under the eyes of neutral diplomatists of every nationality. His statement is that:

"Everyone who possessed even the most "harmless toy apparatus was assumed to "be a spy in communication with the enemy "outside the Dardanelles, and ran the risk "of being hanged by the court-martial, "which rarely paid any attention to the "evidence. The mere fact that the police "made such an accusation was usually "regarded as sufficient. My own wireless "installation was by no means a toy, but a "fairly complete receiving station, with "which I could hear all messages within a "considerable area, and I suppose my doings "were consequently regarded as all the more "suspicious. In any case I had some "exciting experiences with the Turkish "police before escaping from Constan"tinople. . . ."

This Englishman's experience of pre-war days is well worth reading, and his wireless experiences with the "Concert of Europe" (his phrase for the radio messages passing between the various foreign Embassies and their vessels) make amusing reading, and indicate that the discords of wireless only too truly reflected the discords of politicians. Our wireless amateur was able to overhear the various preparations for the reception of the *Goeben* at Constantinople at a time when she was supposed to be far away. After her arrival, the Turkish station at Ok Meidan used to call her up every evening and exchange messages in French. The alteration of the *Goeben's* call letters appear to have proved ineffective in concealing the identity of what Mr. Campbell calls the "high penetrating note of her Telefunken "apparatus." Some of these messages included polite enquiries as to whether the Commander of the *Goeben* had any messages for the German Embassy, a clear demonstration of the complete Germanification of Turkey long before war was declared. This dominance of the Hun at Constantinople was made still clearer a little later on when the Ok Meidan Station started sending out messages in German, and increased its rate of speed, leading Mr. Campbell to the obvious deduction that a German expert had been located there. We must refer readers to our fellow countrymen's own story of how he was denounced to the Turkish Police by the Germans as a wireless spy, and how he was visited and cross-examined on several occasions. The final consummation arrived when, though nothing incriminating had been discovered, he was informed that further enquiries would be instituted as the authorities had not yet been satisfied. Such an intimation brought home to him that the only safe course to take was flight, and we can easily imagine Mr. Campbell heaving a sigh of genuine relief, when, after passing over the Bulgarian frontier, he realised the fact that he was no longer within the power of Teuton-ridden Turkish officials.

* * *

The contrast between the "slick" methods pursued by the apostles of Kultur have not prevented them from claiming, with the most bland and guileless simplicity, the utmost licence under "International Law" from other nations. Despite the *magnificent wireless installation* which they possessed at Dar-es-Salaam before it was smashed by H.M.S. *Pegasus* on August 8th, 1914, the British Government has actually been approached by the perfidious rapers of Belgium, who sent out wireless messages to the high seas announcing the declaration of war with England two days before it actually occurred, to credit the statement that no such message was sent to Dar-es-Salaam, and that poor innocent Teutons were "rushed" unexpectedly by the French at Bonga on August 6th and at Singha by the Belgians on August 7th. Moreover they claim that "Perfidious "Albion" actually had the audacity to proceed to active measures on August 8th. On these grounds they have the impertinence to ask for a truce for Central Africa, and have appealed to the good offices of the United States and Netherland Governments. It seems incredible that the sinkers of the *Lusitania* should be received on such an errand with anything but a burst of sardonic laughter.

* * *

Strange as it may appear, the neutralisation of Central Africa receives support even from some who call themselves Englishmen. A pamphlet was actually received recently by the *African World* advocating this procedure. It was written by Mr. R. C. Hawkins, Barrister-at-Law, and called forth the following comment from our contemporary :—

"Britain did not see her way to comply "with the suggestion so long as the German "wireless stations in Togoland, West Africa, "and East Africa were a menace to our "Fleet and German African ports a possible "refuge for enemy cruisers. Now that the "high seas are cleared, and the German "wireless stations all in our hands, Mr. "Hawkins appears to think that the old "treaty can be revived. But it is difficult "to share Mr. Hawkins's hope. The *Conven-"tional basin* of the Congo includes several "territories, notably parts of the Cameroons "and of East Africa, where operations are "still in progress. Most of the mischief has "been done, and in this world war it will "hardly be found possible to mark out an "area which shall be immune."

* * *

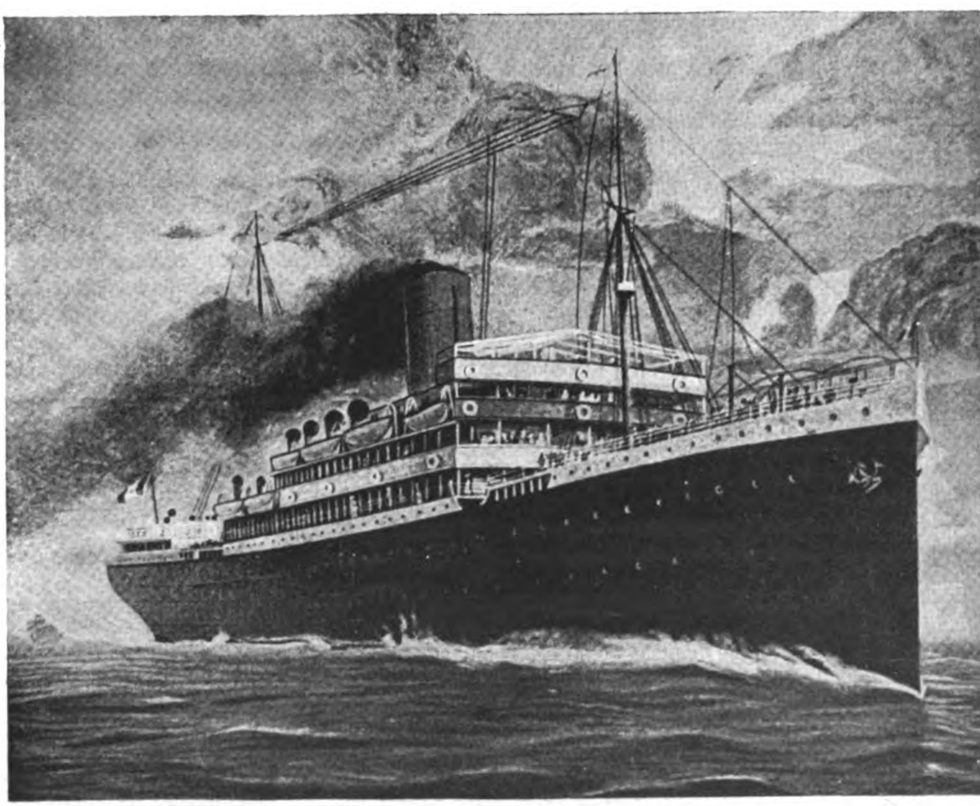
Small wireless telegraphy stations and stores of benzine, etc., were not long ago detected on some of the tiny islets in the Baltic by the Russian naval authorities concerned in the defence of Riga. The method of their equipment seems to have been that swift motor launches should convey the material to these islets by night and store what they bring in caves. There are many such deserted spots off the Russian coast in this region of the Baltic which do not serve as any permanent habitation of men, but only for temporary occupation in the summer and autumn. The ingenuity shown by the Germans in this respect is worthy of admiration ; but, now that the military authorities have had their eyes thoroughly opened to such possibilities, it is hoped that they will take effective measures to prevent the recurrence of such activities in the future.

* * *

There is but little difficulty, as far as ships are concerned, in arranging for the despatch and reception of wireless messages between airships and shore stations. On this type of aircraft the difficulty arises, not so much from any trouble in arranging suitable facilities, as from the necessity of avoiding the dangers referred to by Professor Fleming in his recent address on "Science in the War and After the War," a full report of which appeared in our November issue. The lecturer on that occasion pointed out that there was considerable risk involved in the possible action upon the gases used to inflate the balloon by reduced sparks. He instanced a case of a Zeppelin which had been destroyed in this way, an explosion due to that cause having occurred after the airship had come into collision with a tree. In aeroplanes the difficulty has been one of a totally different nature, and arose from the fact that the noise of the engine was apt to drown the sound of the wireless signals as they were recorded by the telephone receiver, whilst, if the operator stopped the engine to listen, the aeroplane immediately started descending swiftly to earth. The most satisfactory method for overcoming this obstacle has proved to be the adoption of a sound-proof helmet to which the telephone is fastened, and this apparatus, combined with the reduction in engine noise characteristic of the latter types of machine, appears to have completely solved the problem.

Once again the savagery of nature has been outdone by the ruthless brutality of man. The circumstances attending the destruction of the large Italian liner, *Ancona*, of 8,210 register, torpedoed in cold blood off the Southern Coast of Sardinia, are even more revolting in their fiendish cruelty than the long list of German crimes, which up to the present had culminated in the destruction of the *Lusitania*. There would appear to be little doubt from the unanimous testimony of the survivors that the two submarines guilty of the outrage were German. It is true, at the time of actually launching their torpedoes, they flew the Austrian flag, but this had only a short while before been substituted for their true colours, and the first attempt at exculpation of the captains of the submarines came from Berlin, not Vienna. When between Cape Carbonara (south of Sardinia) and Bizerta on the morning of November 7th the submarines were sighted, and the vessel attempted to escape by speed. The shots which at this period were fired may be justified, although we can hardly imagine this course being taken by a British man-of-war when dealing with a helpless merchant vessel. But after she had been brought to a standstill and torpedoed, the Austro-German brutes were actually guilty of firing upon boats crammed with panic-stricken emigrants, mainly women and children, as they attempted to leave the doomed vessel.

The "Marconi tradition" of gallantry at the post of duty was fully carried out, and a number of wireless messages had been despatched, despite the storm of shot and shell bursting around. These were immediately answered from the French stations at Bizerta and Ferryville. From the latter steam launches were promptly despatched, and 160 passengers, together with 10 of the crew, were rescued. The submarine was still on the scene when the rescuers arrived, and the latter were wit-



Ss. "Ancona."

nesses of a successful enemy shot which destroyed a lifeboat in which a number of women and children had for the moment found themselves safe. The bodies of these poor victims were brought in to Bizerta.

* * *

In our November issue we published a plan showing "the wireless brain of the Army" and indicated pictorially the way in which the Chief Command receives and transmits information and orders to its sub-centres and through them to the farthermost units at the front. The Special Correspondent of the *Daily Telegraph*, in a communication dated from the Headquarters of the Russian South-West Army, recently transmitted to his paper an excellent pen-picture, of which we give an extract below, and which will serve admirably as a description in words of what we have ourselves elsewhere indicated pictorially.

"There is little military movement in the "streets; one sees neither guns nor brilliant "cavalcades. But everything that is hap- "pening on the immense front is known here. "At a certain spot a strong spark shines and "crackles restlessly, and when this happens "the silent waves of the wireless spread "through space. Here come all the reports "as to the movements of the enemy; here his "intentions are divined and the necessary "replies given in endless succession. This is "the brain of militant Russia, which thinks "in silence and co-ordinates the thousand "movements of the scattered members, all "with one object in view—to drive away the "enemy and punish him for his invasion."

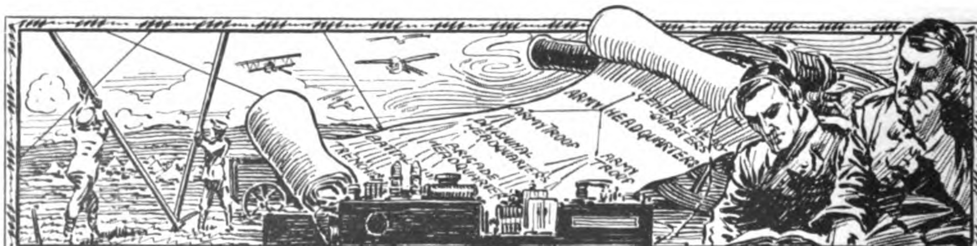
The following extract from the *Scottish Field* will speak for itself. We have often ourselves enunciated the points therein touched on, but confirmation from actual experience published in the pages of so well-known a contemporary appear worthy of record here:—

"I had a pleasant conversation the other "day with an officer of the Royal Engineers. "He had much to tell of the part that "electricity plays in the war, and I was "specially interested in all he had to say "about wireless telegraphy. As is well "known, the wireless apparatus is used very "freely by all the belligerents, and is found "of the greatest utility and reliableness. "It is requisitioned by submarines when "above the surface, and by its means "aeroplanes and airships constantly transmit "the result of their scouting efforts. In "France and Belgium it forms part of each "army's field equipment, and it is used by "our warships for keeping in touch with "each other and with their bases. Not very "long ago it was generally believed that "wireless would in war time prove more con- "fusing than helpful, because the opposing "nations would be able to interfere with "each other's messages. My friend assured "me that these misgivings had turned out "to be quite unwarranted. It is found in "practice that the possibility of jambing is "very slight. Every endeavour in that "direction proves so barren as to be now "deemed unworthy of time and energy. "Each side is so busy with its own messages "that it leaves the others to attend to "theirs."

* * *

We referred in a recent Editorial to the wireless newspaper published on the *Royal Edward*. In the series of interesting "Leaves from an Officer's Diary" recently published by *The Star* we find the officer-author enclosing "a copy of last "Sunday's edition of the *Anzac Argus*. "We get odd scraps of wireless news here, "and as the *Peninsula Press* sometimes "gets delayed in the stormy weather, or "there is not much news in it when it does "arrive, I started an opposition paper, just "to amuse the boys, made up of scraps of "wireless news suitably padded."

The "suitably padded" is delicious.



NOTES OF THE MONTH

IN the annual report of Lloyds' Register of Shipping for 1914-15 it is stated that the past year had witnessed a further increase in the use of wireless telegraphy and submarine signalling in the world's mercantile marine, there being now recorded in that society's register book 2,939 vessels fitted with wireless telegraphic installation and 947 fitted with submarine signalling apparatus.

* * *

The following incident (sent by a correspondent at the front) has a poignant interest now, as it refers to the Rev. C. E. Doudney, C.F., who was recently killed.

He was lecturing on wireless telegraphy to a group of gunners assembled in a room built of odd timber taken from ruined houses. In his review of the subject he arrived in due course at the subdivision of the impulses sent out into so many groups per second and the various tones resulting in the receiving 'phones. "In my own apparatus," he remarked, "which is worked "by the current of the electric light, these "groups are already prepared by the "alternations of that current. The Bath "light current, having a periodicity of 100, "thus giving 200 impulses per second, the "tone heard in the receiver by the operator "at the other end is——"

A voice, apparently coming from the back row, at this moment gave the exact tone, anticipating the lecturer. "Ah," said the latter, "my friend down there understands these matters. He has the tone exactly." The men looked about, but no one confessed to this brilliant grasp of acoustics. There was silence, and then—then—there came from outside the rich, steady note of an old cow! It was some little time before the lecturer could penetrate the storm of laughter which shook the hut. Mention of the late Rev. C. E. Doudney's amateur station, together with a photograph of his church (St. Luke's, Bath), appeared in our November, 1914, number, page 527.

* * *

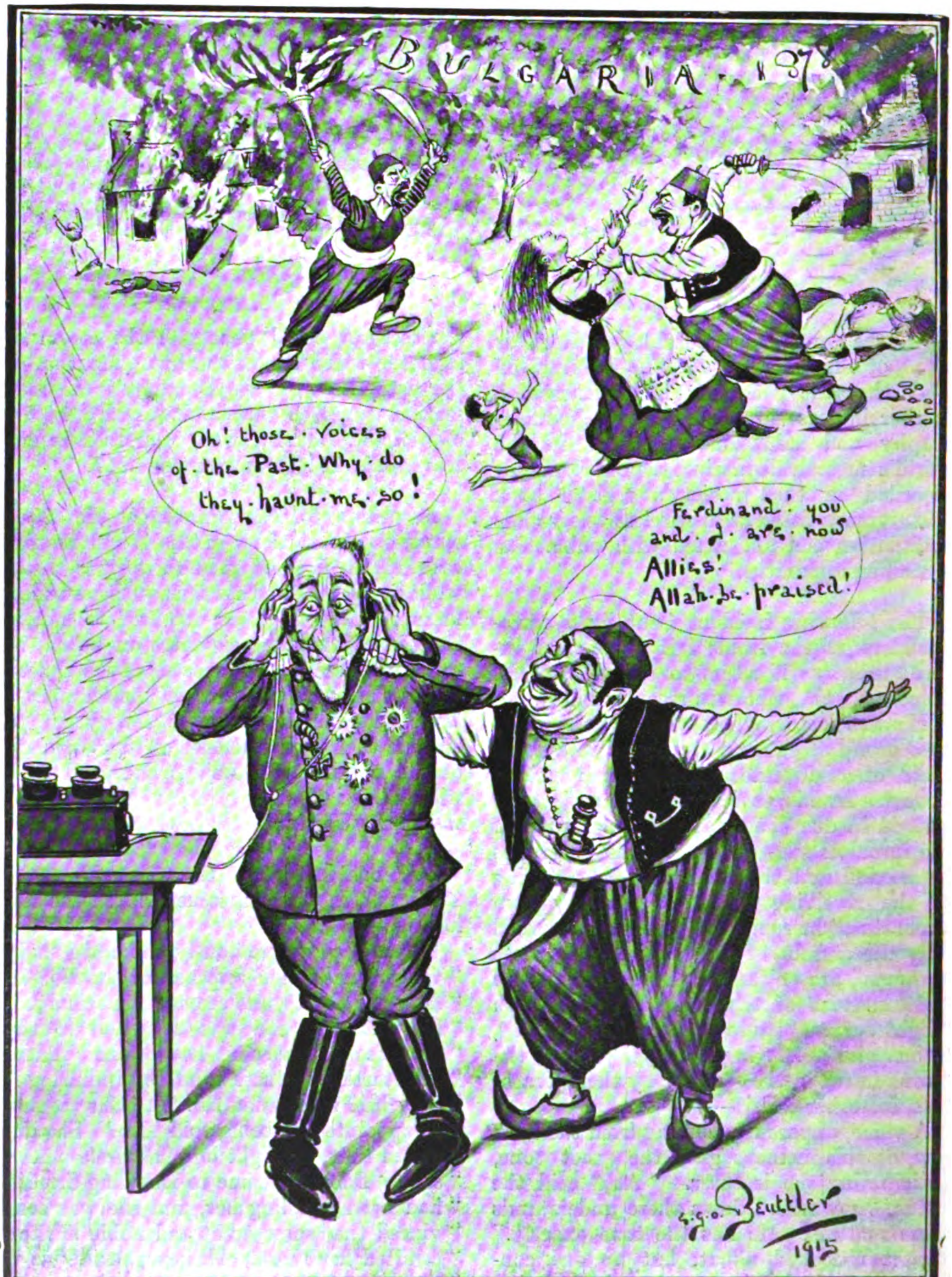
According to *The Steamship*, the 7,000 wireless ship stations in the world require over 15,000 licensed men to operate them, while over 1,000 land stations, with a working force of 3,200 men, are required to handle the business which originates on board, or for these vessels. The records of the United States show that about 2,000 amateurs have been licensed in the past few years to operate their own stations. A fair estimate of the number of warships equipped with wireless is: Germany, 200; Austria, 60; whilst the United States possess over 300.

* * *

Our contemporary the *Sheffield Daily Telegraph*, in a recent issue printed the following:—

"One day a previously unknown lady "visitor made her appearance at No. 10 "Downing Street, and seemed so normal and "ladylike that she was admitted to the "entrance hall without hesitation. There "she startled the attendants by inquiring if "they had wireless at No. 10. She seemed "disappointed at being told 'No.' She de- "clared that, all night long, a wireless mes- "sage, 'Deborah, come to Downing Street,' "had been assailing her, and she was con- "vinced that some great and noble mission "awaited her there. However, said she, if "the message was not from No. 10, it must "have come from the House of Lords. So, "to the great relief of the attendants, she "left for the Gilded Chamber."

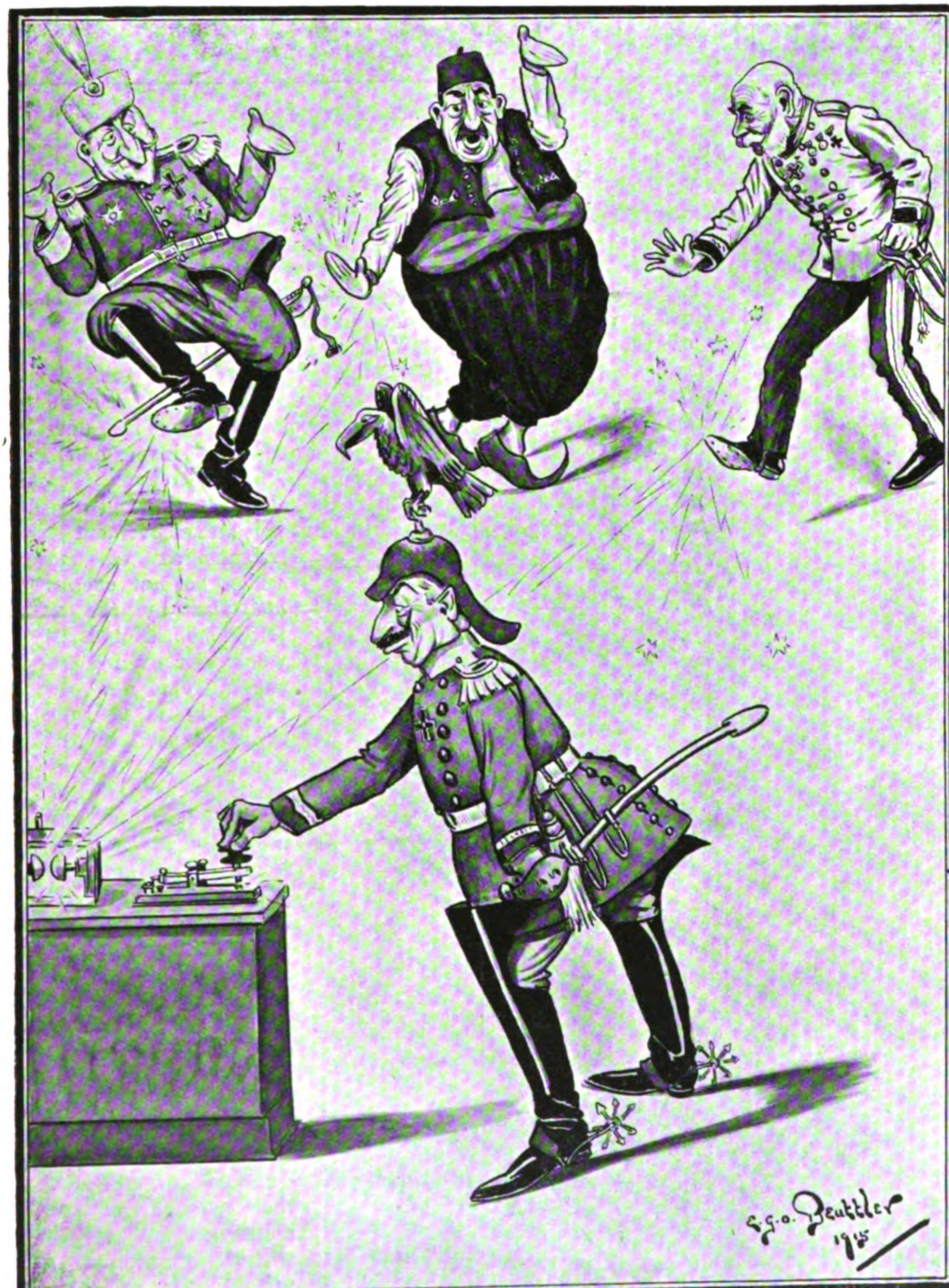
CARTOON OF THE MONTH (i)



MORSE AND REMORSE.

The Wireless Voices of the Unheeded Dead.

CARTOON OF THE MONTH (ii)



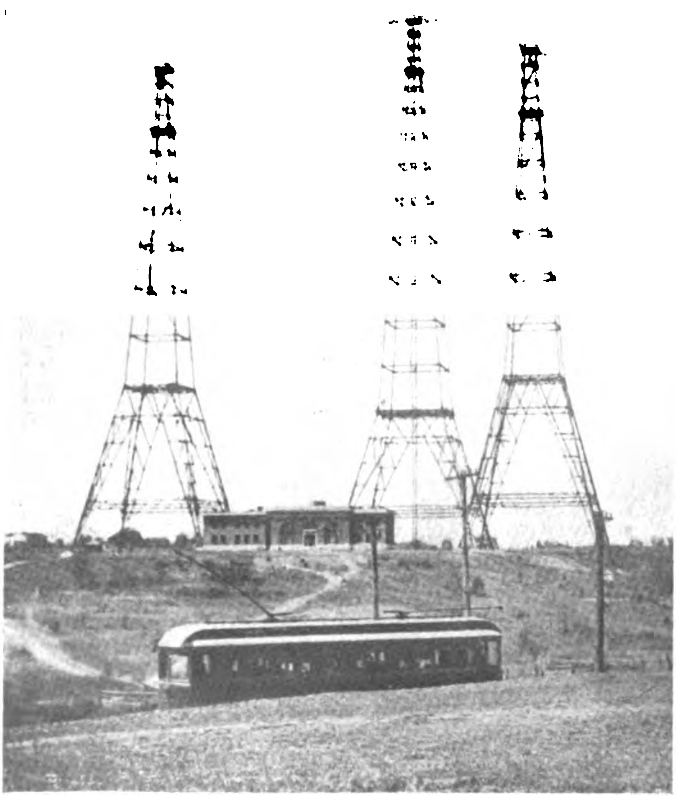
THE "WIRELESS" WIREPULLER.

Potsdam's Champion "Sparking" his Marionettes.

Transatlantic Radio-telephony

The Achievement of a Prophecy.

WHEN some time before the outbreak of war, Mr. Godfrey Isaacs predicted that wireless telephony across the Atlantic would be achieved ere long, a smile of amused scepticism flickered across the faces of many of his hearers. Mr. Isaacs spoke with an assurance which came from knowledge of the wonderful progress that has been made in the art of radio-communication, and cared little for the disbelief which his forecast might arouse. That he was justified in making such a statement is now amply proved by the announcement cabled from America that wireless telephone communication has been effected between the giant station at Arlington, near Washington, and the huge " poste " of the Eiffel Tower at Paris. Had it not been for the overpowering influence of the war, which crowds from the newspapers almost everything save its own records, the brief accounts which were received from New York would have been expanded and written up, illustrated and embellished, until they formed the major portion of a day's issue. The importance of this new development of Senatore Marconi's invention cannot be overestimated, for not only is the new step a fresh link between the Old and the New Worlds, but it is an achievement in the transmission of speech which has not even been *attempted* by the wired telephone. Not a single word, nor even a sound suggestive of a word, has ever been transmitted through an Atlantic cable, nor is there reason to think there will be while the present methods are in use, as every experienced electrician will agree. And yet the ether wave system, a mere child compared with the wire telegraph, has proved such a willing and capable servant that the spoken word has reached from the United States to Paris in a fraction of a second! It has been truly said that there are so many wonders now-a-days that the average newspaper reader accepts everything without question or surprise.



Arlington Radio Towers.

It is fourteen years since Senatore Marconi first received wireless signals across the Atlantic, and since that time the complicated art of long-distance transocean wireless communication has daily grown in efficiency. It will, of course, be a matter of great regret that this new stride forward has not been made by Britain and her wireless experts, who have done so much for the new form of communication. For some time the Marconi Company has been working on wireless telephony, and long before the war they had attained results which were nothing short of marvellous. In the 1915 *Year Book of Wireless Telegraphy and Telephony* an article appeared from the pen of Mr. H. J. Round, a member of Senatore Marconi's staff of experts, in which were described the very interesting experiments in wireless telephony which had taken place up to the time of the publication of that volume. Mr. Round mentions that he had received very fair speech from Berlin at Marconi House so far back as at the end of 1913. In fact, such excellent progress was being made that, but for the intervention of the war, it is more than likely that the Marconi transatlantic stations would have been in wireless telephonic communication some months ago.

The Eiffel Tower.

However, with all experimental work put by the board for the more serious requirements of war, the Marconi Company has perforce postponed its work in this connection. Our American cousins, working without restriction, have taken up the task and made the good progress above reported. Practically no technical particulars are yet available of the experiments, which were undertaken by the American Telephone and Telegraph Company, working in conjunction with the Western Electric Company, but from reports which are current it would appear that the apparatus used was a modification of the well-known Fleming valve, in its newer form as an amplifier and producer of oscillations. If this is so the methods adopted are very similar to those detailed by Mr. Round in the article above referred to. The method probably adopted was to use an ordinary microphone for speaking purposes, the current passing through this being amplified very many times and used to modify a high frequency current of great power, produced by the new oscillating Fleming valve. No special apparatus is required for reception, so that the Eiffel Tower, very kindly placed at the disposal of the Arlington station for a brief period on October 20th, had no need of a wireless telephone installation.

The transatlantic wireless telephone experiments were preceded by some fine results across America from New York to Arlington by wire telephone, and from

Arlington to Hawaii direct by wireless. The total distance thus traversed by the human voice was well over five thousand miles, for it is only a hundred miles less than that distance between Arlington and Hawaii. By means of the new amplifying devices it was possible to connect the wire telephone to the wireless, the speech so being uninterrupted.

And thus the ether wave becomes more and more the servant of the scientist. Who knows but that in years to come clear vision may be had by wireless, in such a way that to look down Broadway or across the sands of Egypt one has but to step to the apparatus and switch on ?

THE CUBE RESISTANCE PROBLEM.

THE letter from a correspondent which we published on page 492 of our November issue under the title " A Little Problem " has aroused considerable interest amongst our

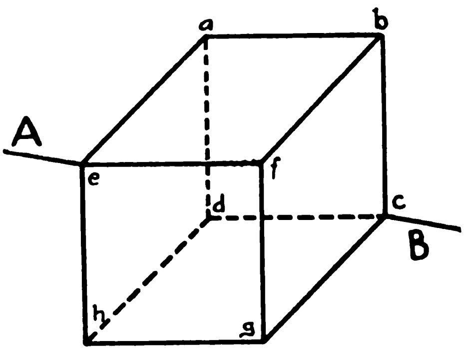


FIGURE 1 Problem Lettered.

readers. Another correspondent, Mr. W. B. Ferguson, has contributed the following explanations, which we think deal with the subject excellently :

First Method.—If the cube be imagined to be pulled apart from points *e* and *c* all confusion at once vanishes, as the cube assumes the shape shown in *Fig.* 3, from which it is obvious at a glance that we have three in parallel (*W*-*X*) in series with six in parallel (*X*-*Y*) in series with three in parallel (*Y*-*Z*), therefore the resistance from *e* to *c* is one-third plus one-sixth plus one-third.—*Answer : Five-sixths of an ohm.*

Second Method.—The current entering at

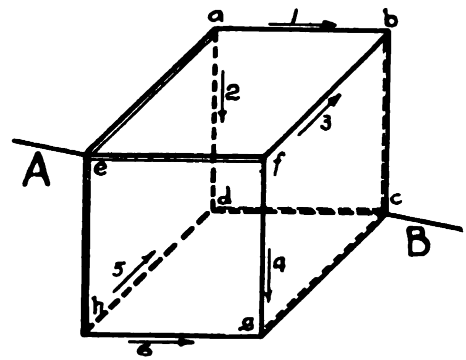


FIGURE 2 : Proof of Figure 3.

e has obviously three 1-ohm paths to follow—viz. (*Fig.* 2), *ea*, *ef*, and *eh* (shown as double lines). The current also obviously leaves by three 1-ohm paths in parallel—viz., *bc*, *dc*, and *gc* (shown as thick lines); but so far there is a gap between the two sections. It will now be noticed that all the lines proceeding from *a*, *f*, and *h* connect on to the inside ends of the thickened lines—two from *a*, two from *f*, and two from *h*—six in all, obviously in parallel, filling up the gap referred to above. So there are three ohms in parallel (one-third ohm) in series with six ohms in parallel (one-sixth ohm) in series with three ohms in parallel (one-third ohm). —*Total, five-sixths of an ohm.*

Alternative Problem (Sides made of 1-ohm Sheets).—In *Fig.* 2 the current entering at *e* divides equally between top, front, and left side (*abfe*, *efgh*, *eadh*), each of 1-ohm resistance, therefore one-third of an ohm total. The current leaves by three sheets—bottom, back, and right side (*cdhg*, *cdab*, *cbfg*), each of an ohm resistance, therefore one-third of an ohm total. The first set of sheets joins direct with the second lot of sheets along the line *a*, *b*, *f*, *g*, *h*, *d*, *a* ; therefore we have one-third of an ohm in series with one-third of an ohm.—*Total, two-thirds of an ohm.*

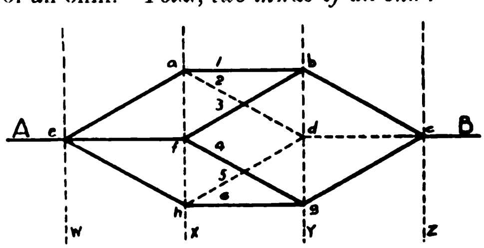
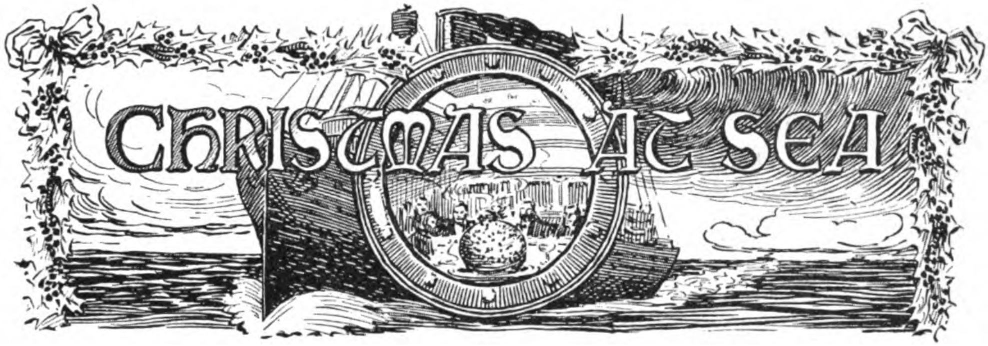


FIGURE 3 : Method Employed



The Feast of Noel on Board Ship

By J. W. FARLEY

TO those who "go down to the sea in ships" the festivities ashore make a great appeal. We landlubbers do not appreciate how "cut off" Jack feels whilst at sea. The narrow compass and restricted environment of his ship constitute for many weeks, perhaps even months, his world. But even so, how very much worse was the plight of our ancestors in the days of the old sailing ships, when children bade their fathers good-bye, and wives said *au revoir* to their husbands—it was then a very different matter. In those days a voyage to New Zealand took anything from four to eight months. Now-a-days the same journey can be accomplished in just under six weeks. It is this very isolation which has caused the sailor to be known as the handy man. He had perforce not only to make himself acquainted with, but actually to engage in all sorts of work which ashore would be done by his wife or other members of her sex.

It is for these reasons that seafaring men form quite a distinct class of the community. They possess very different ideas from those of their friends ashore, and become, as their years of service afloat increase in number, more and more individualistic. This pen-picture, however, is not as true nowadays as it was years ago. Within the last twenty years Senatore Marconi has produced his wonderful invention. Gradually and methodically he has set himself the task of improving and amplifying it so that now it has advanced almost to perfection, and has for some years been within the realms of practical politics. There is no further excuse for those at sea to be exiled from their friends and their country. The wonders of wireless telegraphy are brought into play by him who sits in his cabin unceasingly "listening in" to catch the strange sounds and convert them into messages of greeting and goodwill. Quite a small army of men is required in order that the majority of the ships equipped with the wonderful apparatus may sail with two such operators.

Welcoming Father Christmas.

Cutting up the Turkeys.

ancient customs still survive. On land we are getting so prosaic and so eaten up with our everyday affairs that we have not the time for indulgence in the old frivolities of Guy Fawkes Day, the May-Day celebrations, the Morris Dances, the Old English Fairs; all are gradually sinking into oblivion and are being lost in the whirlpool of modern life. But the old traditions of the sea fortunately remain. Although the officers and seamen are so differently placed in their respective

These men are highly trained and very skilled in the particular work in which they are engaged.

The position of wireless operator on board a ship is no sinecure. The work is responsible and at times very heavy, but since the advent of "two men" ships, each telegraphist is able to have an appreciable time off watch. On board the captain possesses supreme authority. He is a law unto himself, and everyone must yield to his dictates and superior knowledge on all occasions. The wireless operators, as members of the crew, must submit to his ruling in all things, but although theoretically the captain is an out-and-out autocrat, yet in actual practice it is found that his instructions are seldom such as to cause friction between his staff and himself. On the contrary, real British friendship generally characterises the relations between the "skipper" and his subordinates, whilst during "off" times, and at festive seasons like Christmas, the captain is not unmindful of the characteristic British chivalry which permeates all ranks.

Christmas in the Navy is kept with all its festivities in the good old British way. The first item of importance is the welcoming of Father Christmas by the commander of the ship, a photograph of which we are enabled to reproduce. In return the former invites the commander and officers down to the mess deck to sample the fare. It is amongst those whose business calls them to sea that

Fatner Neptune and His Hosts.

The Dining Table Bedecked with Photographs.

stations in life, yet a spirit of true British comradeship animates them all, and on this day of days they partake together of the good things provided at the board. Although "Jack" is a man in every sense of the word, yet at heart he is a child. He loves plenty of holly and mistletoe, turkey and plum pudding. On this occasion the inner man is not forgotten, as our illustration will show. On the contrary, extra fare is supplied to every possible ship. In the picture we see the head men of the messes cutting up the turkeys and fowls. After the feast of feasts, which takes place at midday, the whole ship, with the exception of the few officials requisite for the safe conduct of the vessel, gives itself over to hilarity and enjoyment. Now that most ships, including merchantmen, carry two wireless operators, one of these very necessary members of the crew is enabled to attend the jollifications below.

We are all familiar with the exploits of dear old Father Neptune. On this very important day he visits the ship in greater state than usual. The old gentleman's call is generally associated with crossing the line, but he does not confine himself to this occasion only. Most of us are cognisant of the proceedings consequent upon a visit from Father Neptune when crossing the Line. Everybody on board (and the importance of the wireless operators' work does not excuse him from this) who has not before crossed the equator must submit to the ordeal with a good grace.

The writer well remembers his own experience in this connection when first he crossed the equator, and is thankful that such a procedure occurs only once. The unfortunate "victim" is led with much state to the shaving chair, there to await the visit of Father Neptune. On the arrival of the latter, who seats himself immediately in front of the shaving chair, the former is mercilessly lathered with soap and subsequently scraped with a huge wooden razor. The lathering is most uncomfortable, the soap being well rubbed in all over the face, into eyes, ears, nose and mouth, until the poor creature hardly knows where he is. After this performance he is cruelly tipped backwards out of the chair into a large improvised swimming bath, whence he is ignominously pulled out to the accompaniment of the cheers and plaudits of the onlookers. On Christmas Day Father Neptune changes his costume and appears habited as a diver, dispensing with his customary trident. In our picture we see him surrounded by several of his hosts. It will be noticed that that best-known symbol of Christmas, the Christmas tree, finds a place in the festivities.

The sign of the feast of Noel forms a link with the past. The old legends of Russia, Germany and Scandinavia contain many references to the pine tree. The latitude of the northern European countries is well adapted for the growth of this and other conifers. Perchance its abundance caused it to be chosen as the emblem of that festival of peace and goodwill. Its presence at this time is considered so necessary that jollification on board ship would be incomplete without it. All of us from our veriest youth have been accustomed to the enjoyment consequent upon the receipt of small tokens from the Christmas tree at the party. In like manner does "Jack" look forward to his Christmas tree. We repeat that although the sailor is a man yet at heart he is a child. He longs for the joyous season with all its adjuncts of festivity. To the Englishman the fête makes a more direct appeal than probably any other holiday of the year. It is the time of year when all squabbles are settled and all petty differences put aside. Everybody forgets the troubles which once existed, and it forms, for most of us at any rate, the happiest time of the year. To such an extent is class-feeling sunk on board vessels that the whole ship's company from the Commander to the lowliest cabin boy fraternise together and forget temporarily that such a thing as rank exists.

In another illustration we see the manner in which the tables are laid. Whilst enjoying himself afloat the sailor likes to think of those whom he has left at home, and the dining table is consequently bedecked with photographs of his relatives and friends. Above may be seen decorations composed of the British national flag, the Union Jack, whose honour is at the present time being so effectively upheld. We do not realise the trials and difficulties which the brave defenders of our shores are undergoing at the present time; with the approach of cold weather their plight is anything but enviable. Steaming backwards and forwards over the storm-tossed seas, submitting to the icy blasts of the bitter winter winds without murmur and without complaint, such is the lot of those who are now engaged in preventing the despicable Hun from effecting a

A Fancy Dress Ball.

landing on our shores. After the war we shall learn, thrilled with pride, of the work our Navy has done, of which that accomplished by the wireless operator in particular will not form the least interesting or instructive reading. The legend over the table, " A Merry Xmas," characterises the spirit of the proceedings, whilst on the extreme right of the picture may be seen an iced Christmas cake.

Christmas Messages.

On the great liners which plough the mighty ocean, and carrying those whose business or pleasure compels them to travel on Christmas Day, several forms of amusement are provided. Our picture shows a group of passengers garbed for a fancy dress ball. On the extreme right, with flowing white beard, may be seen the ubiquitous Father Christmas. At this time of the year he has a knack of always slipping in. He delights the children by coming in through the porthole (there are no chimneys to cabins), whilst his frolicsome fun makes amusing entertainment for the elders. Although most people welcome the exile at sea on account of the elimination of the morning letter-bag, yet on Christmas Day all are eager to hear from those at home. The ship's postman and the wireless operator are both exceedingly busy men at this time. In our photograph the former is seen handing a letter to the lucky recipient, whilst on the right the latter has just given a wireless message from home to one of the ship's officers, who is perusing it with evident interest. As the day progresses the mirth increases. The younger passengers and members of the crew indulge in romps or games like Blindman's Buff, whilst the more sedate settle down to bridge, whist, and other card games. During the evening toasts are freely exchanged, and the enjoyment is carried on until late in the night; whilst, sad as it is to relate, the blue twilight of dawn is often already stealthily creeping over the sea before the last merrymaker has turned in. However, " Christmas comes but once a year," and we would be the last to begrudge a few hours' pleasure to our compatriots who find themselves upon the high seas at this festive time.

SHARE MARKET REPORT.

LONDON, *November 18th*, 1915.

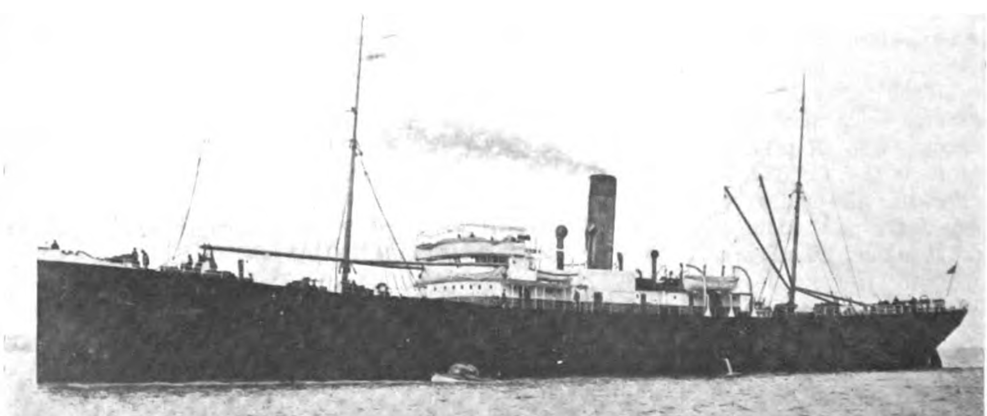
There has been very little business doing in the share market during the past month and prices remain practically unchanged. Marconi (English), Ordinary, £1 17s. 6d.; Preference, £1 13s. 9d.; American, 17s.; Canadian, 5s.: International Marine, £1 5s.; Spanish and General Wireless Trust, 3s. 6d.

MARITIME WIRELESS TELEGRAPHY.

WE have to chronicle this month the employment of wireless telegraphy again to summon help to a vessel in distress. The Norwegian passenger steamer *Iris,* on a voyage from Bergen to the Tyne, lost her propeller early one morning off Peterhead, on the east coast of Scotland. She had twenty-four Norwegian passengers on board, and issued wireless messages for help. In response to these distress calls the steamer *Mira* left Shields in search of her. After experiencing great difficulty in consequence of the terribly foggy weather the *Iris* was located, but it was found that the *Iona,* another of the same company's vessels, had picked the *Iris* up and taken her passengers aboard. The *Iris* herself eventually arrived safely at Shields.

* * *

The *Dacia* is probably the vessel which has been most discussed since the beginning of the war. It will be recollected that she was originally the property of the Hamburg-American Line and was sold to Mr. E. N. Breitung, a German-American, and sent to Germany with a cargo of cotton. During the voyage she was captured by a French warship, towed into Brest, being subsequently condemned by the French prize court. She and her cargo were confiscated, the boat was renamed the *Yser,* and she finally passed into the service of the French. She was recently in the Mediterranean and had responded to a



s/s "Yser" (ex "Dacia").

wireless call for help to the Italian vessel *Eliza Francesca*, which had been torpedoed, when she herself was struck, eventually sinking off Algiers. The passengers and crew reached the shore in safety.

* * *

The application of wireless telegraphy in summoning aid to vessels in distress is becoming so commonplace now that very often one hears nothing of such instances as the following: The steamer *A. W. Perry* left Boston, U.S.A., bound for Halifax. The weather during the first few days of the voyage was exceptionally foggy, when about five o'clock one morning there was a crash and a bump. The ship was on the rocks. In about five minutes' time the captain instructed the operators to send out the S.O.S. signal. The first station to answer was the Camperdown N.S. Naval Station, acknowledgments being also received from the Capital U.S.S. *Miami* and the Canadian Coast Guard Service ship *Premier*. The *Miami* was at such a distance that twenty-four hours would be required for her to steam to the wrecked vessel, but the others sent encouraging replies to the effect that assistance had been sent to her. Once more wireless demonstrated its utility. Tugs duly arrived, but were unable to move the ship. In the meantime, however, the forty-two passengers had been taken off. The vessel listed badly to port, and as the wireless room happened to be on that side the power was quickly cut off. She eventually slipped backwards off the rocks and sank in deep water.

* * *

The November number of the *Wireless Age* contains the following paragraph:

" A wireless call for a surgeon sent out by " a Marconi operator on the steamship *John* " *A. Hooper*, in the Caribbean Sea, brought " medical aid to Miss Annie Christiansen, a " passenger, who, during a severe storm, " fell to the floor of her state room, sustain- " ing a fractured leg. Aid was rendered by " the surgeon on the steamship *Alliancia*, " which, although thirty-five miles away, " responded, and the sufferer was given " attention.

" The doctor, however, recommended " that the patient be sent to the nearest " hospital, which was at Kingston, Jamaica, " where Miss Christiansen was taken. She " is a sister of one of the owners of the " vessel."

* * *

In answer to distress signals the Flamborough lifeboat *Matthew Wood* made a vain search for a vessel sending S.O.S. messages for assistance. The signals came from the direction of Smithwick Sands, and it was presumed that the vessel had grounded there and refloated with the rising tide. A heavy northern gale had fallen considerably and a high sea was still running. It is thought that the vessel was the Wilson liner *Eskimo* with passengers on board. This ship did in effect ground at about the spot whence the signals proceeded, but got off again.

* * *

A singular incident occurred during a voyage to Jamaica of a priest who recently returned from his furlough. This cleric had a recurrence of the complaint from which he suffered previous to his homecoming, but there was no doctor on board to call to his aid. Accordingly a wireless message was sent out over the ocean and succeeded in locating a medical man on another steamer. He was told the particulars of the ailment and a wireless prescription and instructions were sent back, with the result that the patient found relief and steadily improved to the end of the voyage.

* * *

The French liner *Rochambeau*, which left New York recently for Bordeaux, took fire at sea. The captain sent a wireless message to the New York office of the steamer, which carries 171 cabin passengers, 250 steerage passengers and 150 members of the crew. The ship's position was not given, but the officials of the line say that she should be near Halifax. The captain's message reads :—

" Fire in reserve bunkers; spontaneous " combustion. Think there is no danger. " If cannot control, will go into Halifax."

A subsequent wireless message received in New York from the Captain states that the fire was extinguished and that the ship is proceeding to Bordeaux.

* * *

The British steamer *Rio Lages*, which left New York for Queenstown recently, sent a wireless message stating that she was on fire and asked for help. The wireless message actually came from the SS. *Frederick*, saying that in the Western Atlantic in latitude 41.58 north longitude 59.30 west she passed a British steamer with fire in her hold, flying the signals "R.S.W.V.," which correspond with those of the *Rio Lages*. Although no word has been received from the *Rio Lages*, her agents in New York advance the theory that the fire on board was not serious, as apparently she did not ask the steamer *Frederick*, with which she communicated, to stand by, but only to report her to Halifax by wireless, with which the *Rio Lages* is not equipped. The latter vessel carried about 5,000 tons of sugar and is a tramp steamboat of 3,591 tons.

* * *

The crew of the American oil-tank steamer *Llama* were landed at Aberdeen quite recently by the Shetland steamer *St. Rognvald*. The *Llama*, a vessel of 6,000 tons, was wrecked off Noup Head, in the North Isles. She was bound from New York to Copenhagen with a cargo of oil. When the vessel struck assistance was summoned by an S.O.S. wireless call.

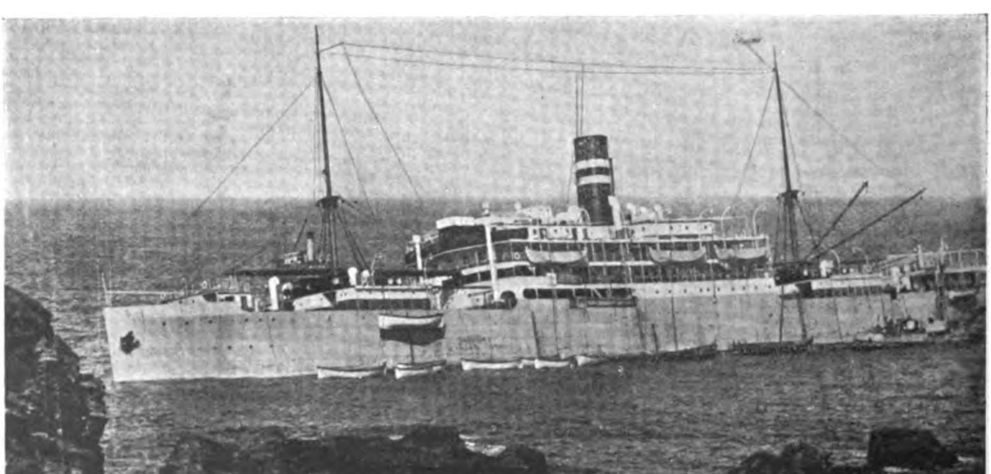
* * *

In our November number, under the heading "Doings of Operators," we gave an account of the loss of the Nelson liner *Highland Warrior*, which was wrecked recently off the coast of Spain. We are now enabled to publish a photograph of the big steamer as she looked after she had run ashore.

The steamship *Mariposa*, of the Alaska Steamship Co., bound from Seattle, Wash., to southern Alaskan ports, grounded at 4.36 a.m., October 6, on the rocky shore off Pointer Island, Llama Passage, about eight miles from the Indian village of Bella Bella, British Columbia. S.O.S. signals were transmitted at 4.40 a.m., and were answered by the steamship *Despatch*, of the Border Line Transportation Co., 30 miles distant, the steamship *Senator* of the Pacific Coast Co., 370 miles distant, and the Canadian land station at Triangle Island, British Columbia, approximately 150 miles distant. The *Despatch* immediately hastened to the scene of the disaster, and after taking off all persons on board the *Mariposa*, remained near by until she could be of no further assistance. The distress call was transmitted on the emergency radio equipment of the vessel, which was installed on the main deck, and which remained above water for six hours, when the vessel slid into deeper water and the apparatus was submerged by the rising tide.

* * *

A message is to hand in London from Malta to the effect that the Spanish steamer *C. Lopez Y. Lopez*, bound from Liverpool to Manilla, in the Philippines, reported by wireless that she had fire aboard, and that she would arrive at Valetta the same day. Nothing further was heard of the fire, and it was therefore presumed that she was able to get it under.



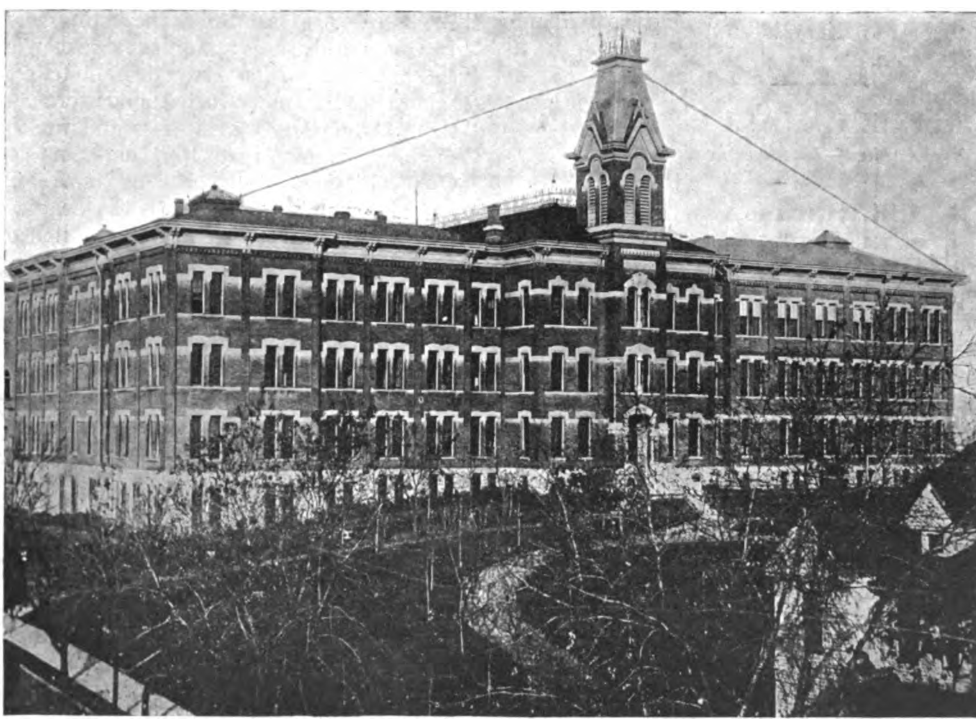
s/s "Highland Warrior" on the Rocks.

Arlington Wireless Time Signals at Creighton University

By FRANK C. PERKINS.

THE accompanying illustration shows the location of the antennae of Creighton University at Omaha, Nebraska, where there has been erected a wireless station for the sole purpose of receiving the Arlington wireless time signals. The chief peculiarity of this station is the extreme simplicity of the antennae, or the outside wiring. This consists of four No. 12 bare copper wires, which unite at the tower over the main entrance on the east front. The north and south wires are each 120 feet long. They are the two seen on the photograph. The other two, not shown on the picture, come from the south-west and north-west, and are each 144 feet long.

It is pointed out that this inequality in the length of the antennae wires may be noted as a second peculiarity of the Creighton station. The four antennae wires are fastened to porcelain knobs at their extremities. They rise about 34 feet to the tower, where they pass through bushings set into the galvanised iron cornice. The single wire, which here unites the four, drops 45 feet inside the tower, runs horizontally through the attic 95 feet, and finally drops 16 feet to the receiving outfit which is grounded to a water pipe close by. It is stated that the antenna wires are so inconspicuous that nobody notices them. They are completely invisible at a distance of 600 feet. The receiving set is an ordinary amateur's outfit. A galena detector is



Antennae at Creighton University, U.S.A.

used. The signals are surprisingly loud. While Arlington is heard almost every night, the whole United States may be said to be audible in the Creighton station, signals coming in from Sayville on Long Island, from the Gulf boats, and from Prince Rupert on the Canadian Pacific Coast. A single one of the four antenna wires sufficed to hear Key West, in Florida.

Arlington is sometimes heard at (Eastern) noon. The wireless station is connected to the astronomical observatory by over 300 feet of wire, 160 feet of which are underground in an iron conduit pipe, 200 being in a lead-covered cable with many extensions of the antenna, and the receiving station transferred to the observatory. Arlington was never heard, although signals came in from the Gulf and Prince Rupert. When the telephone receivers are connected directly, without any battery, to the wires running to the observatory clocks, the clock signals are heard distinctly in the College every even second exactly as if a battery was in series. It is of interest to note the solar clock breaks are dull and short, those of the sidereal clock are loud and sonorous. The break-circuit lever of the first is stiff, that of the other is a steel ribbon tipped with agate.

KLEIDER MACHEN LEUTE.

Anglice—Manners make the man,

THE systematic way in which every class of German is taught by his Government deliberately to disregard every regulation of any neutral country in which he may be located recently found itself exemplified in the case of the Hamburg-American liner *President Lincoln*, interned at Hoboken (U.S.A.). That steamer's wireless was supposed to be out of commission, yet the first intimation of the fact that cholera had broken out on board was picked up, by chance, from a wireless communication sent from the vessel. Considering that this German liner, like so many others, owes her immunity from capture to the protecting ægis of the United States, one would imagine that the regulations of the American Government would be respected by them. Nothing of the sort! Your modern German is deaf to everything—honour and conscience, as well as all the other laws of morality.

WIRELESS FAIRY STORIES IN THE FAR EAST.

Seasonable Comments by an Operator.

AT the time of Christmas our attention is turned in the direction of fairy stories, narratives of ghostly happenings, tales of marvellous adventure and the like. Such matters are amusing and interesting in their proper place, but the following account sent from India by a wireless operator located there will indicate that Christmas tales and fairy stories often produce an extremely annoying effect upon the white man in that sun-kissed land of dusky children of adult age.

After describing the Indian coolie, his characteristics, and the way in which his idiosyncrasies are played upon by agencies seeking to enlist him for emigration, Mr. F. T. Ebbetts goes on to speak of the matter which lies closest to his own heart:

"Wireless is a thing completely beyond the understanding of the ordinary coolie, the only name they have for the wireless room is the motor-car house, anything mechanical being to them a motor-car, whilst the operator is the Howa Taka Sahibque, the Sahib of the Wind-wire. In the cool of the evening they gather on the hatches and have a collection to pay some gifted member to tell long stories to them about fairies, princesses and wicked dragons, or else read to them from an Oriental Hans Anderson long tales and legends, such as are dear to the heart of Western childhood, all in a high-pitched, piercing sing-song. Very harmless no doubt, but scarcely adding to the comfort of an operator receiving weak signals, whose cabin happens to be close at hand, especially when the audience overcome by the enormities of the villain, hurl imprecations on his head at the top of their lung power. After a few days' peaceful voyaging through waters which are, according to Kipling, 'so soft, so deep, so blooming blue,' they arrive at the land of their sojourn, to return in a year or two's time with a little hoard of rupees, and much personal luggage consisting as far as one can see of pieces of teak wood, used petrol tins, and umbrellas, to take over once more the cultivation of their strip of land from that blessing of the East, a wife who works."

The Special Problems of Aircraft Wireless—I.

By H. M. DOWSETT.

It is the writer's impression that a short and not too advanced discussion of the Problems of Aircraft Wireless would prove welcome to many of the gallant men of the R.N.A.S. and R.F.C. engaged on wireless duty. Hence these articles.

AIRCRAFT were first associated with wireless telegraphy as part of their necessary equipment. They were used for supporting the aerials of temporary or portable installations. Thus Commendatore Marconi in 1896–97 used kites on Salisbury Plain, and the British Army in 1899–1900 used kites and captive balloons in South Africa for this purpose.

A kite (Fig. 1) can be flown in a wind; it sinks in a calm. A captive balloon lifts well in a calm, but in a wind it drags at an angle on its moorings, so that the aerial it supports loses much in height (Fig. 2).

As the kite and balloon are thus complementary in behaviour, the kite-balloon (Fig. 3) invented by Parseval in 1896, and now in military use by most of the Governments of Europe, provides a means of support of remarkable steadiness in both calm and strong wind.

When aircraft are used simply as an adjunct of wireless, they introduce no special problems other than those connected with (1) their lifting power, (2) the limitation of the aerial for obvious reasons to a single wire, and (3) the strong atmospheric effects which may follow when the full height made available by the aircraft is utilised.

A short discussion on "lifting power," accompanied by a few examples illustrating the working conditions met with, may prove of interest.

The tailless Baden-Powell kites used in South Africa rose with hardly any wind, but the weights such kites would carry, of course, was strictly dependent on the wind velocity. The wind velocity increases rapidly and becomes less fluctuating as the height above the ground increases, but it is strongly influenced by local conditions.

Thus the air in December and January, 1899–1900, over the plains of the Northern Karoo in Cape Colony, influenced possibly by the scattered, steep, flat-topped hills or kopjes, appeared from the behaviour of the kites to be full of air-pockets.

But reliable statistics as to atmospheric

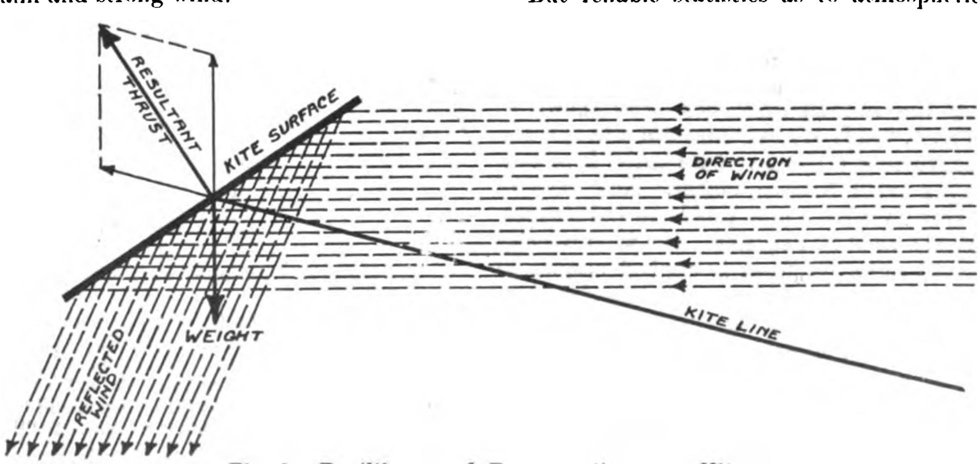


Fig. 1.—Equilibrium of Forces acting on a Kite.

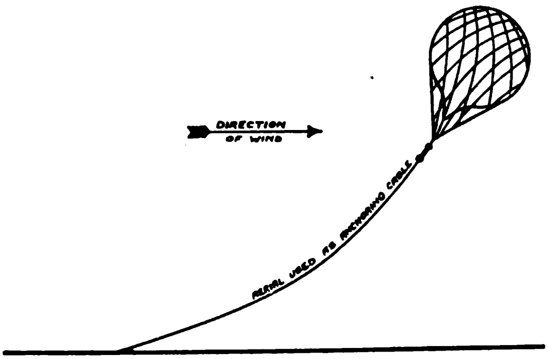


Fig. 2.—Action of Captive Balloon in a Wind.

conditions can only be obtained at present for some places in Europe. For many years the French military authorities have taken daily measurements of wind velocity at Chalais-Meudon, near Paris, and from the results obtained the probabilities of occurrence during the year of winds of various velocities have been calculated, and tabulated for aeronautical use. A few of these values are given below, the first column being in miles per hour instead of kilometres as in the original :—

Speed of wind in miles per hour.	Possibilities in parts of a thousand that the wind velocity will be less than that given in Column 1.	Number of days in year when there is possibility of wind velocity being less than that given in Column 1.
5	100	36
11	323	117
17	543	197
22	708	258
33	886	323
45	963	350
67	995	363
84	999	364
90	1000	365

In the neighbourhood of Paris, then, the average wind works out at about 15 miles per hour.

Suppose this is the wind velocity acting on the two Baden-Powell kites shewn in Fig. 4, which are flying on one kite line and supporting a short vertical aerial kept taut by a small balance weight. Now each of these kites has a 6-ft. backbone and a superficial area of 23·4 sq. feet. If a wind velocity of 15 miles per hour is applied normal to this surface, it is easy to calculate that each kite would offer a resistance to the air—which is the measure of its lifting power—of 27 lb.* But as the kite surface is inclined to the wind its resistance is less, and instead of 27 lb. the actual working value is more likely to be about 12 lb.

Then the two kites, which together have a lifting power of 24 lb., have to support their own weight, the weight of the kite line, the small blocks and aerial counter weight, in addition to the aerial. As the counterweight has roughly about the same weight as the aerial, the two kites would lift under the above conditions about 10 lb. of aerial wire, and if London Electric 7/20 class K cable were used, this would mean a length of about 150 ft. No allowance, however, is made in the above estimate for windage on kite line and aerial, which must also be added to obtain the total effective weight carried by the kites.

Suppose the wind should freshen, say, to 21 miles per hour, the lifting power of the two kites would increase from 24 lb. to about 48 lb., and one can understand that as the resistance offered by the kite increases as the square of the wind velocity, with still further increase the safe limit of working

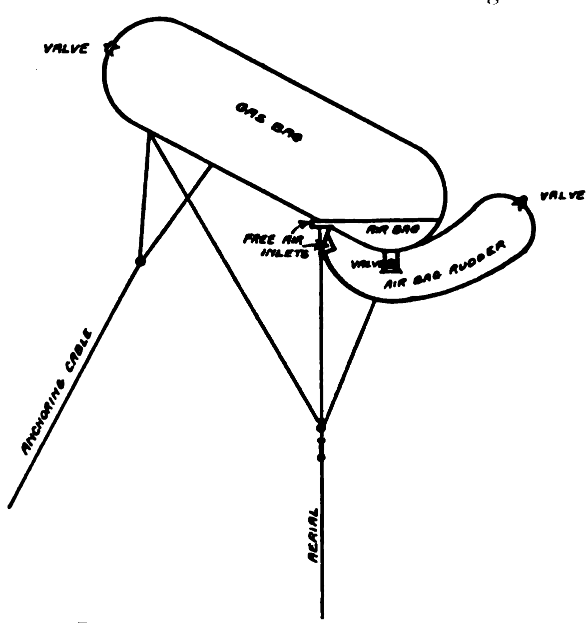


Fig. 3.—The Parseval Kite Balloon.

(In a strong wind the balloon turns its nose to windward, and air passes through the inlets into the air bag and rudder. The balloon rises, the gas in it expands and presses on the air bag forcing the air through the valve into the rudder, and thence through the rudder release valve out into the surrounding air. If the gas pressure becomes too great the gas-bag valve also acts.)

* From formula—Resistance in kilogrammes = ·125 × Surface in sq. metres × Square of Velocity in metres per sec.

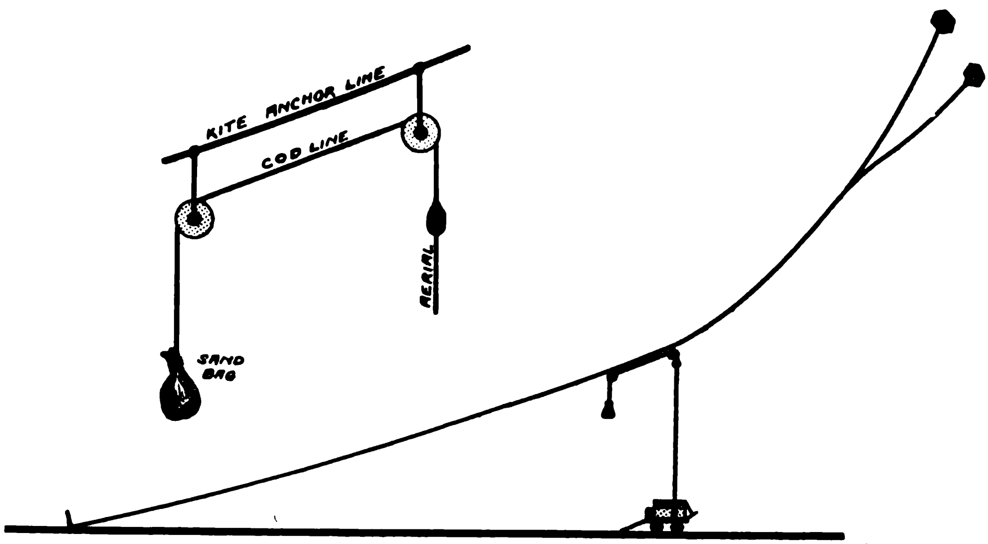


Fig. 4.—Tailless Baden-Powell Kites supporting Aerial as used in South Africa, 1899-1900.

strain for the kite fabric, frame, and cord is soon reached, and unless the kites are lowered something must give way.

The wind is always fluctuating. In South Africa atmospheric conditions are much less steady than in Europe. To correct for this, the kites were frequently flown in tandem (Fig. 5).

The falling of kite A as the wind drops creates a slight wind for kite B, which tends to check their common descent; also any side wobble of kite A is appreciably checked by the resistance of the air to the thrust which results from kite B. The multiple wind surfaces of the Hargrave kite (Fig. 6) act in very much the same way.

Because of wind fluctuations, the method of attaching the aerial shewn in Fig. 4 is not often followed. Instead, the aerial is used as the kite line, so that the weight lifted is that due to the aerial and kite alone. Under such conditions the difficulty of insulating the bottom of the aerial makes it less suitable for transmitting purposes.

Consider now the case of an aerial supported by a balloon. A pilot balloon is quite large enough for the purpose. The type used in South Africa had an envelope of goldbeaters' skin, a diameter of 10 ft., and when completely filled with hydrogen a lifting power of about 39 lb. The weight lifted included the balloon, its net, and the aerial, which was also used as the anchoring cable.

But the effect of the sun had to be allowed for, and on the South African veldt in midsummer the sun's heat is intense. The balloon, therefore, was never filled to its full capacity, and its lifting power was probably not more than 20 lb.

On one occasion the career of the balloon at Enslin, 15 miles south of the Modder River, was abruptly ended by a dust spout, or "sand devil," which travelled across the veldt in an otherwise still atmosphere, made straight for the captive balloon and snapped its anchoring cable of steel-armoured telegraph wire which was used as an aerial with such small apparent effort, that the operator in the instrument cart first looked for a fault in his instruments before realising that his aerial support had carried away. The balloon rose quickly, expanding as it rose, and finally burst at a height of 2,000 ft. with the noise of a gun report, and fell two miles outside the camp.

A full-size captive balloon, say, of 20,000 cubic feet capacity, such as is used for observation work, lifting when filled with coal gas some 800 lb.—which includes its own weight—or with hydrogen some 1,600 lb., or a kite-balloon having a similar ascensional effort, offers of course no difficulty as regards aerial support.

A small steel wire cable would be used for anchoring, and a separate aerial—which would be carried well clear of the steel cable after being fixed by a suitable insulator to the car.

When the relationship of wireless telegraphy to aircraft is the reverse of that dealt with above, and instead of aircraft serving wireless, the wireless apparatus becomes the servant of aircraft on free balloon, airship, or aeroplane, it has to work under special conditions not met with on land or sea, and many new problems have to be faced.

There is first of all the consideration of weight and bulk of equipment.

Weight and Bulk of Apparatus.—A free balloon has very little space to spare in the car. Its equipment must, therefore, be of the simplest character. Frequently it has been limited to a receiver only, fixed to the outside edge of the car (Fig. 7), the arguments against the use of a transmitter being the weight of generator, and accumulator or dry cell battery—which accounts for the weight of the greater part of the transmitter —together with the space it would occupy inside the car, and the aeronaut's uncertainty as to the risks he might run from fire.

Weight and bulk are of less account on an airship, but a natural limit is set to the size of the transmitter by the capacity of the aerial system—which is controlled by the size of the fixed balancing capacity—the safe voltage, and the spark frequency. This limit is about ·5 k.w. aerial power for the largest Zeppelin known to have been built, the L1, 525 ft. in length and 50 ft. in diameter—which was destroyed by gale—or the large French "Speiss" airship, 460 ft. in length, 47 ft. in diameter, both types having a rigid metal frame inside the outer envelope, which is very suitable for a balancing capacity, provided the potential on it is kept very low.

Conditions as regards weight and space occupied by apparatus are not so difficult on an aeroplane. Certainly the set must be as simple and compact as possible, and it should be exceptionally robust; but the aeroplane engine can be used if necessary as a source of power in place of a battery, and the use of a transmitter carries with it no risk of fire.

Aircraft Transmitters.—The choice of a suitable aircraft generator is influenced by the following considerations:

The capacity of the aerial system of a free balloon and of an aeroplane is always small; of an airship it is larger, but it can never exceed that of an average ship aerial.

Then if the aerial system is to radiate appreciable power, it must either be raised to a high potential or its charge frequency must have a high value.

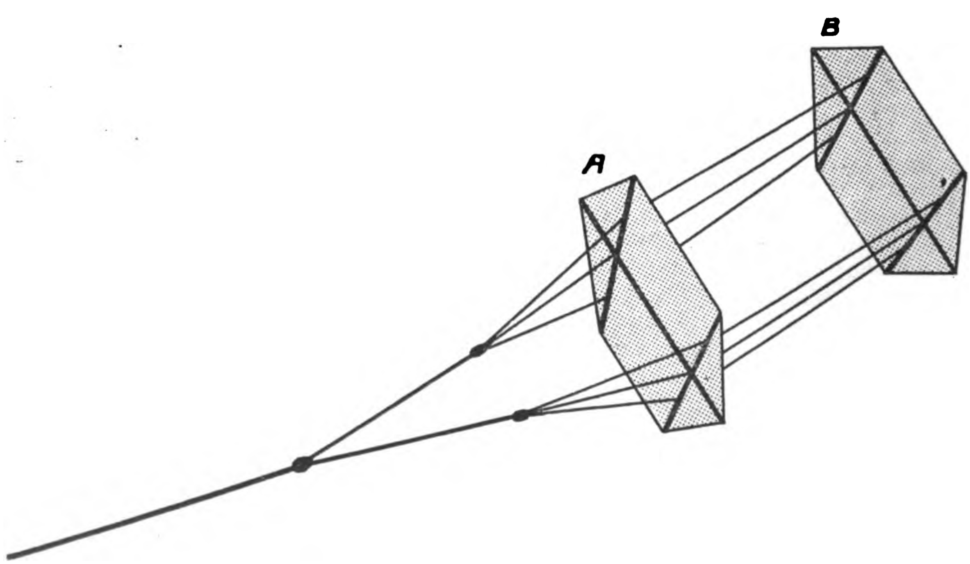


Fig. 5.—Kites flown in tandem for increased stability.

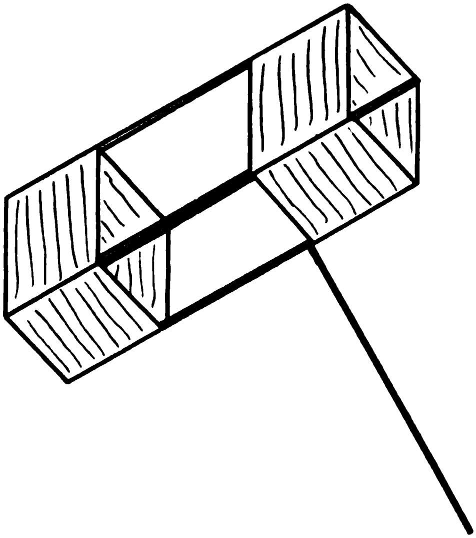


Fig. 6.—Hargrave Kite.

But in the case of balloons and airships there is a strict limit of potential which must not be exceeded if brushing on the balancing capacity—which might result in a gas explosion—is to be avoided.

Then, for the same amount of power delivered to the aerial, the different transmitting arrangements which could be used may be arranged as below in the order of the minimum voltage they would impress on the aerial—viz.:

1. Continuous wave excitation.
2. Close coupled, high note quenched spark.
3. Loose coupled, high note disc spark.
4. Loose coupled, high note plain spark.
5. High note, plain aerial spark.

In default of a robust, compact, continuous wave transmitter, a high note quenched spark, or high note disc spark transmitter comes next in order of suitability; but both types have a certain limitation in application owing to the weight of the generator. Below a certain critical weight energy is best supplied to the coupled transmitting circuits by means of a sparking coil with high speed interrupter.

The following examples illustrate the power-transmitting possibilities of aircraft. Suppose the envelope of a free balloon of 40,000 cubic feet contents were to be completely covered with metal foil, its electrostatic capacity in free space would be that of its radius in centimetres—namely, 647 cms, The practical limit of frequency for high note spark transmission is about 1,000 sparks per second, such as is obtainable from a 500 cycle generator.

Then, if the maximum potential on this metal-covered balloon above surrounding space were limited for reasons of safety to 5,000 volts, the P.D. between the balloon and its hanging aerial would be 10,000 volts, and the power it would deal with would be 114 watts. Again, suppose the Zeppelin L1 mentioned above, instead of having had a metal skeleton framework, were to have had its whole volume enclosed in sheet metal,

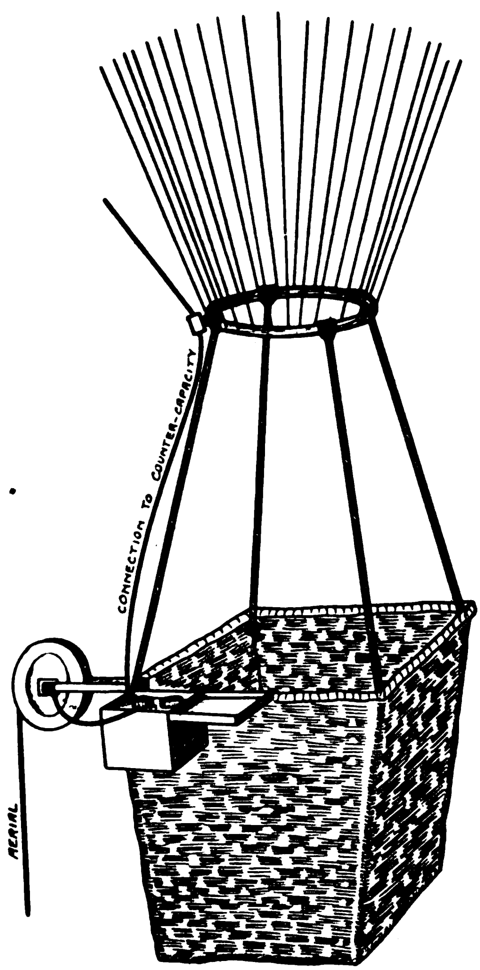
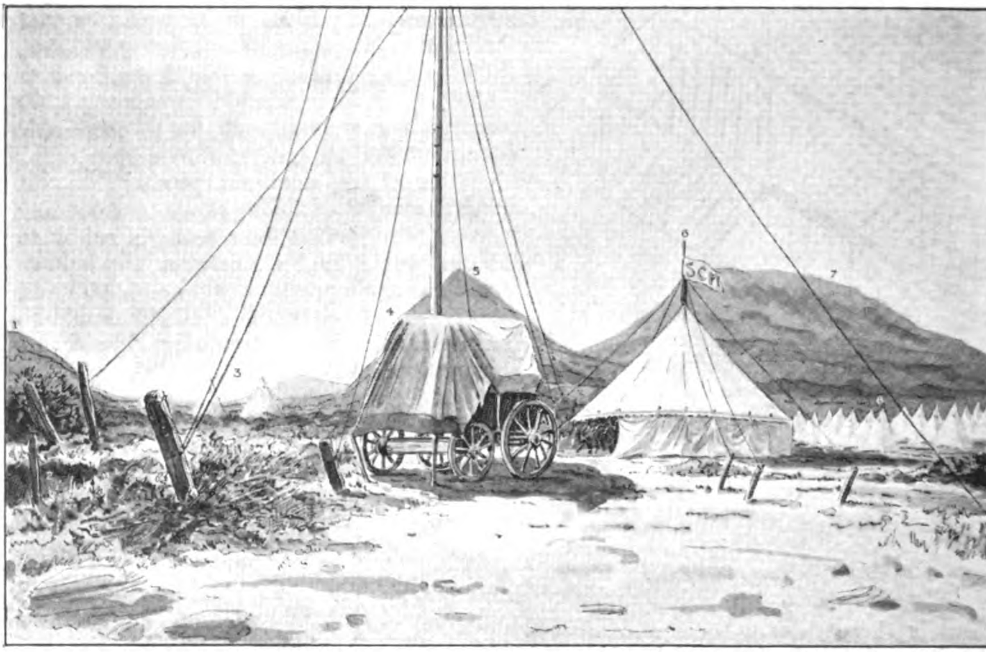


Fig. 7.—Wireless Receiver on Balloon Car.



1, Camp Kopje. 2, Pit for Wireless Balloon. 3, Wireless Camp. 4, Wireless Wagon and Mast. 5, Sharp Kopje. 6, Soldiers' and Christian Association Tent. 7, Big Kopje.

MILITARY CAMP AT ENSLIN, MODDER RIVER, CAPE COLONY (1899—1902).

then its capacity in free space calculated as that of an ellipsoid of revolution would have been 2,620 cms.

If this metal shell had been charged by a 500 cycle generator to the assumed safe maximum potential of 5,000 volts above surrounding space, 10,000 volts P.D. with its aerial, then its power consumption would have been 462 watts. The maximum power which could be utilised by an aeroplane aerial system naturally falls between the two values given above.

These two values of 114 watts and 462 watts may well be on the high side, for in practice not only is there much less metallic surface available for use as balancing capacity than the surfaces dealt with, but the arbitrary value assumed of 5,000 volts maximum potential would under certain circumstances prove dangerously high.

(To be continued.)

CHRISTMAS, 1915.

"PEACE and good will, good will and peace."
As if that message to deny
The shoutings of the hosts increase,
The thunders of the guns reply.

How shall we give that message breath ?
How speak the words—while man with man
Roll in the fiercest strife of death
That has been since the world began !

Is this the harvest we have sown ?
Is this the fruit that knowledge yields ?
The widow's tears, the orphan's moan,
The carnage of a hundred fields !

O faith, that moves the rugged hills,
Be with us, that we yet may dare
To battle with the doubt that kills,
To keep our hope against despair.

To see beyond the battle's cloud
The brightness of a coming dawn,
To hear above the tempest loud
The promise breathed on Christmas morn,

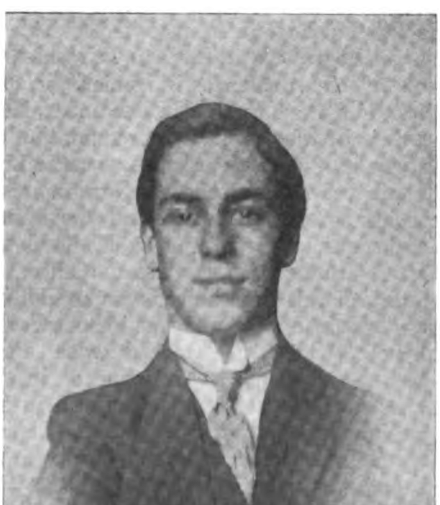
T. IDDON.

Doings of Operators

IN the September issue we wrote in this column of the loss of the s.s. *Jacona* and made reference to a poem by Mr. D. R. P. Coats, entitled "The Merchant Service Man," to which our thoughts turned when learning of the disaster. A correspondent has drawn our attention to the curious coincidence that Mr. Coats himself was at one time on this vessel. It will be remembered that an account of some of Mr. Coats's experiences was given in the July number.

* * *

It is with deep regret that we have to record the death from typhoid of Warrant Telegraphist J. C. Farmery, of the Wireless Station at Demerara. Mr. Farmery, whose home was at Upton Manor, joined the Marconi Company in December, 1912, serving on a number of ships, including the ss. *Remuera*, *Corinthic* and *Macedonia*. In March of this year Mr. Farmery was appointed for Admiralty duty, and as mentioned above, at the time of his death was attached to the Wireless Station at Demerara. The following account, reprinted from the *Daily Argosy* of Demerara for October 19th, will perhaps be of interest to the late gentleman's confrères in the Wireless Service :—



Operator J. C. Farmery.

"We regret to announce the death "at the hospital on Sunday morning of "Warrant Officer J. C. Farmery, of the "Wireless Station, at the early age of 21 "years.

"Mr. Farmery, who was the son of Mr. "and Mrs. Farmery, of London, entered "the mercantile marine as a Marconi "operator, and on the outbreak of war "joined the Naval Service, being stationed "on the auxiliary cruiser *Macedonia*, in the "Southern Pacific, from which he was "transferred to this colony, arriving in "May. He became ill exactly four weeks "ago, and on being taken to hospital his "case was diagnosed as typhoid fever, to "which he succumbed despite the best "attention.

"Mr. Farmery was an enthusiastic mem-"ber of the Georgetown Football Club, and "became such immediately after his arrival "in the colony. He was one of the club's "most keen players, and at once secured a "place in the senior eleven. He played in "the Macdonald Charity and Eye-Witness "competitions and received badges for both. "A favourite with all the members who "knew him, there was sincere regret on all "sides when it was known he was so ill, and "this was intensified when it was known that "he had passed away. As a mark of "respect the club's flags were flown at half-"mast at the ground, and at 39, Main Street "(the club's headquarters). Several wreaths "were received, among them one from the "members of the club.

"THE FUNERAL.

"The funeral, which took place from the "hospital, was well attended, and there "were full military honours, the Rev. R. L. "Macnie, B.D., officiating. Among those "present were Messrs. A. Russell, R. A. "Hoban, J. Nisbet, H. S. Barnes, A. E. "Chapple, W. Millar, F. H. George, W. H. "Badley, A. Gilbert, J. Dennis, J. W. "Gemmel, J. Slater, and J. Dennis, Lieut.

"Smith, Warrant Officers Smith and King, "and first-class stokers Hems and Davis, "from the station.

"Just after 4 o'clock two companies of "militiamen, headed by the band under "Sergt. Bennernagel, and commanded by "Captains Walton and Cleare, Lieutenants "Mullin and Matthey, and Lieut. Laing, the "last-named representing the Artillery "Militia, with Captain King, Staff Officer, "in supreme command, arrived and formed "up in the yard.

"The coffin was then brought out and "placed on a 9-pounder gun-carriage, "drawn by a couple of greys, with Corpl. "McWatt handling the ribbons and Bdr. "July beside him. It was then draped with "a Union Jack, Mr. Farmery's helmet and "sword being placed on top. A firing party "with arms reversed then advanced at "slow march, after which came the other "men, unarmed, the band following, then "the procession. On the way Chopin's "'Funeral March' and the 'Dead March in "*Saul*' were played, and to the cemetery at "Le Repentir, where the interment was "made. The service concluded, three "volleys were fired over the grave, after "which the 'Last Post' was sounded by a "party of buglers."

* * *

We are informed that Operator William Neuville Freeman has been landed at Greenwich Hospital from his ship, owing to illness.

Operator W. N. Freeman.

Petty Officer C. S. Gordon.

Mr. Freeman joined the Marconi Company in January of this year. We trust that his recovery will be speedy, and that he may soon be at his duties again.

* * *

Among the telegraphists who went out to the Gallipoli Peninsula with Petty Officer L. T. N. Sanderson was Petty Officer Charles Stanley Gordon. Mr. Gordon joined the Marconi Company in August, 1911, having previously occupied a post as telegraphist in the Central Telegraph Office, London. After a few trips on the *Oceanic* Mr. Gordon was appointed Officer in Charge of the installation on board the ill-fated *Delhi*, which, as some of our readers will remember, was wrecked off Cape Spartel in December, 1911. The date of the wreck, we may mention for the benefit of the superstitious, was the 13th. For two years after this Mr. Gordon served on coast stations in Spain and the Canary Islands, and on returning to England was allotted duties in the Head Office. In January of this year he took up special war duty, and in due course was despatched to Gallipoli, where he worked with Petty Officer Sanderson, as mentioned in the interesting account recently printed in this magazine (p. 444 of the October issue). Petty Officer Gordon is twenty-five years of age, and was born in Cork. We trust that he will come safely through all the adventures which he is experiencing.

Among the victims of Germany's piracy must be counted the good ship *Den of Crombie*, recently sunk in the Mediterranean. Mr. Percival Denison, the Operator in Charge, was fortunately saved, and by the time this appears in print will have arrived back in England. Mr. Dension joined the Marconi Company two and a half years ago, having previously shown great interest in radio-telegraphy. A keen amateur, he erected his own wireless installation and those of several of his friends, and on occasions lectured locally on wireless telegraphy. Mr. Denison's first voyage as a professional wireless telegraphist was made on board the ss. *Trent*, and later he served on the ss. *Minnewaska*, *Menominee* and *Den of Crombie*.

Operator Percival Denison.

On this last ship, prior to the wreck, he had made a very lengthy voyage, visiting points as far apart as India, Italy and New York. We sincerely trust that he is none the worse for his latest adventure.

* * *

Our readers will have already seen notice in the newspapers of the sinking of the transport *Marquette*. The *Marquette* carried two wireless operators, Harry Whyte Taylor and Arthur Henry Dews. Mr. Taylor was saved, but unfortunately Mr. Dews is reported missing, and little hope is entertained of his being found. Our deepest sympathy is offered to Mr. Dews' parents in their terrible time of trial. Mr. Dews,

Operator H. W. Taylor.

who was born at Yarmouth, joined the Marconi Company as recently as July, 1915, and the *Marquette* was the first ship to which he was appointed.

Mr. Taylor joined the Marconi staff in June, 1913, having previously been employed as a telegraphist on the Great Western Railway. He has served on the ss. *Drina*, *San Lorenzo*, *Remuera*, *Moldavia* and *Marquette*, and is twenty-four years of age.

* * *

Mr. George Daniel Anderson, an operator on one of His Majesty's transports,

Operator A. H. Dews.

Operator G. D. Anderson.

has been presented with the following letter:

"Before leaving for Basra to rejoin "Headquarters I should like to place on "record my appreciation of the excellent "work done by Mr. G. Anderson, of the "Marconi International Marine Communi-"cation Company, on the hired transport "which conveyed troops from Bombay to "the Shatt-el-Arab during the operations "in Mesopotamia, which commenced in "November, 1914. The ship was also used "to convey the disembarkation staff, and all "messages for this staff were sent to her. "Mr. Anderson was kept busy day and "night, and worked without a murmur or a "grumble. We of the embarkation staff "are deeply grateful to him for the impor-"tant part played by him during the disem-"barkation, and we realise that but for "him the work could not have been got "through. I have had much pleasure in "bringing his good work to the notice of 'the General Officer.

"(Sd.) A. R. B. SHUTTLEWORTH,
"Major, D.A.Q.M.G., 6th Division.
"Shatt-el-Arab.
"Dec. 1st, 1914."

We are sure all Mr. Anderson's fellow-operators will be proud of their confrère, and on their behalf we offer him hearty congratulations. Mr. Anderson joined the operating staff of the Marconi Company in 1913, and has since served on a number of vessels, mostly on the Indian coast. In August of this year, and after carrying out the work to which reference is made in the above letter, Mr. Anderson was taken ill and entered the hospital at Bombay. We are very pleased to learn that he has now been discharged, and is again fit for duty.

OUR PRESENTATION PORTRAIT-PLATE.

A fine Picture of Senatore Marconi.

