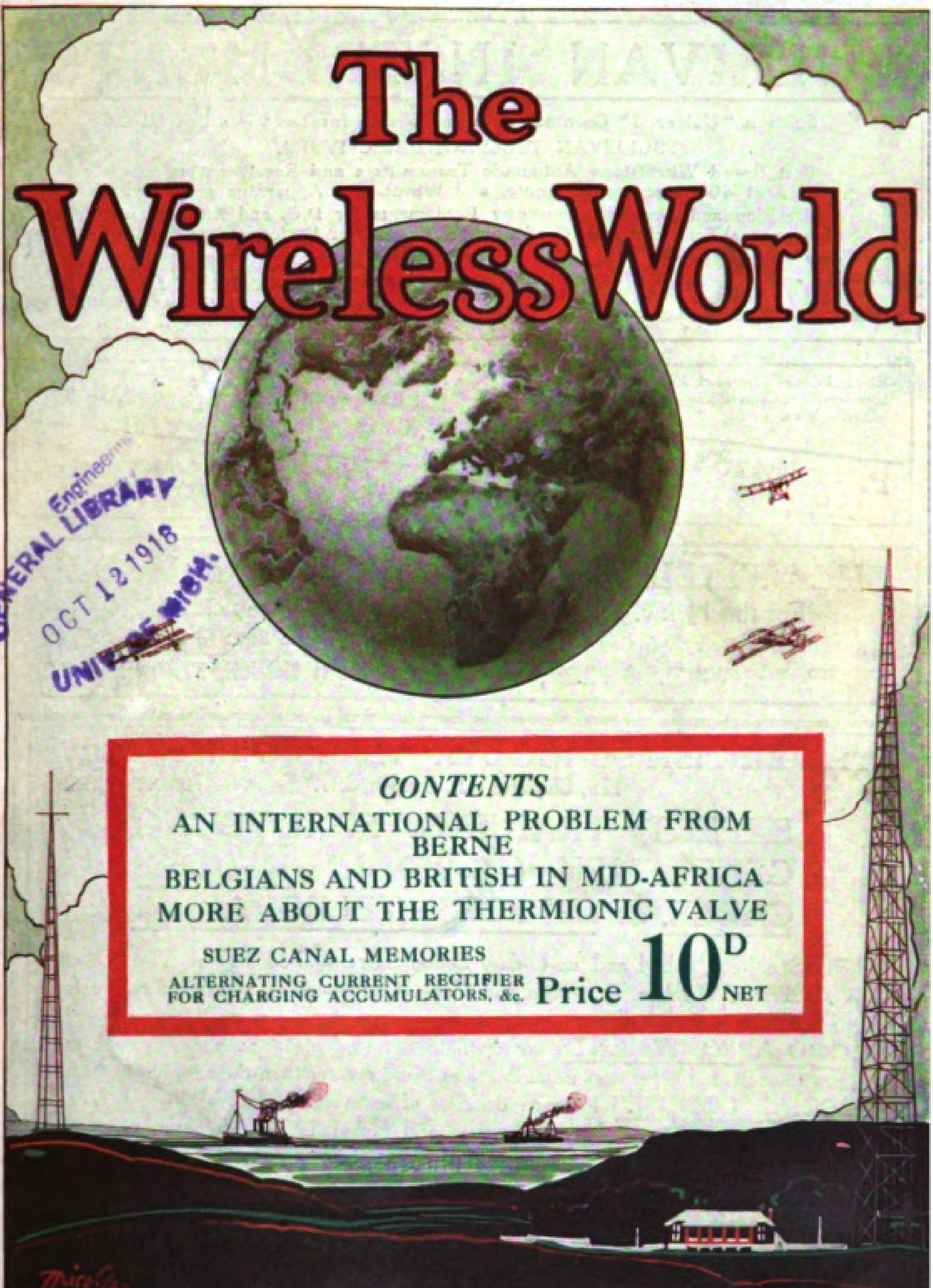
The Wireless World



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The
WIRELESS WORLD

Volume VI. No. 65. AUGUST, 1918.

Belgians and British in Mid-Africa

The Doings of Four Wireless Men on Lake Tanganyika

By H. J. B. WARD, B.A.

WHERE is Lake Tanganyika? And what is included in the Belgian Congo? I suppose that some of us will be obliged to answer two such questions with "somewhere in Africa," and that we should find such a response to constitute the "be-all and end-all" of our information on the subject. It is here that war—like travel in normal times—steps into the breach.

Possibly the four young wireless men, who towards the close of 1915 received orders to proceed to Tanganyika, owned but little more detailed information than the accurate but somewhat vague statement set forth above. One of them, interested in the records of Great British Explorers, knew that its discovery was due to those famous nineteenth century pioneers of ours, Speke and Burton, and that its mountain-fringed waters and lovely scenery formed the scene of some of the labours of Livingstone and Stanley; but with regard to his comrades I cannot say. I can remember, not so long ago, an occasion when a wireless engineer received instructions to proceed to some little known islands much nearer home. He came to tell me of his forthcoming journey, confessed that he scarcely knew where they lay, and sought eagerly for information. To such a purpose, however, did he bestir himself that he knew the subject as well as it could be mastered from books long before he started; and, when he came back after some months of labour crowned with success, he was able to contribute to the pages of THE WIRELESS WORLD as

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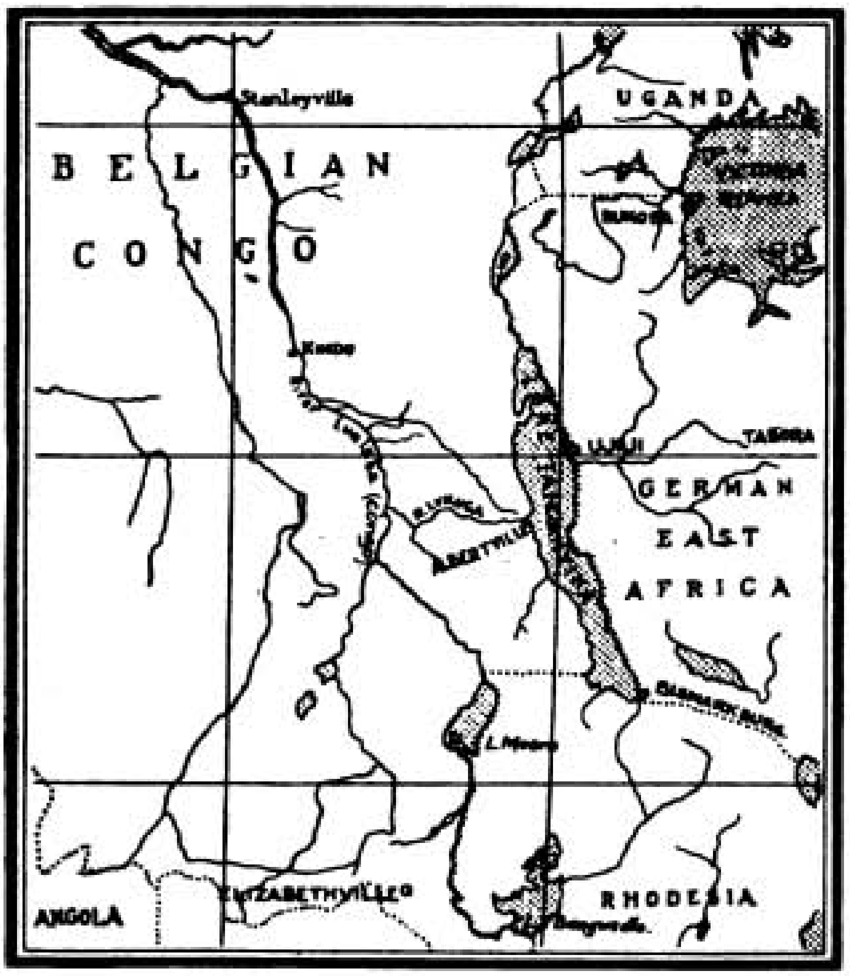
interesting and informative a typographical article as any magazine readers could wish for.

As a matter of fact, the lake to which our friends were ordered forms the eastern boundary of the Belgian Congo and the western boundary of German East Africa. Its southern end is fringed by the northern borders of Rhodesia, whilst immediately to its own northern extremity lies the Uganda Protectorate. It will be seen at once, therefore, that this remote, attenuated strip of deep water—420 miles long, and 15 to 80 wide—constitutes, in a very true sense, the heart of Africa.

So soon as hostilities were initiated against the Central Powers, Britannia stretched forth her trident and cut off from all outside aid the seaboard of German East Africa, that wedge which our insidious foe had been allowed to drive in between Uganda and Rhodesia. Tanganyika is a real inland sea, and the British Admiralty determined that the enemy flag should be deposed from its flaunting superiority thereon. Commander Spicer-Simson was placed at the head of a small Expeditionary Force, and provided with two well-armed motor-boats, which were conveyed first to Capetown and thence by rail over a land journey of 2,000 miles, *via* Bulawayo and Livingstone to Elizabethville in the Belgian Congo. Radiotelegraphy constitutes an inseparable adjunct of the British Navy, and four young wireless men, Messrs. Boileau, Warren, Moore and Williams, were attached to the force. The illustrations of this article are reproduced from photographs taken by Mr. Boileau, and I hope that this brief epitome of their travels and labours will serve the purpose of indicating the nature of the country which formed the scene of their labours, and the indomitable spirit of the men who overcame difficulties which might well have been deemed insuperable.



After leaving Elizabethville, our adventurers had to haul their craft for 150 miles over atrocious roads and across a country varying in altitude from 2,000 to 6,000 ft. This accomplished, a further journey on trucks over a short section of railway brought them to the Lualaba River, the name given to this important section of the Congo, and down this stream the vessels were floated for 400 miles, proceeding now by their own power and now on lighters. Finally, these wandering units of the British Fleet reached their destination and emerged upon Lake Tanganyika at the Belgian port of Lukuga, about halfway up the western shore of the lake.

At this little port of Lukuga was enacted, in the early days of the war, the opening act of hostility on the part of our Teutonic foe. The German steamer *Hedwig von Wiessmann* inaugurated offensive operations by shelling the Belgian coast in August, 1914. The Berlin Act of the 26th February, 1885, had neutralised the Belgian Congo, and, in its second Article, had gone so far as to provide that, in case of war being waged by the ruling Government in another part of the world,

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the Congo territory should be placed under a *régime* of neutrality. Belgium herself had, on the outbreak of the European war, advised France and England on 7th August of her intention to carry out this neutrality provision of the Berlin Act. The almost immediate launching of hostilities, therefore, in this quarter of the globe on the part of Germany, forms a striking illustration of the uselessness of any international pact to which that unscrupulous empire may be a party.

In Africa, as elsewhere, the Huns had long organised for war, not only drilling thousands of stalwart native troops, but entering into compacts with the chiefs of the various warlike tribes to co-operate with the trained forces, and to offset by their swarms of savage levies the lack of cavalry scouts for which the presence of the tsetse fly was responsible. Guns of all calibres and military stores in large quantities had been accumulated. The German armed vessels ensured them absolute supremacy on Tanganyika Lake, and from Ujiji, the lake terminus of the railway from Dar-es-Salaam, the transport of materials for the German offensive against the Belgian and British Colonies went on apace, until the arrival of the British vessels changed the situation.

The speed with which this revolution in the state of affairs was effected may be judged from the fact that the *Kingani*, an important unit of the Teutonic Fleet, surrendered on December 26th, 1915, after having been disabled in a thrilling fight. She was repaired and added to the British flotilla, playing a useful part in subsequent operations. The *Hedwig von Wiessmann*, to which I have referred above, was the next victim, being destroyed in action about six weeks later. The engagement with this second enemy vessel of war was described in a letter home (published by the *Times*), from which readers may be interested to peruse the following extract :

STEAMERS BY THE LAKE.

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TRANSPORT THROUGH THE FOREST.

"I was on the *Mimi* (one of the motor-boats). After running for an hour and a half to two hours the German was sighted and did the usual thing—namely, turned and ran. . . . It did not take us long to catch her, as these motor-boats of ours are pretty fast, and we opened fire. . . . The first hit registered went bang through the boiler of the German, who from then on had a bad time of it. . . . Within half an hour she turned slightly, plainly out of control, and soon afterwards began to sink by the head. She finished up by putting her stern high in the air and diving straight to the bottom. As soon as she had disappeared we made straight for the wreckage and saved every one—namely, twelve Germans and ten niggers. This was slightly different from what the Germans did when the *Good Hope* and *Monmouth* sank. There were fourteen Germans on board, but two were killed in the engine-room and went down with the ship. Out of the twelve, nine were *Koenigsberg* men. What a haul! Without telling you the strength of either side, I can assure you that we are absolutely 'Cock of the Lake' now."

The third and last war steamer maintained by the enemy on the lake, the *Graf von Gotzen*, was announced as destroyed by the Belgians in July, 1916. Our brave Allies succeeded in catching and putting her out of action just as she was in the act of disembarking troops for a surprise expedition.

The country through which our wireless friends and their little party had to make their toilsome way, though inhabited by a vast number of native races in a low state of civilisation (their number has been estimated at fifteen millions), is largely undeveloped and "in the raw." The difficulties involved during that 150 miles of haulage were simply indescribable. The Commander of the Expedition narrates how on some occasions they were obliged to sacrifice not only their washing but their drinking water in order that the boilers of the traction engines should be supplied with the necessary material for progress. He comments upon the self-sacrifice thus shown by his companions in the following terms:

"Only those who have had to work without shade in the thick dust raised by engines under a tropical sun, when you have nothing to wash in and nothing to

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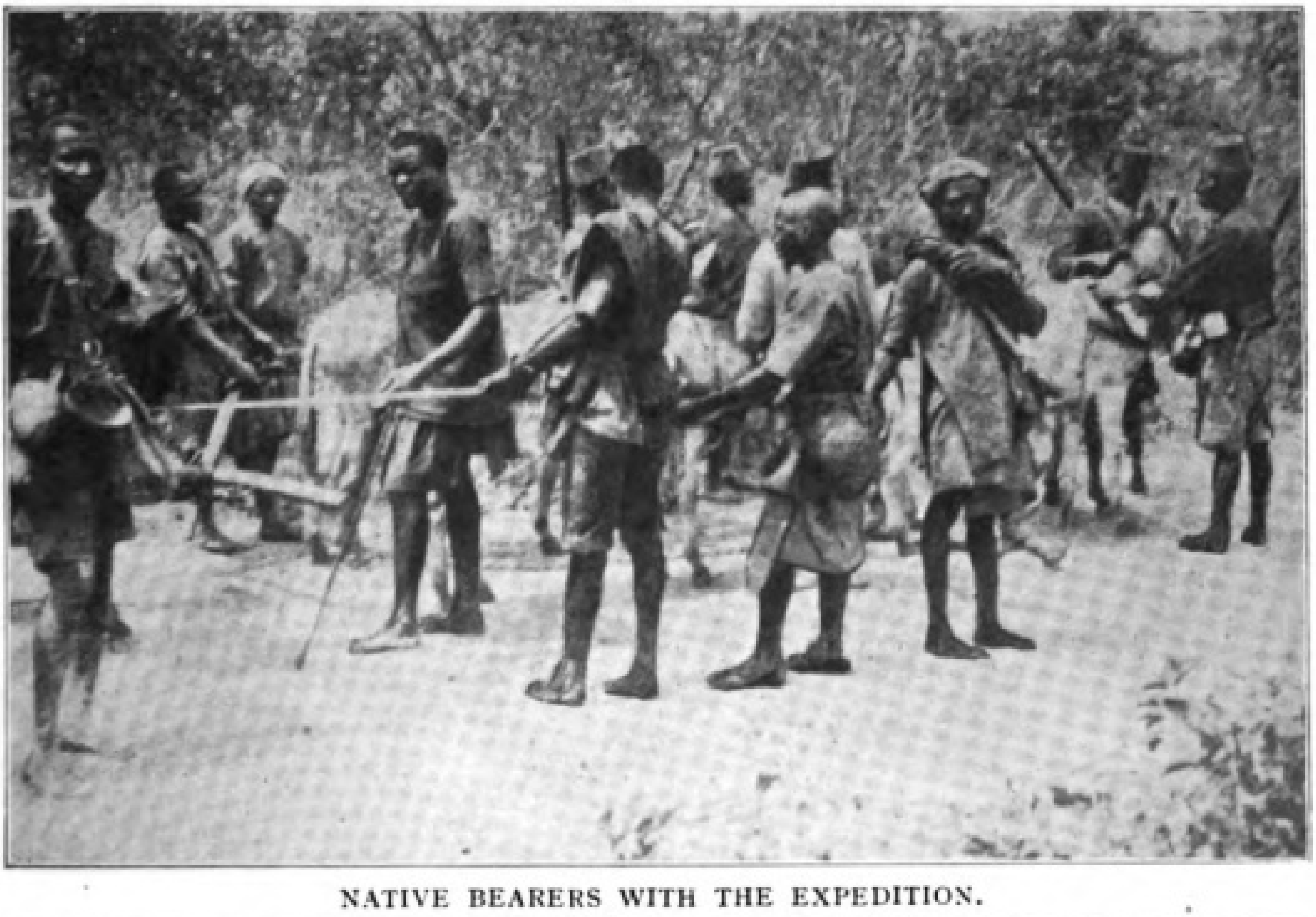
drink, can realise what determination is required to keep up the necessary energy for overcoming the heart-breaking difficulties of the route. It was, in the opinion of all competent judges, sheer madness to attempt to take traction engines over it by themselves, and still more so to try and tow boats by this means or by any other."

Nothing succeeds like success, and the native African judges by results. Apart from material loss inflicted upon the enemy, the success of this naval expedition wonderfully enhanced British prestige amongst the natives, not only in the neighbourhood of the lake but in the northern districts of Rhodesia and in adjacent German territory.

In districts such as this, wireless possesses advantages over all other means of communication, to a far larger degree even than in more favoured lands. This fact was brought out very clearly in the memorable despatch of General Smuts, which summarised his campaign as a whole.* The Belgians, in the course of 1916, linked the Victoria Nyanza with Lake Tanganyika by means of mobile wireless sections, and developed its utilisation throughout their forces in a way which had never been exemplified before in these parts. They claim that the little stations they utilised, though capable of being carried by a despatch rider upon his bicycle, can develop a power of 500 watts, and possess a range of nearly one hundred miles. The announcement of the successful sinking of the *Hedwig von Wiessmann* was reported from Albertville, a town on the Belgian coast of Lake Tanganyika, and was published in the *Times* within a wonderfully short interval after the action had been consummated.

In the course of the expedition it was necessary for the ensurance of success that our Belgian Allies should labour harmoniously shoulder-to-shoulder with our own men. It is a matter of real gratification to know that this co-ordination was characterised by the most striking cordiality throughout, and that British and Belgians alike speak in terms of high appreciation concerning the efforts and fraternal feelings displayed by each other.



NATIVE BEARERS WITH THE EXPEDITION.

* See the article entitled "Human Interest in an Official Despatch" in THE WIRELESS WORLD, page 916 of Vol. IV.

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PERSONALITIES IN THE WIRELESS WORLD

Photo] [*Elliott & Fry.*

MR. RAYMOND D. BANGAY

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THE subject of our notice this month is Mr. Raymond D. Bangay, whose connection with wireless telegraphy has been intimate since quite its early days. It is typical of this, the latest arrival amongst applied sciences, that its prominent votaries should be comparatively young in years. Mr. Bangay, son of Dr. R. Bangay, M.D., first saw the light in 1883 in the municipal borough of Lyme Regis, an old Dorsetshire town mentioned in Domesday Book, which played an honourable part in the earlier history of our country. Epsom College was the scene of his schoolboy days, and, after leaving this establishment, he proceeded to specialise in scientific subjects at the Finsbury Technical College, an institution whose name is closely linked with a number of Britain's most eminent men of science. Mr. Bangay joined the Marconi Company's staff five years after the parent company had been incorporated under the title of "The Wireless Telegraph and Signal Company, Limited"; 1902, the date of his initial connection with the Company, witnessed considerable progress in wireless transatlantic work. Mr. Bangay next crossed the Atlantic and spent five years in America, actively engaged in radiotelegraphic practice. He did not confine his attention to any particular branch, but during the period of his sojourn on the other side made full use of his opportunities, with the result that he then acquired that clear conception of basic principles and practice which he afterwards crystallized, for the benefit of numerous students, in his *Elementary Principles of Wireless Telegraphy*. This, his first essay in book production, originally appeared in 1914, and—constantly improved in successive editions—has ever since "held the field" as one of the best manuals of instruction for students starting on a wireless career. In 1910, during the American period of Mr. Bangay's service, he started to specialise in portable apparatus, a branch of radiotelegraphic activity which has engaged his closest attention ever since. In 1914 he was appointed Chief of the Field Station Department in the service of Marconi's Wireless Telegraph Company, Limited, a capacity in which the specialisation above referred to has stood him in good stead. This responsible post he still continues to occupy, and it has afforded him many opportunities to render extremely valuable service in his country's cause, opportunities of which he has availed himself with patriotic zeal.

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Mechanical Analogies to Inductively Coupled Electric Circuits

By H. M. BROWNING

II.

In Article I. (see July issue of WIRELESS WORLD) the method of using interacting pendulums to demonstrate the action of oscillations in electric circuits was described. Photographs of the apparatus used and experimental results for certain cases were given. In this article the results of theory are set out, and it will be found how closely they agree with experiment. Although the mechanical cases are not perfectly analogous to the electrical cases, yet when the separate pendulums are equal, the ratio of the frequencies of the coupled vibrations is identical with that of the electrical case for equal circuits.

The initial condition in the electrical case is probably an electric displacement in one circuit; thus, if the mechanical vibration is started by a displacement of one pendulum bob there is almost an exact visual representation of the oscillations occurring in the electrically coupled circuits.

THEORY.

The equation for simple harmonic motion may be written:

$$A\frac{d^2y}{dt^2}+Aay=o \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where A is inertia, Aa spring factor, y displacement and $\frac{d^2y}{dt^2}$ acceleration.

When the vibrations are mechanical, and are due to the oscillations under gravity of a pendulum made by a light cord of length l and a heavy bob of mass P, for small amplitude of swing, equation (1) becomes:

$$P\frac{d^2y}{dt^2}+P\frac{g}{l}y=o \quad . \quad . \quad . \quad . \quad . \quad (2)$$

When the vibrations are electrical, and are caused by the discharge of a condenser of capacity R, through a self-induction L, the equation may be written:

$$L\frac{d^2y}{dt^2}+\frac{y}{R}=o \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

In this case y is the charge on the condenser. By comparison of (3) with (1) and (2), it is seen that the self-induction can be likened to inertia and the capacity to the reciprocal of the spring factor if a charge is an electrical displacement.

When a second circuit of capacity S and self-induction N is brought very near to the first and thus made to influence it by electromagnetic induction, the circuits are then said to be coupled. In this state the phenomena in each circuit depend partly on those in the other. The single factor that expresses this dependence or cross-connection between the variables is M, the coefficient of mutual induction. It is of the same physical nature as the two self-inductions of the separate circuits, thus it also functions as an inertia.

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Then as z is the quantity or electric displacement in the second circuit, the equations of motion for the two circuits may be written :

$$L\frac{d^2y}{dt^2}+\frac{y}{R}=M\frac{d^2z}{dt^2} \quad . \quad . \quad . \quad . \quad . \quad (4)$$

$$N\frac{d^2z}{dt^2}+\frac{z}{S}=M\frac{d^2y}{dt^2} \quad . \quad . \quad . \quad . \quad . \quad (5)$$

The coefficient of coupling γ is given by

$$\gamma^2=\frac{M^2}{L.N}$$

So far no exact mechanical analogy has been found in which a second pendulum with bob of mass Q and length ηl can be coupled with the first by means of a connecting mass J, so that the equations of motion may be written :

$$P\frac{d^2y}{dt^2}+P\frac{g}{l}y=J\frac{d^2z}{dt^2} \quad . \quad . \quad . \quad . \quad . \quad (6)$$

and

$$Q\frac{d^2z}{dt^2}+Q\frac{g}{\eta l}z=J\frac{d^2y}{dt^2} \quad . \quad . \quad . \quad . \quad . \quad (7)$$

But, by the arrangements described in Article I., equations of motion are obtained of the form :

$$B\frac{d^2y}{dt^2}+C\frac{g}{l}y=D\frac{d^2z}{dt^2} \quad . \quad . \quad . \quad . \quad . \quad (8)$$

and

$$E\frac{d^2z}{dt^2}+F\frac{g}{\eta l}z=G\frac{d^2y}{dt^2} \quad . \quad . \quad . \quad . \quad . \quad (9)$$

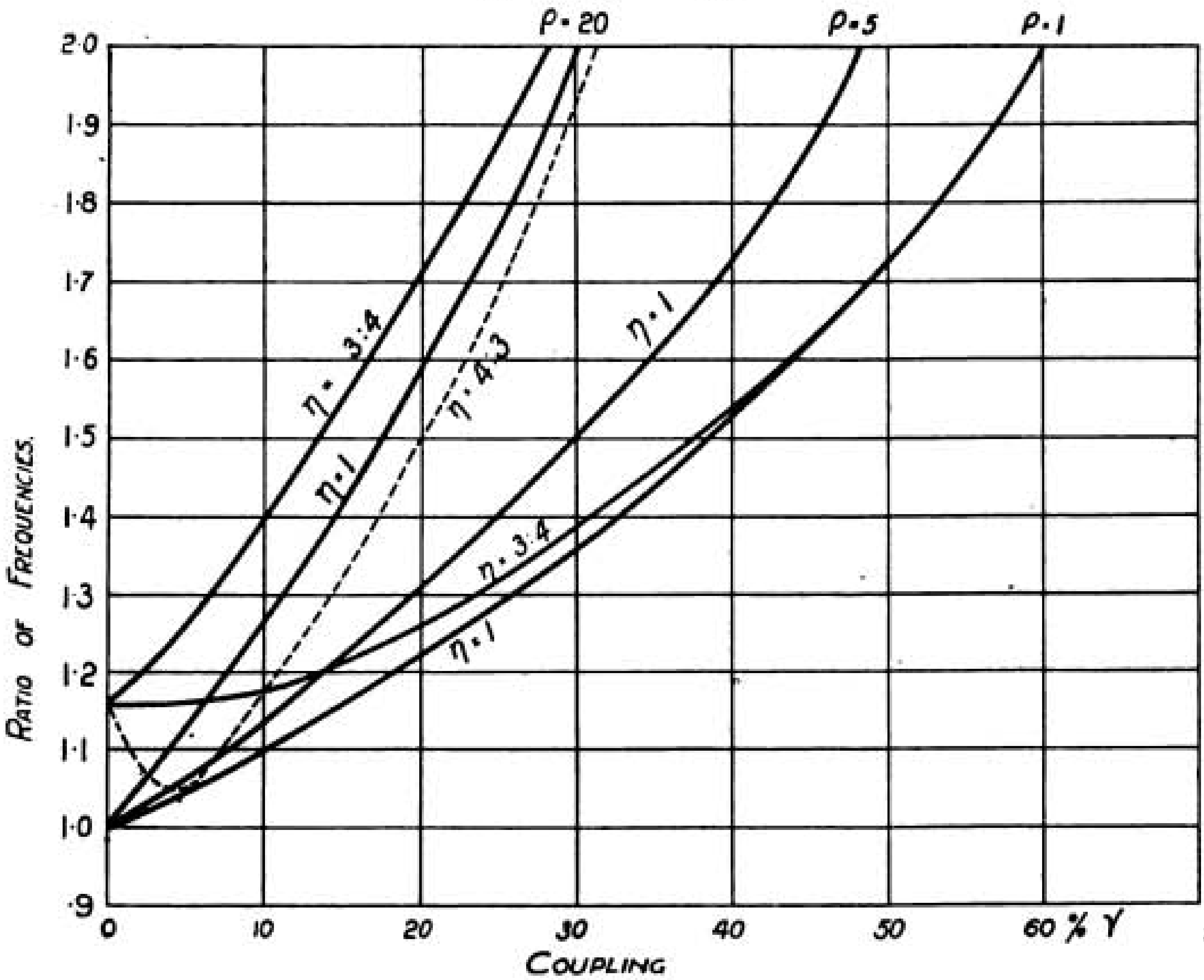

FIG. 9.—FREQUENCY RATIO AND COUPLING.

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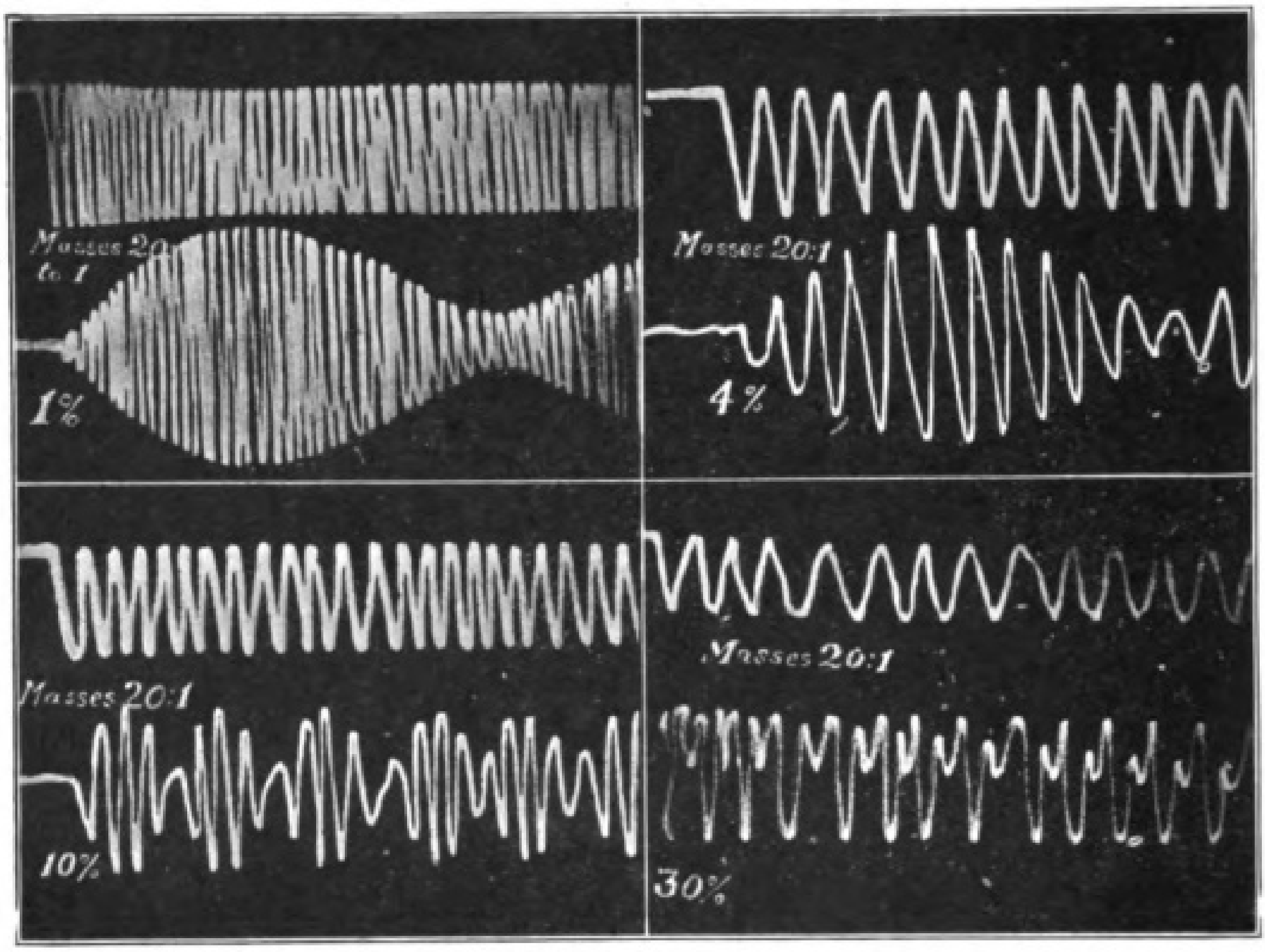

FIG. 10.—DOUBLE TRACES, BOB MASSES 20 : 1.

where B, C, D, E, F and G are functions of the masses of the bobs P and Q, and the ratio of the lengths of the pendulum suspensions, bridle droop, etc.

In this case the coupling is given by

$$\gamma^2 = \frac{D.G}{B.E}$$

Thus coupled pendulums may be used as analogies to electric circuits, the masses representing the self-inductions, the lengths being proportional to the capacities. Then if two pendulums have equal lengths and masses, they are like two similar inductively coupled circuits. If either the masses or the lengths are unequal, or both masses and lengths unequal, the system is like two electric circuits with differing capacities or self-inductions or both. The case of a pendulum with a heavy bob on a short suspension coupled with one having a light bob on a long suspension is analogous to the case of a wireless transmitter with a large self-induction and small capacity, and a receiver with small self-induction and large capacity.

Let m and n be proportional to the frequencies of vibrations of the separate systems, whether mechanical or electrical, and let p and q bear the same relation to the frequencies of the vibrations superposed on one another with which each circuit or pendulum oscillates when the two are coupled. Then in the electrical case—

$$p > m \gtreqless n > q$$

and in the case of the double-cord pendulum, when $m = n$

$$p = m, \text{ and } n > q$$

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but the ratio p/q in this case and for coupled equal electric circuits is identical, and given by $\sqrt{\frac{1-\gamma}{1+\gamma}}$, where in each case γ denotes the coupling.

Fig. 9 shows curves between couplings and ratio of frequencies for the double-cord pendulum. In these curves ρ denotes ratio of masses of bobs and η the ratio of lengths of suspensions.

With the separate frequencies—*i.e.*, lengths of pendulums—equal and a given coupling, it may be noted that the greater the inequality of the masses, the greater is the inequality of the resulting superposed vibrations of the coupled systems.

When the coupling vanishes, the frequencies of the separate vibrations are, of course, undisturbed. Thus for equal lengths, but for any ratio of masses we have for $\gamma=o$, $p:q$ equals unity. But for different separate frequencies—*i.e.*, η not equal to unity—we have for $\gamma=o$, $p:q$ greater than unity. However, for large couplings the effect of unequal separate frequencies gradually disappears. This is also the case for pendulums which have masses and separate lengths unequal, but the large mass on the long length. If the long pendulum has the light mass on it, and the short pendulum the heavy mass, with coupling zero, the ratio of the frequencies is naturally that which applies to the separate pendulums. But in this case, when the coupling is increased, the value of p/q at first diminishes, reaches a minimum and then increases. The dotted curve marked $\eta=4/3$, $\rho=20$, in the frequency-coupling diagram shows this special case. It was first obtained theoretically and afterwards experimentally confirmed.

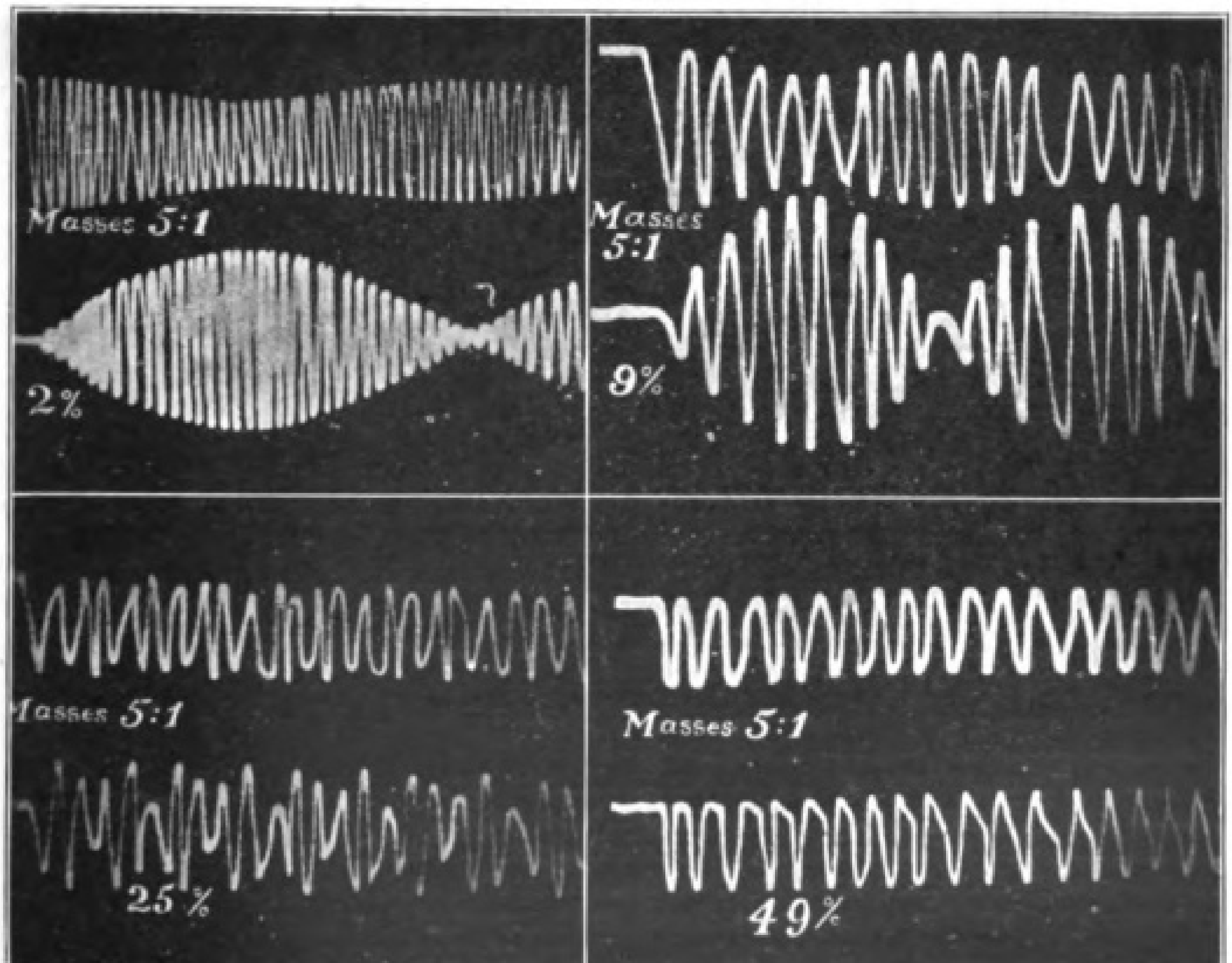

FIG. 11.—DOUBLE TRACES, BOB MASSES 5 : 1.

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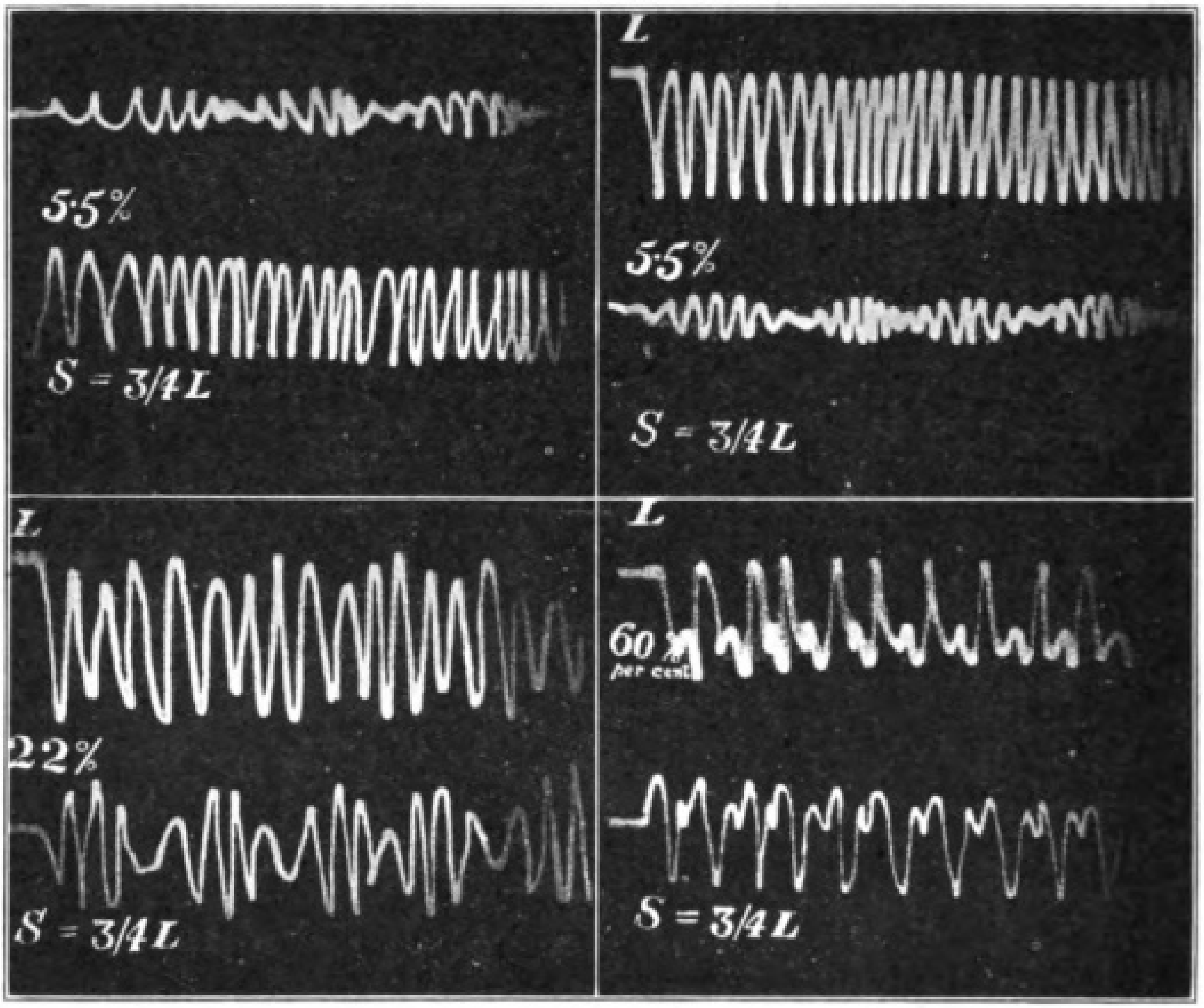

FIG. 12.—DOUBLE TRACES, LENGTHS 3 : 4.

Experiments with Masses of Bobs or Lengths of Pendulums Unequal.

All the experiments for unequal lengths or masses were done on the double-cord pendulum.

Masses 20 : 1.—The bobs were of the order 1,000 gms. and 50 gms. respectively. Photographs (1)–(4) of Fig. 10 represent double sand traces simultaneously obtained when the masses of the bobs were as 20 : 1. The couplings vary from 1 per cent. in the first to a little over 30 per cent. in the last, and are shown as percentages on the figures.

Photographs (1) to (3) were obtained by drawing the heavy bob aside horizontally, the light bob being allowed to hang at rest in its more or less displaced position. This is almost like charging the circuit with larger inductance, while the other circuit is given a slight charge.

In the three photographs shown the initial displacement of the light bob is almost negligible compared with that of the heavy bob, so it approximates to the ordinary method of obtaining coupled electrical discharge, where one circuit only is charged and then allowed to influence the other. Photo (4) was taken with the light bob held undisplaced and the heavy one drawn aside.

Comparing these photographs with Fig. 7 of the previous article, a marked contrast is seen in the behaviour of the upper curve. Because of the inequality of masses in the present case, while the resultant vibrations of the light bob (shown

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in the lower curve) wax and wane in amplitude, those of the heavy bob scarcely fluctuate; thus showing that with masses 20 : 1 the limiting case of forced vibrations has been nearly reached, since the reaction of the driven on the driver appears negligible. The frequencies are, however, still appreciably affected. As in the case for equal masses, increase of coupling causes increase in the inequality of the frequencies of the superposed vibrations, but in this case for coupling 30 per cent. the ratio of frequencies is 2 : 1; whereas for that of equal masses and lengths a coupling of 60 per cent. was necessary to give this frequency ratio.

Masses 5 : 1.—The masses of the bobs used in these experiments were of the order 600 gms. and 120 gms. respectively. Fig. 11 shows double traces obtained with this arrangement. This case is seen to be intermediate to those with masses of bobs equal and masses as 20 : 1. The beat effect left by the lighter bob is seen plainly in the lower trace, while those of the heavy bob show distinct but much slighter fluctuations. Further, a coupling of 49 per cent. is necessary for frequency ratio of the superposed vibrations to be 2 : 1.

Lengths 3 : 4.—The masses of the bobs in this case were equal, but the lengths of suspensions as 3 : 4. The lower trace on each figure is made by the shorter pendulum. Fig. 12 shows four photographs of the double traces. The first of these was taken when the shorter bob was drawn aside, the others with the long one drawn aside, and the other bob at rest in its more or less displaced position or held undisplaced. The couplings are marked on the photographs.

Photos (1) and (2) show that it does not make any difference whether the long or short bob is drawn aside.

It is also seen that the difference in lengths makes the action of the driver on the driven very small for small couplings, so in electric circuits, if one circuit has a different capacity from the other, while the self-inductions are the same, the response of the second to the first is not appreciable. If, however, the coupling is great, the effect of inequality of length disappears, and photograph (4) is seen to be almost identical with photo (6), Fig. 7, of Article I., in which latter case the lengths were equal.

This second article has given a brief general theory, and dealt with the special cases of vibrations with either the masses of the pendulum bobs or the lengths of the suspensions unequal, which cases are somewhat analogous to coupled electric circuits with inductances or capacities unlike.

In a final article it is hoped to deal with the general case for both masses and lengths unequal, and to describe experiments showing why a wireless receiver has to be tuned to obtain waves of a certain frequency sent out by a transmitter.