In response to numerous requests from readers in all parts of the world, we have pleasure in presenting to the purchasers of the Christmas Double Number a specially prepared and beautifully reproduced photogravure plate of Senatore Marconi in the uniform of a lieutenant in the Aviation Corps of the Italian Army. The devotees to the particular branch of science invented by Senatore Marconi have long desired a really good portrait with which to decorate the walls of their sanctum; many for want of a better have cut out from the illustrated newspapers more or less faithful reproductions of the famous scientist. Based as they often have been on casual snapshots taken in the streets, these pictures have rarely had any artistic value, and more rarely still have they adequately represented the clever inventor. Our photogravure, on the other hand, is on delicate sepia-toned paper, mounted artistically by the corners on a backing of brown art paper, the portrait being the most recent of the famous Italian. This plate has been produced at great expense, and after the Christmas Number has been sold out, which will be early in the month, further copies will be obtainable from the publishers at the price of sixpence each, post free. The supply of these will be limited, so we suggest that readers who require further copies for presentation should order them early.

By P. W. HARRIS.

THE penny 'bus which set me down outside Professor Gapp's mansion was not a vehicle for comfortable travelling on a cold and snowy evening, and as my folding opera-hat suddenly collapsed with the weight of snow which had accumulated on its crown, I thanked my stars that I had at last arrived. From the windows of the house, or, rather, through the cracks of the Zeppelin blinds, there came a warm glow of light which spoke of comfort within, of pleasant company and Christmas fare. The door swung open and I entered.

Now everything would have gone quite satisfactorily if it had not been for my opera-hat and the mechanism within it, and even at the present moment I fail to understand what caused the annoyance on the part of the footman. It was no fault of mine that as I handed him the confounded headgear the spring should revive and shoot a handful of dirty snow in his face. It was nothing to what our men have to go through in the trenches, and I told him so. The sounds of altercation brought the Professor to my side. "Ah!" said the great scientist, shaking me warmly by the hand, "Mr. Botkins, of THE WIRELESS WORLD! Welcome to our little party!"

The blaze of light and glitter of the great room to which I was conducted at first took my breath away. Then I began to observe the individuals in the historic gathering to which I had been invited. Famous scientists with foreheads so high that they seemed to need scaffolding to support the immense weight of experience contained therein, world-renowned authoresses whose mental attainments were as dazzling as the Parisian creations they wore, representatives of the Church endeavouring to maintain an expression of pious detachment from such worldly temptations—in fact, a gathering of intellectuals so appalling in its impressiveness that my own importance in the world of science seemed, for the moment, to be overshadowed.

Pausing before a tall, ascetic individual, attired in the robes of a foreign priest and bearing in his face indications of birth in a southern clime, the Professor presented me to him.

"Monsignor Nonsonulla, allow me to in-introduce to you Mr. Botkins, of THE WIRELESS WORLD. Mr. Botkins—Monsignor Nonsonulla. Monsignor Nonsonulla," explained the Professor, turning to me, "is the famous bi-weekly inventor of pocket wireless, of which you have probably read frequent notices in the lay press." The famous man graciously condescended to acknowledge my homage, which I expressed with the deepest reverence. Of his fame I was well aware, for who has not read the paragraphs in the daily press after this style :—

"From our Correspondent in Madrid." (Or Barcelona, or Seville, as the case may be.) "Considerable interest has been aroused in "the invention by an Spanish priest of a "pocket wireless apparatus. Although only

"No fault of mine . . . the confounded headgear should shoot a handful of dirty snow."

"one-eighth of an inch long by three-sixteenths "of an inch wide, the instrument is marvel-"lously sensitive, the inventor having al-"ready received messages from Honolulu, "Glace Bay, and Cleethorpes, to say nothing "of all the Italian stations."

The reverend gentleman explained to me that he had contracts with most of the news agencies to invent the apparatus at intervals of not more than three weeks, and with the proceeds of the press notices (at a penny a line) he had been able to found a hospital in his native village. On my asking him whether the invention had yet reached a practical stage, he replied that unfortunately he was severely handicapped in this respect, as almost as soon as he had invented it properly he was due to invent it again. "The public, you know," remarked the priest, "are really so impatient!"

A little later I had the good fortune to be introduced to Miss Letta Doerwurst, the first lady wireless operator. Miss Doerwurst, who, by the way, is most prepossessing, allowed me five minutes' conversation to speak of the travels which she had perforce to make in order to be discovered in different parts of the world. As Fräulein Schneidersnitsch she was due to appear in Hamburg at the outbreak of hostilities, but luckily missed the boat and remained in America for some months, where, under the name of Masie Popcorn, she had posed (with one hand on the spark-gap and the other on the aerial) for many interesting photographs.

Passing hither and thither among the very highest of the high in the intellectual world, I was enabled to converse briefly with many whom, but for the Professor, I should never have had the opportunity of meeting. Monsieur Tonnerre, the Academician who had discovered that wireless waves, colliding in mid-Atlantic, had caused the explosion on board the ill-fated *Voltfaco*; M. Ilaff Samashu, the famous Polish explorer, who, whilst travelling in China, had obtained irrefutable evidence that Confucius invented the coherer; Madame Iva Kold, the great singer, whose top note has only been equalled by a quenched gap on overload; and many another whose interest in wireless is as practical as it is intellectual.

Suddenly all conversation was hushed owing to the booming note from a loud buzzer concealed in an electrolier. Slowly, and after some preliminary "V's" the announcement of Dinner rolled forth in Morse signals of perfect formation; and then, with but a brief pause, each gentleman received the name of the lady whom he was to lead to the table. By good fortune I had to take the arm of Miss Molly Denite, a first cousin, by the way, of the Official Receiver.

The dining hall of Professor Gapp's mansion had been constructed in perfect imitation of a baronial hall of the Cromwellian period. The Gapp family is a very old one, extending back to the time of the Conqueror, when the first Baron Arress de Gapp gained his title and much land as a reward for repairing the aerial on the Royal transport which brought the Norman Conqueror to our shores. Around the dark oak walls of the hall were ranged many trophies and flags, whilst directly above the Professor's seat were displayed the Gapp arms (argent, three X's gules, in a field magnetic, a strop insulator sinister).

Of the dinner itself I could write much if space permitted. (Space *does* permit. It's no good trying to get out of it that way.—ED.) The long table with its dazzling white cloth was covered with the daintiest wireless decorations that could be imagined. As a centrepiece was placed a silver discharger, rotating at full speed and illuminating the table from the brilliance of its spark. To deaden the sound the whole instrument was enclosed in a crystal case, which enabled everything to be seen and yet muffled the roar down to a pleasant hum.

As soon as we were all seated the Professor rose and addressed the gathering in these words :—

" My dear friends, although speech-making is usually a feature of the latter end of a meal rather than the commencement, I think it necessary to explain before we begin that the whole of the dinner will be served—as it has been cooked—by wireless. In years to come you will perhaps remember our little festivity as the first occasion on which a dinner was organised and completely managed by the aid of radiotelegraphy. First, then, my new invention, the radio-culineriometer, has been installed in the kitchens of the famous Splitz Hotel, whose chef, as you may know, is by repute a true past-master of his art. This invention enables any dish or dishes placed in it to be immediately transported here by electric waves and received in the radio-grubdispersulator which is arranged beneath the table. From this instrument the food will be brought to each guest through a small trap-door in the table. I myself have before me the controlling-keys by which the timing of the courses can be arranged. We will now commence. Potage ! "

As he announced the first course the venerable scientist pressed a key and immediately there arose a roaring sound accompanied by a slight smell of ozone. Then before each guest appeared a plate of steaming soup accompanied by a hot roll. Everyone was delighted, save a somewhat ill-mannered foreign guest, who, having his elbow on the table where his soup was due to appear, received a full charge of mulligatawny in the arm. For the next few minutes the clanking of spoons and the gurgling of soup echoed through the hall and jangled the armour.

" Poisson ! " commanded the Professor.

Again the roaring noise commenced. With an air of experienced expectancy the rows of guests watched the table before them. Then just as suddenly as before the plates appeared with—— But what was this ? Everybody regards the plates with consternation and three ladies faint ! Horror ! Every fish has two legs and a beak ! !

" A thousand apologies ! " cried the Professor. " Be calm, I beseech you ! I accidentally pressed both the fish and game buttons together. The matter can soon

" Scientists with foreheads so high as to need scaffolding."

rectified. REVERSE ! ! " Immediately the plates disappeared and were replaced by others bearing delicate fillets of sole.

In a few moments the slight disturbance had subsided and the unconscious ladies were restored by squirting soda-water down their backs, placing vanilla ices on their bare shoulders, and other homely remedies. Thenceforward course after course appeared with admirable precision, all served in perfect style and each a masterpiece of culinary art. I shall never forget the wondrous scene and the impression made upon me by hearing the champ, champ of the jaws of so many leading lights in the literary and scientific world as they devoured the courses before them.

After the ladies had withdrawn and coffee and liqueurs had appeared, Professor Gapp explained in detail to a fascinated gathering the intricacies of the apparatus which had served us so well. I am afraid the technical details are too complicated to be described here. (Another excuse.—ED.) I must not, however, fail to mention the ingenuity of the great scientist in devising an instrument which caused soup and other liquids to be conveyed in the *trough* of the waves, so as to avoid spilling.

In the drawing-room, where we joined the ladies, arrangements had been made for a delightful musical evening. Seated at the wireless piano Miss Doerwurst was charming the assembled company with a delicious little southern air entitled " I'd send you heaps of love, dear, but the Captain's cut the juice off ! " in which, with touching melancholy, she described the pangs of a darkie operator who wished to violate the Berne Convention by sending " Notes " to his dusky queen. As soon as the applause had subsided Monsieur Ilaff Samashu, who possessed an excellent baritone voice, began to sing that charming old-world melody, " I'll Sing Thee Songs of Ebonite ! " rendering in a sad yet forceful manner his distrust of Bakelite, Condensite, Shellaced paper and other insulating materials. So great was the impression created by this song that one old gentleman, in an ecstasy of emotion, tore off his celluloid collar and threw it into the fire.

And thus, with songs and music, we passed as enjoyable an evening as could be wished. Amongst so many brilliant people a large number were able to contribute by song to the entertainment, and others drew forth sweet melodies from violin and pianoforte. Others, again, recited with great feeling. I particularly remember Mr. Blodiff Ino, the famous Anglo-Siberian, reciting Shelley's

"An ill-mannered foreign guest . . . received a full charge of mulligatawny."

well-known poem, " Ode to an Atmospheric." As most of my readers will remember, it commences :—

Hail to thee, blithe atmospheric !
  Word thou never wert,
That from heaven or near it,
  Pourest thy full heart,
Higher still and higher,
  From the air thou springest,
Like the Eiffel Tower,
  The blue deep thou wingest,
And singing still doth jamb, and jamb-
    ing ever singest.

There was scarcely a dry eye to be seen when the great man came to the lines :—

Such harmonious madness,
  From my lips would flow

and, as Miss Molly Denite remarked to me over an ice, " No one but a madman could have written such stuff."

As a final item in the already full programme M. Ilaff Samashu stepped to the piano and, accompanying himself, trilled forth another old favourite :—

Of all the crystals bright and smart,
  There's none like carborundum,
It is the darling of my heart,
  In spite of German Hun-dom,
There is no crystal in the land,
  So sensitive as Carby,
And if it shouldn't rectify,
  It's dead I'd sooner far be ! "

And then, to close the evening, the great Professor rose to address us, but immediately fell back, overcome with emotion. A large

"Horror ! Every fish has two legs and a beak !"

bottle of emotion and a syphon being near at hand, he attempted to revive himself, with little success. Several other gentlemen, in somewhat negligé attitudes, were assisted to an erect position, and we all said farewell to one another and to our host. By a strange coincidence, I have no very clear recollection of just how the evening ended, probably owing to the philosophic arguments we had had. But that, I suppose, I must regard as the martyrdom of science, and who would not be martyred for Professor Sparkington Gapp ?

Among the Wireless Societies

Notes on Meetings and Future Arrangements.

Institute of Radio Engineers.—A meeting of the Institute was held on Wednesday, September 1st, in the Fayerweather Hall, Columbia University, New York, and a paper presented by Professor J. Zenneck on "The Operating Theory of Frequency Changers." The fundamental equations of the theory of the frequency changer were derived (with certain assumptions), and the application of the solution to unloaded and loaded frequency changers was discussed. The Institute availed itself of the presence of Professor Zenneck in New York to have this paper presented in person.

At the meeting held on October 6th at Columbia University, New York, Mr. M. E. Packman read a paper on "The Training of the Radio Operator." Mr. Packman has had much experience in training operators for commercial service, and his views on the proper methods of training operators in the technical, traffic, and actual operating sides of their profession, and description of equipment actually used for this purpose, were given in detail. The paper was of unquestionable interest to all engineers and operators, and discussion thereon was invited.

On Wednesday evening, November 3rd, Professor A. E. Kennelly read a paper on "The Impedances, Angular Velocities, and Frequencies of Oscillating Current Circuits." As Professor Kennelly has developed a new method of finding the true periods and dampings of any system of oscillating circuits, the paper was of great interest. In the event of time permitting, a second paper by Mr. William C. Woodland was to be presented on "The use of Multiphase Radio Transmitters." The advantages obtained by using multiphase currents and a number of rotary gaps, insofar as high frequency and low high-tension condenser capacities are concerned, were to be discussed.

* * *

Croydon Wireless Society.—Mr. J. E. Taylor, M.I.C.E., of the Post Office Engineering Department, gave a lecture to a meeting of members of the Croydon Wireless Society at the Polytechnic, Scarbrook Road, recently, his subject being "Lightning and other Electrical Properties." Mr. Taylor dealt with the conditions of the atmosphere at various elevations, pointing out the changes which take place up to a certain elevation, and above this the temperature remains almost the same. The conductivity of gases and the effect of the ionising agent were also dealt with, together with the diurnal and seasonal variations of atmosphere, diagrams and records being thrown on the sheets by the lantern illustrating the lecturer's remarks and being of material assistance to members. The electrical conductivity of gases in the normal state is very small, and Mr. Taylor explained how gases may be put into a state in which they conduct electricity, the greater conductivity generally being in mid-winter.

* * *

Timaru Association, New Zealand.—Although amateur activity is very quiet throughout the whole British Empire, a number of societies still carry on their work, if only in a restricted form. We have much pleasure in publishing the following letter from a keen wireless enthusiast in New Zealand, knowing well that British amateurs will reciprocate the kind wishes expressed therein :

"The Timaru Association (N.Z.) A.W.A. "is a branch of the parent society, the "New Zealand Amateur Wireless Associa- "tion, with its headquarters at Wellington "(the seat of Government), and came into "existence in 1914. It was formed by "wireless enthusiasts in the Dominion, so "that as an influential body they can "establish and maintain their rights and "assist the Government by regulating the "conditions under which they may experi- "ment, and by means of its branches carry "out suitable research work in wireless "telegraphy and its kindred subjects. Its "Hon. Secretary is Mr. R. Joyce, 'Stonar,' "Kilburne Parade, Wellington.

"As the oldest member I may state that "I began my experiments in 1900, and was "granted a licence to erect an installation "in 1901, and had to make all my own "apparatus, etc. Afterwards I had the "co-operation and association of Messrs. "A. D. Hathaway, L. J. Hitch, W. A. "Cooper, J. Young, G. A. Warwick, and "H. B. Curtis.

"Mr. A. D. Hathaway has since entered "the Marconi service and is still with them. "The other four gentlemen in the order "mentioned are at present in the N.Z. "Telegraph and Engineer Department of "the N.Z. Government, Mr. Warwick "being stationed at Samoa; Mr. Curtis "and myself being the only 'unattached' "ones in our society. Several young men "at different times evinced a passing interest, "but the society is a small one, and since "the suspension of our licence, and the dis-"mantling of aerials and apparatus, we have "confined ourselves to Morse sounder and "buzzer practice, and the study of the "theoretical side of the subject. We get "all the current literature published so "as to keep in touch with what is being "done in the wireless world.

"If any enthusiasts should happen along "we would be pleased to make their acquaint-"ance and do our best to entertain them, "and we wish you all the Greetings of the "Season, and trust it may not be long before "we can again 'Listen in.'

"W. J. HUGGINS,
"Hon. Sec. T. (N.Z.) A.W.A.
"September 10th, 1915."

* * *

Wireless Society of London.—The Committee, at a meeting held on October 7th, decided that the monthly meetings and lectures shall be discontinued for the present.

This decision was arrived at in view of (1) the restrictions imposed upon all private radio-telegraphy in war time, and (2) the absence of so many of our members on active service. The Statutory Annual General Meeting will be held in December, of which due notice will be given. The financial position of the Society is such as to justify the Committee in remitting the subscriptions for the financial year 1915-16, but last year's subscription should be forwarded to the Hon. Treasurer forthwith, if not already sent.

A NEW ROUTE TO SIBERIA.

Further Use for Radiotelegraphy.

THE terrible European crisis through which we are now passing and the consequent closing of continental routes from one side of Europe to the other have created the necessity for another route to Russia and Siberia. One for passengers, and to a certain extent freight, has been opened across Norway, Sweden, and Finland, but the difficulties of transporting large quantities of produce and other goods have proved almost insurmountable. But enterprising shipping companies have made use of yet another route—viz., that round the north coast of Norway, through the Kara Sea to the Siberian coast. The Russian Government has recently seriously undertaken the exploiting and prospecting of this country. It has erected three wireless stations near the shores of the Kara Sea, which communicate with a station at Archangel. Ships arriving by this newest route are warned by these wireless stations of the presence or absence of ice as the case may be, thus accelerating their passage through the danger zone. In 1913 ships took 23 days from Tromsoe in Norway to the Yenesei. This year the voyage *there and back* was accomplished in 19 days. Thus the ice difficulty has been overcome by the use of wireless telegraphy. Before its invention it was impossible for ships to get adequate information as to the conditions which lay before them. The wireless stations are situated at Yugorski, on the mainland, at the entrance to the Kara Sea; at Vaigatch, also at the entrance to the Kara Sea, on the north side of the island of the same name, between Nova Zembla and the mainland; at the Mara Sale, on the eastern side of the Kara Sea. The first two stations command the two straits which give entrance to the Kara Sea, and approaching vessels can be informed by wireless which strait is freest from ice, and what are the conditions beyond. It is proposed to equip the wireless stations with seaplanes to help in investigating the state of the seas, and to find out in greater detail which way the ice is moving and where open water lies. The utility of "air watercraft" is becoming increasingly felt, and the possibilities which lie in this direction would appear to be boundless.

QUESTIONS AND ANSWERS

Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study to the Editor, THE WIRELESS WORLD, *Marconi House, Strand, London, W.C. Such questions must be accompanied by the name and address of the writer, otherwise they will remain unanswered: and it must be clearly understood that owing to the Defence of the Realm Act we are totally unable to answer any questions on the construction of apparatus during the present emergency.*

C. C. (Dublin).—The new edition of Hawkhead's Handbook just published contains many new diagrams which will perhaps assist you. From the information therein contained you will be able to draw for yourself a complete diagram of 1½ k.w. set; and remember that the drawing of such a diagram will be of great value in teaching you the connections. As separate diagrams are given of the various circuits, it is an easy matter to make a drawing which combines them all.

H. P. R. (Fetter Lane, E.C.) writes.—Under what circumstances and why is a telephone transformer with low resistance telephones preferable to high-resistance telephones for wireless receiving? Given 'phones of a certain low resistance, on what principles are the windings of a suitable transformer calculated?

Answer.—As far as efficiency is concerned, there is little to choose between the two arrangements, but it is much easier to construct a telephone transformer and low-resistance telephones than to make high-resistance telephones. To get a sufficiently large number of turns within the limited space available in a telephone, extremely fine wire must be used, and this is very delicate to handle. The resulting telephone, however carefully it may be constructed, is at the best a frail instrument, and the windings may be totally destroyed by a fairly strong current, such as that given by strong signals. On the other hand, a telephone transformer can have its primary winding of sufficiently high resistance without using an extremely fine wire, as there is much more space available. In the early experiments with the Fleming valve the windings of a ten-inch induction coil were often used to make the telephone transformer, the high-resistance secondary being connected to the detector and the low-resistance primary to the telephones. Telephone transformers are constructed on the same principles as ordinary transformers.

A. W. (Fulham Road, London.)—To answer your queries satisfactorily would require more space than we can spare here, but we may point out that all the information you require—and a great deal more—is to be found in the instructional articles recently published in THE WIRELESS WORLD and in Bangay's *Elementary Principles of Wireless Telegraphy*, published by the Wireless Press, Ltd., and advertised in our pages. We think in any case you would derive more benefit from studying this book than from having your queries answered in this column. If you still find difficulty after reading the book in question, write to us again.

I. M. (South Town, Gt. Yarmouth).—THE WIRELESS WORLD examination scheme is not being pursued during the war, but we hope to take up the matter again when peace is declared. Applicants for entry into the Marconi Company's ship operating staff must be physically fit in every respect, and have to undergo a medical examination before acceptance. They must also possess a good general education. We think our article in the August number on "How to Become a Wireless Operator" will give you a great deal of assistance.

G. S. (Kingston-on-Thames).—On page 317 of the August issue of THE WIRELESS WORLD you will find an article which will give you all the information you require.

J. E. L. (Nagpur, India).—There are reasons why you do not get signals with the arrangements shown in your diagram. First, the crystal is connected in the very worst place, namely, in series with the aerial; secondly, the telephone transformer is connected in series with the crystal and the aerial; thirdly, the potentiometer is so connected that no current can possibly pass through the crystal. We would strongly advise you to study the *Elementary Principles of Wireless Telegraphy*, by R. D. Bangay, as it is evident you do not understand the principles on which a crystal detector is designed. Try short-circuiting the A.T.C. and then connecting the leads which you show in your diagram as connected to DD, to A and E. This will shunt the detector circuit across the A.T.I. and may give you some results. The detector terminals must be short-circuited by a piece of wire and the change-over switch placed on "Std.bi." Write and let us know what kind of results you obtain. You must not expect much, as the tuner in question is not designed for working with potentially operated detectors.

F. G. B. (Yarmouth).—Whilst the Morse Code is easily learnt without a teacher, to acquire a good style of sending without expert assistance is most difficult. If you and your friend could arrange for a few lessons from an expert telegraphist your progress would afterwards be rapid. If you make a few enquiries locally you will perhaps find a telegraphist who would be pleased to give you an hour or so in the evening once or twice a week for a small consideration. Try an advertisement in the local paper. If any Yarmouth reader can help our correspondent, we shall be pleased to forward any correspondence.

W. T. R. (Bolton, Lancs).—An Angstrom unit is the unit wave-length of light with which other light wave-lengths are compared. It takes its name from the physicist who first introduced it. The X-rays are a form of other vibrations whose wave-length is of the order of one Angstrom unit. In answer to your question on the effect of a rotating glass disc on a beam of light, the reply is that the effect would be exactly the same as if the disc were stationary. With regard to the other, very little is known on the subject, and we do not know of any book which is able to give much real information on the subject. Dr. Fleming's definition of the ether in *The Wireless Telegraphist's Pocket Book* is as follows:—"The imponderable medium which is assumed to pervade all space, certain forms of vibration in which constitute electro-magnetic waves, and therefore waves of light or radiant heat. The ether must be supposed to possess a certain absolute dielectric coefficient, and also a certain absolute magnetic permeability. The velocity of propagation of a wave through the ether is 3×10^{10} centimetres per second, and is inversely proportional to the square root of the product of the absolute dielectric coefficient and magnetic permeability of the ether." In *The Principles of Electric Wave Telegraphy and Telephony* Dr. Fleming devotes a considerable portion of the chapter on Electromagnetic Waves to the subject of the ether. With regard to your other question on the inductant calculation, we are not quite sure what you wish to know. Are you certain that you have read correctly?

Instructional Article

NEW SERIES (No. 4)

The following series, of which the article below forms the fourth part, is designed to provide wireless telegraphists, amateurs, and technical students generally, with clear and precise instruction in technical mathematics, in order that they may be enabled to read and understand the more advanced technical articles which appear from time to time.

21. A quadratic equation is one which contains no higher power of the unknown quantity than the second. For example :— $2x^2+x-6=0$ and $x^2-9=0$ are quadratic equations in which x is the unknown.

There are several ways of solving these equations, and we will first of all consider the

22. *Method of Factorisation.*—Taking the first of the two equations above, we can (see Article III.) resolve it into the factors $(2x-3)(x+2)=0$. What we have now to do is to find numerical values for x which, when substituted for x in these two factors, will make the product of the factors equal to 0.

It is obvious that if either one of the factors was equal to 0, then the product of the two would also equal 0, and this gives the clue to the method of finding the required values of x. What we do is this—we take one of the factors, say $(2x-3)$, and *make* it equal to 0, subsequently by very simple algebra finding the correct value of x to make this true.

Thus— $2x-3=0$

$$2x=3 \text{ or } x=\tfrac{3}{2}.$$

We now know that $\frac{3}{2}$ is a value for x which will make one of the factors, and therefore the product (which is also the original equation) equal to 0. Similarly with the other factor—

$$x+2=0$$
$$\therefore x=-2.$$

It can be shown that there are only two such values of x, or *roots*, for any one quadratic equation, and so the *solution* of the equation $2x^2+x-6=0$ is

$$x=\tfrac{3}{2} \text{ or } -2.$$

23. Just as a check on our working, we will substitute these two values in the original equation, and find whether they are correct

$$2x^2+x-6=0.$$

Putting $x=\frac{3}{2}$, we get	Putting $x=-2$, we get—
$2(\frac{3}{2})^2+(\frac{3}{2})-6$	$2(-2)^2+(-2)-6$
$=2\cdot\frac{9}{4}+\frac{3}{2}-6$	$=2\times4-2-6$
$=\frac{9}{2}+\frac{3}{2}-\frac{12}{2}$	$=8-8$
$=\frac{12-12}{2}=0$	$=0$

Thus $x=\frac{3}{2}$ or -2 is the correct solution.

It need hardly be pointed out that this method is applicable, not only to quadratics, but to any equation which can be equated to 0, and then factorised. For example—

$$2x^2-6+x^3=5x$$

Arranging—$x^3+2x^2-5x-6=0$

$(x+1)(x-2)(x+3)=0$ (factorised by trial)

Putting $(x+1)=0$ we get $x=-1$

„ $(x-2)=0$ „ $x=2$

„ $(x+3)=0$ „ $x=-3$.

Therefore $x=-1$ or $+2$ *or* -3.

Another method for solving quadratics is that of

24. *Completing the Squares.*—Let us take the quadratic $5x^2-4x-1=0$.

First reduce the coefficient of x to unity by dividing all through by 5....$x^2-\frac{4}{5}x-\frac{1}{5}=\frac{0}{5}=0$. Next transpose the term not containing x to the right-hand side of the equation.... $x^2-\frac{4}{5}x=\frac{1}{5}$.

We must now find a quantity which, added to the left-hand side of the equation, will make that side a perfect square. This quantity, when found, must be added to both sides of the equation so as to preserve the balance.

Considering the expression $x^2-2ax+a^2$ which we *know* to be a perfect square, being equal to $(x-a)^2$, we see that the last term a^2 equals (half the coefficient of x)^2. For the coefficient of x is $-2a$; half that is $-a$; and $(-a)^2=a^2$ (the last term).

Now in our case we have an expression

$x^2-\frac{4}{5}x$, which we require to make into a perfect square by adding a third term.

We have seen above that the expression x^2-2ax can be made into a perfect square by adding a^2, this term a^2 being (half of $-2a)^2$. Similarly in our case we can make $x^2-\frac{4}{5}x$ into a perfect square by adding (half of $-\frac{4}{5})^2$ $=(-\frac{4}{10})^2=(-\frac{2}{5})^2=+\frac{4}{25}$.

Adding this to $x^2-\frac{4}{5}x=\frac{1}{5}$

we get $x^2-\frac{4}{5}x+\frac{4}{25}=\frac{1}{5}+\frac{4}{25}=$

$$=\frac{5+4}{25}$$
$$=\frac{9}{25}$$

We can write this as—

$$x^2-2(\tfrac{2}{5})x+(\tfrac{2}{5})^2=\tfrac{9}{25}$$
$$\text{or } (x-\tfrac{2}{5})^2=\tfrac{9}{25}=(\tfrac{3}{5})^2$$

Taking the square root of both sides—

$\pm(x-\frac{2}{5})=\pm(\frac{3}{5})$.

The $\pm$ signs are required because the square root of $(x-\frac{2}{5})^2$ can be either $+(x-\frac{2}{5})$ or $-(x-\frac{2}{5})$. Similarly the square root of $(\frac{3}{5})^2$ can be either $+(\frac{3}{5})$ or $-(\frac{3}{5})$. Thus we can have four possible arrangements of our simplified equation—

(i) $+(x-\frac{2}{5})=+(\frac{3}{5}),\ x=\frac{3}{5}+\frac{2}{5}=+1$.

(ii) $-(x-\frac{2}{5})=-(\frac{3}{5}),\ -x+\frac{2}{5}=-\frac{3}{5}$,
$-x=-\frac{3}{5}-\frac{2}{5}=-\frac{5}{5}$ or $x=+1$.

(iii) $+(x-\frac{2}{5})=-(\frac{3}{5}),\ x=-\frac{3}{5}+\frac{2}{5}=-\frac{1}{5}$.

(iv) $-(x-\frac{2}{5})=+(\frac{3}{5}),\ -x+\frac{2}{5}=\frac{3}{5}$,
$-x=\ -\frac{2}{5}=\frac{1}{5}$ or $x=-\frac{1}{5}$.

Thus the four arrangements boil down to two results, one of which is obtained when the signs on the two sides of the equation are the same, and the other when they are different. Thus if we had put $(x-\frac{2}{5})=\pm(\frac{3}{5})$, this would have met both cases, and this is what we do in practice.

The roots are, of course, $x=1$ or $-\frac{1}{5}$.

This method, put shortly, is as follows :—

First, remove the term not containing x to one side of the equation, leaving the x^2 and x terms on the other side.

Secondly, to *both* sides add the square of *half* the coefficient of x, thus making the x^2 side of the equation a perfect square.

Thirdly, take the square root of each side. You will now be left with a simple equation containing x, but *not* x^2. This can be easily solved for x. The last method we shall make use of is that of a

25. *Derived Formula.*—If we take a quadratic $ax^2+bx+c=0$, we can use it as a general equation to cover all cases, as we can always put in the proper values for a, b, and c to fit in with any particular quadratic we have to deal with.

By means of the method used in the preceding paragraph, we can obtain a solution for this equation, as follows :—

$$ax^2+bx+c=0$$
$$ax^2+bx=-c$$
$$x^2+\frac{b}{a}x=-\frac{c}{a}$$

We must now add $\left(\frac{1}{2}\times\frac{b}{a}\right)^2$ or $\frac{b^2}{4a^2}$ to both sides

$$x^2+\frac{b}{a}x+\frac{b^2}{4a^2}=-\frac{c}{a}+\frac{b^2}{4a^2}$$
$$=\frac{-4ac+b^2}{4a^2}.$$

We can write this

$$x^2+2\left(\frac{b}{2a}\right)+\left(\frac{b}{2a}\right)^2=\frac{b^2-4ac}{4a^2}$$
$$\text{or}\quad \left(x+\frac{b}{2a}\right)^2=\frac{b^2-4ac}{4a^2}.$$

Taking square roots

$$\left(x+\frac{b}{2a}\right)=\pm\sqrt{\frac{b^2-4ac}{4a^2}}=\frac{\pm\sqrt{b^2-4ac}}{2a}$$
$$x=-\frac{b}{2a}\pm\frac{\sqrt{b^2-4ac}}{2a}$$
$$=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$

This formula will enable us to find the two roots of any quadratic equation, one root being

$$x=\frac{-b+\sqrt{b^2-4ac}}{2a}\text{ or }x=\frac{-b-\sqrt{b^2-4ac}}{2a}$$

Taking again the equation $5x^2-4x-1=0$, in this case $a=5$ $b=-4$ and $c=-1$.

Then $x=\dfrac{-b\pm\sqrt{b^2-4ac}}{2a}$

$$=\frac{-(-4)\pm\sqrt{(-4)^2-4(5)(-1)}}{2\times5}$$
$$=\frac{4\pm\sqrt{16+20}}{10}$$
$$=\frac{4\pm\sqrt{36}}{10}=\frac{4\pm6}{10}$$
$$=\frac{10}{10}\text{ or }\frac{-2}{10}=1\text{ or }-\tfrac{1}{5}\ \textit{Ans.}$$

[When working these out, *don't forget the signs.* That is, remember that

$b=-4$ *not* $+4$.
and $c=-1$ *not* $+1$.]

EXAMPLE.

Six times a certain number subtracted from three times its square leaves a remainder 105. Find the number.

Let x be the number.

Then we are told that $6x$ subtracted from $3x^2$ leaves 105, or $3x^2-6x=105$, or $3x^2-6x-105=0$.

In this case $a=3$, $b=-6$ and $c=-105$.

Thus

$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$

$$=\frac{6\pm\sqrt{36-4\times3\times(-105)}}{2\times3}$$

$$=\frac{6\pm\sqrt{36+1260}}{6}$$

$$=\frac{6\pm\sqrt{1296}}{6}$$

$$=\frac{6\pm36}{6}$$

$$=\frac{42}{6}\text{ or }\frac{-30}{6}=7\text{ or }-5.\quad \textit{Ans.}$$

To check this result we proceed as follows:

Taking $x=7$, we get $x^2=49$, and $3x^2=147$

$6x = 42$

Subtracting, the difference is 105

which is correct.

Similarly, when

$x=-5$, we get $x^2=25$ and $3x^2= 75$

$6x=-30$

Subtracting, we get -105

again the correct result.

It is very important when solving any equation to remember to *check the results* by substitution of the values obtained in the orginal equation.

26. *Logarithmic Solution of Equations.*—We shall sometimes come across equations such as $3x^{7\cdot3}=17x^{3\cdot5}$. The best way to solve such equations is by means of logarithms (see Articles I. and II.)

As usual, we begin by reducing the equation to its simplest form. This we do by dividing both sides by $x^{3\cdot5}$, when we get

$$\frac{3x^{7\cdot3}}{x^{3\cdot5}}=3x^{7\cdot3-3\cdot5}=3x^{3\cdot8}=17$$

Taking logarithms of both sides—

$$\log 3+3\cdot8\log x=\log 17$$

$$0\cdot4771+(3\cdot8\times\log x)=1\cdot2304.$$

Therefore $3\cdot8\log x=1\cdot2304-0\cdot4771$

$=0\cdot7533.$

Thus $\log x=\dfrac{0\cdot7533}{3\cdot8}$.

To work out the value of $\dfrac{0\cdot7533}{3\cdot8}$ we will use logs again. Log $0\cdot7533 = \bar{1}\cdot8770$

Subtracting $\log 3\cdot8= 0\cdot5798$

we get $\bar{1}\cdot2972$

Antilog $\bar{1}\cdot2972=0\cdot1983=\log x.$

Therefore x = antilog $0\cdot1983$

$=1\cdot579$ *Ans.*

EXAMPLE.

The insulation resistance of a condenser can be measured by charging it to a known voltage, and allowing it to discharge by leakage through its own dielectric. The voltage left in the condenser is measured at different times after the discharge begins. The formula from which the resistance is obtained is $V=Ae^{-\frac{t}{KR}}$ where

V = voltage across condenser (volts).

t = time from start of discharge (seconds).

K = capacity of condenser (farads).

R = insulation resistance (ohms).

e = 2·718

A = a constant.

Given that $V = 100$ when $t=0$

$V = 55$ when $t=1800$

and $K = \frac{1}{3}$ mfd. $=\frac{1}{3}\times10^{-6}$ farads,

find R.

$$V=Ae^{-\frac{t}{KR}}$$

$$\text{Log } V=\log A-\frac{t}{KR}\log e.$$

Putting $V=100$ when $t=0$

$$\log 100=\log A-\frac{0}{KR}\log e$$

$$=\log A-0$$

$$=\log A$$

Therefore $A=100$.

Again, putting $V=55$ when $t=1800$ we get

$$\log 55=\log 100-\frac{1800}{\frac{1}{3}\times10^{-6}R}\log e$$

$$=\log 100-\frac{1800\times3\times10^6\times\log e}{R}$$

$$1\cdot7404=2-\frac{5400\times10^6\times0\cdot4343}{R}$$

$$0\cdot2596=\frac{5400\times10^6\times0\cdot4343}{R}$$

Thus $0{\cdot}2596\ R = 5400 \times 10^6 \times 0{\cdot}4343$

$$\text{or } R = \frac{5400 \times 10^6 \times 0{\cdot}4343}{0{\cdot}2596}$$

$\log 5400 = 3{\cdot}7324$

$\log 10^6 = 6{\cdot}0000$

$\log 0{\cdot}4343 = \bar{1}{\cdot}6378$

Adding $= 8 + 1{\cdot}3702$

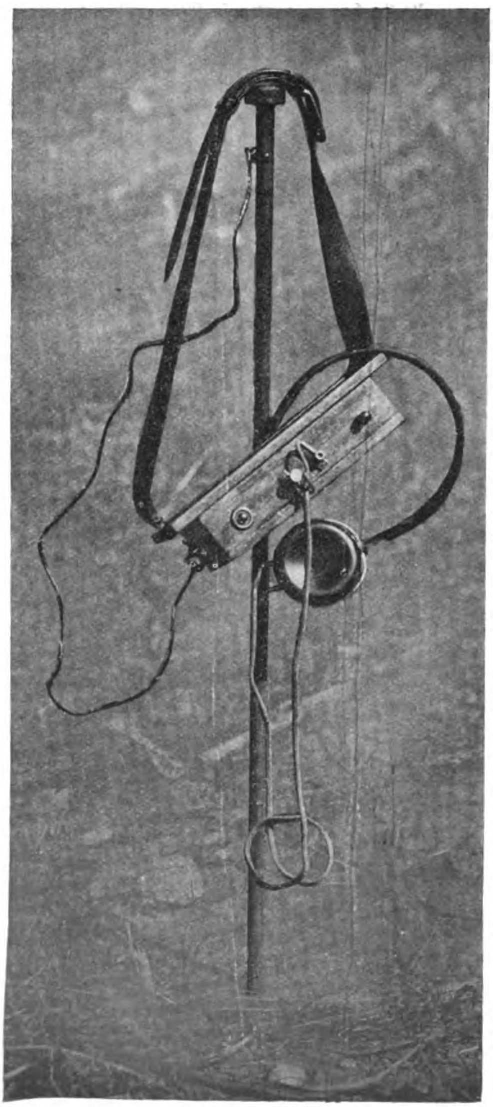
Subtracting $\log 0{\cdot}2596 = \bar{1} + 0{\cdot}4143$

we have left $9 + {\cdot}9559 = 9{\cdot}9559$

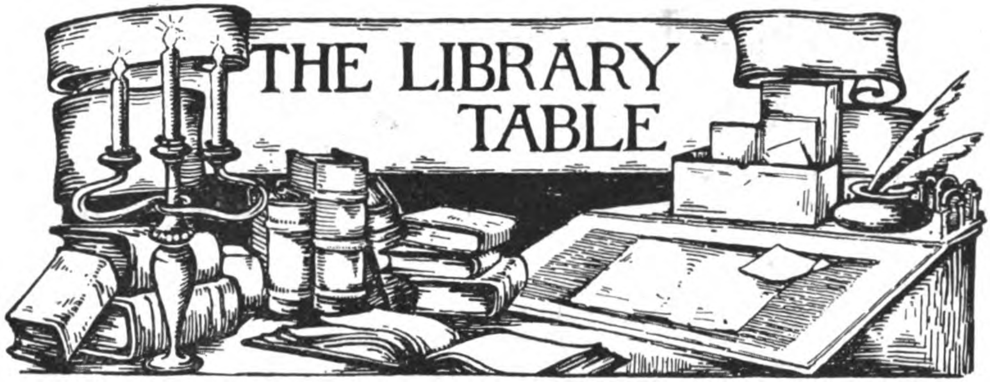
$R = \text{Antilog } 9{\cdot}9559 = (9{\cdot}035 \times 10^9)$ ohms.

or 9035 megohms.

AN ULTRA-PORTABLE WIRELESS INSTALLATION.



THE accompanying photographs show a new American invention by which it is claimed to send and receive wireless messages without any additional apparatus over a distance of several miles. Such portable installations are frequently invented, and as particulars of this little set are not at present available, we are unable to say whether it presents any novel or remarkable features.



"THE GOOD SHIP 'BROMPTON CASTLE.'" By Lady Bell. London: Messrs. Mills & Boon. 6s.

In *The Good Ship "Brompton Castle"* we have a favourable specimen of a novel of the modern school placed in a thoroughly up-to-date environment. The title is, just for once in a way, a true indication of the *locale* of the book. Almost all the action takes place on board an "Union Castle" liner, the "preliminary skirmish" occurring on an homeward voyage and the *dénouement* on an outward. We cannot say that we are much "smitten" with the character of the hero. The very idea of the book is against it, and although the gifted authoress, Lady Bell, tells us that he is a straightforward and manly fellow, his conduct hardly appears to be in keeping with that characterisation. He is represented as afflicted with the unmanly attribute of "not knowing his own mind." This we suppose is necessary in order that a suitable field may be left open for the struggle of the two heroines to win his affections. These ladies, contrary to the ordinary run of such persons, are both of them charming in their own way. Antonia and Hildred represent two different types, the one softly brought up and thoroughly feministic, the other up-to-date and independent, knowing her own mind as the man does not, and thoroughly determined to "go in and win." The victory falls inevitably to the latter; but the story of their struggles and the pictures of life on board are "drawn from life."

It is characteristic of the modern novel that the crucial engagement between the two contending parties is decided *in the Marconi cabin of the s.s. "Brompton Castle."* The hero, who has been in the British Navy, and retired for personal reasons, takes the ladies up there, apparently in order to display his own knowledge of wireless telegraphy. He kindly explains the various technical details in popular language, and the conversation between himself and the senior wireless operator is amusing and not uninforming. Lady Bell is, not unnaturally, guilty of a few minor slips in technical details. We may instance the description of a piece of apparatus described as being the "receiving box," the contents of which must be somewhat weird because they are denominated "receiving informers"! On the whole, however, we beg to offer Lady Bell our congratulations upon the fact that her technicalities are in the main correct, and form in this respect a refreshing contrast to the greater number of such descriptions in works of fiction.

We would specially commend the incident of the junior operator left alone on watch for the first time in the middle of the night. The authoress's description of the thoughts and feelings that arise within him, culminating in an ingenious and happy solution of his mental crisis, constitute in our opinion a well-conceived and well-executed piece of literary workmanship.

The book is one well worthy of more than casual perusal, and we can recommend it to our readers for inclusion among their Christmas purchases.

"THE DYNAMICS OF SURFACES." By L. Michaelis. London: E. & F. N. Spon, Ltd. 4s. net.

This volume, ably translated by Mr. W. H. Perkins, M.Sc., is intended to summarise the essential points in the theoretical treatment of surface phenomena, always keeping in view the object of applying the knowledge obtained to biological purposes. Although, as the author says, it is not a biological work, it is intended for biologists and is written from their point of view.

The book is, of course, of an advanced scientific nature and as such will appeal to but a limited class of readers, but we believe it will be welcomed by many who are interested in pure research and modern scientific problems.

* * *

"RUSSIAN SELF TAUGHT." (5th edition revised.) By Major C. A. Thimm, and J. Marshall, M.A. London, 1915: E. Marlborough & Co. Cloth, 2s. 6d.; Paper, 2s.

The admirable "Self-Taught" series of foreign languages placed on the market by Messrs. Marlborough fill an ever-increasing need. In that particularly under review the usual clear and concise style has been followed. The study of the language of our gallant Ally will be much more prevalent upon the cessation of the present hostilities. In fact it is not too much to say that in view of the increasing commercial expansion of the vast Russian empire it will, to a large extent, take the place of German. The book contains naval and military vocabulary and phrases and should prove of immense service to soldiers and sailors and others in touch with Russia at the present time. We heartily commend the book to the attention of our readers.

* * *

"THE HOLIDAY ADVENTURES OF MR. P. J. DAVENANT." By Lord Frederic Hamilton. Eveleigh Nash. 2s. 6d. net.

In other parts of our journal we have often insisted upon the fact that wireless telegraphy is one of those secular inventions the advent of which is important not merely on account of its effect in influencing a particular branch of industry, but because it signalises its arrival by permeating the whole fabric of Social Existence. Fresh evidence in support of our view is afforded by the book before us and by similar volumes, of which that under review may be taken as typical.

The idea is one familiar enough in the annals of what (for want of a better term) may be denominated *detective fiction*. The hero (yclept J. P. Davenant) is one of those superhumanly clever pieces of precocity whose premature development is looked upon by the author as adding piquancy to his narrative. Actually there is no reason why "J. P. Davenant" should not have been depicted as a highly developed *savant* of the type familiarised to English readers by Sir Arthur Conan Doyle in his well-known "Sherlock Holmes." He possesses the same eagle eye which goes straight to the weak points of the enemy's defence and the same fertility of resources in bringing to nought the machinations of the evil-doer.

But the novelty in this, as in most others of the same type of fiction, lies in the fact that the enemy against whom he has to contend baffles the ordinary routine investigator by the use of wireless. Many other writers of fiction of this type have utilised radiotelegraphic "machinery" without rendering themselves sufficiently acquainted with its technique to avoid ridiculous blunders. Lord Frederic Hamilton has avoided this pitfall, and, so far as we can judge from his descriptions, it would have been perfectly possible for the iniquitous German governess-spy to erect and work her aerials, and for the pseudo-Belgian refugees, working in the cause of Germany, to run up and manipulate their collapsible mast from the specially devised sockets of their large travelling motor-car.

We will not do the author the disservice of detailing his plots, because in this class of story the interest centres round the plot, the characters being mainly puppets introduced to "work" the action. The main idea is that P. J. Davenant, a schoolboy of between 17 and 18, with a (we hope rare) taste for smoking, finds himself on holiday with time hanging heavily on his hands, and devotes himself to the tracking down of the terrible "K.U.W."! This is the short for *Kaiserliche Uberseeische Wacht*, which—being interpreted—means "German Imperial Oversea Guard," an institution specially devised to work against and *strafe* the British. Our detective schoolboy penetrates the secret of their code, and his process of discovery is accompanied by many interesting and picturesque details duly set forth in the novel. Thanks to this excellent start, he exposes the whole series of ingenious machinations of German spies, and even succeeds (at the risk of his life) in bringing about the arrest of the "Master Spy" himself. For our own part we are not extremely struck with the brain power of the aforesaid Master Spy—but let that pass! There is a great deal of ingenuity shown in his detection. Probably the most ingenious incident narrated in the volume is that which includes "wireless and the language of flowers," where a certain amount of "love-interest" is introduced, which centres round a fascinating adventuress who is posing as a Belgian refugee, but all the time working treacherously against England, in combination with the usual feminine companion, and a Prussian criminal disguised as a Belgian abbé.

We may, in all sincerity, congratulate Lord Frederic Hamilton on his work, and recommend it to the attention of those who desire to give a suitable Christmas volume to schoolboys, boy scouts, *et hoc genus omne*.

The author's profits are destined for Lady Lansdowne's "Officers' Families' Fund." Both for the encouragement of the author and for the sake of the fund we hope that the circulation of these "Holiday Adventures" will be large.

* * *

"ELECTRIC BELLS, ALARMS, AND SIGNALLING SYSTEMS." By Herbert G. White. London: S. Rentell and Co., Ltd., 1s. 6d. net. Postage 2d.

Although the average "handyman" is sufficiently acquainted with electricity to fit up a simple electric bell or alarm, and often a six or eight line indicator, yet there are many cases where problems of wiring arise and where great simplifications could be made had the fitter greater knowledge. It is in circumstances of this nature that the above book will prove of considerable benefit, containing as it does particulars of the best and simplest methods of wiring all kinds of bell circuits, indicator systems, burglar alarms and the like. The book is clearly illustrated with numerous diagrams of connections and apparatus which should make it very useful in the hands of all who have either regularly or occasionally to fit up such systems as are therein described. The chapters on fault localisation and mine signalling systems add considerably to the interest and value of the little volume.

* * *

"VILLAGE AND TOWN LIFE IN CHINA." By T. K. Leong, LL.B., B.Sc., and L. K. Tao, B.Sc. London: George Allan & Unwin, Ltd. 5s. net.

Wireless telegraphy has played, and is playing, an exceedingly important part in the opening up of the remote and hitherto little-known regions of the vast Chinese Republic. Its development there is making very rapid strides, and it is not too much to hope that before long it will be possible to communicate with any part of the "Celestial Republic" by its means. The attention of those interested in radio-telegraphy has, for some time past, been centred on this part of the globe, and the book under review, therefore, has been produced at a particularly opportune time. The work is divided into two parts, one descriptive of a Chinese village, and the other of a Chinese town. The authors, Chinese gentlemen, who have lived for many years in a Chinese village and a Chinese town respectively, give true pictures of life in China. They describe the organisation of the village and town, the family, clan, ancestral worship, marriage, education, and many other topics interesting to the student and general reader. The work is of immense interest, and we trust that it will receive the attention of readers interested in the commercial development of that part of the world.

* * *

"AIRCRAFT IN THE GREAT WAR." By Claude Grahame-White and Harry Harper. London: T. Fisher Unwin. 1915. 7s. 6d. net.

"The object of this work is to explain in a popular, dramatic, and perfectly non-technical way just what aerial warfare means, as revealed in the happenings of the great war." These words give, in a nutshell, the *raison d'être* of the book under notice. The authors dwell upon the perils an airman has to run from artillery fire, how he seeks to avoid destruction (by

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various methods of flight), a matter on which Mr. Grahame White can speak with authority, and how the guns are handled which are meant to destroy his craft. They also deal with the destructive powers of aircraft with bomb-dropping, both by airship and aeroplane, and with aerial fighting. The authors devote a chapter to weather and scouting, with a reference to wireless. The application of wireless to aeroplanes has been studied very carefully in the British Flying Corps, and a number of the machines sent to the front have been equipped with radio-telegraphic plant. In the authors' own words, "in the official history of the war, when there is time and space for detail, wireless will be shown to have played its good and useful part."

* * *

"ELECTRIC MINE SIGNALLING INSTALLATIONS." By G. W. Lummis Paterson. London : Constable & Co., Ltd., 4s. 6d.

Mining is at the best risky work, and the occasional disasters which send a thrill of horror through the country only serve to emphasize the need for devices which will in any way lessen the risks of those who toil beneath the ground. Of primary importance in every mine is an efficient system of signalling, for without it little rescue work could be done in case of disaster, and its absence would hamper the winding and haulage arrangements very considerably.

The author of this book sets out to illustrate and describe the mine signalling apparatus which in his experience has been found to give the best results in practical mining work, and to indicate, by plans and diagrams, the most approved methods of installing and maintaining the apparatus. The conditions prevailing in most mines, particularly in those where inflammable gases are likely to accumulate, call for very special precautions to prevent explosions, for even the tiny spark from a bell-push may be sufficient to ignite a mixture of coal dust and air, or the dread "fire-damp," which has caused so many disasters. Moisture and dust also have to be guarded against far more than in the case above ground. All these points are carefully dealt with, and numerous diagrams and illustrations of apparatus elucidate the text. In an appendix an abstract of the rules and regulations issued by the British Home Office relating to electric mine signals, together with the corresponding rules of the American Bureau of Standards, helps the reader to grasp just what is required by the authorities and what are the most important points to be considered. The book is well produced and should supply a distinct want.

* * *

"BROWN'S SIGNALLING." Glasgow : James Brown and Son. 2s. 6d. net.

That the volume before us should announce the seventeenth edition of this well-known volume is sufficient indication of the popularity it has acquired, and few will dispute its claim to be the most complete book on signalling yet published. All methods of signalling are fully dealt with, and wireless telegraphy is treated in a very interesting and lucid manner. Of the twenty-eight pages devoted to this method of signalling, the greater part is devoted to wireless theory and descriptions of apparatus and the remainder to lists of stations, particulars of how to send messages, regulations and other useful information. Some interesting particulars of the Marconi Wireless Direction Finder are also given. The German Telefunken system which certain shipowners introduced on some British ships prior to the war, is described in some detail, its alleged superiority to other "wireless" being ingeniously if somewhat inaccurately set forth. Readers who are acquainted with the real facts will be amused to read the statement "Approxi-
"mately a wireless installation in which
"the spark discharged in the exciting
"circuit is quenched will be twice as effi-
"cient as one in which the spark is not
"quenched, so that, with the use of any
"given primary energy, the range of the
"station will be approximately doubled
"when the excitation circuit is quenched."
Even assuming the superiority of the quenched gap to be what is stated here, we would draw special attention to the latter part of the sentence, which states in effect that if the transmitting power is doubled the range is doubled. Anyone with the least practical acquaintance with wireless telegraphy knows that other things being equal to double the range it is necessary at least to quadruple the power. If any proof were required of the absurdity of the statement

regarding doubled power and doubled range, we would point to the known facts regarding long-distance transmission. As two kilowatts with an average aerial is ample power for communicating over 200 miles in practically all conditions, then if the statement in question were true twenty kilowatts in the same conditions would be ample for two thousand miles! Other arguments in favour of the quenched spark are put forth in a similar fashion, that regarding the use of a musical note suggesting to the reader that the quenched spark system is the only one using a musical note. This, for example: ". . . in which case it would be totally "impossible to distinguish a non-musical "note and communication would so be "interrupted. *For this reason the adoption "of the quenched spark system* in tropical "countries, where such atmospherics are "always present and very intense, *has "been very extensive.*" (The italics are ours.) We do not know whether the article on this system was supplied by the Telefunken Company from Berlin—we hope not—but in any case the arguments strongly suggest the official wireless bulletins from that capital.

The remainder of the book is throughout excellent, both in arrangement and lucidity, and we congratulate the publishers in producing such a thoroughly useful manual.

* * *

"ELECTRICAL ENGINEERING." By. T. C. Baillie, M.A., D.Sc. Vol. I.: Introductory. Cambridge: The University Press. 1915. 5s. net.

The purpose of this book is well set out in the author's preface, in which he states that the volume is designed to serve as a text-book for elementary courses in electrical engineering in technical institutions. "Naturally," says the writer, "one of the main purposes of such a book is to teach first principles, and, while matters of practical utility have been included, an endeavour has been made to avoid overloading it with descriptive details which are more appropriate to oral than to written exposition."

That the author has well achieved his object few will doubt on perusing this excellently written text-book. In the historical introduction, with which the book commences, sufficient consideration is given to the main theories of electrical action which have been put forward since Dr. Gilbert, of Colchester, performed his famous experiments, and we are glad to see that the chapter has not been overloaded, as is so often the case in similar books, with matters which are relatively unimportant. Chapter II. deals in a very practical and thorough way with the Conduction of Electricity. The note on "laws" at the bottom of page 9 will, we venture to think, invest a subject usually regarded as "dry" with an additional interest for those who peruse the book. Magnetism, Current Measurement, Electromotive Force Resistance Measurements, and other subjects, have each a well filled chapter, and the Potentiometer, nowadays so largely used in practical instruction, is treated very thoroughly. The chapter devoted to Batteries is particularly valuable and up to date, the Edison Cell not being overlooked. A final chapter on Electric Light brings us to the end of the volume.

A word must be spoken for the excellent way in which the book is illustrated and produced. These points add much to its value and attractiveness.

TOTALISING AND TALLY COUNTERS.

"TIME is money," is the oft-quoted motto of the business man. With the existence of such a dictum it is only natural that somebody should have racked his brain to produce time and labour-saving devices. In this category fall the instruments sold by Messrs. Markt & Co. (London), Ltd., 98 Clerkenwell Road, London, E.C., comprising the combined Set-back and Totalising Counter, the Zero Ratchet Reset Counter, and the new Veeder Set-back Hand Tally Counter. These instruments fill a long-felt want, and enjoy a very high reputation for the very fine quality of their workmanship They are particularly adapted to, and successfully used on, all kinds of machinery where a correct record of the amount of work done by the machine or the operator is required. We have pleasure in commending them to the attention of our readers.

Foreign and Colonial Notes

Antarctic.

One of the objects of Sir Ernest Shackleton's present South Polar expedition is to establish a wireless station in the Antarctic, the staff to be relieved once a year. The main object of the station would be to keep the civilised world acquainted with the meterological conditions around the Pole. Theoretically the power of such a station need not be very great for long-distance transmission, but during Captain Scott's investigations it was discovered that the Aurora Australis (the South Pole equivalent to the Aurora Borealis in high northern latitudes), somewhat counterbalanced the lessened interference of sunshine.

* * *

Guatemala.

There is good business to be done in the States of Central America. Each country is emerging from its lethargy, and is awakening to the fact that it holds vast resources of wealth. In connection with this commercial development, it is interesting to notice that wireless messages have been exchanged between the Naval wireless telegraph stations at Arlington, Va., and the new Government radio station erected at Guatemala City, via the naval station at Key West, Florida.

* * *

Spain.

During the present time when so many European nations are engaged in warfare, it is refreshing to record the experiments of those remaining neutral. The trial of a Spanish airship will shortly take place in Barcelona. It is the invention of an engineer, Don Francisco Salas, of Seville, who has devoted many years of study to bring it to perfection. The application of radio-telegraphy to aircraft has often been touched on in the pages of this journal. It is gratifying to learn, therefore, that the new airship is fitted with a wireless installation. The airship contains 15 motors, and it is worthy of note that this is the first time that aeroplane motors have been applied to a dirigible. Another important improvement is that no ballast of any kind is necessary, and also that it has no water compartments of any kind. No loss of hydrogen takes place in descending, which forms a very distinct advantage. On a calm day the airship is able to develop a speed of about 80 miles an hour, the average speed being about 55 miles an hour. Stability is procured by an ingenious combination of counter-weights which maintain the equilibrium, thus allowing passengers to move about without causing the airship to pitch.

* * *

United States.

It is interesting to learn that the American Marconi Company has sent a number of specially trained wireless telegraphists from New York to its Pacific stations. These men will work the trans-Pacific wireless service to be inaugurated in the near future with the Japanese Government telegraph system.

* * *

All commercial and amateur wireless stations in the United States will soon be organised by the Navy Department for immediate use in the case of emergency by the Intelligence Bureau of the Navy. In the event of war thousands of operators along the coast lines would be instructed to "listen in" on any radio conversation that might be in progress within range of their instruments, each station using a different wave-length. The result would be to establish a line of radio "eavesdroppers" around the country which would be certain to intercept any message transmitted by ships at sea, or shore stations beyond the borders south and north. Intercepted messages would be promptly reported to the Navy Department, which would be able eventually to communicate with all Atlantic coast wireless stations at least directly from the office of the Chief of Navy operations at Washington. Five wireless antennæ are now being erected on the roof of the Navy building at Washington, and in a sound-proof room will be established a radio exchange station with five operators and five sets of instruments. From that room conversations can be conducted directly with the big central Navy radio plant at Arlington, Virginia, and with Navy stations along the Gulf and Atlantic coasts.

* * *

During the fiscal year 1915, the radio inspectors of the United States Bureau of Navigation reported twenty-six cases of vessels leaving United States ports which met with accident or disaster, requiring the use of wireless to summon assistance. Four of these were from fire; twelve were from running ashore, stranding, or getting into an ice jam; three were from the breakage of machinery; four resulted from collisions; one from shifting of cargo; one vessel was storm-battered and water-logged; and one was torpedoed. Excepting in the case of the *Lusitania*, which was torpedoed, the assistance thus rendered resulted in but two lives being lost.

* * *

The advantages of wireless telegraphy have lately been realised by the United States Government. We understand they have issued orders to the officers of their Navy in the following terms:

"Due to the ease with which the Navy Department can be communicated with from all parts of the world, no commander in-chief, divisional commander, or commanding officer, shall issue an ultimatum to the representative of any foreign government or demand the performance of any service from any such representative that must be executed within a limited time without first communicating with the Navy Department, except in case where such action is necessary to save life."

* * *

The Marconi Company has placed a phonograph and a large supply of records in the Cape Hatteras station for the use of the operators there.

* * *

According to a San Francisco newspaper a government wireless station will be erected at Coos Bay, Oregon.

The United States Bureau of Navigation annually compiles an edition of the "List "of Radio stations of the United States." This year's shows the total number of land, ship and amateur stations in that country to be 5,073, an increase of 1,131 from the 1914 figures. The list shows that the number of government and commercial land stations in 1915 is 224, as compared with 198 in 1914. The number of general and restricted amateur stations is 3,836, an increase of 1,040 on last year's figures.

* * *

The *Electrical World* of October 23rd last prints the following paragraph:—

"The Electrical Commission of the city "of Baltimore, Md., has in service a motor "truck which is equipped with a 'wireless' "receiving outfit, enabling headquarters to "keep in communication with the crew of "the truck at all times, so that emergency "calls can be handled in the field with the "greatest dispatch. The truck serves as a "receiving station only, and for its antennae "is equipped with 425 ft. of No. 14 rubber-"covered copper wire suspended just "beneath its roof. During the preliminary "tests the truck never failed to intercept "messages sent to it within a radius of ten "miles of the sending station. Even under "the most unfavourable conditions, with "the truck running at full speed and "blanketed by tall buildings of steel con-"struction, no difficulty was experienced in "reading the messages. A simple code of "signals has been adopted to avoid the "necessity of engaging trained telegraph "operators."

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Mr. Daniels, the Secretary of the Navy, recently successfully transmitted the first wireless telephonic Naval order to Rear-Admiral Usher at Brooklyn Naval Yard.

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Among the many interesting exhibits at the New York Electrical Exhibition, which was held in October at the Grand Central Palace, New York, was a five-kilowatt wireless sending and receiving station and the central generating station of an American Dreadnought. These were exhibited by direction of the Naval Department and attracted considerable attention.

PERSONAL PARAGRAPHS.

With reference to our note last month in this column that Mr. S. B. Balcombe had been promoted to the rank of Temporary 2nd Lieutenant, we now have pleasure in publishing a few particulars regarding the new officer.

Lieutenant Balcombe went out to the Front within a fortnight of the outbreak of hostilities, and fought through the famous retreat from Mons, and in the advance on the Aisne. Three months afterwards—in November, 1914—Mr. Balcombe was appointed Corporal, and in a further eight months received his promotion to Sergeant. By this time Mr. Balcombe appears to have been well on the move upwards, for only two months afterwards he was gazetted Temporary 2nd Lieutenant. At the time of going to press Lieutenant Balcombe had not received any further promotion.

* * *

Sergeant A. H. Brown, to whom we referred recently in these columns, informs us that he has now been transferred from the Seaforth Highlanders to the Royal Engineers Wireless Training Centre, and is now employed on wireless work.

* * *

Our heartiest congratulations are also due to Captain Benjamin Newton on his promotion from Lieutenant. Captain Newton, who joined the Marconi Company some five or six years ago, has had many varied experiences, for after serving for some time on board ship he took up the position of Superintendent of Telegraphs in Somaliland. This position, however, he had to relinquish owing to ill health, and, after returning to England, carried out various duties in the Marconi Company's Head Office.

Capt. B. Newton.

Soon after the outbreak of war Captain Newton received his commission, and has since been on special duty for the War Office. We are sure his many friends in the world of wireless will be glad to hear of his promotion, and on their behalf we offer him our heartiest congratulations.

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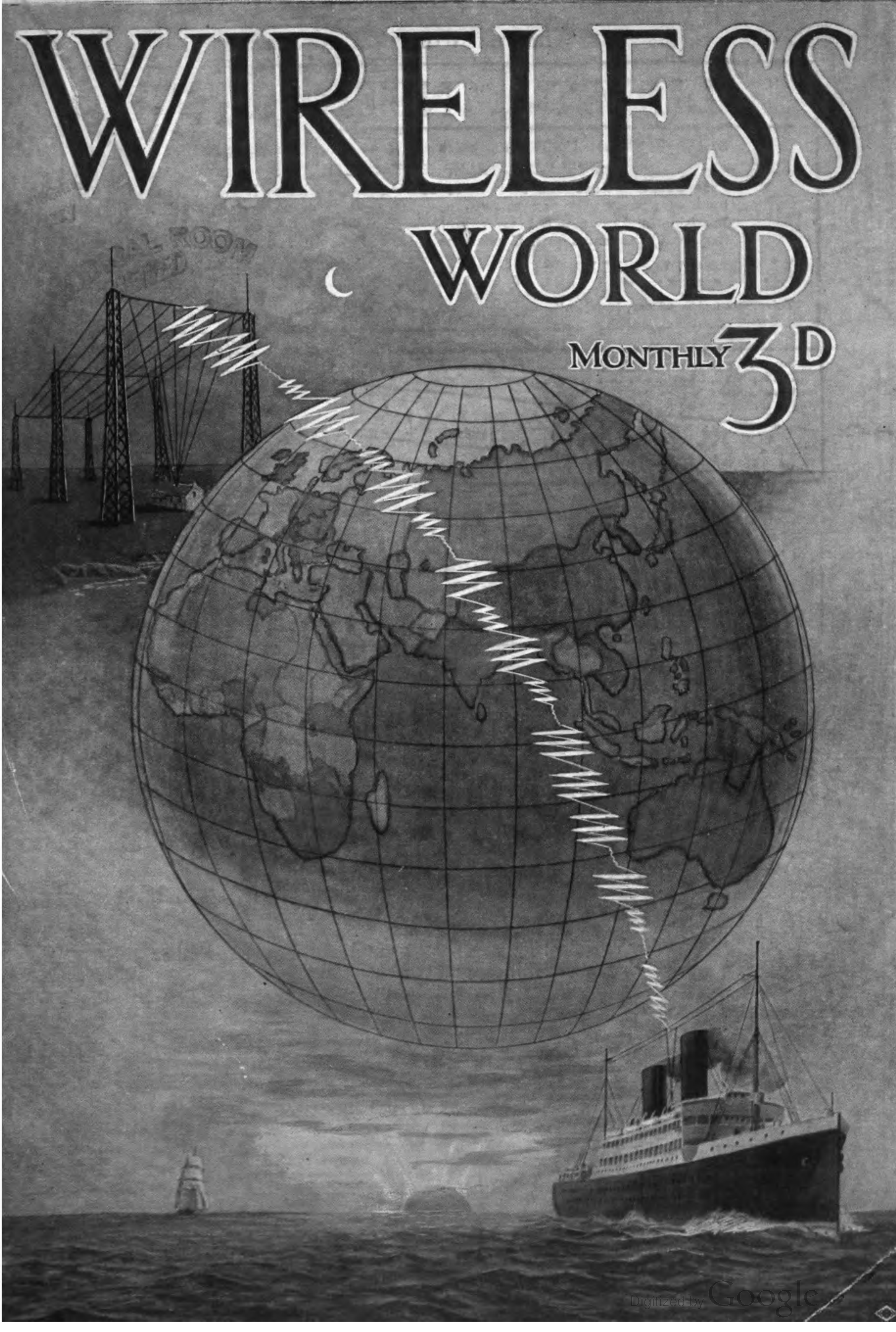


THE WIRELESS WORLD

Vol. 3.—No. 34. (New Series) January, 1916. Subscription 5/0 per annum post free. Price 3d. Post Free 5d.

VISCOUNT FRENCH AND WIRELESS TELEGRAPHY

On December 18th Sir John French issued his valedictory Order of the Day to the British Army in France after a close association extending over sixteen months of crowded events. The language employed is worthy of the occasion, and a great deal is contained in the simple words addressed to every unit under his power, "I thank them all." Amongst those, included in the distinguished Englishman's farewell appreciation, is the army of *wireless telegraphists*, with whose good work Sir John has been much impressed, and whose efforts in the general working of the vast organisation under his command have been adumbrated in our pages, but cannot be dealt with in detail until after the cessation of hostilities.

It is interesting to reflect that in 1867, when our great military hero was serving as naval cadet on the *Britannia*, James Clark Maxwell read his famous paper before the Royal Society, laying down the theory of electro-magnetism and predicting the discovery of the electrical waves which are now used in radio-telegraphy.

In regard to this early connection of our British soldier with the Navy, some of our readers will probably remember that a young *German* contemporary, Heinrich Rudolph Hertz, who early turned his attention to the development of Maxwell's electro-magnetic theory, became (in 1883) *Privat Docent* at Kiel University contemporaneously with the first decade of French's military career. Wireless telegraphy, which employs what is still often known as Hertzian Waves, has become an essential part of the organisation of all navies; but, whilst that of French's Motherland is employing it in all the "Seven Seas," German naval radio-telegraphy is still confined to the neighbourhood of Kiel.

Simultaneously with General French's first command in South Africa in 1889, the British War Office adopted the Marconi apparatus for use in the field, and six electricians left England in November for South Africa, taking sets of apparatus with them. On the sun-baked veldts this new branch of British military science demonstrated its utility, and the staff and sets of apparatus supplied by the Marconi Company were ultimately transferred to the Navy. They thus formed the nucleus of that vast wireless organisation which now renders possible the manœuvring of fleets in a way utterly undreamt of in olden days.

We do not wish to "labour" the connection; but we believe that the few points, above referred to, suffice to indicate that the development of Viscount French's military efficiency and his gloriously strenuous career have coincided with the forward march of the science which plays a large and ever-increasing part in the manipulation, as a coherent whole, of the vast numbers of soldiers who take part in a modern campaign. The latest addition to our British peerage has witnessed at once the growth of British armies from a few thousands to millions of men, and simultaneously with this the development of the practical application of a science which, invaluable in peace time, is absolutely indispensable for handling the gigantic armies used in modern warfare.

MAJOR C. G. C. CRAWLEY,
R.M.A., M.I.E.E., F.R.G.S.

Personalities in the Wireless World

MAJOR C. G. C. CRAWLEY, R.M.A., M.I.E.E., F.R.G.S.

IN our issue of May, 1915, we were enabled to put before our readers a portrait and biography of Commander F. G. Loring, R.N., who holds the important and responsible position of Inspector of Wireless Telegraphy at the General Post Office, London.

The subject of our illustration, Major C. G. C. Crawley, R.M.A., M.I.E.E., F.R.G.S., acts in the capacity of Deputy Inspector of Wireless Telegraphy at the General Post Office and so is brought very closely into touch with Commander Loring, to whom he has rendered considerable assistance in connection with naval wireless. He early nurtured a desire to acquaint himself with matters pertaining to radio telegraphy and his life has been almost exclusively devoted to matters in connection with it.

As early in the history of wireless telegraphy as 1903 he was engaged at that particular work on behalf of the British Navy. On account of the present war we are unable to say anything with regard to the working of radio telegraphy or its application to the needs of the moment, but we can say that those who are engaged in it find their time fully occupied and possess very little leisure in which to indulge in anything else, either in the nature of work or hobby. Major Crawley held this position with distinction until 1913.

Desiring to widen his scope he entered the service of the Post Office, where he remained until the outbreak of war in August, 1914. Immediately on this calamity overtaking the country he was lent to the Admiralty for wireless service, his services being of the greatest value.

Major Crawley became so expert in the science that for six years he was employed as Experimental Officer and Instructor of the Naval Wireless Schools, and for over three years as Wireless Telegraph Officer on the staff of Admirals afloat. Some years ago the subject of our illustration was made a member of the Institute of Electrical Engineers, and in this connection it is interesting to note that Mr. (now Senatore) Marconi was one of his nominators for membership. About the same time also he became a Fellow of the Royal Geographical Society.

During his career Major Crawley has been present at most of the demonstrations of various systems of wireless telegraphy given for the Admiralty, and more recently for the Post Office, and has always been in close touch with the developments of commercial as well as naval radio communication.

His work at the Post Office was largely in connection with the British Imperial Wireless Scheme, and it was he who selected sites for several stations.

Although the incident possesses no wireless interest, yet it is gratifying to note that Major Crawley received the Royal Humane Society's testimonial for saving a boy from drowning, and it affords us very great pleasure to make mention of this gallant act.

The Special Problems of Aircraft Wireless—II.

By H. M. DOWSETT, A.M.I.E.E.

The Aircraft Aerial.

THE aerial seldom departs from the simple form of a single weighted wire uncoiled from a reel mounted on the edge of the balloon or airship car, or aeroplane frame, and hanging clear in space. The wire may be bare stranded copper or bronze, copper-plated stranded steel, or copper-braided hemp. To simplify and speed up tuning, the reel may be fitted with a counter, and the wire painted say every ten or twenty feet.

The free balloon is carried by the wind, and its aerial therefore hangs almost vertical, Fig. 1 (*a*).

An airship aerial encounters greatest air resistance at its bottom end, and least where it is attached to the car. It therefore has the shape shown in Fig. 1 (*b*) (see diagram on page 651). An aeroplane aerial travels against the full resisting force of the air, and therefore takes either the shape shown in Fig. 1 (*c*) when weighted with a heavy bob, or the shape Fig. 1 (*d*) when weighted with a light bob.

Trailing wires affect the speed and manœuvring of aircraft. An airship will be little influenced by a single hanging aerial wire, but in the case of an aeroplane an aerial disturbs its equilibrium. A weighted aerial, Fig. 1 (*c*), will completely alter the flying characteristics of a machine, and this alteration will depend considerably on the point of attachment of the aerial fitting to the frame. For this reason the more vertical type of aeroplane aerial, which should be more efficient for transmission, is less used than the horizontal type which has less influence on speed, manœuvring and stability. It is obvious that the larger the machine and the more powerful its engines the less will its stability be affected by the vertical type of aerial.

The wire may be fixed to the reel by a

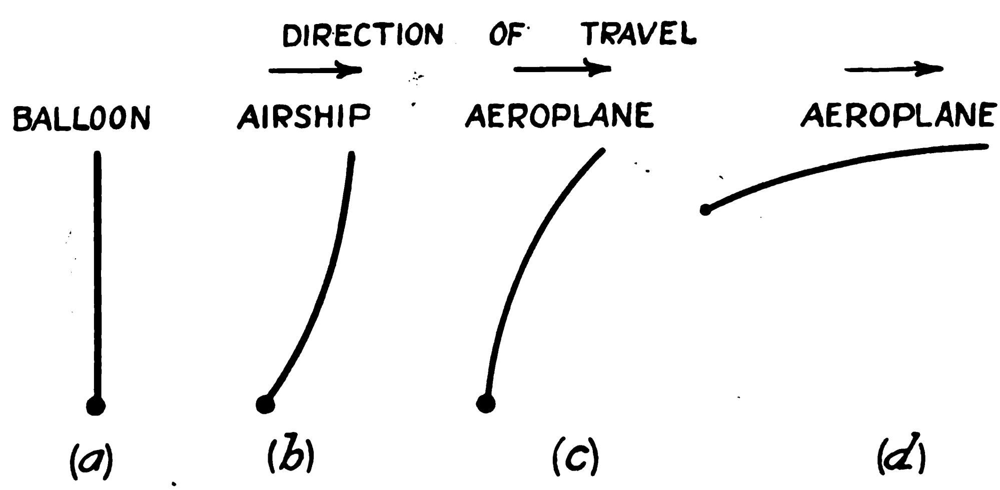


Fig. 1.

safety catch, so that should it foul any ground object it comes away, or it may be inset at intervals with breaking points at which the wire parts under a given stress, say 20 lbs., or again it may be of such a section that its own breaking strain is low enough not to require such safeguards. On some aeroplane sets the wire runs off the reel between the jaws of spring cutters which can be worked automatically by the pilot at an instant's notice to avoid accident when suddenly landing, vol-planing, or when engine trouble develops.

Aircraft Balancing Capacities.
The Free Balloon.

Fig. 2 shows the essential parts of a free balloon. A balloon of 40,000 cubic feet contents, may have a metal valve line and metal ripping cord instead of the usual hemp, the valve and valve seating may be of metal instead of wood, the valve spring is steel, the wooden hoop is bound with steel wire, and the grapnel is of iron. But none of this metal work is suitable for use as balancing capacity. If the valve line were to be used, by adding an aerial to its lower end, the danger from atmospheric electricity due to charge on the wire in the gas bag—and particularly where it enters the gas bag—would be increased.

Suppose the whole balloon envelope were to be metalised. Then the internal metal parts would be screened against atmospheric charge, maximum capacity would be obtained, and minimum ohmic resistance, all good and useful qualities. But the resulting period of oscillation would not be the greatest obtainable from the balloon considered simply as a supporting surface for a capacity, and this is a point of prime importance as the shortest working wave-length is considerably greater than the natural wave of the largest free balloon aerial system.

The natural wave emitted by a conducting sphere on which the charge oscillates from pole to pole has a length 1·4 times the sphere's diameter; whereas a single thin wire equal in length to the sphere's diameter will emit a wave of twice its own length.

A metalised balloon of the size mentioned above, and therefore having a diameter of 42·5 feet, should respond fundamentally to a space wave of 59·5 feet (18 metres), whereas the natural wave of its valve line—neglecting

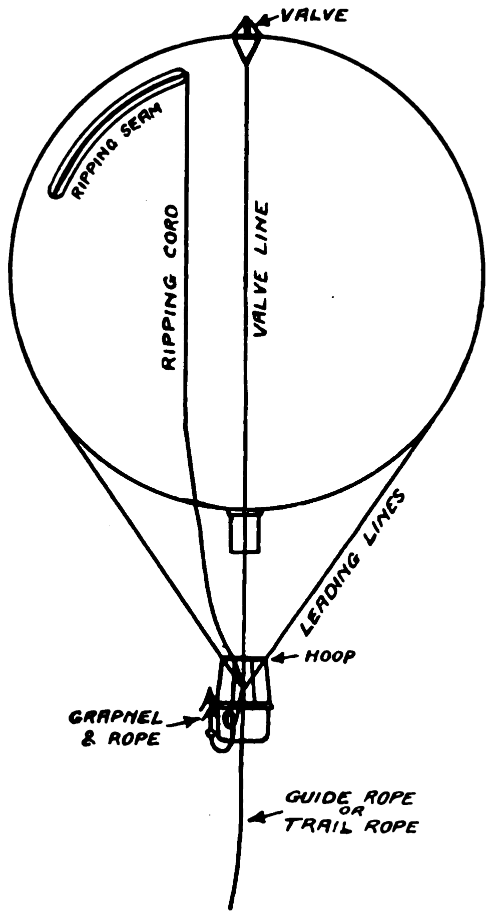


Fig. 2.

that part of it which is outside the gas bag—should be 85 feet (26 metres), and the natural wave of a single wire laid on the envelope from the valve to the neck should be 119 feet (36 metres).

These wave-lengths would be a little more than doubled if the balloon capacity provided only half the oscillator as it would do in practice, the other half being the hanging aerial, as the aerial would have the effect of slightly increasing the balloon capacity.

The balloon envelope may be covered with a fairly wide wire mesh instead of a continuous conducting surface, without losing an appreciable amount of its effective capacity. A 6-inch mesh on a balloon of 40 feet diameter, for instance, would not reduce it by more than about 2 per cent.

All the above facts require to be borne in

Fig. 3.

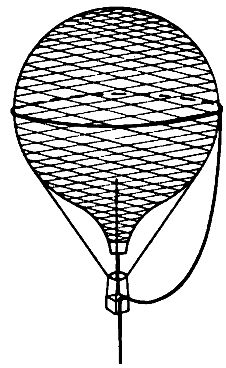


Fig. 4.

mind when considering the relative value of the different arrangements of balancing capacity which have been used at various times, and are illustrated in the figures which follow.

Fig. 3 represents a fairly close approach to a metalised balloon. A number of wires follow the leading lines to the net, a large number of other wires being laced through the net and extending over the whole envelope from the car to the valve, forming a wire cage to which is connected all the metal balloon fittings (Meyenburg). Obviously only small gauge wire could be used for this purpose, about No. 20 S.W.G. (1 mm. diameter) as minimum weight is always a first consideration.

The short wires are supposed to act as a balance for a short aerial, and the long wires as a balance for a long aerial, but the difficulty of obtaining a sufficiently large balancing capacity for the usual working wavelengths cannot properly be met, and in practice in order to get an extended range of reception, it is often found better to use a much longer aerial than the length equivalent to the counter capacity—a long trailing aerial being also much more practicable from a balloon than from an airship or aeroplane. As a result, the balloon receiver is seldom placed at the current antinode of the aerial system, it is usually much nearer the node, this disadvantage, however, being compensated for by the sensitiveness of the modern detector.

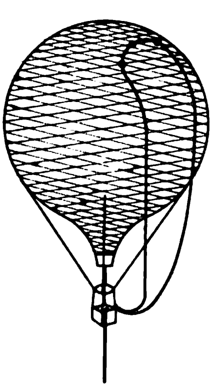


Fig. 5

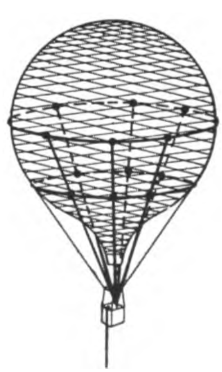


Fig. 6.

A very simple capacity arrangement, one of the first to be tried, is shown in Fig. 4. A single thin bare wire was threaded through the meshes of the net at the balloon's equator, thus forming a ring, and a connection was dropped from this ring to the car (Ludewig). An objection raised against it was that,

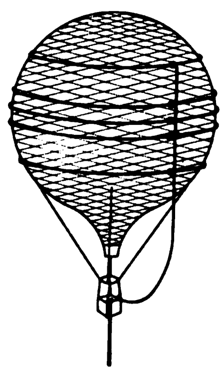


Fig. 7.

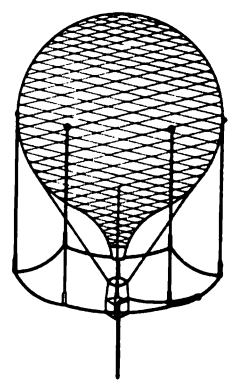


Fig. 8.

under strong atmospheric charge, the single thin wire of the ring would be likely to brush, and ignition of the gas which escapes from the mouth of the rising balloon and mixes with the atmosphere might follow.

Fig. 5 shows a much safer arrangement. A loop of insulated wire No. 20 S.W.G. was fixed to the net, about 6 feet away from the valve at the top, and hanging plumb from the equator downwards. the ends being brought into the car. The top attachments were strips of rubber.

In case of necessity—as, for instance, in a charged atmosphere—the loop could be dismantled by gently and steadily pulling at it until the rubber strips gave way. The loop was also supported by a light cord and pulley so that it could again be hoisted back on to

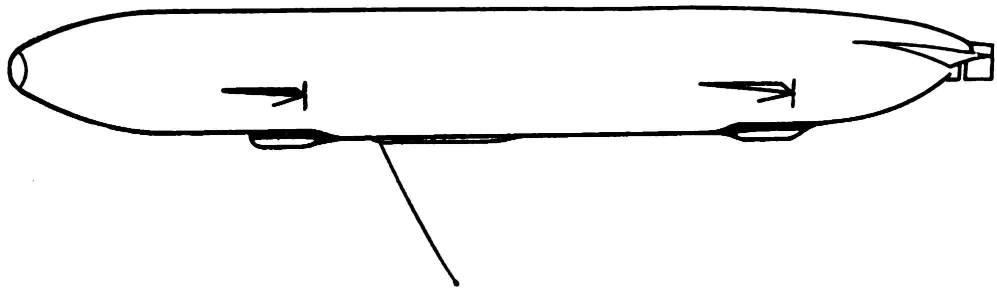


Fig. 10. Zeppelin with Trailing Aerial (see page 648).

the envelope, although not to its original spread-out position (Mosler).

Fig. 6 shows two single rings of No. 20 S.W.G. fixed round the balloon, the top one at the equator, the other 4·5 feet below it. Six wires connect the rings together and lead down to the receiver in the car (Huth). The danger from brushing is reduced by the use of many wires, and this arrangement gives a useful value of capacity.

Another arrangement used is shown in Fig. 7. Three wire rings were fixed on the balloon equator, and two other rings 6 feet above and below respectively which were of insulated wire—the insulation serving to protect the balloon fabric—were connected by a common lead to the receiver (Lutze).

All the above methods of fitting balancing capacities on balloons have been designed and used only for the reception of signals, they were recognised as unsafe for transmitting purposes.

Fig. 8 shows a balancing capacity suitable for transmission which appears to have been used with success, the aerial high tension currents introducing no fire-risk to the balloon. A wire ring hung on porcelain insulators with a slight sag, was supported at about the level of the car by six light cords suspended from the balloon equator round which they were equally spaced. A lead was taken from the ring to one side of the transmitter, the other side being connected in the normal way to the trailing aerial (Ludewig).

An obvious improvement introducing no additional risk would be to extend the ring into a small cage, by adding short lengths of vertical wire between the insulators and the wire ring.

Finally, in order to put them in true perspective, it may be worth while to give a rough estimate of the range of capacity and resonance wave-lengths of these various balancing capacities, treating each as a half oscillator, the other half being the trailing aerial.

Thus, a metalised balloon of 40,000 cubic feet contents would have a capacity of about 660 c/ms. and a wave-length of about 40 metres. When fitted with the arrangement shown in Fig. 6, a capacity of about 260 c/ms. and a wave-length of about 150 metres, and when fitted with the arrangement shown in Fig. 4, a capacity of about 216 c/ms. and wave-length of about 180 metres.

(To be continued.)

WIRELESS AT BOWES PARK.

AN amusing piece of information has just come into our hands. A youth of 17 at Bowes Park has attained to a certain degree of proficiency in wireless telegraphy, and before the war possessed a radio-apparatus. The neighbours declared that they quite recently heard the wireless spark, the sound emanating from the house where the young man resides. On reaching home one evening he was met by the police, who informed him that they were armed with a search warrant, and prepared to arrest him in order to defend the realm. They did not actually search the place, however, being convinced by the boy's explanation and disclaimer. He told the constable that he had invented a new type of motor-horn with a novel musical note, and that possibly this was the noise which had been mistaken for the wireless spark. The police took their departure, with the explanation that they were bound to investigate all rumours or complaints, whether well or ill-founded.

Digest of Wireless Literature

ABSTRACTS OF IMPORTANT ORIGINAL ARTICLES DEALING WITH WIRELESS TELEGRAPHY AND COMMUNICATIONS READ BEFORE SCIENTIFIC SOCIETIES.

ILLUSTRATIONS FOR TECHNICAL ARTICLES.

Many contributors to this magazine display somewhat insufficient knowledge of what is required for illustrating their articles, and for this reason we think some notes from an article by Mr. H. A. Miles, in the *Post Office Electrical Engineers' Journal,* will prove of assistance to our readers.

Mr. Miles commences by pointing out that several important factors have to be considered in the matter of illustrations. Blocks or lantern slides may be prepared from line drawings or photographs. Prints for the latter purpose should be from clean, sharp negatives, and on glossy P.O.P. bromide or gaslight paper. A bromide print is often used as a base on which to prepare a line drawing. The necessary photographic details are outlined and other work executed on the print with waterproof black ink, after which the photographic image is bleached out. This affords a simple method in cases where the complexity of the subject or the draughtsman's want of time or skill renders impracticable the preparation of an elaborate perspective drawing. The majority of illustrations are, however, prepared from line drawings in the usual way.

The preparation of a drawing necessitates the expenditure of a considerable amount of time and trouble, and unless proper care be taken initially the work may require altering, touching up, or re-drawing before it can be of use. The writer says that he has therefore compiled a few hints which, coupled with the essential amount of technical skill in draughtsmanship, will, he hopes, enable anyone to attain a satisfactory result. Artists, draughtsmen, and their near relatives, the authors, are from the first trained carefully to take a very one-sided view of things. Were they to forget this, and decorate both sides of the paper, their work would in all probability go to swell the contents of the editorial wastepaper basket.

The material on which drawings for reproduction are prepared should be smooth and white—either "Turkey Mill" paper or "Bristol Board" will give the best results, but bluish (not yellow) tracing linen may be used if a tracing offers any great advantage over a drawing. Only the blackest inks should be employed. All drawings for reproduction should be prepared to an enlarged scale, but the breadth of the lines and size of the lettering must be proportionately exaggerated so as to bear subsequent reduction. Illustrations for articles in this magazine should preferably be drawn about twice the size they would probably appear.

The art of drawing successfully for illustrations is one not easily acquired. Bold, striking effects, unfettered by a multiplicity of dotted lines representing hidden details, are best, and though shade lines are a distinct advantage if used judiciously, they can, if employed unwisely, obscure rather than elucidate details. A good maxim is never to introduce an unnecessary line or to omit one which is needed.

* * *

A KEYBOARD OPERATED RECEIVING SET.

The November issue of the *Wireless Age* contains an article from the pen of Mr. Austin C. Lescarboura, in which he describes an apparatus brought out by a New York inventor for the purpose of simplifying the operation of a wireless receiver. Whether or not the operation is really simplified by the complicated apparatus described in the article we will leave our readers to judge from the description given.

The writer commences by saying that although wireless receivers of to-day are comparatively simple, yet the equipments in common use have not yet reached the stage where they can be employed by folk generally, as have the telephone, the telegraph—in the form of the stock quotation machine—and other inventions. A New York inventor has now evolved a wireless receiving set in which all the operations are controlled from a simple keyboard. No longer is it necessary to manipulate a varied collection of sliders, handles, switch-levers or delicate detectors. Instead, the unskilled can sit before the cabinet and press the different keys that control the several operations.

The automatic receiving set, as it is called by its inventor, Mr. Walter Goodchild, represents a number of mechanical movements applied to wireless apparatus, closely following standard practice. The mechanical movements are controlled by electro-magnets, the circuits of which are regulated from a keyboard. The set comprises essentially an inductive tuner, extra inductance coils for the primary and secondary circuits, primary and secondary variable condensers, a fixed detector that requires no adjustment, a fixed condenser, telephones and other accessories found in standard receiving sets. The apparatus is contained in a compact cabinet, and controlled from a keyboard of ten keys located in front. The relative values of primary and secondary inductance on the loose-coupler coils, the loading coils, the coupling and the primary and secondary condensers are constantly indicated by a number of dials and movable pointers. It is asserted that the set will tune to 12,000 metres, and that every tuning operation, from the minimum to the maximum value, can be accomplished in twelve seconds.

The ten keys of the keyboard are divided into five groups, each consisting of an "In" and an "Out" key. Both keys perform the same function in the opposite manner. Thus depressing a certain "In" key will increase inductance, and depressing the corresponding "Out" key will reduce inductance in the particular circuit. The first step in operating the set is to make the coupling as tight as possible. This is accomplished by pressing the "In" key of the first group. Then follows the rough adjustment of the primary and secondary circuits by means of the loading coil keys. Fine tuning is then carried out with the variable condenser keys, the necessary coupling being adjusted by the "Out" key of the first group.

The inductive tuner of the set is ingeniously constructed. It consists of four flat spools, two of which are fixed and two movable. The latter are mounted on a framework that can be driven forward or backward by means of a spiral drive that is rotated in either direction by pressing the "In" and "Out" keys of the first group. Thus the coupling of the tuner is readily varied. The primary and secondary consist of two spools each, an active spool and an auxiliary or inactive spool, which are mounted on axles so that they can rotate. The winding is in the form of a flat copper ribbon of almost the same width as the groove in the spools. The under side of the ribbon is coated with insulating enamel. When the "In" button of the second group is depressed the two primary spools rotate, so that the ribbon unwinds from the auxiliary spool on to the active spool, thus putting in more inductance in the primary circuit. Pressing the "Out" button causes the spools to rotate in the opposite direction, removing the winding from the active spool on to the inactive spool or auxiliary spool. The same action takes place in the secondary spools.