An Interesting Anecdote

A REVERSION to the inductive method of wireless telegraphy through the earth is indicated in a little incident narrated by W. J. M. Locke, M.C., in the course of a war lecture recently delivered at Melbourne. It appears that during the attack on the Hindenburg Line east of Bullecourt, a party of Australians found their flank turned by a sudden enemy onslaught. One solitary Australian soldier was seated in an enemy dug-out which had been captured from the Germans earlier in the day, and for some considerable time was completely encircled by the German forces. Being at the transmitting end of an underground earth wireless installation, he was able to send to headquarters a detailed account through that medium of all that was going on. In consequence, the Australian artillery managed to find the range of the enemy, whose counter-attack was ultimately dispersed. The gallant signaller was relieved from his perilous isolation, and some little time afterwards was decorated for his bravery by the Distinguished Conduct Medal.

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Digest of Wireless Literature

Oscillation Valve Circuits.

The purpose of this paper is to explain the general principles upon which depend the uses of the valve for generating electrical oscillations and for amplifying externally impressed oscillations by " regenerative action," and to discuss in detail the action in certain circuits. It is shown that the criterion for the generation of an oscillation and for the measure of its intensity is directly determinable from the constants of the circuit and from the characteristics of the audion.

At the present moment the different connections in which three-electrode valves are used for generating or receiving are very numerous, and the author classifies these into groups, so that any particular connection may be referred to its corresponding group. This grouping has the further advantage that new connections are suggested by the systematic manner in which one group of connections is evolved from another.

The first set of connections considered refers to simple oscillation circuits connected inductively or electrostatically to the valve circuit. The second set refers to connections in which coupled circuits are used with the valves, the couplings between the individual circuits and between the circuits and the valve circuit being tight or loose and effected by electromagnetic or electrostatic means. Each type of connection is again sub-divided into sub-sections by the interchanging of the connections to the filament, grid, and plate.

In each case formulæ are worked out determining the conditions under which the audion tends to maintain impressed oscillations and the conditions under which the impressed energy will be absorbed. It is found that with certain arrangements the audion will have regenerative action only over a very short range in frequency, absorbing energy from oscillations at all other frequencies. This result affords a means of reducing interference especially from unsustained oscillations such as are caused by strays.

If I_p is the plate current and E_p and E_g the plate and grid voltages respectively, g the conductance from the grid to the plate and g_p the quotient of a variation in the plate current by the corresponding variation in the plate potential, then $I_p = E_g g - E_p g_p$ is usually very small compared to g, we may write approximately $I_p = E_g g$. If the plate is positive with respect to the filament there will be an output P from the audion given by $P = E_b I_p$. It therefore follows that $g = P/E_g . E_p$. The smaller this quotient the more easily will the audion oscillate, and if the quotient is greater than the value of g obtainable from the audion no free oscillation will occur, but externally impressed oscillations may be greatly multiplied. This is known as " regenerative action." If an impressed oscillation causes the grid and plate to be of the same polarity its energy will be absorbed and the audion may thus be used to diminish undesirable oscillations. The form of the quotient giving the value of g is symmetrical in E_g and E_p, which shows that the plate and grid potentials are interchangeable.

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The value of g for given adjustments of the audion depends on E_g, being smaller for higher values of E_g. Hence if the highest possible value of E_g is desired for a given energy of oscillation (as in radio receiving), E_g should be made small relative to E_p.

The calculation of the quantity g and the frequency of the oscillations obtainable by means of various connections of the audion is made according to two methods. In the first, all currents are assumed to be in phase with one another, and the power loss in each branch is obtained by squaring the current and multiplying it by the resistance of that branch. In this manner the value of P is obtained. If, however, the resistances are high, or the coupling between circuits very loose, or if high accuracy is desired, both the resistances and reactances of the various branches must be considered together. This is carried out in the second method of calculation by the use of complex notation. One particular connection of the audion is claimed to be novel. This is based on a utilisation of the fact that there are two frequencies of oscillation when the audion is used in connection with coupled circuits. If the audion be allowed to oscillate at one of these natural frequencies while the other is brought into coincidence with that of the signal to be received, the audion may be brought to the verge of changing from one frequency to the other, and amplification is then possible. This is called the "self-heterodyne" principle.

Another set of novel connections is deduced from circuits already in use by interchanging the plate, filament and grid with the filament, grid and plate respectively.

While the author does not claim to have included all possible oscillating audion circuits he hopes that the methods given will lead to the discovery of new circuits of importance. Two appendices are given. In the first a graphical method is given for determining the effective mutual conductance g under working conditions, and a "derived characteristic" representing the conditions during an oscillation is obtained from the characteristic curves of the audion, enabling the relations to be obtained between the coil inductances, or between the condenser capacities, in the plate and grid circuits that will result in the greatest power output from the audion when acting as a generator. The second appendix contains a mathematical proof of the fact that the grid and plate of an audion may always be interchanged.—(L. A. Hazeltine, *Institute of Radio Engineers Proceedings*, April, 1918.)

A RADIO PHENOMENON.

Smoke passing through an aerial has, according to a writer in the *Wireless Age*, the power to transmit heavy deposits of static. Ship operators have perhaps been aware of this fact for a long time, but it is probably news to many land amateurs. "The phenomenon was first called to my attention," says the correspondent, "at Fort Leavenworth, where the college station 'WUV' experienced considerable trouble from a mysterious source. Major J. O. Mauborgne, who took charge of the Signal School there last autumn, quickly traced the trouble to its source and proved conclusively that the frequent violent surges of static which would appear and suddenly disappear on nights which were unusually free from atmospheric disturbances were caused by smoke clouds from passing trains. He expressed a determination at the time to write a paper on his investigations of the phenomenon, but was called for service in the radio laboratories in Washington and has no doubt been too busy to give the matter further thought.

"The writer, whose aerial was also exposed to smoke clouds from passing trains, made frequent tests up until the time the stations were ordered closed, and a passing train never failed to disturb the station when the wind was favourable for passing the smoke through the aerial. The charge of static would 'spill' the audion and made a fine display in the variable condenser which was used in series with the antenna to shorten the wavelength."

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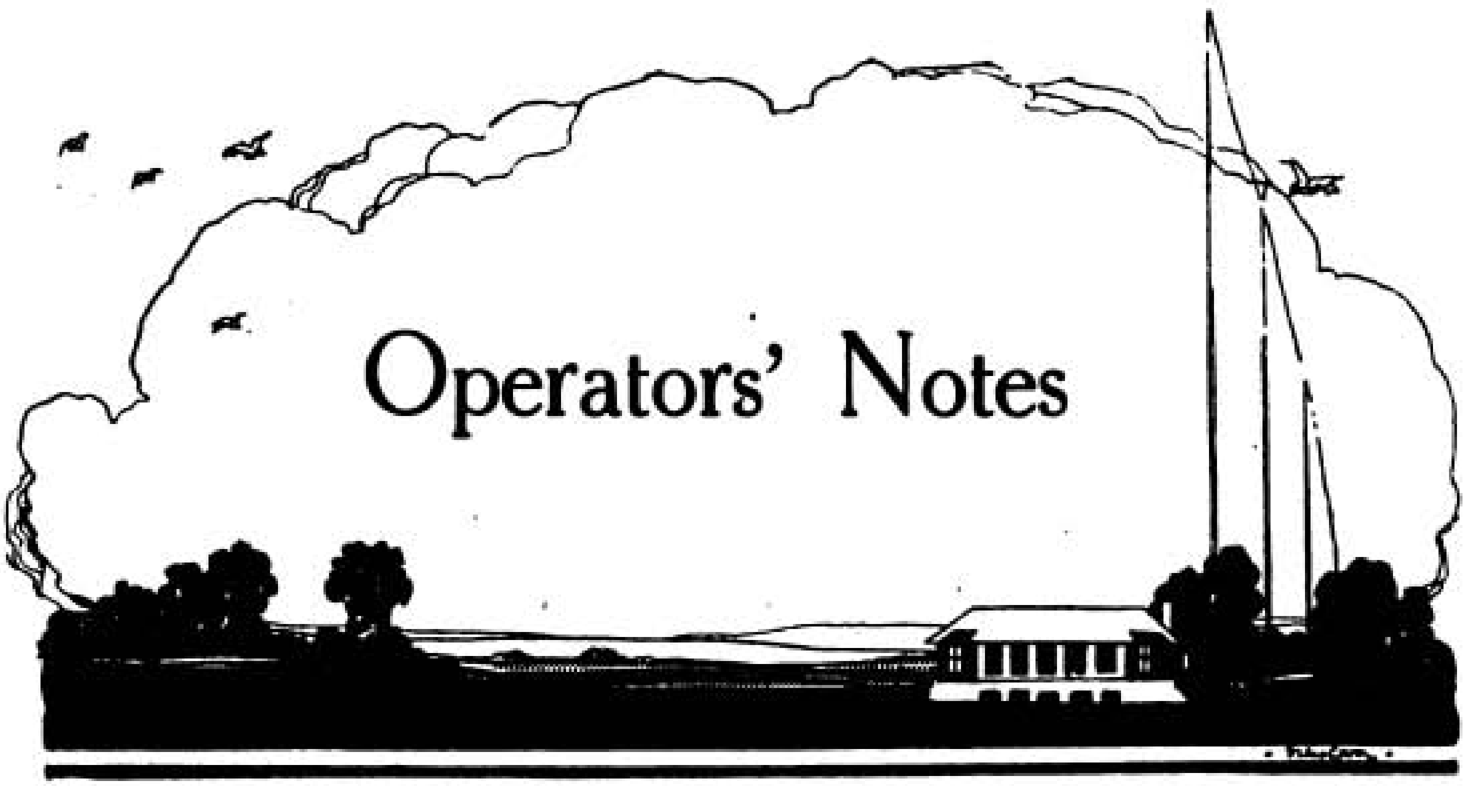

Wires and Wiring (I.)

By ROTAREPO

ALTHOUGH " wireless " is the generally accepted term for radiotelegraphy, it is somewhat of a misnomer, inasmuch as both wires and wiring play a very important part in the construction of a station. It thus becomes necessary to ensure that all joints and connections are perfect, and that wires of the correct grade and gauge are selected.

Junior operators will do well to bear in mind that, although their stations are usually wired ready for use by the Company's engineer, the need for repairs and alterations constantly arises, and they should, therefore, make themselves familiar with the various methods employed in wiring up their sets. From time to time juniors get an opportunity of valuable practical experience, being sent abroad to assist an engineer in fitting a ship's installation prior to taking charge of the set. Needless to say, the man chosen for such a pleasant and instructive task must have some knowledge of the use of tools and simple wiring. All operators keen on their profession should therefore take every opportunity to become good practical mechanics.

The following is a partial list of the most commonly used wires and their particular usages in the construction of a standard ship set. The first figure denotes the number of component strands forming the cable, and the second the gauge of each individual strand.

7/16 tinned copper coated with rubber and insulating tape, the whole being lead sheathed, is used for primary D.C. and A.C. circuits. Sometimes the lead sheathing is earthed.

1/18 same as above is generally used for field and guard-lamp circuits.

3/22 ditto for the same purpose is sometimes used.

7/18 tinned copper I.R.V.B. (insulating tape, rubber, vulcanised and braided) or 7/20 ditto are used for primary circuits of coil sets, earth leads, etc.

Plug connections to aerial are generally made with 30 amp. dynamo flex, insulated with rubber and cotton or silk.

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70/40 copper twin flex, triple cotton, rubber and silk is the wire used for receiving leads.

Bell wire is generally made of No. 22 tinned copper, and is insulated in various arrangements of cotton and rubber or cotton, rubber and silk.

Aerials are formed of a number of various materials, but generally uninsulated, the most common of which is 49/28 silicon bronze.

No. 10 bare annealed copper is employed when making connections of secondary of coil or transformer.

Ordinary switchboard fuse consists of No. 18 lead wire.

Irregular and untidy wiring is most unsightly, besides being the source of numerous "faults." The following general hints should therefore prove of value to all those who are not thoroughly acquainted with this branch of their profession.

Where wires have to be laid up a wall see that they run perpendicularly and parallel to each other. When porcelain cleats are used the wires should be stretched tight before finally screwing up the top piece. If staples are used, take care not to drive them too far home or the insulation will suffer, or even the wire itself get cut. Do not make sharp bends, round them off into sweeping curves. Whenever wiring avoid crossing leads, but should this become necessary make the crossing as near at right angles as possible. Avoid laying wires on top of operating table, or in an exposed position where they are liable to be subjected to heavy knocks or accidental kicks.

In concealed wiring, such as under the table, it is advisable to run the leads from point to point in the shortest possible direction compatible with the foregoing advice.

When joining two single strand wires the joint which gives the most satisfactory electrical connection for the minimum amount of labour expended is formed as follows: Strip and clean, in the case of insulated wire, about two inches of each of the two ends to be joined. Lay these bared portions side by side and tightly bind each one round the other, care being taken that each turn lies close up to the previous one. Complete the joint with solder, and re-cover with insulating tape.

Flex may be treated in a similar manner, except that the joint should be made longer and the turns laid more in the direction of length of wire rather than at right angles to it. If it is desired to retain the flexibility of the joint solder must be used sparingly in the centre only, the turns being held in place by "seizings" (bindings) of thread.

Three-strand wire can also be joined in the same manner, though the component strands should be untwisted, and cleaned individually, for about two-thirds of the whole length bared prior to commencing the joint, in order that each strand may lie in actual contact with the main wire round which it is bound. Perhaps this may be more clearly expressed by saying that there should only be one "layer" of windings round each main wire, and not three, as would be the case if the strands remained untwisted.

If the joint is likely to be subjected to any mechanical strain it should be made in a manner similar to that explained for seven-strand wires.

The joining of seven-strand wires has previously been fully explained by Mr. Ward in the April number under the heading "Repairing an Aerial." However, it will no doubt be of use to point out that the two main wires after the first operation should be in a position similar to clasped hands, with fingers interlocking and palms apart. That is to say, if the wrists represent the main wires to be joined and the fingers their component strands (though in this case we have only five instead of six), then the first finger of left hand should lie between thumb and first finger of right hand, and first finger of right hand between first and second of the left, and so on. From this stage, of course, the jointing goes on as usual, binding each set of components round the main wire of other side of joint.

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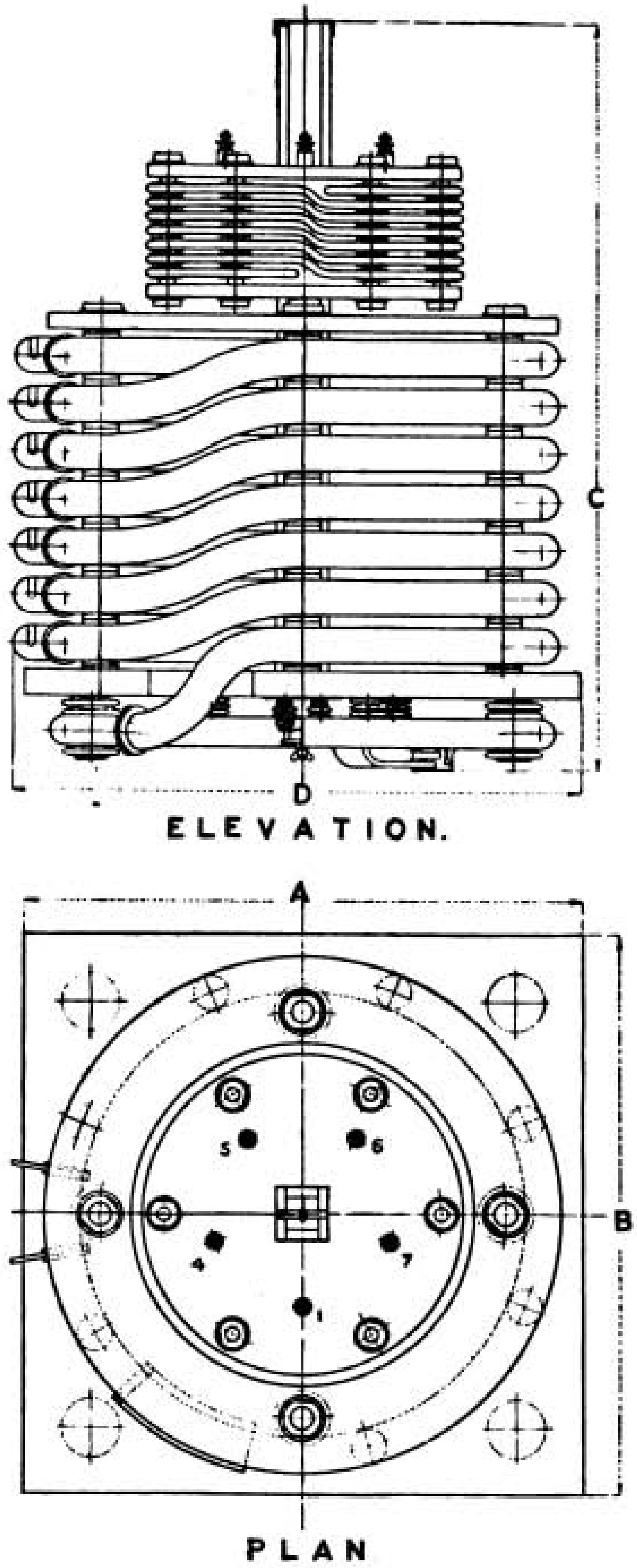

Transmitting Jigger, 20-25 kw.

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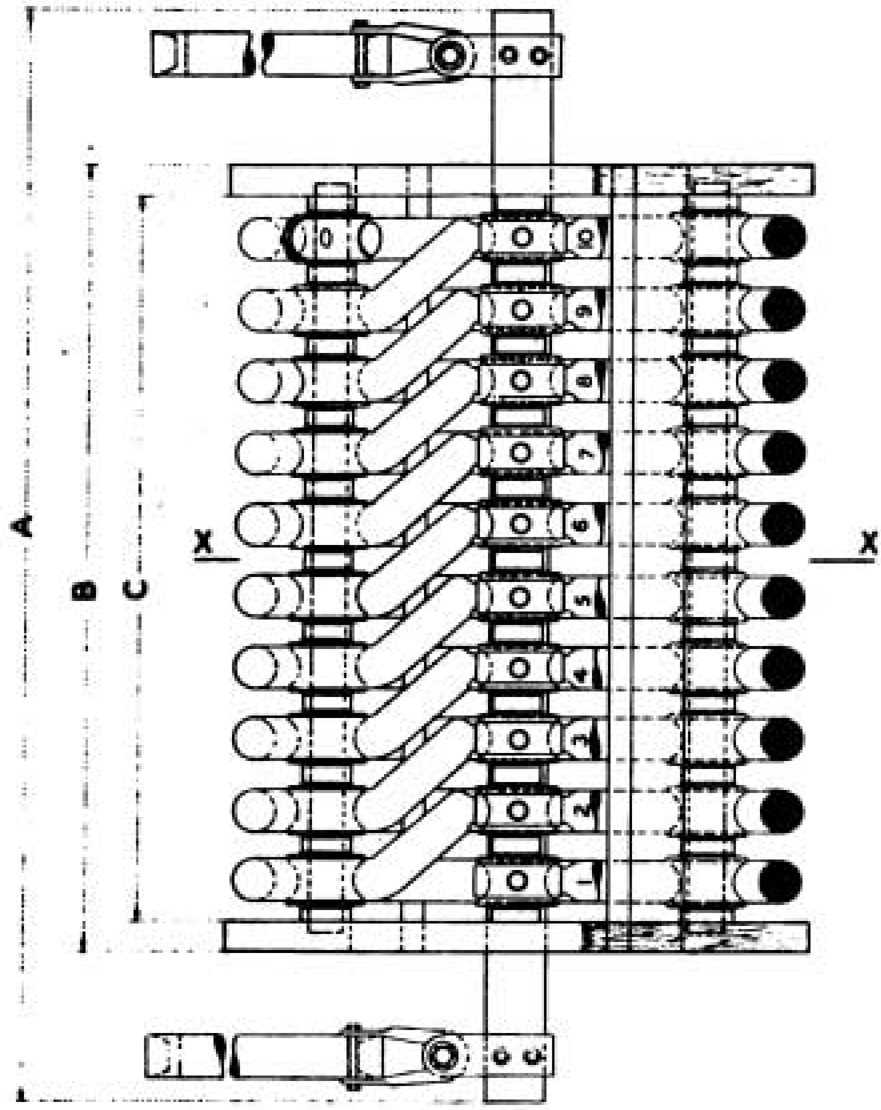

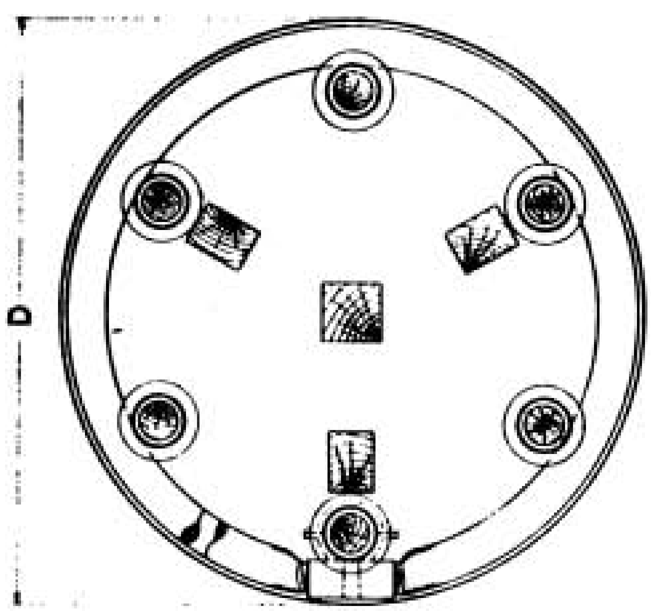

— SECTION ON XX —

Aerial Tuning Inductance for High Power Sets

Wireless Telegraphy In the War

Silver Speech and Golden Silence.

The old Roman statesman-philosopher Cato laid down over 2,000 years ago the maxim, " Regard it as the first of virtues to restrain the tongue," and the same practice of restraint is inculcated in the popular English proverb, " Speech is silver, but silence is golden," a traditional saw which some authorities consider to be of Persian origin. Silence is often more significant than speech, and during the diplomatic manœuvrings which went on just before the Franco-Prussian War of 1870 the famous *Times* correspondent, Monsieur Blowitz, is reported to have said, as a justification for sinister forebodings : " Moltke is silent in seven languages." This celebrated Danish general, who organised the German army and led it to victory, held a high reputation for linguistic attainments.