The connections with the copper ribbon are effected in a novel manner. The inner end of the winding is connected to the shaft of the spool, while the outer end of the active winding is connected by means of a spiral brass belt that fits into the groove, and also serves to guide the ribbon. The brass belt passes over a metal pulley which connects with a binding post.

The driving of the spools in either direction and the altering of the coupling are effected by means of a small motor and friction clutches. Individual motors work the two variable condensers in a similar way. The inductances are altered by a ratchet movement worked by electro-magnets, the studs being put in or out of circuit one at a time. The motors are normally at rest and only come into action when the keys are depressed. Thus on pressing the "Out" key of the coupling device the coupling will get looser and looser until the key is released. A rectifying detector that requires no adjustment and cannot burn out is used, so that the operator is not troubled in this connection. Dials provided with movable indicators are located in front of the cabinet, so that the relative amount of the coupling, loading coils and loose coupling inductance and primary and secondary capacity may be determined at a glance.

In our opinion an operator who knows enough of practical wireless to judge which key to depress and which capacities and inductances to vary when he desires to receive certain signals surely is sufficiently skilled to adjust an ordinary receiving apparatus. However, opinions on this point will probably differ.

* * *

INSTALLATION AND WORKING OF STORAGE BATTERIES.

The importance of keeping the storage battery of a wireless installation in good condition cannot be overestimated. In a paper recently read before the Association of Supervising Engineers, Mr. R. Rankin gave some sound rules, which it would be well for many wireless operators and engineers seriously to study. Some of these rules we reproduce herewith.

1. *Do Not Discharge below the Limits Specified by the Makers.*

It must not be assumed that an engineer can put his battery on load at any time and at any current it will carry unless it is at the time in a fit condition. What a battery can do at any time depends on what it has already done at that time. In this respect it differs from a generator. If it is intended to use a battery at unexpected or irregular times steps must be taken to have it as far as possible always ready in a charged condition. If this is arranged, even a small battery will deal with emergencies which would very much overtax a generator of the same normal rating, the overload capacity of a battery in current being enormously high.

2. *Do Not Have the Battery in a Discharged Condition Longer than is Unavoidable.*

3. *Make Sure that Every Charge is a Full One.*

4. *Unless for Special Reasons Charge Only at the Specified Rate.*

If the discharge is always continued until a definite total voltage is reached, and if the switchboard voltmeter is reading high, the battery may be overdischarged on every discharge, and the effect will be disastrous. Cells slightly lower in capacity than those in the body of the battery will get into bad condition, and will never get a chance to pull round again.

5. *Do Not Predetermine the Charge as a Definite Percentage of the Discharge.*

6. *Attend to Defective Cells at Once.* If low or sick cells are not attended to at once each discharge will bring them into worse condition, and if the trouble is not attended to and removed the cells may be ruined. It may be observed that the amount by which they are out of line with or lower than the others need only be small to give trouble of this sort a beginning. Where cells are properly charged, however, the usual excess charge is sufficient to level up small inequalities in the condition of the cells, but if a few of the cells are allowed to get very low in condition, and the battery as a whole therefore seems low in capacity, nothing but harm can result from overcharging the whole battery on their account.

7. *Check Periodically the Accuracy of the Instruments.*

8. *Keep the Level of the Electrolyte Above the Tops of the Plates by the Addition of Pure Water only.*

* * *

A NEW TYPE OF SPARK-GAP.

The *Electrician* in a recent issue published a translation of a paper by B. Thieme on "An Adjustable Prism-shaped Multiple Spark-Gap." The usual quenched spark and explosive gaps for wireless telegraphy, says the writer, are far from being all that is desired, owing to their rapid deterioration; in fact, the attainment of a pure quenching and impact excitation is practically impossible with the irregular burning away of the sparking surfaces such as generally occurs. It is impossible to avoid burning away the sparking surfaces in the course of time, and the question arises how it is possible to provide for such wireless stations as have, with no reserve of spare parts, to remain at sea for long periods, or, like meteorological stations, have to get along without skilled assistance.

Cylindrical spark-gaps, consisting of silvered copper cylinders provided with means of rotating the discs, are known, such rotation being for the purpose of surmounting the difficulty of the eating away of the electrode material. Such gaps, of which several are used in series, often give good service, but even in their case the spark fairly easily eats into the metal, and then remains fixed at the spot thus affected, so that the quenching effect after a short period of use is mostly very small. The cause of this is to be sought in two directions—namely, first the curvature of the cylinders, due to which the sparks are compelled to pass only at the immediately contiguous edges of the cylinders, and there is a very small area; and secondly, the fact that the separation of the cylinders is never absolutely the same, so that at various places on the sparking line a field of different strength is set up, which behaviour also does not contribute to an enhancement of the quenching effect.

In the author's attempts to produce a spark-gap possessing all the advantages he commenced by employing for his cylinder gap cylinders provided with tungsten coatings, and eventually the cylinders were made entirely of tungsten. These spark-gaps, which have been more fully described in the *Zeitschrift für Technische Physik* (Vol. 2, page 5, 1914) are, however, designed mainly for what may be called technical stations, while the author is concerned, in the present case, more particularly in providing a spark-gap suitable for all purposes, which should not only be as simple as possible to produce, but which could be used for various loadings and different sending methods.

The electrodes were for this purpose no longer cylinders, but were made in the form of prisms; a regular octagonal prism proved the most practical. Several such prisms are connected in series. By laying the prisms on a plane surface parallelism of the sparking surfaces is secured. When, after long-continued use, the sparking surfaces get eaten away, the whole lot of the active prism surfaces can at once be renewed by the simple expedient of lifting them out of their seating and turning them one-eighth of a revolution (the amount of one face).

For the different purposes for which they are to be used the separate prism surfaces can be coated with different materials; the arrangement thus allows for a wide range of adaptability.

In cases where the load may be at times very different from that at other times it is not proposed to adjust for such loads by means of short-circuiting one or more of the gaps, the prisms can be made with unequal sides, so that surfaces of greater or smaller area are opposite to one another (for the purpose of securing low spark decrement).

For adjusting the sparking distance, each pair of prisms is made into one unit, the axes being fastened together, though insulated from one another; each such pair can be interchanged, and can be shifted with respect to the other prism units, perpendicularly to the axial direction and the axial plane. In this way a fine adjustment of the electrode separating distance is obtained by mechanical means in a very simple manner, so that in order to obtain the lowest possible damping the length of the separating spark-gaps can be shortened, even whilst sending is being carried on, to near the limit of the quenching action. The advantage of such an arrangement is obvious. The mechanical micrometric adjustment has the advantage that the irregularities in the electrode separation are almost entirely obviated. As a result of this adjustability the station is in any event capable of handling a larger output.

ANOTHER LITTLE PROBLEM.

On page 661 of this issue we give particulars of a novel prize scheme in which readers both at home and abroad can participate. Meanwhile, we have pleasure in presenting the following little problem which is typical of the class which we desire to receive, and which we are sure will afford much amusement among wireless amateurs and their friends.

Given two steel rods exactly alike in appearance, you are told that one is a magnet. How would you tell which piece is the magnet if you had nothing with which to suspend the rods, no point to poise the rods upon, no other pieces of iron or steel to attract, and no instruments of any kind?

The above problem, the answer to which will be published in the February issue, is submitted by Electrician H. Christie, R.N., of H.M.S. *Bonaventure*.

The Trans-Pacific Service

Further Notes on the Honolulu Station

SUPPLEMENTING the interesting article which we published in our October number, we have now received further data and some new photographs relating to the wireless stations at Hawaii. These, we think, will interest both the general reader and the expert who watches with satisfaction the extension of the ever-growing network of great stations for long-distance radiotelegraphic communication.

In the Hawaiian Islands there are two Marconi stations, one for transmission, and the other for reception, thus following the modern practice of separating the transmitter and receiver in large stations, so as to enable duplex working to be adopted.

The transmitting station is located at Kahuku, the northernmost point of the Island of Oahu, about thirty miles from the city of Honolulu. It is on a strip of low land a mile wide, lying behind coral reefs. Directly south of this strip the mountains rise to considerable height.

The prevailing winds are from the north and catch the salt spray made by the waves dashing on the coral reefs, carrying it over this narrow strip of land to such an extent that scarcely any vegetation has the hardiness to withstand the onslaught.

The receiving and operating station is located at Koko Head, about nine miles west of Honolulu on the south-west corner of the island. This section is on the lee of the island, and is protected from heavy winds by the mountains to the north. The country here is productive, vegetation luxuriant, and withal has a beautiful location.

At the transmitting station the power house is a building of steel and concrete fireproof construction throughout. It is divided into three parts: to the left is the power generating and containing boilers, smoke stack, economisers, turbines, condensers, etc.; the centre portion consists of discharger rooms, the ceiling of which forms a gallery for the wireless apparatus, such as oscillation transformers, inductances, switch keys, etc. The left end of the building is the electrical condenser room. In the boiler room are two 302 H.P. boilers,

View near Honolulu.

Power House (note Insulators on 32 Aerial Wires).

oil fired, supplying superheated steam to turbines of the high-speed geared type for the main units and low-speed direct-connected turbines for the auxiliary units.

The fuel oil to supply the boilers is brought from California in tank vessels, and loaded at Honolulu into tank cars on the Oahu railroad. This road follows the westerly shore line of the island to a siding at the plant. The oil is pumped from cars into two large storage tanks of sufficient capacity to contain a month's supply.

There are three main generating units of 500 H.P. each, one on the San Francisco circuit, one on the Japan circuit, with the third as a spare. These are turbines geared to 300 K.V.A., single phase, 2,000 volt revolving field alternators so located that their extension shafts extend into the discharger rooms to drive synchronously the disc dischargers. Two 125 H.P. turbines directly connected to 100 kw. D.C. 125 volt generators supply current for excitation auxiliary motor feed and lighting. From each main generator the current is raised in five transformers to the condenser charging voltage. From these transformers the current is carried up on to the wireless gallery over the discharger rooms. Here are located choke coils and low-frequency tuning coils, and busses leading to the discharger below to the oscillation transformer and condenser room.

The primary of the oscillation transformer consists of a coil of three turns about 4 feet in diameter. The dischargers are of the rotating-disc type with air-blast quenching. These can either be driven synchronously on the shaft of the main generators or synchronously by separate motors. They are enclosed in sound-proof rooms made with double walls, the space between being filled with a sound insulating material.

An observers' station is made at one end of the gallery, from which point of vantage the engineer on watch has an unobstructed view over the engine room, wireless gear and the condenser room.

The condenser room has two banks of condensers, each consisting of 384 units, and of 3½ mfd. capacity. These are fed by a radiating system of busses so arranged that the current path to every tank in the room is exactly the same length, thus assuring that each tank takes its proportionate share of the total load.

The construction of the units of this bank is noteworthy. They consist of stoneware tanks, each with thirty-one glass plates hung between zinc sheets so arranged in a hard fibre carrier that if a glass sheet breaks the entire contents of the tank can be lifted out as a unit and a new set of plates substituted with a minimum of delay. The broken sheets can then be replaced at leisure.

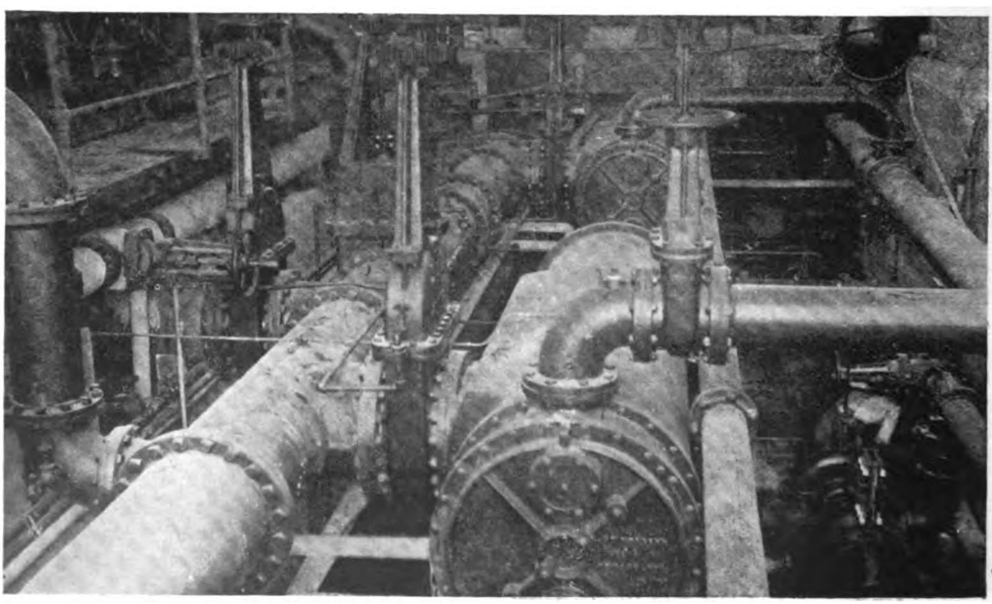
As the station is made for two-way working it is equipped with two aerials, each starting from the power house, the San Francisco aerial extending south-west and the Japan aerial to the east. Twelve masts, each 300 feet high, support the San Francisco aerial. They are arranged in two rows with cross wires joining the tops of each pair. From these cross wires hang insulators supporting the thirty-two silicon bronze wires, each 4,500 feet long, which forms the aerial system. The masts supporting the Japan aerial are similar to the other set, of the same number and arrangement. However, each mast is 450 feet high, and the aerial wires are each 5,000 feet long.

The extremely important matter of a good ground connection has been met by making a continuous ring of zinc plates around the power house, and to this connecting a system of wires buried in the ground parallel to and under the aerial system of each set of masts.

The masts of these stations are of the Marconi type of pressed steel sections bolted together and erected from the base of concrete. The novel feature of construction is the arrangement of guy wires and their connection. To support one of these larger masts requires 12,500 feet of 1-inch diameter steel cable of exceptional tensile strength. The difficulty of the guying problem arises from the necessity of breaking up the lengths of wire at frequent intervals with porcelain insulators. This must be done to prevent absorption of the energy of the wireless waves by the guys, which would occur if any length was long enough to have a period of vibration approximating the wave-length of the transmitting station, or an even division of the wave-length. All energy thus absorbed is lost to any practical work.

The insulators used are of the guy strain type, and capable of carrying a load of 50,000 lb. Every effort has been made to keep the elastic extension of the guys as low as possible. If this extension amounts to only a small percentage of the length of the guy, the mast will vibrate in high winds and exert excessive strain on the guys.

To accomplish this all splices of the rope have been done away with, and the connections at the mast, anchors and insulators made of specially designed bridge sockets which give a perfect and straight pull and develop the full strength of the rope. This is not possible when using any system of



Condenser Pit, Honolulu Station.

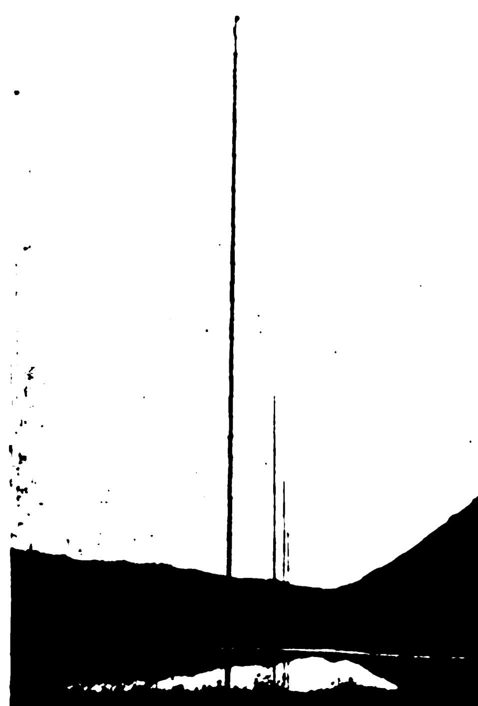
Native Type in Hawaiian Islands.

splicing, and it also permits the use of a rope with a steel core, thus adding about 15 per cent. to the strength for a given diameter of rope. Further, the style of connections used permits the use of a rope of large strands, which not only stands the ravages of the weather better, but also has much less elastic extension than a more flexible cable.

The location of the station at Kahuku is responsible for rapid deterioration of steel due to rust. To combat the ravages of the climate special precautions have been taken. It is found the best paint available has a very short life here. The guys are being protected by painting and serving with a layer of Russian spun yarn. A machine has been developed which will sand-blast any scale or old paint from a guy, give it a good coat of paint and wind it with the spun yarn all in one operation. All that remains for permanent maintenance is a coating of Stockholm tar occasionally. Such a covering is impervious to moisture and the cutting effect of sand and salt spray driven before the wind at Kahuku.

Ordinarily the operating is done at the receiving station at Koko Head, and the transmission effected over a land telegraph line connecting the receiving and transmitting stations. In case of trouble it may be preferred to receive at Kahuku, so an extra two-wire aerial is supported on one line of masts and led to an auxiliary operating building fully equipped with receiving apparatus.

The stations are somewhat distant from a populated or built-up district, so that it is necessary to furnish residences and living quarters for all the operators and employees.



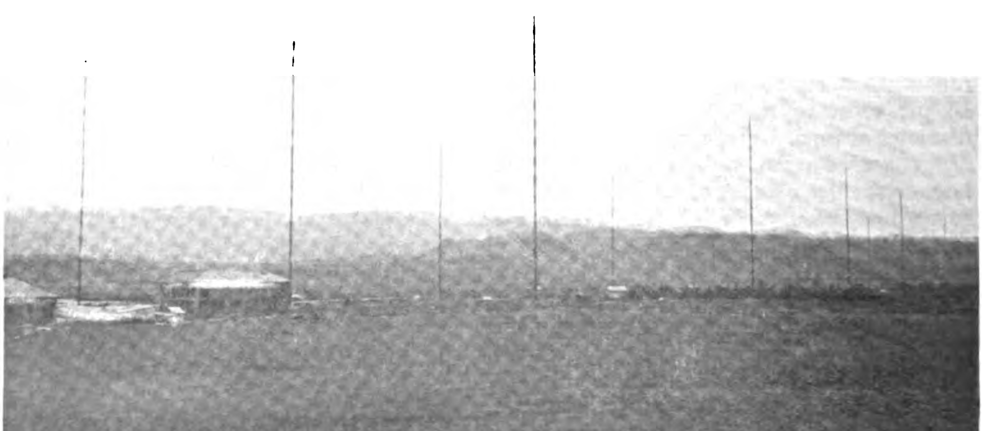
Honolulu Station Masts.

At Kahuku is a small hotel to accommodate about twelve operators, and a cottage for the engineer in charge, and one for the chief turbine engineer, and at Koko Head is an hotel to house about thirty-five operators, with a cottage for the manager and chief operator. The design of all buildings was controlled by a fundamental consideration of providing a permanent type of construction with a minimum charge for maintenance. Fireproof buildings were therefore built of concrete and tile throughout. The roofs are carried by structural steel, on which rests red vitrified roofing tile. The only wood in the buildings is that which occurs in the interior trim and the window and door frames. The residences are of the bungalow type, with five rooms and bath, including living room, dining room, kitchen, two chambers, and bath. At the receiving station, on a basis of thirty-five men, the hotel will provide a room for each man with about one-third of the rooms of larger size than the others, and having private bath attached. Billiard room, card room, reading and writing rooms are also provided. A refrigerating plant, with cold storage room and refrigerators and means to manufacture ice for domestic purposes, are also provided.

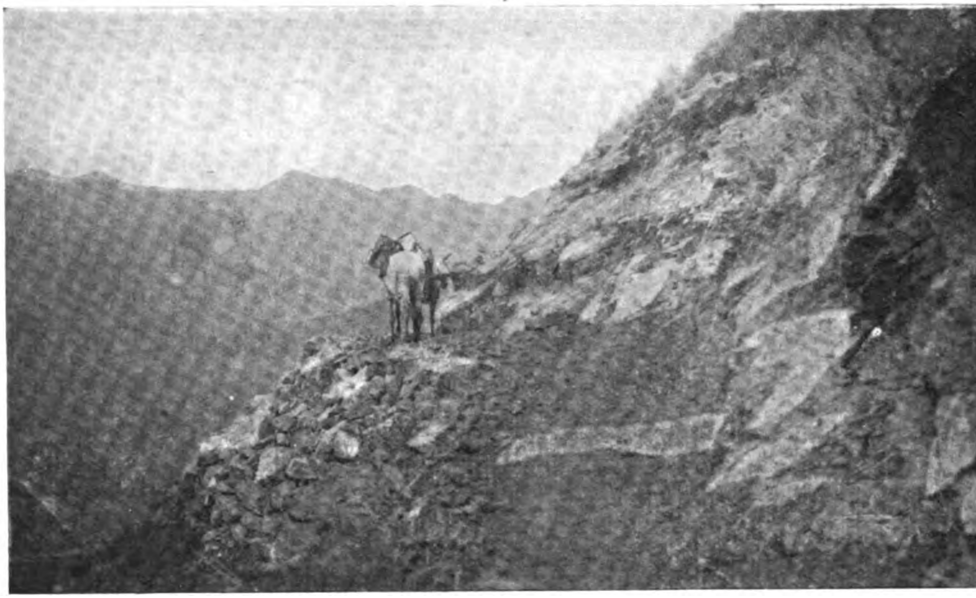
On account of the isolated locations complete water supply and sewer systems are necessary. At Koko Head the water supply is from wells which contain a small percentage of salt. This water is satisfactory for ordinary purposes, but is not potable, and it has therefore been necessary to install distilling apparatus to provide drinking water. All buildings are electrically lighted, and no expense has been spared to make each station as modern and comfortable as is possible.

The aim of the company is to build up a staff which will be contented and loyal. As an aid to this end tennis courts have been built and book and magazine clubs started, also means provided for the men to carry on experiments in wireless work. The desire is to have the force live together as a family, helping each other in education, and to rise in value to themselves and to the service.

At the receiving station is the controlling centre of the system. Here enter the land lines from Honolulu and Kahuku. Operators receive the messages from Honolulu and prepare Wheatstone tape for the automatic transmitters or operate manually the sending key, which in turn actuates the high-power relays at Kahuku. Another set of operators receive the incoming signals and messages.



Another View of Masts.



Mountain Scenery near Honolulu.

The type of receiving apparatus is the same as that used in all of the Marconi long-distance stations, and need not be described here.

To obtain power to operate pumps, ice machine and also furnish current for lighting the hotel and cottages a small power plant has been erected at Koko Head. A crude oil engine of the Diesel type, of 50 H.P., runs a D.C. generator. Storage batteries are provided to carry the load when the engine is shut down, and are of sufficient capacity to run all the equipment for eight hours. One important use for this current is to operate the land operating line between the operating building and the transmitting station.

NEW PRIZE COMPETITION.

OUR readers will remember that in the November issue of this magazine we published an interesting problem relating to the resistance of a wireless cube, and in the Christmas number printed the answer. Since then we have received numerous letters from home and abroad, even from warships at sea, most of them enclosing answers and all testifying to the interest which the problem has aroused. This month we are publishing another problem, the answer to which will appear in the February number. In order still further to exercise the wits of our readers it is our desire to publish other problems, and we therefore offer a prize of ONE GUINEA for the best problem similar to those above referred to. The following conditions must be adhered to:—(1) ALL COMPETING PROBLEMS TO REACH THIS OFFICE BY THE LAST DAY OF FEBRUARY. (2) The Editor reserves to himself the right to publish without payment any or all of the competing problems, but in all cases of publication the name of the reader submitting the problem will be acknowledged. (3) No problem will be considered which is not accompanied by the fully worked-out and correct solution. (4) Competitors must write at the top of their letter-paper the words, "Problem Competition," and no correspondence will be entered into regarding any attempt submitted. (5) Each competitor must fill in and attach to his letter the Competition Coupon printed in this number. (6) The Editor's decision must be accepted as final.

[Under this heading we propose to publish each month communications from our readers dealing with general engineering matters of various kinds in their application to wireless telegraphy, and we would welcome criticisms, remarks and questions relating to the matter published under this heading. We do not hold ourselves responsible for the opinions and statements of our contributors.]

Troubles of a Tropical Wireless Station.

IN the Christmas number we wrote in these columns of the troubles experienced at a snow-bound wireless station. This month we propose to touch upon some of the difficulties which confront the wireless engineer in tropical regions.

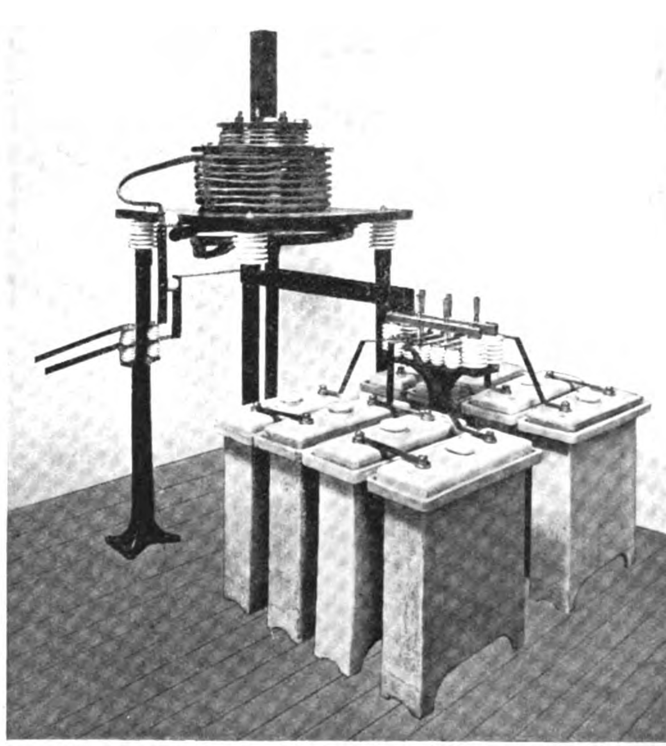
Perusal of the many articles which have appeared in this magazine concerning stations erected in such places as the banks of the Amazon, the Amazon forests, and Bolivia, will have shown our readers that foremost among the many problems is that of transport. Almost without exception a wireless station must generate its own electric current, and this requires that a power plant, consisting either of a boiler and steam engine, or else of an oil engine, be put down. A large station will, of course, require several boilers and duplicate engines, and in many cases the transport of these heavy pieces of machinery presents difficulties only to be overcome by the greatest ingenuity and labour. The erecting engineer may consider himself fortunate if he has a railway running near the spot where the station is to be built, for in this case most of his transport troubles will be readily overcome. In very many cases each piece of machinery has to be carried across country, through jungles and morasses—even over mountain chains.

With regard to the site of a tropical station, this has often to be chosen in forest land and other places where dense vegetation abounds. Recruiting native labour is no easy task for the man in charge, and when a sufficient number of men have been collected together, the work of clearing the site may occupy many weeks. Often a lengthy clearance has to be made from the nearest river to the site, so that the stores and machinery can be brought up as required. In the case of one South American station, where the site was some sixty feet above the river level, an inclined plane had to be cut down the face of the cliff and a short length of track laid in this before the large boilers and parts of machinery could be brought from the barges below.

Steel masts to support the aerial system are almost universally used nowadays, and in any case wood masts, subject as they are to ravages of insects, cannot be erected in many localities. Careful painting at the commencement and frequent renewals of paint afterwards are necessary in the tropics to avoid trouble from corrosion, for the wide differences in temperature between day and night and the frequent mists arising from the marshy lands play havoc with all metalwork not carefully protected. All metal stays have to be similarly treated, otherwise rapid rusting may set in and the stays snap, with consequent disastrous results to the masts.

In the interior of the station numerous minor points need attention. Although commercial wireless apparatus is made sufficiently strong and robust to stand usage in both hot and cold climates, it must not, of course, be unduly exposed to adverse circumstances. Ebonite, for example, if placed in a position where the rays of the tropical sun can fall upon it for hours at a time, will undoubtedly suffer. Wood, too, if exposed in certain conditions will be liable to warp, and so it is one of the aims of the erecting engineer to see that everything is adequately protected.

Porcelain insulation is now largely used where rubber and ebonite are liable to perish. Our illustration shows a portion of a wireless transmitter where this substance is largely used and in which wood casing is conspicuous by its absence.



Portion of Wireless Transmitter.

Such points as the construction of mosquito doors and the precautions necessary to guard the staff against the many little worries of tropical life, scarcely come within the scope of this article, but nevertheless need most careful attention. An adequate supply of stores must always be kept on hand, for it often takes many months for supplies to come out from England. For this and other reasons a well-equipped workshop is a feature of most land stations abroad.

At times it is necessary to overcome strong prejudices of the natives, who are liable to think that the roaring of the spark is the voice of the Devil, and occasions have arisen when the native labourers have suddenly developed hostility from causes difficult to discover. Floods and storms may come upon the busy workers just when such trouble is unexpected, and forest fires may turn the labour of months into a smoking mass of twisted iron and wreckage, so that the work of the wireless engineer in tropical regions is not unattended by risks. We are always glad to hear from readers who have experienced and overcome special difficulties in foreign climes, as this magazine reaches all parts of the globe, and a few notes from a worker in one foreign region may be of special interest and value to another reader in a similar region many hundreds or even thousands of miles away.

AN APPRECIATION.

THE following is an extract from a letter we have received from an air mechanic in the Royal Naval Air Service :—

"I have taken in THE WIRELESS WORLD "for two years, and although I am in the "R.N.A.S. I shall still continue, for in my "opinion it is the very best. If it had not "been for THE WIRELESS WORLD I am "afraid I should never have known any-"thing about wireless, so I will take this "opportunity of thanking you and "your magazine and wishing it every "success."

CORRESPONDENCE

The Calculation of Inductances.

The Editor, THE WIRELESS WORLD.

DEAR SIR,—I thank " Formulæ " for his letter of criticism, and am in entire agreement with him as to communication being the soul of progress, and think that more use might be made of the Correspondence columns of THE WIRELESS WORLD with more advantage resulting to readers.

In many cases querists in various technical and semi-technical periodicals were referred to the formula $L=l\ (\pi DN)^2$ (or in other words that the inductances of different lengths of a uniform solenoid were directly proportional to the lengths), which was obviously absurd, as a few minutes' practical experiment would demonstrate.

Others were referred to some mysterious formula in which a multiplying constant varying between 1 and 3 was included, without any clear instructions how to fix its value under different conditions.

It was in endeavouring to find something more definite that the values of " F " were worked out, and it was unfortunate that the limitations of the formulæ had not been stated with the formulæ.

The article in question was written in June, 1914, long before the most interesting " Instructional Article " was published in the May, 1915, WIRELESS WORLD.

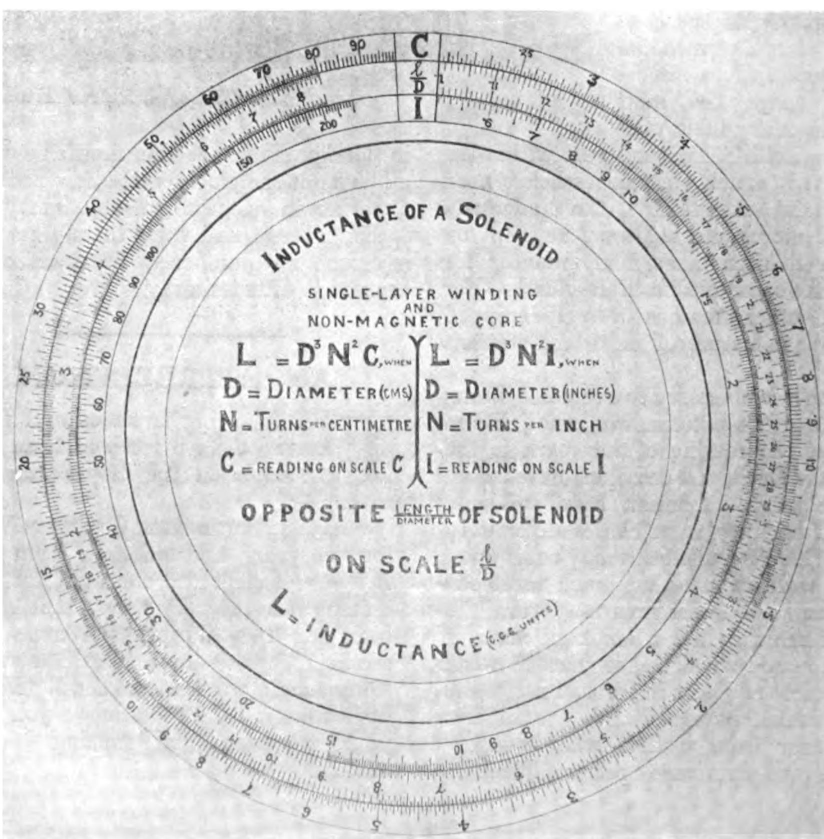
If the formula $L=(\pi\ DN)^2\ lK$ be factorised thus: D^3, N^2, $\frac{\pi^2\ lK}{D}$, the values of the latter factor can be tabulated, when calculation would be considerably simplified.

This has been done in the accompanying circular diagram, and, as the table of values of " K " was not accessible, it is based on the worked out inductances in the table on p. 124 of the May, 1915, number.

If care is taken in reading off the scale values, there should be no difficulty in obtaining a result correct to the formula with an error well below ½ per cent., a sufficient degree of accuracy for all ordinary work.

Yours, etc.,

SAMUEL LOWEY.



Wireless Telegraphy in the War

A résumé of the work which is being accomplished both on land and sea

WE have heard a good deal in the course of the present war concerning "Secret Wireless Stations," but much of what has appeared on the subject in the general Press would hardly seem to warrant serious attention. Secret installations, however, do certainly exist in sober reality, and Sir Cecil Spring-Rice, the British Ambassador to the U.S.A., recently made a communication to Mr. Lansing with reference to a secret German wireless station operating in a suburb of Portland, Maine. British ambassadors do not move in such matters without serious cause for so doing.

* * *

We referred in issue Number 31, of October last, to the model little British campaign in Mesopotamia. The expedition consists of one of those amphibious undertakings which have for very many years formed a speciality of British forces. The paddle-wheel steamers, which constitute the main feature of the naval side, have *not* been captured, as recently claimed by the Germano-Turks. They once plied with passengers in these same waters, and—says Lt.-Col. Sir Mark Sykes—"waddle along with "a barge on either side, one of which contains a *Portable Wireless Station*, whilst "the other transports bullocks for the "traction of heavy guns ashore." Our readers will note with some interest the incidental mention of wireless as natural, and, indeed, indispensable, to the equipment of a modern expeditionary force. An extremely amusing and informative description ends with the following paragraph:

"And this fleet is the cavalry screen, "advance-guard, rear-guard, flank-guard, "railway, general headquarters, heavy "artillery, line of communication, supply "depot, police force, field ambulance, aerial "hangar, and base of supply of the Meso-"potamian Expedition."

* * *

The following extract from a graphic story contributed by a Royal Naval Reservist illustrates the fact that the possession of wireless apparatus, which usually ensures safety, may, under abnormal circumstances, tend in the opposite direction.

Our "handyman" was taking part in the advance up the Tigris above referred to and narrates how, when they were forcing their way past a bend in the river:—

"During the afternoon the Turks sighted "our masthead and *wireless*, and we had to "retire and cut our masthead down, as the "Turks were dropping their shells pretty "close to us. At daybreak on Septem-"ber 27th we all started off to attack with "our batteries on shore and with the gun-"boats. The Turks were ready for us, for "they had quite as many guns as we had, "and four of them were a little bigger. We "had a very lively time for a few hours, but "as usual our gunboats kept creeping up "closer and closer until it got too warm for "them. Then they ran away and left their "guns."

* * *

Our esteemed contemporary the *Yorkshire Post* recently called attention in its causerie columns, appearing under the heading of "Cigarette Papers," to what the writer not unjustly calls the "Wonders of Wireless." Taking as his text the "dis-"tinguishing mark of the Admiralty formed "by the wireless installation crowning its "roof," our contemporary runs through the whole history of the signalling systems, which have for so many centuries centred in the British Admiralty. He starts with the beacons which heralded the approach of the Spanish Armada, and traces the various developments right through to the present-day wireless organisation. The enemies' systematic organisation of wireless "enabled "Berlin at the start of the war to speak "direct to Windhoek, in Damaraland, with "only one relay. But, thanks be to God "and to General Botha, Berlin can do so "no longer!"

* * *

The same lesson of the supersession of all other means of signalling by the science identified with the name Marconi will be found in the November issue of the *United Service Magazine*, where an extremely interesting article on the "Evolution of Flag Signalling in the Royal Navy" is ushered in with the remark that "many of the "functions of flag signalling, even for "harbour work, are in process of being "superseded by a method of communication "more suited to rapidity and secrecy, to "wit: *Wireless Telegraphy*."

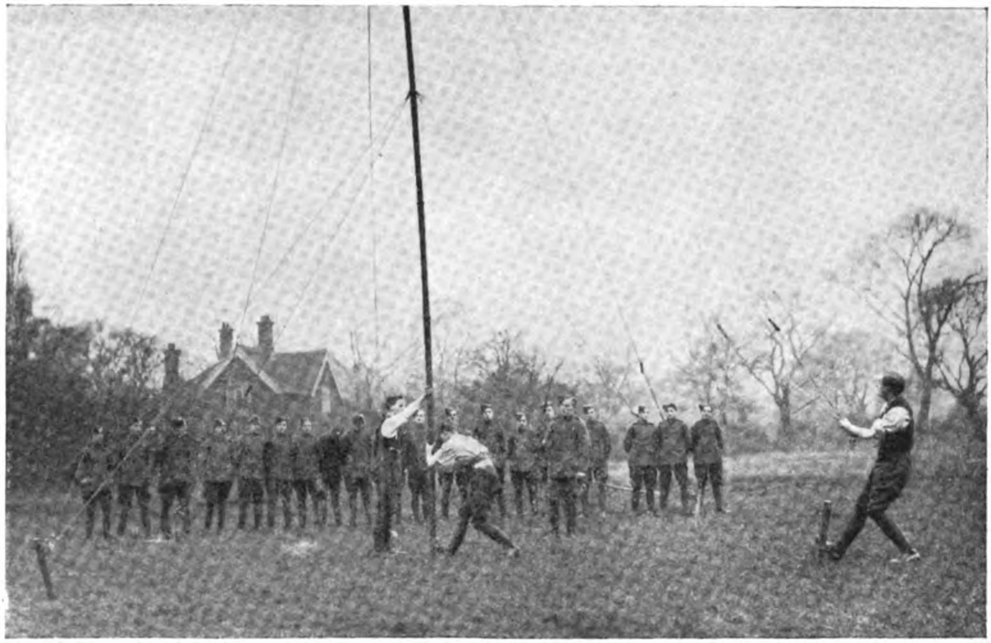
* * *

In our issue of May, 1915, we published an interesting account of the Marconi wireless station at Soller, in the beautiful old Spanish island of Majorca. The operators there recently picked up a wireless message from the Italian liner *Verona* reporting that a large submarine with two periscopes was pursuing her at a speed of fourteen knots. The *Verona* is a large Italian liner with a displacement of over 5,000 tons, plying between Genoa and New York, so that it can be easily understood that the wireless operators who received the message were keenly desirous of finding out what the result might be. Soller station received no confirmation of the pursuit, and was left in doubt concerning the fate of the steamer sending the wireless for some little time. Subsequently, however, private information came to hand which conveyed the fortunate intelligence that the liner succeeded in escaping from her German pursuer under cover of a thick fog.

* * *

Von Tirpitz, from his secret lair in the neighbourhood of Kiel, sometimes indulges in vaporous boasts as to the powers of the German Fleet. He never, however, ventures to put these vaporisings to the test of action, although the British leave him, of set purpose, ample opportunity of so doing. The British sea-dogs proudly boast, "We have not bottled them up—not by any means." But what they have done is to provide that, the moment they show themselves outside their own barriers, *wireless* flashes news to Britain's naval commanders,

Royal Flying Corps out Route Marching.



Royal Flying Corps Erecting Mast.

so that the British Fleet, which lies at moorings in wide and deep though sheltered waters, are certain to be ready for their Teuton foes ere they can issue from their narrow canal and form in battle order. "Der Tag" has been indefinitely postponed.

* * *

We publish in these pages three illustrations of the Royal Flying Corps, whose members are actually engaged in fitting themselves for taking part in the great fight against barbarism and *Kultur*. An important part of their training consists of instruction in "Wireless Telegraphy," and those whose avocation or pleasure takes them, nowadays, along the Strand have become quite familiar with the sight of large numbers of these young men passing to and from Marconi House for instruction in this branch of their duties. Our illustration on page 668 shows the examination of a pupil in the work of transmitting and receiving wireless telegrams; that on this page depicts the field work of erection and dismantling of wireless aerials; whilst on page 666 we see a detachment of the corps out for a route march. From these illustrations our readers will gather a very fair idea of the general appearance, training and uniform of the gallant R.F.C.

* * *

Gradually the great network of German plots and intrigues which have so long permeated the United States are being dragged to light. The American Press is taking a huge and well-justified delight in this mission. It was not long ago since we chronicled in our own pages the history of the abuse of neutrality which culminated in the taking over of the Sayville station; and a trial of historic interest has been successfully conducted in the courts of the United States by the Assistant Public Prosecutor of the American Government. The *Providence Journal* has taken a large part in the elucidation of these stealthy plots, and recently published a copy of a *wireless message*, dated September 5th, addressed to a large bank in New York. The message came ostensibly from a Berlin commercial institution, but in reality emanated from the German Foreign Office, and ordered the payment to Herr Albert of two million dollars. Bribery and corruption on such a gigantic scale are rare in the world's history, but instances of a similar nature have occurred before. The innovation in this instance consists of the fact that, cut off from all other direct communication, the Berlin Government is obliged to conduct its operations by means of *wireless telegraphy*.

* * *

A White Paper issued at the end of November contains interesting correspondence respecting military operations in the Western Pacific opened by an extract from a telegram from Mr. L. Harcourt, Secretary of State for the Colonies, in August, 1914, to the Governor-General of Australia, suggesting that the Australian Government might be willing and able to seize the German Wireless Stations at New Guinea, Yap, in the Marshall Islands, and Mauru on Pleasant Island. Australia accepted the commission and proceeded to carry it out. The published correspondence deals with the progress of the operations of the Expeditionary Force, and the principal human difficulties appear to have been caused by native snipers posted high up in coco-nut trees. Despite all obstacles the Expedition was successful in seizing the *Wireless Station* at Rabaul, New Briton, where the British flag was duly hoisted with picturesque naval and military ceremonial. The correspondence also deals with the capture of the German Wireless vessel *Komet*, and it is interesting to note that, in a war lamentably free from the amenities of chivalry, Dr. Haber, late Governor of German New Guinea, wrote the following testimonial to the courtesy with which he was treated by the British Commander:—

" I may add the expression of the hearty " gratitude which all of our party owe to you " for the courtesy and attention bestowed on " every one of us. I will, of course, be glad " to report to my Government all about the " fair and courteous treatment received by " us from all under your command, and I " hope that my statements will help to " ensure full reciprocity, in case an oppor- " tunity for it should be offered with regard " to British subjects. I take the liberty of " wishing you every further success in your " important command."

* * *

The capture of the German warship *Komet*, just referred to, was marked by several interesting points. She was but a small vessel of 977 tons used for scouting purposes.

Royal Flying Corps—Examination of a pupil in transmitting and receiving.

fitted with wireless and armed with one quick-firing gun. In pre-war days she served as the yacht of the Governor of German New Guinea, but after the outbreak of hostilities was transferred to the German Navy. On "information received" Colonel Holmes, British Administrator in New Guinea, despatched Lieutenant Commander J. M. Jackson in charge of the armed yacht *Nusa* to effect her capture. The *Nusa* herself was a prize taken from the Germans, and on the principle of "set a thief to catch a thief" proved eminently successful. A wireless message reporting the movements of the Australian Fleet was picked up (which was shrewdly surmised to have emanated from the *Komet*), and following up the clue, the German vessel was ultimately located off the North Coast of New Britain. At dusk one Saturday night the *Nusa* dropped anchor close to the unsuspecting foe, and in the morning the *Komet's* masts were seen through the trees 1,500 yards away. Silently and unobserved in the haze, the *Nusa* crept round the point, surprised the enemy and received her surrender. The surprise was complete; the *Komet's* captain, half dressed, was in the act of shaving when the British commander came upon him.

* * *

Mr. Rudyard Kipling has been writing for the *Daily Telegraph* a number of descriptions in his well-known picturesque style under the title of the "Fringes of the Fleet." As his title proclaims Mr. Kipling deals with the auxiliaries of the British Navy, and the following Kiplingesque description may perhaps prove interesting to Wireless readers, and induce them (if they have not already done so) to peruse the whole series of articles. They are well worth it.

"The child in the Pullman-car uniform "just going ashore is a *wireless operator*, aged "nineteen. He is attached to a flagship at "least 120 ft. long, under an Admiral aged "twenty-five, who was, till the other day, "third mate of a North Atlantic tramp, but "who now leads a squadron of six trawlers "to hunt submarines. The principle is "simple enough. Its application depends "on circumstances and surroundings. One "class of German submarines meant for "murder off the coasts may use a winding "and rabbit-like track between shoals where "the choice of water is limited. Their "career is rarely long, but, while it lasts, "moderately exciting. Others, told off for "deep sea assassinations, are attended to "quite quietly and without any excitement "at all. Others, again, work the inside of "the North Sea, making no distinction "between neutrals and Allied ships. These "carry guns, and since their work keeps "them a good deal on the surface, the "Trawler Fleet, as we know, engages them "there—the submarine firing, sinking, and "rising again in unexpected quarters; the "trawler firing, dodging and trying to ram. "The trawlers are strongly built, and can "stand a great deal of punishment. Yet "again, other German submarines hang "about the skirts of fishing-fleets and fire "into the brown of them. When the war "was young this gave splendidly 'frightful' "results, but for some reason or other the "game is not as popular as it used to be."

* * *

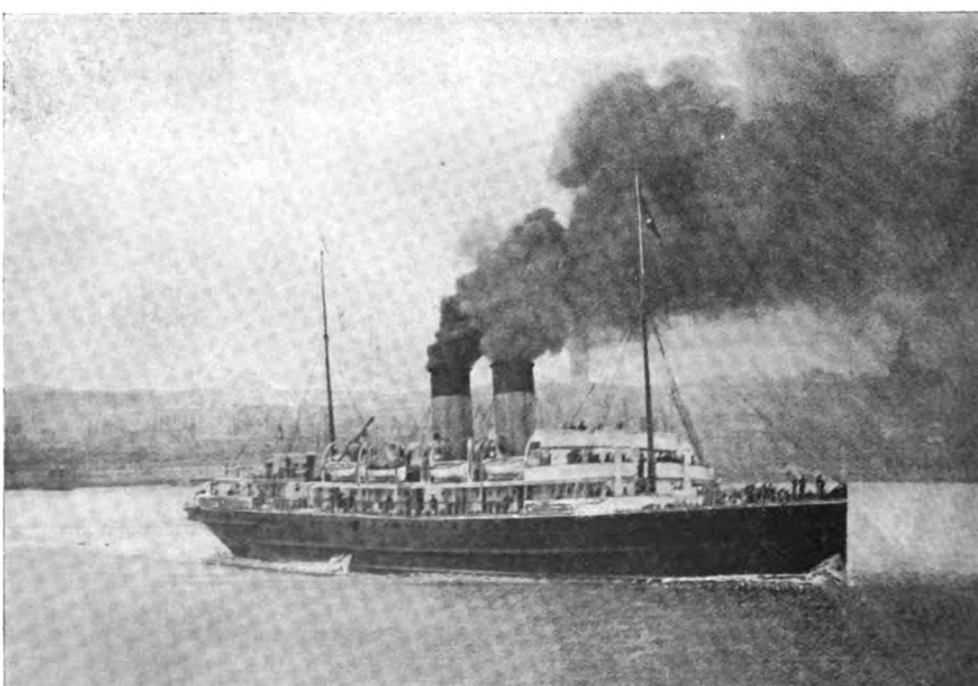
Young Kenneth Triest, recently imprisoned in London as a German spy, ran away from Princeton last January, and joined the ranks of the candidates for the Royal Navy's *Wireless Telegraphic Service*. If the lad had committed the offence of espionage against bloodthirsty Germany he would, as Mr. Theodore Roosevelt very aptly pointed out, have suffered the extreme penalty, promptly and mercilessly. The British Government, on the other hand, listened sympathetically to the father's plea and liberated the young scapegrace on his father undertaking to make himself personally responsible for his son's future behaviour and movements. Mr. Roosevelt, with characteristic bluntness, contrasted the black horror of the execution of Nurse Cavell with the almost parental leniency of the British Government. As the distinguished ex-President not unjustly remarked, "the British Government had a "thousandfold more justification for insisting "upon the execution of Triest than the "German Government had for putting to "death Miss Cavell." Comment is needless; neutrals will judge from this incident among many others of the difference in spirit between the Entente Powers and "Kultur."

* * *

The destruction of the British hospital

ship *Anglia* formed a recent and shocking example of the dangers involved in "mining "areas." "When about three miles from "the shore," said the Captain, "there was a "very loud explosion, doubtless under the "port side forward of the bridge. It blew "the bridge to smithereens, and I was blown "on to the lower deck. I ran up to the "wireless room to order the SOS. call to be "sent, and found the operator coming out "with blood on his face." News of the disaster was sent *by radiotelegraphy* without delay, and the war vessels in the neighbourhood rushed to the rescue. When they reached the *Anglia* she was badly down by the head and the propeller was elevated so high in the air that one of the rescuing vessels was able to pass under her stern. This steamer received 40 men who dropped upon her deck from their precarious position. Many of the passengers were wounded men lying in cots, without feet, without legs, or without arms. Such patients were, of course, perfectly helpless, and only a small proportion of the unhappy victims could be saved.

Our Yankee cousins have been deriving an immense deal of amusement from the project of the motor-car millionaire, Mr. Henry Ford. He secured a peace ship, the *Oscar II.*, and with a numerous party crossed the Atlantic, reaching Kirkwall December 15th. The "Ford's Ark," as the New Yorkers call it, was freighted with a party of peripatetic pacificists, who have proclaimed their intention of *peace-making by wireless*. His German-American secretary has let out the secret, and proclaims that Mr. Ford intends to send wireless messages from the peace ship to soldiers in the trenches "urging them to lay down their arms for Christmas Day and refuse to fight." The effusions sent out from the wireless stations of the German Government have been giving publicity to the "laudable objects" of this buffoon millionaire and his satellites. Innumerable cartoons in the Yankee Press ridicule the bombastic conceit of the motor-car manufacturer, whilst the United States Government has refused to issue passports for himself and his *umbrae*, and the party of



S.S. "Anglia."

The difficulties of Erection of Wireless Masts during Winter Campaigning.

cranks were denied permission to land in England.

* * *

Blackwood's Magazine recently published an interesting account of how H.M.S. *Cumberland* cleaned up the Cameroons. The wireless Arabian Nights stories sent out from Germany itself have convulsed the world to laughter many times by their vainglorious fiction. But they are as nothing compared with the news items perpetrated by the German wireless in the Cameroons. Here the hearts of Teutonic colonists had been continually warmed by information of colossal German victories ashore and afloat. The greater part of the Grand Fleet of England had been sunk several times with graphic details, and on one occasion a pathetic picture was drawn of the last words of Admiral Jellicoe.

The serious side of this part of the business is that the inhuman treatment of the natives by German brutes fostered a bloodthirsty spirit of revenge, with which the British victors have found it very difficult at times to cope. Over and over again our men have had to protect their prisoners from vengeance not unjustly earned by their own unspeakable actions.

* * *

"Great is the American nation!" Their newspaper men have in very reality the larger number of the qualities fictionally bestowed upon his analytical detective hero by Conan Doyle. Many revelations of German plots have already reached us from the "other side"; this is the latest which has come through. In order to get a firm hold of South Africa our Teutonic foes relied not alone on treachery amongst Dutch "Irreconcilables." They had matured an elaborate plan whereby 20,000 trained German soldiers should be transported and landed in South Africa to back them. In conjunction with the trained settlers already there, these would constitute a complete army amply supplied with rifles, cannon, machine guns and munitions. All the guns and stores for 45,000 men had been landed and secreted long before the declaration of war. As for the men, German and Austro-Hungarian reservists poured into New York by thousands from the interior cities. With a view to their transport, all the German ships on the Jersey side of the Hudson had been coaled up. Guards were posted about the decks of these vessels and most stringent precautions were taken to prevent outside observation and interference. Von Spee's Fleet was to round the Horn and rendezvous in the South Atlantic. The 13 liners laden with men were to burst out of New York Harbour, scatter up and down the coast, keeping within the three-mile limit, and—at a given signal—rush to sea at top speed. To the *Vaterland* was allotted the rôle of decoy duck; she was intended to draw the British cruisers in pursuit of herself, whilst the transports headed south, to get quickly under the guardianship of Von Spee's squadron.

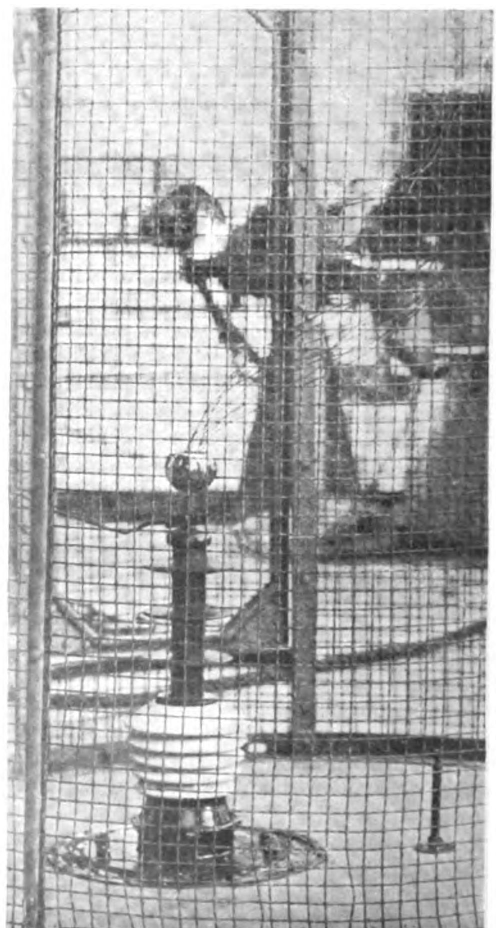
What spoilt the game? *Admiral Sturdee's wireless message!* He ordered the sending of a marconigram to the *Canopus* instructing her to proceed to the Falkland Islands, where, said the message, " new coast defence " guns would protect her." Von Spee recognised the bluff of the " coast defence," but could not resist the temptation of " bagging " the *Canopus* on his way north. The result we all know.

The " coast defence guns " did not exist; but Admiral Sturdee's squadron *did*, and the plans carefully matured by Germany vanished into thin air before the wireless message radiated from the British ships as they went into action, "God save the King." Mr. Balderston tells the whole story in the *Pittsburg Dispatch* and ends his lively account with this final spirited summation:

" Sad, indeed, has been the fate of the " German dreams dealt with in this article. " Von Spee's ships are at the bottom of the " ocean; the 20,000 reservists are back at " work; the thirteen liners are still tied to " their docks in the Hudson and at South " Brooklyn; all the great German colony, " whence the conquering army was to set " forth, is in the hands of the enemy! "

* * *

The Assistant United States Attorney-General recently conducted a successful prosecution of the Directors of the Hamburg-Amerika Line in New York, a trial which was historical in view of the fact that, had it not been for the sacrosanctity of diplomatists and representatives of a friendly Power, would have included in its scope in actuality, as it did morally, members of the German Embassy at Washington. This trial forms part of the Assistant Attorney-General's general investigation into the German conspiracy in the United States. For the prosecution of the inquiry this Federal lawyer has been studying the war book of the German General Staff, and includes in his inquiry the disposition of the nine million pounds sterling raised in the United States by the sale of German bonds. American-German bankers claim that this huge amount was *transmitted by wireless telegraphy* to Berlin. Few independent Americans give any credence to the statement, and little doubt appears to exist that this vast sum is being devoted to the purchase of " neutral " services of various kinds, including the purchase of ships flying other than belligerent flags, the acquisition of large stores and acids for high explosives, and the establishment of submarine *bases* for German boats in Mexican or West Indian waters.



The Wireless Cage which protects the Aerial " Lead-in " on a Warship.

NOTES OF THE MONTH

OUR contemporary, the *Daily Chronicle*, under the heading "British Opportunity for Trade in Canada and the West Indies," recently contained the following paragraph:

"Wireless telegraphy, also, will be an "important factor in the development of "trade relations between Britain and Canada "and in this connection it should be men- "tioned that the Dominion has between "40 and 50 coast stations for communication "by wireless with ships at sea."

* * *

The annual illustrated Christmas Course of Afternoon Juvenile Lectures at the Royal Institution will be delivered this year by Prof. H. H. Turner, D.Sc., D.C.L., F.R.S., his title being "Wireless Messages from the Stars." The subjects are as follows:—"How the Messages are Carried": "How the Messages are Received." First Message: "We are very far away." Second Message: "Some of us are giants and some are dwarfs." Third Message: "But we all behave much as you do." Fourth Message: "And in fact we are your blood relations."

* * *

A revised copy of the Berne International Telegraph Bureau's list of wireless telegraph stations throughout the world brought up to April 1st, 1915, shows that in the matter of coast stations premier position is occupied by the United States with 140 stations, and the second place by Great Britain with 61, whilst Canada ranks third with 47. The most important application of wireless telegraphy, however, is in connection with inter-communication between vessels at sea and the shore, and in the case of ship installations Great Britain leads the way with 1,568, whilst the United States is a poor second with 967, Germany following third with 537.

The training of boys and youths in all methods of signalling has always been a *forte* of the scout organisations throughout the world. We have before us a copy of the December number of *The Boy Scouts Association Headquarters Gazette,* in which it is advocated that "scout-masters should "take up signalling more thoroughly and on "wider lines than they have done in the "past."

The editor of that journal proceeds: "Signalling really falls under three heads:

"*Firstly,* learning to send and read by "means of flags, groups of letters—a test "of accuracy, memory, and disciplined "movement.

"*Secondly,* sending messages in proper "message form between properly con- "stituted sending and receiving stations— "here discipline, co-operation, and strict "attention to the matter in hand is re- "quired.

"*Thirdly,* the use of lamps, heliographs, "field telegraph, and wireless. Here a "great opportunity is opened for boys to "show mechanical ingenuity.

"Also it may be as well to add that "signalling requires accurate knowledge "of the use of maps and compasses.

"All scouts up to the age of fourteen "should understand semaphore sending and "reading; while older lads should be en- "couraged to take up Morse in some form, "preferably telegraphy and wireless, since "these forms of communication have been "more used than any other in the present "war. Buzzers are within the reach of "most troops, and once the boys have "acquired proficiency in their use it will "not be very difficult when the oppor- "tunity comes to acquire the necessary "technical knowledge of telegraphic and "wireless apparatus."

A Wireless Station and Observatory

By FRANK C. PERKINS

THE accompanying illustration shows the observatory and wireless antennæ, while in the second photograph may be seen the electrical equipment at the wireless station of the Illinois Watch Company at Springfield, Ill.

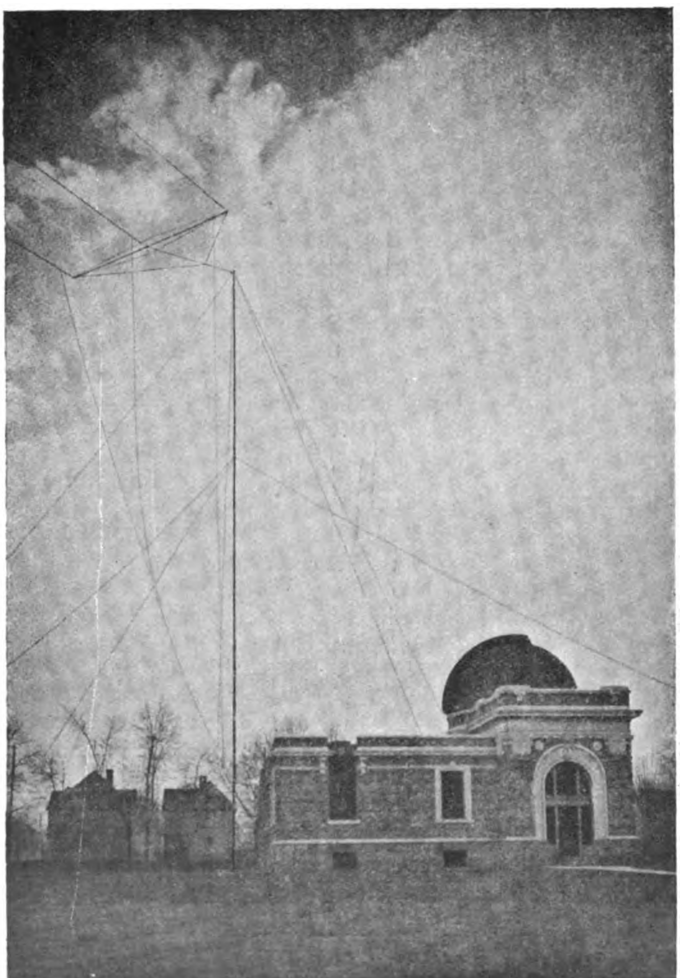


Fig. 1. Wireless Station, Illinois Watch Company at Springfield, Ill.

The engineer at the Illinois watch plant, recognising the fact that the great convenience and accuracy of wireless time signals ensure rapid development of this system of time distribution, lost no time in getting into the field to supplement the service of the Naval Observatory, whose wireless signals from the station at Arlington, Va., at once marked a distinct advance in this line of public service.

In the short period since the "Arlington" wireless time service was instituted hundreds of jewellers throughout the United States and Canada have equipped themselves to utilise these signals. The service is the last word for accuracy, seldom varying from true time more than two-tenths of a second and usually within less than five-hundredths. There are also thousands of amateur receiving stations that daily and nightly make use of the signals. In a short time there will be but few educational institutions down to the high grade school that will not be equipped with a wireless station.

While it may be thought that the Government service from the Arlington station would be sufficient for all needs, it is true that a duplication of the signals at different hours is a real convenience, and the hours of sending from the Illinois Observatory are

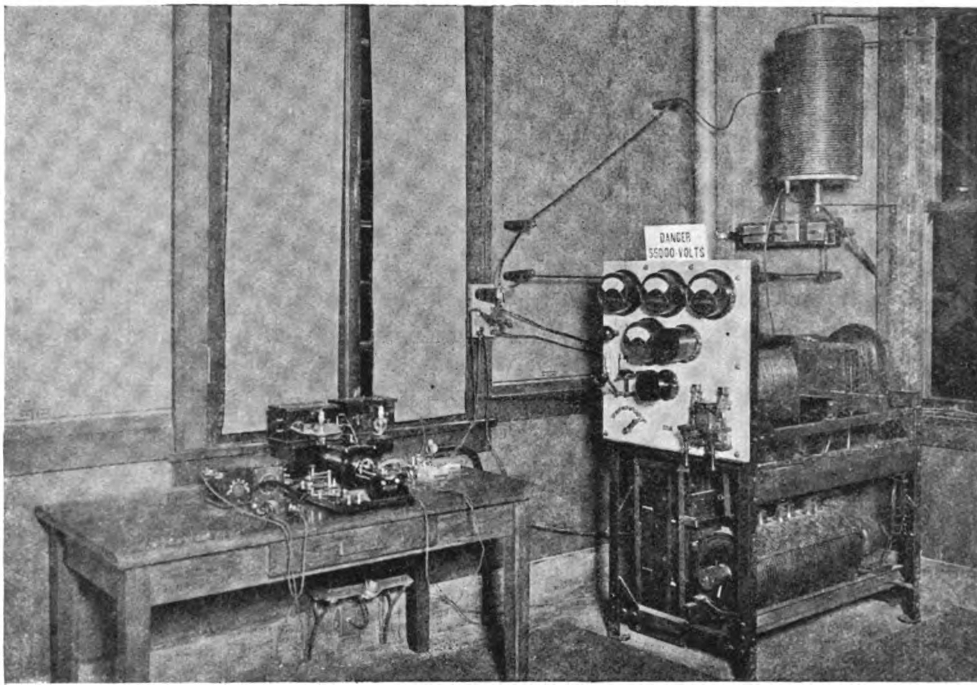


Fig. 2. Electrical Equipment of Illinois Watch Company.

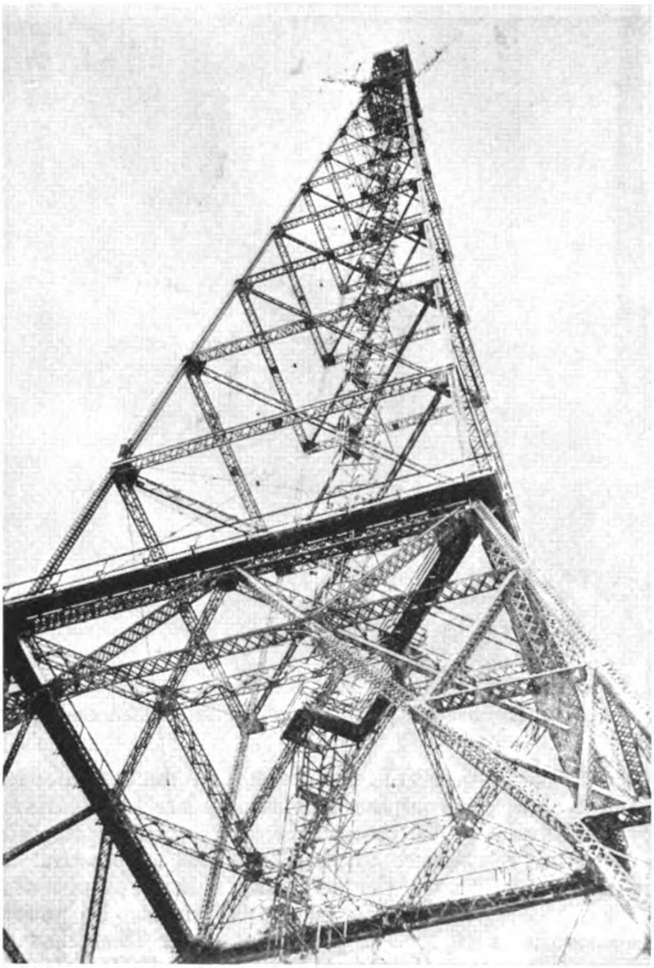
better adapted to the needs of the Central time zone than the 12 noon and 9 p.m. hours, Eastern time, adopted by the Naval Observatory. It also gives an opportunity to receive time four times in 24 hours instead of twice.

The signals from this wireless station and observatory are sent one hour later than the Arlington noon signal and one hour earlier than their evening signal; that is, they are sent at noon and at 8 p.m., Central time. To those unacquainted with the method of transmitting time it may be mentioned that the signals from either source are identical and consist of dashes of about a quarter second duration transmitted each second with certain regular breaks for purpose of identification. The series begins at 5 minutes to the hour, ticking regularly with the exception of a break at the 29th second and from the 55th to the 59th. This latter break is varied on the last minute of the hour by an interruption of 10 seconds before the final signal, which is a long one, beginning exactly on the hour and lasting a full second. With this series of breaks there are ten points of reference in the 5 minute series for the purpose of identification and comparison.

The transmitter used at this Springfield wireless station, while not as powerful as that of the naval station, is yet capable of a readable range of 1,000 miles. Its power, 10 kw., is probably greater than that of any inland station in the United States. The type is known as the rotary quenched spark. It is operated on 220 volt current from the city supply.

It will be seen from the photograph, Fig. 1, that there are no elaborate towers. The three wire aerial, nearly 600 feet long, is supported by masts 100 feet and 140 feet high. The Illinois Watch Company has a large correspondence both with jewellers and other amateurs, who either are reporting the reception of their signals or are seeking advice as to proposed stations.

Everything indicates a rapidly increasing vogue for wireless time service. The photograph shows the receiving and transmitting apparatus. The transmission of the time is automatic, the key being operated directly by the clock through a relay and break circuit wheel in the clock escapement. The



One of Arlington's Wireless Towers.

signals are sent on a wave length of 2,000 metres. This differs so much from the usual commercial lengths that interference is avoided.

TRANSMISSION OF WEATHER REPORTS BY NAVAL RADIO STATIONS.

THE following appeared in the 1915 edition of the list of "Radio Stations "of the United States":

"Through co-operation with local offices "of the United States Weather Bureau, "weather forecasts are sent broadcast to sea "through naval coast radio stations at "certain times, varying with the locality. "Coast stations are gene- "rally prepared to give "local forecasts to pass- "ing vessels without charge, "on request. Storm warn- "ings are sent whenever "received, and the daily "weather bulletins are dis- "tributed by the naval radio "stations at Arlington, "Va., and Key West, Fla., "a few minutes after the "10 p.m. time signal. These "bulletins consist of two "parts.

"The first part contains "code letters and figures "which express the actual "weather conditions at "8 p.m. seventy-fifth meri- "dian time, on the day of "distribution at certain "points along the eastern "coast of North America, "one point along the Gulf "of Mexico, and one at "Bermuda.

"The second part of the "bulletin contains a special "forecast of the probable "winds to be experienced a "hundred miles or so off "shore made by the United "States Weather Bureau "for distribution to ship- "masters. The second part "of the bulletin also con- "tains warnings of severe "storms along the coasts, as occasions for "such warnings may arise.

"Immediately following this bulletin a "weather bulletin for certain points along "the Great Lakes is sent broadcast by the "naval radio station at Arlington, Va., "consisting of two parts. The first part "contains code letters and figures which "express the actual weather conditions at "8 p.m., seventy-fifth meridian time, on "the day of distribution at certain points "along the lakes. The second part of the "bulletin contains a special forecast of the "probable winds to be experienced on the "lakes during the season of navigation— "about April 15th to December 10th."

Maritime Wireless Telegraphy

WAR NOTIFIED BY WIRELESS.

DURING a lecture, held in celebration of the tenth anniversary of the opening of the Darlington Baptist Tabernacle, it was stated that the lecturer was one of three gentlemen chosen to represent the Baptist Missionary Organization on a tour through China, but on the outward voyage to America they received news of the declaration of war by wireless. In consequence, the tour was abandoned and, after a short stay in the United States, the party returned to England.

* * *

BRITISH STEAMER IN DISTRESS.

A wireless message was received in Halifax to the effect that the British steamer *Oakfield*, from West Hartlepool, was in distress 600 miles south-east of Cape Race, Newfoundland. The wireless message was received from the steamer *San Giorgio* which was standing by, and it transpires that the *Oakfield* had lost all her propeller blades. A Lloyds message from Fayal, Azores, was subsequently received saying that the following wireless message was reported from the *San Giorgio*: "Towing steamer *Oakfield* to Fayal. Twice broken lines. Fresh north west wind; heavy sea. No further success possible." The *San Giorgio* gave the *Oakfield's* position, which vessel was eventually brought into Ponta Delgada, Azores, by the Cardiff steamer *Lady Ninian*. The *Oakfield* was bound from Rotterdam to Portland, Maine, and is a large screw steamer of 3,618 tons gross, registered at West Hartlepool.

* * *

WIRELESS TO RECALL A MAIL STEAMER.

For the first time in the history of the service the City of Dublin Steam Packet Company's mail steamer *Ulster*, which left Holyhead one day during the terrific storm which characterised the second week of November last, for Kingstown, with a large number of mails and passengers, received instructions from the Admiralty by wireless telegraphy that in consequence of the Irish harbour being crowded with craft she could not put into it. She was therefore ordered to return to Holyhead and to remain there pending the receipt of further orders. The *Ulster* accordingly put about and made the return voyage in the teeth of a most terrific storm of wind, sea, and rain, the sea at times rising mountains high.

* * *

AN UNTRACED MESSAGE.

During the great storm of early last November a steamer proceeding down channel picked up a wireless message saying, "On way to Scilly Islands. Lifeboats washed away. Big list. Amiral de Vorpont." About the time that this message was received on board a large French steamer was seen to sink off the Island of Guernsey. No further news has arrived and it is feared that all the crew have been lost. The ship issuing the distress signal did not apparently give her position, and the call was therefore rendered futile.

* * *

A HELPLESS LINER.

A wireless message has been received at San Diego, California, to the effect that the steamer *Minnesota*, of the Great Northern Steamship Company, in which an explosion recently occurred, and which it is thought is due to foul play, is lying practically helpless 25 miles south-west of Coronada Islands. The *Minnesota* was on her first voyage from Seattle to London. An earlier message stated that the vessel was returning to San Francisco. It has been reported that three men are suspected of having caused the explosion in the engine-room, and that one of them boasted that the ship would never reach her destination. The *Minnesota* is a vessel of 20,718 tons gross, and was built at New London (Conn.), in 1904.

* * *

A POWERFUL BATTLESHIP.

We are enabled to publish a photograph of the new type of battleship for the United States Navy. Plans for three have been established, and the first is the *California*. They are remarkable in two particulars. The first is that they will displace 32,000 tons, a figure which has not yet been attained by war vessels in any navy of the world, except the Russian, where the four cruisers of the *Borrodina* type possess a displacement of 32,500 tons. The second particular is that they are the first war vessels of large tonnage to be solely propelled by the medium of electricity. The four screws will each make 160 revolutions a minute, and the four electric motors necessary to drive them will possess a total horse-power of 32,000. For supplying the motors with electricity two turbines are provided, each making 3,000 revolutions, and each acting on a 3-phase alternating current electric generator. The use of one turbine only for the four propellers will drive the ship at a speed of 19 knots. It is almost needless to add that the ships are fitted with the latest type of wireless telegraphic apparatus.

* * *

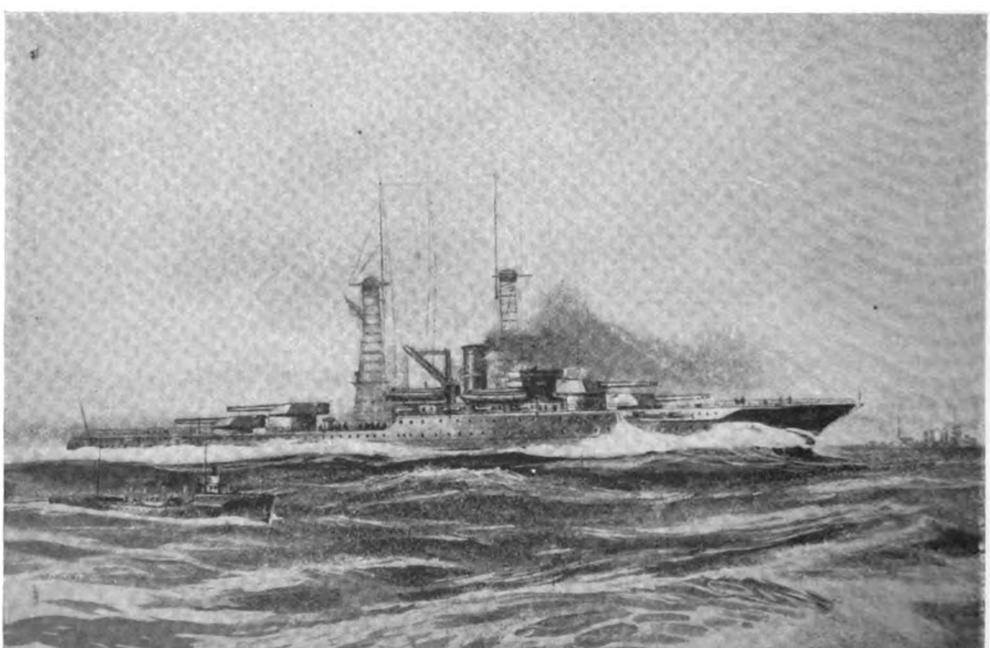
Chilian Ship Lost.

A message received from Lloyd's agent at Vancouver (B.C.) states that the steamer *Princess Maquinna* reports by wireless that a fully rigged ship lies a total wreck at Clayquot Sound, and that all hands were lost. She is thought to be the *Carelmapu*, of Valparaiso, but owing to the tremendous sea and south-west gale the *Princess Maquinna* was unable to render any assistance. The *Carelmapu* was an iron ship of 1,447 tons, built in 1877 at Liverpool.

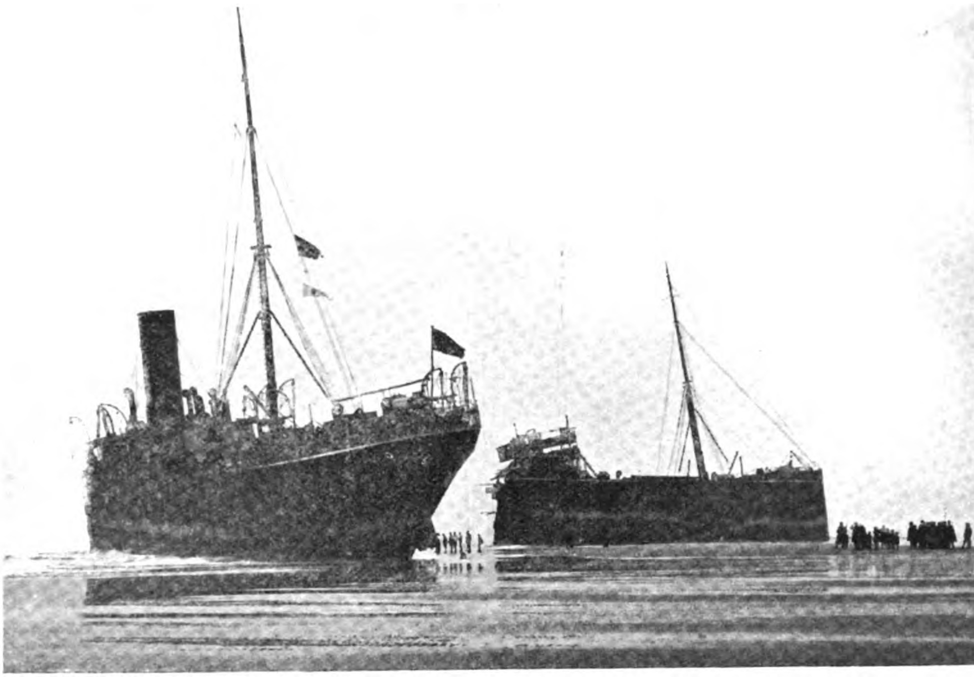
* * *

British Rescue French.

When recently the French liner *Euphrate* was wrecked on the eastern side of the island of Socotra she sent out wireless distress signals. The Ellerman-Hall steamer *City of Nagpur* heard them and called up the Dutch steamer *Tambora*, asking for assistance in the rescue of 670 people on board the ill-fated steamer which was ashore on a reef. The wireless operator of the *Collegian*, which was on a voyage from London to Calcutta, and had reached a position about twenty-two miles east of Socotra, intercepted the French ship's distress call and asked the *City of Nagpur* if she could be of any assistance, at the same time giving her own position. The reply from that vessel was that further help was sorely needed, and gave the position of the wrecked steamer. The captain of the



U.S.S. "California."



S.S. "Socotra."

Collegian at once turned his vessel's head to the indicated position and with all speed hastened to the work of rescue. The French steamer was found to belong to the Messageries Maritimes and was on a voyage from Saigon to Marseilles with a number of passengers and troops. Later in the day a wireless message was received from the *City of Nagpur* saying that everybody had been taken off the wreck.

* * *

THE WRECK OF THE "SOCOTRA."

Grave news has been received from the *Socotra*, which ran ashore at Boulogne during a voyage from Australia to London. The wind shifted to the west and, as is often the case, her position became consequently more dangerous. The captain sent a wireless message that his ship was breaking amidships and that the crew must be taken off. She was subsequently abandoned and became a total loss. She was built on the Tyne in 1897 and is of 6,009 tons.

* * *

FIRE AT SEA.

Another outbreak of fire at sea has to be reported. The British liner *Roscommon* was off the Australian coast when a conflagration broke out in one of her holds. She immediately sent a wireless message to Sydney advising the catastrophe, and shaped a course for Townsville. The fire, however, was extinguished within a couple of hours, but not before 3,000 bales of wool had been affected.

SHIPPING CONVENTION ACT.

A Further Postponement.

It has been announced by the Board of Trade that the Shipping Convention Act (1914) which was to have come into operation on January 1st, 1916, has been postponed. This forms the second time it has been put off, it being originally intended that the act should come into force on July 1st, 1915, but in May, 1915, it was postponed until January 1st, 1916. The act forms a confirmation of the International Convention for the safety of life at sea, and was signed by the delegates to the London Conference in January, 1914. One of its chief points is the introduction of improved reforms in regard to the use of wireless telegraphic and signalling apparatus on board ship.

CARTOON

Turks erecting Field Wireless in the Gallipoli Peninsula.

Selenium

By MARCUS J. MARTIN

Whilst the title of this article might not seem to indicate that it had any connection with " wireless," yet selenium is a substance which has many uses in radiotelegraphy, particularly in connection with " wireless control." Mr. Marcus J. Martin, whose excellent articles on " Radio-photography " in our previous issues have attracted considerable attention, writes as an authority on the subject, and we venture to think that the article below will prove of value to many.

SELENIUM, belonging to the sulphur and tellurium family, is a non-metallic element, and was first discovered by Berzelius in 1817 in a red deposit found at the bottom of sulphuric acid chambers when pyrites containing selenium was employed. This still continues the source of commercial supply, although it is found to a small extent in native sulphur and combined in native sulphides. It also occurs, combined with metals, as selenides, in a few rare minerals, as clansthalite. Symbol, Se; at. wt., 79·2.

Selenium, like sulphur, exists in several modifications, being obtained as a dark red amorphous powder (sp. gr. 4·26), as a brownish black, glassy mass (sp. gr. 4·28), as red monoclinic crystals (sp. gr. 4·47), or as a bluish grey, metal-like crystalline mass (sp. gr. 4·8).

Selenium is sold commercially in the form of small bars, and its value lies in the property which it possesses, discovered by May in 1869, that when in a prepared condition it is capable of varying its electrical resistance according to the amount of light to which it is exposed. It has not this property in its bar form, and to acquire it selenium requires to undergo the rather delicate process of " annealing." This process consists of heating the selenium to a temperature of 120° C. (the melting point), keeping it there for several hours, and allowing it to cool gradually, when it will be found to have assumed a crystalline condition and to have changed from bluish grey to a dull slate colour. In this condition it is very sensitive to light.

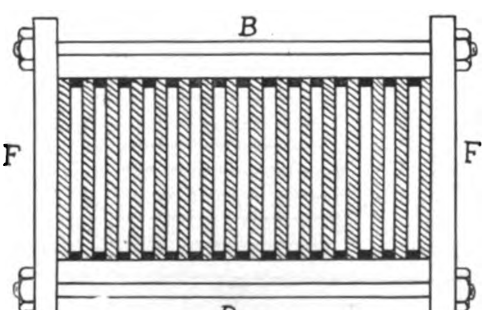


Fig. 1.

SELENIUM CELLS.

To make practical use of the peculiar property possessed by prepared selenium in connection with an electric circuit it is made up into what is technically termed a " cell." A selenium cell in its simplest form consists of merely some prepared selenium placed between two or more metal electrodes, the selenium acting as a high resistance conductor between them. The form given by Bell and Tainter to the cells used in their experiments is given in Figs. 1 and 2. They consisted of a number of rectangular or circular brass plates, P, P^1, separated by very thin sheets of mica, M; the mica sheets are slightly narrower than the brass plates, the whole being tightly clamped together in the frame, F, by the two bolts, B. By means of a sand bath the cell is raised to the desired temperature, and selenium is rubbed over the surface, which melts and fills the small spaces between the brass plates. The cell is kept at the right temperature for a definite time, and allowed to cool gradually, when the selenium will be found to have assumed the necessary crystalline condition. As will be seen from Fig. 2, the plates are connected in parallel, all those marked P being joined together

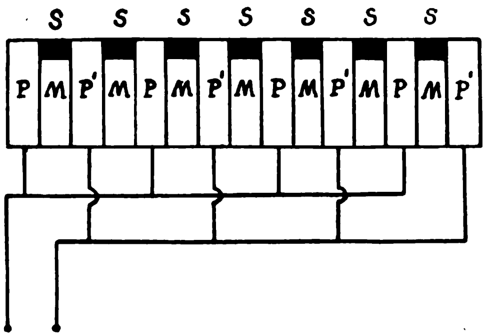


Fig. 2.

to form one terminal, and all those marked P[1] to form the other.

In its natural state selenium is practically a non-conductor of electricity, its resistance being forty thousand million times greater than copper (40×10^9), but Knox, in 1837, found that on being annealed it became a high resistance conductor. As the resistance of any cell depends to a great extent upon the transverse section of the selenium between the electrodes, it is evident that by varying the thickness of the mica strips, and so varying the transverse section of the selenium, cells of any required resistance can be constructed, while by using a number of elements, connected in parallel, a very large active surface can be obtained.

Mercadier adopted a slightly different method of construction. His cells consisted of two very thin brass bands 0·05 inch wide and 0·004 inch thickness, thoroughly insulated from each other by parchment strips, and coiled as shown in Fig. 3, where the dotted and full lines, A and B, represent the brass bands, and the white spaces between the parchment strips. The finishing end of the band, A, is connected to the brass plate, M, and the end of the band, B, to the brass plate, N; the plates, M, N, being provided with terminals, T, T[1]. The complete coil is placed in a wooden frame, F, and clamped tightly together by the bolts, E. One surface of the coiled block is then polished and heated to the required temperature in a sand bath, selenium being then rubbed over the polished surface until it is covered with a very thin layer.

The cell used for commercial purposes is usually constructed as follows. A small rectangular piece of slate, porcelain, mica, or other insulator, is wound with many turns of fine platinum wire. The wire is wound double, as shown in Fig. 4, the spaces between the turns being filled with prepared selenium. A thin glass or mica cover is sometimes placed over the cell to protect the surface from injury.

Characteristics of Selenium Cells.

A strong light falling upon a cell lowers its resistance, and *vice versa*, the resistance being at its height when unexposed to light. Selenium cells vary very considerably as regards their quality as well as in their electrical resistance, it being possible to obtain cells of the same size for any resistance between 10 and 1,000,000 ohms, and also a cell may remain in good working condition for several months, while another will become useless in as many weeks.

The ability of a cell to respond to very rapid changes in the illumination to which it is exposed is determined largely upon its inertia, it being taken as a general rule that the higher the resistance of a cell the less the inertia, and the lower the resistance the greater the inertia; also the higher the resistance the greater the ratio of sensitiveness. Inertia plays an important part in the working of a cell slightly opposing the drop in resistance when illuminated, and opposing to a much greater degree the return to normal for no-illumination. The effects of inertia or "lag," as it is termed, can readily be seen by reference to Fig. 5. It will be noticed that the current value rapidly increases when the cell is first illuminated, but if, after a short time, *t* the light is cut off, the current value, instead of returning at once to normal for no-

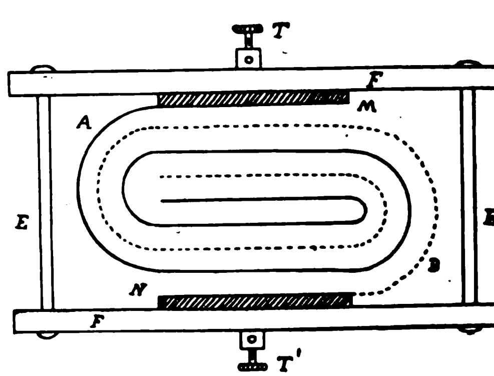


Fig. 3.

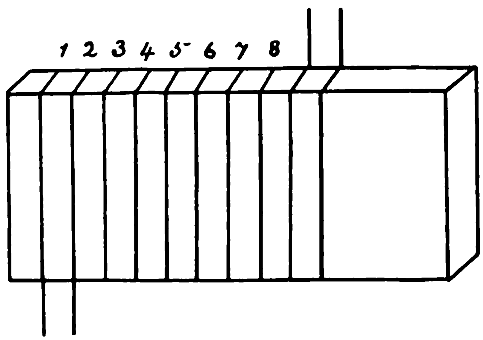


Fig. 4.

illumination, only partially rises owing to the interference of the inertia, and some time elapses before the cell returns to its normal condition; the time varying from a few seconds to several minutes, depending upon the characteristics of the cell and the amount of light to which it is exposed.*

The inertia or "lag" of a cell produces upon an intermittent current—caused by an intermittent varying beam of light being thrown upon a cell—an effect similar to that produced by capacity in a circuit, preventing the incoming signals from being recorded separately and distinctly, The comparative slowness of selenium in responding to any great changes in the illumination offers a serious drawback in many practical applications, but various means have been devised whereby the effects of the inertia can be counteracted. In any arrangement where the changes in the illumination are neither very rapid nor very great the inertia effects would be very slight, but where the source of illumination is constant, but intermittent, and the resistance of a cell is required to drop to a definite value and return to normal instantly, many times in succession, the inertia effects are very pronounced.

The most successful method of counteracting the inertia is that adopted by Prof. Korn, of always keeping the cell sufficiently illuminated to overcome it, so that any additional light acts very rapidly. Another method worked out and patented by Prof. Korn, and known as the "compensating cell" method, gives a practically dead beat action, the resistance returning to its normal condition as soon as the illumination ceases. The arrangement is given in the diagram, Fig. 6. A selenium cell, S^1, is placed on one arm of a Wheatstone bridge, a second cell, S^2, being placed on the opposite arm. The selenium cell, S^1, should have great sensitiveness and small inertia, the compensating cell, S^2, having small sensitiveness and large inertia. Two batteries, B^1 and B, of about 100 volts, are connected as shown, B being provided with a compensating variable resistance, W; W^1 is also a regulating resistance. When no light is falling upon the cell, S^1, light from L is prevented from reaching the second cell, S^2, by a small shutter which is fastened to the strings of the Einthoven galvanometer, H,* and the piece of apparatus, C—relay or galvanometer as the case may be—remains in a normal condition. When, however, light from the transmitting or receiving apparatus, as the case may be, falls upon the cell, S^1, the balance of the bridge is upset, and light from L falls a fraction of a second later upon the second cell, S^2, and the current flowing through C completes the circuit. Needless to say, it is necessary that the two cells be well matched, as it is very easy to have over compensation, in which case the current is brought below zero. It is also stated that by enclosing the cells in exhausted glass tubes their inertia can be greatly reduced and their life considerably prolonged.

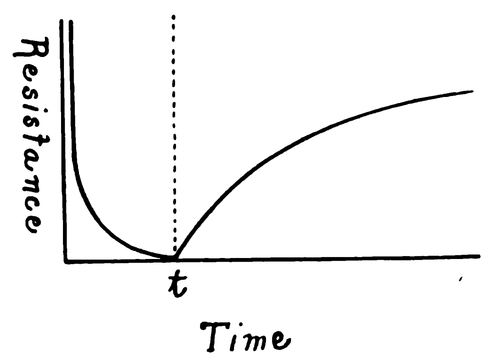


Fig. 5.

The sensitiveness of a cell is the ratio between its resistance in the dark and its

* An actual curve is given on page 295, WIRELESS WORLD, No. 29. 1915.

* A description of this was given on page 104, WIRELESS WORLD, No. 26. 1915.