Radiotelegraphy is but speech communicated through ether waves instead of sound waves ; and there are occasions when the " golden rule " of *tace* applies to radiotelegraphy. We referred last month to the way in which wireless coast defences could detect the presence of hostile warships through radiotelegraphic messages sent out by the latter, even despite the friendly shelter of thick smoke screens. A most striking case, illustrative of the same point, occurs in the narrative of two Australian officers, unwilling passengers on the German raider *Wolf*, which returned to Germany towards the beginning of the year. These gentlemen, Colonel Strangeman and Major Flood, were travelling on board the s.s. *Matunga* at the time when she was captured. Since their arrival in England they have stated that in the course of their sojourn on board the Teutonic corsair they found out that none of the wireless messages which were sent out by the *Matunga* were missed by the foe. The *Wolf* kept two installations going night and day, always receiving but never sending messages. In the Indian Ocean her officers boasted that she received press news through her aerials in four different languages. The same precaution with regard to reception only was not improbably followed as a general rule by the wireless station established on a hill overlooking the pirates' lair, a natural harbour on the north coast of Dutch New Guinea. At least, any transmitting they may have dared to carry out must have involved serious risk of the discovery of the enemy secret.

The well-known naval correspondent, Mr. Ferraby, seems to have been recently treated to a cruise on a " Beef Trip." Some of the irreverent young gentlemen who officer His Majesty's destroyers appear to give this title to a certain class of convoy work, irrespective of whether the cargoes carried be margarine or pit-props, or barrels whose contents can only be guessed at.

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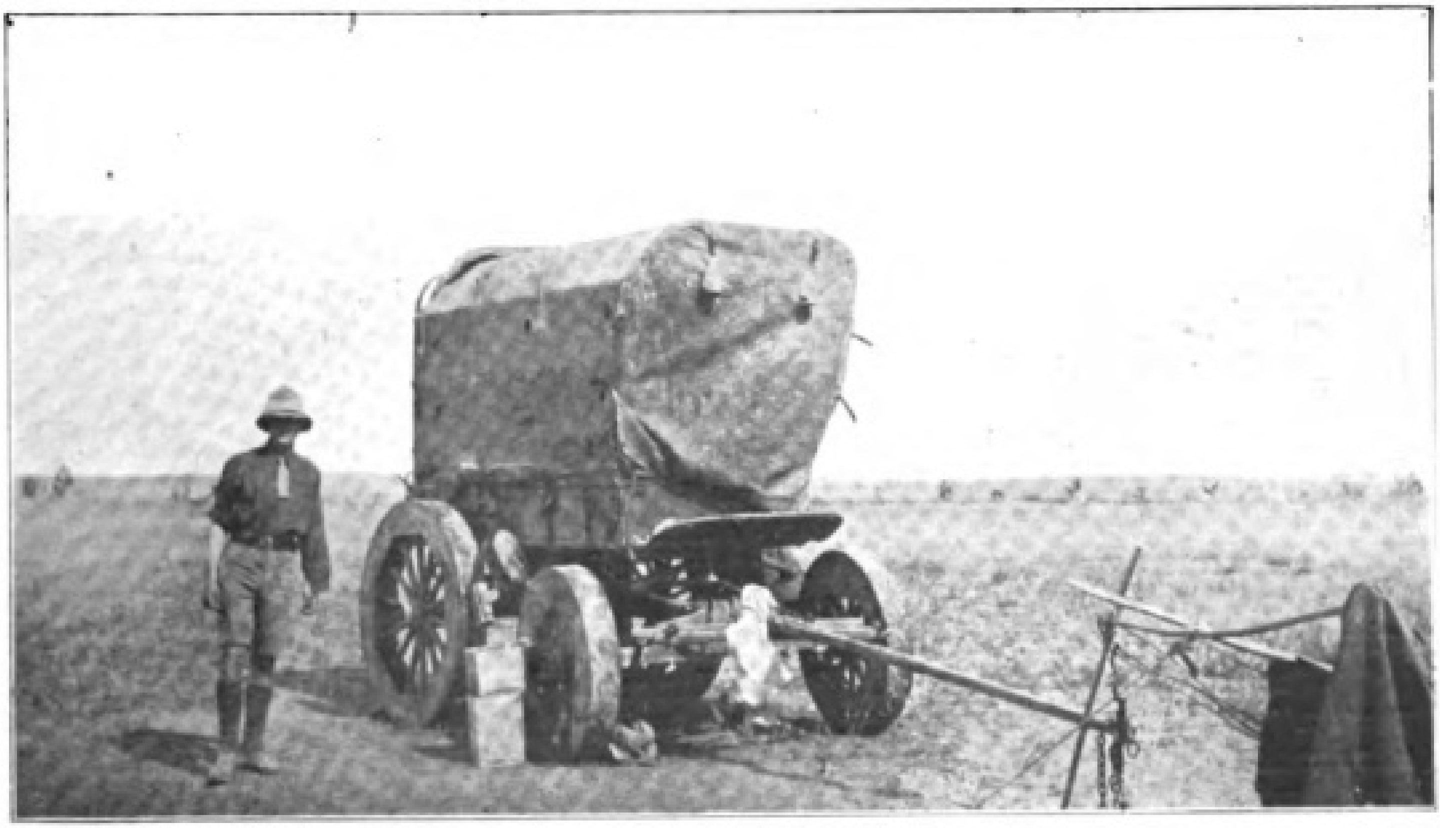
Mr. Ferraby, in the course of the tale he tells, describes how, as they go along, "a seaplane on watch catches sight of an enemy submarine and assails her with its "bombs. Three destroyers rush to the spot and send down depth charges. They "then circle round the spot once or twice: the seaplane glides down, whilst the "observer morses comments. The British convoy is too close to enemy-infested "waters for wireless to be used, and the three destroyers swing back to their places "in the mad quadrille."

You will notice that the reference here is to visual signalling, and it would appear that on such convoys the rule is usually laid down that this form of inter-communication should be utilised—semaphores and flag signalling by day, flash signalling by night. This rule is advisable on account of the sensitiveness of modern wireless instruments, and the danger lest the enemy may be attracted to a spot where his presence is not required. In such emergencies as those when wireless must perforce be utilised, the power employed is kept strictly within certain limits, and one of the problems which wireless experts are constantly endeavouring to solve is that of ascertaining with exactitude the range possessed by given aerials actuated by current of a given strength.

The enemy is as well aware as we are of the dangers accompanying radio speech, under certain circumstances, and our readers will find under the heading "Notes of the Month" in our last issue a reference to the Army Order of the German General Von Hutier, extending his prohibition thereof to telephone messages to or from points within seven miles' distance of the French or British lines. The tongue is sometimes termed "an unruly member" which requires curbing on occasion, though it must undoubtedly be reckoned one of the most useful weapons placed by nature in the armoury of man. The same admonishment applies also to wireless.

SPIES AND SPYING.

The cable companies in days not so very long since gone by used, for trade reasons, to put forward certain staple objections to the employment of wireless. Prominent amongst these stock indictments figured that of lack of secrecy, and it is a curious comment upon this superficially plausible piece of special pleading



FIELD WIRELESS "SOMEWHERE IN THE EAST."

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that we are now treated to so many items of fact and fiction with regard to the secret utilisation of radiotelegraphy by enemy spies! For our own part, we fear it is only too true that the highly organised spy system of our foes would be deprived of their main source of efficiency were it possible to cut off from them all possibility to utilise wireless; cable utilisation by the enemy vanished long ago.

A correspondent of the *Agenzia Volte*, working at Zurich, in Switzerland, recently telegraphed a communication to his principals at Rome that the central spy authorities at Berlin gave credit to radiotelegraphy for what they contend to be a fact, viz., the continuance in efficiency of the German system of espionage all over the world. The Allies and Neutral Governments have, so they assert, been unable to cripple it. Thanks to this efficient system, continues the correspondent, "the "German General Staff has been kept accurately informed concerning the sailing "of troopships from America and knows exactly how many American troops have "been landed in France up to the present." We cannot help seeing in the recent outspoken publication of figures on the part of the U.S.A. Government some recognition of the truth of this assertion.

Again, turn to the story of the sinking of the hospital ship *Llandovery Castle*, which we recount in our article on Maritime Wireless Telegraphy. You will notice that when the captain in command of the most recent victim of Hunnish methods of war was being interrogated by the U-boat commander he found the latter with so fixed an idea that the Red Cross vessel was carrying eight American flight officers as to be scarcely induced to credit that this was not the case, even when one of the Canadian Medical Staff appeared in person before him. The *Daily News*, in their account of the outrage, reported that there were eight medical officers on board the hospital ship until an hour before she sailed from Halifax, when one of them found himself obliged to remain on the other side. Our contemporary suggests that possibly some German spy saw the eight medical men on board and mistook them for American flight officers, either deceived by not having a clear view of the insignia of their office or coming away with the impression that they were Americans in disguise. The spy system which could advise the U-boat commander of such a suspicion in time for him to take action must be well served, and only wireless could do it.

On page 217 of our July issue we refer to the statement of an American writer that by means of small balloons a submarine can raise her wireless to the height of 1,000 feet or more, and that, under favourable conditions, the receiving range of these underwater craft might be estimated at about 3,000 miles. By "relaying" from one submarine to another, almost any distance might be covered in this manner. We have constant information with regard to what goes on in German submarines, and practically every returned visitor emphasises their continual use of radiotelegraphy. Such a persistent practice seems to point in a confirmatory direction; it is difficult to believe that submarine wireless is used for reception only, especially in view of the fact that the largely increased size of the later types would enable much more powerful installations to be carried.

The foregoing remarks refer, of course, more especially to the fact that, despite all the difficulties and dangers surrounding the *sending* of secret messages, the practice is far from having been "knocked on the head." With regard to their *reception* the matter is simple enough, and in the Government pronouncement issued in justification of the Sinn Fein arrests we find the deliberate official statement that Count Bernsdorff assured his employers at Berlin of the existence of numerous private wireless receiving stations in Ireland.

What is the moral of all this? Vigilance, and again vigilance! There is no more a "royal road" to the suppression of spy wireless than there is to complete elimination of the U-boat menace. *Vigila et ora* was the motto of some of our doughty forbears, and such a tradition is well worthy of being carried on by ourselves.

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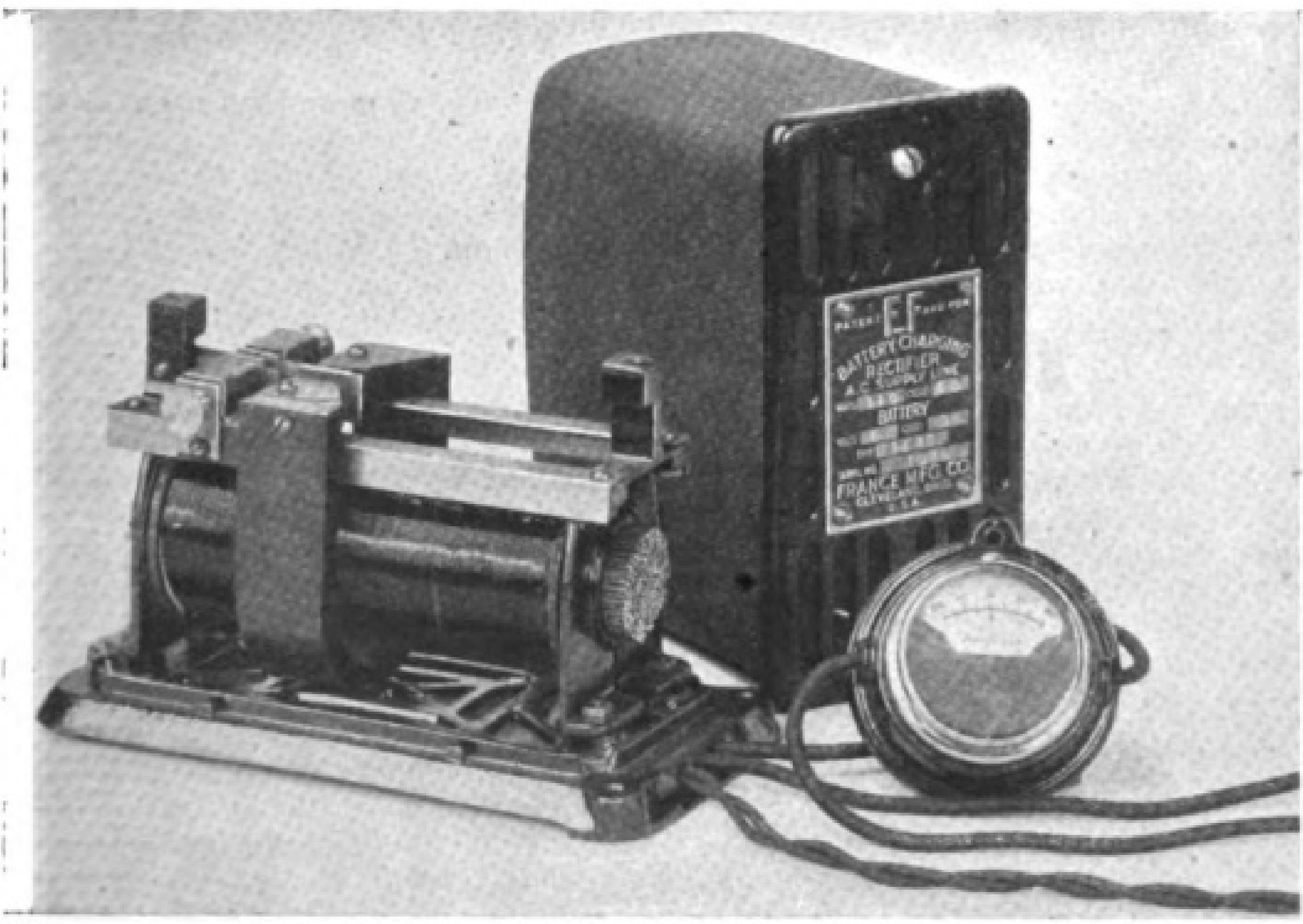
An Interesting Alternating Current Rectifier for Charging Accumulators

THE charging of accumulators from an alternating current source is usually effected through the agency of a motor generator consisting of an alternating current motor coupled to a direct current generator. Another method depends upon the use of chemical rectifiers. The former manner has the disadvantage of the high initial expense of the machine while the latter suffers from low efficiency, so that there should be a good opening for the American device shown in our illustration.

This full wave magnetic rectifier operates as follows. Firstly the line voltage is reduced to the proper charging voltage by a special transformer, and then the



current is rectified by means of the vibrating tongue, which, actuated by magnets in circuit with the alternating supply, automatically connects the line first to one pair of contacts, then the other in exact synchronism with the supply current. The device has thus no rotary parts, and being simple of construction, can be marketed at low cost.

Designed primarily for the charging of motor car starting and lighting batteries, it is yet obviously suitable for many other purposes including the charging of cells for wireless work. The smaller sizes can be rapidly connected to an ordinary lamp socket and the cells, if necessary, charged without removal from their normal position.

The rectifier is self-starting and is not affected by line failures. If the current

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is turned off the battery cannot discharge through the rectifier—as may happen with a motor generator and when the current is turned on the rectifier starts itself; thus night charging is safe and saves time. One type is shown in our illustration. It will charge a 6-volt battery, or two or more 6-volt batteries connected in multiple at an average rate of 10 to 15 amperes. An average starting and lighting battery can thus be charged overnight. The rectifier shown measures 5 by 7 by 9 inches and weighs 14 pounds.

The "Slave of Duty"

ONE of the most whimsical of the late W. S. Gilbert's librettos is that of the "Pirates of Penzance," which contains perhaps the most famous Policeman's Chorus in the world, of which the refrain runs thus:

"When Constabulary duty s to be done—
To be done.
The Policeman's lot is not a happy one—
Happy one."

An article recently appeared in the *Daily Chronicle* of more than usual interest and ability dealing with the life of a wireless operator at sea under war conditions. The subject was treated in just that "jesting about earnest" spirit which pervades the work of our classical British humourist; and—in case our readers may have missed reading it—they may find the following summary of interest. Of course, as our readers will notice, the language used has been "treated" journalistically. "Sparks" himself, that modern "slave to duty" (to employ the sub-title of Gilbert's "Pirates"), is reported to have said:—

"I think the worst time I ever experienced was one voyage when I had "as my wireless mate a fellow whose mother was a German and whom I was "told to watch, as he might be a spy. I tell you it got on my nerves, for we had "codes and all sorts of things in the wireless cabin, and I never dared let the "beggar be alone for long lest he should try some monkey tricks. The nearest "touch I think we ever had was when we were the last ship out of a patrol and "an urgent call came through, 'Come into —— bay immediately—we have "'an urgent message for you which we daren't send by wireless.'

"I asked for the Captain. When he came I pointed to the pad on which "I was writing down the signal. He read it over my shoulder and just as he "was going off to alter the ship's course I said, 'Look here, sir, this sounds O.K., "'but I've got an idea that this may be a German apparatus keyed to imitate "'a British.' (You see, after a bit of practice one can recognise the nationality "of the sender by the difference of the note and so forth. They are all different!) "The call was repeated, and the skipper felt he must obey it, but finally he looked "at me and I shook my head. At last he said, 'No! I'm hanged if we'll go, "'Sparks!' So we held on our course and got safely home. We heard "afterwards that there were two U-boats waiting for us and they'd have put "us down if we'd gone to that bay! . . . .

"With all its anxieties your daily task is most absorbing; though in the "tropics, when one is boxed up and simply dripping with sweat—so much so "that one has to put blotting paper under the arm with which one writes—you "certainly do find it a bit trying. Then, if you are busy picking up some very "distant message and a confounded ass comes blundering along and disturbs "you, it is not unlikely to try your temper 'some.' . . . .

"All the same, it's awfully interesting work, and I love it, and it is rather "good to feel one can be a bit of use now and again."

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The Suez Canal

An Operator's Voyage in the "Highway to the East"

By HAROLD WARD

We were ten days out from London *en route* to the Far East before I managed to get in touch with Port Said, though I had heard him for several nights previously. Up to a year or two before the war the working of this station had been apt to be characterised by irregularity, a defect possibly due to the extremely dry nature of the surrounding land. Owing to this cause its position had been shifted more than once, and at the time of which I write the installation was located on the pier at the head of which stands the statue of the canal builder, M. Lesseps. A ship approaching from Malta is to some extent screened from Port Said by the Nile delta, and this may have been the cause of the trouble. When moored in the bay at Alexandria there have been occasions when I found myself unable to raise him, although the distance is comparatively short.

Two days later, after the usual exchange of MSG'S, we glided past the entrance pier and dropped anchor in mid-stream opposite the coaling wharves. As I leaned over the rail I seemed to "sense" that I had reached the Orient, the traditional "home" of strange beliefs and mysticism, which furnishes such invaluable local colour to novelists of every order. With this feeling fresh upon me I impatiently awaited the continuance of the voyage, so that I might penetrate still further into a land that was old when England was still a youngster as countries go. What entrancing mental visions arose within me of snake charmers and mystic rites, of sun-baked soil and swaying palms, and the whole galaxy of unfamiliar sights which combine to make the Far East the tourist's Mecca! Port Said, to my mind, is quite justly denominated "the gateway of the East."

A traveller from England, provided he has come by one of the regular routes, will here, for the first time, be in an unchristian port. I use the epithet in its literal significance, and any of my readers who boast of any acquaintance with the Mediterranean will readily agree that most of its ports are far from being Christianlike.

At Port Said the larger proportion of the inhabitants are followers of Mohammed, and I was very interested in the curious rites of this branch of "heathen" worship as I witnessed them in the mosque shown on page 275. Having always endeavoured to cultivate the "open mind" on matters of religion, I need hardly say that I use the word "heathen" in no invidious sense, employing it to signify merely a worship other than that of Christ. Many of the native Moslems are fully as law-abiding and refined as the average so-called cultured Christians. Given a suitable

THE LANDING STAGE AT PORT SAID.

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medium I should delight to enlarge upon my personal observations of the manner in which various races adhere to their accepted creed and carry out its precepts. The present, however, is not a fitting opportunity for so doing, and I will only venture to express the opinion, in passing, that it would prove of great subsequent interest to travelling wireless men if they were to take the chances afforded them of noting the characteristics of the followers of the different religions they may come in contact with, and of comparing them with one another.

A BOY CONJURER AT PORT SAID.

In peace times the majority of ships calling at Port Said only stay long enough to coal before passing through the Canal. This operation is performed by hundreds of Arab labourers, each carrying a small basketful of coal. These men run up a plank from the lighter to the ship's side, dump their load down the bunker hatches, and then return by another plank for a fresh supply.

At first the weird chanting, shouting and picturesqueness of the moving streams of swarthy workers provided all the entertainment necessary; but as the dust rose thicker and thicker the passengers, in twos and threes, went ashore in boats to see the sights and buy photos or faked curios. Those who landed first were "old-timers," and they made straight for a large café, where, in the shade and free from dust, they sipped from long glasses in which the ice tinkled most seductively.

As you walk about the streets fresh sights greet you all the time. In my own case I was immensely impressed by the number of beggars I encountered at every turn. Their diseased limbs and faces were often most repulsive, and the constant recurrence of these hideous specimens of humanity did much to spoil my pleasure. Their plaintive and haunting cries of "Baksheesh, mistair, baksheesh for ze poor Araab," rang in my ears for days after.

I did not take long to become "fed up" with the dirty, smelling streets of the Arab quarter; so, having "snapped" a few photographs, I joined the veterans at the café in the shade and waited my turn for showing practical appreciation of the tinkling ice. The boy whose photograph appears above passed among the tables where we sat, performing sleight-of-hand tricks, certain of which were voted to be well worthy of reproduction by some of our own legerdemain experts. His performance was carried on to the accompaniment of a running "patter" couched in what I took to be Arabic, interspersed with frequent appeals to Allah.

When I got back on board I was pleased to find the coal dust washed away and lunch ready. I may say that the latter, despatched in the saloon beneath the cool electric fans, was particularly welcome after the heat and dust ashore.

Shortly after this we commenced our passage through the Canal, and having advised the shore wireless station of the fact, I went on deck just in time to see a homeward-bound mail-boat pass out of the entrance.

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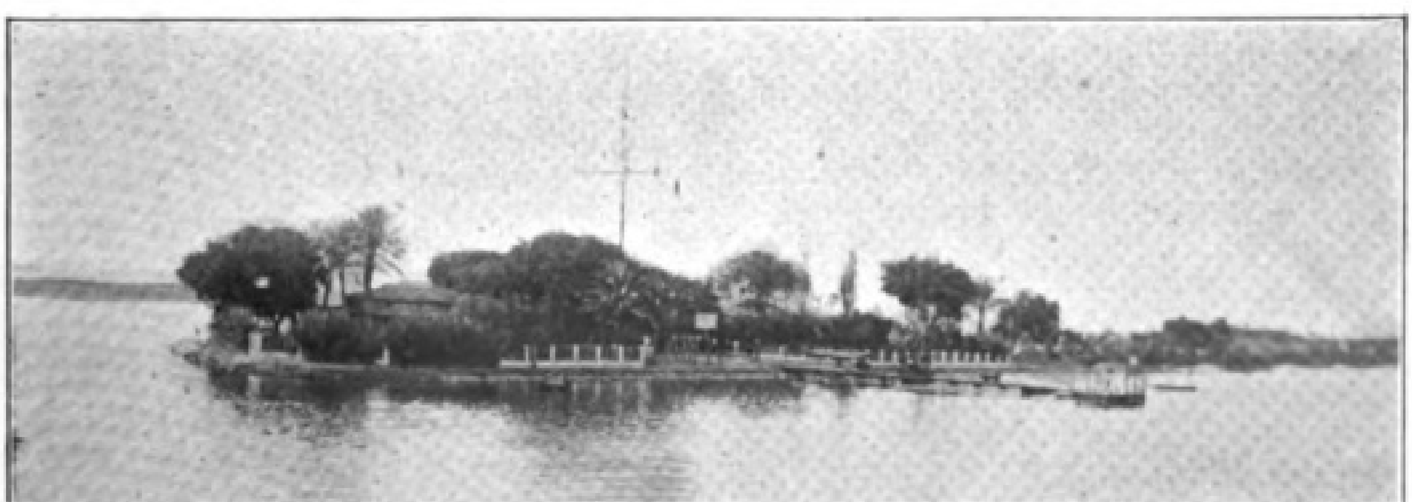
All the passengers at my table were agreed that it was hot, *very* hot, yet to our surprise most of the people on the passing ship were clad in warm clothes. We, for our part, were sporting "whites," and in despite thereof were feeling far from chilly! I found out afterwards that this apparent difference of feeling is frequently noticed; the fact being that, although to the outward-bounder Port Said is hot, to those returning from the Indian Ocean it appears (by contrast) chilly! Such is the difference of "the point of view"!

A MOHAMMEDAN MOSQUE.

The subject of the Canal bristles with statistics; but, as most people dislike them, I will only inflict those few figures which seem indispensable for bringing home the wonderful nature of this engineering marvel.

Building (or digging) was started in 1856 and the Canal was opened for traffic four years later. Thirty years afterwards it was enlarged to accommodate ships of 10,000 tons, this operation bringing the total cost up to £20,000,000. Great Britain owns more than half of the shares of the Company, though the administration is, or was, almost entirely directed by the French. The Canal is about 100 miles long, narrows to 210 feet wide in certain sectors, and has been dredged to a depth of 30 feet. These are pre-war figures, so that it might not be advisable to rely upon them for present-day navigation.

Leaving Port Said behind, and jogging along at about six knots, the Canal speed limit, we entered the Canal proper. During the first twenty miles or so the west bank is fringed with tall reeds, which sway in the wash from the ship's wake. Behind these there stretch away into the horizon the silvery waters of Lake Menzaleh, over whose surface the queer Arab dhows, with their huge lateen sails, glide as gracefully as swans. The word "lateen," by the way, possesses a rather interesting origin. It is said to be a corruption of the word "Latin," and is applied to that curious type of sail typical of most of the small craft one meets with in and around Latin waters.



THE SIGNAL STATION AT EL KANTARA.

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The eastern bank presents a striking contrast in the form of a limitless expanse of hummocky sand which glistens with fearful intensity under the quivering heat haze. Fighting under conditions such as this must be too awful for words. My eyes ached with looking at it, and I pictured to myself the terrible fate which has so often befallen a travelling party which had lost its way or failed to reach an oasis before the water gave out. I have been told, and can easily believe it, that the caravan routes are literally lined with the sun-bleached bones of men and camels.

" BEGGARS INFEST THE STREETS AT EVERY TURN."

About ten miles from the entrance we passed Gare Ras el Esh, the first of the several stations controlling the movements of ships using the Canal. The stations are all much alike; they belong to the bungalow type of erections, and contain the keeper's quarters and office, surrounded by a few dried up palms. These low buildings, together with a small landing-stage and mast, whereon are hoisted the signals indicating whether the ship is to proceed or tie up and allow another to pass, constitute the only evidence of life in this otherwise desolate area.

After passing two more stations—Gare Tineh and Gare Le Cap—we reached El Kantara el Khazneh (the subject of our illustration on page 275), where we were fortunate enough to see a camel train being ferried across on large floats to the other side. As soon as the transit was effected, with much grunting of camels and shouting of men, they all settled down, apparently for a rest.

Having crossed through the two small Balah Lakes, we had to tie up to the bank at El Gisr, in order to allow another ship to pass; the Canal here not being wide enough for two ships to pass in mid-stream.

At El Gisr the caravan route from Syria to Cairo and beyond crosses the Canal

A VIEW OF THE WATERSIDE AT SUEZ.

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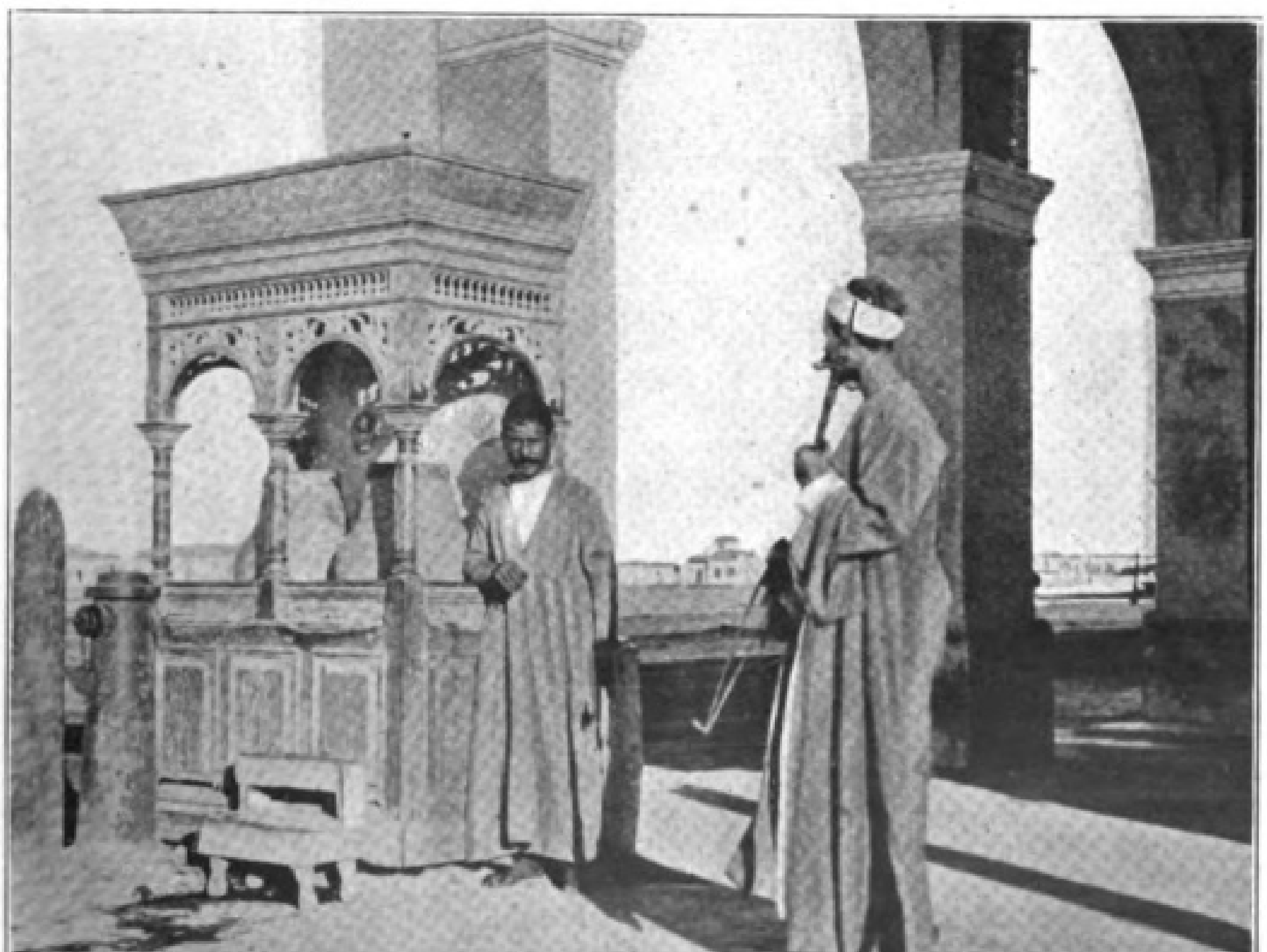
and, as it was now just upon sunset, we were privileged to see the people of a passing caravan at their evening prayers. Squatting down with their faces to the setting sun, they intoned out their evening chant, making deep obeisances with outstretched arms the while. All I could gather from the chant was "Allah il Allah," which is so frequently heard at all times of the day that it loses most of its religious savour. Indeed, Arabs use this term almost as freely as Frenchmen do "Mon Dieu," and with as little spiritual significance.

Sunset over the desert must be seen to be believed, the particular one of which I write glowing with such vivid hues that even Turner in his maddest moments might have hesitated before recording it on canvas. The brilliance of the lighting is indicated in the photograph which appears below.

Complete and inky darkness, relieved only by the brilliant stars overhead, followed quickly after, and, our searchlight having been started, we wended our deliberate way onward to the East. The Canal by night, as seen from the bridge, presents a weird appearance, to say the least of it. The velvety blackness on either side contrasts sharply with the sandbanks brilliantly lit up by the cold intense white glare of the searchlight. From time to time my ear would catch some strange howling, and then, as we rounded a slight turn in the Canal, I would be able to discern some carrion-hunting jackal slink away with a snarl into the "utter"—*i.e.*, *outer*—darkness.

There is little more of interest until Suez is reached, as most of the Canal route lies across Lake Timsah and the Great and Little Bitter Lakes, or, as the Arabs call them, Birket el Mamleh.

This eastern terminus I am unable to describe, because ships, as a rule, only stay to drop the pilot, and I was unable to go ashore. From what I heard of the place, however, it would appear to be very similar to Port Said, only on a smaller scale.



MUSIC AT SUNSET, LOOKING TOWARDS THE DESERT.

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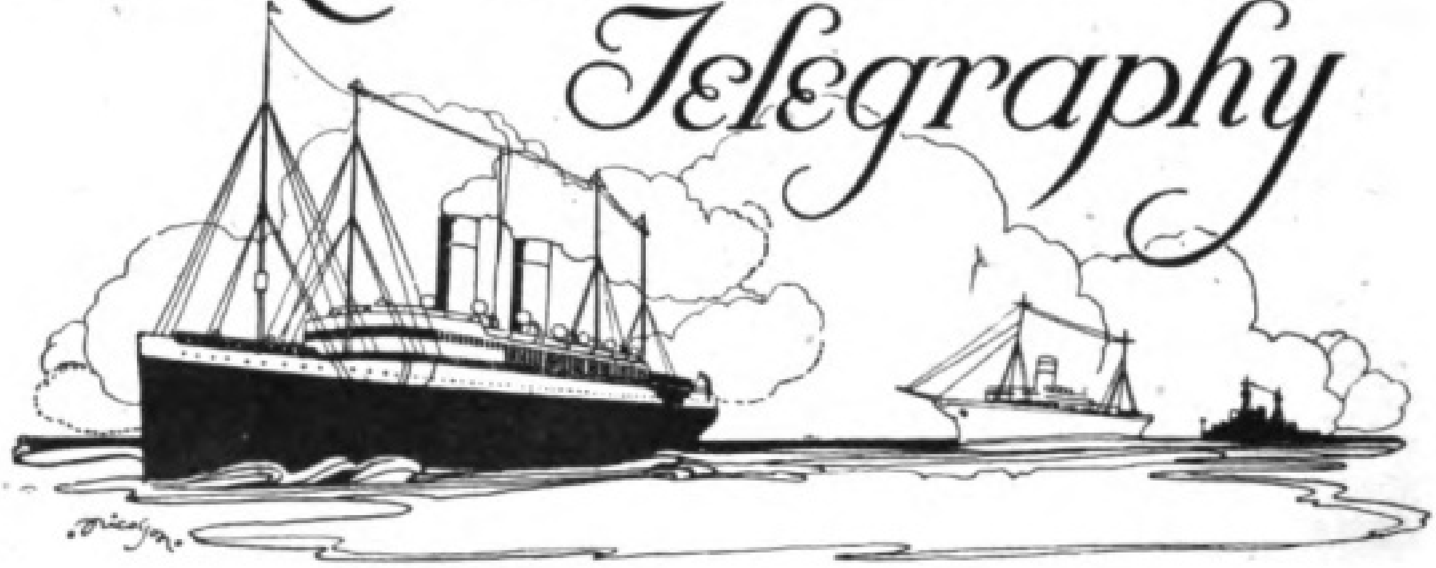
Maritime Wireless Telegraphy



An Attempt at "Spurlos Versenkt."

I suppose that it is not too much to take for granted, at this time of day at all events, that most of us desire to consider ourselves—and to be considered by others—as "broad minded." The evil of the insularity which used to be charged against the average Englishman consisted of an inability to understand the point of view characteristic of nations other than our own. The personal contact which results, or should result, from travel does much to dissipate this particularity in outlook. But travel is not possible to a large proportion of people, and does not monopolise the power of neutralising the limitations of our surroundings; judicious reading is fully as potent.

Does such a phrase as the one I have just used imply dry-as-dust study? Far from it. I can assure readers, on the strength of experience which now goes back a larger number of years than I find altogether pleasant to reckon, that one of the most widening, as well as most interesting, forms of reading consists in the systematic perusal of the magazines of a country other than our own. Nothing, for example, can give an Englishman a better insight into the American point of view than the regular perusal of magazines compiled and printed for a clientèle on the "other side."

* * * * * *

What has this to do with the sinking of hospital ships? Let me explain. Immediately before opening the newspaper which contained an account of the latest German outrage against humanity I was reading one of the most popular American weeklies, a magazine mainly devoted in normal times to fiction. The most striking account of aviation experiences it has been my lot to peruse appeared in that number. It was written by a young American flying man who has won pre-eminent distinction first among the French aviators and afterwards with Lafayette. He confessed that what first attracted him to the battlefields of Europe was the spirit of adventure, but went on to say that since he had been close to the heart of things a radical change had come over his whole mental attitude. He has seen with his own eyes the deeds of infamy whose details a perhaps over-prurient Press refrains from publishing, and his disgust with the nation guilty of these unspeakable crimes—a nation whose folk at home, women and men alike, rejoice in the outrages and applaud—has created within him, as within all the American volunteers in France,

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a settled conviction that the present struggle is a *crusade* in the truest sense of the word. The present generation of Germans is hopelessly corrupt, and the closer contact with that corruption which is being brought about in consequence of active participation in the struggle by the American nation as a whole is marked in every page, not only of the journal I have in mind, but throughout their periodic literature. The difference in tone between pre-war and post-war American journalism is becoming marked indeed.

* * * * * *

Let us not, for our own part, become sated with horrors and *blasé* with infamy. Consider the facts in connection with the *Llandovery Castle* torpedoing. Here we have a vessel devoted solely to the preservation of such sparks of life as may be left in the wretched human frames of victims of war, irrespective of nationality. International agreement, based on universal consensus of reasoned opinion, including that of the Central Empires, has declared such vessels *sacrosanct*. Certain conditions have been laid down; every one was fulfilled. With all her insignia of mercy flauntingly displayed in a manner which would be madness on the part of a vessel

THE UNVEILING AT WOLVERHAMPTON OF A MEMORIAL TO WIRELESS OPERATOR D. M. HARRIS, OF THE DRIFTER "FLOANDI" (SEE PAGE 298).

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subject to acts of war, the *Llandovery Castle* was not only torpedoed without warning but in such a way as to destroy her "top hamper," and thus deprive her of any opportunities of asking for assistance by wireless through the medium of her aerials. Radiotelegraphy, the great life saver, was deliberately forbidden to summon aid, and the Marconi operators strove in vain to transmit the SOS. Captain Sylvester, in command of the victimised ship, was twice summoned by the U-boat commander and subjected to a brutal cross-examination on board the German craft. The British shipmaster, in his sworn statement, reports that after his second summons had been answered, "the Germans opened fire at an unseen target." Out of the seven boatloads of survivors which left the vessel's side only one was left to tell the tale. That one escaped by the "skin of her teeth," after abortive efforts had been made to swamp her. The nursing sisters in the other boats have never been heard of since. Both the young wireless operators are included amongst the number of lost. There can be little doubt that we have here to deal with an attempt to render the ship of mercy *spurlos versenkt*.

The captain's boat, after having had two narrow escapes of being rammed—on one occasion being missed, it is said, by only a couple of feet or so—after pulling for about 70 miles, was picked up by H.M. destroyer *Lysander*, which immediately sent out wireless messages instructing other vessels to seek for the missing boats, herself carrying those rescued into Queenstown.

The semi-official German account denied that the German submarine was responsible, and attributed "the cause of the loss to a British mine." This "explanation" has been treated in the British Press as a gratuitous and barefaced lie. It is unnecessary so to regard it. The U-boat which perpetrated the crime has plainly not yet reached home, and perhaps will never return to her base. This denial may therefore be viewed as nothing more than the not unnatural tribute paid by hypocrisy to the moral laws which it outrages.

Mr. Havelock Wilson and the men of the Mercantile Marine for whom he speaks have pledged themselves to exact a definite penalty in a way which the British Government seems unable, or unwilling, to do. Their virile and determined course of action is being joined by the seamen of other nationalities.

OUR GALLANT TRAWLERS.

WE are glad to note, in the account of the plucky little engagement fought by six small armed trawlers against a giant submarine, specific acknowledgment of the gallantry displayed by the R.N.V.R. wireless operator. WIRELESS WORLD readers will probably recall this little "Epic of the Sea," which was recently allowed publicity by the British Admiralty. We often read such phrases (not altogether devoid of a journalistic sting) as "our Silent Navy"; but a silence which can be broken to such good purpose as this is worthy not only of respect but honour.

One of the newest and largest type of U Boats, shortly before 6 o'clock in the morning, opened fire at about 7,000 yards on six British armed trawlers The German had two 6-inch guns, whilst the trawlers were but lightly armed, and the former was as superior in speed as in armament. Scorning to yield, the little British flotilla swung into line ahead and bore up for action. Though swept by gunfire, the British maintained their line, and the unequal artillery duel continued until the trawler commanders found themselves threatened with lack of ammunition, and the R.N.V.R. officer, in charge of the leading vessel, made ready the signal, "Prepare to ram." As the German, however, closed to shorter range, the trawler second in line placed a shell on the after part of the pirate, and five minutes later the flagship scored two direct hits, the second shell bursting at the base of the big conning tower. A huge cloud of smoke ascended and enveloped the submarine. What happened then is doubtful, but when the smoke cleared away the enemy had disappeared.

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The Evolution of the Thermionic Valve (V.)

(Continued)

By R. L. SMITH-ROSE, B.Sc., A.R.C.S., D.I.C., Student I.E.E.

Read before the Students' Section of the Institution of Electrical Engineers on January 22nd, 1918.

NOTE.—The first part of this valuable paper appeared in our April issue, pp. 10 *et seq.*

(6) THE USE OF THE THERMIONIC VALVE AS A RECTIFIER, AMPLIFIER AND AS A GENERATOR OF ALTERNATING ELECTRIC CURRENTS.

As it is not the object of the present paper to describe in detail the various circuit arrangements and their mode of operation, brief mention only will be made, in conclusion, of the more immediate applications of thermionic valves. For further details concerning the practical operation of these, reference may be made to some recent articles in the WIRELESS WORLD,* and also to a paper read before the Institute of Radio Engineers by E. H. Armstrong in 1916.†

The manner in which these valves may be used as detectors and rectifiers of electric oscillations for use in radio-telegraphic receiving stations has already been described in connection with the Fleming valve and De Forest audion. The pliotron may be used in an exactly similar manner to the audion, except that if it is attempted to use a condenser in series with the grid, as shown in Fig. 8, it will be found necessary to shunt the condenser with a high resistance and often to place a battery of a few volts in series with the resistance, to prevent the accumulation of a large negative charge on the grid.

An interesting discovery was made by Mr. W. C. White, of the G.E.C. Research Laboratory, on the effect of a very minute trace of certain gases introduced into a pliotron valve which greatly increases the sensitiveness of the device as a detector.‡ To produce the desired pressure in the tube and maintain this constant, he used the vapour from a small quantity of silver-amalgam placed in the tube. The quantity of gas in the tube is very much less than that in the audion and there is no evidence of positive gas ionisation. In this condition the characteristics of the tube show a kink, as in Fig. 17, indicating a region of instability for a certain value of the grid potential, and

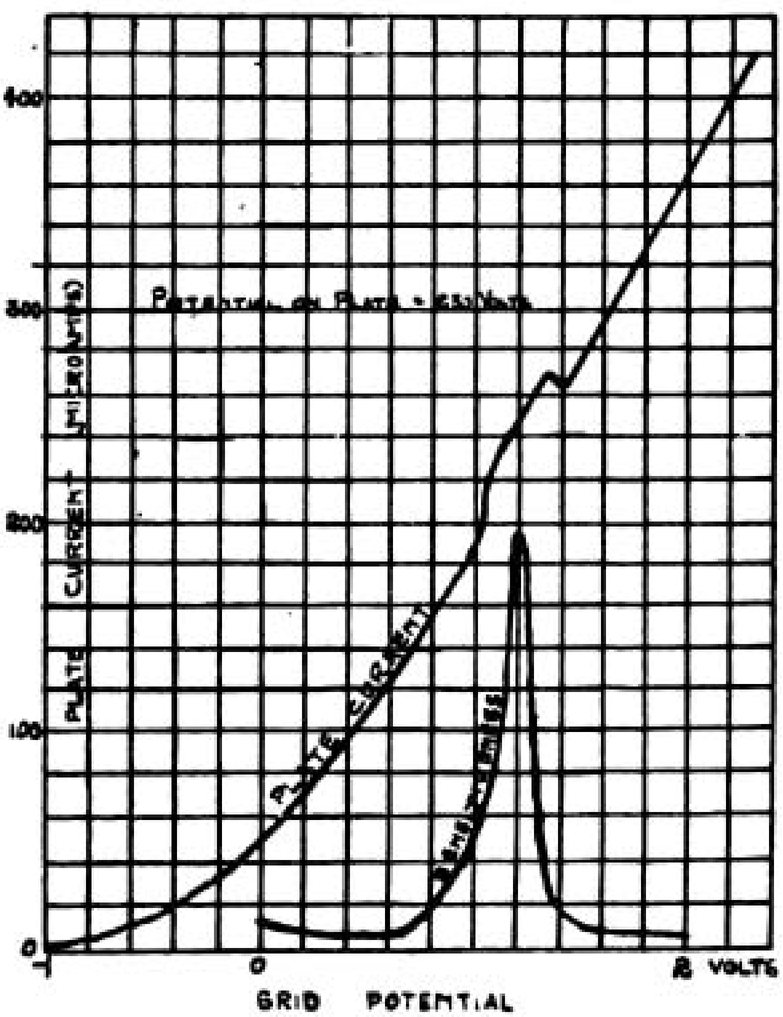

FIG: 17

* WIRELESS WORLD, V., pp. 158, 230, 236, 489, 594, 662 (1917).
† E. H. Armstrong, *Electrician*, lxxvi., p. 798 (1916).
‡ See Refs. 23 and 24.

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in this condition the sensitiveness of the detector is very high. The explanation of this phenomenon is rather obscure.