D

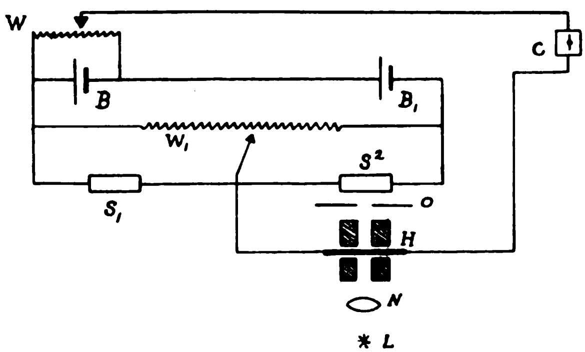


Fig 6.

up to 210° C. the conductivity gradually increases, after which it again diminishes.

Practical Applications.

A sensitive galvanometer was employed by most workers to record the variations in the resistance of a selenium cell, but Bell, by substituting a telephone receiver for the galvanometer, was able to register much smaller variations, and this led to the invention of the "photophone," a piece of apparatus designed for the transmission of speech by means of a beam of light. The late Prof. Rhumer, who contributed many valuable papers on selenium and its properties, employed selenium cells in connection with his television apparatus, and also for obtaining records of eclipses during unfavourable weather conditions. He was also responsible for the invention of an automatic registering instrument which, by the aid of selenium cells, could register variations in the intensity of light, even up to several hundreds per second.

There have been many other applications, more or less useful, but the most remarkable and interesting is that devised by Prof. Korn for the telegraphic transmission of photographs and pictures over ordinary telegraph lines, some good results having been obtained over considerable distances. Selenium has also been employed as a wireless detector.

resistance when illuminated. The majority of cells have a ratio between 2 : 1 and 3 : 1, but Prof. Korn has shown mathematically that by conforming to certain conditions regarding the construction the ratio of sensitiveness may be between 4 : 1 and 5 : 1. Thus a cell of R=250,000 ohms can be reduced to 60,000 ohms from the light of a 16 c.p. lamp placed only a short distance away, while another would only be reduced to perhaps 100,000 ohms. Some of the cells constructed by Bell had a resistance of 1,500 ohms in the dark, which was instantly reduced to 600 ohms when exposed to bright sunlight.

The resistance may be still further decreased by continuing the illumination, but this produces a permanent defect in the cells, termed "fatigue," the cells becoming very sluggish in their action, and their sensitiveness gradually becoming less, the ratio between their resistance in the dark and their resistance when illuminated being reduced in some cases by as much as 30 per cent. Excessive illumination will also produce similar results.

The inertia of a cell is practically unaffected by the wave-length of the light used, but the maximum sensitiveness of a cell is towards the yellow orange portion of the spectrum.

Common sulphur has been used to replace selenium in the cells, but the effects are much slighter than when selenium is employed.

In addition to light, heat has also been found to vary the electrical resistance of selenium in a very remarkable manner, At 80° C. selenium is a non-conductor, but

Theories regarding the Microphonic Action of Selenium Cells.

A selenium cell, owing to its somewhat similar behaviour, is sometimes referred to as a "light microphone," inasmuch as its action under the influence of light resembles the action of a microphone under the influence of sound. The peculiar property possessed by crystallised selenium of reducing its electrical resistance when under exposure to light has been the subject of the investigations of many eminent physicists, including Mose , Siemens, Adams, Bidwell, and Day. Dr. Moser formed his opinion that the microphonic action of the cells was caused by the alteration, due to heat, of the imperfect contact between the selenium and the metallic electrodes, but Mr. Bidwell, by simply heating the cells, has shown that the effect cannot be produced this way, a much higher temperature being required to reduce the resistance of the cells to a point to which they are instantly reduced by exposure to light.

The most generally accepted theory is that put forward by Profs. Adams and Day, in 1877, the results of their exhaustive investigations leading them to suppose that the "electrical conductivity of selenium is electrolytic." They gave the following reasons to support their theory: (1) that the resistance of selenium bars appeared to depend upon the E.M.F. of the battery employed, being generally diminished as the battery power was increased; (2) that the resistance of a bar, A B, was generally not the same for a current in the direction A B as for a current in the direction B A ; (3) that the passage of a battery current was always followed, when the battery had been disconnected, by a secondary or polarisation current in the opposite direction, it being clearly proved that this secondary current was not due to any thermo-electric action, either in the selenium itself or in any other part of the circuit.

The action of light in altering the electrical conductivity of crystalline selenium is supposed by those experimenters to arise from a modification of the crystalline condition when under the influence of light, and in their own words the explanation is as follows: "Light, as we know, in the case of some bodies tends to promote crystallisation, and when it falls upon a stick of selenium tends to promote crystallisation in the exterior layer, and therefore to produce a flow of energy from within outwards, which under certain circumstances appears in the case of selenium to produce an electric current. The crystallisation produced in selenium by light may also account for the diminution in the resistance of the selenium when a current from a battery is passing through it, for in changing to the crystalline state selenium becomes a better conductor of electricity."

HEAT CELLS.

Mercadier, experimenting with Bell's photophone, discovered that sound could be transmitted without using selenium cells and batteries, and that non-luminous heat-rays, under certain conditions, produce similar results. A thin plate of any material serves as a receiver in the "radiophone," by which name Mercadier termed his modification of the photophone, the sounds being conveyed to the ear by a tube running from the back of the plate. The thickness and size of the plates do not affect the intensity or timbre of the sounds to any great extent, but the slightest alteration of the surface makes a difference. Plates, the surfaces of which are scratched or oxidised, increase the intensity of the sounds, while paper and silvered glass give no sounds at all; the material of which the plates are constructed also affects the intensity of the sounds. Good results have been obtained by using plates coated with Indian ink, soot, or other non-radiant matter. Paper or mica plates coated with soot make very sensitive receivers. Plates which absorb the rays strongly, but do not reflect them, generally prove the most effective.

The great sensitiveness of surfaces coated with soot led Tainter to substitute soot for the selenium in a selenium cell, and one form of soot or carbon cell is given in Fig. 7. A film of silver is precipitated upon a glass plate, B, and the silver is divided into two portions by means of a zigzag line, A A, running across the plate, which is filled up with soot. Each portion of the silver coating is provided with a terminal, T, for connecting to the battery and telephone receiver.

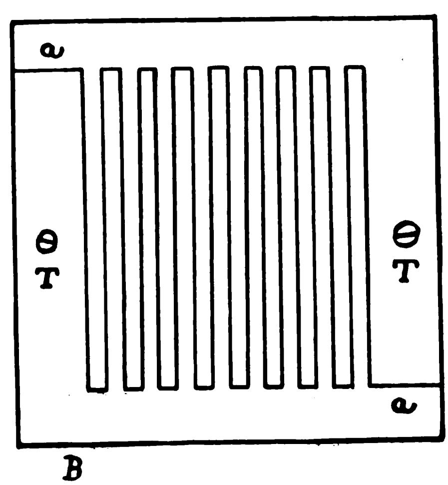


Fig. 7.

Doings of Operators

Operator W. F. Steward.

THE ss. *Californian*, which was recently sunk in the Mediterranean, carried two wireless operators, W. F. Steward and G. F. Ness. Mr. William Fairlie Steward hails from Rutherglen, and is twenty-two years of age Prior to joining the Marconi Company he was for some years in the employ of a Glasgow cotton firm, and on leaving them came to the Marconi Company's London School in June, 1914. Mr. Steward has served on the ss. *Californian* for some time, and before this was on the ss. *Cambrian.*

* * *

Mr. George Findlay Ness, the second operator of the *Californian*, is also a Scotsman, his home being in Fifeshire. He is nineteen years old and had held a clerical position before taking up wireless. His appointment to the Marconi Company's staff dates from June last, and his whole time had been spent on the *Californian*. Both men were rescued uninjured and are now in England.

Operator G. F. Ness.

* * *

The ss. *Mercian*, also sunk recently, carried as operators Messrs. L. Hughes and T. E. Walmsley. Mr. Llewelyn Hughes' home is at Aberystwyth. Born in 1890, he was educated in that town, and for some time was in business at Liverpool. He joined the Marconi Company in June, 1915, and served on the ss. *City of Benares* until he went to the ss. *Mercian*. Mr. Hughes was injured in the head, but is making good progress, and we sincerely trust that he will soon fully recover from his wound.

Operator L. Hughes.

* * *

Mr. T. E. Walmsley, the second operatorr is twenty-two years of age, and is a

Operator T. E. Walmsley.

Lancastrian. Previously engaged in the textile trade, he is quite a new recruit to the wireless service, and did not wait long for adventure, being torpedoed on his second day at sea. At the time of writing we believe him to be uninjured, as his name does not appear in the list of casualties, and we hope that he is feeling none the worse for his exciting adventure.

* * *

Whilst most attention is naturally given to cases where the ship has been the victim of an enemy submarine, we must not forget that there are many other risks to be faced. The ss. *Socotra*, which recently ran ashore near Boulogne (see page 679 of this issue), carried a Marconi installation in charge of Operator A. R. Coomber. Mr. Arthur

Operator A. R. Coomber.

Robert Coomber, whose home is at Rochester, Kent, has served as a wireless operator for fifteen months, joining the Marconi Company soon after the outbreak of war. He is twenty-one years of age, and took to wireless after serving as assistant chemist in a cement works near his home. Mr. Coomber had sailed on the ss. *Comrie Castle*, *Corinthian* and the *Simla* before joining the *Socotra*. At the time of writing we believe Mr. Coomber to be saved from the wreck, and we hope he has not sustained any injury.

* * *

Among the latest casualties is the ss.

Operator G. B. James.

Umeta, of the British India Line. Operator G. B. James, who was in charge, is twenty-two years old, and when ashore lives at Brixton. During his eighteen months in the service of the Marconi Company he has sailed on the ss. *Narragansett*, *Westmeath*, and *Umeta*. Mr. James was, fortunately, saved from the wreck, and is uninjured.

* * *

Peter Rasmussen Rechnagel, the wireless operator who so faithfully carried out his duties on the burning *Athinai* (see p. 522 of November issue), is a member of the operating staff of the Belgian Marconi Company, and was born at Egvad in Denmark on February 3rd, 1890. He was appointed telegraphist in the Marconi service in July, 1914.

Wireless in the Courts

ON November 23rd last, Horace Neate, of Great Quebec Street, Marylebone, was charged with forging and uttering a certificate of identity and character, whereby he obtained a situation as a wireless operator.

It was stated that the prisoner, after undergoing instruction at the school of the Marconi International Marine Communication Company, passed the necessary test on September 20th, and a fortnight later was asked to obtain two letters of identity and character from persons who were not related to him. He furnished two such letters, and on October 14th left the school as a qualified telegraphist for the purpose of joining a hospital ship.

Chief Detective-Inspector Gough, of Scotland Yard, said that the prisoner was arrested on board the hospital ship when she arrived at Southampton. When he was told that the letters of character he had produced were forgeries, he said that the persons whose names appeared on them were personal friends. The inspector added that the prisoner had been a dairyman at Cross Keys, Monmouthshire, for five or six years, and nothing was known against his character.

The prisoner told the magistrate that he wrote the letters himself, as he forgot to get them from his friends until it was too late, and thinking that his negligence might lose him a job, he wrote them himself. He intended to write to his friends telling them what he had done, but was ordered to the Dardanelles before he could do so.

The magistrate inflicted a fine of £20.

* * *

Although William Nettle was working on the wireless telegraph station at Shepherd's Shore, Devizes, he was unpatriotic enough to "use in public certain expressions calculated to cause sedition or disaffection among the civilian population, or to cause disaffection to his Majesty, or to prejudice the recruiting, training, discipline, or administration of his Majesty's Forces." The magistrate, in pointing out the seriousness of the case in this time of war, fined the defendant £2 and 15s. 6d. witnesses' expenses, or in default imprisonment for fourteen days. On his own application, the prisoner was allowed seven days for payment.

* * *

A somewhat interesting case was dealt with last month in the Courts concerning the prohibition by Admiralty Regulations of the use of wireless telegraphy by merchant ships in harbours and territorial waters of the United Kingdom and the Channel Islands. The Dutch steamer *Roepat*, on a voyage from Dutch East Indies with general cargo to London, had called at Deal, and was rounding the North Foreland up the mouth of the Thames when she was heard by a naval officer stationed at Ramsgate calling up the Dutch wireless station at Scheveningen. The actual message was in appearance innocent enough, reading in translation, "Arrived safely at Deal; expect reach London to-night, hearty greetings, Kees." In view, however, of the fact that dangerous communications are often wrapped up in seemingly innocent messages, and seeing that the calls were strong and interfered with Admiralty wireless communications, the captain, Jacob Veenhoven, was charged on warrant at East Ham Police Court. The Dutch captain was able to clear himself of guilty intentions; but as a warning to others, and to emphasise the importance attached to strict obedience of Admiralty Regulations, the Court imposed the substantial fine of £10 and costs.

ADMIRALTY WIRELESS BADGE.

One of the smartest armlets imaginable is the Admiralty wireless badge. Dark red, with two wings and a zig-zag shaft of electricity worked upon it, it is both neat and effective. It is also very rare. "Only thirty-three have been issued since the war," said the wearer of one.

Stranger than Fiction

By E. BLAKE.

I.

IN spite of what metaphysicians may argue to the contrary, there are two distinct kinds of truth. One is the kind which proclaims that twice two are four, and that King John lost his gewgaws in the Wash and died through eating an excess of lampreys—and such-like facts which, owing to their sweet reasonableness, excite no suspicion; the other is that sort of truth which is practically monopolised by the wonders of science and the long arm of coincidence.

Regarding the wonders of science I have nothing to say, and the scientific men must make peace with their consciences as best they may; this story deals with a case of the long arm. Call it fiction if you will, and I answer that truth includes, utterly swallows up the most imaginative fiction, and then still has a word to say. There is nothing in fiction so incredible that its counterpart cannot exist in some concourse of atoms or events in the plastic fabric of Nature or the intricately-woven web of human affairs.

In April, 190—, I was wireless operator on the *Kapitan* in the South American trade. At that time she was the only vessel engaged on that run which carried wireless gear, and as coast stations were scarce I had a fairly easy time. Partly from a sense of duty and partly because I was making some private observations of "atmospherics," I used to wear the telephones for several hours daily, even when the nearest station was over fifteen hundred miles away. In wireless work as in most other human activities it is the unexpected which happens, and a good motto for an operator is, "When in doubt, listen in." You never know when some unheard-of craft, fitted with wireless the day after you left port, may come sneaking within range and bleat for help.

One afternoon I was lying in my bunk, pretending to be on watch, but really reading "The Purple Prince," a novel borrowed from our romantic third mate, when I was suddenly interested by hearing sounds in the telephone which I at first thought to be x's of unusual strength and tone. As I listened I decided that they were not "atmospherics"—at least, not like any I had ever heard. The sounds seemed to come with something like regularity, giving rise to a dim reminiscence of the Paris time-signals. After a time the signals broke up into dots and dashes which seemed systematic enough—not the result of a mere defect of spark, but as though the circuit was being made and broken according to a pre-arranged plan. It was not Morse; not even the Morse as conceived by continental operators of a nationality which shall be nameless. We were at this time about two days' steaming past the Horn, bound for Valparaiso, and reference to the chart showed that the nearest land was about forty miles distant and consisted of an archipelago, a mere scattering of large rocks off the coast of Chile.

I called "CQ" ("all stations") until my apparatus became overheated, but the steady flow of dashes continued, alternating with curious groups of dots and dashes, hour after hour without cessation. The signals, which sounded like those radiated by a "plain aerial," grew weaker as the *Kapitan* proceeded northward, and were inaudible about seven hours after I first heard them. I made a full report of the matter in my log and promised myself that I would investigate it further on the return voyage.

II.

Some weeks later, when the ship again approached the region where I had heard the strange signals, I found myself absurdly excited at the thought of once more getting at grips with mystery. I was possessed by an eerie feeling that somewhere something was wrong; that those regular, insistent ether impulses had a deeper significance than I could fathom. At times I vaguely wondered whether I had chanced upon signals from another planet, explaining their localisation by the supposition that a directional radiator was being employed. I favoured this view when I pondered on the facts that the signals were not those of any known code, and that they revealed none of the small imperfections characteristic of work performed by the hands of men. Then commonsense asserted itself and whispered, "Automatic transmission." But why did it continue for so long? And who, in that desolate region, would be playing with a development of wireless which was still in its infancy in the scientific nurseries of Europe?

At last I realised that my receiver was once more within range of the mysterious

"It was a mass of barnacles shaped roughly like a bottle. 'Hullo!' I said, 'there's something inside it.'"

waves. My trained ear distinguished them as attenuated wisps of sound which impressed my alert imagination with their seeming other-worldliness, and I experienced a disquieting recrudescence of the sense of the uncanny. I felt that behind the physical manifestation worked a mind, which, by means of those rhythmical sense-impressions sought *to convey intelligence*; that it was appealing, under the dire stress of limited means, to a similar mind as though to say, "Given such a phenomenon, in such a place and under such circumstances, what do you deduce therefrom?" I tried to deduce, but in vain; the data were hopelessly inadequate. And yet, although I was present on a rescue ship at the burning of the *Gloria* off Achin Head, and at the loss of the *Arbaces*, I had never heard so poignant a cry for aid as those persistent dots and dashes. Just as one sometimes feels another's presence in the room, so was I sub-consciously aware that I was hearing a deliberate attempt to attract attention to the mind which had conceived that particular arrangement of longs and shorts.

I got the ship's surgeon and three deck officers to listen to and describe the signals, with the following result: short dashes for a period of five minutes; an interval of twenty seconds; then fifty groups each consisting of —— - - —— - —— -   —— —— ; finally, a dot every second for one minute. Then the cycle recommenced.

From the moment when I picked up the signals to when they became inaudible, a matter of seven hours and fifty-three minutes, this continued without variation. The signals at their loudest were never of more than medium strength. We signed my log as five independent observers, and the affair furnished us with ample food for speculation until the ship was docked in London and we went our ways.

I laid my log before those in authority at my office, who, for the space of five minutes, pretended to be interested, and then went on to speak of an undercharge of five cents. . . .

III.

I had been down to the ship in order to fit some new insulators, and noticing that the *Almirante* was lying close by I went aboard for a chat with my friend Croome, her chief engineer. He received me with

"Floated bang up to the boat, and a Lascar hooked it out."

open arms and his best Burmah cheeroots, and we spoke of coal bills and the damnableness of adverse currents plus head winds. Presently I noticed on his locker a curio which I had not seen before, and strolled across the cabin to look at it.

"Ah! funny thing that," he said. 'Found it during lifeboat drill somewhere near the Falklands. Floated bang up to the boat, and a Lascar hooked it out."

It was a mass of barnacles shaped roughly like a bottle. "Hullo!" I said, "there's something inside it." I could easily distinguish the dull clicks as some small object slid about when I turned the relic in my hands. "Shall we break it open?"

"Go ahead," assented Croome, flinging me a hammer. "I expect it's a bit of rock or a shell."

A few blows laid the thing in fragments, and from the midst of the litter of barnacles, weed, and broken glass, I caught a glimpse of paper. Croome started up with an exclamation and began to sweep aside the débris, whilst I stood there tingling with excitement—and something else; I believe I knew even then a great deal about the contents of that bottle.

"Great guns, look here!" Croome held up some folded pieces of yellow paper and a tarnished gold ring. "This was what tinkled," he added, handing me the ring. "And this—it's a blessed long screed. Come on, let's see what Don Rougemont de Crusoe has to say."

We examined the papers, shoulder to shoulder. Sea water had rendered some portions of the writing illegible—it was written in pencil—but the gist of it, except an important detail which I was able to supply myself, was quite readable. We read:

"*January*, 1864.

" . . . of Tierra del Fuego, where . . . "November gales and foundered. Myself "and a spade-bearded ship's carpenter, "Maconochie, were cast upon this rock, "and I fear that every other soul aboard "perished. ["Not the packet *James Hands*, "I suppose?" interjected Croome.] Four "months ago I lived in Palmerston "Square, London, and now I am exiled "amongst these shrieking sea-birds, doomed, "maybe, to watch the face of the Pacific "and the inscrutable heavens till my course "is run. I have little hope of rescue, for

" I believe we deviated much from the customary track of the shipping. And I have no fire, no implement of any sort . . . cold, and we were forced to hew with our hands two holes, graves by their shape, in the immense accretion of guano, in which to huddle our shivering bodies. My food is the seaweed and shellfish, my drink rain-water from the pools. The length of time for which human life can be sustained by this fare in an environment so utterly desolate as mine cannot, I suppose, be very great; loneliness and bodily misery will probably suffice to kill me. Yet I am strangely reluctant to contemplate death, even though my present condition is a death without the mercy of oblivion. Was ever a man in so cursed a situation ? Young, rich, sensitive, educated, I am chained to a rock and live like a beast. And in London a woman waits for me, as she must wait, oh, heaven ! until she dies. The agony of this thought alone seems enough to destroy me, yet I am become strangely calm, though not resigned. The frenzies, in which I raved and blasphemed, shaking impotent hands at these wheeling, screaming birds, have passed, and I am like a child who has wept himself to a drought of tears from weariness and lack of results.

" When I have used all my paper I shall contrive to seal it up in a bottle together with my ring, and deliver my last message to my fellow creatures into the keeping of the sea. Maconochie picked up a bottle, I believe. I beg the finder to send my ring and message to my brother, Mr. Adrian Warner, of Burton-on-Trent, England. My will is with Gunn the attorney, who . . .

" . . . alone. Maconochie died after three days, and lies in his bed and grave, covered with such sand and stones as I could collect. He made a strange end. Perhaps he suffered a blow on the head when the waves dashed him ashore. Just before he passed he raised himself in my arms and said, ' 'Tis a mysteerious warld. I spoke wi' my mother a minute sence.' Then, sinking back almost gone, he whispered, ' Till the day break, laddie—an' the shadows—flee—awa'.'

" Ay, the shadows ! There are shadows between me and my kind ; the shades of ignorance. Did I but know as much as Maconochie I could have a ship here in a few weeks. He spoke to his mother. But I am dumb before the space which separates me and mine. I, a living, palpitating net of nerves, a man of the same stuff as those who discovered the secrets of the stars in their courses, who weighed the sun, raised the Pyramids, and who constructed the telescope and magnetic compass—I am impotent, lost, damned in my ignorance. A point or centre of psychic force, and I am cut off from all other such points. Can this be so ? Can it be that this unit, myself, is utterly isolated ? Is a gulf fixed between soul and soul or mind and mind ? I now see my problem clearly. *To project intelligence across space.* The electric telegraph cannot help me now. I have meditated much on Maconochie, *for he spoke with his mother.* Telepathy ? Is it the fruit of disordered minds or of minds attuned to others ? I have come across other instances of this, and it is true that in every case the communicating persons were bound in sympathy, friend to friend, wife to husband. ' Two hearts which beat as one ' ; better still, ' two minds with but a single thought '—can there be a scientific principle underlying this fancy of the rhymester ? Perhaps harmony is the secret ; the approximation of pulse to pulse, the striking of a chord which echoes in another ; like vibrating only to like. We know so little, so little." [" This is getting uncanny," muttered Croome, chewing his cold cheroot. " It's like watching a blind man grope. The plucky beggar ! " " He's getting on the track, too," I replied. My thoughts flew back to that place near the Chilian coast, and I heard again those appealing signals. I licked my dry lips.]

" I have it ! *There must be a medium.* Just as the electric fluid needs the wires to conduct it, so the subtler thought-currents must travel on some finer threads. But the medium, the medium ? Some intangible, imponderable, all-pervading . . .

" . . . instrument, not a telegraph, to disturb it, vibrate it, to create commotion broadcast, in some invariable and systematic manner from which men may reason from the disturbance, to me, the disturber. The light-ray necessitates an eye,

". . . . *doomed, maybe, to watch the face of the Pacific and the inscrutable heavens till my course is run.*"

" and the sound-wave an ear, thus how will " men perceive the disturbance of the " universal link without some receptor " designed to that end ? Professor Huxley " says he does not believe in thought- " transference because he can trace no " organ of reception in man's body; " I look to my fellow men to produce " that which is sensitive to this action at a " distance. It will come. I have hope, nay, " faith. Perhaps even at this moment " some influence from me may be inspiring " my friend, Mr. Maxwell the mathema- " tician, to turn his mind to the . . ." [" Or conversely," whispered Croome. " Wasn't his theory just out then ? "]*

*In 1864, J. Clark Maxwell published his "Electromagnetic Theory of Light." In the light of present knowledge it is conceivable that telepathic communication may have occurred between him and the castaway.

" . . . faith in man's perpetual endea- " vour. My work lies before me, and it " may be my destiny, here in this utter " solitude, save the birds, to evolve out of " my sore need some astounding thing for " the use and benefit of posterity . . . if I " can keep body and soul together, though " I fear the effect of the increasing cold . . . " religious only in the broadest sense, but I " am strong in the belief that each one is " endowed with . . . to use or neglect . . . " and that man is immortal till his work is " done. I see in the history of our race a " passion for and a striving towards articu- " lateness, expression ; or, as I said, the " power to convey thought. I see it in our " slow, evolutionary march upwards from " the lower, mute forms to the chattering ape " and early man with his primitive lan " guage ; I see it in the first rude sketches " of the cave dwellers, the signal fires, the " hieroglyphics on the enduring monuments " of the East, the sounding war-drums whose " throbbings rolled over forest and creek, " the waxen tablets and frail papyri ; in the " marble marvels of Greece, in the printed " book, in music and poesy, and, later, in our " own modern telegraph. Yes, it will come " as surely as to-morrow's dawn, that " conquest of space, when the shadows " shall flee away and it shall be known that " the visible universe is but as a pattern on " a garment, which is of one stuff from infinity " to infinity. In that day ' there shall be " no more sea,' and man shall speak with " man from one continent to another. I see " it, I see it. . . . . vouchsafed a sign, for I " have just noticed that the after portion of " the vessel lies within reach at low tide, " though it is rapidly breaking up. I can, " however, obtain fire, light, tools, and " comforts against stress of weather. I " shall take everything which time and my " strength permit, but particularly the " electrical machinery, which is new . . . any " medical solenoids and such-like appliances.

" I entreat my brother to search these " parts in the hope of finding me alive, but " in the event of failure I trust that . . . " comfort and sustain for my sake the lady " whom I . . . her and my many friends, " that in my thoughts . . . and cherish the " hope that at . . . memory . . . great " Hereafter.

" (Signed) EDWARD WARNER."

Croome expired a mighty breath and stared at the pieces of paper as though he were uncertain of their reality. "A prophet, a prophet, by gum!" he said in an undertone. As for myself, the strange signals were buzzing in my ears again. Both telepathically and with his "disturbances"—not to mention the message from his bottle—that great man had worked his will.

I started up, seized my hat and hastened to the nearest telegraph office, telling Croome as I ran out that I would see him and explain things on the following day.

. . . .

Adrian Warner, guided by the story I was able to tell him, is on his way to Chile in a fast British cruiser, to look for his unfortunate brother. Will he find a madman, crouching by a wonderful machine which produces electro-magnetic waves, a machine conceived by the genius of desperation and fashioned out of the unpromising materials salved from the wreck, or will he find the second grave sheltering a corpse, and an undreamed-of marvel of human ingenuity, a mysterious, never-failing source of energy, perpetually flinging its creator's appeal out upon the infinite expanse of ether?

AMONG THE SOCIETIES.

Croydon Wireless Society.—The second annual meeting was held at Croydon Polytechnic recently, when Mr. C. Harrison presided. Dr. T. C. Baillie and Dr. J. Erskin Murray continue as presidents, and the officers were elected as follows:—Chairman, Mr. F. G. Creed; Hon. Treasurer, Mr. W. Ryley; Hon. Secretary, Mr. H. T. P. Gee; and other members of the Council: Dr. H. A. Eccles, Dr. F. Knott and Messrs. R. E. H. Carpenter, C. Harrison, C. W. Raffety, and F. F. Roberts. Mr. E. A. Salt gave a short paper on "Primary Batteries, Past and Present," and showed and explained a small double fluid bichromate battery of his own design.

FROM A CORRESPONDENT IN HOLLAND.

"Your publication makes the greatest Providence we could find, wireless amateurs, specially your questions and answers and your clear and precise instructional articles."

THE IMPORTANCE OF MATHEMATICAL TRAINING.

A MATTER under discussion at the moment is the actual value to the student of a mathematical training, and whether it is necessary to go deeply into the subject in order to become a competent electrical engineer. Many have complained that the ordinary methods of imparting mathematical knowledge are far from interesting, and the famous Canadian humourist, Mr. Stephen Leacock, in his new book *Moonbeams from a Larger Lunacy*, particularly emphasises this point of view. He writes as follows:

"Here, for example, you have Euclid "writing in a perfectly prosaic way all in "small type such an item as the following:

"'A perpendicular is let fall on a line BC "'so as to bisect it at the point C, etc., etc.'

"... just as if it were the most ordinary "occurrence in the world. Every news-"paper man will see at once that it ought "to be set up thus:

"AWFUL CATASTROPHE.

"PERPENDICULAR FALLS HEADLONG ON A "GIVEN POINT.

"The Line at C said to be Completely "Bisected.

"President of the Line makes Statement.

"etc., etc., etc."

SHARE MARKET REPORT.

London, December 21st, 1915.

There has been very little business doing in the share market during the past month. The Dividend announcement of 5 per cent. Interim on the Ordinary shares, though favourably received, has not had any material effect on prices, which remain about the same. English (Marconi), Ordinary, £1 17s. 6d.; Preference, £1 13s. 9d.; American 15s. 3d.; Canadian, 5s. 6d.; International Marine, £1 5s.; Spanish and General Wireless Trust, 4s.

QUESTIONS AND ANSWERS

Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study to the Editor,* THE WIRELESS WORLD, *Marconi House, Strand, London, W.C. Such questions must be accompanied by the name and address of the writer, otherwise they will remain unanswered: and it must be clearly understood that owing to the Defence of the Realm Act we are totally unable to answer any questions on the construction of apparatus during the present emergency.

We have to acknowledge receipt of numerous letters from correspondents in all parts of the world relating to the "Little Problem" published in our November issue. In nearly every case the answer sent has been the correct one (5/6ths of an ohm). We would refer our correspondents to the announcement on another page regarding the prize competition for the best problem.

H. L. (Rugby).—Many thanks for your exceedingly well-worked-out letter on the problems. We much regret that space will not permit us to publish it, owing to its length.

Cte. de la B. (Paris).—We are afraid that we cannot answer your question without further particulars concerning the aerial. There is one point, however, which may help you. With the condenser placed as at first, no *direct* current could flow from the wire to the earth. With the condenser in the second position there is a path for the direct current through the crystal and telephones to earth. It is possible that the singing of which you complain may be caused by a small direct current flowing from the telephone wire to the earth via the crystal and 'phones. If this is not the cause, please let us have a few more particulars of the aerial (length, form, whether it is parallel to other similar wires, etc.), and we will endeavour to help you.

W. S. H. (Leicester).—Your answer to the problem was correct. With reference to your question asking what is a rough-and-ready test for the efficiency of a relay, we do not know of any really rough-and-ready method. In the days of the coherer receiver each of the Marconi Co.'s relays for use with the coherer had to pass a test of working with one volt through 350,000 ohms, the resistance of the relay itself being 10,000 ohms. These, however, were not telephone relays. With regard to yours, so much depends on what you call efficiency. If you will let us know what you regard as efficiency we will endeavour to help you further.

We should be glad if "F. G. B." (Yarmouth), who was answered in the Christmas number, would communicate with us again.

J. L. (Blackheath).—The answer to your question is Yes, in the case of the wave-lengths given, provided that the coupling be suitably adjusted. Your detector circuit diagram is not a good one for the purpose, as it would not enable very sharp tuning to be obtained. A condenser should be shunted across the inductance. Sorry we cannot go into constructional details in war-time.

"DUBLIN" asks: (1) "From which direction do the signals come the loudest in a sloping aerial, say the free end pole is 40 feet and the receiving end 20 feet? Do they come loudest from the free end towards the receiver or is there much difference in strength when coming from any other direction?" (2) "In an induction coil connected to an oscillating or closed circuit with a condenser and spark-gap, does the secondary of the coil charge the condenser sufficiently to cause a spark to take place across the gap for every make and break of contact?" (3) "Is it known the duration of the oscillations during a single spark, or in other words, the duration of the spark? I presume it is regulated by the coupling, or is it possible to design an alternating machine of such high frequency so as to catch up on them?"

Answers.—(1) With an aerial of the form referred to by our correspondent signals would be received in greatest strength from the direction opposite to the free end. The longer the distance between the two poles (the heights remaining the same) the more pronounced would be the directional effect. (2) There is one spark every "break." The "make" is comparatively slow, owing to the self-induction of the primary, and only a low e.m.f. is created in the secondary, but the "break" is very rapid and the resulting sudden change of field in the secondary creates a high e.m.f., which enables the condenser to be charged to the full voltage, whereupon it discharges across the spark-gap. (3) From the way this question is worded it is evident that our correspondent is not very clear on the subject. The spark continues as long as the oscillations continue in the closed circuit. How long these continue depends on the frequency of the circuit and the damping. For example, in a closed circuit tuned to a 600 metre wave-length each oscillation will occupy one five-hundred thousandth of a second. If there are fifty oscillations before the spark is extinguished, the duration will be one ten-thousandth of a second. The number of oscillations will depend on the damping of the circuit. As tight coupling withdraws energy more rapidly from the closed circuit into the aerial than does loose coupling, in certain circumstances tightening the coupling may be said to reduce the duration of the spark. The last part of question (3) is not at all clear. A number of alternators have been designed which work with a frequency sufficiently high to be used directly for wireless telegraphy, but of course when such machines are used there is no need for a spark. The purpose of the spark is to release the charge in the condenser suddenly and create oscillations; if you have an alternator which in itself gives currents of an oscillatory frequency, it can be used directly on the aerial, the condenser circuit and spark gap being dispensed with.

J. de N. (The Hague).—Thanks for your letter and answer to problem. With regard to the query in the second half of your letter, we should be glad if you would write more fully stating clearly what you wish to know, and if possible giving references to the books from which the equations are taken, as so far we have been able to trace only one of these. We are pleased to hear that you like our magazine, and trust that in the future you will find it even more helpful.

Instructional Article

NEW SERIES (No. 5)

The following series, of which the article below forms the fifth part, is designed to provide wireless telegraphists, amateurs, and technical students generally, with clear and precise instruction in technical mathematics, in order that they may be enabled to read and understand the more advanced technical articles which appear from time to time.

The Circle.

(a) Circumference.

27. Take some circular body, say an ordinary glass tumbler, and a piece of string. Wind the string tightly round the top of the tumbler, and mark off in some way the length of string which just makes one turn. This length, say 9 in., will be approximately equal to the circumference of the top of the tumbler.

Next measure the diameter across the top and you will find that it is about $2\frac{3}{4}$ in., and so the ratio $\frac{\text{circumference}}{\text{diameter}}$ is $\frac{9}{2\frac{3}{4}}=3{\cdot}3$ (nearly).

Now, if you repeat this simple experiment with any circular body, you will always find that the ratio $\frac{\text{circumference}}{\text{diameter}}$ is rather greater than 3, and if the measurements are made with absolutely no error then the ration will always be 3·1417 .... This value is given a Greek symbol π (pi), and so the circumference of a circle equals $(\pi\times d)$, where d is the diameter. As $d=2r$, where r is the radius, we can put

$$\text{circumference}=\pi d$$
$$=\pi\times 2r=2\pi r.$$

EXAMPLE.

What length of wire is required to wind a coil of 100 turns on a former 3 in. in diameter ?

One turn of the coil would need (πd) inches of wire, or $(\pi\times 3)=3{\cdot}1417\times 3=9{\cdot}4251$ in.

Therefore 100 turns would require

$$100\times 9{\cdot}4251=942{\cdot}51 \text{ in.}$$

This length $=\frac{942{\cdot}51}{12}=78{\cdot}54$ ft.

Thus 80 ft. of wire would be sufficient, this leaving about 9 in. to spare at each end of the winding.

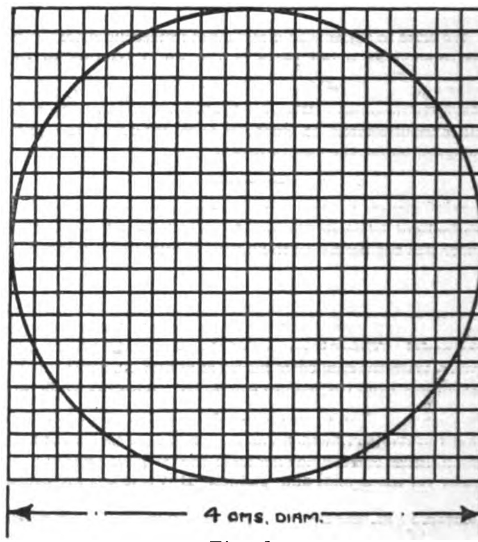


Fig. 6.

(b) Area.

28. A circle with a radius of 2 cms. is drawn upon squared paper (Fig. 6). The squares are each of 2 mm. sides, and so the area of each is $(0{\cdot}2\times 0{\cdot}2)=0{\cdot}04$ sq. *cms.*

On counting up all the squares and parts of squares enclosed by the circle, you will find that the total is about 308 squares, and so the area of the circle (being the number of squares multiplied by the area of each square) is $(308\times 0{\cdot}04)=12{\cdot}32$ sq. cms.

Now $(\text{radius})^2=r^2=(2)^2=4$, and so the ratio $\frac{\text{area}}{r^2}=\frac{12{\cdot}32}{4}=3{\cdot}08$.

If we had found the area with sufficient accuracy we should have got

$$\frac{\text{area}}{r^2}=3{\cdot}1417\ldots=\pi.$$

Now this is true for *any* circle, and so the area of a circle is equal to πr^2, or putting $\left(\frac{d}{2}\right)$ for r, area $=\pi\times\left(\frac{d}{2}\right)^2$

$$=\frac{\pi d^2}{4}=0{\cdot}7854d^2.$$

EXAMPLE.

A condenser is made up of two brass plates each 10 cms. in diameter, and placed 0·5 mm. apart in air. Find the capacity.

The capacity of two parallel plates of equal area, separated by air, equals

$$\frac{A}{4\pi t\times 9\times 10^5}\text{ mfds.,}$$

where A = area of each plate (sq. cms.) and t = distance apart (cms.).

$$\text{Now area}=\frac{\pi d^2}{4}=0{\cdot}7854(10)^2$$

$$=0{\cdot}7854\times 100=78{\cdot}54\text{ sq. cms.}$$

$$t=0{\cdot}5\text{ mm.}=0{\cdot}05\text{ sq. cms.}$$

$$\text{Therefore capacity}=\left(\frac{78{\cdot}54}{4\pi\times 0{\cdot}05\times 9\times 10^5}\right)$$

$$=0{\cdot}00014\text{ mfds.}$$

29. Before leaving the subject of circles it will be as well to note the following formulæ:

(1) The area of the *curved* surface of a cylinder with radius r or diameter d is equal to the *circumference* of the base multiplied by the length of the cylinder, or $(\pi d\times l)=(2\pi rl)$.

(2) The volume of the above cylinder equals the *area* of the base multiplied by the length of the cylinder, or

$$(\pi r^2 l)=\left(\frac{\pi d^2 l}{4}\right).$$

(3) Volume of a sphere of radius r

$$\text{is }\frac{4}{3}\pi r^3=\frac{4}{3}\pi\left(\frac{d}{2}\right)^3=\frac{4}{3}\pi\frac{d^3}{8}=\frac{\pi d^3}{6}.$$

(4) Surface of the above sphere

$$=4\pi r^2=4\pi\left(\frac{d}{2}\right)^2=4\pi\frac{d^2}{4}=\pi d^2.$$

EXAMPLE.

If 1 cu. ft. of cast-iron weighs 450 lb., what must be the diameter of a ball to weigh 10 lb.?

1 cu. ft. = 1728 cu. in.

Thus, as 1728 cu. in. weigh 450 lb., a weight of 10 lb. would require a volume of

$$\left(\frac{10}{450}\times 1728\right)=\frac{1728}{45}\text{ cu. in.}$$

Let d inches be the diameter of the required ball.

Then volume of the ball (see above)

$$=\frac{\pi d^3}{6}=\frac{1728}{45}.$$

Therefore $\pi d^3\times 45=6\times 1728$

$$\text{or } d^3=\frac{6\times 1728}{45\times\pi}=\frac{2\times 576}{5\pi}=\frac{1152}{5\pi}.$$

Now log 5	= 0·6990
Log 3·1417	= 0·4972
Adding	= $\overline{1{\cdot}1962}$ = log (5π)
Log 1152	= 3·0615
Subtracting log(5π)	= 1·1962
	$\overline{1{\cdot}8653}$ = log d^3
Dividing by 3	= 0·6218 = log d
Therefore d	= antilog 0·6218
	= 4·186 in., say 4·2 in.

Measurement of Irregular Areas.

30. In later articles the subject of curve plotting will be dealt with, and we shall there see that an area such as ABCD (Fig. 7), contained by a curve AB, and the two perpendiculars AD and BC, taken to a base line, CD, will have a definite meaning. For instance, if AB was a curve showing the relation between force and distance moved, then the area ABCD would equal work done.

Now to find this area we can proceed as follows.

Divide DC into any suitable number of equal parts, say ten, and erect perpendiculars at each division point, thus dividing the whole area into ten strips of equal width.

Then, if we consider any one of these strips *pqrs*, we see that the area of the strip is equal to the base *rs* multiplied by

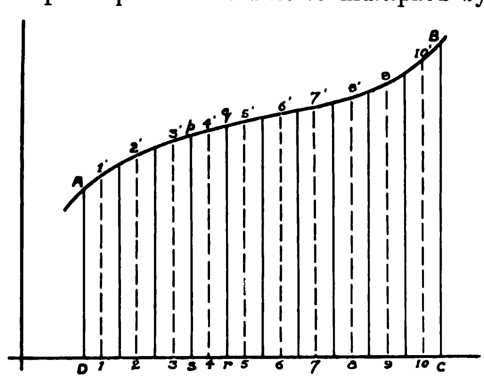


Fig. 7.

E

the *average*, or *mean height*. Now this mean height is obviously greater than ps and less than qr, and so *if we have made our strips so narrow that the pieces of curve across the tops are practically straight lines*, we can take the mean height as being the mean of ps and qr, or $\frac{ps+qr}{2}$.

The usual method of arriving at the mean height, however, is to draw a third vertical midway between r and s, and to take the length of this as the mean height of the strip. Thus the area of the strip $pqrs$ is equal to the base rs multiplied by the length of this central vertical, called the mean *ordinate*.

It is obvious that the total area ABCD equals the sum of the areas of all the separate strips, and so equals each particular base multiplied by each particular mean ordinate.

We can write this as:
(base 1 × ordinate 1) + (base 2 × ordinate 2) + (base 3 × ordinate 3) + ... + (base 10 × ordinate 10).

As, however, base 1 = base 2 = base 3 = ... = base 10, the above expression simplifies down to:
(common base or width) × (ordinate 1 + ordinate 2 + ... + ordinate 10) or area = (width of strips × total sum of all the mean ordinates).

In our particular example (Fig. 7) the common width = 0·5 cms., and

ordinate	1.1′	= 2·55	cms.
,,	2.2′	= 2·82	,,
,,	3.3′	= 3·04	,,
,,	4.4′	= 3·19	,,
,,	5.5′	= 3·30	,,
,,	6.6′	= 3·41	,,
,,	7.7′	= 3·50	,,
,,	8.8′	= 3·64	,,
,,	9.9′	= 3·82	,,
,,	10.10′	= 4·15	,,
	Total	= 33·42	,,

Thus, the total area is (0·5 × 33·42) = 16·71 sq. cms.

31. This method can be adapted to measuring the area of a figure such as ABCF (Fig. 8).

By dividing the figure into strips as before, and using any convenient line, ED, as a base line, we can find firstly the area, ABCDE, and, secondly, the area, AFCDE.

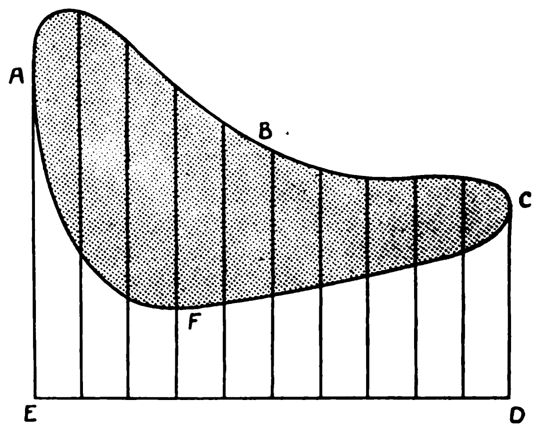


Fig. 8.

By subtracting the latter from the former we have left the area of the figure ABCF.

It must be remembered that the accuracy of this and the following method is dependent on the figures being divided up into a sufficiently great number of strips for the pieces of curve across the tops of the strips to be very approximately straight lines. The greater the number of the strips, the more accurate will be the final result.

Simpson's Rule.

32. Taking a similar area to that in the last case, we first of all draw two *parallel tangents* AB and CD at the extremities of the figure (Fig. 9). A tangent is a line which just touches a curve without cutting it. In this case the tangent AB runs along the left-hand end of the figure between the points a_1 and b_1, and so a_1b_1 is the *first ordinate*. Similarly the *last ordinate* is $a_{11}b_{11}$.

The mid points of a_1b_1 and $a_{11}b_{11}$ are next joined by a straight line XY, and XY is then divided up into any suitable *even* number of parts—in this case ten. Ordinates a_2b_2, a_3b_3, etc., are drawn through the points of division along XY.

By Simpson's Rule the area of the figure is obtained as follows:

Add together the first ordinate, the last ordinate, twice the sum of all the other odd ordinates, and four times the sum of all the even ordinates; multiply this sum by one-third of the common (perpendicular) distance between the adjacent ordinates.

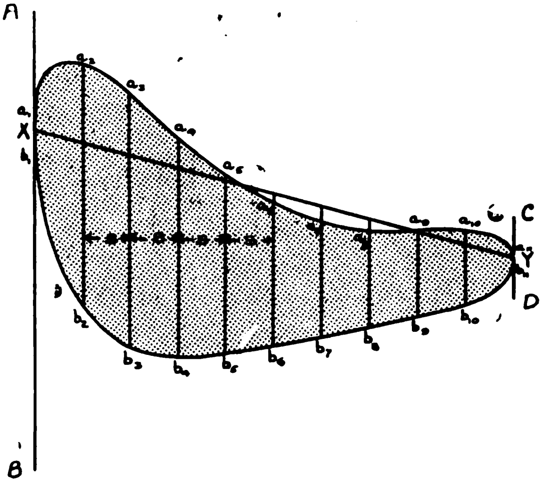


Fig. 9.

Thus, in our case, the area is

$$\{a_1b_1+a_{11}b_{11}+2(a_3b_3+a_5b_5+a_7b_7+a_9b_9)+4(a_2b_2+a_4b_4+a_6b_6+a_8b_8+a_{10}b_{10})\}\frac{S}{3}$$

Now $a_1b_1=0{\cdot}16$ in.	$a_7b_7=0{\cdot}48$ in.
$a_2b_2=1{\cdot}02$,,	$a_8b_8=0{\cdot}41$,,
$a_3b_3=1{\cdot}06$,,	$a_9b_9=0{\cdot}36$,,
$a_4b_4=0{\cdot}91$,,	$a_{10}b_{10}=0{\cdot}33$,,
$a_5b_5=0{\cdot}75$,,	$a_{11}b_{11}=0{\cdot}03$,,
$a_6b_6=0{\cdot}60$,,	$S=0{\cdot}20$,,

From this, area

$$=\{0{\cdot}16+0{\cdot}03+2(1{\cdot}06+0{\cdot}75+0{\cdot}48+0{\cdot}36)+4(1{\cdot}02+0{\cdot}91+0{\cdot}60+0{\cdot}41+0{\cdot}33)\}\frac{0{\cdot}20}{3}$$

$$=\{0{\cdot}19+2(2{\cdot}65)+4(3{\cdot}27)\}\frac{0{\cdot}20}{3}$$

$$=(0{\cdot}19+5{\cdot}30+13{\cdot}08)\frac{0{\cdot}20}{3}$$

$$=\frac{18{\cdot}57\times0{\cdot}20}{3}=6{\cdot}19\times0{\cdot}20=\underline{1{\cdot}238\text{ sq. in.}}$$

33. To divide a straight line into any number of equal parts we can use the following simple construction.

Let us divide the line AB (Fig. 10) into seven equal parts.

First, draw any convenient line AC from the point A, and along it, starting from A, mark off seven equal parts of any suitable length. This can be done either with a pair of compasses or with a ruler. Let A*a*, *ab*, *bc*, *cd*, *de*, *ef*, *f*C be these seven parts.

Join CB, and through *a*, *b*, *c*, *d*, *e*, and *f*, draw aa^1, bb^1, cc^1, dd^1, ee^1, ff^1, parallel to CB, and cutting AB at a^1, b^1, c^1, d^1, e^1, and f^1.

Then the line AB will be divided into seven equal parts Aa^1, a^1b^1, b^1c^1, c^1d^1, d^1e^1, e^1f^1, and f^1B.

Right-Angled Triangles.

34. A right-angled triangle is a triangle one angle of which is a right angle. ABC (Fig. 11) is a right-angled triangle, in which the angle ABC is the right angle.

Let us construct squares on each of the three sides AB, BC, and CA. Now AB=0·55 in., BC=1 in., CA=1·14 in.

Area of square on AB=$(AB)^2=(0{\cdot}55)^2=$ 0·3025 sq. in.

Area of square on BC=$(BC)^2=(1)^2=$ 1·0000 sq. in.

Area of square on CA=$(CA)^2=(1{\cdot}14)^2=$ 1·2996 sq. in.

You will see that the square on AB *plus* the square on BC (0·3025+1·0=1·3025 sq. in.) very nearly equals the square on CA (1·2996 sq. in.). Indeed, if our measurements had been sufficiently exact the two values would have been exactly equal. Thus $AB^2+BC^2=CA^2$.

If this is tried with *any* right angled triangle it will *always* be found that the sum of the squares of the two sides which *include* the right angle is equal to the square of the side *opposite* the right angle.

It will be easily understood that if two sides of *any* right-angled triangle be known, the third side can always be calculated.

EXAMPLE.

What length of wire would be needed to stretch from a window 6 ft. above the ground level to the top of a 40-ft. pole, which is 30 ft. away from the house ?

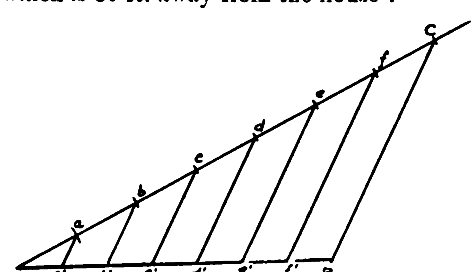


Fig. 10.

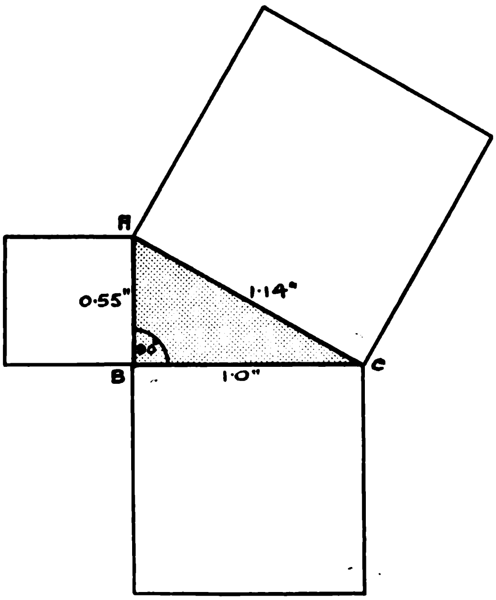


Fig. 11.

In the diagram (Fig. 12) draw, at the 6-ft. window level, a horizontal line, CB, to a point, B, on the pole. Then if A is the pulley at the top of the pole

$$AB=(40-6)=34 \text{ ft.}$$

Also BC=30 ft., and angle ABC is a right angle.

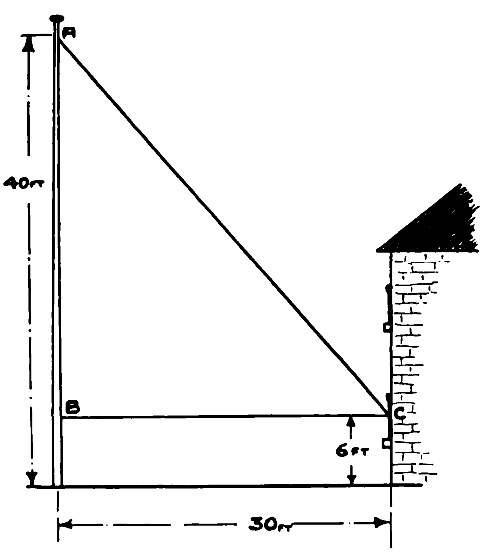


Fig. 12.

$$\begin{aligned} \text{Thus } AC^2 &=(AB)^2+(BC)^2 \\ &=(34)^2+(30)^2 \\ &=1156+900 \\ &=2056. \end{aligned}$$

Therefore $AC=\sqrt{2056}=45{\cdot}34$ ft., say $45\frac{1}{3}$ ft. or 45 ft. 4 in.

PRO BONO PUBLICO.

Some Further Notes.

Sergeant Wissaerts.

IN the Christmas number we gave some short accounts of the heroic efforts of certain members of the Belgian Marconi Company. We are now enabled to give particulars of two more brave men belonging to the same company—Sergeant G. T. Wissaerts and Sergeant F. Befahy. Both these gentlemen were telegraphists in the Belgian Company's service when war broke out. When their country was dragged into the war they were called up for active service and have been doing their share continuously ever since. We offer them our best wishes for their continued safety.

Sergeant Befahy.

The LIBRARY TABLE

"WIRELESS TIME SIGNALS." London: E. & F. N. Spon, Ltd. 3s. 6d. net.

Appearing as it does at a time when all time-signal wireless work and experimentation is in a state of suspended animation, this little volume—the authorised translation of the French official handbook, *Réception des Signaux Radiotélégraphiques par la Tour Eiffel*—will not have the ready sale which would have been its lot had it appeared in the smiling days of peace, but nevertheless we are sure many will purchase and study it in preparation for the happier days which are to come.

Chapter I. is devoted to a description of receiving apparatus and how it can be simply constructed for the reception of signals from the Eiffel Tower. The circuits described are of simple design and free from complications likely to confuse the new student. One or two points in the text call for comment, such as the translation of the word "commutateur" on page 19 as "commutator" instead of "switch." A bad error, too, is made in translating "L'absence d'organe de réglage de la différence de potentiel" as "The absence of an *induction coil* for regulating the potential difference" (page 16). These points will doubtless be corrected in a future edition.

The remainder of the book is devoted to particulars of the signals themselves, and calculations arising therefrom. The translators have added some useful appendices to the original work, that including a vocabulary being very helpful to the amateur unacquainted with the French language. When peace is proclaimed and aerials again rear their masts into the air, we are sure many listeners will find this volume of great assistance in their work. Meanwhile, we think that the publishers might have added a little note to the effect that none of the constructional work described may be undertaken during the war, as it is conceivable that some purchasers, unacquainted with all the provisions of the Defence of the Realm Act, might commence to erect the simple apparatus referred to. The note might take the form of a small gummed slip.

* * *

"ALL ABOUT FLYING." By Gertrude Bacon. London, 1915: Methuen & Co., Ltd. 1s. net.

The science of aeronautics in peace time forms as interesting a study or hobby as it is possible to conceive. More particularly is this statement true at the present time, when half the civilized world is engaged in deadly combat. The little book under review forms one of Messrs. Methuen's "sport" series, and the information given in so small a compass is just what those superficially interested in flying want to know. Its title would seem at first glance to be a little presumptuous, but from the non-technical standpoint there is very little more that could be said. Miss Bacon has evidently devoted a considerable amount of time and energy in producing it. She does, however, devote one chapter to the power unit, in which she explains briefly the engine and other apparatus necessary for the propulsion of the machine. Her last chapter is devoted to a comparison of flying in peace and war, and it is in this latter that the mention of the application of wireless telegraphy to aircraft occurs.

* * *

"A Treatise on the Theory of Alternating Currents." (Second Edition.) By Alexander Russell, M.A., D.Sc., M.I.E.E. Cambridge: The University Press. 15s. net.

Whilst the practical side of alternating current work is receiving increasing attention from technical writers, the theoretical aspect is not being neglected, as is evidenced by the appearance of this volume. Of a purely theoretical nature, it assumes that the student is already acquainted with the elementary theory of electricity and magnetism, and has a working knowledge of trigonometry and the elements of the calculus. Electricians and students interested in the application of high frequency currents to wireless telegraphy will find Chapter VII. of interest, for in it the author has discussed high frequency currents at length. A brief *résumé* of the theory of two coupled oscillation circuits is also given in Chapter IX. The five hundred or more pages of the book are well filled with important and useful matter, and will doubtless afford much pleasure and instruction to those who have proceeded somewhat further in electrical studies than the students of elementary classes.

* * *

"The Mystery of the Green Ray." (Second Edition.) By William Le Queux. London, 1915: Hodder & Stoughton. 2s. net.

The name of the author of this book forms a recommendation to his works in itself, and the fact that the book is already in its second edition aptly bears out the justice of this statement. The basic facts of the story, as might be judged from a knowledge of the author, are concerned with espionage and refer to the present war. The principal figure and his friends are introduced to the reader during a holiday boating trip on the Thames at the time of the outbreak of war. This news causes his friends to abandon their trip and return to London bent upon enlisting. The hero before enlistment proceeds to Scotland to bid good-bye to his fiancée, and whilst on the Scotch express comes into contact with a man purporting to be an American who owns a large house within a mile or two of the residence of the fiancée's father. This girl with her friend roves over the mountains one day and at a particular bend in the stream is suddenly struck blind. Investigations point to the fact that the American owner of the house close by is responsible for this, and it is assumed that by some wireless agency he is able to produce a bright green flash which blinds those who see it. Another remarkable fact ascribed to these wireless waves is the withdrawal of its life-giving properties from the air, and in this connection the hero very nearly loses his life. It subsequently transpires that the American and various accomplices were German spies sent to establish a submarine base in one of the lochs of the Western Scottish coast. To those interested in wireless the book should make a thrilling appeal, and we commend it to all who revel in exciting adventure.

* * *

"Relativity and the Electron Theory." By E. Cunningham, M.A. London: Longmans, Green & Co. 4s. net.

This book is one of the excellent series of Monographs on Physics which Messrs. Longmans are publishing, and forms a companion volume to *The Spectroscopy of the Extreme Ultra-Violet*, recently reviewed in these columns. As its title suggests, it is a volume dealing with advanced physics, and as such will, we are afraid, make little appeal to many of our readers, but to those who have already mastered the elementary stages of the science we do not doubt it will afford much interesting reading. In Chapter I. the author in a very clear manner introduces his subject, and in subsequent chapters treats of the Origin of the Principle of Relativity, The Relativity of Space and Time, Mechanics and the Principle of Relativity, Relativity and the Objective Aether, and other matters. The book contains much of interest to the advanced wireless student, as it deals with the Aether and the difficulties which have arisen in endeavouring to arrive at a proper conception of its properties.

* * *

"BRAZIL AND THE BRAZILIANS." By G. J. Bruce. London, 1914: Methuen & Co., Ltd. 7s. 6d. net.

Of all the countries of the South American Continent Brazil probably possesses the largest resources and the biggest commercial possibilities. The exploration and definition of the interior proceeds apace, and every year witnesses the formation of new towns and settlements according to the importance of the neighbourhood. The author glances briefly into the history of the country, gives a description of the Indian Aborigines and the civilized Brazilians, touches upon politics and laws, makes short reviews of the States, and deals generally but more fully with the natural resources of the land from a commercial standpoint. He describes the inhabitants as "a people reaching out." Many of them have already reached out, and wireless telegraphy has been brought into use in order to keep them in touch with the more populous districts. Radiotelegraphic stations are springing up all over the South American Continent in increasingly large numbers, and their utility is proved by the eagerness with which the prospectors of unknown lands desire outfits. In a vast territory like Brazil the commercial use of wireless is not overlooked. And this is due to the impracticability of laying cables through the dense tropical forests and the wide marshy expanses of land. To those interested in the commercial application of radiotelegraphy the book should prove of unending interest and we can heartily recommend it.

* * *

"SPECIFICATION AND DESIGN OF DYNAMO-ELECTRIC MACHINERY." By Miles Walker, M.A., M.I.E.E. London: Longmans, Green & Co. 32s. net.

The purpose of this volume is well explained in the Preface, where the author points out that there appeared to be no book of precedents of electrical specifications analagous to the famous "Conveyancing Precedents," compiled by Prideaux, which are so widely used by lawyers; and it occurred to him that such a book would be of some use to those engineers who have from time to time to draw up specifications for the purchase of electrical machinery. Professor Miles Walker is to be congratulated on his achievement in producing this book, for it is a volume of more than six hundred large pages filled with information, diagrams, and illustrations of the greatest value to all who have to do with the specification of such machines. The book is divided into two parts, the first dealing with short rules for use in the design of dynamo-electric machinery, and the second with the specification and the design to meet the specification. At the conclusion the author introduces an index of the clauses in the specification together with a carefully compiled general index.

* * *

"A TEXT-BOOK ON PRACTICAL MATHEMATICS FOR ADVANCED TECHNICAL STUDENTS." By H. Leslie Mann, B.Sc., A.R.C.Sc. London: Longmans, Green & Co. 7s. 6d. net.

As lecturer in advanced practical mathematics at the Woolwich Polytechnic, the author of this book is in a good position to appreciate the difficulties which confront the average student of mathematics, and to know the chief points upon which to lay emphasis when teaching the subject. Based upon some of the work done by the senior students at the institute above referred to, the volume before us assumes in the reader a knowledge of the fundamental principles of Algebra, Trigonometry, Mensuration, and the use of Logarithms and squared paper. It is the intention of the author that the book should cover a two- or three-years' course and he has divided it into three sections, the first being devoted to Algebra and Trigonometry, the second to the Differential and Integral Calculus, and the third to the application of the subject-matter of the two previous sections to concrete examples. Numerous examples, carefully chosen in accordance with the text, are provided wherever the need for them has shown itself, and should prove of great assistance to the student. The book is well printed and will doubtless be welcomed by many teachers and students.

Foreign and Colonial Notes

Guatemala.

It was announced recently in the United States Navy Department that congratulatory messages had been exchanged between the President of the United States and the President of Guatemala in celebration of the opening of the new high-power radio station at Guatemala City, and referred to in our Christmas Double Number.

* * *

Japan.

A new regulation came into force in Japan on November 1st last by means of which radio telegraphic apparatus may, subject to a licence being first obtained, be installed by private persons outside the State Telegraph and Telephone area in vessels and on aircraft. Up to the present no one, other than officials, has been permitted to set up or work any wireless apparatus in that country. It may be noted also that licences may be obtained by persons who take experiments in wireless telegraphy.

* * *

Oceania.

A high-power wireless station has been erected on Ocean Island in the Pacific Ocean, which is a spot of some considerable importance. It lies almost on the equator and about 2,400 miles due north of New Zealand. It possesses a wonderfully rich deposit of phosphate, a native population of about 450, in addition to some hundreds of native labourers engaged in recovering the phosphate, and 50 white men who act as overseers and engineers.

* * *

Paraguay.

A wireless station has been erected at Asuncion, the capital of Paraguay, constituting the second military zone. It was opened to public service at the beginning of October.

Portuguese East Africa.

A wireless station has been opened at Lourenço Marques, and it is interesting to learn that the cost of its erection was borne by the Union of South Africa as a return for certain services rendered by Portugal. It is able to receive messages up to a distance of nine hundred miles, whilst its transmitting range is nearly one hundred miles.

* * *

Straits Settlements.

It is learnt that a wireless telegraph station has just been erected for public service at Singapore.

* * *

Sweden.

Our contemporary, the *Morning Post*, in its issue of November 19th, prints a message from Stockholm regarding a wireless telephonic invention, by means of which messages may be transmitted from trains and automobiles travelling at the highest speed. The simply constructed apparatus forms the invention of two Swedish army officers, and in one instance, it is alleged, messages were intelligibly received from a distance of over 700 miles.

* * *

United States.

The well-known inventor, Mr. Thomas A. Edison, recently made a trip out to sea on board the *Mayflower*. Whilst undertaking this voyage Mr. Edison desired to communicate with the new high-power station at Arlington. He sent the following message to Captain Bullard, the chief of the United States Naval Radio Service :—" Congratulations on your big Arlington plant. I have heard the small and large sets, seated in the wireless room of the *Mayflower*, and they are great." After a short delay the following reply was flashed back :—" My compliments to Mr. Edison and the Naval Advisory Board, by this message, transmitted on the 100 k.w. spark set."

The contractors have begun work on the installation of wireless telegraph apparatus at the Navy Department building. This will place the station at Arlington, and all other naval wireless stations, in direct communication with the bureau of operations through which all the movements of the fleet are directed. Five sets will be placed on the roof of the building, and that number of operators will be able to receive all the messages which come into Arlington from the vessels of the fleet, and also from numerous wireless stations. Also five separate short distance sending sets will allow the Navy Department to communicate without interrupting the work of the Arlington station.

* * *

The value of wireless telegraphy has been recognised very considerably. We understand that if the private telephone line, built by the Empire Gas and Electric Company, U.S.A., and connecting its six plants, is put out of commission by storms or other causes, two, and eventually all, of the stations will be able to communicate by radio telegraphy. Several employees of the company have become proficient in the use of wireless apparatus in an amateur way and others, it appears, will be instructed.

* * *

At the "Electrical Prosperity Week" celebrations which took place in the United States from November 29th to December 4th last an interesting spectacular feature was the showing by wireless on a miniature scale of the manœuvres of a battleship, a facsimile of a submarine, an aerial battle, and various high-frequency electrical discharge features of a nature to interest the public. The whole thing was the climax of a gigantic and unprecedented advertising campaign.

* * *

It is interesting to record that the wireless operator at the Great Lakes, Illinois, wireless station recently distinctly heard one of the new stations in Japan, which was about 5,000 miles distant, talking to Kokoa Head station in the Hawaiian Islands. To eliminate any doubt upon the efficiency of the new wireless station at Great Lakes, the Japanese message was transcribed word for word.

Uruguay.

The *South American Journal*, in its issue of November 13th, states that the Uruguayan Government have under consideration a proposal for the erection of a high-power wireless station similar to that projected in Argentina.

COMPANY NOTES.

MARCONI'S WIRELESS TELEGRAPH COMPANY, LTD.

THE Directors of Marconi's Wireless Telegraph Co., Ltd., have issued the following circular:

"DEAR SIR (OR MADAM),—The Directors "regret that they have not yet been able to "obtain from Government Departments a "basis of settlement in respect of either "remuneration or compensation for services "rendered, for the use of their stations since "the commencement of the war, nor in "respect of other matters in which the "Government is indebted to the Company.

"However, without taking into account "the considerable sums which are estimated "to be due to the Company in respect of "these matters, the business which has been "actually completed for the current year "has been satisfactory, and the Directors, "without departing from the policy, which "was approved at the last General Meeting, "of husbanding their resources, feel justi-"fied in declaring the 7 per cent. Prefer-"ential Dividend upon the Cumulative "Participating Preference Shares, and an "Interim Dividend of 5 per cent. on the "Ordinary Shares.

"Warrants for the Dividends upon the "registered shares will be forwarded by "post on the evening of January 31st next.

"Notice will be given in due course, by "advertisement in newspapers in London, "Italy, Montreal, Buenos Aires, and the "United States, regarding the deposit of "coupons for the payment of Dividends on "Bearer Shares."

THE MARCONI INTERNATIONAL MARINE COMMUNICATION CO., LTD.

The Directors have declared an interim dividend of 5 per cent., equal to one shilling per share, less income tax, on account of the current year, payable on February 1st next to shareholders registered at December 24th.

PERSONAL PARAGRAPHS.

Hearty felicitations to Warrant Telegraphist Eric Sharp on his marriage. Mr. Sharp has for some time been engaged on Admiralty duty, and has been in the thick of the Gallipoli fighting as well as in other places. Prior to joining the Forces, Mr. Sharp had considerable experience as an operator on board ship, having joined the Marconi Company some five years ago. We trust the happy couple will have a long and prosperous life.

* * *

Mr. W. G. Martin, who at the outbreak of war was Chief Instructor in the Marconi Company's London School, has received the following letter from Sapper Holmes, of the Wireless Signalling Section of the Royal Engineers, British Mediterranean Expeditionary Force. Sapper Holmes was for some time a student in the London School, and had only just passed his Postmaster-General's Examination, gaining a First-Class Certificate, when the war broke out and he was called up for service in the Territorials, to which he already belonged. The numerous members of the Marconi Company's Operating Staff who studied in the school with Sapper Holmes will, no doubt, be interested to hear of his adventures, and so we reproduce the letter practically in full.

"I must apologise for not communicating with "any members of the Marconi School staff since I "left in August, 1914. Whilst I was in England I "did not think it was necessary, but as I am now on "the Gallipoli Peninsula, and have been here for "the last eight weeks, I take the liberty of writing "you as being the most likely person to remember "me. If you remember, I had to leave the school "on mobilisation, as I was in the Territorial Royal "Engineers. I came and saw you about last "January, and had then joined the above Signal "Company in order that I might not get out of "touch with wireless, etc. We left England on "22nd May, and, after a brief stay in Egypt, were "sent to General Headquarters. I was a member "of a pack set, and our instruments are the standard Marconi field sets of ½ kw. They are used "with pack horses, and have proved very reliable "indeed, even when used as permanent stations. "My section was engaged in the landing on August 6th, 1915, and we had to erect and work "under fire from the very beginning. I was "slightly wounded about a quarter of an hour after "landing which was done, by the way, at 4 a.m. in "the semi-daylight. The bullet cut a mark about "2 in. long on my back, and, after being bandaged "up, I was able to take my turn at operating without any inconvenience.

"We are acting as a flanking station, and keep up "communication with the ships and the shore "during bombardment, etc. This is the eighth "week we have been here, and are safely established in a dug-out quite out of harm's way "although shells come over pretty well every day. "I am the only original operator left out of our "pack, and we have been reinforced with five "operators at various times, and each one in turn "has gone sick after a few days with us.

"We work ship's watches with three operators— "a sailor, a new man from England and myself. "The flies are simply terrible, due, no doubt, to "the close proximity of dead bodies, the firing line "being roughly two miles away.

"Trusting that you are in excellent health, and "with my kind regards,

"I am, Sir,

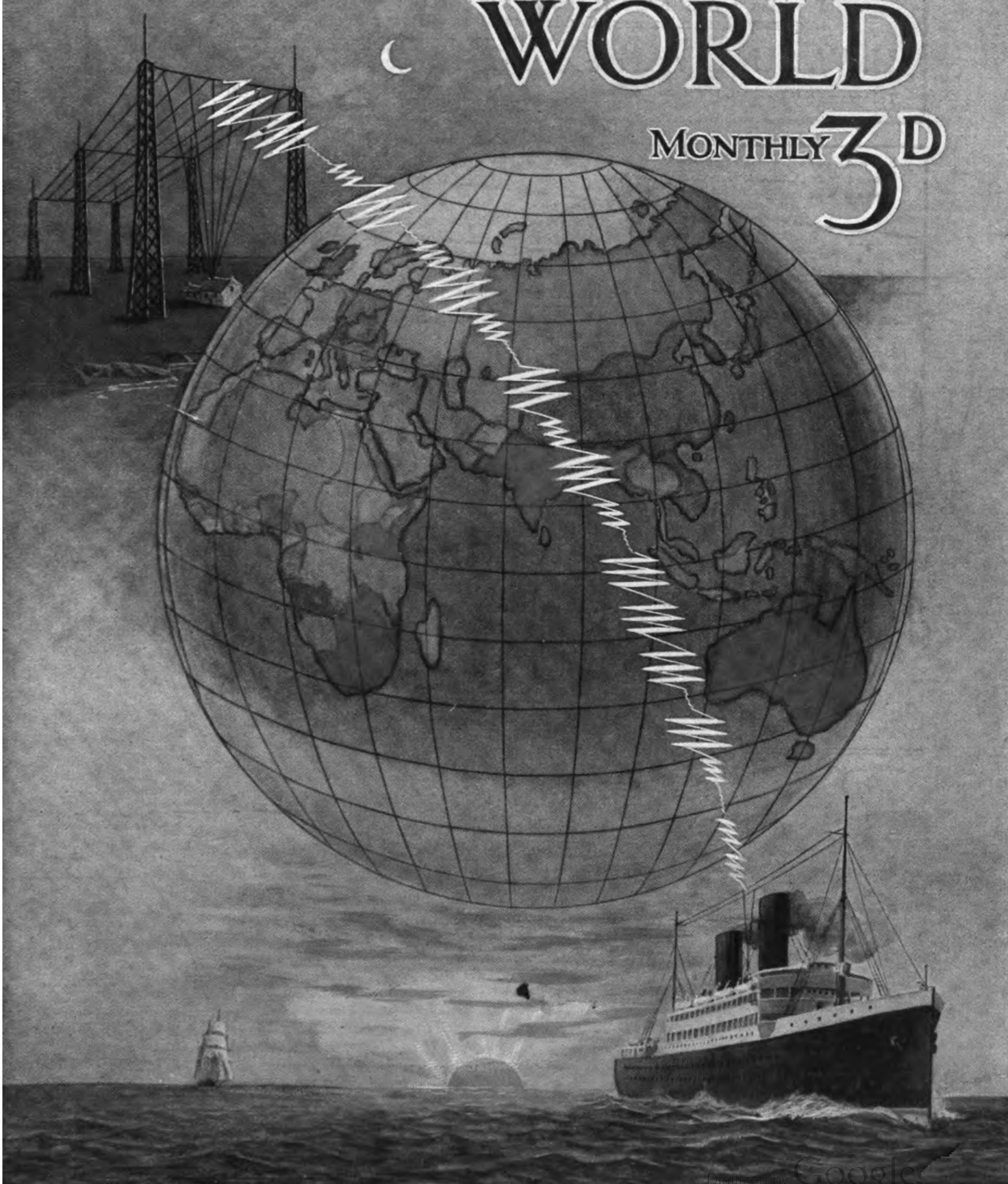
"Yours, etc.,

"(Sgd.) C. F. HOLMES."

No. 35. (New Series.) Registered at the G.P.O. for transmission to Canada by Canadian Magazine Post. FEB., 1916

WIRELESS WORLD

MONTHLY 3D



THE WIRELESS WORLD

Vol. 3.—No. 35. (New Series) February, 1916. Subscription 5/0 per annum post free. Price 3d. Post Free 5d.

WIRELESS IN THE BALKAN PENINSULA

A Note on the Trend of Events in the Near East

IN the earlier days of the war, when, as far as the general public was concerned, the development and utility of wireless were comparatively little known, the attention of newspaper readers was continually directed by their journals upon the constantly recurring evidence of its importance. Now the public has become so familiarised with its manifold branches of activity that the ordinary daily press places radiotelegraphy in the limelight much less than it did.

This, however, does not by any means imply that radio-telegraphy is retreating into the background. Far from it! We find that, whenever it becomes necessary to direct energetic measures against any fresh objective, a central feature of that objective consists of an important wireless station. Thus, when General Botha was skilfully conducting his operations against the Germans in South West Africa, his main objective, the capture of which enabled him to bring his conquest to a victorious issue, was the German centre of Windhoek, with its powerful wireless station. In the same way to-day, when the Allies are taking measures to chastise the insolent ambition of Bulgaria's petty Cæsar, one of the first operations of which we hear is a Russian naval attack upon Varna, the main Bulgarian port in the Black Sea, and the only town in Bulgaria, as far as we know, provided with a wireless installation.

The Balkan Peninsula forms in one way a historic landmark in the progress of wireless from the point of view of military operations; it was, we believe, the first scene of its employment to any great extent in general field warfare. It is true that some preliminary wireless experiments were conducted at the time of the British South African war and during the course of the Russo-Japanese struggle, but in those days the combination of portability and reliability which are essential for successful and rapid field work had not been attained. By the time, however, that the Balkan imbroglio of 1913 occurred, military wireless had reached such an advanced stage that it became indispensable to the operations of all the armies concerned. Our readers will remember how a portable set at Adrianople demonstrated itself to be of the greatest use in communicating with Constantinople from the beleaguered city, and indicated strikingly to the world at large that, thanks to radiotelegraphy, it was no longer possible for a besieged town to be cut off from outside communication in the way that was possible before the advent of marconigrams. Such isolation, for example, as was effected by the Russians in their famous 1877 siege of Plevna, and which had been the general rule when a town blockade was made really effective, has become, thanks to wireless, no longer possible.

The present writer, in the course of an extremely interesting interview at the Serbian Legation, was given to understand that the wireless sets in the possession of the Serbian army proved of the greatest utility to that hardly tried force in the course of their exhausting retreat across the Albanian mountains; in fact, it formed the only means available for keeping the Serbian units in touch with one another.

RT. HON. SIR JOSEPH WARD,
BART., P.C., K.C.M.G., D.C.L.,
LL.D.

Personalities in the Wireless World

THE RT. HON. SIR JOSEPH WARD, BART., P.C., K.C.M.G., D.C.L., LL.D.

OUR Australasian cousins have for some time appreciated the benefits which may accrue from the adoption of wireless telegraphy to supplement or supersede the other means of telegraphic communication already in use in that part of the world. And this is due in no small measure to the interest and initiative of the subject of our illustration. The Right Honourable Sir Joseph Ward, Baronet, is an Australian by birth, having first seen the light at Emerald Hill, Melbourne, in 1856. He is thus just sixty years of age, and his career has been as varied as his life has been long.

He commenced at the bottom of the ladder as a telegraph messenger boy in the department over which in later years he presided as Minister. In 1887, when thirty-one years old, he entered the New Zealand Parliament, and after three years accepted the portfolio of Postmaster-General (February 4th, 1891) in the Ballance Ministry, and held that position, with the exception of the period 1896 to 1899, continuously until 1912, when he resigned it. He was three times Acting-Prime Minister during the absence of the late Rt. Hon. R. J. Seddon from New Zealand, and after the death of the latter gentleman in 1906 he assumed the position of Prime Minister, which he resigned in 1912.

Sir Joseph Ward was one of the first advocates of the All-Red Cable Service, which he had the satisfaction of seeing inaugurated on the Pacific side. His introduction, on January 1st, 1901, of penny postage into the relations of New Zealand with countries overseas formed the crowning result of many years of sustained effort in pursuit of that beneficent measure. The reduction of postal rates, the extension of telegraph facilities, the pushing of mail services into the wilderness, are among the many postal and telegraphic conveniences which mark the activity of his mind and his generous foresight in the public interest.

He quickly saw the advantages of wireless telegraphy, and as a result of his efforts contracts were let in 1910 for the installation of two high-power wireless stations at Awanui and Awarua respectively and three low-power stations at Auckland, Wellington, and Chatham Islands respectively. In this connection it is interesting to note that the first radio station opened in New Zealand was situated in the tower of the General Post Office at Wellington, and was opened on July 26th, 1911. Sir Joseph Ward has been one of the most prominent figures in the politics of the Dominion for the last quarter of a century, and his powerful influence has been felt in practically every legislative field during that time.

The Special Problems of Aircraft Wireless—III

By H. M. DOWSETT, M.I.E.E.

Aircraft Balancing Capacities. Airships.

THE airship radiating system comprises a fixed balancing capacity, and a trailing aerial let out to such a length that it has the same natural period as the balancing capacity. This is the simplest arrangement. Considerably longer wave-lengths than what would be thus obtained are often used for transmitting, in which case the radiating system is tuned by inserting an inductance coil in series with the fixed balancing capacity and by letting out more wire of the trailing aerial. Should the airship be travelling low or at high speed, it may be found convenient to insert inductance also in series with the aerial instead of increasing its length. When the capacity and inductance in the radiating system are thus no longer distributed but are concentrated and separated, it becomes of use to know what the electrostatic value of the balancing capacity actually is.

Airships are divided into three classes: (1) "rigid," (2) "semi-rigid," and (3) "non-rigid," according to the degree of support given to their gas-bags.

The "rigid" class, of which the Zeppelin, the Schütte-Lanz, and the Speiss are examples, has several gas-bags enclosed in a skeleton frame of metal or wood.

The "semi-rigid" class, to which belong the Lebaudy and the Gross, has a metal or wood frame keel built on the gas-bag.

The "non-rigid" class, which includes the Clement-Bayard, the Parseval, and the Astra-Torres, has a perfectly flexible gas-bag, but sometimes, as in the case of the Clement-Bayard, a stiffening girder is supported by triangulated steel ropes some distance below the gas-bag.

The form of radio balancing capacity used will naturally vary with the type of airship and the degree the airship's structure lends itself to form a suitable capacity surface.

In Class 1, the Zeppelin stands in a grade by itself. Its aluminium skeleton, to which two boat cars or gondolas are rigidly fixed, forms an excellent balancing capacity of comparatively high value and also of low ohmic resistance. To this last quality it owes a well-established reputation for better wireless reception than can be obtained on any other type of airship.

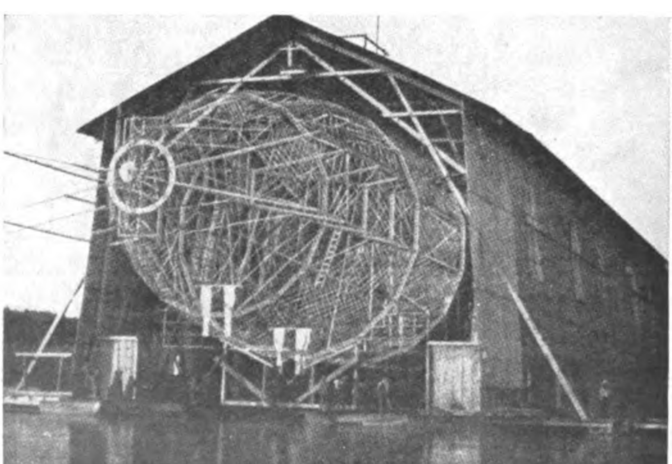


Fig. 1.—Zeppelin Airship under construction in dock on Lake Constance.

Fig. 1 shows the frame of a Zeppelin under construction. The mass of light girder work and cross-bracing forms a lattice cylinder having an electrostatic capacity in free space not very much less than that of a cylinder

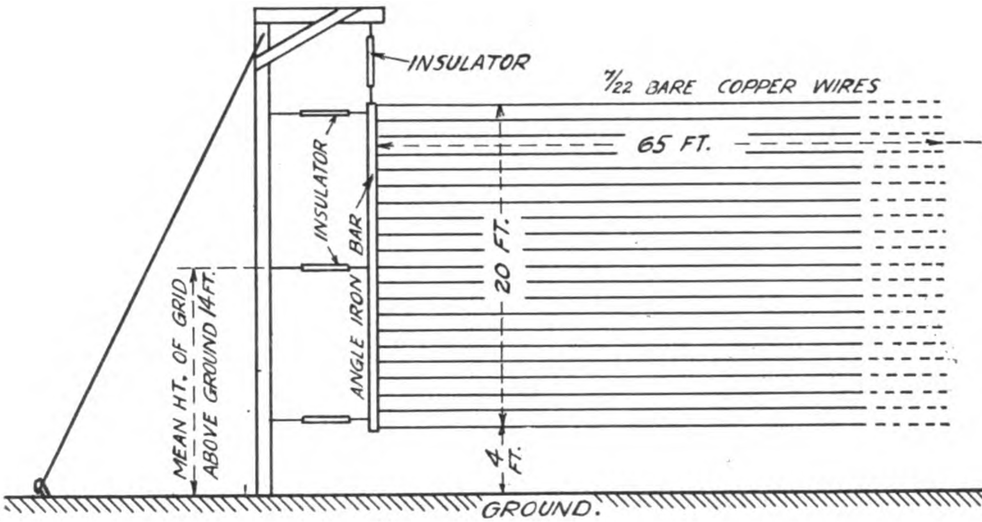


Fig. 2.

of equal size but having an unbroken surface of sheet metal.

The following test carried out at the Marconi Works some three and a half years ago illustrates this point. Two insulated angle iron bars 20 ft. long were suspended and stayed vertically 65 ft. apart, from scaffold supports, the bottom of the bars being 4 ft. above the ground. They were connected by horizontal wires of 7/22 S.W.G. bare tinned copper, carefully adjusted to equal length, the number of wires being varied from 2–20 ft. apart to 101 2·4 in. apart, *see* Fig. 2. The capacity of the wire grid so formed was measured, and the results obtained are indicated in the curve, Fig. 3. Sufficient values are given to determine the general shape of the curve, which shows that the increase of capacity with increase of number of wires ceased to be measurable at about 70 wires, and that therefore the capacity given by 101 wires separated 2·4 in. was practically the same as that of a plate of sheet metal of the same area. In fact, two or more wires which share the same charge have their individual free space capacity reduced by being brought near one another, and, as is well known, this reduction is proportional to, "log (length/distance apart)." The following table shows that for a ratio of "length/distance apart" of 130 : 1 there was a reduction of 1·25 per cent. from the maximum capacity, for a ratio of 65 : 1 a reduction of 10·9 per cent., and so on.

Number of 65 ft. 7/22 wires.	Distance between centres.	Capacity mfds.	Difference from max. capacity.	Length Distance apart.
			% less	
101	2·4 in.	·00412	—	325
41	6 ,,	·00407	1·25	130
21	1 ft.	·00367	10·9	65
11	2 ,,	·00300	27·2	32·5
2	20 ,,	·0015	63·6	3·25

Now the Zeppelin, as is shown very clearly in Fig. 4, is a sixteen-sided vessel, and the *L I*, 525 ft. in length and 50 ft. in diameter, will have had its main longitudinal members separated a distance of 9·8 ft. But the effect of its wire cross-bracing must also be allowed for, and, as shown in Fig. 5*b*, this was equivalent to introducing two parallel wires between each pair of longitudinal members, so that for the purpose of calculating the capacity of the *L I* skeleton it may be considered as a cylinder of 48 longitudinal members instead of 16, without cross-bracing, spaced a mean distance apart of 3·3 ft. Then its ratio "length/distance apart" was 160 : 1, and from the table given above its capacity in free space could not have differed from that of a cylinder of sheet metal of equal size, by much more than 1 per cent. If no allowance were made for the cross-bracing the difference from maximum capacity would be 17·5 per cent. The formula for the capacity of a prolate ellipsoid which would be used to calculate the capacity of a Zeppelin skeleton is as follows :

$$C_{cms.} = \frac{2\sqrt{l^2 - r^2}}{\log_e \dfrac{l + \sqrt{l^2 - r^2}}{l - \sqrt{l^2 - r^2}}}$$

where l=*half* the length in cms., and r= radius in cms. of the framework.

Fig. 4 is a view of the *L II*, a vessel 487 ft. long, 55 ft. diameter, and a ratio "length/distance apart" of its effective longitudinal members as calculated above of 135, from which it follows that its capacity in free space must have been about 1·25 per cent. less than that of a sheet-metal cylinder of the same overall dimensions. The *L II*, it may be remembered, exploded in mid-air, and her crew of twenty-eight were burnt in the wreckage.

It may be of interest here to give the capacity values in one or two practical cases.

The *L I*, 525 ft. long, 50 ft. diameter, probably had a capacity in free space of 2,620 cms. A single 7/18 S.W.G. wire of the same length, by calculation—*see* formula (1) below—should have a capacity in free space of 723 c/ms. Although less than 1/4000th of the Zeppelin diameter, it would have more than a quarter of its capacity.

The capacity of long straight wires is useful to know, as the balancing capacity used on the Schütte-Lanz type of airship—which is rigid like the Zeppelin, but has a framework of ash and poplar instead of aluminium—is made up of one or more parallel wires stretched between the gondolas (Fig. 6). The position of the gondolas is about half-way between the centre of the airship and each end. The largest German airship in commission before the present war was a Schütte-Lanz, the *L IV*. It sank in the North Sea.

A flat grid, 50 ft. wide, of equally spaced wires, each wire 525 ft. long, the grid being, therefore, equivalent in area to the longitudinal section through the *L I*, would have by calculation—using formula (2) see page 714—a free space capacity of

1,988 c/ms.	with	21	wires.
2,000	,,	24	,,
2,041	,,	42	,,

the last value being practically the same as for sheet metal of the same area, as the ratio "l/d" in this case is 430 : 1. This same value is only 22 per cent. less than the capacity of the complete Zeppelin skeleton.

Suitable formulæ for calculating the capacity of a parallel grid of wires, and also as will be seen later, of grids of wires which are not parallel, should prove of considerable use to the aircraft wireless engineer.

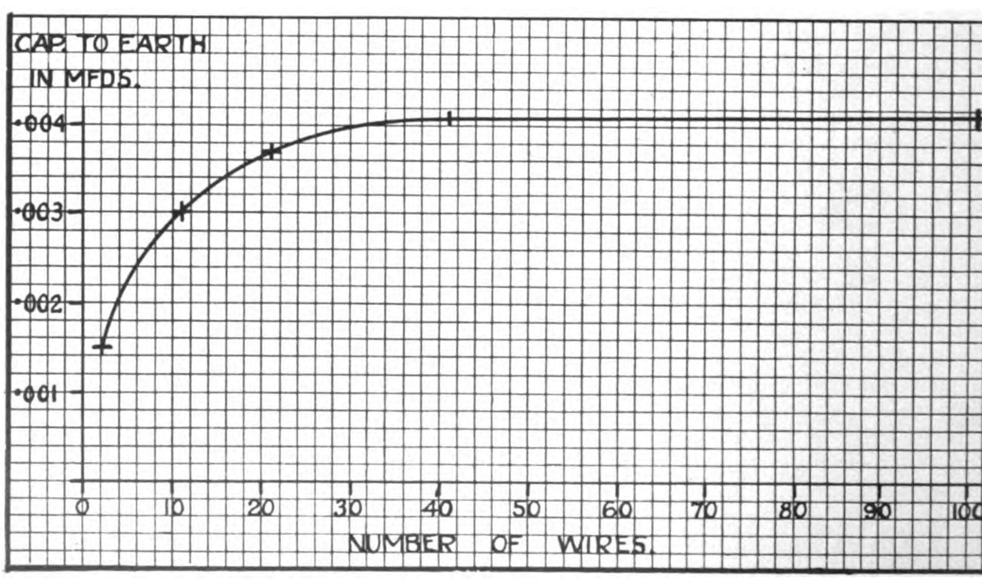


Fig. 3.