In 1916 an account was given by Mr. G. S. Meikle of the use of thermionic rectifiers for charging batteries at central stations.* For this purpose it is inconvenient to use the kenotron type of valve, owing to the high voltage necessary for its operation. Consequently a gas-filled rectifier is used, and it was found in the course of its development that the introduction of pure argon into a kenotron tube at a pressure of from 3 to 8 cms. of mercury, while being quite effective in supplying positive ions to neutralise the space charge effect had no influence on the thermionic emission from the tungsten cathode and caused no serious disintegration of the latter. Valves on this principle may be designed to rectify currents of from a few milli-ampères up to several ampères, at potentials of from two or three up to several thousand volts.

A further description of this commercial type of argon-filled rectifier with a charging capacity of from 2 to 6 ampères was given recently by R. E. Russell, who designates this valve by the term " tungar rectifier."†

The use of the three-electrode type of valve as an amplifier of the small electric oscillations occurring in the receiving circuits of a radio-telegraph station were described in the chapters on the audion and the Lieben-Reisz valve. This amplification may be carried out in either the radio-frequency or audio-frequency circuits, or both, as desired, since the operation of all the types of thermionic valves described is independent of the frequency of the currents used.

For this reason the valves may be employed for the amplification of speech currents in ordinary wire telephony, where it is desired to extend the range of speech transmission, or where the line is already so long that the attenuated currents are not sufficient to give an audible sound when the receiver is connected direct. In introducing an amplifier in this manner, the leads previously connected to the receiver are connected between the grid and the filament, the receiver being either transferred to the plate circuit or connected to the secondary of a transformer, the primary of which is connected in the plate circuit. Several valves may be connected in cascade as described in connection with the audion, in order to obtain increased amplification.

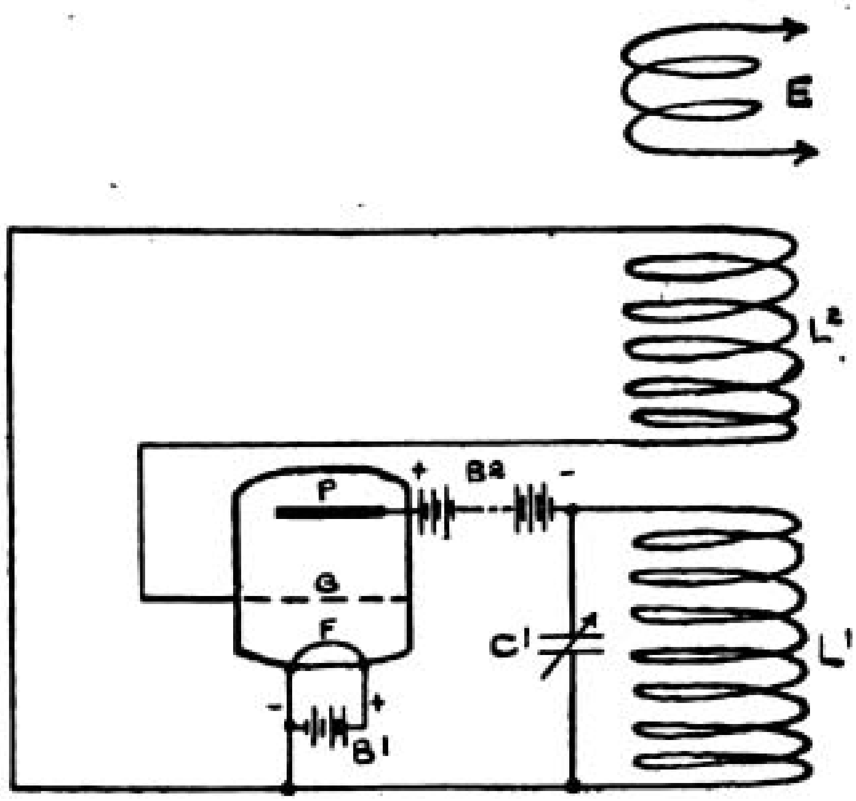

FIG. 18.

Thermionic valve relays were used for the amplification of speech currents on this principle in the recent long-distance telephone tests between New York and San Francisco, a distance of 5,000 kilometres. Similar and more recent use of these valves as telephone relays on the line between Paris and Marseilles have shown that this application can effect a considerable saving in the amount of copper which must be used in the laying of trunk telephone lines.

The property of the three-electrode thermionic valve of amplifying small alternating currents enables it to be used as a generator of electric oscillations, with but a slight

* G. S. Meikle, *Electrical Review*, lxxviii., p. 472 (1916).
† R. E. Russell, *General Electric Review*, March, 1917.

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modification of the circuit arrangements. Instead of the alternating potential being supplied from an external source, it is supplied from one winding $L2$ of a transformer, the other winding L^1 of which is connected in the plate circuit as shown in Fig. 18.

If we apply a small oscillatory potential-difference to the grid circuit a magnified oscillation will result in the plate circuit. If the transformer connections are correct this increased current in the plate circuit will induce a further increased potential variation in the grid circuit. This will result in a further increased current in the plate circuit, and so the two circuits will continue to react on each other and the amplitude of the oscillations in the plate circuit will continue to increase until the whole system settles down to a steady state. By this means fairly powerful oscillations may be set up, depending upon the size of valve used, and by means of a third coil, E, coupled to the transformer, the generated alternating current may be drawn off and used for any purpose required.

The frequency of the oscillations is determined by the dimensions of the self-induction, L^1, and capacity, C^1, in the plate circuit, and by varying these the frequency may be altered within wide limits. Mr. W. C. White* has described experiments in which a pliotron was made to give oscillations at the extreme frequencies of one-half cycle per second and fifty million cycles per second.

The thermionic valve in this way provides a very convenient generator of perfectly steady, pure sine wave alternating current, the frequency of which may be varied at will. The currents can be obtained of almost any desired amplitude by using a valve of suitable dimensions and characteristics. Pliotrons can be constructed with an output of 1 kilowatt, and greater powers than this can be easily obtained by connecting several of these in parallel. Used in this manner the thermionic valve would appear to provide an ideal generator of continuous oscillations for use both in radio-telegraphy and radio-telephony. In this application it is noteworthy to remark that some 300 to 500 of such oscillating valves were used in the successful long-distance wireless speech tests carried out in 1916 between Arlington, U.S.A., and the Eiffel Tower, and between Arlington and Honolulu, a distance of 5,000 miles.†

The smaller form of the oscillating valve has also provided a very simple form of detector for use in continuous wave radio-telegraphy, on the heterodyne principle. The valve receiver is arranged to generate local oscillations of a frequency somewhere in the neighbourhood of those arising from the incoming signals. Those two frequencies, both too high to be audible themselves, are made to interfere, producing beats of a frequency equal to the difference of the two original frequencies, and audible in the telephone receiver as a musical note.

Possibilities and Impossibilities

THE wonders actually performed by wireless possess so many characteristics which are classified by the average " lay " mind as miraculous, that a serious hearing is now secured for all sorts of (apparently) fantastic projects which would in old days have been dismissed with contumely. Frequently all that it is possible to say about them is that, whilst they do not run counter to any known theory, the practicability of the whole depends upon detail working which—not unnaturally—is almost invariably lacking. To such a class belongs the "automatic soldier" suggestion, which recently found a place in the pages of our enterprising contemporary the *Daily Mail*. The invention is credited to " A Danish Engineer," and the " soldier " in question consists of one steel cylinder working inside another, the larger one being sunk vertically in the ground.

" Through a very simple mechanism which is set in motion by wireless telegraphy, the inner cylinder rises from the ground, and at the same time an automatic rifle mounted therein fires 400 shots in any given direction."

* W. C. White, *General Electric Review*, September, 1916.
† P. R. Coursey, WIRELESS WORLD, iv., p. 220 (1916).

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Notes of the Month

THE "POLITE PIRATE" UTILISES WIRELESS.

NOT long ago a series of U-boat sinkings took place off the American coast, and details of what occurred have recently come in by mail. These particulars furnish, in a way that no brief telegraphic communication can do, a confirmation of the theory that this interlude of war constituted an attempt, on the part of the German authorities, to ascertain what the effect would be on the American public rather than any serious essay to hinder American transportation. Incidentally, the fuller accounts of what happened on the occasion of the sinkings in question go to prove (if proof be necessary) that the horrors perpetrated by Hun commanders in other waters are strictly in accord with orders issued from Headquarters. In marked contrast to the "frightfulness" and studied brutality displayed in the perpetration of such crimes as the sinking of the *Llandovery Castle*, the Teutonic captain assumed the *rôle* of the "Polite Pirate," treating his victims to wines, cigars and general hospitality. According to more than one American captain's reports, the Yankee officers would seem to have been treated more as "trippers" than foes. They were shown over the ship, regaled with exhibitions of speedy submersion, introduced to the German wireless operators at work, and enabled to witness the Teutonic "Sparks" listening-in to the news bulletins sent by wireless from America.

WIRELESS TIME SIGNALS IN SWITZERLAND.

Since August, 1916, Swiss telephonic subscribers have, in consequence of the sequestration of all wireless telegraph apparatus in the Helvetian Federation, been allowed the privilege of receiving telephonically every day, between 10.56 and 11 a.m., the time signals radiated from the Eiffel Tower, received at Berne and repeated simultaneously. Our French contemporary *La Nature* states that a recent communication from Monsieur Paul Ditisheim to the Swiss Geophysical Society reports that this telephonic service has been found by experience to work thoroughly satisfactorily. The signals transmitted under the arrangement above mentioned only differ by ·087 seconds from the time of their transmission from Paris.

RADIOTELEGRAPHIC MUNIFICENCE.

The possession of great riches, we are often told, involves as great a responsibility. Were that doctrine more consistently carried out in practice, we should probably hear very little of socialistic nostrums. In some outstanding instances this wealth-responsibility is, however, recognised by the fortunate possessors. Prominent amongst these public-spirited millionaires we may count Sir Basil Zaharoff, whose foundation of Chairs of Aviation at the Universities in Paris, Petrograd and (just recently) London, affords practical testimony of his high-minded liberality. On the occasion of a visit paid by Sir Basil to Greece, in pursuance of certain projects designed to assist the cause of the Allies, he made a donation for

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the special purpose of establishing at Athens a radiotelegraphic station there. The amount of the handsome cheque handed over for this object was no less than £100,000.

A Striking Sign of Rapid Expansion

British, French, Dutch and German Suggestions to meet an International Situation.

ONE branch of the activities of the International Radiotelegraphic Bureau at Berne consists of the allocation of Call Letters to the stations belonging to the various nations who are parties to the International Radiotelegraphic Conventions. The arrangement up to the present has been that each station should have a Call Signal of *three* letters. It was thought at the time when this was settled that the various combinations possible would suffice for many years to come, but so rapidly has radiotelegraphy developed that it has for some time past been evident that the possible combinations would ere long be exhausted. Various solutions have been proposed; and in Circular No. 98, dated at Berne on June 18th last, we find the replies which have reached the Bureau after the first enquiry five months ago on the subject of the proposal of the British Administration, printed in Circular No. 93 of January 1st, 1918. This proposal consists of a suggestion that, after the combinations on the present system are exhausted, each Administration shall be able to use signs of *four* letters formed by the letter T followed by one of the combinations reserved for its use.

Out of 71 Administrations, 28 have replied to the initial enquiry of Circular No. 93. Of these replies 23 approve the British proposal. The Administrations of Germany and the Netherlands each made counter-suggestions. The former approves of the adoption of combinations of four letters with the addition of the letter T, to *follow* the triple combination instead of preceding it. The Netherlands, whilst not objecting to the British solution, think that it would be better if the letter T were replaced by the letter P, basing this modification on an idea that the use of T might give rise to confusion in cases where transmission was inadequately carried out. France, Morocco and Tunis are of opinion that it would be expedient to postpone the consideration of the matter until the meeting of the next International Radiotelegraphic Conference.

No more striking evidence could be adduced of the rapid strides made in radiotelegraphy. With regard to the alternatives mentioned above, we cannot help being impressed with the reasons adduced for the German modification of the British proposal. . Telegraphists have become familiar with the combinations allocated to the various nationalities, and this familiarity would be utilised if the fourth modifying letter followed, instead of preceded, the present triple letter signal. Moreover, seeing that all combinations starting with T are allotted, under present arrangements, to Germany and Turkey, if an additional T were added at the beginning, telegraphists familiar with present usage might possibly be liable to jump to the conclusion that the ship in question was German or Turkish. The same misunderstanding could not occur if T were added at the end.

The Dutch suggestion involves the insertion of an unnecessarily lengthy sign, and it is a hopeless task to attempt to provide against all the possibilities latent in the postulation of inefficient working which they suggest might result from the use of an additional index letter with a short morse symbol. Of course the Hollander's interest in P is easily understood; the combinations starting with that letter have, so far as at present allotted, been confined to Holland and Brazil. With regard to the French suggestion: are not our Gallic friends a little too optimistic with regard to the date at which it may be possible to hold an International Conference?

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Among the Operators

It is our sad duty, month by month, to record the death of the brave operators who have lost their lives at sea by enemy action and other causes in the wireless service of their country. Owing to the necessity of preventing the leakage of information likely to assist our adversaries the names of ships and localities of action cannot be published. With the exception of Messrs. Clarke, Crawford, Green and Millington, who died from natural causes, the lives of the operators mentioned this month have been sacrificed as the result of hostile activities. Both on our own part, and on that of our numerous readers, we extend to the parents and relatives of these young men, who so nobly upheld the "wireless tradition," the deepest sympathy in their sad bereavement.

MR. REGINALD COMER BOND, formerly employed as a clerk in the Accountant's and the Traffic Department of the Marconi International Marine Communication Company, Ltd., was born at Peckham on January 5th, 1894, and educated at St. Mark's College Schools, Chelsea, and College de St. Germain-en-Laye, France. He was trained at Marconi House School and, after gaining the P.M.G. Certificate, appointed to the Operating Staff in August, 1914.

Born at Rutherglen, Lanark, on September 10th, 1899, MR. JOHN FLEMING DRUMMOND was educated at MacDonald Public School, Rutherglen, and Skerry's College, Glasgow, and trained at the North British Wireless Schools, Ltd., in that city. He received the P.M.G. Certificate, and was given an appointment by the Marconi Company last September.

MR. HAROLD DOUGLAS HILL was born at Handsworth, Birmingham, on October 12th, 1899, and went to the Albert Road Council School and King Edward's Grammar School, Aston. Commencing his career in an insurance broker's office, he subsequently attended the City School of Wireless Telegraphy, Ltd., Birmingham, and obtained the P.M.G. Certificate. Mr. Hill's service with the Marconi Company started in April of this year.

Of Welsh birth, MR. BRINLEY THOMAS HUGHES, twenty-two years old, was born at Halfway, near Llanelly. He received his education at Dafen County Council School and attended the evening class at Swansea Technical School. Starting life as a carpenter and joiner, he turned his attention to wireless and was trained at the South Wales Wireless College, Ltd., Swansea, where he gained the P.M.G. Certificate. Mr. Hughes was appointed to the Marconi Company's Staff on September 16th, 1917.

MR. CHARLES GERALD MARKWELL was born at March, Cambridgeshire, on November 27th, 1899. He was educated at the South District Council School, March, and at March Grammar School. Before receiving training in wireless telegraphy at Marconi House School he was an engineer's apprentice. On qualifying for the P.M.G. Certificate he was placed on the staff of the Marconi Company on May 6th this year.

High Bickington, North Devon, was the birthplace of MR. CECIL FRANK NEWBERY eighteen years ago. After receiving his education at the Council School there he was employed as a solicitor's clerk, afterwards being trained at Marconi House School. In April last he won the P.M.G. Certificate and joined the Operating Staff of the Marconi Company.

MR. THOMAS STANLEY SMITH, born at Cockermouth on January 8th, 1899, was educated at Weston Lodge High School, Cockermouth, and started his career as a surveyor's pupil. His wireless training was received at the Manchester Wireless Telegraph Training College, and, on receipt of the P.M.G. Certificate, he proceeded to sea in the Marconi Company's service in June, 1917.

MR. FRANK WILLIAM STALLY was born on September 27th, 1900, at Fulham, and received his education at Northfields School, Ealing. He was in the employ of

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ROLL OF HONOUR.

R. C. BOND.
CECIL F. NEWBERY.
J. G. CLARKE.
Wm. H. MILLINGTON.
H. W. CRAWFORD.
F. W. STALLY.
HAROLD D. HILL.
JOHN DRUMMOND.
EVANDALE C. GREEN.
T. STANLEY SMITH.
BRINLEY THOMAS HUGHES.
C. G. MARKWELL.

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Honor Bros., Hanwell, as assistant wireman, subsequently leaving that firm to take up wireless telegraphy. Trained at Marconi House School, Mr. Stally qualified for the P.M.G. Certificate, and entered the service of the Marconi Company on February 2nd, 1917.

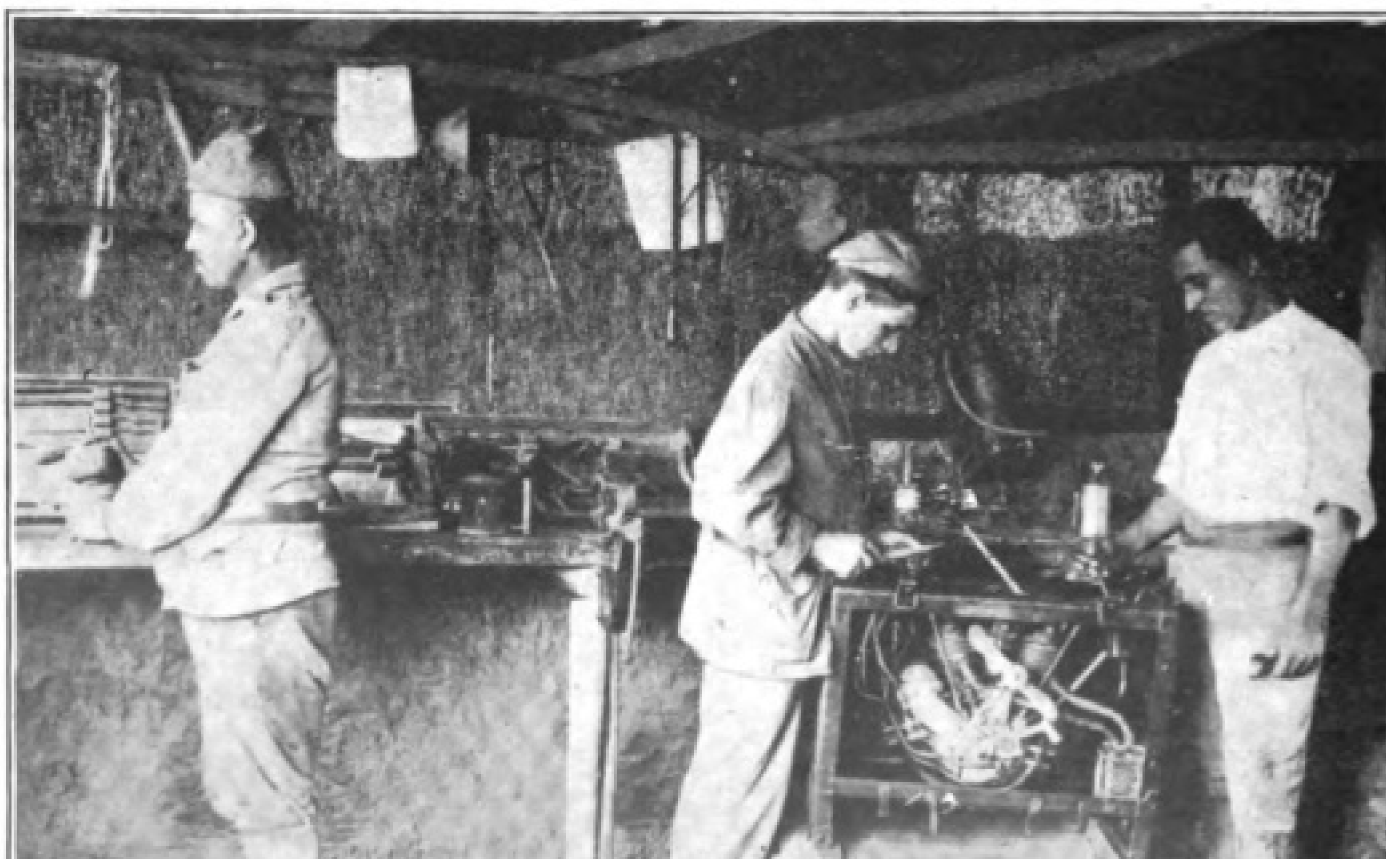
Born on June 9th, 1900, at East Plumstead, MR. HENRY WILLIAM CRAWFORD was educated at the Higher Grade School, Greenock, and afterwards was employed as a fitter in the Royal Naval Torpedo Factory at Greenock. Trained in wireless telegraphy at the North British Wireless Schools, Ltd., Glasgow, he obtained the P.M.G. Certificate, and joined the Marconi Company's Staff on June 16th, 1917.

Formerly a clerk with the London City and Midland Bank, Ltd., MR. WILLIAM HENRY MILLINGTON was born at Birmingham on November 16th, 1899, and educated at King's Norton Secondary School. He took a course of training in wireless telegraphy at the Birmingham Technical School and received the P.M.G. Certificate. Mr. Millington entered the Marconi service in February last.

MR. EVANDALE CROWTHER GREEN was born on March 8th, 1896, at Norwood, and attended college at Bishop's Stortford. His training in radiotelegraphy was received at the British School of Telegraphy, Ltd., London. On gaining the P.M.G. Certificate Mr. Green was placed on the Marconi Company's Operating Staff in July, 1915.

An Irishman, MR. JAMES GOGARTY CLARKE was born at Ballinasloe on August 22nd, 1895, and received his education at the Town School and at St. Joseph's College. He was a student at the Liverpool Wireless Telegraph Training College, and qualified there for the P.M.G. Certificate. Mr. Clarke was placed on the sea-going staff of the Marconi Company on November 9th, 1913.

Adjusting Turkish Transmitting Gear



The above photograph (for which we are indebted to the courtesy of Miss W. F. Haynes) depicts the adjustment of the transmitting gear of Turkish field wireless.

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Instructional Article

NEW SERIES (No. 5).

EDITORIAL NOTE.—Below we give the fifth of a new series of twelve Instructional Articles devoted to PHYSICS FOR WIRELESS STUDENTS. *Although at first sight the subject of physics would not seem to have a very intimate connection with wireless telegraphy, yet a sound knowledge of this subject will be found of the greatest use in understanding many of the phenomena met with in everyday radiotelegraphy. As in previous series, the articles are being prepared by a wireless man for wireless men, and will therefore be found of the greatest practical value.*

Sine Curve with Logarithmic Decrement.—If it be imagined that the length of the moving radius OP decreases as the revolutions continue the point P will describe a spiral curve, as in Fig. 22, and the harmonic motion in such a case can be represented by a sine curve the amplitude of which decreases instead of remaining constant like that of the simple sine curve of Fig. 21.* The damped oscillations of a pendulum or of the current in an oscillatory circuit are familiar examples following the sine law modified by the introduction of a logarithmic decrement.† In each case, during the first swing some of the energy imparted to the system is frittered away so that for the succeeding swing there is less energy available and consequently it is of smaller amplitude. This process continues until the original energy has been used up or wasted, as the case may be, and then the oscillations are said to be "damped out." In the ordinary wireless telegraph transmitter, where a condenser is discharged across a spark-gap and through an inductive circuit the value of the current in the circuit at any time during the discharge is shown graphically by a curve of similar type to that in Fig. 22, and as it is desirable that the student should thoroughly understand the sine law as applied to damped high-frequency oscillations we shall deal with the subject somewhat more fully than would usually be considered necessary for an elementary article; it must be assumed, however, that he knows how to use logarithms and that he understands or will ascertain from his text-books what a log. dec. is.

The equation of a sine curve with a log. dec. is of the *form*.

$$y = b\varepsilon^{-ax} \sin (cx + g)$$

and it may be encountered written as

$$i = I_{max}\, \varepsilon^{-at} \sin \theta$$

or $$i = I_{max}\, \varepsilon^{-\delta nt} \sin \theta, \text{ or, } i = I_{max}\, \varepsilon^{-\delta nt} \sin 2\pi nt.$$

but all four *forms* are alike and although they may appear complicated they are really simple. For instance, $i = I_{max}\, \varepsilon^{-\delta nt} \sin \theta$ is clearly nothing but the now familiar equation (1) $i = I_{max} \sin \theta$ multiplied by $\varepsilon^{-\delta nt}$, and might be written $i = (I_{max} \sin \theta) \times \varepsilon^{-\delta nt}$. $\varepsilon^{-\delta nt}$ is a correcting factor for the damping at any time t, and, supposing that we are dealing with the current in an oscillatory circuit, the equation simply means that the current in the circuit at any instant is equal to the product of:

(1) I_{max}, or the value of the current at the initial amplitude.
(2) sin θ, or the sin of the angular displacement at the instant t.

---

* See page 240 of July issue. † Called hereafter log. dec.

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(3) $\varepsilon^{-\delta nt}$, or the base of Naperian logarithms raised to the negative power of the product of (*a*) the log. dec., *d*.
(*b*) the frequency, *n*.
(*c*) the time, *t*.

By taking appropriate figures this equation can be whittled down to the form, $i = \varepsilon^{-\delta nt}$, when it will be much simpler to handle in the examples we shall work out in order to test the truth of the equation. We begin with

$$i = I_{max}\, \varepsilon^{-\delta nt} \sin \theta.$$

Now, as no sine can be greater than 1 we will take a case in which $\sin \theta = 1$. This gives us

$$i = I_{max}\, \varepsilon^{-\delta nt} \times 1.$$

To reduce this further we can also make I_{max} equal to 1, when our equation becomes

$$i = 1 \times \varepsilon^{-\delta nt} \times 1 = \varepsilon^{-\delta nt}.$$

We took the case where $\sin \theta = 1$, and reference to Fig. 22 shows that $\sin \theta = 1$ when OP has moved to the position OP^1, for θ is then 90°, the sine of which is 1. Calling the frequency (n) 2, if P completes two revolutions every second it will take one-eighth of a second to reach P^1. Hence in this case $t = \frac{1}{8}$, and we can write

$$i = \varepsilon^{-\delta \times 2 \times \frac{1}{8}}$$
$$= \varepsilon^{-\frac{\delta}{4}}$$

To get rid of the negative sign of the exponent we must take the reciprocal of the expression, hence

$$i = \frac{1}{\varepsilon^{\frac{\delta}{4}}}$$

We shall now consider two cases: (1) in which there is no log. dec.; (2) in which there is a log. dec. of 0·15.

Case I.—If there is no log. dec. the current follows the simple sine law $i = I_{max} \sin \theta$, and as we took I_{max} and $\sin \theta$ equal to 1 in each case, $i = 1 \times 1 = 1$ (when $t = \frac{1}{8}$) and the amplitude is 1 throughout every cycle. The same result can be obtained by using the formula

$$i = \frac{1}{\varepsilon^{\frac{\delta}{4}}}$$

for there being no log. dec. we can write

$$i = \frac{1}{\varepsilon^{\frac{\delta}{4}}} = \frac{1}{\varepsilon^{0}} = 1.$$

Thus it is seen that $I_{max} \sin \theta$ is multiplied by $\varepsilon^{-\delta nt}$ to correct for the log. dec., and that if there is no decrement $\varepsilon^{-\delta nt}$ equals 1, a multiplier which leaves the expression $I_{max} \sin \theta$ unchanged.

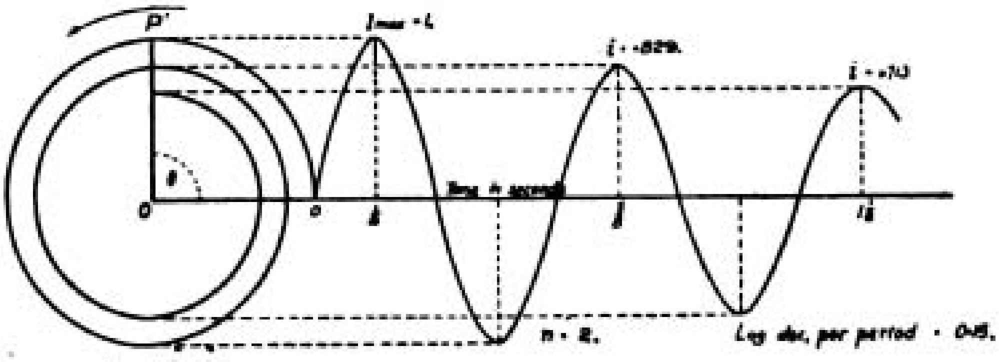

FIG. 22.

Case II.—It now remains to examine the effect upon i of a log. dec. of 0·15. The initial amplitude (or I_{max}) of 1 is reached in one-eighth of a second, during which time P moves to P^1 (Fig. 22). The next amplitude *in the same direction* will be attained when P again reaches P^1 and t will then be $\frac{5}{8}$ sec.—*i.e.*, at the completion of the fifth quarter-cycle.

$$i = I_{max}\, \varepsilon^{-\delta n t} \sin \theta$$
$$= 1 \times \varepsilon^{-\delta n \frac{5}{8}} \times 1.$$

As $\delta = 0.15$, $\varepsilon = 2.718$ (always) and $n = 2$, we can write

$$i = 1 \times 2.718^{-0.15 \times 2 \times \frac{5}{8}} \times 1$$
$$= \frac{1}{2.718^{.1875}}$$

Simplifying this fraction,

$$\log 2.718^{.1875} = .1875 \log 2.718$$
$$= .1875 \times .4343$$
$$= .0814$$
$$\text{antilog } .0814 = 1.206.$$

Whence $$i = \frac{1}{1.206} = .829 = \text{Second amplitude in same direction.}$$

The third amplitude *in the same direction* is attained when $t = 1\frac{1}{8}$ sec. Applying the formula

$$i = \frac{1}{2.718^{.3375}}$$

and simplifying

$$\log 2.718^{.3375} = .3375 \log 2.718$$
$$= .3375 \times .4343$$
$$= .1465$$
$$\text{antilog } .1465 = 1.402.$$

Whence $$i = \frac{1}{1.402} = .713 = \text{Third amplitude in same direction.}$$

The log. dec. may be defined as the Naperian logarithm of the ratio of two successive amplitudes and may be given per cycle or per half-cycle, that is, the two amplitudes chosen may both be in the same direction (both positive or both negative), or one may be in one direction and the other in the opposite direction. In the present case 0.15 is the log. dec. **per cycle** and we have three consecutive amplitudes in the same direction, viz., 1, .829 and .713, the last two being found by our formula. By definition, therefore, δ ought to equal $\log_e \frac{.829}{.713}$.

$$\delta = \log_e \frac{.829}{.713}$$
$$= \log_e 1.162$$
$$= (\log_{10} 1.162) \times 2.302^{*}$$
$$= .0653 \times 2.302$$
$$= 0.15$$

which is the value we assigned to δ.

The student should not fail to draw on squared paper a series of curves similar to that in Fig. 22, taking various values of δ and I_{max} and calculating the ordinates from the equation we have given. He can then compare the ratio of

* To find the log. of a number to the base ε note that we multiply the log. of the number *to the base 10* by 2.302. In general, $\log_e x = (\log_{10} x)\, 2.302$.

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the heights of two successive ordinates with ϵ^δ, when he should find that $\frac{I_1}{I_2} = \epsilon^\delta$ and therefore that $\delta = \log_e \frac{I_1}{I_2}$. The quickest method of understanding the meaning of curves is to draw a large number of them.

WORK AND ENERGY.

WORK.

Work is done when the point at which a force is applied is displaced in the direction in which the force is acting; it is measured by the product of the force and the displacement. This product is *not a vector product*, because only the respective *magnitudes* of the force and displacement are multiplied. Fig. 23 represents a case where a point, P, is displaced by a force, F, from P to P^1, a distance d. **The work done by the force F is F × d.**

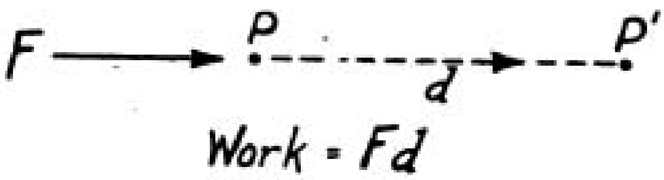

FIG. 23.

If the point is displaced in a direction other than that of the applied force the work done is measured by the product of the magnitudes of F and d and the cosine of the angle between the two directions. Fig. 24 will make this clearer. The force F is here acting in an easterly direction, and P is displaced to P^1, a distance d in a NE direction. The work done is the product of F, d, and cos θ, F and d being magnitudes only.

Work done by F = Fd cos θ.—This product is the *scalar product of two vectors.* Note that when $\theta = 90°$—that is, when the two directions are mutually at right angles—the work done is zero because cos $90° = 0$. This point throws light upon the fact that if a weight is carried along level ground no work is done *against gravity*, because the direction of the displacement is at right angles to that of the force supporting the weight.

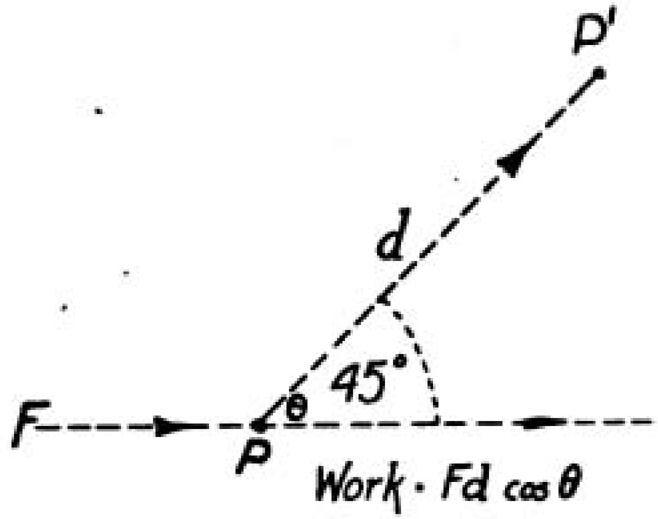

FIG. 24.

The student is strongly advised to act upon the hint that if he will go deeper into this matter of the scalar products of vectors and of *vector* products he will discover plenty of work which bears directly upon the electrical and magnetic phenomena in which he is interested.

Units of Work.—When unit force produces unit displacement unit work is done. Work being the product of force and displacement, the **dimensional unit of work** is:

$$\left[\frac{ML}{T^2}\right] \times [L] = \text{Force} \times \text{Displacement} = \left[\frac{ML^2}{T^2}\right] = [ML^2T^{-2}]$$

When a force of one pound acts through a distance of one foot the work done is one **foot-pound,** which is called the **Gravitational Unit of Work.** The work performed in lifting a weight of half a hundredweight to a height of a yard is therefore

Weight (in lbs.) × height (in feet) = 56×3 = 168 foot-pounds.

When a force of one poundal acts through a distance of one foot the work done is one foot-poundal; this is the **British absolute unit of work.**

The C.G.S. absolute unit of work is that which is done when a force of one dyne acts through a distance of one centimetre, and is called the **Erg.**

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The practical electrical unit of work is the Joule, and is the work done in one second by a current of one ampere at a pressure of one volt.

$$1 \text{ joule} = 10^7 \text{ ergs.}$$

From the definition of the joule given above it will be seen that the work done when a current flows in a conductor equals ($E_{volts} \times C_{amperes} \times T_{secs.}$) joules, where T is the time during which the current is maintained. If $E = 1$ volt, $C = 1$ ampere, and $T = 3{,}600$ secs., the amount of work done is given the name of **watt-hour.** One thousand watt-hours are equal to one **kilowatt-hour,** sometimes called the **Board of Trade unit** or the **kelvin.**

Area of Work Diagram.—In Fig. 25 the line F represents a force of 2 pounds, and the line D represents the distance through which that force acts, in this case 2 ft. Since Work $= F \times D$ the work done in this instance is $(2 \times 2) = 4$ foot-lb.; but the product FD is clearly the area of the figure, so that if we draw a diagram the ordinates of which represent the force, while the abscissæ represent the displacement, then the area of the figure represents the work done. All the ordinates in Fig. 25 are equal because ab is perpendicular to F, and this means that

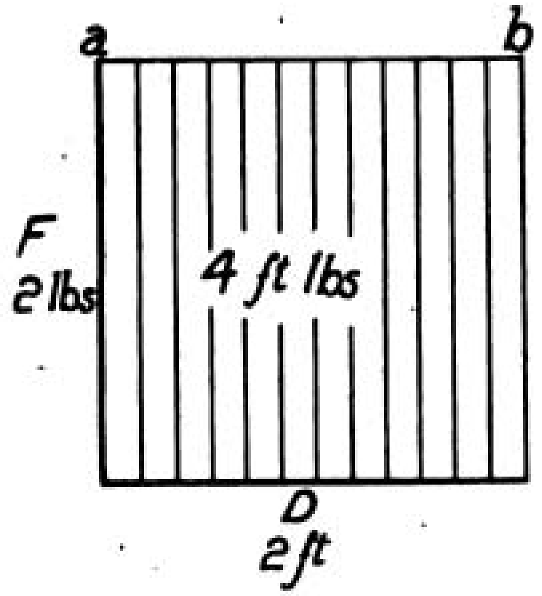

FIG. 25.

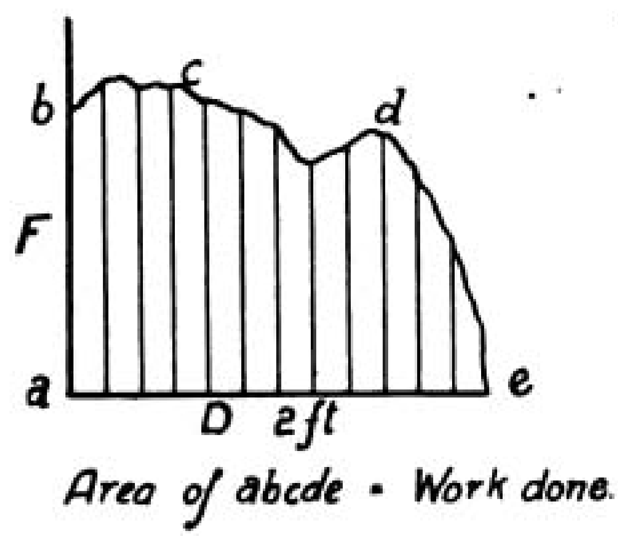

FIG. 26.

throughout the whole displacement the force is uniform. Fig. 26 shows graphically an example of a non-uniform force acting through 2 ft., and the height of the ordinate above any point on D represents the force at that point, *in the units of the scale to which F is drawn*. The area of the figure is in this case also the work done, but is not found so readily as in the case of an uniform force. Nevertheless the methods of finding the area of an irregular diagram are quite easy to learn and the student should supplement his knowledge at this stage by reference to his mathematical text-books; let him turn to **Simpson's Rule** and the **Mid-ordinate Rule** and practise them, for he is here assured that the work is quite relevant to his future studies in electricity.

POWER.

Thus far we have not taken into account, save in the special case of the joule, the amount of *time* needed to effect a displacement. Such a consideration is of the greatest importance, as will be readily understood if it is pointed out that the force F referred to in connection with Fig. 25 may require to act for a second in order to bring about the displacement D, or, on the other hand, it may require a week. The work done is precisely the same in each case but it is very evident that there is a big difference of some sort between the two performances, for the rate at which the work is done is enormously greater in one than in the other

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Even if a force does useful work it uses up equally valuable time and therefore it is highly necessary to have some measure of the amount of work a force can do in a given time. **The rate at which work is done is called power. The British unit of power** is the **horse-power,** and is equivalent to a rate of 550 ft.-lb. per second or 33,000 ft.-lb. per minute.

$$\text{H.P.} = \frac{\text{Work in ft.-lb. per sec.}}{550}$$

The C.G.S. unit of power is the rate of **1 erg per second. The practical electrical unit of power is the watt.** One watt is equivalent to 10^7 ergs (or 1 joule) per second, or $\frac{1}{746}$ horse-power.

Power in watts $= E \times C \times T$, T being 1 second. A larger unit of power is the **kilowatt,** in terms of which the power of wireless telegraph transmitters is usually expressed. Thus the well-known $1\frac{1}{2}$-kilowatt wireless transmitter installed on so many merchant ships might be called a 1,500-watt installation.

Power and Work in A.C. Circuit.—The equation, Power $= E \times C$, refers only to a direct current. For an alternating current,

$$\text{Power} = E \times C \times \cos\phi,$$

ϕ being the angle of lag. If a power curve be plotted for an alternating current, with various values of $E \times C$ as ordinates, the *times* being abscissæ, the *area* of the curve will represent the work done by the current; but if the current is not in phase portions of the total area are *positive* and other portions are *negative*—that is, they are respectively above and below the base line along which time is measured, which means that the generator is alternately *giving out* and *absorbing* power. The difference between the total positive area and the total negative area for a period gives the total work done during that period.

An Echo from the Past

MR. GODFREY ISAACS, in the course of his address to shareholders at the Cannon Street Hotel, a full report of which will be found on pages 300 to 302, referred to the achievements of wireless telegraphy and the progress that had been made in the twenty odd years of Mr. Marconi's labours. This reference on the part of the Managing Director of the Marconi International Company brought forth a reminiscence from a Member of Parliament which appeared in the pages of *Town Topics*, and is worth recording here :—

"It is just twenty years ago since Mr. Marconi, now Senatore Marconi, gave "an exhibition of his wireless invention to members of the House of Commons. "He wanted to prove that a wireless message could be sent from the Terrace to St. "Thomas's Hospital, some three or four hundred yards across the river, and members "flocked to the Terrace to witness the experiment. There were considerable doubts "as to the result. John Burns busied himself in the arrangement of the small instru- "ment in one of the passages leading to the Terrace, and in fixing, to Mr. Marconi's "instructions, the eight- or ten-foot pole that stood against the Terrace wall some "thirty feet from the instrument.

"When arrangements were completed, Mr. Marconi invited the writer of these "notes to send any message he liked to the party in charge of the machine at the "hospital.

"At that moment the news came in that Gladstone had died, and the message "transmitted recorded that fact, and added a few words about the great statesman. "The instrument was set to work, and scarcely had the words been tapped off "when acknowledgment was announced from the other side. Hearty cheers were "given for the great inventor, but still there were some present who doubted whether "the invention would ever be of any practical use."

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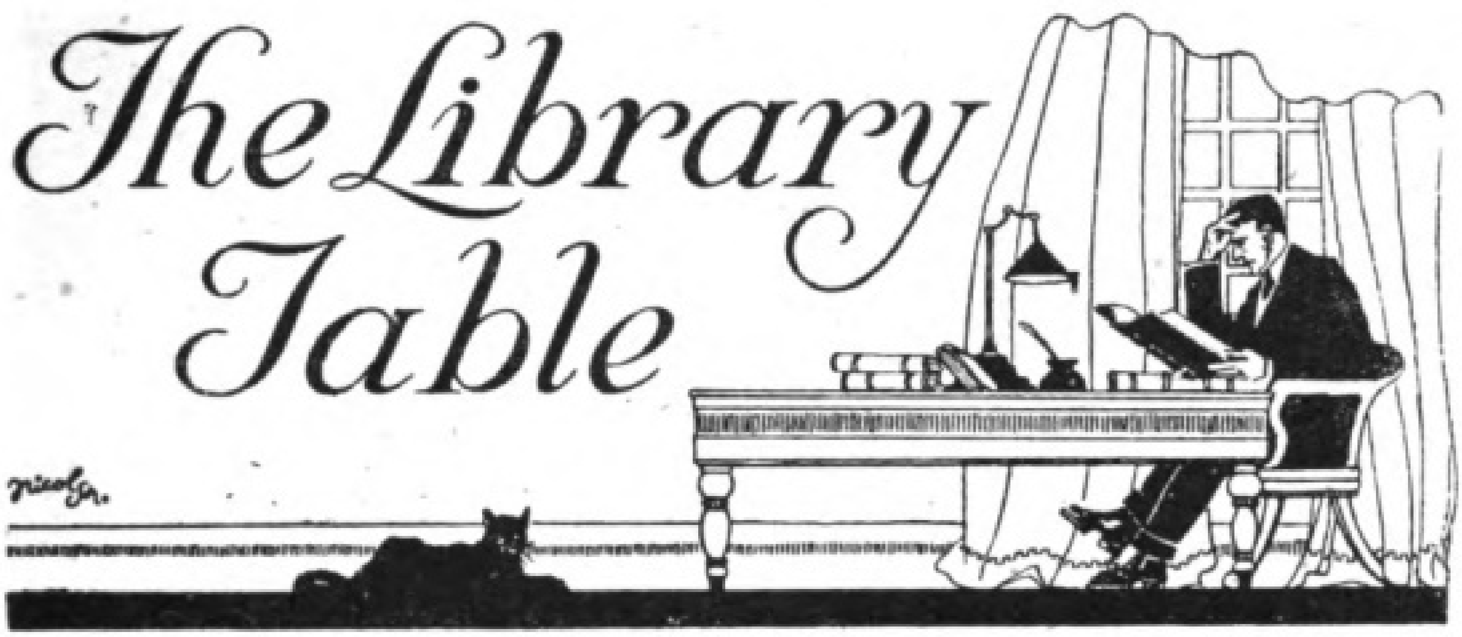

MATHEMATICS FOR ENGINEERS. *By W. N. Rose.* *London: Chapman & Hall.* *8s. 6d. net.*

The modern tendency to specialise is increasingly reflected in the publication of textbooks. Thus, happily, we no longer see the bulky tome endeavouring to cover every branch of the subject, and failing both by reasons of the limitations of the author's knowledge and the meagre treatment of individual parts. To such have succeeded the smaller volumes, devoted to a single phase of the subject and written with expert knowledge of that phase. It is in this category that we must place the book before us.