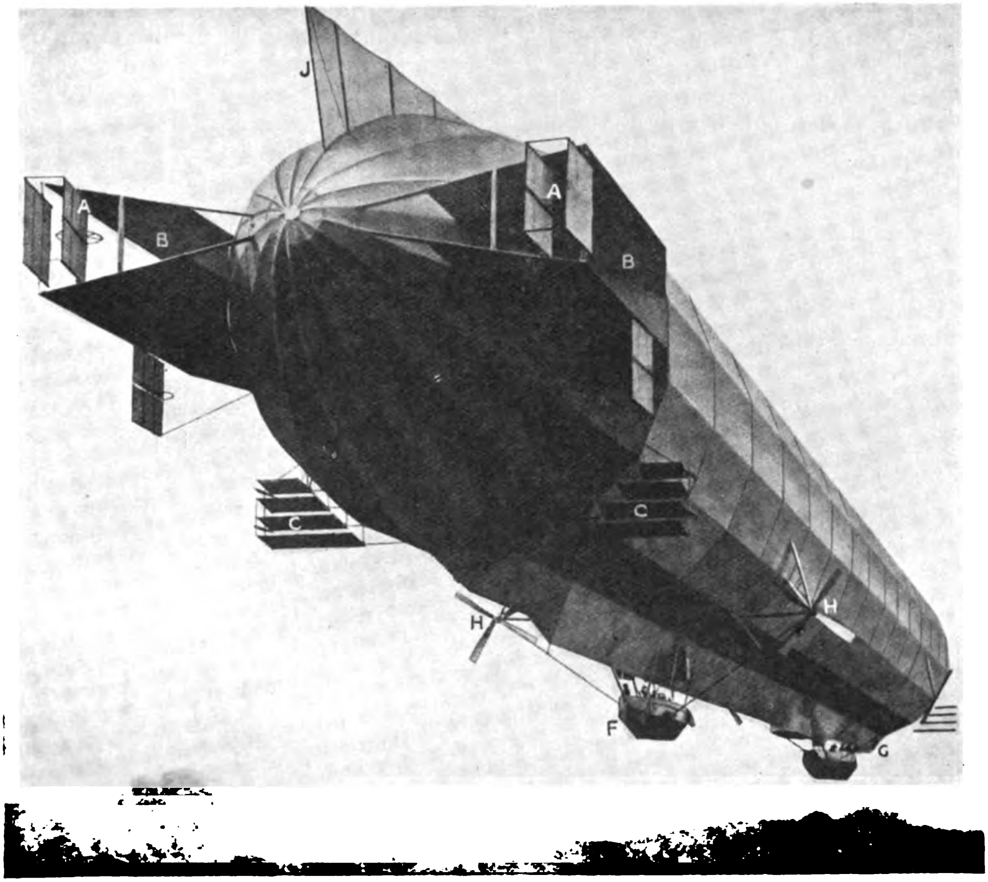


Fig. 4.—Zeppelin L II.

AA Rudder planes. BB Air passages. CC Dipping planes. F Stern gondola.
G Forward gondola. HH Propellers. J Rudder.

Of the several attempts which have been made to construct such formulæ the work of Prof. G. W. O. Howe has been particularly thorough. His formulæ are practical in shape, and by the aid of curves they have been made simple to handle.

Within certain limits they appear to give reasonably accurate results.

According to Howe * the capacity in centimetres of a single wire far removed from earth is

$$C = \frac{l}{2 \log_e (l/r) - 0{\cdot}618} \quad . \quad . \quad . \quad (1)$$

The approximate capacity of a parallel grid of such wires is:

* WIRELESS WORLD, December 1914.

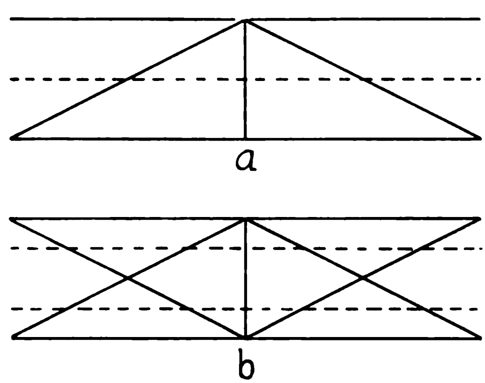


Fig. 5.—Extra Capacity due to Cross Bracing

(*a*) Equivalent to single wire shown dotted, parallel to and midway between longitudinal members.

(*b*) Equivalent to two wires shown dotted, parallel to and spaced ¼ and ¾ the distance between the longitudinal members.

$$C=\frac{nl}{2\{n\log_e(l/d)+\log(l/r)-B\}} \quad (2)$$

A closer approximation to the capacity of such a grid is obtained by the following formula provided " l " is a large multiple of " nl."

$$C=\frac{nl}{2\{n(\log_e l/d-0{\cdot}309)+\log_e d/r-B\}} \quad (3)$$

and the following expression is said to be rigidly accurate:

$$C=\frac{nl}{2[n\{\log_e(l/d+\sqrt{l^2/d^2+1})-\sqrt{1+d^2/l^2}+d/l\}+\log_e d/r-B]} \quad (4)$$

where l=length of each wire.

r=radius of each wire.

d=distance between wires.

n=number of wires.

B=the mean of the values $(\log_e \underline{/n-m/m-1})$ for the whole grid of wires, each wire in turn being the mth.

Values of B up to 12 wires in the following table have been calculated by Prof. Howe. The values for $n=21$, 24, and 42 were calculated by the writer in order to test the above formulæ. When the number of wires is large, the calculation of B is a tedious operation, but it has only to be done once, and then can be used for all future calculations involving a like number of wires.

n	B	n	B
2	0	9	8·06
3	0·46	10	9·80
4	1·24	11	11·65
5	2·26	12	13·58
6	3·48	21	34·2
7	4·85	24	42·03
8	6·40	42	95·7

Using formula (4) the calculated capacity in free space of 42—7/22 wires forming a grid 65 ft. by 20 ft., as shown in Fig. 2—is 289·7 cms.

Correcting for the effect of the earth,* the capacity becomes 397·5 c/ms.

Now the measured value for 42 wires from curve, Fig. 3, is ·0041 mfds. or 369 c/ms.

The calculated value is, therefore, 7·6 per cent. high. As the calculated value assumes a perfect earth, whereas under the conditions of test the earth was far from perfect, being simply grass-covered soil containing no earth-plates or wires in the close neighbourhood, this difference is quite reasonable, and the test results may be said to support the formula.

(To be continued.)

* WIRELESS WORLD, January 1915. Formula not needed for calculating aircraft capacities.

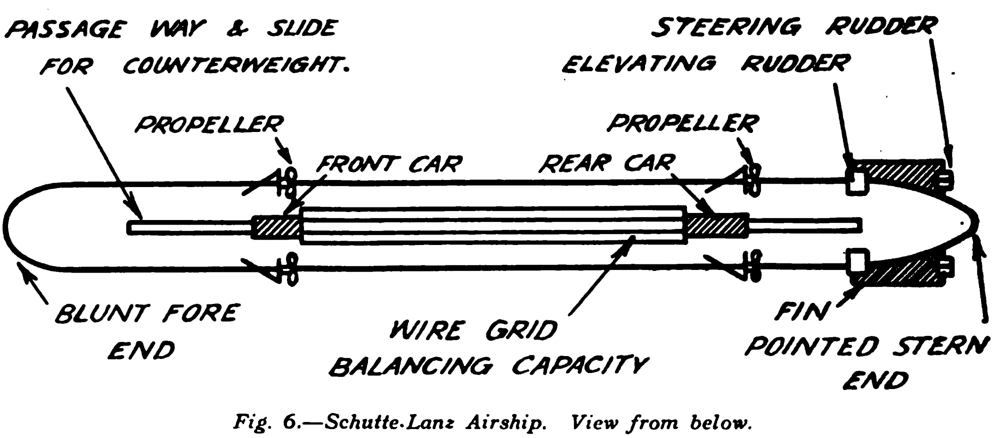


Fig. 6.—Schutte-Lanz Airship. View from below.

Wireless apparatus generally in front car. Wire grid balancing capacity may sometimes be extended beyond rear car.

Digest of Wireless Literature

ABSTRACTS OF IMPORTANT ORIGINAL ARTICLES DEALING WITH WIRELESS TELEGRAPHY AND COMMUNICATIONS READ BEFORE SCIENTIFIC SOCIETIES.

PREVENTION OF COLLISIONS IN FOG.

In a paper presented at the Royal Society by Professor J. Joly, a method of estimating distances at sea in fog or thick weather was outlined. The method depends on the different velocities with which disturbances travel in different media.

If aerial and submarine signals are simultaneously emitted at a lighthouse or lightship the lag of the aerial as compared with the submarine sound is about 4·3 seconds per nautical mile. If therefore an approaching ship can pick up the signals and measure the lag even to a quarter of a second, she becomes aware of her distance to less than a quarter of a mile. If the faster moving signals are sent out in groups, the individual signals being spaced to regular intervals, say of one second, and the slower moving signal is always emitted simultaneously with the first signal of a group, the navigator has only to count the faster signals till the slower signal reaches him in order to estimate his distance from the signal station. In this case the signals themselves tell him his distance, and no actual time measurements are required on board the ship. Similarly wireless and submarine signals or wireless and aerial signals may be used.

The system may be extended to the problem of avoiding collision in fog. If vessels possess the means of emitting a loud and crisp sound signal which can be sent out simultaneously with a wireless or submarine signal, the determination of distance thereby rendered possible, together with the wireless information as to course and speed, will enable the navigator on each ship to determine with certainty (1) whether or not there is a risk of collision, and (2) the point on his own course and the moment at which collision is threatened. The solution of the problem is based on the fact that at each instant the rate of approach is the maximum if the ships are advancing so as to collide. A simple geometrical construction, which by its character is unlikely to involve error, enables the navigator to solve the problem immediately the signals are received.

* * *

THE EFFECTIVENESS OF GROUND ANTENNÆ.

Mr. R. B. Woolverton recently read a paper before the Institute of Radio Engineers, New York, on the Effectiveness of the Ground Antenna in Long Distance Reception. The subject of the paper was suggested in October, 1914, when resonance curves were being taken by the writer at Eccles, Cal., on waves emitted by the various high powered commercial stations situated in the vicinity of San Francisco, at a distance of approximately 100 miles. The antenna used in taking these resonance curves consisted of the top wire of a five-foot fence extending in a north-westerly direction for a distance of approximately 4,000 feet. Although the antenna used was quite aperiodic, as might be expected, the received energy in the secondary circuit was remarkably large, signals being heard from stations in the Hawaiian Islands and Alaska. By using the ordinary crystal detector full scale deflection was obtained on a portable galvanometer when taking resonance curve data on the wave emitted by the high powered Marconi station at Bolinas, Cal.

In view of the results obtained at Eccles, the writer conducted on October 9th and 10th, 1915, experiments of a somewhat more quantitative character at the Palmer B. Hewlett ranch, situated ninety miles south by east of San Francisco. The receiving apparatus was of the oscillating vacuum valve type, using a second step amplifying bulb, and the audibilities were read on an audibility meter.

Before beginning the experiments it was thought that a comparatively long single wire antenna would be so directional in effect that it was decided to confine the readings to one particular station; and Sayville, Long Island, was chosen, the antenna being made as nearly directional toward that station as possible. Buildings slightly interfered with this plan, however, and the antenna's true direction from the receiving apparatus was west-south-west, instead of more nearly west. As soon as readings were begun it became apparent that this directional effect did not exist, as is shown by a table accompanying the paper. The two antennas consisted of 500 foot and 1,000 foot lengths respectively of a single Number 28 B. and S., cotton covered magnet wire laid on dry earth without support at any point. The audibilities for the four transmitting stations are shown below.

Antenna.	Sayville.	Honolulu.	Arlington Arc.	Arlington Spark.
500 feet ...	50	100	60	100
1,000 feet ...	80	160	80	160

The audibility of atmospherics was unity in each case. Atmospheric audibilities taken during the period of the tests on a five-wire antenna, 45 feet high and 100 feet long, averaged 100. The results are, therefore, of great interest to all who are concerned with the problem of eliminating atmospheric trouble.

The paper closes with a foreshadowing of further experiments by the writer, showing that he intends to go much further into the matter.

* * *

THE EXPANDING HOT-WIRE AMMETER.

The measurement of antenna current in a wireless transmitter is usually carried out by means of a hot-wire instrument, the high frequency of the current to be measured making it impossible to utilise many of the forms of ammeter suitable for currents of lower frequency. Mr. William H. Dettman, in a recent number of the *Wireless Age*, writes an interesting article on the Physics of the Expanding Hot-Wire Ammeter, from which we extract the following notes.

In forcing a current against the resistance of a wire, a certain amount of electrical energy must be expended which manifests itself as heat. Let (R) be the resistance of the wire in ohms and (I) the current in ampères, made to flow through it under the potential difference of (E) volts applied to its ends. Then the power expended in the wire is given by the equation:

$$P=EI \text{ or } I^2R. \text{ since } E=IR,$$

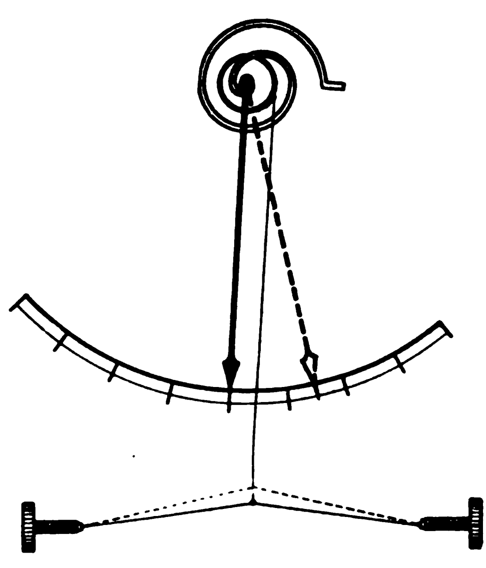
which appears as heat. The total energy (W) transformed into heat in (t_1) seconds.

$$W=I^2Rt_1 \text{ or } EIt_1 \text{ Joules.}$$

The unit of heat in the C.G.S. of units is the gram calorie, which is the amount of heat required to raise one gram of water through 1 degree centigrade. One Joule equals ·24 calorie.

$$W^1=\cdot 24\ I^2\ Rt_1 \text{ calorie.}$$

This heat raises the temperature of the wire above the temperature of its surroundings, with the consequent increased rate of heat loss by radiation, convection and conduction. A body is said to give off heat by radiation when the heat is conveyed away from the body by ether waves, these waves being similar to light waves but much longer. A body loses heat by convection when it is immersed in a fluid such as air or water as a result of the molecules of the fluid coming into contact with the hot body and robbing it of some of its heat, thereby raising their own temperature. These molecules are then carried away from the heated object by the motion of the fluid. A body loses heat by conduction when it is in contact with solid objects, the molecules in contact with the heated body taking some of



the heat from it and handing it on to other molecules further away from the body.

If the wire lost no heat by any of the methods referred to, all the heat would go to raise the temperature of the wire. If (W) is the weight of the wire and (S) the specific heat of the material of the wire, which may be defined as the ratio of the quantity of heat required to raise the temperature of the material through 1 degree centigrade, to that required to raise the same mass of water through 1 degree centigrade, then the temperature (T) acquired by the body after (t_1) seconds, assuming (R) and (S) remain constant, is given by the equation

$$T = \frac{\cdot 24\ EIt_1}{WS}$$

The temperature of the conductor would continue to rise until it would melt, and thereby break the circuit. But the above state of affairs is never realised, since every body, when at a temperature above its surroundings, always loses heat by radiation, convection and conduction, except when placed in a vacuum, as the filament in an incandescent lamp, when it loses heat by radiation mostly, and a small amount by conduction along the lead-in wires which may be neglected.

After giving further explanations regarding temperature, amount of heat radiated, etc., the author says that it can be seen from an equation given that if other things are constant, the increase in length of the wire is proportional to the square of the current, and therefore this property of the wire may be used to indicate the root mean square value of the oscillatory currents used in radio communication, if this wire be so mounted as to show by means of a pointer its elongation when the currents flow through it. Since the coefficient of linear expansion for most wires is very small, the elongation will also be small for moderate currents, and therefore moderate rises in temperature of the wire.

By using a very fine wire we not only increase the resistance, but also at the same time decrease its surface. The resistance can furthermore be increased by employing a wire having a high specific resistance. This specific resistance should not only be large, but it must be practically constant for such changes in temperature as are encountered in the use of the wire as a current indicator, otherwise the accuracy of the instrument will be impaired.

Even after taking all the measures mentioned to make the increase in length for a given current as large as possible, it is still so small as to necessitate some arrangement for magnifying this elongation. The method generally adopted for effecting this magnification in the hot-wire ammeter used for measurement of high frequency currents is indicated in the figure.

The extremities of the wire through which the currents to be measured pass are fastened to the screws shown. To the centre of the wire one end of a silk thread is fastened whilst the other passes round the drum behind the spiral spring. The drum and the pointer are fixed to a spindle which turns in jewelled bearings to diminish friction, and the spiral spring serves to keep the thread and wire taut. It will easily be seen that if a current passes through the wire and causes it to sag the pointer will move over the scale.

* * *

THE SIGNALLING RANGE IN RADIO-TELEGRAPHY.

The several series of long-distance transmission tests, carried on jointly by Dr. L. W. Austin and the National Electric Signalling Company, are referred to by Mr. John L. Hogan, junr., in an interesting paper bearing the above title in the *Electrical World*. These tests, says Mr. Hogan, included measurements of the effects on signalling range of antenna height, antenna current and wave-length. Heights from 37 feet to 130 feet, sending currents from 7 amp. to 30 amp., and wave-lengths from 300 metres to 3,750 metres, were observed at distances up to 1,000 nautical miles. Correlation of the data thus secured led to the expression

$$I_r = \frac{4{\cdot}25\ I_s h_1 h_2}{\lambda d}\,\epsilon^{-0{\cdot}0015 d/\sqrt{\lambda}}$$

where I_s and I_r are sending and receiving antenna currents in ampères, h_1 and h_2 effective heights at sending and receiving antennas in kilometres, λ and d the wave-length and signalling distance in kilometres. As is easily seen, the expression can be used to compute the antenna currents or heights necessary to produce a required signal strength at any given distance under normal daylight conditions. With average

500 cycle spark senders and good crystal receivers, about 10 microamp. receiving antenna current are necessary for barely audible signals.

Later tests over greater distances extended the observations to antenna heights of 450 feet, sending currents of 110 amp. and distances of 2,300 nautical miles. None of the data then obtained indicated need of altering the functional relations of the several quantities given in the equation (1), though it was found that with the rectifying heterodyne receiver on 5 microamp. receiving antenna current gave signals of unit audibility, even with spark transmitters.

The expression (1) above has therefore been fairly well verified by applications to many instances of radio transmission. It is probably the most nearly accurate equation for computations of the sort necessary if signalling distances and intensities are to be predetermined rather than estimated For rapid numerical work it is desirable to state the various quantities in the units which are most convenient for their measurement; for instance, if sending current is in ampères, receiving current in microampères, antenna heights in feet, wave-lengths in metres and distances in kilometres, the equation becomes

$$I_r = \frac{392\, I_s h_1 h_2}{\lambda d} \epsilon - 0{\cdot}0474 d/\sqrt{\lambda}$$

Or if, the other units remaining as just stated, distance is expressed in nautical miles, the coefficient of I_s should be 212 and the exponential coefficient 0·0877.

After pointing out that the simple algebraic solution is possible for all quantities except λ and *d*, Mr. Hogan says that these latter cannot be determined explicitly by the common methods, since they occur both linearly and exponentially. He then explains an ingenious logarithmic method of solving *d* which is the basis of a series of curves used at the United States Navy Yard, Puget Sound, Wash. A chart is also given for computing signalling ranges for various antenna heights and wave-lengths.

* * *

WIRELESS AND AIRSHIPS.

In view of the series of articles on Wireless Telegraphy as applied to Aircraft which have been appearing in our pages, we think that the following extracts from a paper read at the Royal United Service Institution by Lieut. (now Commander) F. L. M. Boothby, R.N., will not prove uninteresting. The paper was read so long ago as April, 1912, and our contemporary, *The Aeroplane*, publishes a number of extracts by permission of the Council of the R.U.S.I. We reproduce below one of the parts dealing with wireless telegraphy.

When we come to consider the behaviour of airships at sea in relation to the weather, says the writer, we shall find that wireless telegraphy is of the greatest assistance. A point in favour of the airship is that, unlike the aeroplane, it can receive as well as send a wireless message. Such importance is wireless likely to assume that I imagine in the near future the Meteorological Office will have to be fitted with its own wireless station and work on its own special tune to transmit warning and advice to aircraft.

In searching for hostile submarines the airship has an advantage over the aeroplane, in that she can hunt slowly and carefully with four times the number of lookouts. To keep aircraft off, submarines would have to remain on the surface, where they are liable to be attacked by ordinary ships, so, when once they are located, their position will not be very enviable. Once the battle fleet knows the whereabouts of the submarines they can easily avoid them, and the long range wireless telegraphy of the airship is a very great advantage here, as she can pass information without losing sight of the enemy; in fact, wireless is at present the most important part of the equipment of aircraft, practically doubling their range and utility, and once they have got important information through, it does not very much matter what ultimately becomes of them.

The Editor of the *Aeroplane* adds, in parenthesis, that this last is a very noteworthy piece of prophecy. Few people, even in the services to-day, realise that wireless is at present the most important part of the equipment of aircraft.

"S.O.S"

From "*The Star.*"

A morning paper describes "Wireless telegraphy as a calling for women." To the tune, we suggest, of "Who's dat a-calling so sweet?"

In Revolutionary Mexico

A Trip South to fit s.s. "Cetriana"

By L. MAYNE.

THE trip south to Mazatlan, Mexico, *via* San Francisco, was very ordinary and uneventful except for a visit to the Exposition at San Francisco, which was a veritable wonderland.

The southern trip was made on the s.s. *British Empire*, a very old freighter of the well-deck type (correctly named, for it never was dry).

On Sunday, April 11th, we arrived at Mazatlan; beautiful clear skies and hot weather seemed to be the rule here at this time of the year. The city, as will be seen from the accompanying photo, is somewhat quaint, and possesses a street-car system comprising two cars and five mules, all very much the worse for wear.

From April 11th to the 16th the time was spent looking over the sights, owing to the Customs delaying the transfer of the wireless apparatus from the s.s. *British Empire* to the s.s. *Cetriana*, for which vessel the set had been shipped from Vancouver, B.C.

On April 16th the apparatus was on board the *Cetriana*, and the vessel left for San Francisco. The operator who was to remain on board the vessel, and myself, trying to make up for lost time by working like Trojans, managed to have the installations completed and the aerial aloft by the afternoon of the 18th. On the evening of the 18th we sent out our first message from the extreme southerly point of Lower California to the Marconi station at East San Pedro (KPJ). Considering that the installation was the Marconi ½ kw. Standard Ship Set, and the distance covered about one thousand miles, the result was gratifying.

April 20th saw us running short of fuel, but nothing to cause any real worry. We passed the Japanese warship stranded in Turtle Bay during a heavy fog; several Japanese vessels were standing by salving her.

On the 22nd, at 8 a.m., we arrived at Ensenada, Mexico, and from now on things

Panorama of Mazatlan.

Mazatlan Cathedral.

began to take great strides in making our trip eventful.

Our captain went ashore to clear Customs and land our 150 passengers. The passengers consisted of Hindu, Japanese and Chinese. We had no food or water left and only six tons of coal on board. It was hoped, therefore, that we should have been able to replenish supplies and proceed that same afternoon to San Diego, Cal.

About 9.30 a.m. it was seen that something was amiss, as the captain's gig was taken from the wharf and anchored in the bay, and later the owner of the vessel (who was on board the *Cetriana*) asked me to try and get the U.S. Naval Service and see if it would be possible to procure some fuel from them.

Nothing matured during the day, and, without being relieved in any way, we retired for the night.

Next morning (23rd) found us still anxious for our shore party, which consisted of the captain and purser (the latter being a native of Ensenada), until about 12.45 p.m., when a note was sent aboard from the captain asking me to send out the SOS and get in touch if possible with a British warship—there were some in that locality—and explain our plight. Lying at anchor, abeam our vessel, was the s.s. *Mazatlan*, an American vessel that had been taken charge of by the port authorities, and immediately I had completed the call for help the operator on the *Mazatlan* began making dashes, and continued at this for some time, until an armed party came aboard and took operator Periard and myself prisoners. At first we resented, but there was no other course open. Landed on the wharf, we were escorted to the military court, and for the first time learned something of the charge laid against our ship.

It appeared our vessel had no clearance papers from Mazatlan (Caranza district, and we were now in Villa territory), also that the vessel was supposed to have acted as a troopship for the Caranza forces, and that wireless had been installed on the vessel to enable us to carry on our "filibustering" (as they termed it) with greater success.

No charges were laid against the operator or myself, but we were not allowed back or near the *Cetriana*, and we were allowed freedom of the two main streets from sunrise until 8 p.m.

We were quartered at the hotel, paying for our meals, although we were prisoners.

Accidentally we remained out one night in company with the captain, who was allowed the same privileges as ourselves, until 9.20 p.m., so our guard was increased, and we were rounded up to the hotel at 8 p.m. each evening.

The *Cetriana* had on board a very valuable cargo—gold, silver, hides, hemp, and other foods, and many thousand pesos gold.

Villa's people being very short of funds, the cargo of our vessel would have proved a veritable godsend.

The shippers were Germans, and the consignees were also Germans; so the British Consul would not act to save the cargo, and we were detained until the Court had *authority* to seize what we had.

The American Consul made every effort to save the cargo, and left for San Diego to get in touch with Washington, as he was refused the use of the telegraph lines, and the British Consul busied himself in trying to find out who was responsible for my being brought ashore by force of arms, as I was shown on the ship's papers as a passenger —a Britisher on board a British ship.

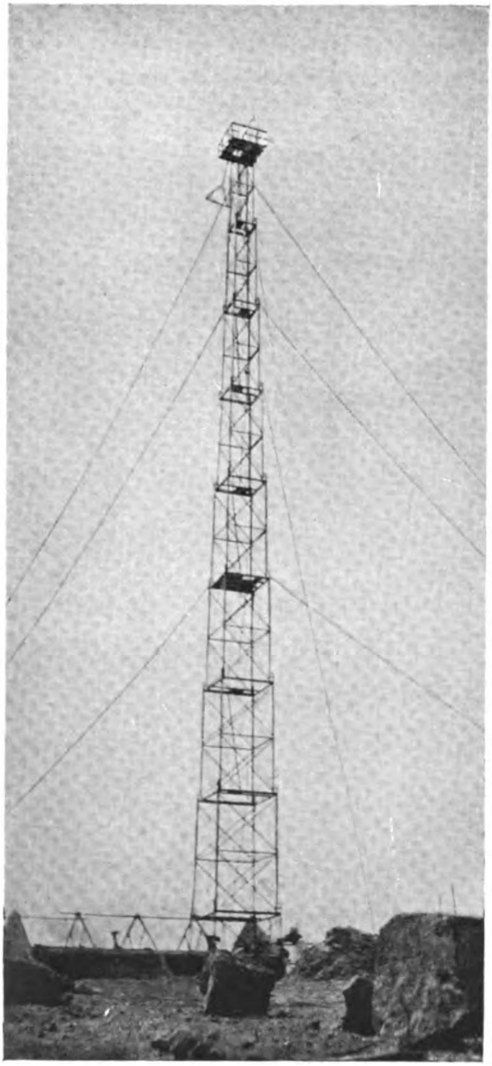
The outcome of these various actions on our behalf was the arrival of the U.S.S. *Denver*.

On Wednesday, the 28th, things looked a little worse, and the British Consul, fearing for the safety of our captain, took him home with him to his ranch, but when this was discovered it made our position rather awkward, as there was an impression that some movement was on foot to get us back to the *Cetriana*.

The following morning we met the captain of the American gunboat, and in company with him went in search of our captain. We all visited the Courts, and at 9 p.m. we were free once more. In the excitement we had eaten nothing all day, so on arrival on board the *Cetriana*, after all the handshaking had been gone through, we looked around for food; it was only then that we learned the awful plight of those on board since the ship's arrival practically without food or water.

The gunboat *Denver* sent over some canned beef and fresh water; the water was pumped into a lifeboat and towed over to us by a launch, but as there was a very heavy sea running at the time and our boat riding very low a number of seas were

Types of Mexicans.



Wireless Tower, Mazatlan.

shipped before our vessel was reached, almost destroying our supply of fresh water.

It was arranged that the *Denver* should take us in tow at 4 a.m. on Friday, but a gale sprang up and they advised by semaphore of their inability to take us out till later on. I was on the bridge at the time, and my experience in semaphoring came in handy at the time, as I was able to take their messages and forward our captain's replies.

Owing to the huge breakers rolling into the harbour it was necessary for us to move our position to the port quarter of the *Denver* in order to obtain some shelter. The wind did not die down until Saturday morning, and, although there was a heavy sea running, a tow-line was passed aboard at 7 a.m. and our journey started. At 8.10 a.m. the line broke, but without very much delay another line was made fast by the tars of the *Denver*, and we continued on our way, arriving at San Diego about 6.30 p.m. the same day.

On our arrival at San Diego fresh water and provisions were the first things brought on board, and the memory of that, our first square meal for one week, still lingers.

Almost an entire week was spent at San Diego trying to straighten out the tangle caused by the passengers who could not land in the States and were not allowed to land at Ensenada. They resented being taken to San Francisco.

We left San Diego on Saturday, May 8th, and tried to land the passengers on the beach, north of Ensenada, but this attempt was blocked by Mexican coastguards and a squad of soldiers, and as the few other likely places where such a landing could be effected were closely watched there remained no other course open but to steam north to San Francisco.

We arrived at San Francisco, Tuesday, May 11th, and I left at noon the same day for Seattle, Wash., thence to Vancouver and home.

A CORRECTION.

With reference to our first paragraph under the heading "Maritime Wireless Telegraphy" in our Christmas Double Number, Mr. Josef Eide points out that the vessel which picked up the *Iris* was the *Irma*, and not the *Iona* as stated by us. We give below a photograph of the *Irma* lying alongside the quay at Bergen, preparatory to leaving for England.

S.S. "Irma" alongside Quay.

[Under this heading we propose to publish each month communications from our readers dealing with general engineering matters of various kinds in their application to wireless telegraphy, and we would welcome criticisms, remarks and questions relating to the matter published under this heading. We do not hold ourselves responsible for the opinions and statements of our contributors.]

Moulded Insulators.

IT is obviously the duty of every electrical engineer to investigate the properties of all substances used by him in the course of his work, and particularly of those materials which serve as insulators. The wireless engineer above all needs to pay very special attention to insulation problems. In the early days of wireless telegraphy the number of substances used for insulation was small, ebonite taking a prominent place in both indoor and outdoor work. Of late years many other materials have been adopted, and porcelain specially manufactured for high-tension work now takes a large share of the duty. Many of the most important and interesting points in the manufacture of this substance have been touched upon in these columns, as our regular readers will remember. (See WIRELESS WORLD, September and November, 1915.) Apart from ebonite and porcelain, there is a large class of substances which may be termed "built-up insulators" passing under various fancy trade names, and growing in use both in this country and America.

A few years ago the choice of insulating materials which could be readily moulded lay practically between porcelain, ebonite and similar rubber compounds, and the so-called shellac compounds. Each of these materials has its disadvantages, and inventors were not lacking who endeavoured to produce other substances with the advantages of those materials just mentioned, and none of their drawbacks. Mr. Hemming in his book on Moulded Insulation* classifies the moulded insulators of to-day under nine headings. These are as follows:

1. Organic Hot Moulded Materials.
2. Organic Cold Moulded Materials.
3. Inorganic Cold Moulded Materials.
4. Ceramics.
5. Rubber Compounds.
6. Organic Plastics.
7. Synthetic Resinous Products.
8. Hardened Fibre Materials.
9. Moulded Mica.

Some manufacturers claim that their products are suited for all purposes, but this is decidedly not so. For instance, whilst materials of Class 4 are fireproof, waterproof, and inert under all climatic influences, their use is limited to such purposes as do not require accuracy of dimensions and great mechanical strength. While materials made under Classes 1, 2, 3, 5, 6, and 7, on the other hand, can be moulded more or less to true sizes and are mechanically strong, they are not as proof against climatic conditions as materials in Class 4.

* "*Moulded Electrical Insulation and Plastics.*" By Emile Hemming. (New York: Ward Clausen Co. $2. London: S. Rentell & Co., Ltd. 8s. 6d. net.)

Of the raw materials used in the manufacture of moulded insulators the following are the most important: Asbestos, Clay, Mica, Silica and its compounds, Hydraulic Cement, Alkaline Earths, Vegetable Fibres, Camphor, Wood Pulp, Cotton, Hemp, Flax, Asphalts, Shellac, the Resins, Paraffin Wax, Linseed Oil, various other drying oils, Alcohols, Crude Rubber, Formaldehyde, and Phenol.

The first requirement of a moulded insulating part is that it be stable. It must retain its shape and physical and electrical characteristics under service, and must not deform or disintegrate. It must also retain its dielectric strength. Neither heat, cold, nor sudden temperature changes, the action of the electric current, nor chemical actions induced by this current, must exert any deleterious effect upon it. No material in use to-day perfectly fulfils all of these conditions. The materials which most nearly meet these requirements are the ceramics, but the inorganic compounds in Class 3 are also very stable. These last possess the peculiar characteristic of improving with age and exposure to the air and weather, in which particular they differ from porcelain and all other forms of moulded insulating material which deteriorate more or less with age. With regard to the rubber compounds in Class 5, rubber when properly compounded is very stable, but unfortunately the increasingly high cost of the better grades of this valuable substance offers great temptations to the manufacturer, and practically all commercial rubber is adulterated with low grade resinous gums and other substitutes which greatly reduce its life and consequently its usefulness as a material for moulded insulating parts.

The synthetic resinous compounds form a new class of peculiar products which have been in use for a comparatively short period, and definite judgment must be withheld until time has demonstrated their value. Very broad claims are made for these products, and it would appear that such claims are not extravagant.

The ability to resist the effects of moisture is a very essential requirement of moulded insulating material. No matter how good it is in other respects, if it is affected by moisture to such a degree that it either deforms, disintegrates, or loses its dielectric properties to such an extent as to cause short-circuit, it is useless.

Moisture has no effect on the ceramics. In their unglazed state they absorb water to a certain extent, but this is entirely overcome by the glazing process. Fibre has fallen into direpute because of its very hygroscopic nature, but the newer class of this material is expected to gain favour because it does not exhibit this disadvantage. The other classes resist the weather well, provided they are properly made. Heat proof qualities need also to be carefully considered, and here again we find the ceramics at the top of the list. Porcelain is, however, liable to crack under sudden temperature changes. When for mechanical or other reasons porcelain is not suitable, the choice lies between the organic cold moulded materials, the inorganic cold moulded materials and the synthetic resinous products. All these materials may be considered heat proof in that they do not soften or otherwise become disadvantageously affected when continuously subjected to a temperature of 100 deg. C., which is the usual maximum working temperature of electrical machinery. Classes 1, 5, and 6 are all seriously affected by the continuous application of such a temperature. Of the three classes 2, 3 and 7, the last is the strongest, and because of their excellent moulding qualities and their neat appearance they are to be preferred where cost is a secondary consideration. These materials will withstand continuously a temperature of from 150 deg. C. to 250 deg. C., depending on the nature and percentage of the filling medium employed. In general, it is advisable to manufacture arc deflectors and all parts which are subjected to constant arcing and similar conditions of the inorganic cold moulded materials, as their inorganic nature precludes all possibility of softening or charring.

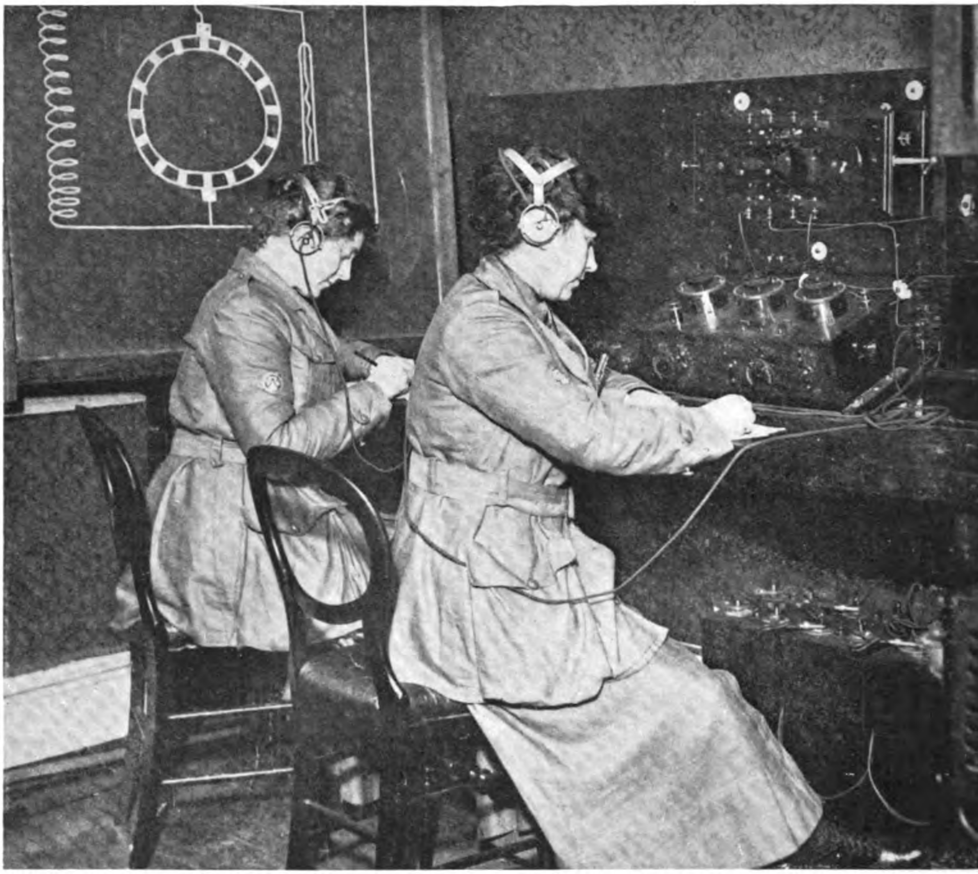
Materials intended to withstand the continued action of acids or alkalies must be carefully chosen. Whilst most insulating compounds will resist these actions to a greater or lesser extent, few of them are proof against acids or alkalies for any great period of time. The only materials which can safely be employed for this purpose are the ceramics and to a certain extent the products of Class 5.

Wireless Telegraphy for Women

An Innovation by the Women Signallers' Territorial Corps.

THROUGH the kindness of the principal of the East London Wireless College, the members of the Women Signallers' Territorial Corps are now being instructed in wireless, and by the courtesy of the Marconi Company an instrument is available for regular practice. This woman's movement (described by a writer in the *Standard* as "undoubtedly the most useful and effective of all the semi-military organisations of women") was originated in the early days of the war. The aim of the corps is to link up every town and village throughout the kingdom, and to release the men for the firing line, and also to act as instructors to men in the services. Commanding officers needing instructors for their commands are invited to apply to the organisers. It was believed that by organising a corps of women signallers in their own districts many men might be released to join the army. It rests with women to prove their capacity for sustained public service by taking up this movement with enthusiasm and perseverance. Efficiency with the least possible delay, that they may be ready in emergencies, is the immediate ambition of members. The Government has made it clear that it is incumbent upon women to fill every possible post that may be vacated by men fit for service in the forces. The habits of discipline and co-operation inculcated by the training should prove invaluable in fitting them to take their share of responsibility in the present crisis. Our photographs

Buzzer Practice.



At the Instruments.

show a class of women practising the Morse code by means of a buzzer, and a member of the corps actually at the instrument.

ANSWER TO SECOND LITTLE PROBLEM.

The second problem as set forth in our January issue, was as follows:

Given two steel rods exactly alike in appearance, you are told that one is a magnet. How would you tell which piece is the magnet if you have nothing with which to suspend the rod, no point to poise the rods upon, no other pieces of iron or steel to attract, and no instrument of any kind? Solution: Offer each end, in turn, of each piece of metal to the centre of the other piece. There being neutral magnetism in the centre of a magnet, no attraction will take place when you offer the non-magnet to the centre of the magnet.

Next month Dr. Fleming on the Cube Resistance Problem.

SPECIAL NOTICE TO AMATEUR SOCIETIES.

The secretaries of all amateur societies which have not been suspended owing to the present war are requested to forward full particulars of their societies to the editor, in order that suitable notices may be inserted in the 1916 edition of the "Year Book of Wireless Telegraphy and Telephony."

THE NEW VOLUME.

Do not fail to order the first number ***early*** from your bookseller or direct from us.

Wireless Telegraphy in the War

A résumé of the work which is being accomplished both on land and sea

THIS month we publish three illustrations which will give our readers a fair idea of the latest scene of Entente activity in the Mediterranean district. After the failure of the German submarines to blockade our British shores and the increase of naval and military activities in the Southern Seas, these underwater "Rovers," whose nefarious practices are necessarily directed by *wireless telegraphy*, found a more fruitful field of operations in the historic waters of the "Great Sea."

Corfu, situated at the junction of the Adriatic and Mediterranean, proved an admirable headquarters from which the messages directing the operations could be issued and petrol supplies provided. The fact that the historical palace of the Achilleion is the leasehold property of the German Emperor rendered the opportunity all the more easy. Here, undeterred by the decencies of diplomatic etiquette or regard for neutrality, our Teutonic foes established arrangements for supplying their pirate craft with petrol—and instructions, most of which were probably sent by wireless.

* * *

On page 742 of this issue will be found an excellent description of the radiotelegraphic apparatus with which these enemy craft are furnished, an ingeniously contrived method of installation which enables them to keep in close touch with their base. At actually what spot the Germans placed any secret wireless installation which may have been necessary, we do not as yet know, but it is inconceivable from the needs of the craft and the requirements for their operations that a supply base should have been without the means for communicating with the vessels for whose needs it had to cater.

* * *

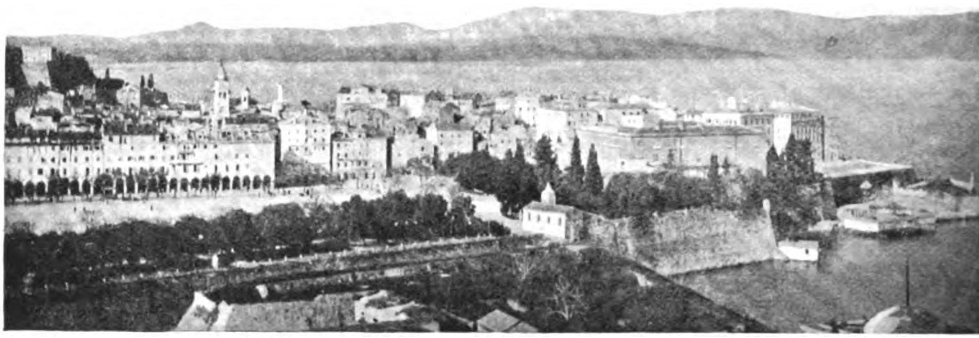
The landing by the Allies at Corfu has been effected with the greatest regard for Greek susceptibilities. Indeed Mr. Donohoe, one of the British correspondents in this part of the world, characterises their *régime* not only as "benign but ultra-tolerant," and the only arrests reported up to the present are those of two of the most active member of the local German espionage organisation.

Our illustration on page 728 shows the town of Corfu as seen from the old fortress; on page 729 appears the fortress itself, *Fortezza Vecchia*, which was occupied by the British from the fall of Napoleon until the election of a constitutional King of Greece in 1863; whilst on page 730 we show a picture of the Isle of Ulysses, *Ponticonnissi*, which lies off the coast. This latter view will indicate at once the charming nature of the scenery in these Ionian Islands and the facilities afforded by their bays and creeks as lurking grounds for enemy submarines.

* * *

In the days when telegrams were a novelty the advent of the special messages, with their buff envelopes, was in many domestic households looked upon as a harbinger of woe. The reason appears to have been that the new method of speedy communication was only resorted to in cases of emergency, and emergency in a large number of instances means trouble. A similar disagreeable experience is occasionally the lot of recipients of *wireless messages*. A German correspondent in one of the newspapers of the Fatherland, the *Berliner Lokal-Anzeiger*, recently narrated the pathetic wireless story of a German sentinel whom he found one evening guarding a bridge on the Western Front.

Herr Karl Rosner observed a man with his head bowed as it were in deep thought. Answering an inquiry concerning the cause of his abstraction, the German soldier remarked, "I am constantly thinking of England, where I have left my wife and my seven dear children." This German's name was Raymond Wollner, a worker of Middlesbrough,



Corfu, from the old Fortress.

who after two years of seafaring life married an Englishwoman and settled down. On the morning of August 1st, 1914, Wollner saw the declaration of war on Russia by Germany, and was torn between domestic affection and patriotic duty. He communicated with the German Consul, and, in company with about forty comrades, was shipped to the Hook of Holland. In mid-Channel a *wireless message* arrived announcing war between England and Germany and summoning German reservists to the colours. That message finally sundered the man from his home and family, and there the Berlin correspondent found him, guarding his bridge, anathematising the strife which caused him so much anguish and the wireless message which had summoned him to duty.

* * *

In a recent issue we referred to the fact that at the Christmas and New Year Seasons much interchange of good wishes had in the past taken place through the medium of wireless telegraphy. Every year adds to an increased use of this medium for the conveyance of good-will, and in this connection an interesting item recently appeared in the daily press. After narrating how General Sarrail, Commanding Officer of the Allied Forces in the Orient, exchanged messages with General Moschopoulos, commanding the Third Corps of the Great Army, the Special Correspondent of the *Daily Chronicle*, Mr. George Renwick, narrates that the distinguished French officer received, by *wireless* from London, greetings from the British Imperial Staff for himself and the army under his command.

* * *

Sixteen months after the daring exploit for which the decoration is awarded, came the announcement that H.M. the King had been graciously pleased to bestow the Distinguished Service Order on Lieut. T. A. Bond, of the Royal Australian Naval Reserve. It is nearly a year and a half ago since the British-Australian Navy made its successful attack upon the wireless station at Bita Paka, German New Guinea, which formed the occasion when Lieut. Bond displayed the gallantry which had called forth this honour from the hands of his King.

* * *

So long ago did this expedition take place that a book has been written by Mr. F. S. Burnell, an Australian journalist, who accompanied the expedition. He entitles his work "Australia *versus* Germany," and published it last June. Herein we read the story of how Captain Travers and Lieutenant Bond took successive possession of the first and second line of German trenches. As soon as they had received the surrender of the enemy they pushed on to the wireless station, capturing *en route* a mounted noncommissioned officer and a cyclist dispatch bearer. They arrived at the wireless station about dusk, and—we cannot do better than extract the account of this portion of their activity from Mr. Burnell's book:

"The trenches were unoccupied, and, "going boldly forward, the three proceeded "to seize the station and its astonished "occupants. Besides about 26 natives, "seven German wireless officials were "found, quietly seated at dinner, in com- "plete ignorance of the turn events had "taken. With a philosophic shrug they all "surrendered without resistance. In re- "lating his experiences afterwards, Travers "could not sufficiently express his admira- "tion of the coolness with which Lieutenant "Bond behaved throughout. 'He strolled "along the road,' said Travers, 'as though "'we were out for a picnic, talking about "'the various plants we were passing at "'the side of the road. He's an enthusiastic "'botanist. There he was, discoursing on "'lepidoptera and such-like, with the immin- "'ent risk at every moment of being picked "'off by some nigger up a tree. "Splendid" "'is the only word I can imagine for his "'coolness.'"

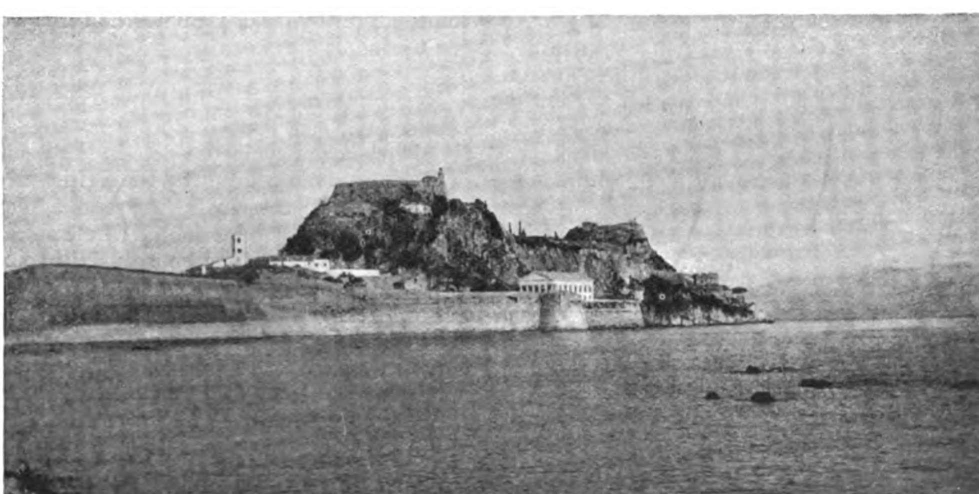
Besides the incident narrated above, the official *procès-verbal* attached to the record of the distinction conferred upon Lieutenant Bond emphasises his "conspicuous ability and coolness under fire in leading his men through most difficult country and enforcing the terms of surrender whilst drawing off an attack by another body of the enemy." A number of other officers and men received commendation for services rendered during the course of the same operations.

* * *

Amongst the affidavits which were produced by Germany in support of their allegations against the action of H.M.S. *Baralong* in sinking a German submarine when the latter was attacking the *Nicosian* will be found that of an American youth pamed Garratt. Whilst all these various precious affidavits differ materially amongst themselves, that of Garratt varies considerably from any of them. He states that on August 19th the *Nicosian was informed by wireless* that German submarines were seeking for the *Arabic* to destroy her. He was on board the *Nicosian* when the captain "ran up a flag which I suppose meant surrender," and states that he saw the *Baralong* come up flying the American flag, which was lowered in favour of the British before the disguise was thrown off, and the British vessel started firing.

* * *

We have often alluded in general terms to the utility of wireless telegraphy from the point of view of calls for assistance in wartime, and here is an excellent case in point. The offer made by Sir Edward Grey in response to the impudent German official claim has, of course, been refused. Full and



Old Fortress, Corfu.

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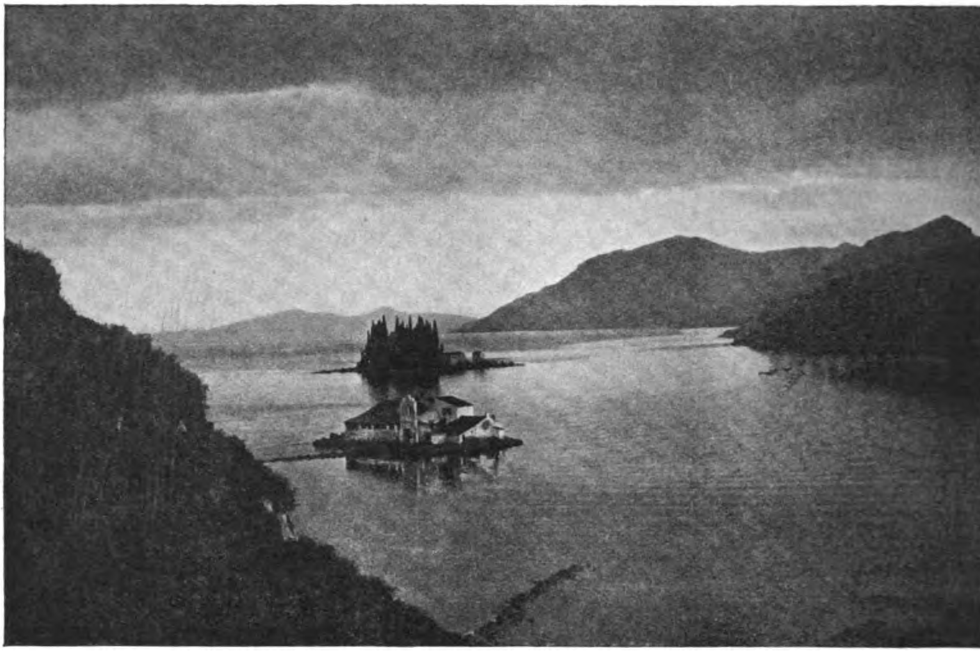


Isle of Ulysses, off Corfu.

impartial enquiry is the very last thing that the Germans desire. A gunner on the British auxiliary cruiser narrates the whole incident in an account published by a Yorkshire paper. He tells how they received the *wireless message* from the *Nicosian*, how they sighted the vessel, and how under the white ensign they started firing. He claims that the *Baralong* was less heavily armed than the submarine. whose crew appear to have lost their heads as soon as an armed enemy engaged them. Two Americans on the *Nicosian* confirm the British version of the story, and one of them not only states that he could see no American flag displayed on the British cruiser, but definitely asserts that he saw her fly her own colours.

* * *

The consequence of Germany's almost entire dependence upon wireless telegraphy for speedy long-distance communications is sometimes responsible for quite a "comic effect." The American Press all through Christmas and the New Year was to its intense amusement flooded with *wireless despatches*, narrating in detail how Germany was no longer dependent upon American cotton either for naval or military purposes. Cellulose made from wood, said the boastful Teuton, was more valuable than cotton for ammunition purposes, whilst as for textiles all that they needed to do was to resort to the common thistle. Reports from the battlefield, however, tend to show that the boasted wood cellulose results in shells that do not explode, and the unimpressed American points to the fact that thistles have been found useful by other asinines than those of the Germanic species.

* * *

Every means of long-distance communication has been used in this war, and although the carrier pigeons' loft in the South of England, long utilised by the British Admiralty, was dismantled a few years ago on account of the introduction of wireless telegraphy, we know that pigeons are still being used by the British for war purposes. Only quite recently the War Office authorities issued instructions to the effect that it was hoped that British sportsmen who were not able to distinguish between ordinary wood pigeons and carrier pigeons would abstain from pigeon shooting altogether. The reason for this appears to have been that some of our own sportsmen were destroying British flying dispatch bearers. The fact of the matter with regard to all these things is that the latest method may for all ordinary purposes supersede its predecessors; but in times of strain and stress it is wise to have as many strings to one's bow as possible.

* * *

One of the points referred to in the last American Note deals with the detention of neutral ships at sea by British men-of-war, acting on evidence, not found on the ship itself, but *obtained by wireless telegraphy*. The Yankee lawyers who are responsible for the compilation of this document apparently considered that the commanders of British men-of-war should shut their ears to wireless messages tending to show that vessels under the protection of a neutral flag are really trading with the enemy. This application of the procedure of courts of law to conditions of actual warfare will assuredly hardly commend itself either to our own citizens or to those of the United States. Our American cousins claim, not unjustly, to be a practical people, and as such must have little sympathy with the technical formalities which shut out evidence that is not "before the court," however relevant it may be to the issue at stake.

* * *

It is significant that the American authorities have recently been obliged to increase the stringency of their own regulations with regard to *wireless apparatus*. One of the latest official announcements from New York states that after prolonged conference it has been officially decided that all belligerent ships entering New York Harbour must dismantle their radio-telegraphic installations. This equipment must remain sealed until the vessels have passed beyond the limit of territorial water. Notices to this effect are being served on all incoming captains by an United States "destroyer" stationed to guard the bay.

* * *

The United States of Brazil have been in this war confronted with much the same difficulties as have affected the authorities of the U.S.A. Whilst the South American route is served by steamers of practically all European countries, by far the most important lines are British and German. Thanks to the *wireless warning* to German commerce vessels referred to by Mr. Isaacs in his speech, reported on page 416 of our September issue, the greater number of the German merchant steamers are able to take refuge in neutral ports, and those of Brazil contain a very large number of such refugees. The Brazilian Government have loyally endeavoured to fulfil all the conditions of neutrality, and, in common with other Governments, have forbidden, from the start of the war, the use of wireless telegraphy by vessels sheltering in Brazilian harbours. Like other countries they have had many difficulties to contend with in controlling the activities of their German guests, but the Brazilian Navy has, on the whole, been successful in enforcing respect for their wireless regulations. During the activity of the German Cruising Squadron in the waters of the South Atlantic a few vessels are believed to have escaped their vigilance, got into *wireless connection* with the ships of war, and supplied them. But the number of these is very small in comparison with the aggregation of German and Austrian vessels still crowding Brazilian ports, whose total burden has been calculated to approximate to 200,000 tons.

* * *

The *Times* special correspondent at Bucharest recently published an interesting account of the situation in Bulgaria. This includes a description of the exultation produced by the acquisition of territory by Bulgarians at the expense of the Serbians, but also indicates an almost universal fear throughout the country of an invasion from Russia. The Bulgarian General Staff, which, according to this writer, is mainly composed of German officers, has directed the construction of a series of fortifications on the heights commanding the Danube and in the neighbourhood of the Roumanian frontier. Germany contributes the artillery and German soldiers are designing and superintending the fortifications. German officers have also established, and control, a series of observation stations, furnished with searchlights and *wireless telegraphic* apparatus. These vedettes and wireless stations extend all along the river and the line of frontier as far as the Black Sea. The Bulgarian portion of the river is patrolled nightly by Austrian monitors and German torpedo boats. Not only the Military, but the Civil Administration, at Rustchuk is subordinated to the

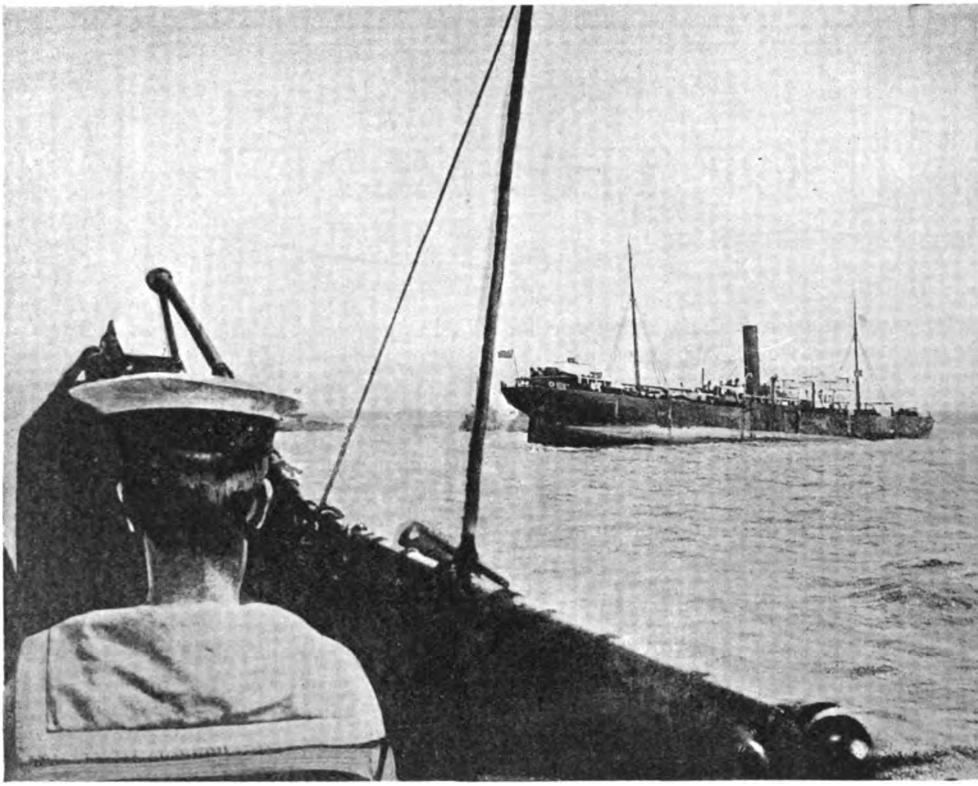
German Commandant, so that the inhabitants feel like a conquered people. The way in which the Germans organise their *chains of wireless stations* as an essential part of their fortified positions is characterised by the same thoroughness and system as most of the other military operations conducted by these efficient foes.

* * *

The illustration on this page depicts a French field radio set in active operation. This particular photograph was taken at Salonica at a time when the apparatus was being used for communication with one of the Entente aeroplanes on duty there. Pictures bring home, in a graphic way unattainable by written description, the extent to which wireless has revolutionised military scouting. The airman whose messages are being received by these operators may be noting from his aerial point of vantage the activities of the Germano-Bulgarian enemy, whose boasts about striking at the Salonica position of the Allies have been many, but who up to the presént have judged discretion the better part of valour.

We have referred in former issues to the great utility of wireless telegraphy to the British forces operating in Mesopotamia, and given extracts from correspondents describing the nature of the equipment. Since the series of unbroken successes which marked the earlier stages, the enemy were found to be in much greater force than was anticipated. Hence the British Expedition has found itself obliged to retire and entrench at Kut-el-Amara, and for communication with the relieving forces under General Aylmer, General Townshend has had to rely mainly on the same agency. Wireless, therefore, will form the means employed by the two generals for co-ordinating their efforts to secure an eventual junction, which recent news appears to show is unlikely to be long delayed. The German Wireless News boasts that General Townshend's force is expected by the enemy to be compelled to surrender before help can reach it; but that boast was evidently made before the recent successes won by General Lake's advancing columns, and is quite unlikely to be justified by events.

French Field Radio Set.



A Destroyer Rushing to Sinking Merchantman.

We have many times published in these columns notes relating to the assistance given by British torpedo boats, destroyers, and cruisers, to merchant vessels mined or torpedoed by the enemy, in answer to S.O.S. signals. The illustration on this page depicts the actual occurrence of one of these rescues. Readers will see the forepart of a British destroyer which has received the wireless message of distress and is rushing to save the helpless non-combatants on board the doomed vessel. There has never been a war at sea conducted on these inhuhuman lines since the days of early savagery. There is only one thing that "Jack" enjoys more than rescuing these helpless victims of Kultur, and that is—avenging them on their pirate foes.

* * *

Perhaps the most graphic description of any operation in the war is that given in the message from Captain Bean, the official representative of the Australian forces in the Dardanelles, when he gives a glimpse of the naval operations during the Anzac and Suvla Bay withdrawal. He puts it into diary form, under times instead of dates, for, of course, a single night witnessed the whole of each operation. The messages of which he describes the receipt in graphic style were sent by *wireless telegraphy*, and he records the final Marconigram, received at 4.15 a.m., in the following terms:

"A wireless message has just been re-" ceived stating that the whole embarkation " has been completed. The naval officer " next me turns round and holds out his " hand, 'Thank God.' . . . The Suvla wire-" less station is now closed also. The navy must " have timed the embarkations perfectly."

Although perhaps it would be going too far to say that these operations would have been impossible without the use of radiotelegraphy (for "Jack" is used to doing without all sorts of necessary things), there cannot be the slightest doubt that wireless telegraphy discharged a prominent and priceless service on those two eventful nights.

NOTES OF THE MONTH

A recent Order in Council makes further alterations in previous Orders governing the export of certain commodities. It is interesting to note that amongst those prohibited to all destinations appears material for wireless telegraphs.

* * *

A number of permanent sub-committees to work in conjunction with the Central Committee of the Admiralty Board of Invention and Research have been appointed. Submarines, mines, searchlights, torpedo-nets (not on ships), wireless telegraphy, and general electrical and electro-magnetic subjects are covered by a single sub-committee.

* * *

In connection with the Marconi Athletic Club at Chelmsford, a smoking concert was held recently at the club rooms, Mr. A. E. Eddington presiding. There was a very good attendance, which included several members of the Marconi Company's Chelmsford staff, and a splendid programme had been organised by Mr. G. Barlow. The singing of Staff-Sergt.-Major Stainton and Staff-Sergt. Watson, from the Chapel Royal, Windsor, was a feature, whilst Mr. Davis was very dramatic in his recitation, "The Highwayman." Mr. Cousens well displayed his sleight-of-hand in the manipulation of a pack of cards. The whole evening proved an unqualified success.

* * *

The annual report of the Department of Technology of the City and Guilds of London Institute has just come to hand. According to this report, the results of the examinations have been most gratifying. The Institute unfortunately is not really very well known, but it does excellent work amongst those who are compelled by force of circumstances or otherwise to increase their technical knowledge by means of evening classes, often after a hard day's work in the shop or office. It is interesting to note that the number of candidates in telephony was double the number of those in the chemical and allied trades combined. We draw the following extract dealing with telegraphy from the report referred to :—

"The results are still disappointing in "the Final Grade. The standard reached "generally is far below what it should be, "seeing that the questions set are all within "the syllabus and are not of a very difficult "character. . . . The fact that few candi-"dates attempted the question on oscillating "circuits, and that most of the answers were "not of a high order, indicates that the now "important subject of wireless telegraphy "receives scant attention from teachers and "students."

* * *

The *Montgomery County Times* recently contained the following paragraph :

"The men of the Marconi Guard at "Towyn had a very pleasant Christmas. "The barrack dining room was seasonably "decorated, and the Christmas dinner of "goose, beef, and plum pudding was excel-"lent. Several gifts arrived by the mail. "A nice box of briar pipes came for Welsh-"pool men from Mr. Robert Owen, and the "children of the National School sent "Christmas cards of their own painting, "which were very much appreciated. New-"ton, Dolgelly, and Machynlleth men all "received Christmas gifts. Towyn and the "outside districts seemed to have forgotten "their men, and a few men had to be con-"tent with the Welshpool children's Christ-"mas card. The Y.M.C.A. hut with its "billiard table was a great attraction, and "most of the men spent the hours off duty "there."

Maritime Wireless Telegraphy

JAPANESE STEAMER SUNK.

INFORMATION has been received from Malta to the effect that the Japanese steamer *Sado Maru* was sunk recently by a German or Austrian submarine in the eastern waters of the Mediterranean. Assistance was requisitioned by wireless, and this was immediately organised and forthcoming from Alexandria.

* * *

LOST IN THE ICE.

The Russian wireless station at Archangel recently received a message from the French packet boat *Bretagne* to the effect that she had struck an iceberg in the White Sea and was in the gravest danger. Two icebreakers and some tugs were immediately sent to the scene of the disaster, but all that could be found there was some wreckage buried in the ice. It is surmised that it belonged to the packet boat.

* * *

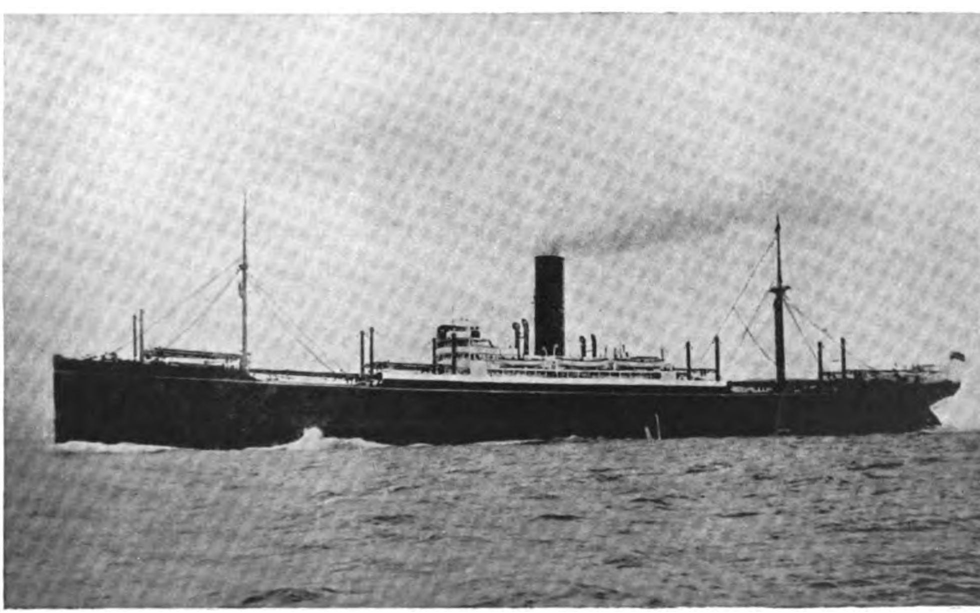
"SANTA CLARA" STRANDED.

Early in the morning of November 2nd last the steamer *Santa Clara* ran aground on the bar of Coos Bay, Oregon, and details of the accident have just come to hand. It appears that the wireless operator immediately called up the station at Marshfield, Oregon, saying that the vessel was aground, and asking the aid of the life-saving corps. By this time there were indications that the ship was in danger of breaking in two, and a further distress call was made. The *Adeline Smith* answered that she was only a short distance away, and the *Santa Clara* therefore asked her to stand by. Another ship also responded, but she was twenty miles away, and therefore could not give immediate help. Boats were launched, and all on board the *Santa Clara* were transported safely to the shore.

* * *

NEW "GLEN" LINER SUNK.

It was announced recently from the office of the Glen Line that their passenger steamer *Glengyle*, of which we are enabled to reproduce a photograph, was sunk in the Mediterranean on January 2nd last. Her comple-



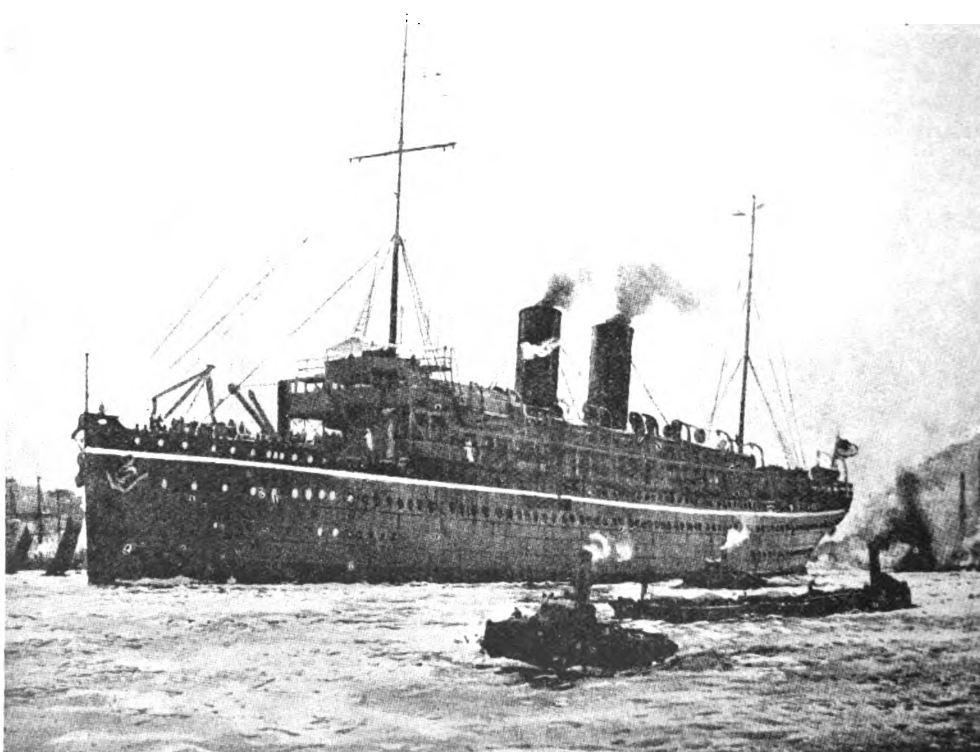
S.S. "Glengyle."

ment of passengers and crew amounted to 120, of whom all but ten have been accounted for. The majority of the passengers were British subjects, and the missing are seven Chinese and three Europeans. The *Glengyle* was homeward bound from Vladivostok for London, and had taken on board a large quantity of cargo at Shanghai and also a quantity at Singapore for Genoa. She was a vessel of 9,395 tons, built by Hawthorn, Leslie & Co. only last year, and was the largest ship of the Glen Line. She was specially built for Eastern trade, and it is interesting to note the comparison of her speed of 13 knots with the 18 knots of the *Persia,* which latter was sunk very near the scene of the *Glengyle* disaster. She was fitted with wireless telegraphic apparatus.

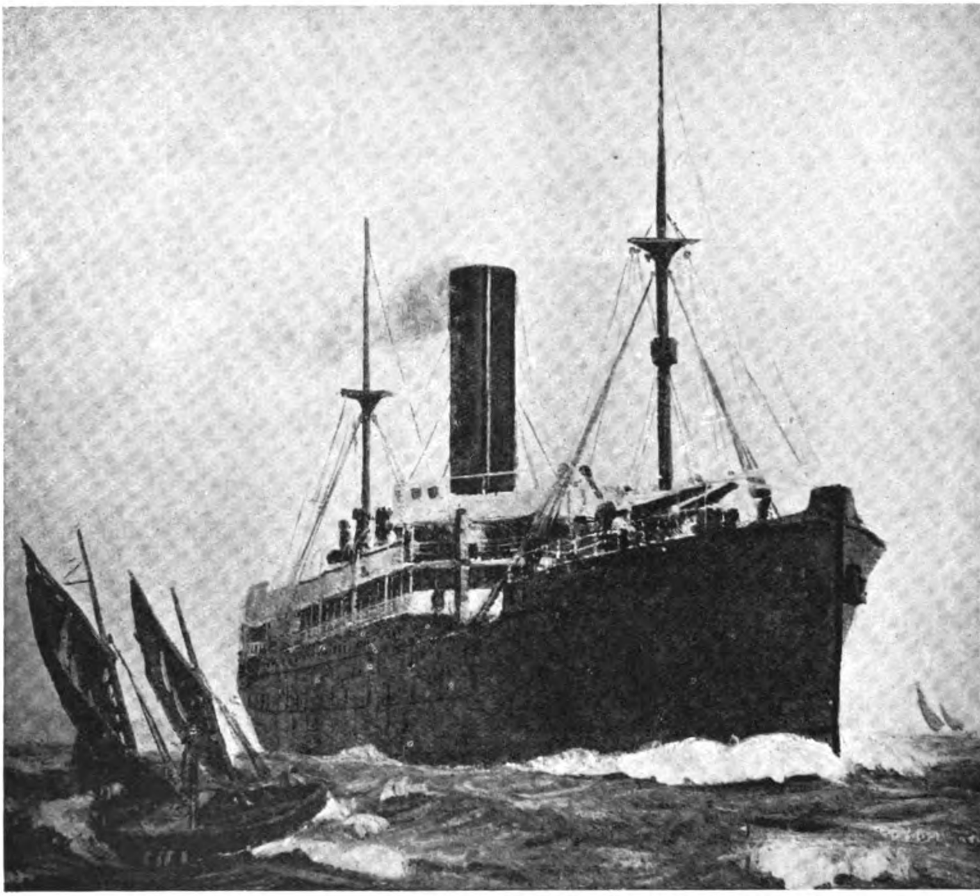
* * *

S.S. "PERSIA" TORPEDOED.

With their usual brutal disregard for human life the Teutons have now excelled themselves. This time, without any previous warning, they have callously sunk the Peninsular and Oriental Co.'s fine vessel *Persia* off the coast of Crete in the Mediterranean. The vessel made no attempt whatsoever to escape, and this hostile action is entirely unwarranted. She carried no troops or war material of any kind. The *Persia* was of 7,974 tons gross, and was built by Caird & Co., of Greenock, in 1900. Her engines developed 11,000 I.H.P., which gave her a speed of 18 knots. Her length was 499 ft., and her breadth 54 ft., and she was fitted with all the latest improvements, including wireless telegraphy. A reference to our "Doings of Operators" pages will give some information concerning the wireless operators. We are enabled to publish a very artistic illustration reproduced from a painting of the ship. A poignant interest attaches to the fact that the captain's wife, who was aboard the *Medina* on her way to Malta to spend the winter, was advised by wireless of her husband's death.



S.S. "Persia."



S.S. "Geelong."

ANOTHER P. & O. LINER SUNK.

Within a day or so of the sinking of the *Persia* the world was astounded to hear of the loss of another of that company's steamers. This time our enemies do not appear to be to blame. She was sunk after a collision with the steamer *Bonvilston*, and fortunately all the passengers and crew were saved. She was fitted with wireless telegraphy, possessed a tonnage of 7,951 tons, was built by Barclay, Curle & Co. in 1904, and originally belonged to the Lund Line. When that firm's interests were acquired by the P. & O. she, with other vessels of the fleet, was taken over and placed in the P. & O. Co.'s service to Australia *via* the Cape of Good Hope. By a strange coincidence the *Geelong* was a sister ship to the *Waratah*, which was lost in mysterious circumstances off the African coast in July, 1909, while homeward bound from Australia with a large number of passengers and a valuable cargo.

* * *

DUTCH STEAMER MINED.

According to a correspondent of a news agency at The Hague, a wireless message reports that the Dutch steamer *Ellewoutsdijk*, of Rotterdam, struck a mine in the North Sea. It transpires that the crew were rescued by the steamship *Batavier III*. The *Ellewoutsdijk* was a steamer of 1,412 tons net.

* * *

MEDICAL AID BY WIRELESS.

A wireless call was sent out from the steamship *Radiant* recently for the treatment of an engineer who had for three days remained unresponsive to the medicines administered by the captain. The wireless operator communicated with the station at Tampa, Florida, and also with the steamer *Comus*, belonging to the Southern Pacific Steamship Company. From this latter vessel doctor's advice was obtained, and the sick man greatly relieved.

* * *

CLAN LINER ASHORE.

The Fort Patrick wireless station recently received the following wireless message from the British steamer *Clan Davidson* with a request that it be transmitted to Seaforth :

"Ashore in the Gun Island, about "Ballyquinton, on the fourth rock."

She was eventually got off, and proceeded to her destination. The *Clan Davidson* was on her way from London to the Clyde.

* * *

RUDDER LOST BY NORWEGIAN SHIP.

The Dutch steamer *Noordwyk* recently reported by wireless telegraphy to Land's End that the Norwegian steamer *Gæa* was anchored, with rudder lost, in lat. 49.45 N., long. 6.23 W., after having been twice taken in tow by the Dutch steamer. It appears that this latter took part of the *Gæa's* crew on board and stood by her. The position was 30 miles south of Falmouth. The *Gæa* is a steamer of 1,002 tons, was built in 1900, and owned by Pedersen and Co , of Christiania.

* * *

A NEW MOTOR SHIP.

We are enabled by the courtesy of Messrs. Page's *Engineering Weekly* to place before our readers a photograph of the new motor ship *Kangaroo* which has been acquired by the Government of Western Australia to carry produce from that Colony to the United Kingdom. The vessel is very up-to-date and possesses all the latest improvements, including Diesel engines and electrically operated steering gear and deck machinery. The vessel has been built to the highest class at Lloyd's, and is fitted with wireless telegraphy. Her length over all is 381 ft. and her gross tonnage 4,348.

* * *

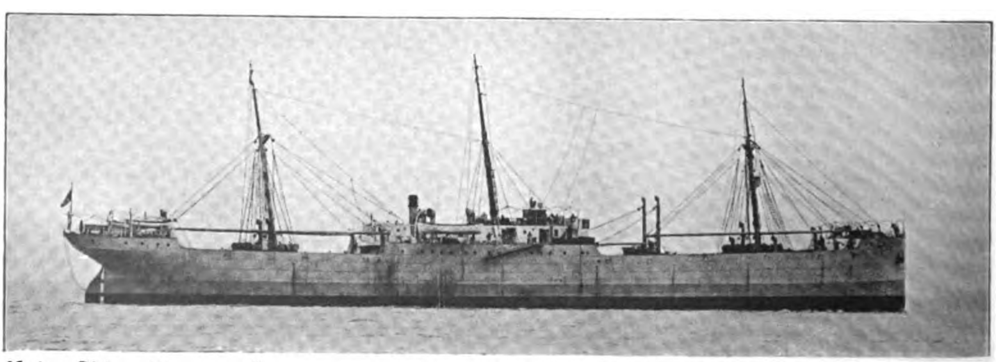
GREEK STEAMER IN DISTRESS.

According to a Central News Agency report from New York wireless calls for immediate help have been received from the Greek steamer *Thessaloniki*, which was three days out from New York. A search by coastguard cutters, however, failed to find her, as she did not give her position. Subsequent advices state that she was taken in tow by her sister ship *Patris*, but the line broke and the *Patris* no longer stood by. Meanwhile the Danish steamer, *United States*, received the distress call, and at once altered her course and went to the assistance of the *Thessaloniki*. It is understood that all the passengers have been taken off by the British steamer *Perugia*, and that the *Thessaloniki* has sunk. The *Thessaloniki* is a vessel belonging to the National Steam Navigation Co., of Greece, and possessed a tonnage of 4,682.

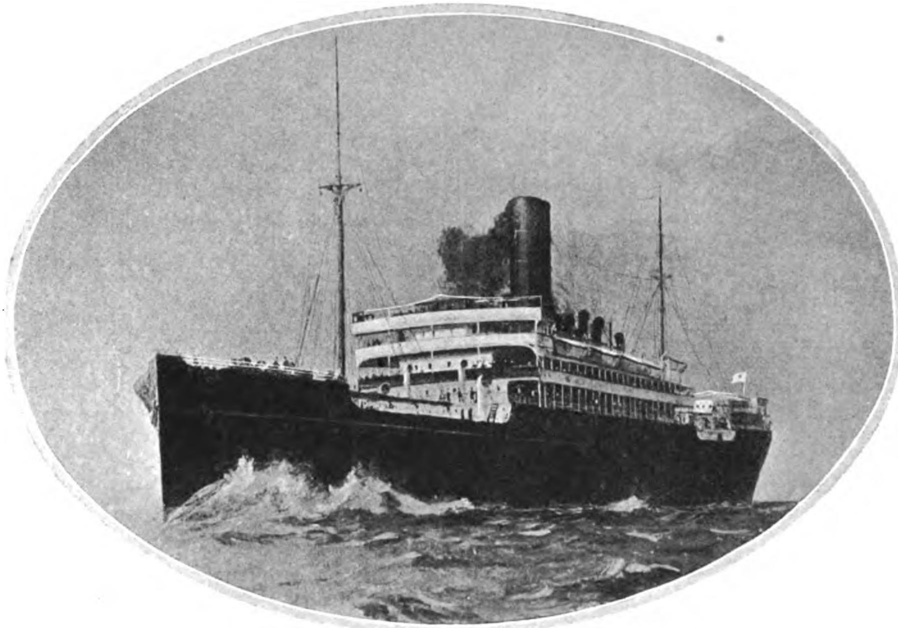
* * *

LOSS OF THE "YASAKA MARU."

The *Yasaka Maru* forms the second Japanese steamer to fall a victim of Teuton savagery. It transpires that either a German or Austrian submarine was the cause of the disaster, which took place in the Mediter-



Motor Ship "Kangaroo."



S.S. "Yasaka Maru."

ranean, whilst only fifty minutes elapsed between the impact of the torpedo and the total disappearance of the liner. Great relief was occasioned amongst the relatives of those on board when it became known that the whole of the crew and passengers had been saved, owing to the timely advent of a French gunboat, which was summoned by wireless from Alexandria, and which landed the occupants of the doomed vessel at Port Said. The steamer was one of the finest of the fleet belonging to the Nippon Yusen Kaisha, and was built in 1914. She possessed a tonnage of 11,000. We are enabled by the courtesy of the *Syren and Shipping* to publish a photograph of the sunken ship.

* * *

Utility of Wireless Demonstrated.

In September, 1914, it was decided by the Pacific Cable Board to fit their cable ship *Iris* with wireless telegraphy, principally on account of the fact that at that time enemy warships were at large in the Pacific, and, to a lesser extent, for future purposes. The vessel made her voyage from Bamfield to Norfolk Island and Auckland to repair the cables damaged in the vicinity of that station. The installation was made in the month prior to the departure of the vessel for Fanning Island, and its utility has already been demonstrated in connection with the search for the schooner *Strathcona* (*vide* p. 378 of the September issue).

* * *

The "Emden" a Total Wreck.

According to the Sydney correspondent of the *Syren and Shipping*, a wireless message has been received from the gunboat *Protector* to the effect that the *Emden* is now a total wreck, the fore part of the vessel only remaining on the beach. Salvage operations will therefore be abandoned.

* * *

Exceptional Distances.

According to the *Wireless Age* the senior operator on the s.s. *Vauban* has reported that on the night of September 1st last at ten minutes past ten he copied time signals and the weather report from Arlington, the vessel being 3,320 miles distant from that land station. On the following night he also copied time signals and the weather report from Arlington. The vessel then was 3,597 miles away. The operator stated that the signals were quite distinct.

CARTOON I(i)

"PRIDE GOETH . . . ."

"I'll put a girdle round about the Earth."

CARTOON (ii.)

". . . . BEFORE DESTRUCTION."

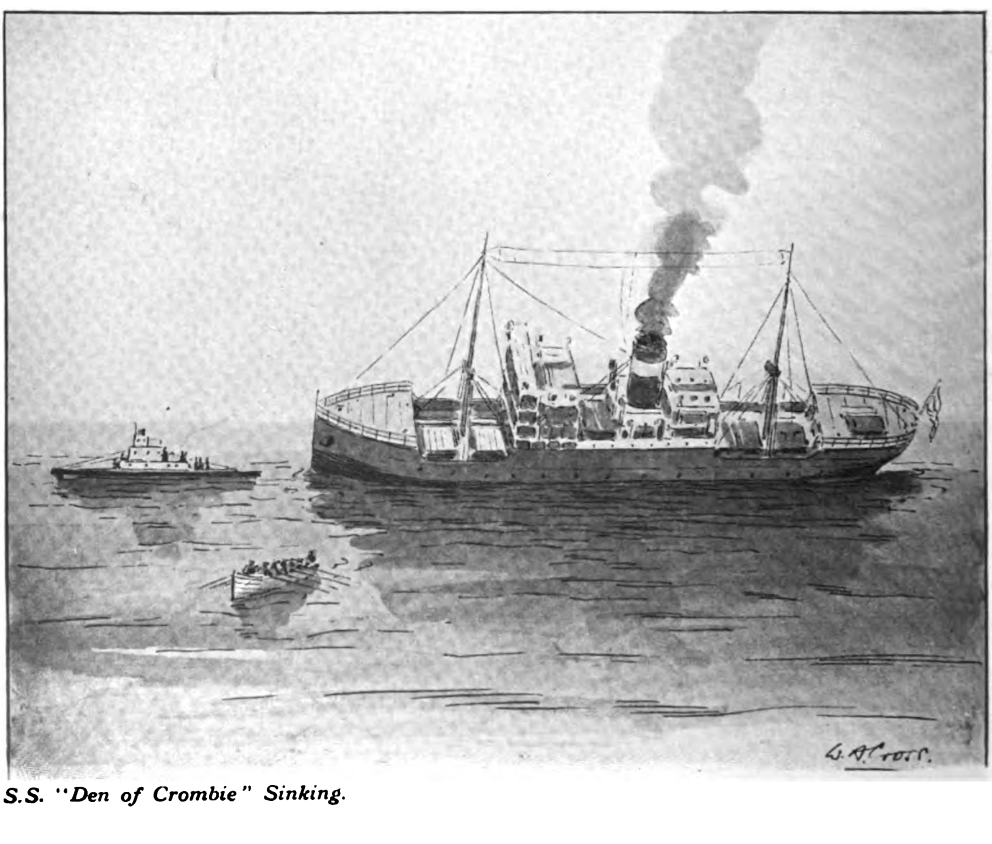
! ! ! ! ! !

The Wireless Equipment of German Submarines.

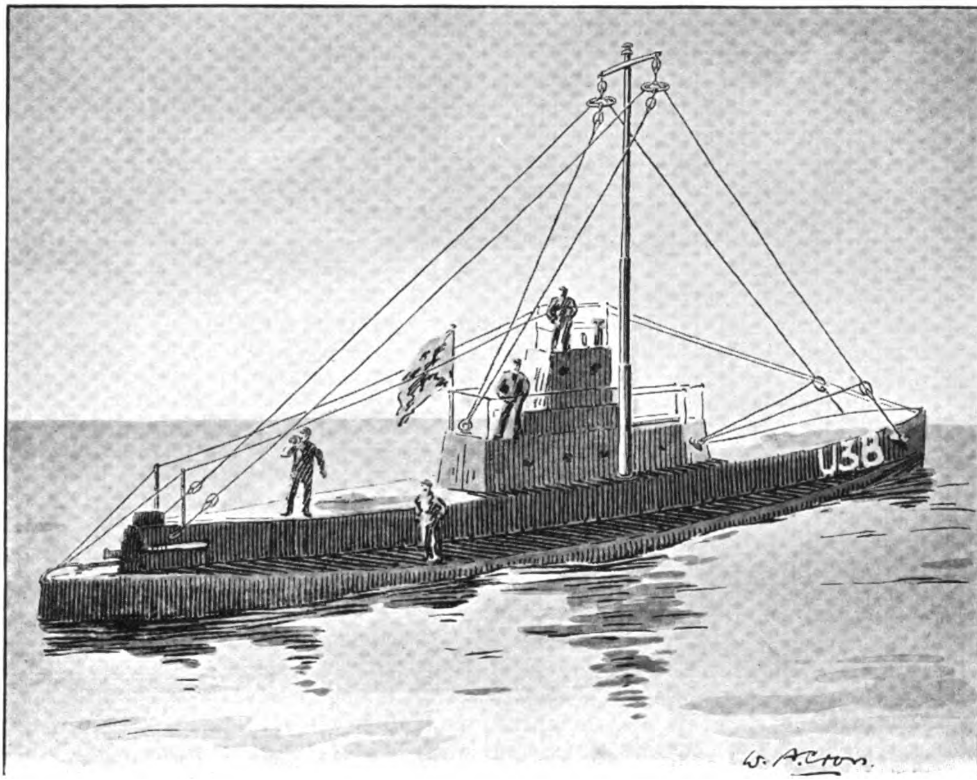
ONE of the outstanding features in the rapid development of wireless telegraphy during the Great War has been the equipment of practically all submarines and small craft with this means of communication. Most elaborate systems of intercommunication have had to be evolved for the use of these vessels, and doubtless many fascinating stories will be written on this subject when the veil of secrecy is finally lifted.

Many questions have been asked regarding the exact form of aerial adopted on submarines, for it is recognised by all who take more than a superficial interest in radiotelegraphy that limitation of space and height create difficulties which require much ingenuity to be overcome. It is unnecessary to state that no particulars can be given of the equipment of British or Allied submarines, but no purpose can be served in withholding from our readers some interesting information which has come before us regarding the exact form of aerial on a German craft quite recently seen in the Mediterranean.

If anything at all can cause intense annoyance to von Tirpitz (we can scarcely call him Admiral), it must be the comparative calmness and indifference with which the British sailor, true to all the traditions associated with our Naval and Mercantile



S.S. "Den of Crombie" Sinking.



German Submarine, U 38.

Marine, regards the abortive submarine blockade which was to bring Great Britain suddenly to her knees.

In our Christmas number we referred to the sinking of the s.s. *Den of Crombie* by an enemy submarine, and spoke of the interesting experiences through which it was the lot of the operator, Mr. Percival Denison, to pass. Mr. Denison, as we mentioned in that issue, was a keen amateur wireless enthusiast before joining the Marconi Company, and his interest in the subject has not abated since he has been at sea. As soon as the *Den of Crombie* was held up by the enemy submarine he noticed that the latter had a wireless equipment, and with a coolness worthy of the *Marconi traditions* he forthwith made a rough sketch of the equipment. When making away from the sinking vessel he also sketched the scene behind him. These two rough sketches have been handed to our artist, who, following them as accurately as possible, has produced the illustrations which accompany this article. In the second illustration particular care has been taken to show the aerial equipment exactly as drawn by Mr. Denison.

A single telescopic steel mast is erected amidships and carries at the top a permanently fixed spreader. The aerial, which is of the two-wire type, is attached at one end to two porcelain compression insulators secured by short wires to one end of the deck, and then passes up to similar insulators suspended from the spreader, thence to insulators at the other end of the deck, and from them to the lead-in insulator, which can be seen protruding from one side of the superstructure. The aerial is thus a modified form of the " L " type.

The most ingenious feature of the installation appears to be the method for rapidly erecting and dismantling the aerial structure. If our readers will observe the illustration carefully, they will see that on the way from each end of the deck to the spreader the aerial passes through a ring on each side. These rings, which are apparently made of brass or bronze, are connected through insulators to two ropes secured to a ring bolt in the deck. When the commander wishes to lower the aerial the mast is rapidly telescoped, whilst at the same time a member of the crew hauls in the ropes attached to the rings. The spreader at the top of the mast then descends to a height equal to that of the conning tower, and is attached to the front of this structure by hooks. The rings by this time have slid over the aerial wire, doubling it up and taking in the slack caused by the reduction in height. The ropes are then secured and the aerial wires found to be taut and trim along the sides of the deck and out of harm's way. By this arrangement the need for unshipping the mast and wires is obviated, and, as can be imagined, much time and trouble are saved. The whole of the operation can be carried out after the order has been given to submerge, and before the upper portions of the deck and conning tower are awash.

The first sketch, which, as we have previously mentioned, was made by Mr. Denison from a lifeboat in which he found a place, shows the ill-fated merchantman heeling over to port a few minutes before she disappeared beneath the water, the submarine shown close by watching the result of her work. How quickly punishment descended upon her we cannot say, but we hope that her fate was as swift and sure as that which came upon the pirate found by H.M.S. *Baralong*. We think all our readers will join with us in congratulating Mr. Denison on his coolness in time of peril, his powers of observation, and his lucky escape.

WIRELESS IN THE TROPICS.

THE following extract from a letter received from Duala, Cameroons, may prove of interest to our readers :

" A discovery has been made here which may be or may not be news, but which is certainly very interesting.

" Field wireless sets came out to be used for this campaign in charge of Lieut. R——, R.E. It was of the greatest importance to establish communication between the columns working from different directions towards Jaunde, but over the forests of the Southern Cameroons every attempt to send wireless messages failed utterly. Two posts mutually visible 25 miles apart could not communicate. A reason for this had to be found, and, perhaps for the first time, electric conditions in tropical forests came to be studied by an expert. Lieut. R——, by watching thunderstorms, has come to the conclusion that for 100 ft. to 200 ft. above the trees the atmosphere is intensely charged with electricity.

" This electric strata apparently breaks up the lightning flashes, and accounts for the well-known fact that trees or ground are rarely struck in forests.

" In view of the more or less well-known influence of electricity on weather, quite a new light seems to be thrown on the effect of forests on rainfall. Trees are usually regarded as tending to connive ground water and atmospheric humidity, but this theory credits vegetation with a comutative general effect.

" A connection between woodlands and rain exists as an observed fact, but in the absence of any apparent reason, it has always seemed doubtful whether a small forest belt could actually precipitate rain locally. These electrical observations by R. seem to supply a plausible reason for such effects, if it is established that small forest areas do increase precipitation."

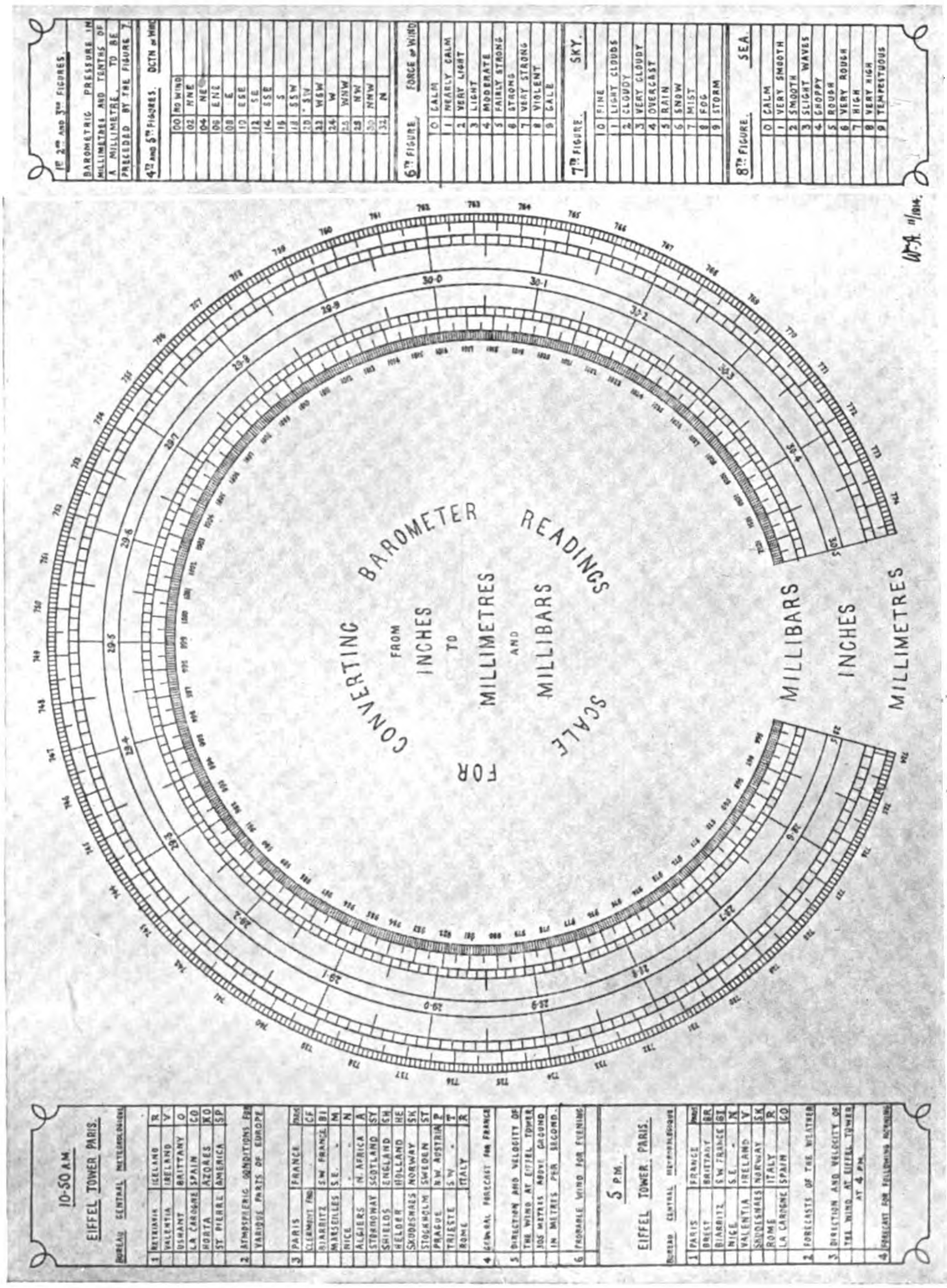
LIVERPOOL UNDERWRITERS' ANNUAL REPORT.

The Committee of the Liverpool Underwriters remark in their report that they have more than once called attention to signalling on ships, which has become more important than ever at the present time. They feel pleasure in recording that tests of proficiency in signalling now form a regular feature of Board of Trade Examinations. Regarding Wireless Telephony the report states that striking developments have been effected during the year, the new apparatus devised by Mr. Marconi giving a range at sea of upwards of 70 miles.

TRAGEDY AT ST. JOHN'S WOOD.

An inquest was recently held at Marylebone on Helen Marie Curtiss, aged 32, who was found dead. It appears that she had been very worried and she was obsessed with the notion that the Germans had set up a Wireless Installation on the roof of a country bungalow where she had spent some time.

A New Chart (*See next page*)



A NEW CHART.

THE chart on previous page, but for the fact that all private wireless stations in belligerent countries are at present closed down, would be of great value and interest to all amateurs. However, devotees of this most fascinating hobby can scarcely have too large an accumulation of such information, and we all look forward to the time when its utility can be made use of to the full.

In the left-hand column is given a list of meteorological stations with their code letters for both the Paris morning and evening weather reports.

The method of decoding these reports is given in the right-hand column.

It is an advantage in keeping tables of the various barometer readings at different times to have all in the same scale of measurement, and the scale in the centre is useful for conversion from millimetres to inches in the Paris reports, and from inches to millimetres in the British Admiralty reports.

THE RESTORATION OF AN ANCIENT CUSTOM.

The Pope to Bless Wireless Telegraphy.

IT has been announced in Vatican circles that the Pope is preparing officially to bless wireless telegraphy. By adopting this course His Holiness thus restores an ancient custom of the Church. From time immemorial it has been usual to bless inventions which confer great benefits on humanity. This forms a very important step on the part of the Pope, exemplifying the recognition of the importance of wireless telegraphy by the religious world. We have been enabled to obtain a very good photograph of the Pope standing in one of the corridors at the Vatican. It may be interesting to some of our readers to note that the present Pope in 1887 joined the household of Cardinal Rampolla and in 1907 was consecrated Archbishop of Bologna. His admission to the Sacred College of Cardinals dates only from the year 1914, and his elevation to his present important office took place at the end of the same year.

His Holiness Pope Benedict XV.

A SOLDIER'S PRAYER.

O God of Hosts, if on the battlefield
The Death which cowards shun should
come to me,
In heat of close encounter, suddenly,—
Or, oozing slowly through a crimson wound,
The Life Thou gavest me should pass away,
As from a lamp whose oil being spent
The light grows dim, and flickering expires,—
Grant, Lord, I may not meet Thee unprepared;
That, ushered swift before Thee, I may
stand
In meek humility and with the calm
Of one who feels his little best is done;
That on the Frontier of Life and Death
I may not fear the crossing, but in Faith
And Courage may go forward with a smile.

DOUGLAS R. P. COATS.

A Model Alternator.

By L. F. ISAAC.

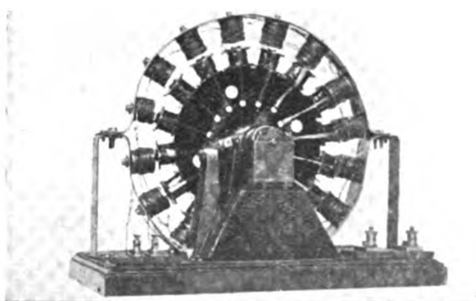
[The restrictions at present placed upon all amateur working in the field of radiotelegraphy do not, of course, touch the construction of electrical apparatus which is not directly connected with "wireless." The following article on a model alternator will, perhaps, enable readers to pass a few hours in very interesting constructional work—work which will give them a deeper insight into many alternating current problems than would many hours of theoretical study.—ED.]

READERS may be interested in the following description of a small generator constructed for the purpose of experimenting with small alternating currents. The general design and dimensions can be seen from the photograph, the base being about 9 in. by 6 in. It is a sixteen pole multicoil machine made from odd material I had on hand, and I chose a design that entailed a minimum of mechanical work, only two drills and one tap being used throughout.

The field magnet yoke was made from soft iron strip 1 in. by 1/16 in., hammered into two semi-circles, which were bolted together to form a circle about 8 in. in diameter. The sixteen pole pieces were made of ¼-in. soft iron rod, each ¾ in. long; these were drilled and tapped, and fastened by small iron screws at equal distances round the inside of the yoke. As the latter had not been bent into a perfect circle, I made all the pole pieces slightly too long, and filed them down when in position, so as to make the air gap as regular as possible. Small circles of wood were glued on the ends of the pole pieces, and they were then wound with about 1 oz. of No. 26 double cotton-covered wire. These coils were all wound in the same direction, but joined up in series so as to produce alternatively north and south poles. The two free ends of these windings were connected to the small terminals seen on the left of the photograph.

The armature core was made of a few 32-slot armature stampings, 6 in. in diameter, with alternate projections removed so as to leave a soft iron plate with sixteen poles on the circumference. Sixteen cardboard bobbins were made, about ½ in. by ½ in., each wound with No. 36 enamelled wire, and soaked in shellac varnish. These were slipped on to the projections of the core, being protected from centrifugal force by radial bindings of thin wire, which can be clearly seen in the photograph. The windings are connected up in series in the same manner as the field magnets, so as to make all the alternate coils of the same polarity. The armature was bolted on to a Meccano wheel, a piece of rod 4 in. long from the same source being used for the shaft. On the latter in front of the armature are fixed two slip rings, made of brass tube mounted on discs of hard wood, and these are connected to two opposite points of the armature winding, so as to put the two halves of the latter in parallel.

The brass pillar seen to the left of the front bearing supports a small block of fibre, upon which are mounted the brushes, made of fine wire gauze; these are connected to the terminals on the right. The bearings, 1½ in. high, were filed out of brass sheet, ¼ in.



thick, mounted on wooden blocks 2 in. high, and the method by which the field magnet yoke is fastened to the base can be clearly seen.

Owing to the fact that the machine is wound with such thin wire, it produces a high voltage and small current; when the field magnets are excited with a current of about 2 ampères it will give a powerful shock at a speed of less than 500 revs. per minute, partly in consequence of the large diameter of the armature.

I think that if the machine were wound with thicker wire, more attention given to the regularity of the winding and the reduction of the size of the air-gap, the output would be considerably greater, but at present it is giving excellent results through the medium of an old induction coil converted into a step-down transformer.

On Mathematics.

By W. PERREN MAYCOCK, M.I.E.E.

1. A man taking up mathematics is like a man entering for the first time a vast museum, where everything is of some moment, but most beyond his comprehension.

2. The average man is stunned at the extent of things, and recognises that time (or life) is too short to do them justice.

3. The exceptional man under very able guidance will acquire just that kind and amount of knowledge which is useful to him in his particular work.

4. Another kind of exceptional man under the same guidance will follow up matters on his own account. He will then mature into either a great man or a monomaniac.

5. The average man under the same guidance may or may not be able to grasp the work.

6. Men under ordinary guidance soon sift themselves out into exceptional men and smatterers, generally the latter.

7. Mathematics is like astronomy. A man can devote his whole life to it, and be of little real use on earth.

8. Mathematical engineers in the highest sense are like one type of high army officer. Other types of such officer are needed; and the whole army cannot consist of officers.

9. The very exceptional man can pick up by himself just as much of the right sort of mathematics as he needs. The average man trying to do the same thing is like a ship without a rudder.

10. The average man should absorb just as much of the right kinds of mathematics as he can manage without detriment to his other work.

11. If some good mathematical men were to collaborate in a series of really good books of technical mathematics suitable for different callings they would accomplish great work.

12. Really good books of this description must contain matter most carefully sifted and selected, and must be models of concise, clear, simple and good English and arrangement.

13. It is as impossible for everyone to be mathematical as it is for everyone to make money, or be musical.

14. Money makers—by the way—are seldom mathematical.

15. Some mathematical men act as very superior beings. If they excel in other ways they certainly are so.

16. Some inventions or developments are arrived at mathematically, some are not.

17. The carrying-out of an invention or development through the numerous stages which culminate in monetary return or public weal, or both, depends mostly upon an army of non-mathematical men.

18. The moral is that we want both mathematical men and men talented in numerous other ways.

19. If these "other ways" were stated the mathematical man would be lost in the crowd.

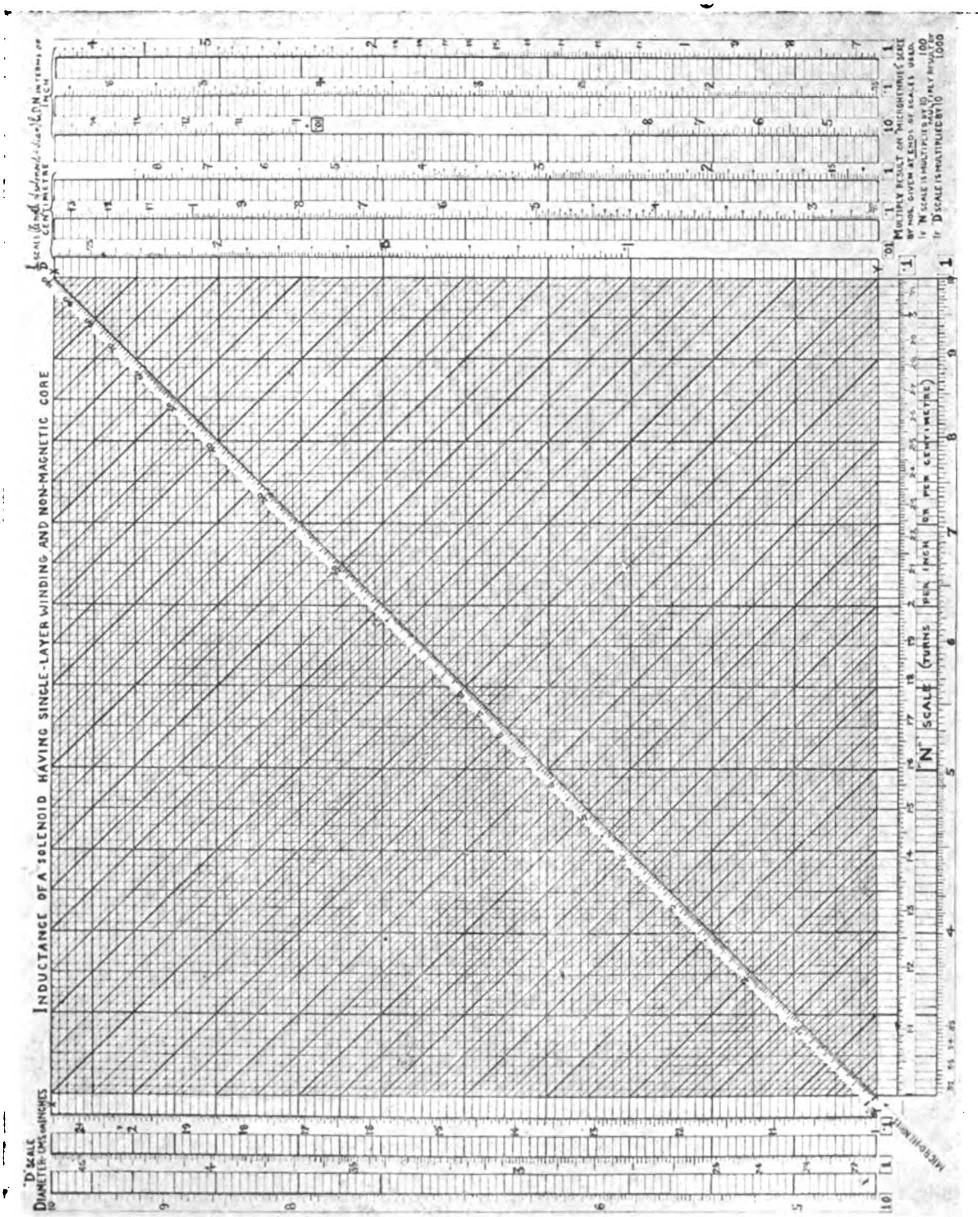
20. Many mathematical men will think this nonsense; non-mathematical men will not.

Inductance Calculations Simplified

By SAMUEL LOWEY.

THE formula for the calculation of self-inductance of a solenoid—viz., $L=(\pi^2 DN)\,lK$ may be split up into three main factors:—

$$D^3;\ N^2;\ \text{and}\ \frac{l}{D}\pi^2K.$$



In the diagram the "D" scale is marked, so that the scale length to a given number is equal to the mantissa of the logarithm of that number cubed.

Similarly the "N" scale, to the logarithm of the number squared; the left hand $\frac{"l"}{D}$ scale to the logarithm of the product $\frac{l}{D}\pi^2K$ corresponding to the value of $\frac{l}{D}$ indicated, while the right-hand $\frac{"l"}{D}$ scale is marked to the log. $(2{\cdot}54\frac{l}{D}\pi^2K)$ to correct for the measurements being in terms of the inch instead of the centimetre.

By suitable manipulation, three scale lengths on "D" "N" and $\frac{"l"}{D}$ scales may be added together, referred to a scale of antilogarithms, and the result for any particular case obtained directly.

The *modus operandi* can be most conveniently described by indicating the necessary movements geographically, as one would if dealing with a map.

From diameter of solenoid on "D" scale proceed *East*, and from turns per centimetre (or inch) on "N" scale *North*, and from junction either N.W. to line X.—.—.X (multiply result by 10), or S.E. to line Y.—.—.Y

Thence South or North respectively, *and* from $\frac{\text{length}}{\text{dia.}}$ of solenoid on $\frac{"l"}{D}$ scale, West to junction; thence either N.W. or S.E., and note reading where "microhenries" scale is cut.

The reading on "microhenries" scale gives the significant figures of the answer; the decimal point is fixed by following the instructions given on diagram.

With care, a result correct to the formula within about 1 per cent. may be obtained, which is usually sufficient, and, in the case of more accurate work, the diagram would be useful in obtaining a first approximation.

Similar scales could be constructed for a large variety of purposes, such *e.g.*, as for showing what capacity is required with any given value of inductance to tune to any wave-length, etc.

WIRELESS EXPEDITION ATTACKED.

That prospectors on behalf of wireless telegraphy in sparsely populated districts have an easy, enjoyable time is given the lie by an incident which has just been recounted. It appears that an expedition of six men were endeavouring to locate a site for a wireless station at the entrance to Hudson Bay, when they found themselves adrift on a huge ice-floe in a blinding snowstorm. The following day they were without food, and on the approach of night discovered that they were being surrounded by two dozen polar bears. The men took refuge on the top of a giant berg, while the bears gathered and laid siege. During the night the bears made an effort to reach the men, when one of them was killed by a well-directed shot.

In the morning the unwelcome visitors beat a retreat, and the men, half starved and badly frost-bitten, succeeded in reaching camp.

WAR PREPAREDNESS.

The December number of the *Wireless Age* contains an interesting page article on war preparedness among American Marconi operators. Captain W. H. G. Bullard (a biography of whom appeared in our issue for September, 1915) has made the suggestion to the American Marconi Company that the latter should lay before their operators a letter from him, asking these young men to enrol themselves for Government services in the event of war. The American Marconi Company has accepted this excellent suggestion, and is taking a keen interest in it. Thus another link has been forged in the chain of American National defence, the importance of which has been demonstrated by the unhappy European cataclysm.

WIRELESS AIDS IN FIGHTING FLAMES.

A disastrous fire recently occurred at Avalon, California, when a large section of the town was destroyed. Aid was summoned by wireless telegraphy, asking that the fire boat *Warrior* be rushed across the channel. A passenger steamer was already on her way when she received notification of the fire and proceeded at top speed to the relief of the distressed town.

Doings of Operators

THE latest name to inscribe upon the rolls of honour of those who, magnificently upholding the "Marconi Tradition," have given their lives for the great cause of humanity is operator George Henry Dewey, who perished in the wreck of the P. and O. liner *Persia*. So sudden was the transition from safety to disaster, from a speedy and comfortable liner bearing its living freight, all unconscious of the proximity of the slinking foe beneath the waves, to the heeling wreck plunging deep into the blue waters of the Mediterranean, with all who were able making away in the lifeboats, that very little is known of the last moments of any who met their death to make a German holiday. Mr. Dewey was still young, having attained his majority as recently as August last. His home was at Grantham, and he was educated at Croxton Kerrial and at Sedgebrook Grammar School.

Operator Salmon.

After completing his education he entered the Post Office as a learner, afterwards becoming sorting clerk and telegraphist. Conceiving the desire to take up the more modern form of communication, he studied wireless telegraphy at the British School of Telegraphy, London, and afterwards entered the Marconi Company's London school, from which he was soon transferred to the operating staff. His first voyage was made upon the s.s. *Lancastrian*, and subsequently he served upon the steamships *Vitruvia*, *Count of Seville*, *Briton*, and *Morvada*. In the middle of December last he was appointed to the hapless liner *Persia*.

Operator Dewey.

One of the passengers on board the *Persia* was operator Herbert Charles Salmon, who was proceeding by this vessel to a port abroad for the purpose of joining another ship. He was fortunately among those saved, and is apparently none the worse for his adventure. Mr. Salmon, whose home is in Cricklewood, has been eighteen months with the Marconi Company, one of the ships upon which he has served being the famous *Falaba*.

Operator Wellington.

THE LOSS OF THE S.S. "GLENGYLE."

Most of our readers will be acquainted with the sinking of the liner *Glengyle* by an enemy submarine. We are pleased to be able to report that operator Cecil Wellington, who was in charge, has been saved. Mr. Wellington is a native of Oakham, Rutland, and is 20 years of age. He was educated at the Oakham School, Rutland, and afterwards at St. Cuthbert's College, Worksop, Notts., and on leaving studied wireless at the British School of Telegraphy, Clapham. He entered the Marconi Company's school in November, 1913, and was appointed to the staff about a month later, proceeding to sea on the s.s. *Antillian*. He then served on the s.s. *Ortega*, *Den of Ogil*, and *Remuera*, taking up his appointment on the s.s. *Glengyle* in August, 1915.

* * *

THE WRECK OF THE S.S. "GEELONG."

Within a few days of the loss of the *Persia* the P. & O. Company had the misfortune to lose a second large liner, the s.s. *Geelong*. Operator Christopher Rapsey was in charge of the wireless installation, and at the time of writing we have no information as to whether he is among the survivors. Mr. Rapsey, who was born in December, 1891, at Fulham, was a teacher of handicraft before taking up wireless telegraphy as a profession, and upon the Marconi Company opening a course of evening classes entered the London school for training. He was appointed to the staff in October, 1913, serving first on the s.s. *Minnehaha* and subsequently upon the s.s. *Patia*, *Englishman*, *Montfort* and *Middlesex*. He was appointed to the s.s. *Geelong* in August of last year. We sincerely trust that he has come safely through the perils of shipwreck, and is none the worse for his experience.

* * *

S.S. "LANGTON HALL."

Mr. Charles Thomas Seaton, operator of the lost steamer *Langton Hall*, is 24 years of age, and hails from Lancashire. Born and educated at Leicester, he was for some little time in the service of the Post Office, and afterwards entered business in Uppingham, whence he proceeded to positions in Nuneaton, Liverpool and Earlston. Taking interest in wireless telegraphy, he entered the Liverpool Wireless Training College, and was accepted in the Marconi Company's London school in June, 1914. After a finishing course he was appointed to the operating staff at the end of July of that year, and served successively on the s.s. *Potaro*, *Minneapolis*, *West Point*, *Start Point* and *Langton Hall*. We are glad to say that he is safe and sound, and has, in

Operator Seaton.

Operator Baker.

fact, already taken duty upon another steamer, the s.s. *Nore*. He is to be congratulated upon his lucky escape.

* * *

LOSS OF THE S.S. "ORTERIC."

Still another victim of Hunnish piracy is the s.s. *Orteric*, upon which Mr. Frederick Horsey Baker served as operator. Mr. Baker, who has been in the service of the Marconi Company some four years, is 27 years of age, and was born at Corsham, Wiltshire. On leaving school he took to telegraphy as a profession, and served a number of years on the telegraphic staff of the Great Western Railway. He was accepted in the Marconi Company's London school in September, 1911, and after a course of training in wireless made his first voyage to sea upon the s.s. *Virginian*. Upon his return he was appointed to the s.s. *Huayna*, and afterwards to the s.s. *Oronsa*, *El Argentina*, *Gloucester Castle*, *Urubamba*, and finally to the *Orteric* about a month before the outbreak of war. Mr. Baker had had a very long voyage with this steamer when she was torpedoed, but fortunately he escaped unscathed, and has again taken up his duties, now serving on the s.s. *Mississippi*. The pluck and determination shown by these young men is emphasised by their willingness to repeatedly tread the path of danger when duty calls.

FEATURES OF THE NEW VOLUME.

IMPORTANT IMPROVEMENTS IN THE "WIRELESS WORLD."

OUR next number will bring to a close the third volume of the "Wireless World." Starting with the April number, we shall present our readers with a magazine much larger in size, with an extended and very comprehensive scope, and many additions and improvements. A number of appreciative letters from all parts of the world, some of which have appeared in our pages, have indicated to us the direction in which progress could most suitably be made. Next month we shall return to the subject and give full details.

In order to find space for these improvements the size of the journal has had to be increased, with the consequence that it is no longer possible for us, especially in view of the enormous increase in cost ot materials and production, to issue the magazine at the price of 3d. Will readers kindly note, therefore, that the subscription rate with the new volume will be 8s. per annum, post free, and the price of a single copy 6d., or 9d. post free.

A new and artistic cover is in course of preparation, and will, we are sure, find many admirers when the day of publication arrives.

QUESTIONS AND ANSWERS

Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study to the Editor,* THE WIRELESS WORLD, *Marconi House, Strand, London, W.C. Such questions must be accompanied by the name and address of the writer, otherwise they will remain unanswered: and it must be clearly understood that owing to the Defence of the Realm Act we are totally unable to answer any questions on the construction of apparatus during the present emergency.

We again wish to draw the attention of readers to the note at the head of this page. Both the construction and use of wireless apparatus by amateurs is at present prohibited, and we cannot answer any questions as to how aerials and other parts of a wireless installation can be constructed, neither can we criticise diagrams of connections sent to us. A number of correspondents have also addressed letters to us asking what their position would be in the event of conscription. Not being blessed with the gift of prophecy we can only reply in the words of Mr. Asquith: "Wait and see."

Many thanks to the many correspondents—too numerous to reply to individually—who have sent in interesting letters on the subject of the "Little Problem." Next month we shall publish an article on the Cube Problem from the pen of Dr. Fleming, who is an authority on all such calculations.

P. R. (Co. Wexford).—The educational qualifications which you state that you possess should be sufficient to have your case considered, but your suggestion that the Marconi Company should find you another situation in your present trade after the war is over almost takes our breath away. Seriously, P. R., where do you think the Marconi or any other company would be in a little while if it devoted its energies to finding situations in other trades for its present or would-be employees?

C. C. B. (Crouch End) writes: (1) "Where can I find a fuller explanation of the phenomenon of the production of electric waves in the æther by the interaction of electro-magnetic and electro-static lines of force emanating from an aerial, mentioned on p. 259, column 1, of THE WIRELESS WORLD, Vol. I.?" (2) "On p. 333, col. 1, *ibid*, the three things which determine the power in an oscillating circuit are mentioned. What is the formula for this?" (3) "On p. 523, col. 2, *ibid*, it is stated that 'the most efficient coil . . . for the secondary circuit of the crystal receiver is one whose wave-length by itself will be the required value without the addition of any extra capacity.' If this be so, why not make the inductance variable and dispense with the condenser altogether? Lower down it says, again, that 'the maximum efficiency is obtained when the capacity across the secondary condenser is reduced to zero.' When this state of affairs is reached, however, surely the crystal, potentiometer and 'phone becomes part of the oscillating circuit (the condenser being, for the nonce, a mere break in the circuit), all of which have great resistance, which, as pointed out earlier in the article, is very bad in an oscillating current?"

Answers.—(1) The subject of electro-magnetic waves is dealt with very fully in Dr. Fleming's book, *The Principles of Electric Wave Telegraphy and Telephony*, and also to some extent in the *Handbook of Technical Instruction for Wireless Telegraphists*. To go at all deeply into the subject requires considerable mathematical knowledge. (2) The formula for the power in the circuit you mention is:

$$P = \tfrac{1}{2}NCV^2$$

where N is the number of times per second the condenser is discharged, C the capacity in microfarads, V the voltage, and P the power in watts. (3) There are several objections to making the inductance variable. Without a lot of trouble it can only be made variable in steps, whereas the capacity can easily be made continuously variable; then, again, if the inductance is made variable by the usual methods, the end turns not connected to the detector are still connected to the rest of the inductance and the whole coil is free to resonate at its natural wave-length, thus hindering sharp tuning. There are other objections which may occur to you when you think matters over. High efficiency modern receivers in which the secondary inductance needs to be variable have arrangements for cutting the inductance not needed right out of circuit. With regard to the second part of the query, the telephone, crystal and potentiometer are not in an *oscillating* circuit. You must remember that the inductance with its self-capacity forms an oscillating circuit, and the crystal, etc., is tapped off this. If it were not for this self capacity the circuit would not be tuned.

H. J. G. (Walthamstow).—Many thanks for your appreciative remarks. It is unusual to build a condenser as shown by you. The two outer plates should be of the same polarity, thus giving one side of the condenser one more plate than the other. The capacity can then be calculated from the formula given in paragraph 601 of Vol. II. of THE WIRELESS WORLD, December, 1914.

G. B. (Millom, Cumb.) writes: "On page 528 of THE WIRELESS WORLD, Vol. II., there is an article 'A Morse Practice Set,' by C. Barnard. In the diagram of connections shown I do not quite follow the direction of the current. Also, is the key shown a single contact key or a double contact one?"

Answer.—Both keys have contacts at the front and the back, also connections to the bridge. If you will look at the diagram you will see that the keys are drawn open at both contacts. Now imagine the left-hand key depressed (front contacts together) and the right-hand key in its normal position—namely, with the two back contacts together, then the current will pass from the right-hand battery up through the back contacts of the right-hand key, through the primary "*f*" along the top wire, through the second primary, down the front contacts of the left-hand key, round the bottom wire up through the buzzer and down again to the battery "*d*." When the left-hand key is in normal position and the right-hand key is depressed you will be able to trace the current from battery "*D*" in the same way.

F. M. (Ballinacurra).—Certificates in other systems are granted only when the applicant has had *practical training* on the apparatus of those systems. We would advise you to master the Marconi system before taking up the study of other apparatus, as it is far better to be thoroughly proficient in one system than to have a smattering of several. Why are you anxious to take a certificate in a German system?

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This coupon must accompany each entry for the above. A separate coupon must be submitted with each problem.

Full particulars as to prizes and latest date for entries are given on another page.

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Instructional Article

NEW SERIES (No. 6)

The following series, of which the article below forms the sixth part, is designed to provide wireless telegraphists, amateurs, and technical students generally, with clear and precise instruction in technical mathematics, in order that they may be enabled to read and understand the more advanced technical articles which appear from time to time.

Trigonometry.

35. In commencing a study of trigonometry, our first need is of some method of measuring angles. There are two methods in common use, and we will first consider that known as

SEXAGESIMAL MEASURE.

Imagine the line A B (Fig. 13) to be hinged at A, so that the end B can be moved round A along the circumference of a circle—shown dotted. If we move A B anti-clockwise to a position A B_1, then the line A B will have *swept out the angle* B A B_1.

Suppose now we continue to turn A B until it reaches a position A B_2, perpendicular to A B, then A B will have turned through *one right angle*. Continuing round the circle, we reach a position A B_3, such that B_3 A B is a straight line, and then A B will have swept out *two right angles*. Proceeding, when A B reaches the position A B_4, such that A B_4 is perpendicular to B_3 A B (or where B_4 A B_2 is a straight line), then A B will have passed through *three right angles*. Finally, when A B reaches its original position it will have passed through *four right angles*.

In *sexagesimal measure* these four right angles, corresponding to one complete revolution of the line, are divided into 360 equal parts, called *degrees*.

As four right angles equal 360 degrees (written 360°), one right angle equals $\frac{360°}{4}=90°$.

For more accurate work each degree is sub-divided into 60 equal parts called *minutes*, and each minute is in turn divided into 60 *seconds*.

Example.

Find the value of one-seventh of a right angle to the nearest second.

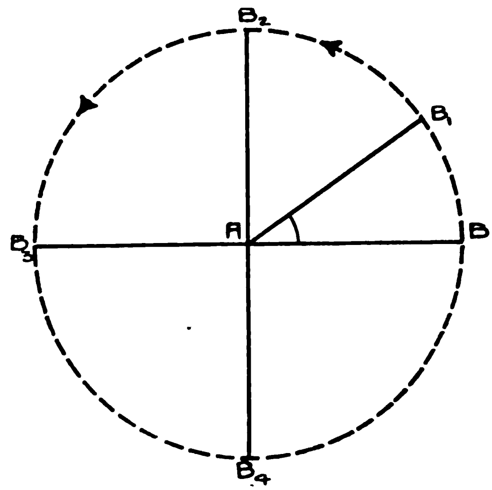


Fig. 13.

One-seventh of a right angle

$= \frac{1}{7}$ of $90° = \frac{90}{7}° = (12\frac{6}{7})°$.

$\frac{6}{7}$ of a degree $= \frac{6}{7}$ of 60 minutes.
$= (\frac{6}{7}\times 60)$.
$= \frac{360}{7} = (51\frac{3}{7})$ minutes.

$\frac{3}{7}$ of a minute $= \frac{3}{7}$ of 60 seconds.
$= (\frac{3}{7}\times 60)$.
$= \frac{180}{7} = 26$ seconds (approx.).

Ans.—12 degrees 51 minutes 26 seconds, written as 12° 51′ 26″.

36. It must not be supposed that 360° is the greatest possible angle, for the line A B could be made to rotate indefinitely, sweeping through an additional angle of 360° in each complete revolution. Thus an angle of 800° would consist of two complete revolutions, making up (2×360)°=720°, *plus* an additional angle of 80°.

37. The second method of measuring angles is called

Circular Measure.

This is the method used in all higher mathematics. The unit by which angles are measured in this system is obtained as follows:

Draw a circle B C D (Fig. 14) with any radius A B. From B measure off a length B C, *along the circumference*, equal to the radius A B (r). Then, on joining C A, the angle B A C is a unit angle of one *radian*. It is most important to note that it is *not a straight line* B C, which is equal to A B, but the *length of that portion of the circumference* which lies between B and C.

It can be easily proved, mathematically and by trial, that an angle of one radian marked off in this way is an absolutely constant quantity, quite independent of the size of the circle used. Thus the radian can be used as a fundamental unit by which to measure angles, and it is so used in circular measure.

In Article V. we saw that the whole length of the circumference of a circle is equal to 2π times the radius, and so we can mark off 2π successive lengths, each equal to the radius, round the circle. Now obviously (see Fig. 14) each of these 2π lengths will face an angle of one radian at the centre of the circle, and so the whole four right angles or 360° at the centre will be equal to 2π radians.

Thus 2π radians $=360°=4$ right angles.

π ,, $=180°=2$,,

$\frac{\pi}{2}$,, $=90°=1$,,

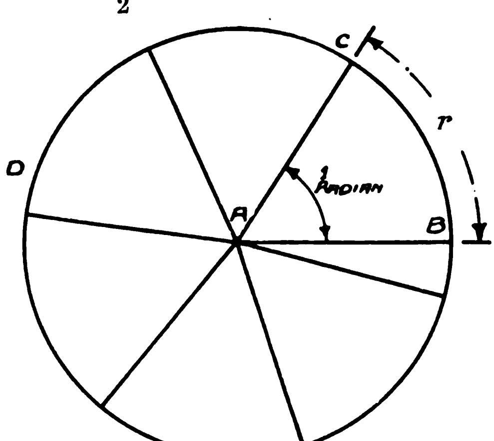


Fig. 14.

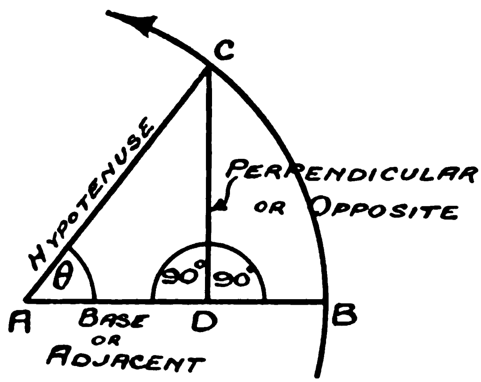


Fig. 15.

Example.

Find the value, in sexagesimal measure, of 1 radian.

π radians $=180°$.

Therefore 1 radian $=\left(\frac{180}{\pi}\right)^{\circ}$

$=57.3°$

$0.3°=\frac{3}{10}$ of $60'=18'$

Thus 1 radian $=57°\ 18'$ (approx.).—*Ans.*

Example.

Find the value of 140° in circular measure.

$180°=\pi$ radians.

Therefore $140°=\frac{140}{180}$ of π

$=\frac{7}{9}\pi$ radians
or 2·445 radians. } *Ans.*

Trigonometrical Ratios of Angles.

38. For the present we shall only deal with angles which are smaller than one right angle.

Reverting for a moment to our revolving line, we will assume it has reached a position AC (Fig. 15), and we will call the angle BAC by the Greek letter θ (Theta). CD is a line drawn from C perpendicular to AB; thus angle BDC and angle ADC are each equal to one right-angle or 90°.

Dealing with the angle DAC and the triangle ACD, we will call AD the *base* or *adjacent* side,

AC the *hypotenuse*,

And DC the *perpendicular* or *opposite*.

As the line AB revolves about the centre A, the values of the perpendicular and of the base will continually vary, the perpendicular *in*creasing and the base *de*creasing: the hypotenuse remains constant. This will be easily seen by considering Fig. 16, which shows various positions of the rotating arm AB from 0° to 90°.

From this figure you will see that as AB moves round, the *ratios* existing between the various sides of the triangle ACD, taken in pairs, are continually changing in value according to the size of the angle BAC. It can be shown, moreover, that for any given size of angle the *ratio* $\frac{\text{opposite}}{\text{hypotenuse}}$, say, is a constant, quite independent of the *actual* lengths of these two sides. Obviously we could specify any given angle by saying that its ratio $\frac{\text{opposite}}{\text{hypotenuse}}$, obtained from a right-angled triangle such as the triangle ACD, is equal to some stated numerical value. Thus it is that the question of these ratios between the three sides of the triangle is of very great importance.

39. The three sides we have called adjacent, hypotenuse and opposite can be arranged in the following six ways, each of which is given a name :—

(i) $\frac{\text{opposite}}{\text{hypotenuse}}$ = sine of angle θ.

(ii) $\frac{\text{adjacent}}{\text{hypotenuse}}$ = cosine of angle θ.

(iii) $\frac{\text{opposite}}{\text{adjacent}}$ = tangent of angle θ.

(iv) $\frac{\text{hypotenuse}}{\text{opposite}}$ = cosecant of angle θ.

(v) $\frac{\text{hypotenuse}}{\text{adjacent}}$ = secant of angle θ.

(vi) $\frac{\text{adjacent}}{\text{opposite}}$ = cotangent of angle θ.

Note that cosecant is the reciprocal of sine, or cosecant = $\frac{1}{\text{sine}}$.

Similarly secant = $\frac{1}{\text{cosine}}$.

And cotangent = $\frac{1}{\text{tangent}}$.

These ratios look somewhat forbidding at first sight, but they are of the utmost importance, and must be learnt. The reciprocal ratios are quite easy once the first three (sine, cosine and tangent) have been learnt, but it must be remembered that :—

(*a*) sine and *co*secant ;

(*b*) *co*sine and secant are reciprocals, NOT *co*sine and *co*secant.

40. For convenience in writing and printing the following notation is adopted :—

"The sine of the angle θ" is written as sin θ.

"The cosine of the angle θ" is written as cos θ.

"The tangent of the angle θ" is written as tan θ.

"The cosecant of the angle θ" is written as cosec θ.

"The secant of the angle θ" is written as sec θ.

"The cotangent of the angle θ" is written as cot θ.

Instead of writing "The angle whose sine is 0·7," we write $\sin^{-1} 0{\cdot}7$, and similarly for "The angle whose tangent is 0·3"—$\tan^{-1} 0{\cdot}3$. "The angle whose secant is 3·7"—$\sec^{-1} 3{\cdot}7$, and so on.

41. Let us take a triangle ABC (Fig. 17) in which angle B=90°.

Angle A=angle C=45°.

Then AB=BC=1 (say) because the triangle is isosceles.

As angle B=90°, $AC^2=AB^2+BC^2$
$=1+1=2.$

Thus $AC=\sqrt{2}$.

From this sin 45°=sin BAC

$$=\frac{CB}{CA}=\frac{1}{\sqrt{2}}$$

$$\cos 45° = \frac{AB}{AC} = \frac{1}{\sqrt{2}}$$

$$\text{and } \tan 45° = \frac{BC}{BA} = \frac{1}{1} = 1$$

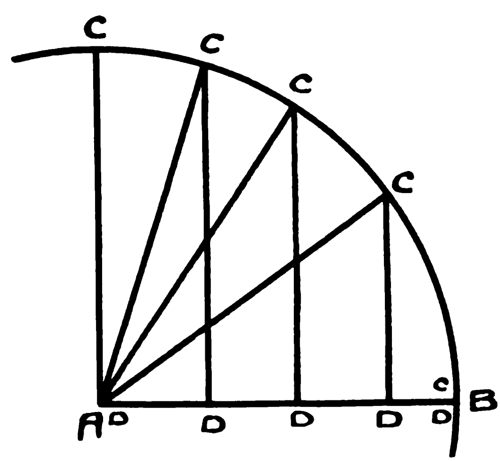


Fig. 16.

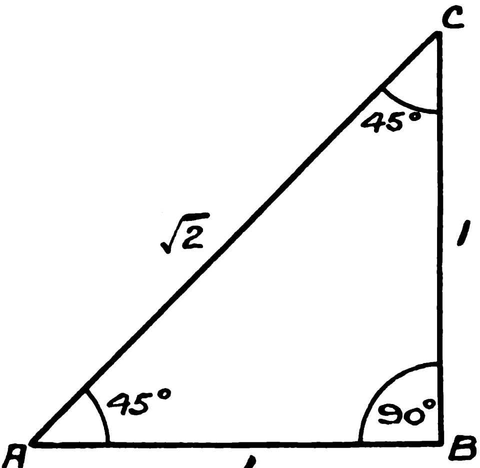


Fig. 17.

Also $\text{cosec } 45° = \dfrac{1}{\sin 45°} = \sqrt{2}$

$\sec 45° = \dfrac{1}{\cos 45°} = \sqrt{2}$

$\cot 45° = \dfrac{1}{\tan 45°} = 1$

42. Triangle ABC (Fig. 18) is equilateral, and so each angle is equal to 60°; also let each side equal 2 units. If AD be drawn perpendicular to BC, then angle DAB = angle DAC = 30°; angle ADB = angle ADC = 90°; and BD = DC = 1.

From the right-angled triangle ADB—

$AB^2 = AD^2 + DB^2$

or $AD^2 = AB^2 - BD^2$

$= (2)^2 - (1)^2$

$= 4 - 1 = 3.$

Thus $AD = \sqrt{3}$.

From this $\sin 60° = \dfrac{AD}{AB} = \dfrac{\sqrt{3}}{2}$

$\cos 60° = \dfrac{BD}{BA} = \dfrac{1}{2}$

and $\tan 60° = \dfrac{DA}{DB} = \dfrac{\sqrt{3}}{1} = \sqrt{3}$.

From this figure we can also get the values for the various ratios of an angle of 30°, in which case—

BD is "opposite."
DA is "adjacent"
and AB is "hypotenuse."

43. In Fig. 19 the angle BAC (or DAC) has become very nearly 90°. It will be easily seen that now CD has become nearly equal to CA, which we can call unity: AD has nearly vanished altogether. Obviously, when CA has turned a little farther anti-clockwise, so that the angle BAC *is* 90°, then CD will equal CA (which equals 1), and DA will be equal to 0.

Thus $\sin 90° = \dfrac{CD}{CA} = \dfrac{1}{1} = 1$

$\cos 90° = \dfrac{AD}{AC} = \dfrac{0}{1} = 0$

$\tan 90° = \dfrac{DC}{DA} = \dfrac{1}{0} =$ infinity (written ∞).

Similarly the values for 0° can be obtained, and we can then construct the following table of ratios for these angles:

	0°	30°	45°	60°	90°
Sine .	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
Cosine .	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
Tangent	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	∞

44. In company with log tables will generally be found tables giving the values of these trigonometrical ratios for all angles between 0° and 90°. An extract from such a table is shown below:

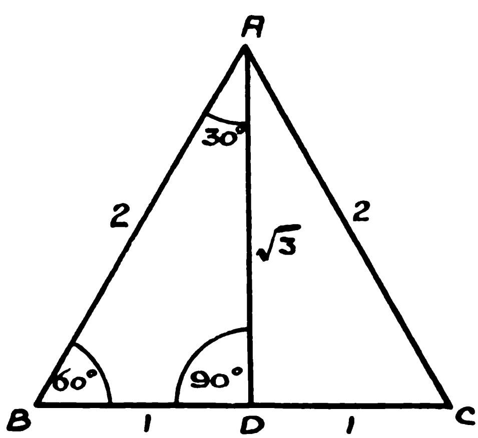


Fig. 18.

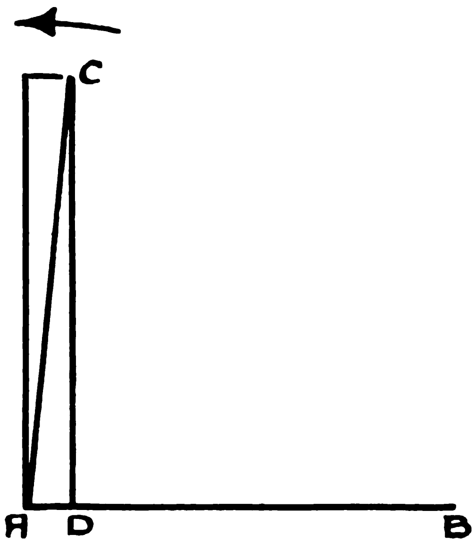


Fig. 19.

Deg.	Sine.	Tangent.	Cotangent.	Cosine.	
14	·2419	·2493	4·0108	·9703	76
15	·2588	·2679	3·7321	·9659	75
16	·2756	·2867	3·4874	·9613	74
17	2924	·3057	3·2709	·9563	73
18	·3090	·3249	3·0777	·9511	72
19	·3256	·3443	2·9042	·9455	71
20	·3420	·3640	2·7475	·0397	70
21	·3584	·3839	2·6051	·9336	69
22	·3746	·4040	2·4751	·9272	68
	Cosine.	Cotangent.	Tangent.	Sine.	Deg.

For angles up to 45° we work *downwards* from the top, and for angles greater than 45° we work *upwards* from the bottom. For example, cos 17° is 0·9563, found *under* " cosine " and opposite 17° in the left-hand column. The value of cos 74° is 0·2756, found *above* " cosine " and opposite 74° in the right-hand column.

Similarly—

$\cot 18° = 3{\cdot}0777$
$\tan 69° = 2{\cdot}6051$
$\cos 73° = {\cdot}2924$
$\sin 19° = {\cdot}3256$
$\tan^{-1} {\cdot}3839 = 21°$
$\sin^{-1} {\cdot}2419 = 14°$
$\cot^{-1} {\cdot}3443 = 71°$
$\cos^{-1} {\cdot}30 = 72\tfrac{1}{2}°$ (approx.).

WIRELESS AT BOWES PARK.

THE note in the January number entitled " Wireless at Bowes Park " has brought forth the following letter from the person actually concerned :—

" DEAR SIR,—I notice your reference to " me last month, and beg to add a few re- " marks on the subject. The incident dis- " closes a characteristic trait of the average " individual ; the over-powering desire to " participate in something. Everyone seems " to possess it. Thus, some people will sub- " scribe to the ' Fund for Homeless Hippo- " ' potami,' or some other good and deserving " cause, just for the sake of seeing their " names in a subscription list. Others amal- " gamate to wage war on harmless (?) experi- " menters like myself. My instruments were " taken away shortly after war broke out, " but this did not prevent the police from " paying me periodical visits, because some- " one was sure that our clothes-line was an " aerial in disguise. It was not until I had " hoisted a huge Union Jack on the disused " aerial mast that the patriotic neighbours " were satisfied that I had no pro-German " tendencies. With their breasts swelling " with a sense of duty well executed, they " retired temporarily and gave me a few " months' rest. Then I invented an " electric motor horn, with a particu- " larly aggressive and penetrating note, " which, I might add, I hope shortly " to place on the market. That did it ! " I was again presented—metaphorically— " with a high-power wireless station by the " indignant neighbours, and the visits were " renewed in consequence. Between our- " selves, however, it does not say much for " their knowledge of ' wireless ' if they can " confuse the sound emitted by an electric " horn with the crackle of a low-power " amateur transmitter. Perhaps, however, " it possesses certain advantages ; it keeps " these persons from doing worse mischief " elsewhere, it gives me a par. in the local " paper, and—but I see the editorial blue " pencil hovering over this letter on account " of its length, so wishing this magazine— " which I have read with interest and much " advantage from No. 1—every success,

" Yours, etc.,

(*Signed*) " ARTHUR W. HULBERT."

"AN INTRODUCTION TO APPLIED MECHANICS." By Ewart S. Andrews, B.Sc. Cambridge: At the University Press. 1915. 4s. 6d. net.

The subject of applied mechanics is one which presents difficulties to both teacher and student. To steer a clear course between too much applied mathematics on one hand and too much engineering application without sufficient explanation of principles on the other is a task not lightly to be undertaken by an author, and we think the writer of this treatise has acquitted himself excellently. As a class book in the junior classes of engineering colleges and those schools which give attention to engineering, as also for the home student who is not very far advanced, this volume should be of welcome assistance.

* * *

"INTRODUCTION TO MAGNETISM AND ELECTRICITY." By E. W. E. Kempson, B.A. London: Edward Arnold 3s.

One of the most favourable features of this book, and one which might well be copied by other writers, is the treatment of Static Electricity in such a way as to show its relation to Voltaic Electricity. All who are concerned with the teaching of wireless telegraphy know the confusion in the student's mind created by his learning about frictional electricity, the electrophorus, the Wimshurst machine, and other similar matters as something entirely separate from voltaic electricity, and then, after a further period of study during which he learns of batteries and dynamos, his finding that wireless telegraphy utilises condensers similar to Leyden jars in connection with the same batteries and dynamos. Mr. Kempson—who, by the way, is senior physics master at Rugby—is fully alive to the importance of treating the two branches of the science in such a way as to show their inter-relation, and in the book before us elaborates his lecture notes for a year's course of Electricity and Magnetism as given to the science forms in that famous school. The book is well produced, with clear diagrams, and should prove useful to both schools and private students. It is particularly to be recommended to those about to take up the study of wireless telegraphy who desire to obtain a good sound grasp of elementary electricity.

* * *

"THE AVIATION POCKET-BOOK, 1915–16." By R. Borlase Matthews. London: Crosby Lockwood & Son. 3s. 6d. net.

The number of specialised "pocket-books" grows apace. Only a month or two ago we reviewed Dr. Fleming's "Pocket-Book for Wireless Telegraphists," and now we have before us the third edition of "The Aviation Pocket-Book" with a mass of up-to-date information, well digested and tabulated, of great value to all who are interested in the art of flight. Unlike too many so-called pocket-books, the little volume under review can readily be slipped into the pocket without creating a decided "lump." Commencing with a review of aviation developments, the editor points out that "whereas the effect of the war has "in many cases been derogatory to development, the science of aeronautics has on "the contrary been stimulated, and every "possible effort has been and continues to "be put forward by Allies and enemy alike "to improve the efficiency and reliability "of their flying equipment." Of particular interest to the wireless student is the statement that, prior to the outbreak of hostilities, the German Admiralty had ordered a British seaplane (a Sopwith), fitted with wireless apparatus driven by a separate engine. Following this review of progress, we find some interesting statistics of German aeroplanes and dirigibles, together with a list of some notable British aeroplane war achievements. Next come a number of chapters on Air Pressure and Resistance, Aeroplane Theory and Design, Structural Materials, etc., etc., and some important information on aeroplane engines, piloting, and aviation generally. Mention must also be made of the useful glossary of terms at the end of the book. Altogether, this is a very useful and well-compiled volume.

* * *

"POLYPHASE CURRENTS." By Alfred Still, A.M.I.C.E. Second Edition. London: Whittaker & Co. 6s. net.

This book aims at providing a non-mathematical treatment of the principles underlying the operation of polyphase currents. The reader is presumed to be acquainted with direct current principles, but not with alternating work, and the first chapters are therefore given up to an elementary study of alternating currents, self-induction, capacity, and the like.

Whether the author is justified in giving up nearly a quarter of the book to such elementary considerations is a point on which opinions will vary. For our part, we think that very few students will purchase a book on polyphase currents before having thoroughly mastered the general principles of alternating current work; and for those who approach the subject without a previous knowledge of alternating current phenomena these chapters are scarcely sufficient preparation. However, the two chapters in question will doubtless serve to refresh the memory of students on points of importance before they proceed to the main subject.

Those parts of the book which deal with polyphase currents are clearly written and well illustrated, chapters being devoted to general principles and synchronous generators, measurement and calculation of power in polyphase circuits, polyphase transformers, motors, and other matters. We have no doubt that the volume will be welcomed by many whose mathematical knowledge is insufficient to enable them to follow the reasoning in the more advanced treatises, and who have not the time to spare for a deeper study of the subject.

* * *

"FOR FLAG AND EMPIRE." By T. Wilkinson Riddle. 1915. London: Marshall Bros., Ltd. 1s. net.

It is with pleasure that we accede to the request of Lord Radstock to review the above book in the pages of our journal. The sub-title is "The Story of the British and Foreign Sailors' Society in Peace and War." The book forms an exposition of the aims and objects of the Society and the great work that is done by them in the alleviation of distress amongst the sailors of the world's navies and mercantile marines. Within the latter category is classed the whole army of wireless operators throughout the world, who, although they are not in the trenches, are not one whit the less "doing their bit." The naval fleets keep the seas open whilst the mercantile fleets bring food and other necessary material to our shores. We hope that all our readers will obtain a copy of the book, and thus help forward the excellent work so unostentatiously done by this Society. It is interesting to note that the poem entitled "The Merchant Service Man" has been reprinted from THE WIRELESS WORLD.

* * *

"THE GREATER POWER." By Guy Thorne. 1915. London: Gale & Polden, Ltd. 1s. net.

In the dedication of this book the author explains the why and wherefore of the story. A friend had asked him "to write "a sensational novel dealing with an aspect "of the world-war *in a fortnight*." The author did it. The book deals with a powerful plot conducted in the heart of the

Vatican itself in which wireless telegraphy plays an important part. One of the priests of the Papal Court was suspected of sending wireless messages from the golden ball above the dome of St. Peter's, Rome, to the Austrian forces. The hero and his brother determined to stop this, and their ways and means to accomplish this end should be sought in the book. Altogether it forms very thrilling reading.

* * *

"DAILY MAIL YEAR BOOK, 1916." Edited by David Williamson. London: Associated Newspapers, Ltd. 6d. net.

The sixteenth annual edition of this useful compendium of information has come into our hands. It is fuller than ever of things one wants to know. Naturally in the present edition a very large amount of space has been given to the war and matters concerning the war. To our readers the article which will make a special appeal is entitled "Wireless and the War," which records some of the achievements of Senatore Marconi's invention. No reference bookshelf is complete without this amount of information.

* * *

"FIGHTING SHIPS." By Fred T. Jane. 1915. London: Sampson Low, Marston & Co., Ltd. 21s. net.

In spite of the difficulties consequent upon issuing such a book during the present state of affairs, a work altogether worthy of the author and publishers has been placed upon the market. It is true that no designs or silhouettes are allowed to be published in the section dealing with the British ships, but with that exception the book practically contains all its well-known and much-appreciated features. In his preface the author tells us that a great deal of money has been expended in an effort to secure odd items of information not generally known, especial care being devoted to the German section. Mr. L. Cecil Jane, M.A., the well-known historian of Oxford, has written an article entitled "Historical Analogies and the Naval War," and this replaces that usually contributed on the progress of Naval Engineering, which has been temporarily suspended from the book. All our readers should possess a copy and especially in view of the large and important part played by wireless telegraphy in naval matters. It is understood that after the war a complete issue, including the full British particulars, will be placed on the market.

* * *

"AN UNTAMED TERRITORY" (The Northern Territory of Australia). By Elsie R. Masson. London, 1915: Macmillan & Co., Ltd. 6s.

The material for this book, says the author, was collected in the northern territory of Australia during the years 1913 and 1914. Miss Masson, in the course of her stay, studied life in Darwin, and also saw something of the more outlying parts of the territory. The whole social life of the territory is fully dealt with, and a very interesting insight into the manners and customs of the aboriginal blacks is given. Some excellent illustrations adorn the book. Miss Masson made a trip out through the bush by motor-car to Undidu. She recounts how during the last two years the experiment has been made of using an automobile instead of a horse. "It was a bold experiment in a country roadless, sometimes for long stretches waterless, and sparsely populated, and there have been difficulties with tyres, petrol or water." Australia within the last two or three years has seriously taken up the question of radio-telegraphic communication between various points within the Commonwealth and outside it. There is a vast field for further scope in this connection to which the Australian Government is fully alive.

* * *

"PORTUGAL AND THE PORTUGUESE" ("Countries and Peoples" Series). By Aubrey F. G. Bell. London, 1915: Sir Isaac Pitman & Sons, Ltd. 6s. net.

The excellent "Countries and Peoples" series placed upon the market by the publishers have now become standard works. From time to time we have had the pleasure (it is a pleasure) of commenting on books in this series, and it has now fallen to our lot of reviewing yet another. Mr. Bell is a well-known writer on all matters pertaining to the Iberian peninsula, and his contributions to literature have received well merited distinction. The present book is quite up to his usual standard and its perusal afforded us great pleasure.

Foreign and Colonial Notes

Japan.

The Funabashi wireless station, which has just been completed, has for some time since been receiving and despatching wireless messages to and from Honolulu. There has been received from the *Hawaii Shimpo*, a Japanese paper, the following message, addressed to the *Tokyo Asahi*:

"As the result of the great success of the "Marconi wireless system Japan and Hawaii "have been linked with each other, the two "countries being aerial neighbours. We "beg to utilise this felicitous occasion to "render our warmest compliments to our "contemporary, which is working for the "attainment of the high objects, which we "have in common, of advancing the common "interests of mankind and harmonising the "civilisations of East and West."

* * *

Pacific.

According to the *Electrician* the contracts for the erection of the 600 ft. steel towers for the United States Government wireless stations at Cavite (Philippines), Honolulu, and San Francisco, have been awarded to the Chicago Bridge Company.

* * *

Philippine Islands.

Work on the new wireless station at Margosatubig (Philippines) is nearly completed, says the *Electrician*. Margosatubig will then be in direct communication with Samboanga, Malabag, and the Manilla submarine cable system.

* * *

United States.

On account of numerous complaints made by American exporters and importers against censorship delays of commercial cable messages in London, and the apparent inability of the United States Government to effect relief, the State Department at Washington, according to the *Wireless Age*, is about to advise these firms to use wireless instead of cable. The principal protests have concerned the detention of commercial messages of American firms to and from Norway, Sweden, Denmark and Holland.

* * *

It is recorded that the American Government closed for a fortnight from October 9th last the new radio station at the Great Lakes Naval Training Station. The Government explanation was that during the manœuvres of the fleet off the Atlantic coast it was possible that messages sent to captains of the ships would be interfered with by activity at the Great Lakes Station.

* * *

A wireless operator at Honolulu, Hawaii, on November 29th last, according to the *Telegraph and Telephone Age*, recently picked up messages transmitted from Nauen, Germany, to Tuckerton, N.J., approximately 9,000 miles away. It is stated that the signals as received were very clear.

* * *

At the annual gathering of Alaskans on November 20th last at the Arctic Club, Seattle, to commemorate the close of the summer season in Alaska, the guests were greatly surprised to discover in the banquet room a complete Marconi wireless system, and during the dinner a message was received direct from the Governor of Alaska. Its arrival was marked by prolonged cheering, and the fact that the message was received over the Marconi system direct from Juneau without being handled by land connections was prominently brought home to all present. A wireless reply was sent to the Governor. The set installed in the banquet room consisted of a ½ kw. quenched gap panel set to which was attached a large antenna on the Smith Building, wherein is situated the Seattle station. Messages were relayed from the high-power station at Astoria.

Company Notes

The Marconi Wireless Telegraph Company of Canada, Limited. Annual Report for the Year ending January 31st, 1915.

THE Directors, in submitting the Annual Report of the company's business, together with a Statement of Accounts for the year ending January 31st, 1915, recorded that during the six months which elapsed before the outbreak of the war the business of the company continued to make normal and satisfactory progress.

The range of the Cape Race station has been greatly increased by the equipment of that important station with steel masts 250 ft. high replacing the 160 ft. wooden spars, and on the return to normal conditions there should be a marked improvement in the earnings of the station.

The establishment of a well-equipped factory in Montreal with excellent shipping facilities has been amply justified, and, despite increasing difficulties in obtaining raw materials, the company has been able to meet all demands. During the year permanent stores and offices have been opened at Toronto, Ont., and Vancouver, B.C.

Message traffic to and from ships, which forms an important source of the company's revenue, and which prior to the war was showing a gratifying increase, has naturally been adversely affected by the severe censorship imposed, the general dislocation of passenger traffic, and the placing of important stations at the disposal of the Government.

It was impossible to fully relate the very important services rendered to the Naval authorities. Calls for assistance have been received almost daily, operators required at short notice for special duty, apparatus for urgent requirements installed practically on demand, and especially powerful installations for new stations supplied in record time. It is a tribute to the company's organisation to record that in no single instance has it failed to fully meet the demands made upon it. In addition the company has had to provide for the loss of trained operators and engineers who have enlisted for active service.

The Directors accordingly submitted appropriate claims to the Naval authorities for compensation in respect of the reduced revenue of the various coast stations as compared with the corresponding period anterior to the war. This matter is still in abeyance, but the Directors have reason to believe that an equitable settlement will be duly arranged.

Practically the whole of the mercantile marine of Canadian and Newfoundland registry has now been equipped with Marconi wireless telegraph apparatus. Towards the close of the year the Newfoundland Government enacted legislation providing for the compulsory wireless equipment of all vessels engaged in the Seal Fishery.

The company's transatlantic service has shown important gains in traffic despite the adverse conditions imposed by the war. The publicity campaign inaugurated by the Board two years ago has made "Marconi" a household word among the cabling public and throughout Canada.

The accounts show that the deficit of $15,335.75 at January 31st, 1914, has been converted into a surplus of $5,727.87.

SHARE MARKET REPORT.

A steady demand for the parent company shares since the declaration of the interim dividend, and the issue of the circular showing the favourable position, has resulted in a steady appreciation of the parent and subsidiary companies' shares.

Latest prices :—Marconi (English) Ordinary, £1 18s. 9d., Preference, £1 15s. 0d.; International Marconi, £1 5s. 0d.; American (on purchases from America), 18s.; Canadian, 7s. 6d.; Spanish and General Wireless Trust, 4s. 9d.

PERSONAL PARAGRAPHS.

Great sympathy will be extended to Mr. and Mrs. Davison, of Muswell Hill, in the loss of their only son, Ronald Arthur Pool Davison. The late gentleman, who was treasurer of the North Middlesex Wireless Club, enlisted at the outbreak of war in the 1/7th Batt. London Regiment, and was killed in action during the great advance on September 25th last. He was a member of the Synchronome Company, Clerkenwell Road, and was much respected amongst his friends and acquaintances.

* * *

We notice amongst the list of saved from the ill-fated H.M.S. *Natal* the following men:

Chapman, F. W., Boy Telegraphist, J.29830 (Ch.).
Fox, H. E., Telegraphist, J.15438 (Ch.).
O'Brien, W. A., Ord. Telegraphist, J.20699 (Ch.).
Paxford, E., Ord. Telegraphist, J.23287 (Ch.).
Pinner, W. H., Boy Telegraphist, J.32686 (Ch.).
Shatford, H. S., Ord. Telegraphist, J.23083 (Ch.).
Thomas, J. E., Telegraphist, J.43503.
Whittaker, G. C., Boy Telegraphist, J.33990.

* * *

In our July, 1915, issue, under the heading "Personal Paragraphs," we made mention of the fact that Lieut.-Commander Hubert Dobell had been taken prisoner by the Germans. By the courtesy of the *Cheltenham Chronicle and Graphic*, we are now enabled to publish a photograph of Lieut.-Commander Dobell in his prison room at the Officers' Camp, Bischopswerver, Saxony. He shares a sitting-room with several other officers (of various nationalities), and the Germans treat them very well.

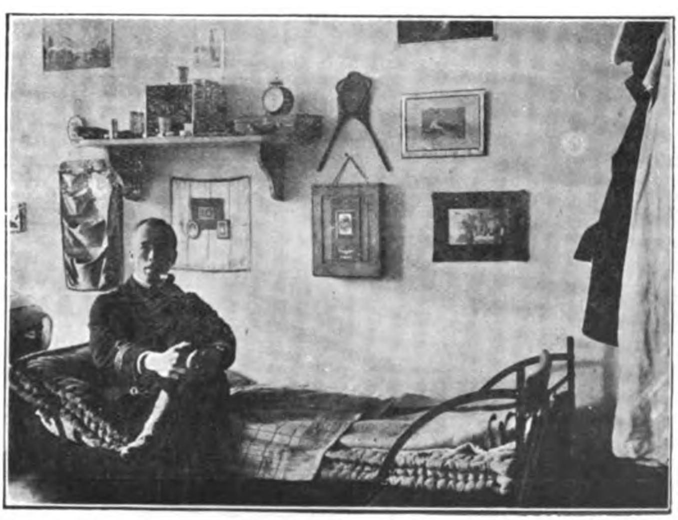
* * *

It is interesting to note that Mr. G. M. Bosworth, who has recently been appointed chairman of the

Capt. Newton.

company entitled the Canadian Pacific Ocean Services, Ltd., which was formed to take over and operate the steamers of the Canadian Pacific Railway and the Allan Line, is a director of the Marconi Wireless Telegraph Company of America.

* * *



Lt.-Commander Dobell in German Camp.

The following letter recently appeared in the *Daily Graphic*, and will, we are sure, draw a response from those of us who know how "tedious and lonely" the evenings may be in a distant wireless station.

"On behalf of the men of "this lonely station on the "outposts of Empire, I would "earnestly ask any of your "readers who have a gramophone and records they could "spare to send it along.

"It would be greatly appreciated here, where amusements are practically nil, and "the long dark evenings very "tedious and lonely. If you "could, sir, kindly appeal for "us in your valued paper, you "would earn the gratitude and "thanks of all here. Thanking "you in anticipation,

"Yours truly,
"W. J. HILLS, W.O., R.N.R."
"Naval Wireless Station,
"Mombasa, Brit. East Africa."

F

Lieut. Balcombe.

We have pleasure in providing this month an excellent portrait of Lieutenant (? now Captain) Balcombe, of whom we recently wrote in these pages. Lieut. Balcombe, our readers will remember, was on the staff of the Traffic Department of Marconi's Wireless Telegraph Company, Ltd., at the outbreak of war, and went to the front immediately hostilities commenced. We also publish a recent photograph of Captain Newton, of whom we wrote in the Christmas number.

* * *

On December 17th last the Lord Mayor of Hull presented the Distinguished Service Medal to Charles Wm. Jeffrey, formerly a wireless operator in the Royal Navy, for meritorious services while mine-sweeping at the Dardanelles. Major-General Ferrier, C.B., officer commanding the Humber defences, was present, and cordially congratulated the recipient.

* * *

Mr. George Maurice Wright has been granted a commission in the Royal Naval Reserve. Sub-Lieut. Wright, who is 25 years of age, held a post in the research department of Marconi's Wireless Telegraph Co., Ltd., at Chelmsford, where he had been for three years.

* * *

We offer our sincere congratulations to Second-Lieut. McEwen, concerning whom a note appeared in these columns in our September issue. We now learn that he is the lucky recipient of the Military Cross.

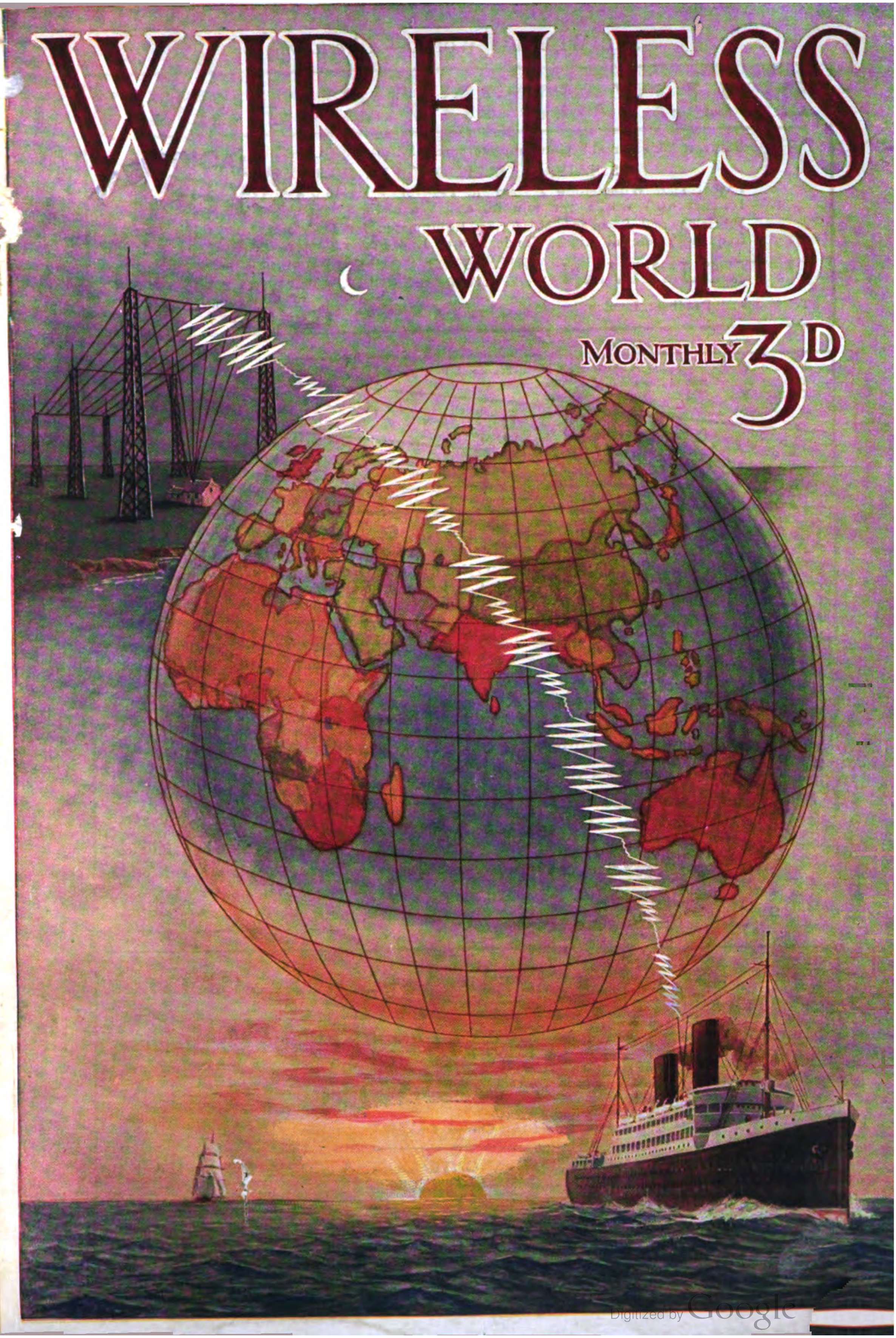
Allusion was made at a recent meeting of the Metropolitan Asylums Board Committee to the fine progress of William Lawson, who was sent to the training ship *Exmouth* by the Camberwell Guardians, and now at 20 has been advanced to the rating of leading wireless telegraphist.

* * *

Sergeant Holehouse, Royal Engineers, attached to the Wireless Section at Worcester, broke his leg in a motor-cycle accident at Worcester recently. He was about to turn a corner, and swerving to avoid one dray, he collided with another.

* * *

We regret to state that Mr. George N. G. Tucker, of the Electrician Printing and Publishing Co., Ltd., passed peacefully away on January 15th last, at his residence, 109, Lordship Road, Stoke Newington, in his 64th year. He was interred at Abney Park Cemetery on Wednesday, January 19th, last.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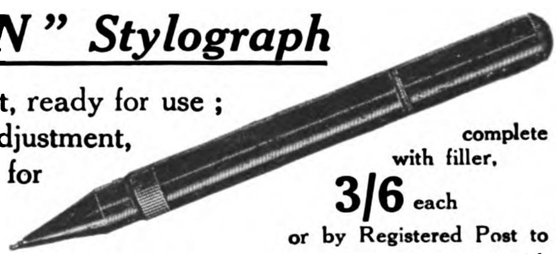


THE WIRELESS WORLD

Vol. 3.—No. 36. (New Series). March, 1916. Subscription 5/0 per annum post free. Price 3d. Post Free 5d.

OUR NEW VOLUME

Some Notes of Progress and a Recommendation.

LAST month we briefly advised our readers that the new volume, which commences with the April issue, will embody a number of alterations, all of which will assuredly commend themselves to our readers. It is not every magazine that finds itself in the position of being able to enlarge its scope under war conditions; yet such is the appreciation shown by our friends that we feel ourselves justified in making the forthcoming substantial increase and improvement.

The outward and visible sign of this extension will strike the eye as soon as the magazine is sighted in shop or bookstall. The new and artistic cover needs but little comment. In former days it was necessary to emphasise the fact that wireless, like Alexander, had set out "to conquer the world." It is now a matter of common knowledge that no portion of the hemispheres is free from the influence of radio-telegraphy, and the globe, therefore, disappears from our cover design.

Notable amongst the innovations will be found additional space devoted to technical articles. This is a point which in the past has been repeatedly urged upon us by readers to whom these sections have appealed. Under former circumstances, in justice to other readers, we were not able to comply with their request. Now the way is open. We are availing ourselves of the present opportunity in a manner which will certainly appeal to the more scientifically inclined of our *clientèle*. We are adding, moreover, in "Operators' Notes," a feature whose title speaks for itself, and whose matter will be found of great practical value.

Instead of a single pictorial account of stations in various parts of the world, each of our issues will contain two. We intend, moreover, to recognise the increasing value of volumes dealing with the various branches and activities of wireless telegraphy, by producing monthly a long article devoted to some one or other of the more important recent publications. This will be additional to our regular feature of "The Library Table."

In order to relieve the monotony of wireless operators at sea, we are introducing a section devoted to Operators' Pastimes, and dealing with such recreations as are suitable under the circumstances. The appeal of such articles should be a wide one, and we shall be glad to hear from readers on any point connected therewith. Mr. Heath Robinson, the world-famous humorous artist, contributes the monthly cartoon for our first issue.

One point which we would commend to *readers' special attention* is that of placing definite standing orders for THE WIRELESS WORLD with their newsagent. This recommendation should not be treated lightly, because, partly owing to the shortage of paper which is affecting every branch of the newspaper and magazine world, and partly owing to our increase in price from 3d. to 6d., we are obliged to make every endeavour to avoid wastage, and any reader who fails to adopt the course we recommend is liable to serious risk of finding himself unable to obtain the magazine.

RT. HON. J. A. PEASE,
P.C., M.P.

Personalities in the Wireless World

THE RIGHT HON. J. A. PEASE, P.C., M.P.

(*Postmaster-General of the United Kingdom.*)

THE appointment of a new Postmaster-General is an event of the greatest importance to the Wireless World, because it means that that sphere of its influence which is known as the United Kingdom will now be under the control of a new Governor, who will have charge of its destinies for good or evil. A moment's thought will impress upon the reader what power and authority the new Minister of the Crown assumes when he takes up his duties as Postmaster-General.

He becomes by nomination Supreme Ruler of a mighty organisation; a network of telegraph and telephone cables stretching to the four corners of the earth is under his control. He holds the threads in his hands. Packet-boats travelling over every section of the high seas are under his command; mail trains are speeding past mountain and valley, over moor and fen, to fulfil his purpose. Again, messages pass and repass like motes in a sunbeam, voice speaks to distant voice; but, over and above all, invisible ether waves are radiating through space carrying inaudible messages to unseen ears. It falls to the Postmaster-General to regulate this complex machinery, which is itself the mainspring of modern existence.

Yet every year this scene increases in grandeur and breadth. For some time wireless telegraphy has subjected illimitable space to its suzerainty, and now wireless telephony can claim a similar privilege. But, after all, to most of us who live in a workaday world and have letters to scribble and posts to catch and telegrams to despatch, little enough time is left for contemplation. We prefer facts to words; therefore we conclude with a biographical sketch of the personality who fulfils the important office.

The new Postmaster-General is a man well fitted for his appointment, for he is in every essential a capable minister and withal a courtly gentleman. He is comparatively young for the important office which he holds; he attained the age of fifty-six on January 17th last. His parliamentary career, if brief, has been far from uneventful. He began as private secretary to Mr. John Morley, and after serving as Junior Whip and then as Chief Liberal Whip (from 1908 to 1910) he entered the Cabinet as Chancellor of the Duchy of Lancaster in 1910.

From 1911 to May, 1915, he ably filled the important office of President of the Board of Education. At the Cabinet crisis in May, 1915, room was not found for him in the newly constituted Coalition Cabinet, and he consequently retired from office. Last June he was granted a political pension of £1,200 a year, and in the following month, at the request of the Army Council he undertook the post of Civil Member (unpaid) on the Claims Commission in France. In consequence he resigned his position on the Cabinet Committee for the Prevention and Relief of Distress and the Chairmanship of the Professional Classes Sub-Committee.

He was responsible for the introduction of an Education Bill in the closing days of the 1913 session. Mr. Pease is a member of the well-known Yorkshire family, and a Director of Pease and Partners, Ltd. He represents in Parliament the Rotherham division of the West Riding of Yorkshire in the Liberal interest. In his earlier days he was a master of draghounds and beagles, was captain of his county cricketing eleven (Durham) for several years, and an all-round sportsman. It is interesting to note that Mr. Pike Pease, Assistant Postmaster-General, is a cousin of the new Minister, and will retain his post.

The Special Problems of Aircraft Wireless—IV.

By H. M. DOWSETT, M.I.E.E.

Aircraft Balancing Capacities.
Airships—(continued).

"SEMI-RIGID" and "non-rigid" airships, as will be seen from the illustrations given below, must of necessity have balancing capacities of less simple form than those already dealt with; consequently it becomes more difficult to calculate their actual capacity values, and more reliance must be placed on measurement.

Fig. 1, for instance, is an outline sketch of *La Patrie*—unfortunately lost in the North Sea—a vessel of the improved Lebaudy type, which may be considered fairly typical of the semi-rigid class. It was similar to, but smaller than, the vessels *La République* and *La Liberté*.

A rigid frame, *FF*, forming a flat plane, was built into the lower part of the body of the balloon, and from this the car was supported. Under the frame was a strengthening girder, *H*. The frame and girder were both covered with rubber fabric, and extensions of both were carried well towards the rear of the balloon, the whole construction forming two "stabilisating planes," one horizontal and one vertical. The extensions

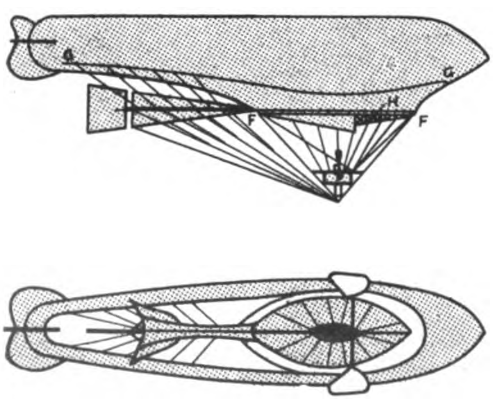


Fig. 1. The Semi-Rigid Dirigible, "La Patrie."

obtained their support from wire suspensions, terminating in "goose-feet" of hemp fastened to boxwood stakes, which were enclosed in the girth *GG* sewn into the balloon fabric.

The *Gross* airship has similar stabilisating planes extending almost the whole length of the balloon, but they are not built into the envelope; instead, they are made semi-rigid with the balloon by means of triangulated wire bracing to the longitudinal girths.

It is the wire suspensions, the metal frames of the fixed stabilisating planes, the aluminium or tubular steel strengthening girder, that the wireless engineer must make use of for his balancing capacity. If the plane frames are metal it is clear from what has already been said * that it is not worth while to metalise completely the planes as the additional gain in capacity is relatively small.

In many cases the frames of the planes, and in the smaller airships especially, the main frame and strengthening girder are not constructed of metal, but of bamboo, ash, or other suitable woods, and only the wire suspensions, properly adapted for the purpose so as to avoid the danger of high-tension corona effects, can be used. The maximum capacity obtainable in this way may be too small to give satisfactory results, and it has been found advisable on vessels of the *République* type to add to the capacity by spanning additional wires to the top of the balloon.

In the *Clément-Bayard*, Fig. 2, one of the most successful of the non-rigid airships, the wireless engineer finds a system of wire suspension and stiffening girder which lends itself more readily to form a useful balancing capacity than any other example of the semi-rigid or non-rigid types. Also the simple geometrical shape of the system sug-

* WIRELESS WORLD, February, 1916.

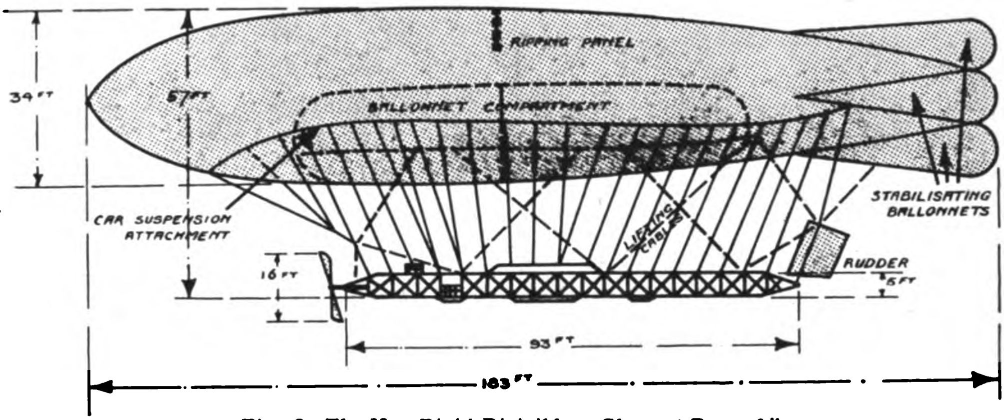


Fig. 2. The Non-Rigid Dirigible, "Clement-Bayard."

gests that its capacity value can be calculated.

The car consists of a cubular lattice frame of steel tubing 93 feet long, the sides of the cube being 5 feet, and the tubes 1·2 inch and 1·6 inch diameter. Wire diagonals fitted with stretchers maintain the rigidity of the structure. This frame, suitably insulated from the steel suspension and lifting cables, has been used as a balancing capacity. If it is treated as an ellipsoid of revolution it is a simple matter to calculate what its value should be in free space, making allowance for the wire diagonals as being equivalent to two additional wires on each of the four sides of the frame and parallel to the length.*

The calculated capacity of a sheet metal ellipsoid of the dimensions given is 414·2 cms.

The ratio of "length/mean distance apart" of all the longitudinal members —tubes, and equivalent wires—is 56 : 1, so that the above value is about 14 per cent. high—see curve, Fig. 3—and the actual value will be about 356 cms., quite a low figure.

Obviously a much larger capacity could be obtained by including as great a length of the suspension cables as possible. These cables are of stranded steel, three threads to each strand, some 3 mms. others 4 mms. in diameter. Can we estimate the full amount of capacity obtainable in this way ?

The shape and dimensions of the system are shown approximately in Fig. 4. The steel lifting cables, being inside and fairly close to the suspension cables, can add little to the total capacity, and so are omitted. Suppose we assume the suspensions to be attached to the *bottom* of the car frame so as to enclose and electrically screen it, then the amount the frame will add to the total capacity will also be small.

To further simplify the problem, assume that the two suspension girths are parallel, and at a distance apart equal to their actual mean distance.

Also that the suspension cables run right up to the girths instead of being attached to them by hemp goose-feet, and are parallel, the end cables being separated a distance equal to the mean of AB and CD, Fig. 4. We shall then obtain a V-shaped wire frame dimensioned somewhat as shown in Fig. 5.

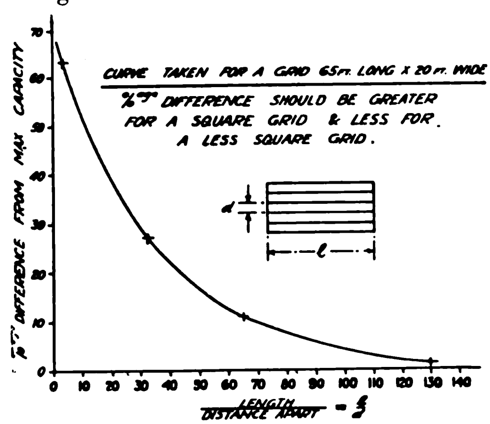


Fig. 3. Curve showing the approximate percentage difference between the capacity of a rectangular area of sheet metal, and a parallel wire grid of the same shape and area, for different values of l/d.

* WIRELESS WORLD, February, 1915.

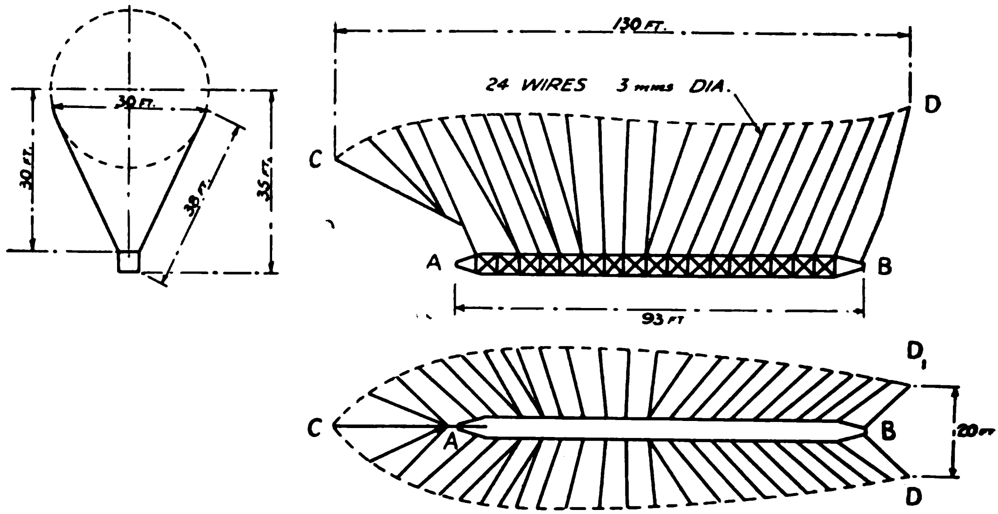


Fig. 4. Suspension System and Car of the "Clement-Bayard."

To calculate its capacity we can treat it as two grids, the wires of which are transverse to the length instead of parallel to it, the more usual case, and which are inclined to each other at a definite angle.

Professor Howe's formula,* which we have already found applicable when the wires are parallel to the longer dimension of the grid, cannot be used in this case. An inspection of it shows that when the distance between the wires is greater than their individual length it cannot be accurate, as the principal term in the denominator "log l/d" then has a negative value, which represents a decrease of potential, due to the influence of the wires on each other, equivalent to an *increase* of capacity per unit length of wire—instead of a *decrease*.

The writer was interested to know at what ratio of "l/d" the denominator vanished altogether and thus gave an infinite value for the capacity.

For grids of both 24 wires and 42 wires this occurs when the width is about 3·7 times the length.

As no safe working formula has been put forward up to the present which is applicable to the type of grid described,† it becomes useful to know the limit of application of the Howe formula, and, taking this into account, to see whether its range cannot be extended by some suitable method so as to include this type of grid also. What accuracy has the formula when applied, for instance, to a grid of width equal to its length?

This case can be tested, for we can compare the capacity of a thin circular disc of a given area, calculated from the well-known rule "C=diameter in cms./π," with the capacity of a square of sheet metal of the same area calculated from the Howe formula for a square wire grid, and corrected for sheet metal in the usual way by the aid of curve, Fig. 3. The two values should not be substantially different.

Suppose the disc to have the area of a section through a 40,000 cubic foot balloon—to keep to a dimension already familiar in these articles—and therefore to have a diameter of 42·5 feet. We will assume that its thickness is ·084 inch, which is equivalent to that of 7/22 S.W.G. copper wire.

The ratio of "diameter of disc/thickness" will then be 6080 : 1, which is large enough

* $$C=\frac{nl}{2[n\{\log_e(l/d+\sqrt{l^2/d^2+1})-\sqrt{1+d^2/l^2}+d/l\}+\log_e d/r-B]}.$$

† The theory of the capacity of parallel wires relative to the earth has been studied by: A. Russell, *The Theory of Alternating Currents*, vol. 1, 1914; L. Cohen, *Electrician*, February 14th and 21st, 1913; P. O. Pedersen, *Jahrbuch der Drahtlosen Telegraphie, etc.*, Band. 7, Heft. 4, 1913; and a collection of useful formulæ is given by: W. H. Eccles, *Wireless Telegraphy and Telephony*, 1915. But the capacity in free space of a grid of parallel wires of equal length, having a greater distance between the outside wires than their individual length, does not appear to have yet been worked out.

for us safely to assume that the capacity due to the thickness compared with the total capacity will be negligible. The capacity of the disc works out as 412·4 cms.* A square grid of the same area as the disc will have a side of 37·6 feet.

Let this grid be made up of 42 equally spaced wires of 7/22 S.W.G.; then they will be ·92 feet apart.

The ratio " l/d " will be 41 : 1, and therefore the capacity found will be at least 22 per cent. less than the capacity of a square of sheet metal of the same area and thickness—see curve, Fig. 3. The capacity of the grid works out as 449 cms.; adding 22 per cent. increases this value to 548 cms., which is 33 per cent. greater than the calculated capacity of the circular disc.

If, then, the formula for a disc is to be accepted as correct, the case of a square wire grid can be taken as the limit of application for the Howe formula when used with a correcting factor of 33 per cent.

The writer proposes to make this a basis from which to obtain an approximation to the capacity of the grid in Fig. 5.

First consider the part *ACDB* by itself. A section through its field is shown in Fig. 6. It divides clearly into two distinct parts: a part (A) which is nearly parallel, denser towards the ends than at the middle, and a part ($B1+B2$) which is radial. The field ($B1+B2$) is common to grids of all widths, and approximates to that of a single wire in free space. The part (A) can be calculated in sections, and, provided the width of each section is about the same as the length, or greater, the error in adding their values plus the capacity of a single wire to obtain the capacity of the whole is only small.†

The grid *ACDB* is composed of 24 wires 4·82 feet apart. To assist calculation

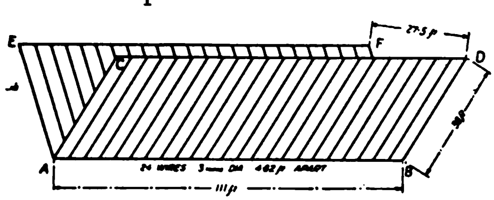


Fig. 5.

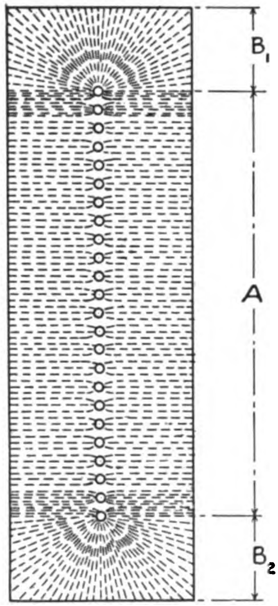


Fig. 6. Section through Grid ACDB at right angles to the wires, showing electrostatic field.

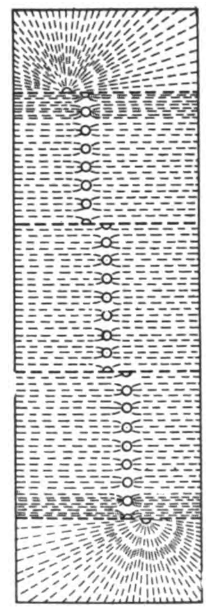


Fig. 7. The Grid and Field in Fig. 6. split up into sections for the purpose of calculation.

assume there are 25 wires spaced 4·62 feet apart, the overall width of 111 feet thus remaining the same. Fig. 7 shows this grid divided into three equal sections, the divisions between the sections cutting through the wires and thus equally dividing the field; the outside half wires which account for the radial field being also shown.

Then to calculate the value of one of these (A) sections use the Howe formula with correcting factor, for a grid 38 feet long and 37 feet wide, made up of nine 3-mm. wires spaced 4·62 feet apart, and subtract from it the capacity of one 38-foot wire. Thus:

	cms.
Capacity of one (A) section by formula	325·7
Less 33 per cent...	107·4
Less capacity of one single 38-foot wire	67·1
Total for one (A) section ..	151·2
Total for three (A) sections ..	453·6
Three (A) sections plus capacity of one 38-foot wire	=520·7

which gives the approximate capacity of grid *ACDB*.

* This value is as much as 63·7 per cent. of the capacity of a metalised balloon of the same diameter.

† The error consists in the omission of a correction for the increase of potential on each section due to the presence of the others.

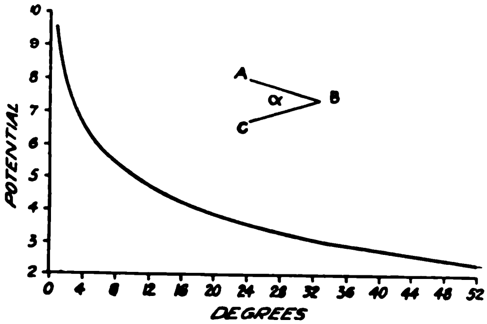


Fig. 8. Average Potential on AB due to Unit Charge per Centimetre on BC.

Finally, to obtain the complete capacity of the V-shaped grid make use of the curve Fig. 8, which corresponds to Fig. 28 in Professor Howe's paper.* This curve gives the average potential on one wire due to a uniformly distributed charge of one unit per centimetre on another wire inclined to it at any given angle, and should also be applicable to the case of two inclined similar grids.

The potential on the grid *ACDB* can be obtained from the expression for the capacity $C=Q/V=ln/V$, where V is the average potential on all the wires in the grid due to a uniformly distributed charge of one unit per centimetre length.

Then $V=ln/C=1{,}158$ cms. $\times 25/520{\cdot}7=55{\cdot}6$ units. For two grids inclined to each other at an angle of 42° 28′ this potential should be increased according to the curve by 2·65 units. Then the capacity of the two grids forming the V will be

$$\frac{2\times 1158\times 25}{55{\cdot}6+2{\cdot}65}=994 \text{ cms.}$$

Another leading type of non-rigid airship is the *Parseval*, illustrated in Fig. 9. As far as it is generally known the largest vessel of this kind has a length of 240 feet, a diameter of 40 feet, and a car 30 feet × 6 feet of aluminium tube and wood, supported on rollers by the main vertical cables, *AB* and *CD*, and oblique cables, *EFG*, on each side of the balloon, all of half-inch steel, with manilla rope attachments to the suspension girths. Only some of the intermediate suspensions are shown in Fig. 9. The cable available as balancing capacity would be the part below *EHACKG*.

Further details of dimensions are not available, but it may be fairly assumed that a vessel of the size mentioned above will not have its car more than 30 feet below the balloon, as, for reasons of speed and control, the shorter the suspension the better. Then the oblique cable, *EFG*, will be about 200 feet.

Where there is great disparity in the lengths of the individual wires composing the balancing capacity—as there must be in the present instance—there is clearly a gain if all the extreme ends of the wires are connected together. Thus *EHACKG* should all be joined by wire. The capacity of such a system in free space—consisting of two grids roughly triangular in shape, each with,

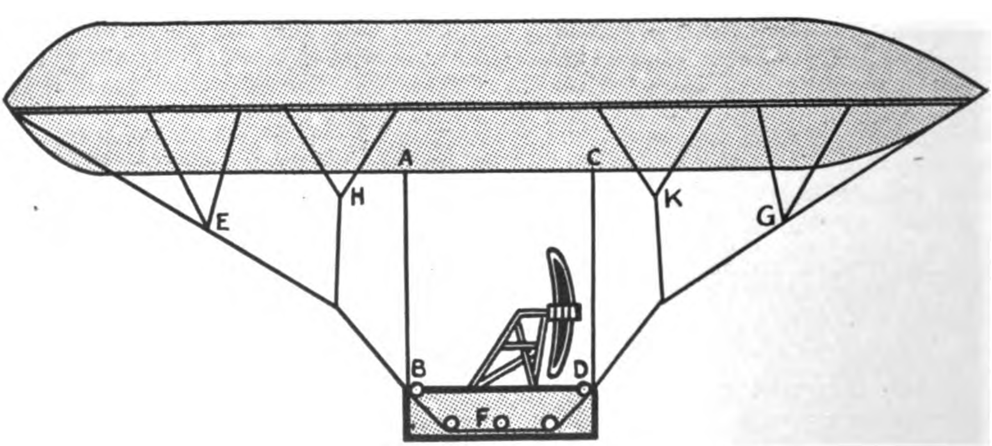


Fig. 9. The Non-Rigid Dirigible "Parseval."

* WIRELESS WORLD, January, 1915.

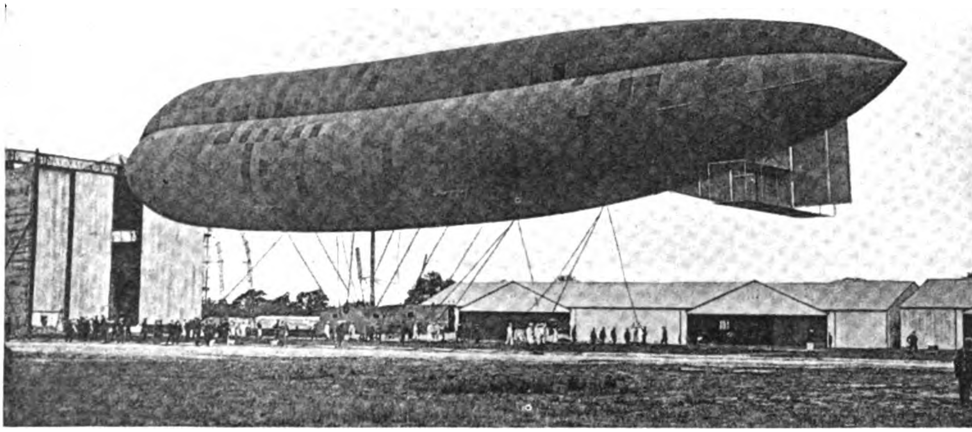


Fig. 10. The Non-Rigid Dirigible "Astra-Torres."

say, six intermediate suspension wires, and inclined to each other at the car at an angle of about 47°—will be of the order 540 cms.

This general review of the conditions obtaining among airships which determine the character of the balancing capacities used would not be complete without a reference to the non-rigid airship *Astra-Torres*, Fig. 10. The big step forward which this type illustrates introduces an important new problem to the radio engineer, or rather reintroduces an old problem in a new form.

It is estimated that air friction on the wire and rope rigging of the *Parseval* is responsible for the reduction of this vessel's speed by about 60 per cent. The *Torres* invention aims at diminishing air friction on the suspension system to a minimum. It does this by supporting the suspension *inside* the balloon instead of outside. A section of the gas bag is shown in Fig. 11. The envelope, *AAA*, forms three semi-cylindrical bags joined together on a triangular support of cloth bands, *BBB*. The suspensions, *CC*, are attached to the two top angles of the triangle, and end in a ring connection to a single cable which emerges through a special accordion sleeve in the lower wall of the envelope, and forms one of the supports of the car, or cars—two being sometimes used in tandem. The only external metal work available as balancing capacity is the frame of the car, the part of the suspension system outside the gas-bag after it has been effectively insulated from the inside part, and perhaps a few short steady stays, in all an amount not enough to be of much practical use. If the capacity were to be increased by long wires hung from insulators on the outside of the envelope they would introduce additional air friction,

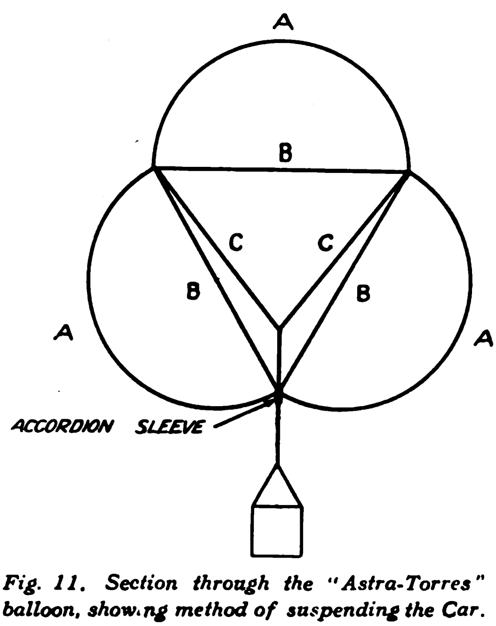


Fig. 11. Section through the "Astra-Torres" balloon, showing method of suspending the Car.

and part of the advantage of the inside suspension would thereby be lost.

The case is one which suggests that the requirements of wireless could best be met by a capacity system, arranged, if possible, *inside* the gas-bag. This brings us face to face again with the problem of the safe use of a charged wire in an explosive gas, a problem similar to that presented by the *Zeppelin*, which uses the metal frame of its balloon as a balancing capacity, and does so apparently with reasonable safety.

The danger of explosion due to brush discharge and the tendency which the brush has to burn the wire supports without creating an immediate explosion would both have to be seriously considered; but there is no longer any doubt that with our present knowledge it should be possible to design a satisfactory internal capacity system for the *Astra-Torres*, which would carry with it no greater risk of fire than that which exists at present on the *Zeppelin*.

The special features of such a design will be discussed later under a more convenient heading.

(*To be continued.*)

BACK FROM EXILE.

Wireless Operator and Meteorological Expert Recalled.

THE auxiliary brigantine *Rachel Cohen* recently arrived at Sydney, says a special message to the *New Zealand Times* (Wellington), after a smart trip of six days from Macquarie Island. She brought over as passengers the wireless operator (Mr. F. J. Henderson), meteorological officer (Mr. A. C. Tulloch), and cook (Mr. Ferguson). The wireless station has been closed on account of the expense of upkeep.

Messrs. Tulloch and Henderson, interviewed on arrival, said that they were tired of sea-lion tongue, Maori hens, penguins, and penguins' eggs, and were looking forward to a good square " tuck in " on civilised fare after their two years' solitude.

Mr. Tulloch mentioned that subsidies for the wireless station amounted to £1,500, made up of £1,000 from the Commonwealth and £500 from New Zealand. The arrangement was for a term of three years, dating from 1912. The Commonwealth Government has decided to economise, and so the station was closed. The value of the station for meteorological and weather reports was greater than most people imagined. The prevailing wind was south-west, and it had a west-to-east velocity of 400 miles a day. That is to say, New Zealand, being approximately 600 miles distant, an approaching storm would take one and a half days to reach New Zealand (from the Macquaries), and so the Macquarie Island station could give the Dominion at least 36 hours' warning of an approaching storm. The same thing applied to Australia. Melbourne was 1,200 miles distant, and so could receive three days' warning.

Mr. Henderson said the wireless station had worked successfully throughout his territory. They were frequently in communication with Awanui (Auckland), at a radius of 1,500 miles, and with Wellington, Bluff, and the Chathams. By some freak of wireless they were sometimes able to speak with the Chatham Islands station while unable to call up Wellington or other stations. That was all the more remarkable because the Chathams station was much lower-powered. They had been unsuccessful in getting into communication with Shackleton's expedition; nor had they even heard a word from them, although the *Aurora* was lying in M'Murdo Sound—Scott's old quarters. It was only a radius of 1,000 miles, and they were surprised that they could not get a response. The expedition's other vessel (the *Endurance*) was in the Weddel Sea, but she was separated by a 10,000 to 12,000 feet range of mountains, and there was less chance of reaching the *Endurance* than the *Aurora*. No doubt the Falklands Island station would have a better chance of communication.

Mr. Henderson mentioned that the wireless station at Macquarie Island was considerably above sea level, and for convenience in heavy weather he had installed a small receiving station at Eastern Harbour, the timber for which he salvaged from the wrecked schooner *Clyde*. Although not able to transmit with it he was able to receive calls when it was perhaps impossible to get up the hill to the main station.

Digest of Wireless Literature

ABSTRACTS OF IMPORTANT ORIGINAL ARTICLES DEALING WITH WIRELESS TELEGRAPHY AND COMMUNICATIONS READ BEFORE SCIENTIFIC SOCIETIES.

WIRELESS AND BOMB EXPLODING

The *Wireless Age*, in an article entitled "Those Wireless Bomb-exploding Devices," says that it is just possible that gullible newspapers and pseudo-scientific journals will now drop a certain type of story which has been appearing with regularity on an average of once a month over a period of some three years. A story referred to is that an inventor has perfected a death-dealing machine which can sink battleships and blow up impregnable fortresses from a distance by the aid of a wireless spark.

No less an authority than Dr. Edouard Branly says what those self-confessed inventors purpose doing is an impossibility. And for those who do not know Dr. Branly it may be mentioned that he is the inventor of the coherer, which was so prominent a feature in early wireless telegraph apparatus. Besides this, Dr. Branly has the degrees of Doctor of Physical Science and Doctor of Medicine; he received for his exhibit of radio conductors the *grand prix* awarded by the International Jury of Superior Precept Instruction, and the order, Chevalier of the Legion of Honour, for his valued aid in the discovery of wireless telegraphy. Many other French honours have come to Dr. Branly in the 71 years of his lifetime.

"The human species," says Dr. Branly, "is paying a sufficiently large tribute to science in this war; it is scarcely worth while to discuss the visionary powers that are attributed to it. The false notion of those who pretend to transmit destructive power through space arises from the fact that wireless telegraphy is accomplished through the production of a minuscule spark at the receiving station. That spark being sufficient to produce an effect upon extremely sensitive instruments at a great distance, they conclude that at a limited distance a much stronger spark could be produced; as that spark is supposed to go through all sorts of obstacles, they inferred that it could also pierce the steel shell of engines of war. In the first place no available power could produce a spark of sufficient intensity; there isn't the slightest calorific power in the wireless spark at the receiving end. In the second place it would be necessary for it to strike with absolute precision a joint or fissure in the plates in order to get into contact with the explosive. Different accidents erroneously attributed to the wireless current may have put some of these visionaries on this track.

"The Eiffel Tower wireless transmitting station produces most formidable sparks, yet not the slightest accident has been caused in the vicinity. To produce explosions at a distance something different from wireless electric currents must be found. Most of the inventions for this purpose that have come to my notice when thoroughly investigated were found to be connected with concealed clockwork, and in no case where powder was brought in by disinterested parties were they able to provoke an explosion."

* * *

ELECTRICAL WORK OF THE BUREAU OF STANDARDS

The *Electrical World* prints in a recent issue a valuable article from the pen of Mr. F. Nicholas on the above subject. It is headed by the following statement made by Secretary Redfield:—

"The Bureau of Standards works in close harmony with the great technical and engineering societies of the country (U.S.A.), and with the practical engineers who in many lines of applied science are doing the work of the country. It studies the problems of chemistry and electricity and operates a varied and mechanical plant working out the problems which vex the industrial manager. Its domain is the scientific world, but it does not enter fields which can be covered effectively by private laboratories. It is a stimulus to the establishment of industrial research laboratories, and it helps our industries to be more scientific."

This statement of the aims of the Bureau of Standards should interest many who are concerned with the establishment of a proper scientific organisation for fostering British trade. The article then proceeds to give an account of the researches which have been carried out in the past and outlines the work being performed at the present time. Dealing with radio research work the author says that the European war has stimulated this branch of the work of the bureau, part of which is conducted in conjunction with the Army and Navy Departments. In general, however, the investigations of the bureau are directed chiefly towards measures to promote the safety of life at sea and the safety of navigation. Small radio outfits have been designed for lighthouse tenders. The bureau is engaged on plans for the design and installation of radio fog-signalling apparatus at lighthouses on important coasts. Similarly the bureau is urging the equipment of lightships with radio apparatus. One of the contributions to the art of radio communication made by the radio section of the electrical division is the decremeter, which was invented after the passage of the radio navigation law to provide a simple means of measuring directly the logarithmic decrement of wave-lengths.

Among the investigations now under way or completed during last year we find radio communication, radio interference, and design of inductance coils for wireless work.

* * *

HIGH SPEED GENERATORS

Considerable attention has been devoted in recent years to the construction of high-frequency alternators for use in wireless telegraphy, with the result that a number of such machines, more or less practical, have been brought before the scientific public. One of the earliest was constructed by Professor Fessenden, and enabled him to conduct some successful experiments in wireless telephony. By far the most ingenious of such machines is that due to Professor Goldschmidt, the patents for which were acquired by the Marconi Company two or three years ago.

All high-frequency generators require to be driven at a very high speed, and because of this present a number of difficulties in construction, particularly in high-powered machines where the rotor is of considerable weight. A paper recently read before the Institution of Electrical Engineers by Professor A. B. Field deals with some of the difficulties experienced in the design of high-speed generators, and, although the paper does not devote itself to the type of generator used for producing high-frequency currents for wireless telegraphy, it nevertheless contains matter of interest to those who are interested in such machines.

An illustration of the process of evolution, says the writer, may be found in the development of steam turbo-generators. In early days the limitation of speeds imposed by the generator design acted somewhat as a handicap in the rapid development of the turbine, but recent years have witnessed a concurrent development of both turbine and generator, with the raising of the speeds of the combined sets to the limits corresponding to a 2-pole and 4-pole design. Simultaneously the output per machine has been greatly raised.

In attaining these results many difficulties have been overcome in as many different ways. Speaking of a certain 20,000 kw. 3-phase machine, the writer points out that the design of such a machine represents to a greater degree than is usually the case a compromise between many conflicting mechanical and electrical requirements. Viewed in a general way, there is first the problem of constructing a rotor which must necessarily weigh something of the order of 60,000 lb., and which will be running with a peripheral speed in the neighbourhood of 24,000 ft. per minute. Such a rotor, unfortunately, must be of the nature of a cage, being irregularly cut into from the periphery and carrying much metal which is not self-supporting. The centrifugal force acting upon a 1-lb. mass at the periphery will be about 1 ton.

Dealing with the question of critical speed of the rotor, Professor Field stated that, while many large rotors are running satisfactorily at operating speeds above their critical speeds, it is believed that there is a distinct advantage in keeping the critical speed above the running speed, when this is feasible.

"The Home of the Blizzard" *

An Interesting Account of Wireless Telegraphy and its Uses in Polar Exploration.

THE inherent curiosity which exists in man has made itself apparent from the earliest ages. The desire for knowledge eclipses every other trait in human character. The ancient Phœnicians with their lust for wealth voyaged westward through the Mediterranean, even passing beyond the Pillars of Hercules, the supposed westernmost limit of the then known world. Historians inform us that records exist proving that these people actually traded with the old Celts, who inhabited the county of Cornwall.

Down through the ages the peoples living in the countries bordering on the Mediterranean Sea developed a keen taste for discovery and exploration; this became very marked during the Middle Ages, and we read with thrilling excitement the exploits of such adventurers as Vasco da Gama, Christopher Columbus, and Prince Henry the Navigator.

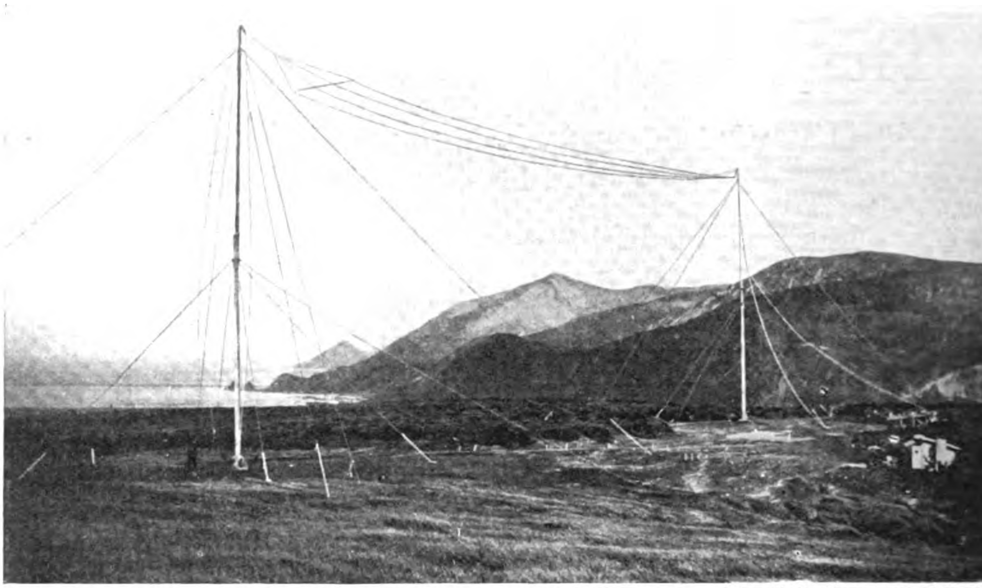
As time went on and men's knowledge of the world increased, it was only to be expected that further efforts should be made to visit hitherto untravelled regions. About the beginning of last century these comprised roughly the interiors of the four extra European continents and the North and South Polar regions. How entrancingly interesting is the perusal of the pages of a book such as that under review can only be learnt by experience.

[From "The Home of the Blizzard."
The Wireless Cabin at Macquarie Island.

Until within the last ten or twenty years Polar exploration had been confined almost entirely to the districts which encircle the North Pole, but within this period the vast icy wastes of Antarctica have received their due meed of attention.

All our readers are familiar with the gallant deeds of the late Captain Scott and his worthy companions, whose undying fame and imperishable memory will go down to the end of all time. He only missed discovering the South Pole by a few months, the palm of honour in this connection going to the intrepid Norwegian explorer, Captain Amundsen. But the writer of *The Home of the Blizzard*, Sir Douglas Mawson, did not thirst for fame; his expedition to the Antarctic was rather in the nature of geographical and scientific exploration of the lands reputed to surround the Southern Pole. In order to treat the business from a thoroughly practical point of view, Dr. Mawson spared himself no pains in putting the venture on a proper basis. His *modus operandi* was to tackle the situation from Tasmania. Nearly 1,000 miles south of Hobart and about half-way between that port and the nearest Antarctic land lies the wind-swept and cheerless Macquarie Island. It forms the abode of quantities of seals and many millions of penguins, and serves as an admirable base for the whaling expeditions which frequent those seas. Its utility as a species of halfway house evidently did not escape the attention of Sir Douglas, and his choice of it was proved by experience to be a wise one. The inestimable benefits which wireless telegraphy has conferred upon mankind were not overlooked by the enthusiastic explorer, and he established a fully equipped wireless station on the island, leaving a party

* "*The Home of the Blizzard*," by Sir Douglas Mawson, D.Sc., B.E. 2 vols. London: Wm. Heinemann. 36s. per vol. in Great Britain and Ireland.



[From "The Home of the Blizzard."

The masts and aerials of the Wireless Station at Macquarie Island, which was used by the explorers as an intermediary for communicating with Hobart, nearly 2,000 miles from Antarctica.

of men in permanent occupation. It was his intention to set up one or more radio-telegraphic depots on the Antarctic Continent, and thus keep in touch with the civilised world almost continuously. The wireless cabin at Macquarie Island was erected on the top of the hill which was subsequently known as Wireless Hill. It would have been

[Photograph: Underwood.

The kind of "country" the explorers had to negotiate in their travels over the Southern Antarctic Continent.

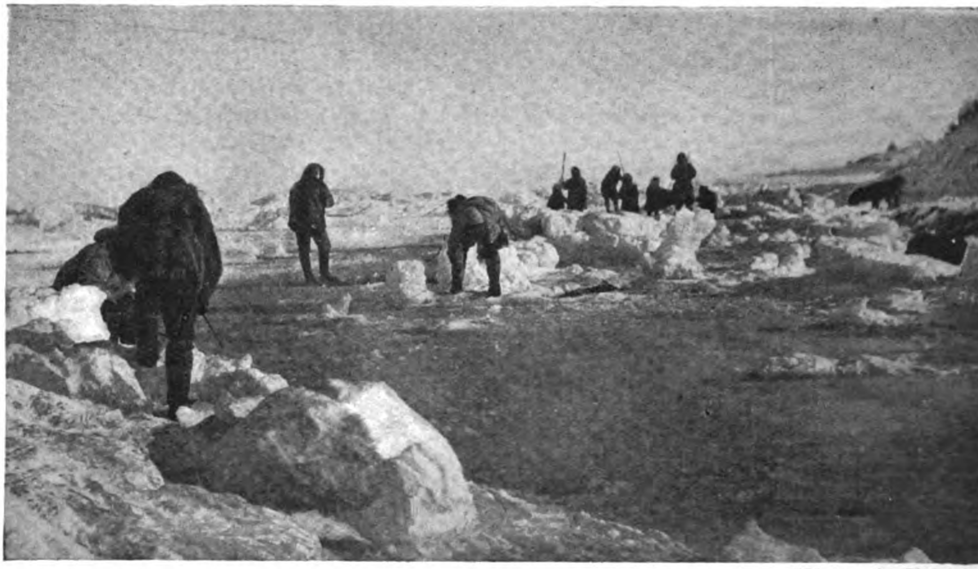
much handier in connection with the landing of material, and afterwards in operating the installation, had the plant been set up on the beach close to the living hut. But the free outlook and increased electrical potential far outweighed these advantages. Sir Douglas mentions that the ground at the hill-top situation proved to be peaty and sodden, and therefore a good conductor, thus presenting an excellent "earth" from the wireless standpoint. The transportation of the heavy masts, petrol engine, dynamo, induction-generator, and other miscellaneous gear, from the beach to the summit—a vertical height of 300 feet—formed no light task. With the good will of his comrades and their dexterous help, all this work was successfully accomplished. After the party which was to stay on the island had been landed, the wireless installation set up, huts constructed, and everything put in shipshape order, the rest of the band re-embarked and proceeded south on their scientific quest, the while making oceanographical investigations.

On arrival in the region of snow and ice the ship party split into two sections, the Main Base Party, and the Western Base Party. During the whole time the Expedition was in the Antarctic a very close watch was kept on auroral phenomena, with interesting results, especially in their relation to the "permeability" of the ether to wireless waves.

That the utility of the wireless installations was realised to the full by the explorer and his companions is evident from the fact that the first thing undertaken by them on arrival at any particular point was to set up the apparatus. In connection with wireless telegraphy in Polar regions it should be borne in mind that during the summer months wireless communication with the outside world is impossible owing to continuous daylight, this reducing the effective range. In summer the range was only a few hundred miles, and the effective working distance for all times of the day probably did not exceed 100 miles. One contingency with which the explorers had to contend was the difficulty of staying the wireless mast strongly enough to support it during the terrible gales and blizzards which frequently swoop down with tremendous force. The wireless experts, however, were fully alive to this position and in consequence,

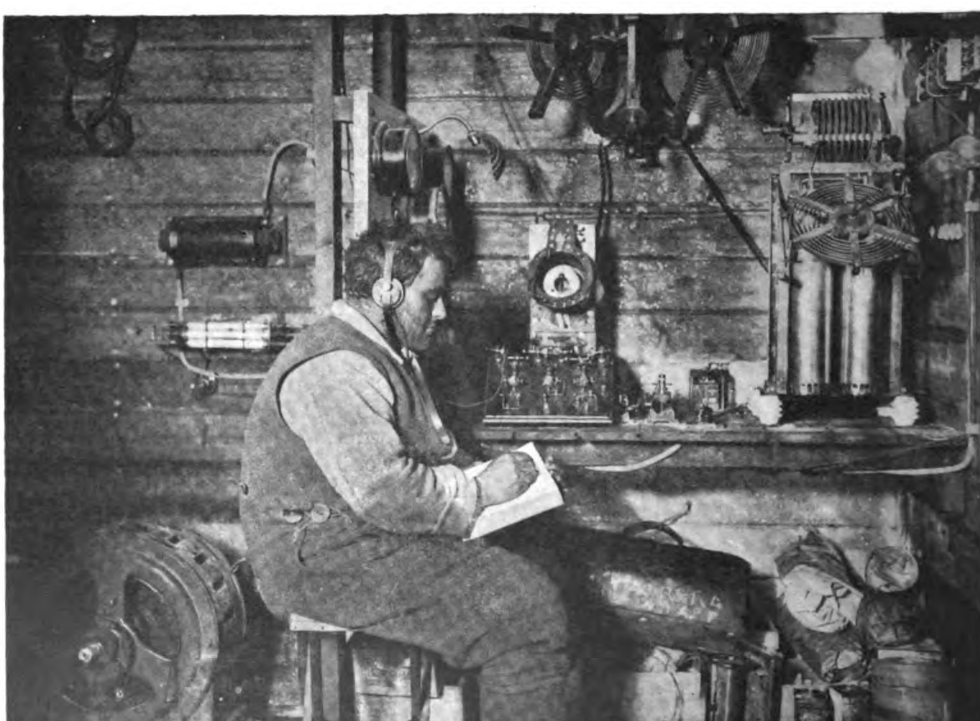
[*From "The Home of the Blizzard."*

Wireless Hill in the storm-swept Macquarie Island, shewing general view of the Wireless Station on the abrupt promontory situated at the north of the island.



[Photograph : Underwood.

Explorers prospecting for a favourable place at which to erect the mast of their Wireless Station which was to keep them in touch with the outside world



[From "The Home of the Blizzard."

A member of the expedition receiving time signals from Hobart, Tasmania, which allowed the explorers to calculate with more precision their exact longitude.

therefore, very few untoward incidents occurred.

During the course of the second winter—to be precise, on the night of Febuary 15th—one of the members of the party stationed on the Antarctic Continent suddenly surprised his companions with the exciting intelligence that he had heard Macquarie Island sending a wireless coded weather report to Hobart. The engine was immediately set going, but though repeated attempts were made no answer could be elicited. Each night the darkness became more pronounced and signals were consequently easier until, on the 20th, the call reached Macquarie Island, which immediately responded by saying "Good evening." At this point the insulation of a Leyden jar broke down and nothing more could be done until it was remedied. Later signals were again exchanged and a message was despatched to Lord Denman, Governor-General of the Commonwealth of Australia, acquainting him with the situation of the party and other matters, and through him a message was sent to H.M. the King, requesting the latter's royal permission to name a tract of newly-discovered country King George the Fifth Land.

Wireless communication in one instance was found to be exceedingly difficult owing to the month being very "disturbed," in consequence possibly of the brilliant auroræ.

Radio-telegraphy was used very successfully in the reception of time signals from Melbourne Observatory by way of Macquarie Island, and the meteorologist was thus able to attempt to establish a fundamental longitude.

The two complete sets of wireless apparatus used by the expedition were purchased from the Australasian Wireless Company, and they proved thoroughly satisfactory.

Among the Wireless Societies

Institute of Radio Engineers.

RESULTS OF THE ELECTION OF OFFICERS FOR 1916.—President, Prof. A. E. Kennelly; Vice-President, John L. Hogan, junr.; Treasurer, Warren F. Hubley; Secretary, David Sarnoff; Managers (serving until January 2nd, 1918), Louis W. Austin and John Hays Hammond; (serving until January 3rd, 1917), Robert H. Marriott and Guy Hill; (serving until January 1st, 1919), Edwin H. Armstrong and Capt. W. H. G. Bullard; (serving until January 3rd, 1917), Lloyd Espenschied, John Stone Stone and Roy A. Weagant; Editor of Publications, Prof. Alfred N. Goldsmith; Advertising Manager, Louis G. Pacent.

A very interesting paper was presented by Prof. A. Hoyt Taylor on "Variations in "Nocturnal Transmission," by Prof. A. Hoyt Taylor and Mr. A. S. Blatterman, at the meeting of the Institute, held at Columbia University, on January 5th, 1916.

A discussion followed, and amongst those discussing the paper were Capt. W. H. G. Bullard, head of the United States Naval Radio Service, and Mr. V. Ford Greaves, of the Department of Commerce.

After the meeting at Columbia University, the new Board of Direction for 1916 met at the Holland House, where the three additional directors to serve on the Board for 1916 were appointed, and a general discussion held as to the best methods by which to increase the activities of the Institute, which has shown remarkable progress during the year just ended.

WIRELESS AMATEURS IN HOLLAND.

We understand that a movement is on foot to start a wireless society for Dutch amateurs. There are a large number of keen wireless amateur enthusiasts in Holland, and there should be no difficulty in forming a strong and healthy society. Will Dutch amateurs who sympathise with the scheme kindly communicate with Mr. J. Grootes, of the Rotterdam Wireless Training College? We shall be only too pleased to publish accounts of the meetings in our journal.

Types of Mast for Wireless Aerials.

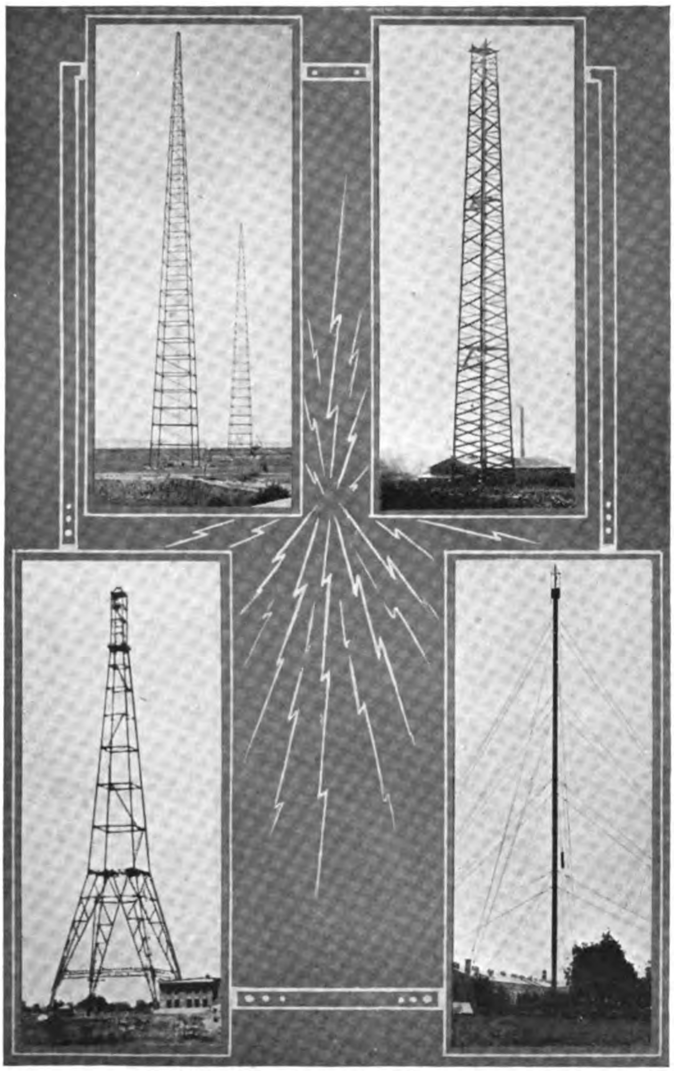
TO an engineer, one of the most interesting features of a modern high-power wireless station is the system of masts used to support the numerous aerial wires. The first stations to be erected, necessarily of low power owing to the primitive state of the apparatus, needed comparatively small aerials, and these were generally supported by a convenient flagstaff or specially erected wooden masts in three sections. It was but rarely that such masts were higher than 160 ft., and as they presented no new features there were but few difficulties to contend with.

The first really large aerial to be erected was that of the Poldhu station, a large collection of wires being supported by a ring of wooden masts each some 200 ft. high. An elaborate system of staying was needed for this ring, but after a short period of working the whole structure collapsed and was supplanted by four wooden lattice towers over 200 ft. high, each provided with a short wooden topmast. The towers were constructed by bolting together a number of planks to form a lattice mast of tapering form as shown in the top right hand illustration. It is interesting to note how the construction of these towers caught the imagination of the public, as for many years artists in portraying wireless coast stations almost invariably showed this form of aerial support.

For some time it was thought that metal towers, by absorbing a considerable amount of the radiated and received energy, would largely diminish the efficiency of transmission and reception. When it was proposed to erect a wireless station in Paris and to use the Eiffel Tower for a support, considerable interest was manifested in the radio-telegraphic world as to what absorption effects would be found. In the case of small metal towers the natural period of electrical vibration of the structure is often high compared with the frequency of the waves it is desired to transmit and receive, and provided the difference between the two periods is large, no very harmful effect demonstrates itself. In the case of the Eiffel Tower, however, being of such an enormous height, it was inevitable that it should have a natural period similar to that of the waves used in practical work, and a number of trials on different wave-lengths had to be made before a suitable wave-frequency was found. As it is there is an appreciable absorption of power by the steel structure which cannot be avoided.

With the growth of high-power stations in various parts of the world and the need for high aerials, various types of mast, mostly of lattice form, came to be erected. The directional aerial used by the Marconi Company can be made suitable for very long wave-lengths without being made of excessive height, but the umbrella aerial used in many stations needs to be of great height to radiate some of the extremely long waves in modern long-distance working. Some engineers, particularly in Germany, endeavoured to overcome the absorption difficulty by making the steel tower part of the aerial system and a number of such high structures, completely insulated from the ground, have been successfully erected.

Perhaps the largest of these is at Nauen, near Berlin, the aerials at this station being supported by a triangular lattice mast approaching 900 ft. in height. The insulating base supports the hemispherical foot of the lattice tower, after the manner of a ball-and-socket joint, allowance thus being made for a slight swaying of the mast in high winds. Steel wireless towers of lattice formation with very broad bases and narrow tops have been erected in several parts of the world, notably in Russia and the United States. One of the towers at the famous Arlington Station near Washington is shown in the lower left hand illustration. Perhaps the most successful of all antenna supports is the steel sectional mast now standardised by the Marconi Company and erected at numerous stations all over the world. These masts, which may be up to 450 feet in height, are made of steel sections bolted together, all sections being the same size. The method of erection is extremely simple. A pair of the sections, which may be termed flanged half-cylinders, are first bolted together to the base, and and a wooden topmast inserted in the tube so formed is used to haul up the next pair of sections. As soon as these two are bolted together and to the first pair, the topmast is raised and used to erect the next sections, and so on. A cylindrical cage surrounding the mast is used in the course of erection. A photograph of one of these masts, some 450 ft. high, erected at the Marconi Company's works at Chelmsford, is shown in the lower right-hand illustration.



The remaining illustration shows one of the steel lattice towers at the Marconi station near Cadiz.

The staying of the giant structures mentioned in this article and the tremendous strains placed upon them by the weight of the wire in the aerials, more especially wind pressure, give rise to many problems, and the successful erection of a large modern aerial and its supports is nothing if not a highly skilful engineering feat.

Administrative Notes

Austria-Hungary.

A copy of absolute and conditional contraband of war communicated by the Austro-Hungarian Government to the United States Embassy in Vienna on November 12th last has been handed to the British Secretary of State for Foreign Affairs by the United States' Ambassador in London. A full English translation was recently published in the *London Gazette*. Amongst the articles put down as conditional contraband are materials for telegraphs, wireless telegraphs and telephones.

* * *

The coast stations at Trieste, Sebènico and Castelnuovo, until further notice, will not deal with private radio telegrams.

* * *

Azores.

By telegram on January 17th the Portugese Government informed the International Telegraph Bureau at Berne that on account of a hurricane the wireless telegraph coast station at Flores is temporarily interrupted.

* * *

Belgium.

The coast station at Nieuport has suspended its service for the present.

* * *

Bolivia.

The International Telegraph Bureau at Berne communicates the following :—

" In a letter dated the 30th October, 1915, " the Bolivian Administration advises us " that by supreme decree of the 21st August, " 1915, the Bolivian Government subscribes " to the London International Radio Tele- " graph Convention, and that this fact has " been notified to the British Government. " The Bolivian Administration adds that it " desires its name to be added to the fourth " class as far as its contribution towards the " general expenses of the International " Bureau relative to radio-telegraphic service " is concerned."

* * *

Brazil.

Communication through the Brazilian coast stations, except in the case of distress calls, is forbidden. The Brazilian Government has decided to accept official despatches and also telegrams in plain language passing between ships and passengers of the one part and steamship companies' agents of the other part on condition that telegrams in this latter category deal only with private matters appertaining to the steamship companies or their passengers.

* * *

China.

The International Telegraph Bureau at Berne advises us that the coast station at Foochow was opened on January 1st, 1906.

* * *

Colombia.

The Colombian Government has informed the International Telegraph Bureau that in order to observe strict neutrality during the European war it has suspended the service of the two Colombian coast stations.

* * *

Denmark.

By Article 17 of the Radio Telegraphic Convention telegrams in code (letters or figures) are prohibited. Telegrams in transit are always transmitted without restrictions, as are also all State telegrams. Telegrams for Denmark must be written in German, English, French, or one of the three Scandinavian languages. The text of these telegrams must be intelligible to the telegraphic employees, but may contain commercial marks and commercial abbreviations (these restrictions do not apply to the Faroe Islands, to Iceland, or to the Danish West Indies). The Danish coast stations at Blaavandshuk and Copenhagen are temporarily closed. Telegrams coming from or destined for Denmark, also in transit through that country, may be written in Russian. Private telegrams from or to Denmark are liable to censorship, but not telegrams in transit. Telegrams concerning news regarding military dispositions of Denmark or those evidently incompatible with the neutral position of Denmark are prohibited. Private telegrams sent in contravention of these orders are refused or stopped without notice to the office of origin.

Dutch Indies.

Until further notice the use of radio-telegraphy in the territorial waters of the Dutch Indies is prohibited for belligerent ships. Communication between the ships and coast stations will not be accepted if the ship stations refuse to give the information mentioned in article 28, paragraphs A, B, C and D of the International Radio-telegraphic Service rules. All communication between belligerent ships and coast stations will be prefixed with a request that the steamers shall state where they are, within or without the territorial waters of the Dutch Indies. If no reply be received communication will cease.

* * *

France.

The French coast stations Ajaccio TSF, Boulogne-sur-Mer TSF, Brest-Kerlaer, Cherbourg TSF, Cros-de-Cagnes, Dunkerque TSF, Lorient TSF, Ouessant et Rochefort TSF, are closed to public communication. The coast stations at Bouscat TSF, and Havre TSF, are closed to public communication, but they will accept private radio telegrams addressed to captains of ships from shipping companies or shippers and *vice versa*.

* * *

French Oceania.

We are advised by the International Telegraph Bureau at Berne that French Oceania has subscribed to the London International Radio Telegraph Convention.

* * *

The International Telegraph Bureau has been advised by the Minister of the French Colonies that the radio telegraph station at Tahiti will soon be opened to the public. This station will effect a service with ships at sea, and with neighbouring islands.

* * *

French West Africa.

The working of the coast station at Tabou is temporarily interrupted.

* * *

Great Britain.

The use of radio-telegraphy is prohibited on ships in British territorial waters with the sole exception of British warships. As far as ships outside territorial waters are concerned, the transmission of radio telegrams necessitating the intervention of coast stations in the United Kingdom is prohibited except in the following cases: (1) Radio telegrams sent on behalf of the British Government, or the representative Governments of the British possessions; (2) Radio telegrams sent on behalf of Allied or neutral Governments; (3) Radio telegrams exchanged between the captain of a ship and the agents for its cargo. Radio telegrams sent for the service of neutral Governments or by persons specified in number 3 must bear the address and text in plain language (English or French). These messages are only accepted at sender's risk. They are liable to censorship by the British authorities—that is to say that they may be stopped, delayed, or treated as the authorities think without notice to the senders. No claim for refund of cost of transmission can be entertained by the British Government. It is very important that these radio telegrams should bear the name of the sender at the end of the text, otherwise they will be stopped until this name is communicated by telegram. Registered telegraphic addresses are not allowed in the address or in the signature.

* * *

Greece.

The use of radio telegraphy on ships in Greek territorial waters is prohibited until further notice.

* * *

Italy.

Only telegrams and radio telegrams written exclusively in plain Italian, French or English are allowed on Italian and Italian Colonial lines. They must bear a clear and complete address and also the name of the sender. Addresses and signatures in code are not permitted. Telegrams containing no text are not allowed. The special services of urgency, reply paid, etc., are only allowed in case of telegrams and radio telegrams. They must be expressed in complete words in French and not by the abbreviated indications allowed by the rules. All telegrams and radio telegrams are submitted to censorship and are only accepted at sender's risk. No claim for reimbursement can be entertained. This applies also to special services. Code is only allowed in the State telegrams exchanged between the Italian Government, the Allied or neutral Governments and the diplomatic missions respectively. No private or State telegrams from or to or in transit through enemy countries are allowed on the Italian or Italian Colonial lines. All Italian coast radio-telegraphic stations and those in the Italian Colonies are closed to private service.

* * *

Japan.

According to the *Shipping Gazette*, the Japanese Government has stated that the new wireless station at Funabashi, near Tokio, is completed and will be ready for trans-Pacific communication soon after the new year. Experimental work between Honolulu and Funabashi has been going on, and it was said recently that reports indicate that the system is working in splendid fashion at both terminals, which are separated by a distance of 3,400 miles.

* * *

Oceania.

The radio-telegraph station at Kawieng (New Ireland) is now open for the transmission of public correspondence. Traffic is sent *via* Rabaul, the rate being fourpence per word plus land-line charges. The hours are 6 to 10 a.m. and 4 to 6 p.m.

* * *

Peru.

The Western Union Telegraph Co. has advised the International Telegraph Bureau of Berne, in a letter dated December 6th last, that the tariff applicable to the following Peruvian Radio-telegraphic offices is 1.25 francs (1s.) per word more than the rate fixed for other offices in the same country—Masisea, Orellana, Requena, Itaya, Iquitos, Puerto Bermudez, and Putumayo (new office). The old telegraph office of Puerto Bermudez, has become, as will be seen, a wireless telegraph station. The same company announces that the existing Peruvian offices at Chala, Ilo, Pisco, may also be used radio-telegraphically from Lima on payment of a supplementary tax of 60 centimes (6d.) per word, and by indicating "Via Lima radio." Ordinary language is now allowed in telegrams through the above radio-telegraphic offices as well as numbers expressed in figures. Telegrams addressed to these offices are also allowed in all languages authorised for international telegraphic service, and they must be written in clear language, but they continue to be accepted only at the sender's risk.

* * *

We are advised by the International Telegraph Bureau at Berne that Peru has subscribed to the London International Radio Telegraph Convention.

* * *

Philippine Islands.

All telegrams, with the exception of American Government messages, for wireless telegraph stations in the Philippines must be written in plain language.

* * *

Russia.

Express radio telegrams are no longer accepted.

* * *

Sweden.

Commercial marks and other incomprehensible expressions are not allowed in private radio telegrams, neither is news relative to the military forces of Sweden or anything that is evidently incompatible with the neutral position of Sweden. Private radio telegrams sent contrary to these restrictions are refused or stopped without notice to the office of origin.

* * *

Turkey.

The use of radio-telegraphy on steamers within Ottoman territorial waters is forbidden.

* * *

United States.

Radio telegrams containing information regarding the situation or movements of the armed forces of a belligerent nation or relative to material or the *personnel* of a belligerent nation will be considered as a violation of neutrality, and will not be transmitted by the radio telegraphic stations placed under the jurisdiction of the United States, except in the case of wireless telegrams in code sent by or destined for representatives of the United States. Any telegram in plain or code language will be transmitted to a ship of belligerent nationality by the coast stations situated in the United States or its possessions or territory under its jurisdiction. If such radio telegrams are received by the coast stations from ships belonging to belligerent nations they will neither be transmitted nor delivered. No communications whatever will be authorised between the coast stations under the jurisdiction of the United States and warships of belligerent nations, except distress calls, meteorological radio telegrams or telegrams relating to dangers concerning navigation. No radio telegram in plain or code language routed *via* a foreign radio telegraphic station belonging to a belligerent nation will be sent or received by the wireless stations of the United States except through certain stations directly authorised by the Government. Press telegrams in plain language relative to the war, with the authorisation quoted in each, will be allowed between these stations provided that no information is given concerning the movements or situation of war or other belligerent ships. No radio telegram which in any way indicates the position or the probable movements of ships belonging to a belligerent nation will be sent by the coast stations of the United States or placed under the jurisdiction of the United States to a ship belonging to a belligerent nation or any other coast station. Radio telegrams in plain or code language are allowed (1) Between coast stations entirely under the jurisdiction of the United States, (2) Between coast stations of the United States of the one part and ships belonging to the mercantile marine of neutral countries or the United States or neutral coast stations of the other part, provided that, in these various cases, the radio telegrams are not destined for a belligerent subject and contain no information of an unneutral character, such as the situation or movements of ships belonging to belligerent nations. In these radio telegrams code addresses either in letters or figures are not allowed with the exception of those registered before the 1st July, 1914, and of which certified copies have been lodged with the radio telegraphic stations of the United States through which the radio telegrams are to be sent. All wireless telegrams must bear either the name of the sender or a name duly certified and registered which fulfils the conditions of the registration of addresses. Radio telegraphic companies which accept such radio telegrams must prove to the Government censor the neutral character of the messages. All radio telegrams sent or received must be submitted to the censor at the time named by him, which latter will be arranged in such a way as not to cause delay to their transmission. Generally speaking, the officials entrusted with the censoring of telegrams will satisfy themselves that no telegrams violating neutrality will be allowed. In order to ensure that the censors shall be well informed of the contents of the radio telegrams, they shall require if necessary that the messages be presented to them for their information in a language which is understood by them. In every radio telegraphic station where the censor is not present at the time when the radio telegrams are received for retransmission either radio telegraphically or by any other means they will be sent on without being submitted to the censor if it is clearly seen that they are of a neutral character, but the radio telegraph company will be held responsible for the execution of these instructions by its operators.

* * *

According to the Exchange Telegraph Company's Washington correspondent, the United States is erecting a high-power radio station to be in operation by January, 1917. Communication will be effective at 4,700 miles.

* * *

The Marconi Wireless Telegraph Company of America advises us that, commencing on January 12th, the hours of operation of their Jacksonville, Florida, Station will be from 6 a.m. to 8 a.m., from 10 a.m. to 1 p.m., and from 4 p.m. to 7 p.m., local time.

SHARE MARKET REPORT.

LONDON, *February 23rd*, 1916.

The market has been very quiet during the last month, but the shares of the Parent Company have been particularly firm, rising to 39s. 6d. The Canadian and American Companies' shares have fallen back in sympathy with lower prices in America :

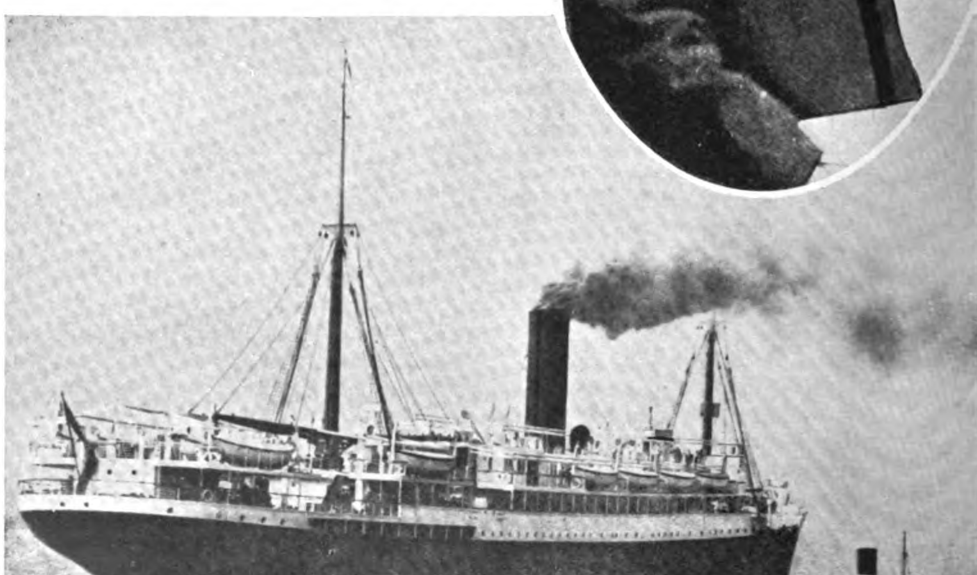
Marconi (Ordinary), £1 18s. 9d. ; Marconi (Preference), £1 15s. ; International Marine, £1 5s. ; Canadian, 6s. 3d. ; American, 16s. 3d. ; Spanish & General Wireless Trust, 5s.

C

Wireless Telegraphy in the War

A résumé of the work which is being accomplished both on land and sea

WE have all been reading with great interest the romance of the sea which centred round the *Appam*. Few writers of fiction have imagined a more romantic series of incidents than the story of this great liner on her way home to England with a large number of passengers on board, some of them men of high distinction, approached by what appeared to be a harmless tramp, but which when within close range of the vessel drops the screen which gave her her apparently innocuous character and discloses her true identity as a rover with guns grinning threats of destruction. The enemy was aware of the weak points in his armour, and his first orders consisted of a prohibition to utilise the radio-telegraphic apparatus carried by the liner. As soon as the Germans



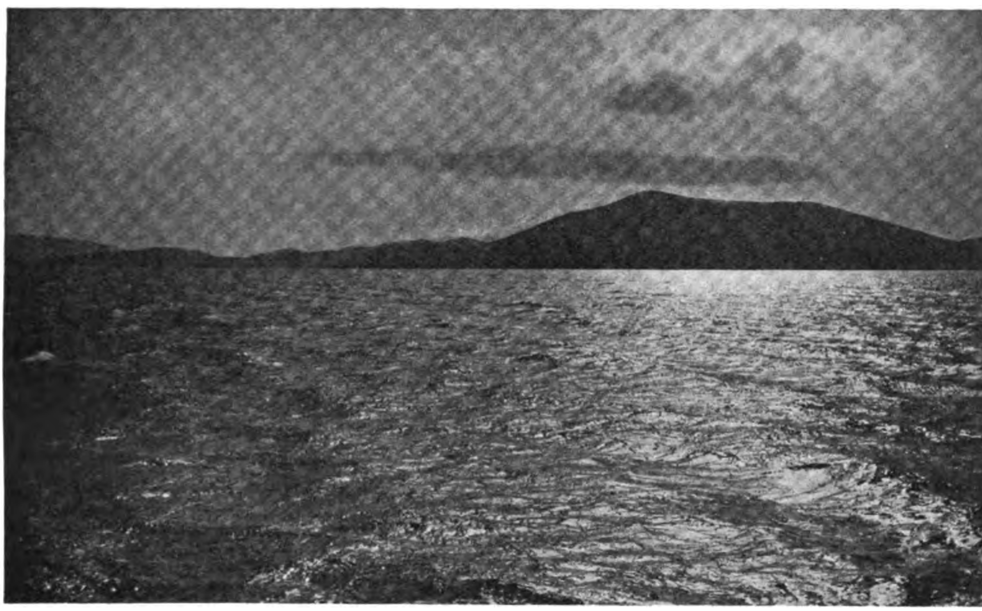
"S.S. "Appam." Inset, Lt. Berg, who captured her.

sent on board their prize crew, Teutonic operators were stationed in the *Appam's* wireless room, and all through their long voyage the vessel *received* all communications floating through the ether, but entirely refrained from sending any. Strict adherence to this rule enabled the vessel to avoid British cruisers, and the twentieth century privateers were able to conduct the vessel into port in the United States, there to provide one of the most interesting problems for naval lawyers with which they have been recently confronted.

The officers of the *Appam* are alleged to believe that the German vessel was advised by wireless of the movements of British ships on the initiative of vessels flying neutral flags and stationed near neutral ports.

* * *

One of our Yorkshire contemporaries contains an amusing letter written by a soldier from the Island of Lemnos in the Ægean Sea, forty miles south-west of the Dardanelles. Our British warrior describes his voyage as having taken place in



One of the lovely Islands in the Ægean Sea.

An interesting point in connection with the German privateer which captured the *Appam*, whether she be named *Möwe* or *Ponga*, consists in the assertion by Captain Harrison, commanding the Elder Dempster liner, that the vessel whose guns are masked behind hinged ports is " painted black with a single funnel and two masts with unusually high wireless masts." The object of fitting the raider with these unusually high aerials was manifestly that of giving her a wide range of communication. That this object was attained appears to be indicated by the fact that she was able to sink seven ships and capture an eighth within eight days.

" a big liner with a well-known name," and a great deal of his epistle is taken up with incidents in which the " ubiquitous wireless " plays an important part. Whilst the writer was in the Atlantic on his way to Mudros, the vessel, " a wonderful ship in peace time, and great now," picked up an SOS signal from a vessel off the Spanish coast attacked by a submarine. In times of peace every ship within a radius offering a possibility of assistance would have felt it her duty to obey the call of humanity, but under war conditions many considerations come into play besides that of the humanitarian impulse.

Scene in the Isle of Lemnos, the Greek Ægean Isle, the recent destination of many British vessels during the present phase of the World's War.

A highly interesting article appeared in the January issue of the *United Service Magazine*, contributed by Mr. Hector C. Bywater, under the heading of " A German Corsair." He refers to a series of incidents which have now passed into history; the German corsair having, for the duration of this war at least, practically ceased to exist. But no one who reads the account furnished by Mr. Bywater can fail to be struck with the predominating part played in these operations by *wireless telegraphy*.

The writer describes the career of the *Karlsruhe* from particulars furnished by a German engineer who had served on board, together with the narrative based on the diary of Paymaster Mahlstedt, who formed part of the personnel of the *Kronprinz Wilhelm* throughout her cruise. The junction of the two German vessels was effected under such conditions that neither dared to make use of its wireless apparatus, " as to do so might have betrayed " our presence to the enemy."

In this connection the following further interesting paragraph occurs in the article:

" On November 1st wireless messages were " picked up from a British squadron of five " armoured cruisers, which was in pursuit " of Admiral von Spee's ships. The narrator " observes here that hostile warships repeatedly betrayed their presence by using " their wireless, whereas the *Kronprinz* " *Wilhelm* consistently refrained from sending a single message. To this policy Herr " Mahlstedt mainly attributes the immunity " his ship enjoyed for so many months." Our German diarist believes that it is possible " to have too much of a good " thing!"

Mr. Bywater ends, as he starts, by emphasising the shortage of speedy British cruisers available in the early months of the war.

He estimates the value of the prizes sunk by German corsairs at over six and a half millions sterling, and points the moral that " cruisers are cheaper than commerce " destruction."

The enemy has utilised the call for attracting to his own sphere of activity vessels belonging to the Allies which he desires to destroy, and British soldiers on active service are too precious to have their lives risked by over-readiness to heed a possibly bogus appeal. The disregard, therefore, of the humanitarian impulse in such cases is apparent only, and the matter-of-course way in which the soldier accepts it shows he recognises this to be the case.

Later on they themselves appeared to be about to incur the same kind of danger from a similar lurking foe. The wireless operator reported that he had picked up a message informing him of the presence of a submarine at ten o'clock in the morning on a spot which they themselves had crossed five hours before.

We can easily imagine the interest raised by such an announcement and the anxiety with which all on board would scan the sea for possible signs of the presence of the enemy. Our friend describes the commotion aroused by the assertion of someone on board that the periscope was in sight. Great was the general relief when cautious investigation showed that the object was only a chair floating upside down!

NOTES OF THE MONTH

THE Imperial Merchant Service Guild, having made representations to the Admiralty concerning free railway passes for their members serving on board transports who are proceeding on leave, have received from the Director of Transports a letter stating that the class of pass which should be issued is as follows: First-class passes to masters and chief engineers; second-class passes to other mates, other engineers, pursers, and, in the case of passenger ships, Marconi operators and chief stewards; on railways where second-class accommodation is not provided, first-class passes may be issued; third-class passes to petty officers and each member of the crew.

* * *

During 1914–1915 it is estimated that the expenditure of the Post Office directly due to the war amounted to £1,237,172. Details of this expenditure, given in the appropriation accounts, include an item of £1,400 for dismantling private wireless stations on the outbreak of war.

* * *

Our article in the February number on wireless telegraphy for women came at a most opportune moment. The daily Press have been full of the growing idea that the service of women in connection with wireless telegraphy might be very materially and usefully employed. Our article will have shown that the idea is not by any means as new as these paper reports suggested. The Women Signallers' Territorial Corps some months ago approached the Marconi Company with a view to making an arrangement for the supply of wireless apparatus, in order that their members might thoroughly learn wireless telegraphy. We do not know what further calls will be made upon our manhood before the present war is ended, and this real attempt on the part of women to acquaint themselves with some of the work previously undertaken by men deserves the highest commendation. It is interesting to note that the British Government has appointed women in charge of the wireless stations at Rathlyn Island and Island of Mull.

* * *

The following is an extract from the *South Wales Daily Post:*

"The undermentioned 'wireless messages' "were received during the evening at the "presentation smoking concert at the Salis- "bury Club, Swansea, on Thursday:—De "Wet: 'Sorry, too dry after 9 o'clock.' "Lord Derby: 'Am busy testing Ramsay "'Macdonald.' McKenna: 'Counting up "'conscience money from conscientious ob- "'jectors.' Beelzebub: 'Busy preparing a "'place for Wilhelm II.' Jellicoe: 'Still one "'U boat at the North Pole; must have it be- "'fore joining you.' Constantine: 'The Allies "'are making me sit up, so dare not move.'"

* * *

Dr. J. A. Fleming, whose interesting article on the "Resistance of Networks of Conductors" appears in this number, recently addressed the Royal Society of Arts on the subject of the organisation of scientific research. "Unless we wish Germany's crime-stained hands to take back in commerce what she has lost in war," said Dr. Fleming, "we have to create and maintain an entire scientific and economic independence of our own."

* * *

At the annual meeting of the National Home Reading Union at the University of London, South Kensington, early last month, the Librarian, Miss Harraden, quoted some of the orders which have been given by soldiers. The requests varied in taste from Browning's poems to Sexton Blake, and from Thomas Hardy's novels to scientific works. In her report it is interesting to note that Miss Harraden makes special mention of the fact that on more than one occasion text books on wireless telegraphy had been asked for.

WIRELESS SIGNALS FOR THE HOME

A GREAT INNOVATION FOR PRIVATE STUDENTS

The New Marconi Official Disc Records.

OF the millions of men so bravely fighting both on land and sea for the freedom of the world from Prussian tyranny, there are already some thousands whose duties are concerned exclusively with wireless telegraphy. There is no need here to write of the tremendous utility of radiotelegraphy in warfare and in peace—it must be realised by all who peruse this magazine—but we are not at all sure that the British public realise the debt the nation owes to the amateur wireless enthusiast and his part in the present war.

Wireless telegraphy as a hobby was, before the outbreak of hostilities, perhaps the most fascinating pursuit that a young man (or an old one for that matter) could wish to find. Hundreds of aerials reared themselves above the houses and gardens of the United Kingdom, whilst in studies, attics, even cellars, tiny installations, in many cases entirely constructed by the hands which operated them, gave pleasure and instruction to the amateur and his friends. Now, alas! all apparatus has been dismantled and packed away, much of it being carefully stored by the Government authorities. But it must not be forgotten that these amateur installations, often of the most inexpensive nature, have taught their owners the wonders of the ether, and enabled them to take their place with but little training as wireless telegraphists in His Majesty's Forces.

Those amateurs who remain and are either too young or for some other reason prevented from serving can only carry on their hobby by means of theoretical study. No longer can they sit through the dark evenings, telephone receivers pressed closely to their ears, listening to the musical note of Poldhu ringing out the evening news, to the strong rough signals from the Eiffel Tower, or to the piping note of the Telefunken Stations on the other side of the North Sea. The practice they were able to obtain in receiving the Morse characters from these distant stations has been lost to them for considerably more than eighteen months, and only those who have skilled friends able to send both upon a Morse key and buzzer, and the more fortunate ones with access to properly equipped training schools have been able to keep "in form."

GOOD NEWS FOR THE HOME STUDENT.

Now, however, we are able to announce a very welcome piece of news for all who wish to keep in the finest trim as far as this part of the subject is concerned. Bearing in mind the present need for skilled instruction in radio-telegraphic receiving, The Wireless Press, Ltd., and the Gramophone Co., Ltd., have produced a series of splendid records which can be reproduced on any disc talking machine using the ordinary needle method of reproduction, and which give signals in Morse characters of the exact sound heard by a wireless operator when listening to a high-power station. By means of these records amateurs can sit in comfort, with no fear of breaking the Defence of the Realm Regulations, and listen to first-class Morse sending at various speeds on a pure musical note. They will also have the satisfaction of knowing that they are receiving instruction from a first-class wireless operator of many years' experience

HOW THE RECORDS ARE GRADED.

The set of records now being placed upon the market consists of six double-sided discs (any of which may be purchased separately), containing instruction both for the beginner and the advanced student. Each side gives from three to four minutes' instruction, according to the speed at which the record is run, the complete set thus giving up to three-quarters of an hour of first-class sending. The student possessing these records will have the sending completely under his control, for he can repeat either the whole of the record or a part as many times as he wishes and, within the limits of his particular gramophone, at various speeds. What amateur in peace time, listening to a brief spell of "press," has not wished that the operator would repeat it for him at a slightly slower speed; or even at the same speed perhaps, and what new activities will arise in many amateur societies now that this new means of instruction is at their disposal!

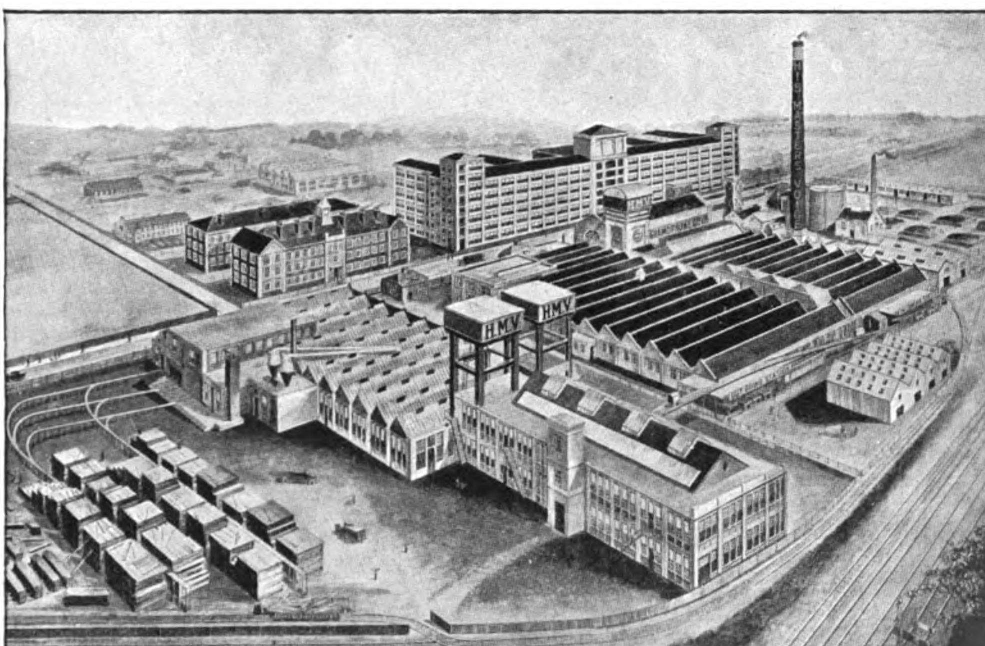
THE MORSE CODE COMPLETE.

The first record, which is designed specially for beginners, and as a standard record suitable for all schools, where even the elements of wireless telegraphy are taught, contains on one side the Morse code, including full figures, abbreviated figures and all signs of punctuation, exactly as printed in the Postmaster-General's Handbook. The characters are sent slowly so that their formation can be readily distinguished by all. On the second side of this record, difficult letters, such as C, Q, Y, etc.—letters which experience has shown give most difficulty to the learners—are picked out, and each sent several times in succession; there then follows a sentence sent slowly and deliberately, containing every letter of the alphabet. For this disc alone we anticipate an enormous sale, for a knowledge of the Morse Code is a valuable asset to practically everyone, whether he or she intends professionally to take up telegraphy or not.

Heads of colleges, schoolmasters and all who are concerned with instruction of the young will, without a doubt, welcome this record as an easy means of providing first-class instruction.

"PRESS" AT DIFFERENT SPEEDS.

The second disc contains on one side "press" at a speed in the neighbourhood of ten words per minute, and on the other similar matter at a speed some 50 per cent. faster. We may take this opportunity of pointing out that practically every gramophone has a speed regulator by which the records can be run either slower or faster



Bird's-eye view of Factories of the Gramophone Co., Ltd., Hayes (Middlesex), where the new Marconi records are made. This picture does not show the additional stories now being built on the Cabinet Factory in the foreground.

as required. The student using the Marconi official records will be able to vary the speed of reception within quite appreciable limits, thus a record whose normal speed gives ten words per minute can be adjusted to give any speed from 8 to 12 or 13 words per minute approximately. Upon receipt of the records the student can easily carry out a test with his own machine and ascertain its limits.

A "His Master's" Voice Gramophone, which may be used for the records of Wireless Signals.

MESSAGES PROPERLY TRANSMITTED.

Both sides of the third Record contain dummy messages properly numbered, timed and counted, just as sent by Post Office wireless stations to ships at sea and *vice versa*. It is a well-known fact that many students, either to save themselves trouble or because they have no proper guide, confine themselves to the transmission and reception of "press" and are totally unable to send and receive in a correct manner an ordinary wireless message. This third disc is specially designed to lead them in the way they should go.

BUSINESS MESSAGES.

On one side of Record Four we find more difficult messages containing figures, fractions, Stock Exchange terms, etc., with the transmission of which every would-be operator must be fully acquainted. In order that the student may understand how mistakes are corrected during transmission one or two errors have been introduced into the message records and immediately "crossed out" in the accepted style. This is one of the points in which the Marconi Official Records are so much better than any clock-work sending device. All of the discs are recorded from first-class *hand* sending, and are thus exactly the same as heard at sea.

CODE AND CIPHER.

On the second side of this record we find the whole of the space is occupied with code words and ciphers, normal transmission being at the rate of 20 words per minute. It is unnecessary to lay emphasis upon the need for practice in receiving such matter, and this disc will no doubt be very popular.

MESSAGES AT 25 WORDS PER MINUTE.

Continuing the progression the student will find on one side of the Fifth Record a collection of messages of various degrees of difficulty, such as are encountered by the operator in the course of an ordinary day. The speed is so timed that normally the message would be transmitted at 25 words per minute. This should prove an excellent practice record even for the expert.

MESSAGES IN FOREIGN LANGUAGES.

In order that the student may become acquainted with the class of message transmitted by coast stations abroad and destined for foreign passengers the reverse side of the Fifth Record has been devoted to a collection of messages in French, Spanish and Italian. These messages are also timed 25 words per minute, the whole record thus being the same speed.

A JAMMING RECORD!

Perhaps the most interesting record of the whole series, and without a shade of doubt one of the most valuable, is the sixth, which has been specially made to include signals from two distinct transmitters on slightly different notes. The home student who has not had access to a wireless installation will now, for the first time, be in a position to hear just what signals sound like when "jammed," and will at the same time be given exceedingly valuable preparatory instruction for the time when he takes up his duties on board ship. Nowadays, when so many wireless installations are working, it is the exception rather than the rule for signals to be heard without at least a slight interference from other stations. Many an operator on his first trip to sea has been hopelessly confused by the jumble of signals reaching his ear from several installations, and it is only after some days of practice that he has been able mentally to select the signals he requires from other sounds. The Marconi Jamming Record contains on one side "press" transmitted at a normal speed of 25 words per minute and jambed by similar matter at a slightly slower speed; and on the reverse side mixed messages at 25 words per minute also jammed by "press." It will thus be seen that this record contains more matter than any of the others, for the student can read either note at will. Both notes are musical and exactly similar to those given by the installations with a disc discharger, the difference between the two notes being sufficient for good reading.

Now that we have explained the contents of the series the reader will realise the enormous utility that such records can give to the thousands of home students and would-be operators. Think what it means to sit in comfort by the fireside with a pad of paper before you and your gramophone reproducing first-class wireless signals which can be repeated a hundred times if you will, not only to you but to your friends who are also wireless enthusiasts and who have come round for the evening. And if you be an experimenter whose installation has been dismantled and packed away under the care of the Post Office will you not welcome again those signals to which you used to listen with such interest, and which were teaching you receiving so well when war broke out and everything had to be put away?

And if you are not a practical man, but one whose interest in wireless has so far been confined to theoretical aspects, do you not think that it would benefit you to understand just what those wonderful ether signals are like and what interference between two stations really means?

PRICE WITHIN THE REACH OF ALL.

Although these records have been specially made for us by the Gramophone Co., Ltd., makers of the famous "His Master's Voice" records and acknowledged to be the finest producers in the world, we are able to offer them at a price of 21s. for the complete set of six double-sided records, or 3s. 6d. each for the separate discs. A charge of 4d. will have to be made for the packing of single records, but complete sets will be packed free. Postage in each case will be extra. A very large demand is anticipated, and orders will be dealt with strictly in rotation. Readers are, therefore, advised to place their orders as early as possible to avoid delay.

PLAYED ON ANY GRAMOPHONE.

The Marconi Official Records can be used on any disc talking machines which reproduce with a needle, and those readers who possess disc machines with a sapphire can purchase at a low cost a needle reproducer, which will enable them to play these records on such machines. The Editor of THE WIRELESS WORLD will be only too glad to give advice to readers with regard to suitable machines, and The Wireless Press, Ltd., the publishers of this magazine, are in a position to supply the standard "His Master's Voice" gramophones at list prices to any readers who require them. All communications on this subject should be addressed to The Wireless Press, Ltd., Marconi House, Strand, London, W.C., and the envelopes marked "Marconi Official Records."

Maritime Wireless Telegraphy

An Exceptional Distance.

THE wireless operator on the Japanese steamship *Toyohashi Marun* has reported that he recently communicated with San Francisco, California, whilst 2,614 miles away. The vessel is equipped with a 120-cycle ½-kw. Marconi set.

* * *

An American Ship Attacked.

According to advice from Athens an unnamed American ship sent out the SOS distress call, stating that she was being attacked by an Austrian or a German submarine, to the south of the Island of Crete. Subsequent efforts to communicate with the vessel, however, were fruitless.

* * *

The "Peace" Ship.

It will be remembered that part of the plans of the peace campaigners was to send wireless messages broadcast whilst the *Oscar II.* was traversing the Atlantic Ocean. One such message, as follows, was sent by wireless to the monarch of each belligerent country in Europe :—

"We do earnestly entreat you and the "rulers of all the other warring nations to "declare an immediate truce. Let the "armies stand still where they are. Then "let the negotiations proceed, so that the "soldiers may be delivered from another "bitter winter in the trenches, and sent back "to their firesides. There is no other way to "end the war except by mediation and dis-"cussion. Why waste one more precious "human life ?"

A wireless message was also sent to Washington asking support for peace action. As was to be expected many newspaper correspondents accompanied the expedition and freely used the Marconi wireless service to send reports of the happenings on board.

* * *

S.S. Tyninghame Ablaze.

A wireless message was received recently by a firm of shipping agents in New York to the effect that the British cargo ship *Tyninghame*, which left Brooklyn for Liverpool with 5,000 tons of sugar aboard, was on fire in No. 4 hold, and was returning to port. The master asked for assistance, and the fire boat *Seth Low* immediately went out in search of her. The freighter was anchored between the Statue of Liberty and Staten Island. When the fire boat went alongside the hatches were removed and several hundred tons of water pumped down on to the burning sugar for three hours until the blaze was subdued. By that time fire and water had ruined several thousand bags of sugar, valued at more than £151,000. Whilst the *Tyninghame* was being loaded in dock for that very voyage a fire started in the same hold, causing £4,000 worth of damage before it was got under control.

* * *

Japanese Steamer in Collision.

A wireless message received at Halifax. Nova Scotia, from the wireless station at Cape Race, states that the oil-tanker *Silvershell* and the Japanese steamer *Tahata Maru* have been in collision 2,000 miles south-east of Cape Race. A further wireless message says that the *Tahata Maru* was still afloat, but that her engine-room was flooded. The *Silvershell* is standing by. No further details are available at present. The *Tahata Maru* belonged to the Nippon Yusen Kaisha, and possessed a tonnage of 6,718. Her value is £95,000, partly insured in London ; that of the *Silvershell* is £15,000, partially covered in London.

* * *

German Pirates Trapped.

Under dramatic circumstances the first German prisoners in the Balkan Campaign were recently taken. It appears that an accident to the machinery compelled an English cargo boat which had just left Salonika to stop. A short time later a German submarine appeared and fired at the ship. The vessel at once sent out a wireless message asking for immediate help whilst a small boat put off from a submarine, and reaching the cargo boat began to search her. In response to the wireless message a French destroyer arrived, at the sight of which the submarine immediately dived, leaving the members of its party on board the cargo boat. The latter, escorted by the French destroyer, returned to Salonika with her six prisoners on board.

* * *

TWO STEAMERS LOST.

The White Star cargo boat *Bovic*, from Manchester for New York, on arrival at the latter place reported having intercepted wireless messages indicating that two steamers have been lost, one the British tank steamer *Appalachee* and the other an unknown steamer. The Red Star liner *Finland* rescued the crew of the latter.

* * *

A PREVIOUS WARNING.

In connection with the Board of Trade enquiry which is being held over the loss of the *Persia*, and personal allegations made against her captain, a correspondent of one of our contemporaries desires to say how exercised the late Captain Hall was by the tremendous responsibility on his shoulders. It seems that on a previous homeward voyage, whilst his ship was just clearing from Gibraltar, a wireless message was received from the *Mongolia*, belonging to the same company, to the effect that an enemy submarine was prowling about off Cape Finisterre. Captain Hall never for an instant relaxed his vigilance and went without sleep night and day in order to keep a personal look-out in the dangerous circumstances.

* * *

LOSS OF THE "KING EDWARD VII."

The *Grimsby Daily Telegraph* recently contained a very interesting letter from a survivor of the ill-fated battleship *King Edward VII.*, from which we extract the following :—

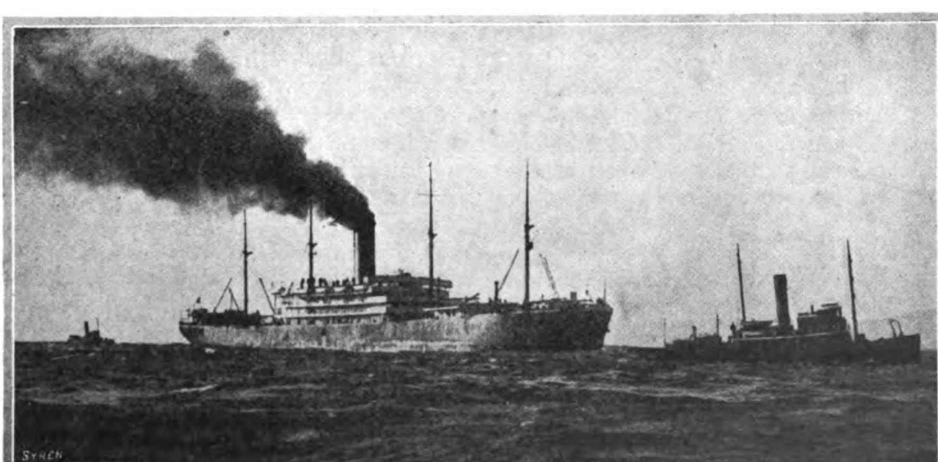
"We struck at 11.45 in the morning, and "she disappeared at 1.45 p.m. There was "a high wind at the time, but a moderate "sea. In response to wireless messages, "destroyers came up and took us in tow, "but before they arrived a collier rendered "valuable service.

"Soon after midday the weather got "worse, and the towing hawsers broke. "The captain gave out the order, 'Every "man for himself.' Some got away in the "boats, and the destroyers took the rest. "The wireless switchboard watchkeeper "performed a fine act of bravery. He "dashed below and turned on the switches, "holding them there until our messages were "answered."

* * *

ACCIDENT TO S.S. "MINNESOTA."

In our January issue under the heading "Maritime Wireless Telegraphy," we gave a few details regarding an accident to some of



S.S. "Minnesota" being towed to port after the bad internal accident which totally disabled her.

the internal parts of the s.s. "Minnesota." By the courtesy of *Syren and Shipping* we are enabled to put before our readers a photograph of the big ship after the accident as she was being towed to port.

* * *

FROM ALTANTIC TO PACIFIC.

Another remarkable achievement in regard to wireless communication is to be recorded. Ships of the United States Atlantic and Pacific fleets exchanged messages across about 2,500 miles of intervening land, and both sides report that the messages were strong and easily read. It appears that unusual atmospheric conditions made this conversation possible.

* * *

STEAMER IN DISTRESS.

The following message has been received from the Spanish wireless station at Cape Finisterre :—

"At 11.30 p.m. the Italian steamer "*America* reported the following to all "stations : Steamer *Pollentia* calling for "help west of the Azores. Inaudible hear "directly. Steamer *San Gugliemo* reported "she was going to assist the *Pollentia*, and "another steamer of the same nationality, "situated 152 miles from the steamer "*Siamese Prince*, reported she was at a dis-"tance of 90 miles and would arrive on the "spot shortly. It was only known that the "*Pollentia* was sinking, but the cause was "unknown. Subsequently the *Pollentia's* "dynamo broke down, but the *San Gugliemo* "reported that she hoped to arrive in time "to save the crew."

A Halifax, Nova Scotia, telegram states that the steamer *Pollentia*, which was in distress for several days 700 miles from Cape Race, Newfoundland, has foundered. All on board were rescued. A later message from Lloyd's states that the Italian steamer *Giuseppi Verdi* took over the crew of the *Pollentia* shortly before the latter vessel sank.

* * *

WIRELESS TO THE RESCUE.

An extraordinary case of lighthouse-keepers being forgotten has just come to hand. Two men, a woman, and three children were found starving in a lighthouse on the Mexican coast by the Ward liner *Mexico*, which arrived at New York from Vera Cruz. One woman had already died of hunger, as the only food for fifteen days had been fish and water, but they had kept the light burning. As the *Mexico* was passing the West Triangle Lighthouse, 150 miles from Progreso, and on the Yucatan coast of the Gulf of Mexico, the captain happened to look towards the light, which was five miles away, and saw a signal flying the international code letters "N.J.," which mean "Need assistance "immediately." The light is on a barren island, and the captain divined that food was needed. The lifeboat was stocked with beef, flour, eggs, and coffee, and, accompanied by the ship's surgeon, was rowed to the light. One of the lighthouse keepers said it was customary for a Mexican tender from Vera Cruz to visit the light every two months and leave provisions, but for some reason no boat had come near during four months. The men and women caught what fish they could, but become so ill and weak that in a few days all would have perished. The *Mexico* wirelessed their predicament to Progreso and waited for the reply that the message was understood before she continued her voyage.

* * *

ATLANTIC LINER DISABLED.

The Lamport Holt liner *Holbein* arrived at Queenstown recently in a very battered condition after having battled for nine consecutive days against Atlantic gales. She was bound from Manchester to New York and encountered severe hurricanes, which caused her to strain heavily. A pipe burst, the forehold almost filled with water, and the wireless telegraphic apparatus was dismantled. In view of all this damage the captain decided to abandon the voyage and return to port.

* * *

LOSS OF H.M.S. "NATAL."

It is unfortunate that the year 1915, which opened with a big maritime disaster, should have also closed with a similar unhappy event. The loss of the *Formidable*, which was sunk in the Channel by a mine, was announced on New Year's Day, 1915. New Year's Day, 1916, was marked by the advice of the loss of the *Natal*. Again the country will mourn the loss of a useful ship and many valuable lives. In our "Personal" pages of the February number we gave the names of the wireless telegraphists who were on board the ill-fated ship at the time of the explosion.

ENCOUNTER WITH A SUBMARINE.

Reports of the sinking of vessels by hostile submarine craft have of late unfortunately been only too common. It is refreshing therefore to learn that the s.s. *City of Marseilles* whilst on a recent voyage to the East encountered a submarine, from which, however, she escaped. She was off the south coast of the island of Sardinia in the Mediterranean when the submarine was sighted. The latter approached and commenced shelling the ship. As soon as the captain discovered that his vessel was in danger the SOS signal was sent out by wireless telegraphy, and a reply was received from an Italian hospital ship which was not more than thirty miles away, saying that she would stand by and go to their assistance if necesssary. Luckily the submarine did not fire a torpedo, and in the end the merchantman succeeded in escaping.

* * *

STEAMER CHASED.

A wireless message has been received at Soller, Majorca, from the steamer *Tafna*, calling for help and saying that she was being chased by a submarine. A later message received at Barcelona said that she had escaped and had lost sight of the submarine.

* * *

DUTCH STEAMER MINED.

According to various wireless messages picked up by the station at Scheveningen, the Dutch steamer *Maashaven*, 2,609 tons, of Rotterdam, has struck a mine west of the Galloper Lightship. The crew abandoned the vessel, which is still afloat and drifting, with the forecastle afire. Fourteen men of the crew were rescued by the steamer *Goentoer*, which also saved the ship's papers. Eight other men were taken on board the steam trawler *Juliana*.

* * *

OIL STEAMER AFIRE.

The Canadian Marine Department has been notified that the Swedish steamer *Texas*, supposed to be an oil-tanker, is on fire off Cape Race. The information was received by wireless from a steamship of the Head Line.

A subsequent wireless message from the steamer herself, which is on a voyage from New Orleans to Christiania, states that she is steering for Queenstown. The fire is in the cotton for'ard of the bridge, and probably 'tween deck under the bridge.

DUTCH STEAMER BEACHED.

According to a wireless message, the steamer *Prinses Juliana*, from Flushing to Tilbury Docks, met with a mishap on a recent crossing and made water on the starboard side aft. Lloyd's states that the steamer has now been beached at Felixstowe. The *Prinses Juliana* is the well-known mail boat, which runs in the Zeeland Company's service between Tilbury and Flushing.

* * *

ITALIAN STEAMER SUNK.

The Italian steamer *M. Benlliure*, of 2,528 tons, which left Glasgow for Genoa with coals signalled by wireless that she was sinking 40 miles north-west of Scilly; assistance was promptly sent to the distressed vessel.

BRAVERY REWARDED.

THE following is a translation of a letter from the Italian Ministry of the Navy, lauding the action of the Marconi operators on board the s.s. *Ancona* when that ship was recently torpedoed in the Mediterranean :—

"The Committee who had charge of " investigating the circumstances attending " the sinking of the s.s. *Ancona* have felt it " their duty to make special mention of the " efficacious and commendable work done " by the two Marconi operators, Mr. Pietro " Buffa and Mr. Nicola de Crecchio, by " making timely important communications " to the captain of the ship, by the rapidity " wherewith they sent wireless signals of " danger and help so as to enable the French " steamer *Pluton* to arrive at the scene of " the disaster only five hours after the " sinking of the ship; and also because, not " being in a position to continue their work " on account of the wireless station being " destroyed, they saved themselves only on " the last lifeboat that left the ship.

"I am well pleased to bring to your notice " the two above-named operators, who in " this disaster gave proof of serene energy " and a high sense of duty.

"I therefore consider that they deserve " special praise, which you will please give " them in my name.

"Yours faithfully,

"The Under Secretary of State
"for the Navy,
"(Signed) A. BATTAGLIERI."

CARTOON

"*Gott Strafe Wireless!*"

On the Resistance of Networks of Conductors

By J. A. FLEMING, D.Sc., F.R.S.

SEVERAL correspondents in recent issues of THE WIRELESS WORLD exhibited interest in a certain problem concerning the resistance of a skeleton cube of wire, each side of which had a resistance of 1 ohm.

The problem was to find the resistance of the cube between two diagonal corners. The correct answer is $\frac{5}{6}$ of an ohm. It does not seem to be generally known that I gave, thirty years ago, in a Paper to the Physical Society of London (see *Proc. Phys. Soc. Lond.*, vol. vii., p. 215, 1885), a general rule for finding the resistance of any such network drawn in a plane. Many cases of networks in space of three dimensions can easily be reduced to cases of plane networks. The general rule for plane networks is as follows: Consider any network consisting, say, of five conductors joined as in Fig. 1,

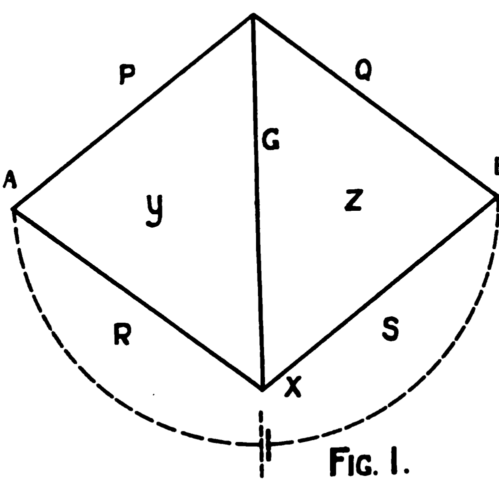


FIG. 1.

Call these resistances P, Q, R, S, G, and let it be required to find the resistance between the points a and b. Imagine a and b joined by a conductor of zero resistance represented by the dotted line in which there is an electro-motive force of 1 volt. If we call r the total resistance of the network then the current flowing through the network from

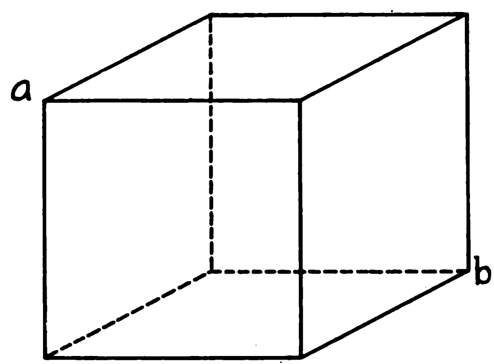


FIG. 2.

a to b is clearly equal to $1/r$ of an ampère. Hence the resistance of the network is equal to the reciprocal of the current flowing through the conductor of zero resistance represented by the dotted line under an electro-motive force of 1 volt.

The method of calculating the current which flows through any branch of a network of conductors is given in the author's *Wireless Telegraphist's Pocket-Book of Notes, Formulæ and Calculations*, and is as follows: Give to each mesh of the network a symbol x, y, z, etc., to denote an imaginary current flowing in the same direction round each mesh. Then form a series of equations by multiplying each such symbol by all the resistances which bound that mesh and subtracting the product of each neighbouring symbol, each multiplied by the resistance of the common resistance, and equate that result to the electro-motive force acting round the mesh. Thus in the case above considered we have the three equations—

$$(R+S)x-Ry-Sz=1$$
$$-Rx+(P+R+G)y-Gz=0$$
$$-Sx-Gy+(Q+S+G)z=0$$

Now by the rules given (see *The Wireless Telegraphist's Pocket Book*, p. 5) for solving such equations by determinants, we have for the value of x,

$$x=\frac{\begin{vmatrix}(P+R+G), & -G \\ -G, & (Q+S+G)\end{vmatrix}}{\begin{vmatrix}(R+S), & -R, & -S \\ -R, & (P+R+G), & -G \\ -S, & -G, & (Q+S+G),\end{vmatrix}}$$

and hence the resistance of the network between a and b is the reciprocal of the above expression. The rule, therefore, for finding the resistance of any network of conductors taken between two points is as follows :

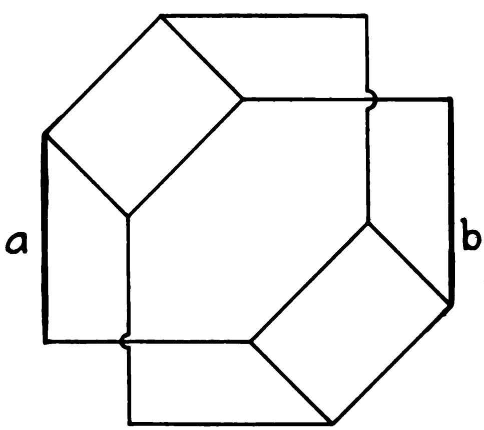


FIG. 3.

Assume the two points joined by a conductor of zero resistance in which there is an electro-motive force of 1 volt, and find the reciprocal of the current in that zero condutcor.

Returning, then, to the case of the skeleton cube, it is clear that the twelve 1-ohm wires which from the cube arranged as in Fig. 2 are equivalent in resistance to the arrangement

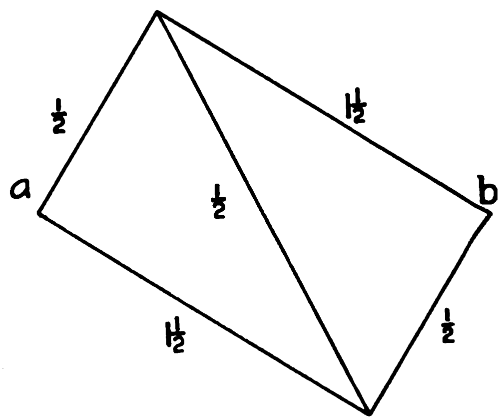


FIG. 4.

shown in Fig. 3, where the bars marked in thick lines a and b have zero resistance.

Again, a little thought will show that the arrangement of twelve 1-ohm wires as in Fig. 3 is equivalent in resistance to the arrangement shown in Fig. 4, where the numbers marked against the sides show the resistances of them.

Now Fig. 4 is the case already considered first, and therefore by the rule given the resistance between a and b is expressed by the quotient of two determinants—viz. :

$$r=\frac{\begin{vmatrix}2, & -1\tfrac{1}{2}, & -\tfrac{1}{2} \\ -1\tfrac{1}{2}, & +2\tfrac{1}{2}, & -\tfrac{1}{2} \\ -\tfrac{1}{2}, & -\tfrac{1}{2}, & +2\tfrac{1}{2}\end{vmatrix}}{\begin{vmatrix}2\tfrac{1}{2}, & -\tfrac{1}{2} \\ -\tfrac{1}{2}, & 2\tfrac{1}{2}\end{vmatrix}}=\frac{5}{6}$$

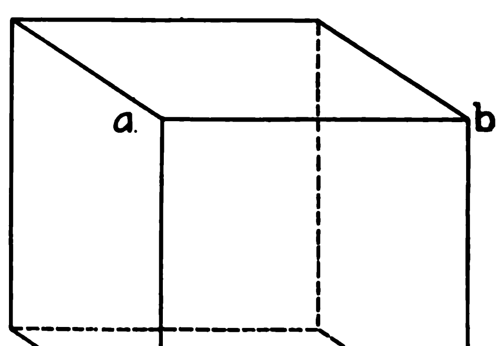


FIG. 5.

The reader will find the rules for calculating out numerical determinants given in Chapter I. §3 of *The Wireless Telegraphist's Pocket Book of Notes, Formulæ, and Calculations* (The Wireless Press, Ltd., Marconi House, Strand, London). They need not, therefore, be repeated here.

As an additional problem the student may take the case of the resistance of the same skeleton cube between two adjacent corners, a and b (see Fig. 5).

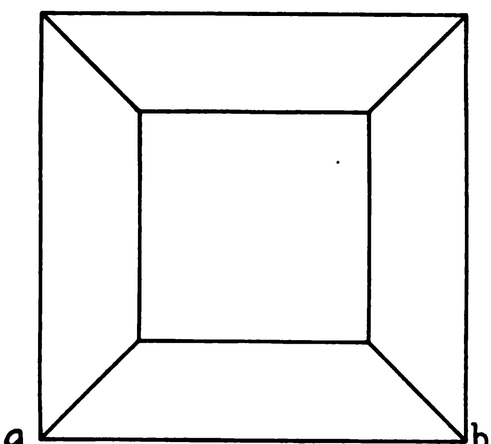


FIG. 6.

Now this is clearly the same as that of the plane network shown in Fig. 6, each branch of which is 1 ohm. Hence, if we supply the zero conductor and the mesh symbols we have merely to find the resistance between a and b of the plane network of 6 meshes, as in Fig. 7.

The mesh equations are then :

$$x-y=1$$

$$-x+4y-u-v-w=0$$

$$4z-u-v-w=0$$

$$-y-z+4u-v=0$$

$$-y-z-u+4v-w=0$$

$$-y-z-v+4w=0$$

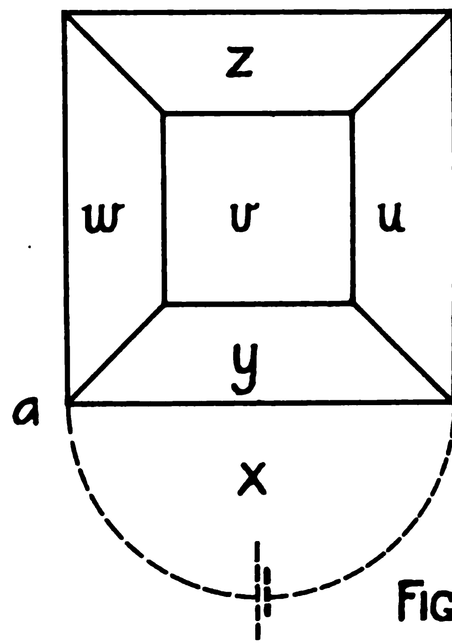


FIG. 7.

Hence the resistance between a and b is the quotient of two determinants :

$$\frac{\begin{vmatrix} 1 & -1 & 0 & 0 & 0 & 0 \\ -1 & 4 & 0 & -1 & -1 & -1 \\ 0 & 0 & 4 & -1 & -1 & -1 \\ 0 & -1 & -1 & 4 & -1 & 0 \\ 0 & -1 & -1 & -1 & 4 & -1 \\ 0 & -1 & -1 & 0 & -1 & 4 \end{vmatrix}}{\begin{vmatrix} 4 & 0 & -1 & -1 & -1 \\ 0 & 4 & -1 & -1 & -1 \\ -1 & -1 & 4 & -1 & 0 \\ -1 & -1 & -1 & 4 & -1 \\ -1 & -1 & 0 & -1 & 4 \end{vmatrix}} = \frac{224}{384} = \frac{7}{12}$$

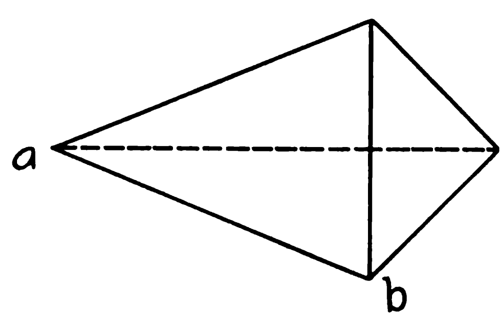


FIG. 8

The working out of these numerical determinants by the rules given in *The Wireless Telegraphist's Pocket Book* may be left to the reader. The answer is $\frac{7}{12}$ths of an ohm.

As a final example, consider the case of skeleton tetrahedron each side of which is a 1-ohm wire. Find the resistance between two adjacent corners.

It is obvious that when a conductor joins two points at the same potential its removal will not alter the resistance of the network. Hence the resistance of the tetrahedron is equivalent to the resistance of the plane network in Fig. 9, each bar of which is 1 ohm. This is obviously, then, ½ an ohm, which is therefore the resistance of the tetrahedron in Fig. 8 between adjacent corners.

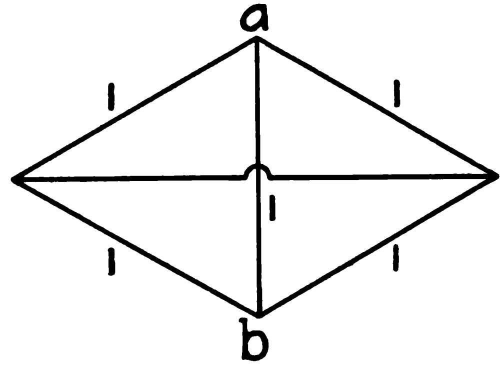


FIG. 9.

The Calculation of Wave-Lengths of Aerials

By W. H. NOTTAGE, B.Sc.

THE wave-length of a circuit in which the inductance and capacity are localised in separate units is given by the formula $\lambda_m = 1885\sqrt{LC}$, the units being metres, microhenries and microfarads respectively.

To obtain the wave-length of a circuit in which the inductance and capacity are distributed over the same unit as they are for an aerial, a different formula must be used, since the effective values differ from the measured or calculated values of these quantities.

When the aerial is tuned to some other than its natural wave-length, by adding inductance coils or condensers, or both, we have a circuit consisting partly of distributed and partly of localised inductance and capacity, the wave-length must be calculated from a formula which takes account of the ratio of the localised to distributed values.

In an article in the *Electrical World* for January 30th, 1915, Dr. L. Cohen has given a formula by which the wave-length of an aerial with an inductance coil in series may be determined for the case of an aerial with *uniformly* distributed inductance and capacity.

The formula, reduced to the usual units of microhenries, microfarads and metres may be put into the form—

$$\lambda = \frac{1885\sqrt{LC}}{Q}$$

where $$\cot Q = Q\frac{L_1}{L_0}$$

$$Q = \frac{\pi}{2}\frac{\lambda_0}{\lambda_1}$$

By plotting graphs of $y_1 = \cot Q$ and of $y_2 = \frac{L_1}{L_0}$ the points of intersection give the values of Q to insert in the formula for the fundamental wave-length and harmonics, the first intersection being the value for the fundamental.

This formula is evidently suitable when the ratio of the aerial inductance to added inductance is known, but is not so convenient when the inductance of the aerial is not known. Examples of its use will be found in Dr. Fleming's Pocket Book.

By extending the calculations the author has worked out the following table, by which the ratio of these inductances can be determined if the two wave-lengths of the aerial, unloaded and loaded, be measured, the inductance added being known.

From this the inductance of the aerial, and therefore its capacity, is at once determined, so that the method affords a simple method for measuring these quantities with the aid of a wave-meter and a coil of known inductance.

$\frac{L_1}{L_0}$	$\frac{\lambda_0}{\lambda_1}$	$\frac{\lambda_1}{\lambda_0}$	Q	$\frac{\lambda_c}{\lambda_m}$
0·00	1·00	1·00	1·57	1·57
·05	·962	1·040	1·51	1·54
·10	·909	1·100	1·46	1·50
·20	·838	1·194	1·31	1·44
·30	·777	1·29	1·22	1·39
·40	·728	1·37	1·14	1·35
·50	·687	1·45	1·078	1·32
·60	·651	1·53	1·022	1·29
·70	·616	1·62	·968	1·26
·80	·589	1·70	·925	1·24
·90	·568	1·76	·892	1·228
1·0	·544	1·84	·853	1·207
1·5	·468	2·13	·735	1·162
2·0	·414	2·42	·650	1·128
2·5	·376	2·66	·590	1·102
3·0	·347	2·88	·545	1·093
3·5	·325	3·08	·510	1·083
4·0	·302	3·31	·475	1·072
5·0	·278	3·60	·437	1·068
6·0	·252	3·98	·400	1·060
7·0	·235	4·26	·369	1·049
8·0	·220	4·52	·347	1·039
9·0	·208	4·80	·327	1·036
10	·199	5·03	·312	1·033
12	·181	5·52	·285	1·026
14	·168	5·95	·264	1·023
16	·158	6·35	·247	1·021
18	·149	6·72	·234	1·018
20	·141	7·09	·222	1·016
22	·135	7·43	·212	1·014
24	·129	7·74	·203	1·012

In the table L_0 is the inductance and γ_0 the natural wave-length of the aerial itself, L_1 is the added inductance and λ_1 the resulting wave-length; λ_c is the wave-length given by the formula $\lambda = 1885\sqrt{LC}$, and λ_m is the actual measured wave-length.

The second column gives the ratio of the wave-length of the loaded aerial to the natural wave-length of the unloaded aerial, and the third column gives the reciprocal ratio.

In column four the values of Q are given, and in the fifth column the ratio of the wave-length calculated from the ordinary formula to the true wave-length is given. It will be noticed that as the value of $\frac{L_1}{L_0}$ increases this ratio becomes more and more near to unity, so that for large values of $\frac{L_1}{L_0}$ the wave-length given by the formula is approximately correct.

A similar calculation can be made for the case of an aerial tuned to another wave-length by a series condenser.

In this case the formula is—

$$\tan s = -s\frac{c}{c_0}$$

$$s = \frac{\pi}{2}\frac{\lambda_0}{\lambda_1}$$

(see Eccles Handbook.)

The negative sign for the values of tan s indicates that angles with negative tangents are to be used in the formula.

The values of s and $\frac{\lambda_c}{\lambda_m}$ have not been given as they are not of so much value as in the inductance formula.

It will be noticed that the tables give only the values for the fundamental wave-length to which the aerial will be tuned by the given inductance or capacity, since for the purpose of measurement these are alone required.

The harmonics can be found from the graphs as in the case for the inductance formula. To show the use of the tables we append some numerical examples.

$\frac{C_1}{C_0}$	$\frac{\lambda_1}{\lambda_0}$	$\frac{\lambda_0}{\lambda_1}$
4·0	·917	1·091
3·8	·913	1·095
3·6	·908	1·101
3·4	·904	1·106
3·2	·899	1·112
3·0	·894	1·119
2·8	·888	1·126
2·6	·882	1·134
2·4	·874	1·144
2·2	·866	1·155
2·0	·855	1·170
1·8	·842	1·188
1·6	·830	1·205
1·4	·816	1·225
1·2	·798	1·253
1·0	·774	1·292
·9	·760	1·316
·8	·744	1·344
·7	·727	1·376
·6	·708	1·412
·5	·685	1·460
·45	·675	1·48
·40	·661	1·51
·35	·646	1·55
·30	·630	1·59
·25	·612	1·63
·20	·592	1·69
·15	·571	1·75
·10	·549	1·82
·05	·525	1·91
·00	·500	2·00

Example 1.

An aerial of natural wave-length, 300 metres, gives 924 metres when an inductance of 875 microhenries is connected in series. What is the inductance and the capacity of the aerial?

Ratio of wave-lengths $\frac{\lambda_1}{\lambda_0} = \frac{924}{300} = 3{\cdot}08.$

From the table the ratio of $\frac{L_1}{L_0}$ which corresponds to this is 3·5.

Hence inductance of the aerial is

$$\frac{875}{3{\cdot}5} = 250 \text{ microhenries.}$$

The natural wave-length of the aerial is given by

$$\lambda = \frac{1885\sqrt{LC}}{1{\cdot}57}$$

1·57 = value of Q tor $\frac{L_1}{L_0} = 0$, which is the case for the plain aerial.

$$(300)^2 = \frac{(1885)^2}{(1{\cdot}57)^2} \times 250 \times C$$

$$C = 00025 \text{ mfds.}$$

Example 2.

To what wave-length will this aerial be tuned if a capacity of ·0001 mfd. be connected in series?

We have $\frac{C_1}{C_0} = \frac{\cdot 0001}{\cdot 00025} = \cdot 4,$

for which $\frac{\lambda_1}{\lambda_0} = \cdot 661,$

whence $\lambda = 198$ metres.

The formulas and tables are only strictly applicable to aerials of which the inductance and capacity per unit length is constant for the whole length of the aerial, as this forms one of the conditions of Dr. Cohen's mathematical investigation.

There has not yet been published any paper by which corrections in the non-uniformity of the inductance and capacity per unit length can be allowed for, and it is, of course, impossible at present to determine the corrections experimentally for certain standard forms of aerials—an investigation which would be of great use.

* * *

NOTE—Since the above was written there has appeared, in the *Electrical World* for January 15th, 1916, an article by Mr A. F. Buchstein dealing with the case of two aerials in series.

The equations are very complicated, and it has not been possible to combine the results of this investigation with the present article.

NOTHING DOING.

Under the heading " The Week's Fables " our contemporary, the ***Weekly Dispatch***, publishes the following paragraph:

" ' Richest and the most powerful nation,'
" sputtered the whining German wireless,
" ' please do let us be friends and have a
" ' heart-to-heart understanding with one
" ' another ! '

" But in the hot and crackling flame, the
" American Wireless flashed back: ' L-U-
" S-I-T-A-N-I-A ! ' "

Doings of Operators

IN THE CAUSE OF HONOUR.

It is with the deepest regret that we have to announce the death whilst on active service of Operator John Kenneth Lush, who entered the service of the Marconi Company in September, 1910. The late Mr. Lush, who was born at Kilmington, was 23 years of age, and first studied wireless at the British School of Telegraphy. On joining the service he entered the Liverpool School, and was soon appointed to the s.s. *Ascanius*, afterwards serving on a number of vessels. At the outbreak of war he volunteered for active service, and proceeded to the Near East, later enlisting in the Australian Force, and eventually landing at the Dardanelles. It was whilst serving in the trenches that he met his death, being struck in the head by a bullet. We understand that his death was painless, as he was killed instantaneously. All those who may have come into contact with Mr. Lush will be grieved to hear of his death, as wherever he was he made himself a popular figure. By his decease the Marconi Company loses the services of a thoroughly gentlemanly and competent operator, and we take this opportunity of expressing to the late gentleman's relatives our deepest sympathy in their time of trouble.

The late Operator Lush

The late Operator Baker.

* * *

DIED IN HOSPITAL.

We also have to announce with deep regret the death of Operator James Robert Baker, who passed away at the General Hospital in Alexandria, Egypt, on January 19th. Some days previous to this the late gentleman had been landed from the steamer on which he was serving suffering from acute pulmonary tuberculosis, his condition being extremely grave. Mr. Baker, who was but 22 years of age, entered the Marconi Company in April, 1913, and in June of that year was appointed to the s.s. *Adriatic*. He later served upon the s.s. *Orissa*, *City of Florence*, *Whakurua*, and a number of other vessels. We are sure all our readers will join with us in extending the deepest sympathy to the late Mr. Baker's relatives in their terrible bereavement.

We have to record still one more death in the operating staff, this time of Charles Christopher Porter, who passed away towards the end of last year. Mr. Porter, who was not quite 21 years of age at the time of his death, received his preliminary training in wireless telegraphy at the Atlantic Wireless College, and entered the service of the Marconi Company in December, 1914. He first went to sea on the s.s. *Manitow*, later transferring to the s.s. *Kenilworth Castle*. After some further service he was taken ill, and proceeded on sick leave in June last. Unfortunately he never recovered, and passed away after five months' illness. We take this opportunity of expressing our sincere sympathy to the late gentleman's relatives in the sad loss they have sustained.

The late Operator Porter.

* * *

THE S.S. "MARERE" SUNK.

We are happy in being able to report that Mr. William Alexander Guy, who was in charge of the wireless installation on board the s.s. *Marere*, recently sunk by an enemy submarine, has been saved. Mr. Guy, who entered the service of the Marconi Company in December, 1912, is 19 years of age, and makes his home at Hampstead. Entering the clerical staff of the Marconi Company, he became interested in the practical side, and after a course of training in the company's evening classes at Marconi House joined the operating staff in August, 1914. Previous to serving upon the s.s. *Marere* he sailed on the s.s. *Rowanmore*. He is to be congratulated upon coming through this exciting adventure without mishap.

Operator W. Guy

* * *

THE FOUNDERING OF THE S.S. "POLLENTIA."

On page 800 we give particulars of the loss of the Cunard liner *Pollentia* off Cape Race. This ship carried two operators, Messrs. Rose and Davies. The senior

Operator Rose.

operator, Mr. Frederick William Rose, is 25 years of age, and resides at Highgate. He received his wireless training at the Marconi Company's evening classes, and was appointed to the staff in October, 1914, since serving on a number of ships. The junior operator, Mr. Alfred Charles William Davies, is a comparatively new recruit to the wireless service, having joined in September last. He received his preliminary wireless training at the South Wales Wireless College, and upon appointment to the staff first served on the s.s. *Aidan*, and thence was transferred to the *Pollentia*. Both gentlemen, fortunately, were saved, and are none the worse for their exciting experience.

Operator Davies.

LOSS OF THE S.S. "NORSEMAN."

The ill-fated s.s. *Norseman*, which was recently reported as sunk, carried two operators, Messrs. Oliver and Browne. The senior operator, Mr. John Robert Oliver, whose home is at Clapham, is 19 years of age, and first studied wireless at the British School of Telegraphy. He entered the Marconi Company's service in May, 1915, making his first voyage to sea on the s.s. *Jose de Larrinaga*. The junior operator, Mr. Francis Thomas Browne, a native of Kildare, received his wireless training at the Irish School of Telegraphy. He is 20 years of age. Since joining the Company in July, 1915, he has served on the s.s. *Nicosian*, *Nortonian*, *Aidan*, and was appointed to the s.s. *Norseman* at the end of last year. Both

Operator Oliver.

men have fortunately been rescued, and we congratulate them upon their escape.

* * *

THE S.S. "APPAM."

Mr. Robert Jones, whose photograph and biographical notes appeared in these columns in connection with the torpedoing of the s.s. *Hesperian*, has again been forced to undergo a most exciting experience by virtue of his position as wireless operator on board the famous liner *Appam*. Upon his return to

Operator Browne.

Operator Robert Jones.

this country he will no doubt have an interesting story to tell, but at present we are unable to publish any particulars of his adventures. For particulars of Mr. Jones's service in the Marconi Company we would refer our readers to page 468 of the October issue.

* * *

SERBIAN GOLD MEDAL FOR WIRELESS OPERATOR.

It is with the greatest pleasure that we are able to report that Warrant Officer Harry Noble is the proud recipient of a Gold Medal bestowed on him by King Peter of Serbia for distinguished services to the Serbian Government. Mr. Noble is 23 years of age, and resides when in England at Saddleworth, Yorkshire. He received his education in his native town, at Oldham Hulme Grammar School, and at Manchester Technical School. Upon becoming interested in wireless telegraphy he took a course at Fallowfield Wireless College, Manchester. Here he received his Postmaster-General's First Class Certificate, and in November, 1913, joined the Marconi Company. After serving on the s.s. *Minnetonka* he was transferred to the s.s. *Palma*, and upon the outbreak of war volunteered for active service. As it may interest our readers, we reproduce below a letter addressed to the Vice-Admiral, Malta, a copy of which Mr. Noble received with the medal. It reads as follows :—

" Belgrade, Serbia,
" 20th September, 1915.

" SIR,—I beg to forward herewith the " Serbian 'Gold Medal for Zealous Service " in War,' which medal his Majesty King " Peter of Serbia has graciously conferred " upon Mr. Harry Noble, Warrant Telegra- " phist, R.N.R., serving under my command " in Serbia until 4th July last, and I request " that steps may be taken for this medal " to be handed to Mr. Noble. In a despatch " from his Britannic Majesty's Minister in " Serbia, dated 18th September, 1915, I am " informed that the King has been graciously " pleased to grant full and unrestricted per- " mission to the officer to accept and wear " this medal.

" I have the honour to be, Sir, your " obedient servant,

" (Signed) E. TROUBRIDGE,
" *Rear-Admiral.*
" Head of British Naval Mission
" in Serbia.

" The Vice-Admiral and Senior
" Naval Officer, Malta."

Operator Noble.

QUESTIONS AND ANSWERS

Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study to the Editor,* THE WIRELESS WORLD, *Marconi House, Strand, London, W.C. Such questions must be accompanied by the name and address of the writer, otherwise they will remain unanswered: and it must be clearly understood that owing to the Defence of the Realm Act we are totally unable to answer any questions on the construction of apparatus during the present emergency.

SPECIAL NOTICE.

Readers are requested to note that save in exceptional circumstances we are unable to deal with queries through the post.

H. H. (The Hague, Holland).—The method of amalgamating a zinc rod by letting it stand in a little mercury is well known. The mercury creeps up the zinc much as you find the liquid in the cell creeping up the side and giving a crust of crystals. (2) The rotary type of variable condenser is used in most cases because its capacity is far larger for a given size than the tubular form. Where only a small capacity is required the tubular type is often used.

PTE. J. F., R.A.M.C. (Brit. Exp. Force).—We cannot express an opinion on the case you mention, but if the applicant writes to the Traffic Manager, Marconi International Marine Communication Company, Ltd., Marconi House, Strand, W.C., his case will receive consideration.

Our contemporary the *Publishers' Circular* prints the following:

"Will the editor of the excellent all-British monthly, THE WIRELESS WORLD, tell us what words the letters SOS stand for, which are flashed out by ships in peril on the sea? Are they used by all nations? They might well stand for 'Send out succour'—as that is their effect—but ours is not the only language heard on the sea."

Answer.—This is a query which has been put to us on several occasions recently, and we have much pleasure in dealing with it here. First of all the international distress signal called SOS is not sent as S.O.S. and is not really SOS at all. The signal transmitted consists of three dots three dashes, and three dots, thus . . . — — — . . . It was chosen because it happened to be a rhythmic signal quite unlike any of the signs for letters, figures, or punctuation used in ordinary wireless correspondence. In the official International Regulations it is never referred to as SOS, but is always printed in the characters above shown. It is popularly called SOS as these letters *sent together without spacing between them* give the signal required, but for that matter so do the letters VTB, SMB, IJS, and many other combinations. The reader will now understand that contrary to the widely held opinion, SOS does not stand for "Send out succour," "Save our souls," "Sink or swim," or any other highly dramatic phrases. Just as the sign "dot-dash" in the International Code stands for the letter A, whatever language is being used, so the signal three dots, three dashes, and three dots stands for a distress call, whether the ship using it is English, French, Spanish, or belonging to any other nationality. It pains us to remove the happy idea relating to "Send out succour," an idea so largely exploited in the daily press, but above are the facts of the case, and we must print them.

F. V. M. (Co. Kerry).—Thanks for your letter. We would not for a moment suggest that you are actuated by any motives other than those of strict patriotism. The cause of our remark was that we did not know whether you were aware that this system was of alien origin. It doesn't do in these times to give your neighbours or associates the idea that you are studying anything German, does it?

H. A. (Junior) (Gibraltar).—You do not state in your letter whether you are a British subject. If so, with the qualifications you possess your services could probably be utilised in His Majesty's Forces. Otherwise you might communicate with Messrs. The Marconi's Wireless Telegraphic Co. of America, Woolworth Buildings, 233 Broadway, New York, stating your qualifications and giving full particulars of yourself, at the same time asking whether they have any vacancy which they could offer you. There might also be vacancies for a wireless man in the Official Services of the South American Republics. We have no information regarding the rank and pay of a radio-telegraphist in the United States Navy.

F. S. (Wells, Norfolk).—We are not in the position to answer your first question. In reply to the second query, we understand that in certain cases complete training is given, but if you have a good knowledge of the Morse code, and some acquaintance with the theory, this should be of great benefit. In answer to the third question, if you have well studied the books mentioned by you, you should be well equipped with theoretical knowledge, and we do not know of any volumes of greater use to you.

A. P. (High Lane, Cheshire).—We would advise you to apply to the nearest naval recruiting office for particulars of enlistment in the branch of the service to which you refer. We think, however, that in view of the injury to your forearm you would be unable to qualify for such an appointment. In any case, there is no harm in applying, and we are sure that full information would be given. If you drop a line to any of the wireless colleges advertising in THE WIRELESS WORLD they will send you particulars of fees, etc. Thank you for your kind remarks regarding our magazine, which we trust will continue to be of great use to you.

T. J. H. (Banfield, Vancouver Island, B.C.).—The calculation of capacities of transmitting condensers is fully dealt with in THE WIRELESS WORLD for December, 1914, and January, 1915. We would advise you to obtain these articles if you are interested in the calculation of capacities, as they contain many practical hints and go fully into the subject.

W. H. H. (Goldhanger, Essex).—Thank you for your kind remarks regarding our magazine. We regret we are not in the position of giving you any information concerning the wireless section of the branch to which you refer. We think you will understand that it is not advisable for us to publish such particulars in our magazine.

F. O. R. (Conway, North Wales).—There are several wireless schools in the neighbourhood of Liverpool where you could obtain the necessary training. A line to any of the colleges advertising in THE WIRELESS WORLD will bring you full particulars. A large amount of study can be done at home, particularly with regard to the theory and the new "Marconi Official Records," announced on another page, should prove of the greatest use to you. Certain of the colleges run corresponding courses, and these you will find referred to in our advertisements. If you know nothing whatever of the subject, we would advise you to purchase the "Handbook of Technical Instruction for Wireless Telegraphists," by J. C. Hawkhead and H. M. Dowsett, obtainable from our publishers, price 3s. 10d. post free. This contains all the theory that it is necessary to know in order to pass the Postmaster-General's examination If you have a gramophone, the "Marconi Official Records" will give you an excellent preliminary training in receiving wireless signals. We hope to publish shortly one or more articles concerning home training in sending and receiving, and we think that these will prove of great help to you.

W. S. H. (Leicester), who is very deaf and cannot hear ordinary 'phones even of the best quality, wishes to know of some approximate test so that he may be able to know if a telephone relay which he has invented compares favourably with one made professionally; that is, as far as the volume of sound delivered is concerned when compared with the volume of sound which would be delivered by an ordinary wireless 'phone.

Answer.—We think that the best method in the circumstances would be to connect an ordinary telephone headpiece, as used in wireless telegraphy, to a feeble alternating current supply, so as to give a hum in the headpiece, and then to reduce the strength of the current until the sound is just inaudible to a person of normal hearing wearing the telephones. If then the relay connected in place of the 'phones gives a sound equivalent in strength to what is usually termed "good wireless signals," and provided that it is fairly robust and keeps in adjustment without trouble, it can be considered as an efficient and serviceable instrument. The sensitivity of a telephone varies with the frequency, and so, if possible, tests should be made at the spark frequency most likely to be received. The minimum current which will give a sound depends on resistance, etc., of the telephone, sensitivity of the ear and frequency of note, and hence cannot be given off-hand. We should be very interested to hear the result of the tests, and any further assistance we shall be only to glad to give.

D. E. R. (Treorchy, Glam.).—Submarine signalling is generally carried on by means of vibrations in the water. The transmitter usually consists of a submarine bell, and the receiver is a sensitive apparatus carried on board ship and giving the sound of the bell in telephones, at which the officer making the observations can listen. Two telephones are used, one connected to the port receiving apparatus and the other to the starboard. In order to determine the direction from which the submarine signals are coming, the officer listens alternately to the port and starboard receiving instruments, and if the signals are coming from the starboard side, the signals on that side will be the louder. If the bell is dead ahead the sound will be equal in both receivers.

J. J. M. (Moate, Co. Westmeath).—"The Marconigraph" is incorporated with THE WIRELESS WORLD, and is not kept on as an independent paper. In answer to the second question, once the hammer of an electric bell is removed the instrument becomes a buzzer, and with a little adjustment can be used for practice purposes.

SIGNALLER T. M. (8th K.O.Y.L.I. Transport, B.E.F.).—According to some theories of electricity an uncharged body contains positive and negative electricity in equal quantities. A body is said to be charged positively when the positive electricity is not in excess and negatively when the negative is in excess. Does this give the information you require? If not write to us again. In reply to your second question, prior to the war civilians were allowed to erect wireless stations provided they obtained a licence from the Postmaster-General and complied with certain requirements regarding maximum power, wave-length, etc. The transmitting apparatus had to be tuned to prevent as far as possible interference with other stations. At the present time nothing in the nature of an amateur wireless installation is of course allowed.

H. J. M. (Newcastle, N.S.W.).—We understand that the articles to which you refer contain all the information at present available on the apparatus mentioned by you. We cannot publish detailed particulars and connections of patented apparatus for obvious reasons. We are delighted to hear that you appreciate our publications, and trust that they will be of continued use to you.

A number of queries are unavoidably held over owing to lack of space.

Patent Record.

14422. Oct. 12th. Marconi's Wireless Telegraph Co., Ltd., & I. Shoenberg. Frequency multipliers. (*Provisional.*)

14500. Oct. 13th. Joseph Bethenod & Emile Girardeau. Radio-telegraphy. (Convention date, Oct. 15th, 1914, France.) (*Complete.*)

14696. Oct. 18th. Siemens & Halske Akt., Ges. Spark gap arrangements for oscillatory circuits. (Convention date, Nov. 23rd, 1914, Germany.) (*Complete.*)

14729. Oct. 19th. Arthur W. Long. Arrangements of circuits for the transmission and reception of ether waves—*e.g.*, those used in wireless telegraphy. (*Provisional.*)

14769. Oct. 19th. British Thomson-Houston Co. (General Electric Co., U.S.A.) Wireless signalling systems. (*Provisional.*)

14864. Oct. 20th. John Gell. High-frequency generators. (*Provisional.*)

14918. Oct. 21st. Siemens & Halske Akt., Ges. Production of vacua and means therefor. (Convention date, Nov. 14th, 1914, Germany.) (*Complete.*)

15237. Oct. 28th. British Thomson-Houston Co. (General Electric Co., U.S.A.) Wireless signalling systems. (*Provisional.*)

15713. Nov. 6th. Alban J. Roberts. Relays. (*Provisional.*)

15915. Nov. 11th. Alexander W. Sharman. High-frequency alternating-current relays for radiotelegraphy and the like. (*Provisional.*)

15978. Nov. 12th. Adrian E. Sykes & Solomon Ford. Electro-chemical microphones, principally for use in connection with wireless telegraphy and telephony. (*Provisional.*)

16151. Nov. 16th. Marconi's Wireless Telegraph Co., Ltd., and Raymond D. Bangay. Variometer for use in wireless telegraphy. (*Provisional.*)

17954. Dec. 23rd. Marconi's Wireless Telegraph Co., Ltd., and Charles S. Franklin. Means for controlling the speed of a machine. (*Provisional.*)

18019 and 18020. Dec. 24th. Gogu Constantinesco and Walter Haddon. Signalling by wave transmission. (*Provisional.*) High-frequency wave transmission generator. (*Provisional.*)

18203. Dec. 31st. Charles S. Lenz. Switch for eliminating dead-end effects in wireless receiving apparatus. (*Provisional.*)

Instructional Article

NEW SERIES (No. 7)

The following series, of which the article below forms the seventh part, is designed to provide wireless telegraphists, amateurs, and technical students generally, with clear and precise instruction in technical mathematics, in order that they may be enabled to read and understand the more advanced technical articles which appear from time to time.

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45. We have so far only considered the trigonometrical ratios of angles lying in value between 0° and 90°; in Fig. 20 we have an angle ABC having a value θ, of something between 180° and 270°. In order to get at its trigonometrical ratios we drop a perpendicular CD on to AB produced.

Then for the angle θ, CD is the "perpendicular" or "opposite" side, DB is the "base" or "adjacent" side, and the rotating arm CB is, as always, the "hypotenuse."

Now there are two very important conventions which are adopted in this connection.

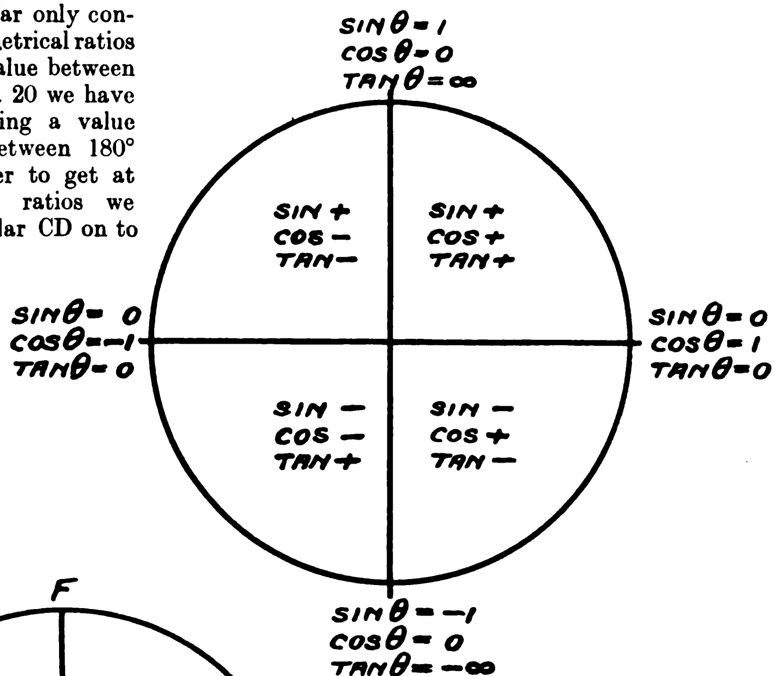


Fig. 21.

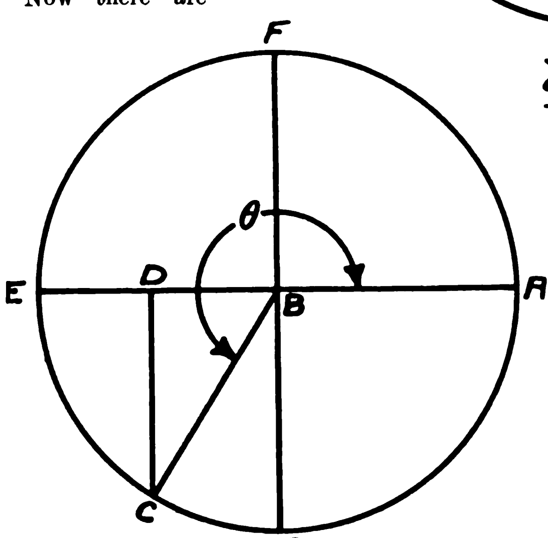


Fig. 20.

46. The first is that the angle swept out by an *anti-clockwise* rotation of the arm is a *positive angle*, and an angle swept out by a *clockwise* rotation is a *negative angle*.

The second convention is adopted in regard to the signs (positive and negative) of the *lines*—*i.e.*, (*a*) the distances (such as DB) along the horizontal; (*b*) the lengths of the perpendiculars (such as DC), and (*c*) the rotating arm (BC). Let us divide the circle in Fig. 20 into four equal part

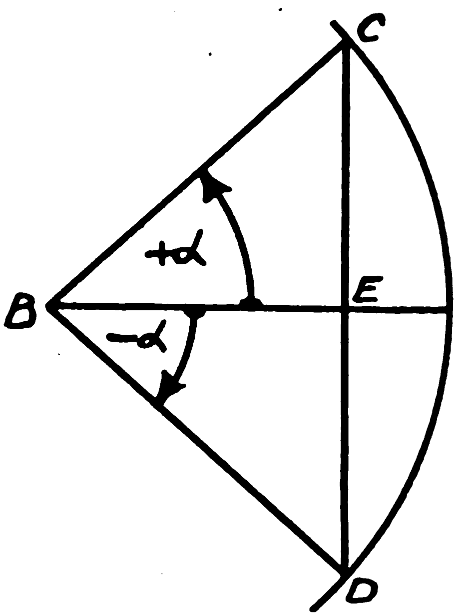


Fig. 22

or four quadrants, by producing AB to make the diameter AE, and then drawing a diameter FG perpendicular to AE. The convention regarding the positive or negative character of the lines is as follows:

Perpendiculars *above* AE are *positive*; perpendiculars *below* AE are *negative*; horizontal distances to the *right* of FG are *positive*; horizontal distances to the *left* of FG are *negative*, and the rotating arm BC is *always positive*.

Thus, considering the angle θ in Fig. 20, DC and DB are negative, while CB is positive. Thus

$$\sin\theta=\frac{-CD}{+CB}\text{ is } \textit{negative}$$

$$\cos\theta=\frac{-BD}{+BC}\text{ is } \textit{negative}$$

$$\text{and }\tan\theta=\frac{-DC}{-DB}\text{ is } \textit{positive}.$$

Fig. 21 shows the sign (+ and −) for sin θ, cos θ, and tan θ, for all values of θ; all values from 0° to 90° come in the first quadrant, all values from 90° to 180° in the second quadrant, and so on. The actual values of the three ratios at 0° (or 360°), 90°, 180°, and 270°, are also shown.

47. In Fig. 22, if AB sweeps out the angle ABC equal to α in an ***anti-clockwise*** direction, and then returns and sweeps out the angle ABD, also equal to α, in a ***clockwise*** direction, then angle ABC is +α, and angle ABD is −α.

As CED, the straight line joining C and D and cutting AB at E, is perpendicular to AB, then,

$$\sin(+\alpha)=\frac{CE}{CB}=\frac{-DE}{DB}$$
$$=-\sin(-\alpha)$$
$$\cos(+\alpha)=\frac{BE}{BC}=\frac{BE}{BD}$$
$$=\cos-(\alpha)$$
$$\tan(+\alpha)=\frac{EC}{EB}=\frac{-ED}{EB}$$
$$=-\tan(-\alpha).$$

48. In trigonometrical tables the values of the various ratios are only given for angles between 0° and 90°. If then we wish to find the value of, say, sin 240°, we must convert sin 240° into some ratio of some angle between 0° and 90°.

The angle ABC, Fig. 23, is an angle of 240°, and so if ABD is a diameter of a circle with centre B, then the angle DBC is (240° − 180°) = 60°. Thus, if CB be produced, as shown to E, the angle ABE will also equal 60°.

Proceeding as before, we drop two perpendiculars CF and EG from C and E respectively on to AD.

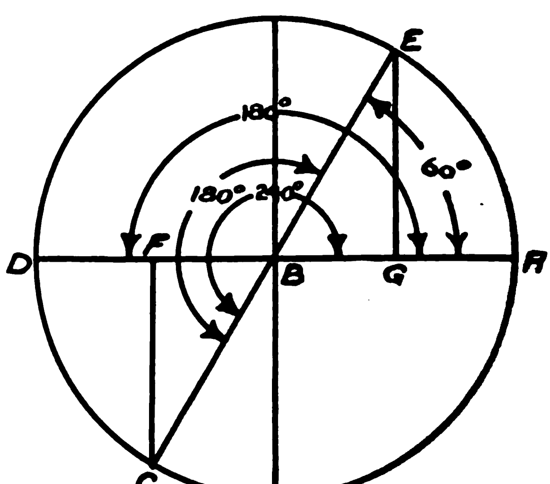


Fig. 23.

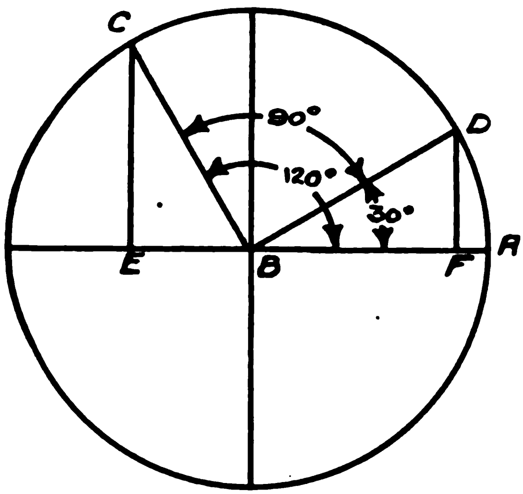


Fig. 24.

Then $\sin 240° = \frac{CF}{CB}$, and is obviously equal to $-\frac{EG}{EB}$ (for FC = −EG and BC = BE).

Thus $\sin 240° = -\sin 60°$

$$= -\frac{\sqrt{3}}{2}.$$

The net effect of drawing the diameter CE and then considering the angle EBG has been to cut 180° off the angle of 240° with which we had to deal.

We have seen that

$$\sin 240° = -\sin 60°$$
$$\sin (180° + 60°) = -\sin 60°$$
$$\text{or } \sin (180° + \theta) = -\sin \theta.$$

49. In Fig. 24 the angle ABC is 120°—between 90° and 180°—and we will suppose we want to find the value of tan 120°.

Draw the radius BD, as shown, perpendicular to the rotating arm BC. Then angle

$$ABD = \text{angle } ABC - \text{angle } CBD$$
$$= 120° - 90°$$
$$= 30°.$$

Draw perpendiculars CE and DF as shown. Then $\tan 120° = \frac{CE}{EB}$.

As the triangles CEB and BFD are equal in every way, in place of

$\frac{CE}{EB}$ we can write $\frac{BF}{FD}$.

Now CE is positive and EB negative, and so tan 120° is negative. As, however, BF and FD are both positive, we must write—

$$\tan 120° = \frac{CE}{EB} = -\frac{BF}{FD}$$
$$= -\cot 30°,$$
$$\text{or } \tan (90° + 30°) = -\cot 30°,$$
$$\text{or } \tan (90° + \theta) = -\cot \theta.$$

Similar arguments apply to the other ratios, and from the results obtained we can make out the following tables :

$$\sin (90° + \theta) = \cos \theta.$$
$$\sin (180° + \theta) = -\sin \theta$$
$$\sin (270° + \theta) = -\cos \theta$$
$$\cos (90° + \theta) = -\sin \theta$$
$$\cos (180° + \theta) = -\cos \theta$$
$$\cos (270° + \theta) = \sin \theta$$
$$\tan (90° + \theta) = -\cot \theta$$
$$\tan (180° + \theta) = \tan \theta$$
$$\tan (270° + \theta) = -\cot \theta.$$

50. We see from the foregoing that the trigonometrical ratios of any angle could be obtained from a table giving the values of the ratios for angles from 0° to 90°.

In Fig. 25 the first quadrant ABC of a circle radius AB has been divided into two equal parts by the radius BD at 45° from AB. ABE is any angle θ, greater than 45° and smaller than 90°. EF is the usual perpendicular from E on to AB.

If, now, we consider the angle ABE or we see that $\sin \theta = \frac{EF}{EB}$

$$= \cos BEF.$$

Now all the three angles of triangle FBE added together equal *two* right angles, and

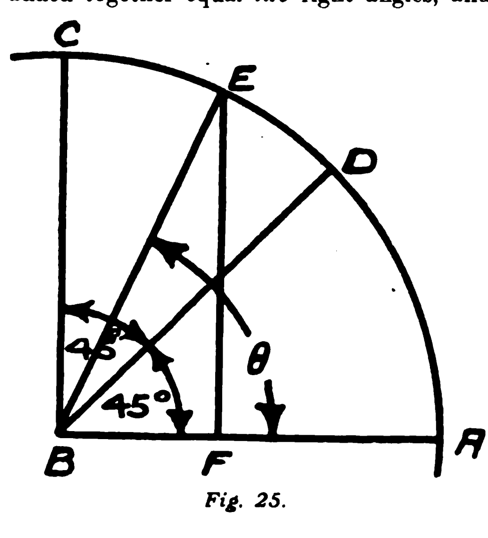


Fig. 25.

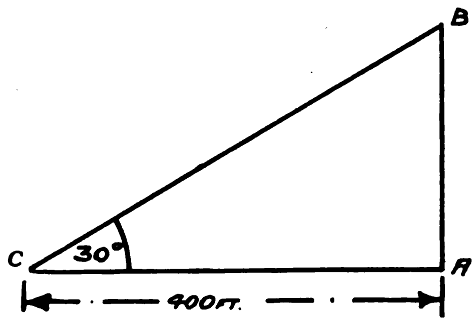


Fig. 26.

the angle EFB has been made equal to *one* right angle (EF being perpendicular to AB). Thus the two remaining angles EBF and BEF are together equal to one right angle or 90°, and as EBF is *greater* than 45°, BEF must be *less* than 45°.

From this we see that the sine of any angle θ greater than 45° and smaller than 90° can be obtained from a table giving the cosine of an angle $(90°-\theta)$ smaller than 45°, or $\sin\theta=\cos(90°-\theta)$.

Similarly $\cos\theta=\sin(90°-\theta)$,
and $\tan\theta=\cot(90°-\theta)$.

From the above considerations it will be easily seen that in compiling a table giving $\sin\theta$, $\cos\theta$, and $\tan\theta$ from 0° to 90°, we should find that all the values tabulated for angles greater than 45° would have occurred as (different) ratios for angles smaller than 45°. For example, the values for sin 60°, sin 61°, sin 62° . . . . . would be the same as the values for cos (90°—60°), cos (90°—61°), cos (90°—62°) . . . . . or cos 30°, cos 29°, cos 28° . . . . .

This is why trigonometrical tables are arranged as we saw in the previous article, the values from 0° to 45° being read off *downwards* and from the *left*, and values from 45° to 90° *upwards* and from the *right*, (see § 44).

A few examples are appended, giving applications of trigonometry to simple problems.

Example 1.

At a point on the same level as the base of a mast, and 400 ft. away from the base, the angle of elevation of the top of the mast is observed to be 30°. Find the height of the mast.

In Fig. 26 AB represents the mast, and C is the point at which the observation is made.

AC being horizontal, the angle of elevation is ACB, given as 30°.

Now $\frac{AB}{AC}=\tan ACB$

or $\frac{AB}{400 \text{ ft.}}=\tan 30°.$

Thus $AB=(400\times\tan 30°)$ ft.

$=400\times\frac{1}{\sqrt{3}}$

$=\frac{400}{1{\cdot}732}=231$ ft. *Ans.*

Example 2.

Find the height of a mast when it is found that, on walking directly towards it 100 ft. along a horizontal line through its base, the angular elevation of its top changes from 30° to 45°.

In Fig. 27 AB is the mast, and C and D are the two positions occupied by the observer when measuring the angles of elevation.

We are told that CD is 100 ft., angle BCA is 30°, and angle BDA is 45°.

Let $BD=x$ ft., and let the height of the mast$=h$ ft.

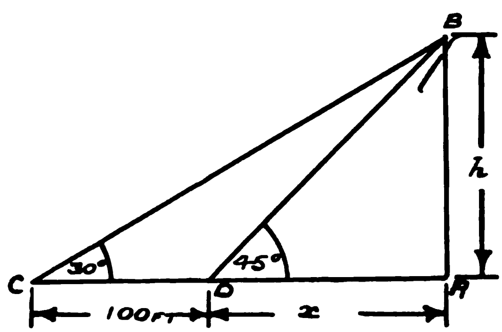


Fig. 27.

From triangle ABD we get

$\frac{AB}{AD}=\tan BDA$

or $\frac{h}{x}=\tan 45°=1.$

Thus $h=x$.

From triangle ABC we get

$\frac{AB}{AC}=\tan BCA$

or $\frac{h}{(100+x)}=\tan 30°=\frac{1}{\sqrt{3}}.$

Thus $\sqrt{3}\times h=100+x$.

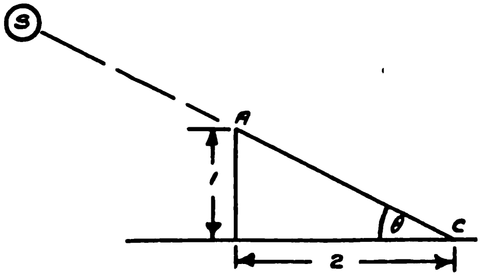


Fig. 28.

But $h=x$, and so

$$\sqrt{3}\times h=100+h$$
$$\sqrt{3}\times h-h=100$$
$$h(\sqrt{3}-1)=100$$
$$h(1{\cdot}732-1)=100$$
$$h\times 0{\cdot}732=100 \text{ or } h=\frac{100}{0{\cdot}732}=136{\cdot}6 \text{ ft.} \quad \textit{Ans.}$$

Example 3.

What is the angle of elevation of the sun when the length of the shadow of a pole is twice the height of the pole ?

In Fig. 28 BC is the shadow of the pole AB, S being the sun. We are told that

$$BC=AB\times 2$$
or if $AB=1$
then $BC=2$.

Thus, if we call the angle of elevation of the sun θ, we know that $\tan\theta=\frac{AB}{BC}=\frac{1}{2}=0{\cdot}5$.

Now from tables we see that the angle whose tangent is 0·5, or $\tan^{-1} 0{\cdot}5$ is nearly 27°.

Thus $\theta=27°$ (nearly). ***Ans.***

Example 4.

A lighthouse sends out a fan-shaped beam of light extending over an arc from north-east to north-west. An observer on a steamer which is sailing due west first sees the light when he is 5 miles away from the lighthouse and continues to see it for 45 minutes. What is the speed of the steamer ?

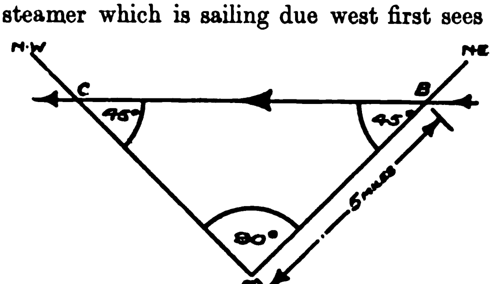


Fig. 29.

In Fig. 29 A is the lighthouse and BAC is the angle covered by the beam of light. BC is the course of the steamer, and as this is due east to west we see that

$$\text{angle } ABC=45°=\text{angle } ACB,$$

and also angle $BAC=90°$.

We also know that $AB=5$ miles.

Now $\frac{AB}{BC}=\sin ACB$ or $\cos ABC=\sin 45°$ or $\cos 45°$,

and so $BC\times\sin 45°=AB$,

$$\text{or } BC=\frac{AB}{\sin 45°}=\frac{5}{\left(\frac{1}{\sqrt{2}}\right)}=5\sqrt{2} \text{ miles}$$
$$=5\times 1{\cdot}414$$
$$=7{\cdot}07 \text{ miles.}$$

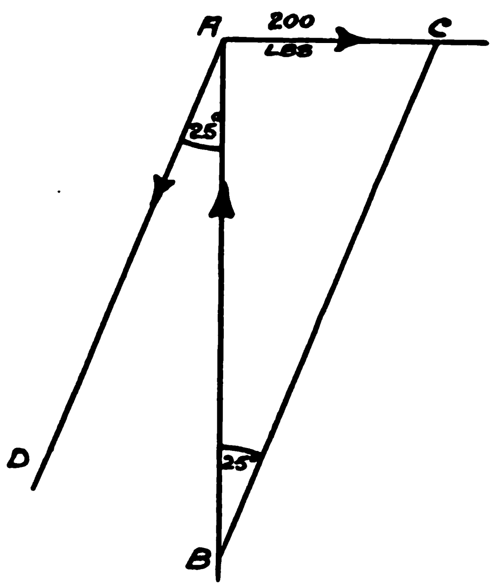


Fig. 30.

Now the steamer covers this distance of 7·07 miles in 45 minutes, and so its speed is

$$\frac{7{\cdot}07}{(\frac{3}{4})}=7{\cdot}07\times\frac{4}{3}=\frac{28{\cdot}28}{3}=9{\cdot}43 \textit{ miles per hour (nearly).} \quad \textit{Ans.}$$

Example 5.

Fig. 30 shows diagrammatically the forces acting at the top of a wireless mast. AB is the vertical line of the mast itself, AD represents a stay making an angle of 25° with the

E

mast, and AC is the horizontal pull of the aerial. We require to find the tension in the stay and also the pressure acting down through the mast, given that the horizontal pull of the aerial is 200 lbs.

In the second series of Instructional Articles (Article 1, May, 1914) it was shown how, by making AC equal to 200 lbs. to any convenient scale, and by drawing CB parallel to the stay AD, the forces acting in the stay and in the mast were given by the respective lengths of BC and BA read off to the same scale as AC.

We will take *any* point C in AC and draw CB parallel to AD. Then angle ABC= angle BAD=25°.

$$\text{Obviously } AB=\frac{AC}{AC}\times AB=AC\times\frac{AB}{AC}$$
$$=AC\times\cot 25°,$$
$$\text{or force } AB=200 \text{ lbs.}\times 2{\cdot}1445 \text{ (cot } 25° \text{ from tables).}$$
$$=428{\cdot}9 \text{ lbs.}$$
$$\text{Similarly force BC (or AD)}=AC\times\frac{BC}{AC}$$
$$=200 \text{ lbs.}\times\operatorname{cosec} 25°,$$
$$\text{or } 200\div\sin 25°$$
$$=\frac{200}{{\cdot}4226}=473{\cdot}3 \text{ lbs.}$$

Pressure in mast=428·9 *lbs.*
Pull in stay=473·3 *lbs.* } *Ans.*

"THE WIRELESS WORLD" PROBLEMS

DURING the month we have received a very large number of letters from readers giving the answer to our last little problem, the majority of the replies being correct. To write and thank our correspondents individually is, we regret, mpossible, and so we take the opportunity of thanking them here.

Readers are reminded that the competition for the *best problem* closed on the last day of February, and the result will be announced in our April number.

Our contemporary the *Electrical Review*, in quoting the cube problem, and in referring to the fact that the answer to the sheet metal part of the problem as given by our correspondent is the same as that given by an *Electrical Review* correspondent says:

" With regard to the second part of the " cube problem, although both solvers " arrive at the same result, we are unable " to agree that the solution is correct. In " point of fact, on consideration of the con- " ditions—a cube constructed of sheet " metal, with current led in and out by " diagonally opposite *corners*—we have " come to the conclusion that the problem is " one of considerable difficulty. The solvers " appear to assume that the resistance of one " side is one ohm, no matter in what direc- " tion the current passes through it, but " this is clearly an inadmissable assump- " tion. It must, of course, be taken that " the sides are in contact along every edge ; " and the resistance of each side from edge " to edge is one ohm—if it is taken diagon- " ally it becomes indeterminate."

We have received a very interesting letter on this subject from a correspondent in Rugby, Mr. H. Liddiard, and hope to be able to deal fully with it at an early date. We also regret that space does not permit of our printing a letter from " C. P. S." of New Brighton.

TRADE NOTE

We are advised that Mr. A. J. Greenly and Theodore Denison have taken over Baldwin & Wills' works, St. Albans Road, Watford, and commenced business as manufacturing electrical and mechanical engineers under the style of Greenly & Denison. The offices of the partnership are 37 and 38 Strand, W.C., and in addition to the munition work which they have undertaken they are in a position to quote for small turning, boring, screw-cutting, planing, die casting, and wood-working of every description.

The business known as Greenly Advertising Service will be carried on by Mr. Greenly as heretofore.

VOLUME III.

The present number brings the third volume of THE WIRELESS WORLD to a close. As all our readers know, THE WIRELESS WORLD is the only authentic British journal devoted exclusively to radio telegraphy.

Anybody who desires a complete bound volume can purchase one from the publishers at Marconi House at a cost of 4s. 6d. plus 6d. for postage. Those who prefer to have their numbers bound on their own account can obtain binding cases, including the full index of the volume, for 1s. 3d.

Order your bound volume early as only a limited supply will be available.

Transmission of Weather Reports by Arlington, Va. (N.A.A.).

By HARRY ROBINSON

ALL bulletins begin with the letters U.S.W.B. (United States Weather Bureau), and the weather conditions follow. The first three figures of a report represent the barometric pressure in inches (002=30·02); the next figure, the fourth in sequence, represents the direction of the wind to the eight points of the compass: 1=north, 2=north-east, 3=east, 4=south-east, 5=south, 6=south-west, 7=west, 8=north-west, and 0=calm. The fifth figure represents the force of the wind on the Beaufort Scale, given below.

BEAUFORT SCALE OF WIND FORCE.

Number and Designation.	Statute miles per hour.	Nautical miles per hour.
0. Calm	0 to 3	0 to 2·6
1. Light air	8	6·9
2. Light breeze... ...	13	11·3
3. Gentle breeze ...	18	15·6
4. Moderate breeze ...	23	20·0
5. Fresh breeze... ...	28	24·3
6. Strong breeze ...	34	29·5
7. Moderate gale ...	40	34·7
8. Fresh gale	48	41·6
9. Strong gale	56	48·6
10. Whole gale	65	56·4
11. Storm	75	65·1
12. Hurricane	90 and over	78·1 and over

In order to simplify the code, no provision has been made for wind force greater than 9, strong gale, on the Beaufort Scale. Whenever winds of greater force than 9 occur the number representing them is given in words instead of figures, thus: Ten, eleven, etc.

The points for which weather reports are furnished are designated as follows:

For Atlantic coast and Gulf points—

S=Sydney.	H=Hatteras.
P=Pensacola.	T=Nantucket.
C=Charleston.	B=Bermuda.
DB=Delaware. Breakwater.	K=Key West.

For points on the Great Lakes—

DU=Duluth.	G=Green Bay.
D=Detroit.	M=Marquette.
Ch=Chicago.	V=Cleveland.
U=Sault Ste. Marie.	L=Alpena.
	F=Buffalo.

EXAMPLE OF CODE.

U.S.W.B.—S 96465, T 91674, DB 94686, H 99886, C 01214, K 02622, P 03613, B 00065.

Translation.

United States Weather Bureau.

Station.	Pressure.	Wind.	
		Direction.	Force.*
Sydney	29·64	SW	5
Nantucket	29·16	W	4
Delaware Breakwater	29·46	NW	6
Hatteras	29·98	NW	6
Charleston	30·12	N	4
Key West	30·26	NE	2
Pensacola	30·36	N	3
Bermuda	30·00	SW	5

* See Beaufort Scale.

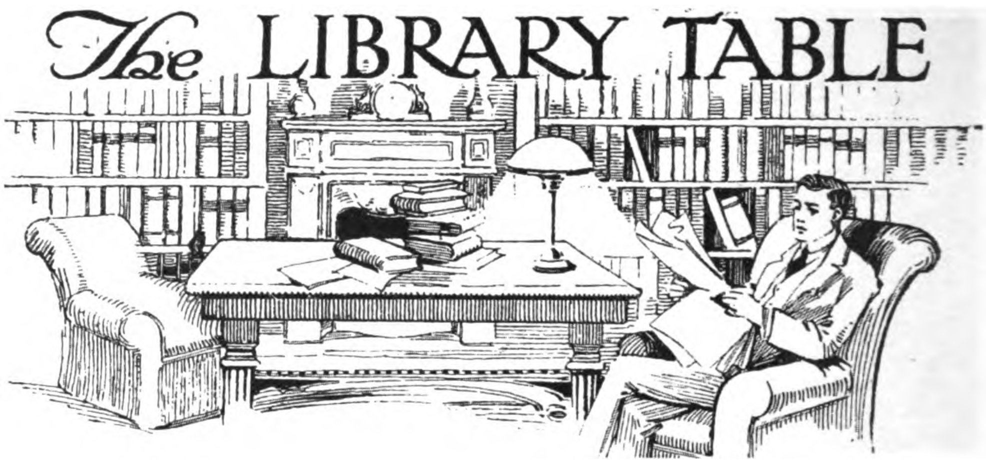
U.S.W.B.—DU 95826, M 97635, U 00443, G 96046, Ch 95667, L 00644, D 00842, V 01054, F 01656.

Translation.

United States Weather Bureau.

Station.	Pressure.	Wind.	
		Direction.	Force.*
Duluth	29·58	NE	6
Marquette	29·76	E	5
Sault Ste. Marie ...	30·04	SE	3
Green Bay	29·60	SE	6
Chicago	29·56	SW	7
Alpena	30·06	SE	4
Detroit	30·08	SE	2
Cleveland	30·10	S	4
Buffalo	30·16	S	6

* See Beaufort Scale.



"THE WIRELESS TRANSMISSION OF PHOTOGRAPHS." By Marcus J. Martin. London: The Wireless Press, Ltd. 2s. 6d. net.

If anything were needed to impress upon us that Senatore Marconi's invention was not only the provision of a new system of telegraphy, but also the foundation of a new science, it is the publication of a book devoted exclusively to "The Wireless Transmission of Photographs." We have already passed the time when the literature of the new science of radio-telegraphy consisted solely of a few treatises and manuals on wireless telegraphy and telephony, and we are now well into the period of specialised handbooks.

Mr. Marcus J. Martin is already well known to readers of this magazine by his excellent series of articles on radio-photography. In this volume these articles have been revised and expanded, and with many new diagrams constitute a comprehensive treatise on a subject of growing importance.

It will come as a surprise to many to learn how much is already known and achieved in connection with the sending of pictures from one place to another by wireless. In Chapter I. the author outlines the earliest experiments, the advantages of radio-photography over transmission by wire and the system invented and demonstrated by Mr. Hans Knudsen. This latter, although very ingenious, has not proved very practicable, and the reasons for this are given. In Chapter II. the many points of difficulty and interest connected with the transmitting apparatus are fully considered, and not many pages will be turned before the reader discovers that Mr. Martin is truly a master of his subject. Unlike many text-books on new applications of science, this volume is not given over to eulogistics of inventors and vague prophesies of what may come; on the contrary, it is full of practical information and records of actual experience. Chapter III. is devoted to receiving apparatus; Chapter IV. to the most important subject of synchronising and driving the motors; whilst Chapter V. consists of a detailed description on Mr. Martin's own apparatus, and results obtained therewith. In view of the extreme importance of a full understanding of selenium, which is largely used in the present methods of wireless transmission of photographs, the author has added an appendix on selenium cells. A further appendix has been added on preparing the metal prints. It is upon the production of these prints that much of the success of the system depends.

Mr. Martin's book is without doubt a valuable addition to the literature of wireless telegraphy and allied subjects. After the war, when private experiments are again commenced, we can foresee that numerous amateurs will be led by this book to take up this fascinating subject, and, may be, in a few years, the London evening papers will contain photographs received by wireless of New York's morning occurrences. Many experimenters will need to do much work before this is achieved, and to these, as to everyone interested in wireless telegraphy, we can heartily commend this book. A word of praise must be given to the publishers for the excellent way in which the volume is printed and bound. Both letterpress and diagrams are extremely clear, and reflect great credit on all concerned.

* * *

"HISTORIC JAMAICA." By Frank Cundall, F.S.A. London, 1915. West India Committee. 5s. net.

Xaymaca, as the island of Jamaica was known by the old Caribs, the aboriginal inhabitants of the island, is a veritable "earthly paradise." Isolated from the main body of the Antilles, it yet has a future of abundant prosperity in store. The opening of the Panama Canal has already put it on the direct route from the Atlantic to the Pacific, and its prosperity bids fair to become increasingly large. In the opening up of the new route wireless telegraphy has not been in the background, and every coign of vantage from the radio-telegraphic point of view has been seized upon and utilized. In the mind of the majority of people the "New World" seems to constitute quite a modern discovery. But in effect it is now over 400 years ago since Christopher Columbus first set foot on Watling Island and so brought the new vast store of wealth within reach of the inhabitants of the Eastern Hemisphere. Mr. Cundall's historical survey of the island forms excellent reading and offers enlightenment on very many points which have hitherto been enshrouded in obscurity.

* * *

"EXAMPLES IN ALTERNATING CURRENTS." Volume I. By F. E. Austin, B.S., E.E. London: E. & F. N. Spon. 10s. 6d. net.

We often find that much of the knowledge acquired by a student at a technical school is rapidly forgotten through lack of practical application. This book is designed to remedy this by providing a series of problems and examples fully worked out and illustrated where necessary by diagrams. The student who works carefully through these cannot fail to derive considerable benefits therefrom, and much of the information he has gained at technical classes will thus be firmly impressed upon his memory.

For some reason not at all evident to the reviewer, the publisher has thought fit to print this volume in a most irritating green ink, otherwise the book is quite well produced.

* * *

"EGYPT OF THE EGYPTIANS." By W. Lawrence Balls. London, 1915. Sir Isaac Pitman & Sons, Ltd. 6s. net.

The study of peoples and the lands where they dwell forms as interesting a means of recreation as can well be imagined. Although so many books have been written on Egypt and the Egyptians, there is yet an immense field which has not been tapped. Wireless telegraphy has probably done more to open up remote and little-known parts of the world than any other invention of modern times. It is stretching its tentacles into the Arctic wastes surrounding the Poles; it is spreading its feelers into the burning deserts of Africa, Asia and Australia, and it is making its influence felt throughout the swampy jungles of Brazil and other equatorial regions. All our readers should possess themselves of this book.

* * *

"THE BOOK OF THE SEXTANT." By A. J. Hughes. Glasgow: James Brown & Son. 2s. 6d. net.

To the navigation officer skilled in use of the sextant and other instruments of navigation this book will prove of great interest. It should also make an appeal to the general reader, for it tells the story of the progress made with instruments for taking altitudes at sea, commencing with the astrolabe invented by Hipparchus over 2,000 years ago.

A large number of illustrations, excellently drawn, assist the reader in understanding the methods of construction and working, and enable all who peruse this volume to realize how accurately these instruments need to be made and how delicately they must be handled.

The full details regarding the construction and use of the instruments described and numerous hints of the greatest use to the young officer go to prove that the author is a master of his subject and must have devoted the closest attention to the production of this book. It can be recommended to all who for business or pleasure wish to become acquainted with the sextant and allied instruments.

"THE BRITISH DOMINIONS YEAR BOOK, 1916." London: The British Dominions General Insurance Co., Ltd.

The present issue of this interesting annual contains contributions by such well-known writers as Mr. F. T. Jane, Mr. Edward Salmon, Sir Leo Chiozza Money, Sir Laurence Gomme, Mr. J. Ellis Barker, and others. The contents of the book are devoted mainly to matters in connection with the war and include some coloured plates of the medal ribbons of the British Army. The book will not be published in the ordinary way, but will be presented to the public and business men and women in the hope that it may be of service.

* * *

"THE PRACTICAL ELECTRICIAN'S POCKET BOOK AND DIARY, 1916." London: S. Rentell & Co., Ltd. 1s. net.

In these days, when the term "pocket book" is applied to bulky volumes whose size is such that nothing but the largest pocket of an overcoat can contain them, a word of praise must be given for the size of the little volume before us. Although it is crammed with most valuable matter and seems to cover practically all points necessary to be covered by such an annual, it nevertheless measures but slightly more than 5 inches by 3½ inches, and can be quite conveniently carried about in the course of one's work. The contents have been well revised, and although the new issue contains but four more pages than that of last year, much new matter has been included in the space made available by careful condensation of the older matter and omission of material now out of date. Altogether this is a most useful book and one which has already established for itself a firm position in the electrical industry.

* * *

"HAZELL'S ANNUAL, 1916." Edited by T. A. Ingram, M.A., LL.D. London, 1916. Hazell, Watson & Viney, Ltd. 3s. 6d. net.

This well-known and deservedly popular annual scores, as usual, many distinct successes. It has of late made a special feature of giving the personnel of Government offices and important public bodies with greater fulness and detail than many other works of reference, and we notice with interest that the staff of the new Ministry of Munitions is set out, as is the case of the other offices. Other features include the complete list to the recipients of the Victoria Cross, the Roll of Honour, containing the names of those who have lost their lives in the war, a section devoted to the British Colonies and Self-Governing Dominions, tables of warship types, and articles on aeronautical, military and naval matters. It should certainly find a place on all reference book-shelves.

* * *

* * *

"'THE PRACTICAL ENGINEER' ELECTRICAL POCKET BOOK AND DIARY, 1916." London: The Technical Publishing Company, Ltd. 1s. net.

This is a handy little book of convenient size, already well known to electricians by its excellence in previous years. The new edition has, of course, been brought thoroughly up to date, and we notice that sections relating to telephones and first aid have been added. Several of the tables have been recalculated and recast, and the standards of electrical machinery of the Engineering Standards Committee have been revised in accordance with the report issued last October. For the benefit of those concerned with the design of electrical cooking and heating apparatus a description of the simple method of calculating the flow of heat through furnace and oven walls, due to Dr. E. E. Kennelly and Mr. Carl Hering, has been introduced. We must congratulate the editors on providing so much matter of value to electricians in so small a compass.

* * *

"THE POCKET GUIDE TO THE WEST INDIES" (New and Revised Edition, 1914). By Algernon E. Aspinall. London: Duckworth & Co.

This handy little volume has already been reprinted three times, the latter of which (that under review) forms an entirely new and revised edition. The West Indies constitute as delightful a spot as it is possible to conceive. The islands of the Spanish main are jewels set in an emerald sea. Mr. Aspinall's knowledge of each and every one is very wide, as he has travelled considerably throughout that district. The book is profusely illustrated with maps, pictures and diagrams, and should form a useful addition to the reference library of each of our readers.

Foreign and Colonial Notes

Antarctica.

According to the *Hobart Mercury* (Tasmania) no more meteorological reports will be received in New Zealand from the Macquarie Island wireless station, which was established by Sir Douglas Mawson as a branch of his Antarctic expedition, and subsequently taken over by the Commonwealth Government. The Dominion meteorologist reported on December 1st that the station had been closed temporarily, the final message having been received a few days before. It appears that the Commonwealth Weather Bureau at Melbourne has sent away about ten members of its staff in connection with the war and is unable any longer to spare the skilled meteorologist who has been stationed at Macquarie Island. New Zealand has contributed towards the support of the station, which has proved of the utmost importance in the investigation of weather conditions in the Southern Hemisphere. For this reason it is considered to be rather a pity that the station has to be closed at the present time, especially as Sir Ernest Shackleton's expedition is still in the south, and the Macquarie Island plant would have been a most important link in co-ordinating Antarctic conditions with those experienced in lower latitudes. Messages first began to be transmitted to Wellington from the Island on March 12th, 1912.

* * *

Australasia.

The Deputy Postmaster-General advised that wireless telegrams containing the text, "Christmas Greetings," "New Year Greetings," "Compliments of the Season," would not be accepted last Christmas at the reduced rates provided in the wireless regulations. Hitherto such messages were accepted from the public for transmission to New Zealand or to vessels equipped with the wireless apparatus registered in Australia or New Zealand, those to New Zealand being charged for at the rate of 4s. and those to vessels registered in Australia or New Zealand at 3s. each.

Australia.

According to the *Electrician* it is stated that the capital expenditure of the Australian Commonwealth's Radio Telegraph Station at Canberra will be about £18,500.

* * *

China.

China is preparing to install a chain of wireless telegraph stations all along her north-western frontier and in alignment with the Great Wall. In the days when the wall was a real rampart of defence, messages of danger were flashed from it by beacons across hundreds of miles of country. The station of most interest to Britain is that in Shansi, being located at Ningwu-fu, which stands just inside the Great Wall west of the famous Yen-monn Pass, one of the four places in the wall at which the Government still keeps troops. It is a curious thought that the Great Wall of China should now be chosen as the alignment for wireless telegraphy.

* * *

Italy.

A wireless message from Rome recently stated that numerous bodies of men, women and children lost through the torpedoing of the *Ancona* have been picked up on the seashore of Pizzo in Calabria.

* * *

Morocco.

An official message from Ceuta states that at 6.30 on February 5 a hurricane carried off the roof of a building in one of the exposed posts, causing numerous victims. Telephonic and telegraphic communication was interrupted, and the wireless station was rendered useless. The latter has been repaired, and this message is the first radiogram despatched.

* * *

Pacific.

The first wireless message from the station recently completed by the French Government at Tahiti was received in San

Francisco on January 5th. The station is approximately 3,500 miles from San Francisco.

* * *

Sweden.

The Elsinore *Avis* says that persistent and well-founded reports are current that a large German warship has gone down near Fladen Grund in the Kattegat, between the island of Anholt and Sweden. It is stated that the wireless apparatus and other wreckage has been washed up on the coast of Sweden, but the name of the vessel is not known.

* * *

Tasmania.

The Federal Government has decided to improve the facilities for communicating news of vessels in distress and other shipping information by installing a wireless station on Tasman Island, which will enable the lighthouse there to keep in constant touch with Hobart. At present the only means normally available of getting messages from Tasman Island to Hobart is by pigeon post. The plant it is proposed to put up on Tasman Island will be a comparatively small one, and the main purpose for which it will be used will be for communicating with Hobart and with vessels comparatively near at hand. It will probably not solve the difficulty now sometimes found by vessels approaching Tasmania from the westward in getting into touch with the Hobart station, owing to the position of Mount Wellington.

* * *

United States.

According to the *Telegraph and Telephone Age*, the sum of 25,000 dollars was recently sent from Newark, U.S.A., by wireless money order. This sum represented the receipts from a bazaar held in Newark to raise money for the relief of the war sufferers of Germany and her allies.

* * *

On the night of December 24th last, Mr. J. Daniels, the Secretary of the United States Navy, sent a wireless telegram to all ships and naval stations of the American Navy, sending greetings to the officers and men of the service on behalf of the Navy and people.

* * *

Some weeks ago the aerial of an amateur wireless station in Astoria, Long Island, sagged and came into contact with an electric light wire during a storm. A servant in the family of the young amateur, whilst cleaning near the instruments, accidentally touched a wire, receiving the full charge of 2,400 volts. She was instantly killed.

* * *

We made mention in these columns a month or two ago of the part played by wireless telegraphy in keeping the port of Galveston, Texas, which was isolated on account of inundations caused by a hurricane, in touch with the outside world. It transpires now that in order to keep the plant which supplied the current for the wireless apparatus running, boiler water was hauled in cans from an adjacent well, and fuel oil was pumped to the plant from the storage reservoirs by belting one rear wheel of an automobile to the oil pump. A tall chimney stack was used as a wireless tower, after all the other wireless stations had been blown down, and the aerial was stretched from the top of the stack to the nearest pump, the apparatus being set up in a room in the basement.

* * *

According to the *Wireless Age*, arrangements are being made for the organisation of a Motor Cycle Corps to be added to the 13th Regiment, First Artillery of the United States Army. It is intended to have the corps composed of twenty-four listed men, who will be trained in all kinds of signalling such as heliographing, searchlight, acetylene, and wireless.

* * *

The utility of wireless has been very materially demonstrated lately. During a blizzard in the district traversed by the Delaware, Lackawanna and Western Railroad, the ordinary telegraph wires were blown down. Marconi wireless telegraph apparatus was employed for train despatching, the Hoboken, New Jersey, tower keeping in communication with the snowbound trains.

* * *

According to dispatches from Washington, wireless control from an aeroplane of a coast defence torpedo has been developed. The Navy Department has asked Congress to appropriate nearly £200,000 to acquire the rights. Aeroplane control, navy officers explain, makes it possible for the operator to guide the radio-torpedo through the water from any height, air bubbles from the compressed air motor of the torpedo giving him a certain guide to steer it against a ship's hull.

* * *

The Bureau of Investigation of the Department of Commerce issued a special licence, known as commercial extra first-grade, to radio-operators whose trustworthiness and efficient services entitled them to confidence and recommendation. These licences are given consideration by the Civil Service Commission in examinations for positions requiring knowledge of radio-telegraphy, when experience is stipulated as a part of such examinations. Applicants for this grade of licence must pass a special examination. To be eligible for this examination they must hold commercial first-grade licences, and their certificates of skill in radio-communication must record eighteen months' satisfactory commercial service at sea or at land stations, either or both, during the two years previous to the filing of the application for examination, as shown by endorsement on the licence service records or other satisfactory evidence, and provided that the applicants have not been penalised for a violation of the radio laws and regulations. A speed of at least 30 words per minute continental Morse, and 24 words per minute American Morse (five letters to the word) must be done. The technical questions and the questions on the radio laws and regulations are considerably wider in scope than those for commercial first-grade and a higher percentage is required. All examination papers, including the code test sheets, are marked and forwarded to the Commission of Navigation with the recommendation by the radio inspector or examining officer. Examination papers are marked upon the basis of 100, and licences are recommended only for 80 or better number attained.

* * *

From the January number of the *Radio Service Bulletin* we notice that several amateurs in the Western States have been reprimanded and penalised for violation of the 15th regulation of the Act of August 2nd, 1912, for using a wave-length in excess of 200 metres for the use of fraudulent call signals and interfering with the commercial traffic being handled by public wireless telegraph stations and certain merchant ships. Several amateurs have also been reported for operating stations without proper licence in violation of the Radio Act, and the cases have been referred to the United States District Attorney for prosecution. The maximum penalty for the latter violation is a fine of £100 and confiscation of the radio apparatus unlawfully used.

* * *

During a severe sleet storm on December 29th last the antenna of the wireless station at Sayville, Long Island, was brought down by the weight of sleet. Repairs were made at once.

* * *

During an unusually severe thunderstorm at Astoria recently the marine wireless telegraph station was struck by lightning, slightly injuring the operator on duty. The entire receiving set was burnt out, and considerable work was necessary to repair it. The transmitting apparatus was but little affected. The power line transformer was damaged, and some delay was experienced before the current could be restored. Within twenty-four hours everything was in running order again.

* * *

International conferences on radio-telegraphy were held at Berlin in 1903 and 1906 and in London in 1912. We understand from an American contemporary that the next is to be at Washington, D.C. The regulations adopted have been agreed to by most of the countries of the world.

CONTRACT NOTES

The Marconi Wireless Telegraph Company of America has contracted for the erection of a new station building at Cape May, New Jersey. A tower 140 feet high will also be built.

* * *

The Inland Navigation Company of New York and the Marconi Wireless Telegraph Company of America have entered into a contract whereby the latter company will install wireless apparatus on thirty freight barges which are soon to ply upon the River Mississippi. The agreement provides for two kw. sets having a communication range of 400 miles or more Marconi operators will be supplied, and service with land stations provided as in maritime navigation.

PERSONAL PARAGRAPHS.

We notice in the list of survivors of the ill-fated s.s. *Tara*, sunk in the Mediterranean, the name of Warrant Telegraphist A. Dutton.

* * *

According to the *Boston Guardian*, news was recently received by Mr. and Mrs. Evison that their son George, who is attached to the Royal Flying Corps, is now in hospital at Cairo with synovitis. He was in the employ of the G.P.O. at Alford until last summer, when he enlisted as a wireless operator in the Royal Flying Corps and was sent out to Egypt about three months ago.

* * *

Our congratulations to Corporal Edgar James Jezzard upon his marriage with Miss M. Burnett. Corporal Jezzard joined the Marconi Company in June, 1914, as telegraphist, and upon the outbreak of war was called up to join the Forces. He has already distinguished himself in the field, being mentioned in despatches, and on December 26th last received his promotion from Sapper to Corporal. On January 25th he was able to obtain a few days' leave for his marriage, which took place on the day following at Manchester Cathedral. We wish the newly married pair a very happy future.

* * *

In an Admiralty list of appointments recently published we find the name of Mr. C. K. Chandler, lately in the Applied Science Department of the Sheffield University. From Marconi's Wireless Telegraph Company he has been appointed Sub-Lieutenant in the R.N.V.R., gazetted to H.M.S. *President* for wireless work with the Royal Naval Air Service.

* * *

David Hendry, wireless operator in the Royal Flying Corps, Mediterranean Expeditionary Force. has been wounded.*

* *

Mr. G. T. Vick, of Church End, Finchley, has received information from the War Office that his nephew, Mr. Frederick De Barr, a chief of wireless telegraphy, is missing from the *Natal*. Some mystery exists here, says the *Finchley Times*, as it was supposed that Mr. De Barr was on the *Elizabeth*, and in writing at a period ten days previous to the disaster to the *Natal* he made no mention of any transference.

* * *

The Admiralty announces that the following acting promotion has been approved for service in connection with the capture, on October 12th, 1914, of the German armed vessel *Komet*:

To be Acting-Commander, to date November 23rd, 1915:

Lieut.-Commander John Metcalfe Jackson, R.N.

The *Komet* was a small sailing vessel which had been equipped with a complete wireless installation.

* * *

Flight Sub-Lieut. Harwood James Arnold, R.N.A.S., who has been awarded the D.S.O. for his gallant conduct while observing in an aeroplane during the destruction of the German cruiser *Königsberg*, is a former resident of Bridgewater. He was for some time a wireless operator, serving at the Marconi station on Vancouver Island, B.C.

* * *

Mr. A. Harris, a member of the New Zealand Parliament, has joined the Samoan Relief Force as a wireless operator.

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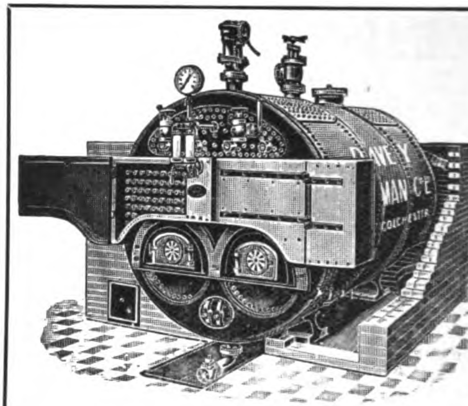

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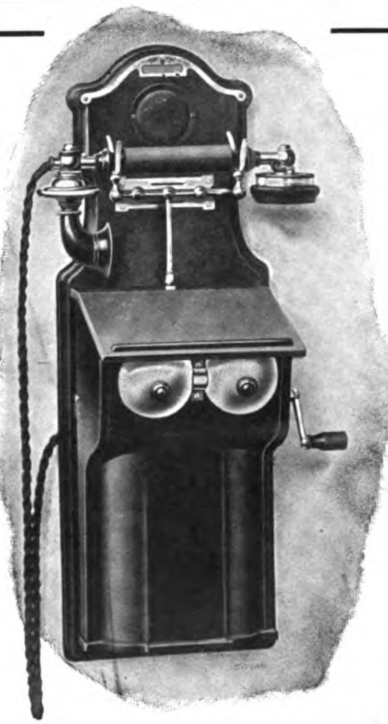

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The Editor will be pleased to receive contributions; and Illustrated Articles will be particularly welcomed. All such as are accepted will be paid for.

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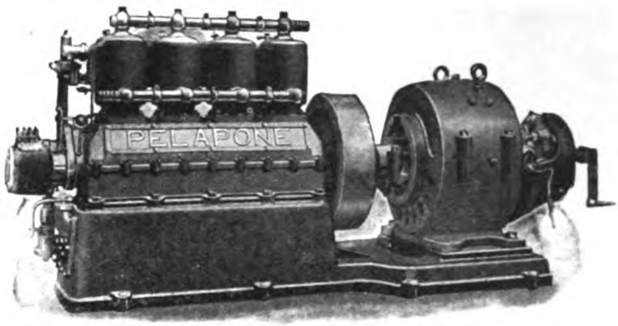

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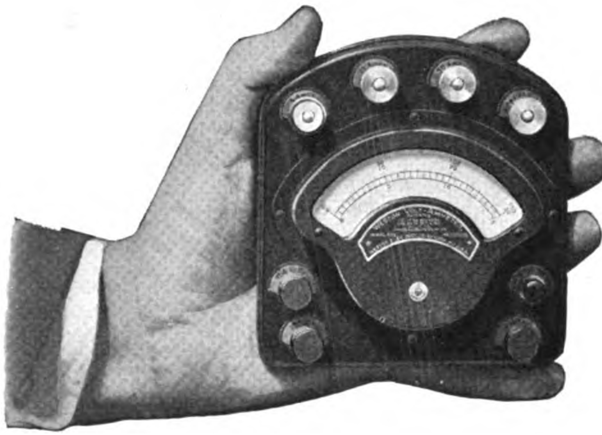

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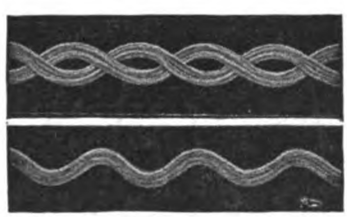

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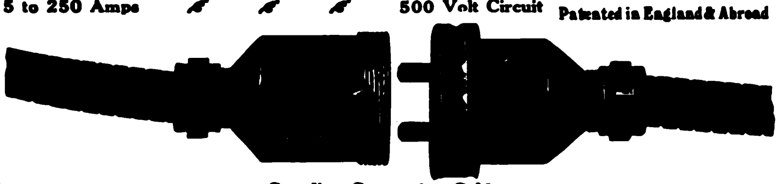

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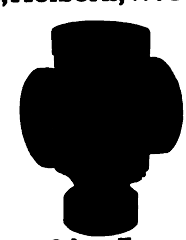

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