Although this is by no means the first book to specialise in Engineering Mathematics, it is nevertheless designed to fill a gap the existence of which has been obvious for some time past. Most books deal with this important science either from a strictly theoretical standpoint, bearing little relation to everyday practice, or else err in the other direction, by offering the facts without reasonable explanation of principles.

In the words of the author, "An endeavour has here been made to produce a treatise so thorough and complete that it shall embrace all the mathematical work needed by engineers in their practice, and by students in all branches of engineering science." This, it will be granted, is an ambitious aim, and one inviting criticism which might otherwise be withheld. Let us say at once, however, that the author appears to have carried out his work in a very thorough fashion, keeping always before him the daily work of the engineer.

In the compass of one volume it is impossible to bring together everything needed, and therefore a second is announced as shortly to appear, completing the subject. The work is divided so that in part one the fundamental rules and processes of Algebra are dealt with, as are those of Plane Trigonometry, Mensuration, and Graphs; while in part two the Calculus and its applications, Harmonic and Vector Analysis, and Spherical Trigonometry will come in for treatment. The "Directly Useful" textbooks, of which this is the latest to appear, has already established itself firmly in public favour, and we can foresee a steady sale for this book, as for the other volumes of the series.

* * * * * *

HUNS IN PALESTINE. *By L. de Sousa.* *Andrew Melrose, 3 York Street, Covent Garden, London.* *5s. net.*

The British expeditions to Mesopotamia and Palestine, their fluctuations in fortune and ultimate success, have recalled popular attention to those ancient

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lands. The situation in the civilised world, during the period of history covered by the books of the Old Testament, may be briefly summarised as follows: On the North lay Assyria, pre-eminently the great Military Empire. On the South stretched the land of Egypt; and civilisation (as it existed then) found a safe and congenial home in the lands fertilised by the beneficent waters of the Nile. The latter was simultaneously the country of mystery and enlightenment; the problem of the mighty river with its unknown sources exercised the thinking powers and imaginative speculation of explorers and men of letters in those days, as it continued to do until the secret yielded to the indomitable courage of the nineteenth-century explorers. In Arts and Sciences, the Egyptians obtained such a lead as to form the source of inspiration for the whole ancient world. To them the Assyrians owed their sculpture, the Greeks their architecture and painting, the Romans their methods of government and administration. Between these two great Powers stretched the small country of Palestine; dominated, though not entirely peopled, by the Jewish branch of the Semitic race. The kingdoms of David and Solomon occupied the position of what we call a "Buffer State," now inclining on the one side, now on the other; but managed to maintain their independence so long as Israel and Judah held together. The separation proved fatal.

Mr. de Sousa has chosen for the scene of his drama that point in history when the Prophet Isaiah had stirred the religious enthusiasm of his co-patriots, and when Hezekiah had succeeded in moulding Jewish enthusiasm into a concrete shape. The Military Power of Egypt was at low tide, that of Assyria on the flood. Those were the days when even patriotic Jewish writers were forced by the logic of events to speak of "The Great King, the King of Assyria." Sennacherib, to quote the words of Byron, "came down like the Wolf on the Fold." Hezekiah, listening first to the partisans of the Northern Kingdom, attempted to avert the storm by sending tribute. The Assyrians accepted the tribute and then proceeded to invest Jerusalem. What happened then we do not know *historically*, but legend has been busy and our novelist devotes some striking passages to the traditional episodes. The siege terminated in a disaster to the Assyrian arms, and the rest of Sennacherib's career was dogged with misfortune, until his subjects ended it by revolt and assassination.

Such is the story told us by the author of *Huns in Palestine*, who has clothed his narrative with more than ordinary skill, utilising the traditional material of Love, Ambition, and War. A beautiful daughter of Hezekiah—Nehushta is her name—furnishes the love; Shebna, Hezekiah's treacherous Minister, the ambition; and Amon, Prince of the tribe of David, the war. The local colour has been extremely carefully laid on, and we congratulate Mr. de Sousa on the way in which he has managed to convey the "atmosphere" of bygone ages. We can assure readers that a true breath of Eastern air pervades the incidents throughout.

History repeats itself, and the title *Huns in Palestine* not unjustly recalls the present situation, when the spirit of freedom and independence is struggling for delivery from the withering influence of military dominance. Moral degradation combined with physical strength; infamous treachery allied to skilful scheming; self-complacency wedded to utter contempt of the rights of others, characterised the Assyrians of this far-off period, as they characterise the Germans of to-day.

Share Market Report

London, July 17th, 1918.

DEALINGS in the shares of the Marconi Group have been very active during the past month. The issue of the report for 1917 of the parent company was extremely favourably received, and has brought in considerable investment buying of the shares of the various issues. The prices are very firm as we go to press. Marconi Ordinary, £3 16s. 3d.; Marconi Preference, £3 5s. od.; American Marconi, £1 5s. od. (*ex. D.*); Spanish and General Trust, 11s.; Canadian Marconi, 12s.; Marconi International Marine, £2 16s. 3d. (*ex. D.*).

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Personal Notes

Awards.

Mr. J. I. de Wardt, one of the principal officials attached to the Secretary's Office at the G.P.O., was included in the recent Honours List as recipient of the title of *Officer of the Order of the British Empire*. Mr. de Wardt has been for many years interested in Wireless Telegraphy and is well known to a number of our subscribers. We tender him our hearty congratulations both on our own behalf and that of our readers. It is highly gratifying to note this official recognition of his services, and we take this opportunity of expressing a hope that he has a long and honoured career in front of him. We may say that to his courtesy The Wireless World is indebted for the personal particulars relating to the late Mr. E. W. Farnall which appeared in our June issue.

Sergeant H. Squelch, Wireless Section, R.E., who a few weeks ago was made a King's Sergeant, is now the recipient of the D.C.M. Prior to the outbreak of hostilities Sergeant Squelch was on the postal staff at Chislehurst. He enlisted in the Royal West Kents in September, 1914, and served overseas with that regiment, subsequently being transferred to the Wireless Section, R.E.

For Meritorious Services.

Operator William Crossley Bowey, whose name (inadvertently given as C. Bovey) appeared in the list published last month of those to whom grants have been made by the "Ships' Gratuity Committee," has received high commendation from the captain and chief engineer of the ship on which he was senior operator for his praiseworthy conduct on the occasion when she was torpedoed. The captain was trying to save the vessel by running her aground, and had ordered port and starboard lifeboats away, when Mr. Bowey, who had done all that was possible in connection with his wireless duty, volunteered to stay with the captain and assist him in case the ship foundered.

MR. W. C. BOWEY

The aerial wire had by this time become damaged, but at the captain's request further efforts were made to radiate distress signals by Mr. Bowey, who then stood by the bridge to render whatever assistance might be possible and in any way that he could.

When the captain's efforts to ground the ship were successful, and both anchors let go, Mr. Bowey went below and conveyed the message to stop the engine.

In Hospital.

One of the participants in the Jutland battle, and latterly on submarine duties, Wireless Operator Herbert Brooke, of Mirfield, Yorks, is at present in the Royal Naval Hospital, Gosport, suffering from the effects of an accident.

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MEMORIAL.

Crowds of people assembled in front of S. Peter's Old Collegiate Church, Wolverhampton, on Sunday, June 23rd, to witness the unveiling of the bust of DOUGLAS MORRIS HARRIS, A.B., R.N.V.R., the heroic wireless telegraphist on board the drifter *Floandi*, who, while the enemy was shelling the vessel, continued to send messages and only ceased to do so when killed. He fell dead over his log-book while writing. The monument was unveiled by Vice-Admiral and Major-General Mark Kerr, C.B., M.V.O., and bears the following inscription:

STATUE ERECTED IN MEMORY OF OPERATOR D. M. HARRIS

"Douglas Morris Harris, A.B., R.N.V.R., the heroic wireless operator who continued to record messages in the log-book on the shell-torn drifter *Floandi* until killed by enemy gunfire, Adriatic Sea, May 15th, 1917."

Photographs of Telegraphist Harris and the mutilated log-book were published in our issue of September, 1917, pp. 398, 399 and 414. The block which accompanies this page shows the statue just unveiled, whilst that on page 279 depicts the unveiling ceremony.

OBITUARY.

The death of MR. P. H. JOHNSON, which occurred on June 6th, came as a shock to his many friends, and deep sympathy is felt for his family in their bereavement.

Mr. Johnson, who joined the Marconi Company's Operating Staff in 1903, returned from Callao last year, where he had spent four years in the capacity of Resident Inspector, and since had been attached to the Traffic Manager's Department, Marconi House, taking duty up to within a few days of his death. Having been in indifferent health for some time past, he underwent an operation medically advised, but unfortunately, although this was successfully performed, did not rally. The funeral took place on June 12th, at Woolwich Cemetery, the Rev. J. Wilson, uncle of the deceased, conducting the simple service held in the cemetery chapel, at which the Traffic Manager was represented. Many relatives and friends attended to pay a last tribute, the numerous and beautiful wreaths which were placed on the grave (including one from the Marconi International Marine Communication Company, Limited) testifying to the esteem and affection in which he was remembered by all with whom he was associated.

We regret to announce the death of LIEUT.-COLONEL DOUGLAS HYDE HYDE-THOMSON, aged 27, who was killed while flying over Kent on May 21st. He first served in the Royal Navy, attaining the rank of Lieutenant, and joined the Royal Naval Air Force in 1914, being connected with the early experimental work of that arm. His energies had latterly been devoted to matters electrical, mainly wireless telegraphy, and his loss will be greatly felt in this branch of service.

News that Air Mechanic and WIRELESS OPERATOR JACK COLINSKY has died of wounds received in action has been received with much regret. An artist, and previously on the staff of the *Daily Sketch*, he joined the Royal Flying Corps in 1916.

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Wireless Workers in a Good Cause.

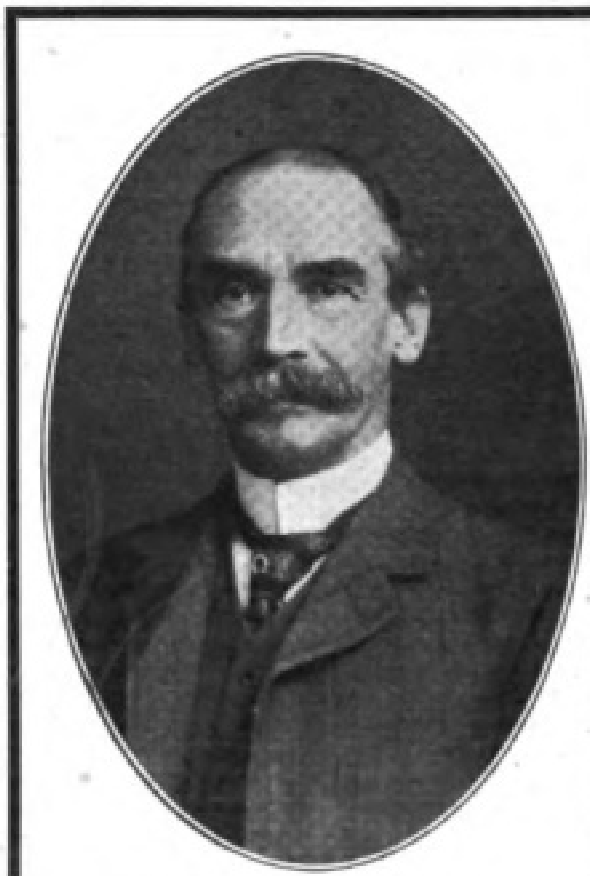
On June 7th last was held what is known as "Salvation Army Flag Day," when that well-known institution endeavoured to get together a substantial sum of money for expenditure on huts and ambulances in France. The lady workers at Marconi House undertook to help the cause, and so effectively did the 60 girls composing this little wireless army work that no less a total than £150 was handed over to the Central Fund. This amount, so the Salvation Army authorities inform us, constitutes a record for any depot in London, either this year or last year.

The district covered ranged from Chancery Lane to Wellington Street; about 26,000 flags were disposed of, and the multitude of the small offerings which made up this creditable total may be gauged from the fact that it took two strong men to carry the coin after it had been bagged. Mrs. Bramwell Booth and her daughter, Miss Mary Booth, O.B.E., called personally to express their gratitude, and desire that each worker should be individually thanked for her exertions.

In Memoriam

Of a strenuous life devoted to Radiotelegraphic Progress

On Sunday, June 16th, Mr. John Bottomley, Vice-President of the Marconi Wireless Telegraph Company of America, passed away at his private residence in New York City, in the seventieth year of his age. Mr. Bottomley was sprung from a good old Irish family located in the "Black North," and first saw the light at Belfast in 1848. He was justifiably proud of his origin, and more particularly of the fact that he could claim the relationship of a nephew to the late Lord Kelvin. His education was conducted at Queen's College, and he started in life by engaging in the British export trade, first crossing the water to New York in 1880. Once over "on the other side" he devoted his energies to the study of law and practised extensively in that profession until 1898, when his imagination was fired by the discoveries in radiotelegraphy of Senatore Marconi. Mr. Bottomley, full of enthusiasm for the new science, undertook the task of introducing it to the American world of commerce. Four years subsequently he became General Manager, Secretary and Treasurer of the Marconi Wireless Telegraph Company of America, and successfully guided the Company through its early struggles. The welfare of the Company and the advancement of radiotelegraphy were "as the breath of his nostrils" and he died, as he lived, in harness. He took a very keen interest in the human side of the corporation and was ever ready with a helping hand to the younger members, finding time, moreover, out of a busy life, for engaging actively in church and social work. His death removes a notable figure from the world of American Wireless, and leaves a gap which will never be filled in the business and social life of his colleagues.



MR. JOHN BOTTOMLEY.

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Company Notes

Marconi International Marine Communication Company, Ltd.

Continued Development of the Business

A "VERY IMPORTANT NATIONAL SERVICE."

THE 18th Ordinary General Meeting of the Marconi International Marine Communication Company (Ltd.) was held on Tuesday, July 2nd, at the Cannon Street Hotel, Mr. Godfrey Charles Isaacs, the Managing Director, presiding.

The Secretary (Mr. Henry W. Allen, F.C.I.S.) having read the notice calling the meeting and the Auditors' report,

The Chairman said :—Ladies and gentlemen,—I had hoped yesterday that our illustrious Chairman, Senatore Marconi, who arrived in London on Sunday night, would have been able to preside at this meeting to-day. He has, however, come here as the head of the Italian Mission for the International Commercial Conference; his duties commenced to-day, and they will detain him during the whole of this meeting. In those circumstances he asked me to excuse him to you and to preside at the meeting in his place. The report and balance-sheet are before you, and I propose to adopt the usual course of taking them as read, and proceed at once to deal with the figures in the accounts before touching upon other matters.

BALANCE-SHEET CHANGES.

If you will look to your balance-sheet, you will find the increase in the capital of the Company from £350,000, as it stood at the end of 1916, to £600,000 at the end of 1917. The whole of this capital was issued, and, but for a few pounds then outstanding, was entirely paid up by the end of the year. The Debentures have been reduced from £114,360 to £112,280 by purchases during the year. The general reserve account, which stood at £47,653 10s. at the end of 1916, has now been increased to £258,009 3s. There is an increase in the creditor balances arising very naturally from the greater volume of the Company's business. Upon the credit side "Plant, apparatus, furniture, and stores," which stood at £350,320 at the end of the preceding year, from which the usual substantial depreciation has been written off, nevertheless shows a very substantial increase, amounting to not less than £227,000. This, of course, represents the greatly increased number of stations installed on board ships during the year 1917. The next item shows but a trifling change. The debtor balances have increased by some £116,000, which, again, is due to the greater business; and our cash resources, both in regard to cash at bankers and investments in War Loans, and in short loans against securities, amounted together at the end of the year to some £410,000 in round figures, as compared with £75,000 at the end of 1916, the increase being accounted for in large part by the increase of capital and otherwise, of course, by the accumulation of profits.

THE PROFIT AND LOSS ACCOUNT: LARGELY INCREASED RECEIPTS.

If you will turn to the profit and loss account, there are, under the several headings covering salaries, general charges, expenses, etc., merely such variations of figures as you would expect from the considerable development of the company's business. The amount of depreciation of plant and apparatus of £39,529 is shown separately, and is, I think you will agree, a substantial but nevertheless a reasonable, sum. The receipts from ships' telegrams, subsidies, etc., have increased from £270,000 to £470,000; and the profit carried to balance-sheet amounts to £192,000, as compared with £96,000 in the preceding year. I should point out to you here that the increase in the profit is due entirely to increase in the volume of the business. In the appropriation account there figures the 5 per cent. interim dividend declared at the end of last year and paid on February 1st, and, as you will see, we propose, subject to your approval, to declare a further dividend of 10 per cent., which will absorb a further £60,000. We are placing £50,000 to reserve for obsolescence of plant—a course which we think necessary, for, when this war is over, we shall require to replace a great many of our ship stations by stations of new design, which it has been impossible for us to do during the war, and which, in fact, we cannot attempt even now, for the urgent need of equipping ships with wireless installations is so great that we must continue to manufacture as fast as we can of the design with which those employed in the work of manufacture are used, and, therefore, can most quickly produce. We have good reason to believe that due and proper consideration will be given to this question in dealing with the question of excess profits. We propose to carry forward the sum of £105,417 19s., subject, of course, to the excess profits duty for the years 1916 and 1917, when these amounts are finally agreed. I do not think that there is anything more in the accounts which calls for comment or information, and you will, I am sure, agree with me that we have every reason to be well satisfied with the business of the past year, particularly when it is borne in mind that our telegraph business on board ship is reduced to the extreme minimum in consequence of the necessary restrictions arising from the state of war.

THE INCREASE IN THE CAPITAL.

It will also be borne in mind that for the reasons which we explained in our circular last year it

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became necessary for us, in order to meet the obligations which we had undertaken with the Board of Trade to provide for installations on board a large number of additional vessels, to increase the capital of the Company to £600,000. It will be remembered that this increase of capital took place towards the end of the year, and therefore for the year under review we had practically no benefit from this increase of capital, but we are nevertheless paying the dividend upon the increased amount of £600,000 instead of £350,000, the amount of the capital in the previous year. We offered, as you know, this increase of capital to our shareholders on terms which we thought would be sufficiently tempting to them, and I am very glad to be able to say that the whole of the amount was taken up by shareholders; in fact, it was considerably oversubscribed, and I think they have every reason to congratulate themselves that they did avail themselves of our offer. Not only will they have received, if shareholders endorse the Directors' recommendation this afternoon, a dividend of 15 per cent. upon the shares for which they subscribed late in the year, but they have, I think, a very sound and improving security, with the very substantial profit of about 20s. per share attached to their investment.

The Company's Stations: The Total Rentals.

By the end of the year, as we have told you in our report, the total number of public telegraph stations owned and worked by the Company on the high seas had increased from 1,472 at the end of December, 1916, to 2,265. But these figures really do not give you any precise indication of the number of ships fitted during the period, which, as you can well imagine, was considerably more than the mere subtraction of the one figure from the other would suggest. For very obvious reasons I do not propose to tell you what the missing figure is, but you will all quite well appreciate that it was a very considerable one, and represented the number of ships with installations on board which were lost during the year. To the end of June, after making a similar deduction for ships lost during this year, the total number installed and, so far as we know, plying the seas was 2,446, showing a further substantial increase for the first six months of this year.

At the end of 1916 our total rentals were at the rate of £352,000 per annum; at the end of 1917 this figure had increased to £570,000 per annum, and at June 30th of this year they amount to £703,374. I do not think it is necessary for me to say more to indicate to you the continued satisfactory development and growth of our business.

Wireless Operators and their Pay.

It is probable that many of you have felt a little anxious in recent times as a result of the threatened strike of wireless operators in consequence of their being dissatisfied with their rate of pay. I therefore propose to say a word to you upon this subject in order that our position in this matter may be clearly understood by all. Firstly, I would explain to you that the contracts which we enter into with shipowners provide for the most part for a certain annual payment to be made to us in respect of operators' wages so long as the scale of pay continued as at the time of the contract. If an increase became necessary we had to agree with the shipowners before consenting, and whatever that increase amounted to had to be added to the sum paid to us by the shipowners to cover the further cost arising from such increased pay to the operators. You will therefore see at once that in so far as we are concerned we are unable to deal with any question of increased pay without the agreement of shipowners, unless we choose to accept the responsibility of it ourselves, and for our own account. This is not contemplated under the terms of our agreements with shipowners. We did, however, think well at the end of last year, in consequence of the great increase in the volume of our business, and the consequent spreading of standing charges, to give an all-round increase of 5s. per week, which entailed a considerable burden upon the Company, but beyond that we could not go.

Improved Terms of Employment.

As a result of the very much increased rates of pay to the mercantile marine, given under directions of the Ministry of Shipping to all seafaring men, the wages of the operators no longer seemed adequate, and application was accordingly made to the Ministry of Shipping to agree to the increase demanded by the Association of Wireless Telegraphists. Inasmuch as the Ministry of Shipping was, I understand, so fully occupied with other questions, this matter was deferred longer than the operators felt it should have been, and therefore the threat to strike. The Company, however, have had the opportunity of conferring with the representatives of the Association of Wireless Telegraphists, and in so far as all matters touching the conditions of employment by the Company are concerned a complete agreement was arrived at. A new scale of pay was also considered, and the Company recommended its acceptance to the Shipping Federation and to the Ministry of Shipping. I am glad to be able to say that the Shipping Federation have recognised the recommendation as reasonable, and, subject to argeement with the Ministry of Shipping, the new terms will be put into operation.

What I particularly wish to point out is that, although operators are employed by the Company and paid by them, their remuneration is provided by an agreed subsidy from the shipping company. Your Directors have been glad to recommend the improved terms of employment of operators, for their conduct as a body has been magnificent during these very perilous times. No praise of them could be too high. I am sorry that public interests do not admit of my publishing at the moment innumerable instances of their great courage and self-sacrifice. One day, however, their brave deeds will be recorded, and it will then be generally recognised what great services to their country and to the general public have been rendered by these young men, popularly known on board ship by the name of "Sparks."

Heroism of Wireless Operators.

I could not refrain last year from giving you one or two examples of how they acted in moments of peril; since then one could write volumes upon their heroic conduct. I must relate to you one case, however, illustrative of so many more, to help you to appreciate the material of which this body of men is composed. During the latter part of last year a ship (I must not mention her name) was some 140 miles from the coast when she was attacked by a submarine, which launched a torpedo at her. Fortunately the torpedo passed under the ship without doing any damage. Very soon afterwards the submarine appeared on the surface at a distance of about four miles and commenced to shell the ship. This continued for about an hour, during which period the operator remained in his cabin and got into communication with a land station, from which he was promised the immediate assistance of a destroyer. During the

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whole hour the ship was being shelled the operator remained at his post in the hope of getting into touch with a ship which would be able to give earlier help. The captain sent a message by the first mate to the operator to the effect that, having obtained communication with the coast and the promise of assistance, it was advisable that he should leave his post, which was in a most exposed position, and take shelter. The operator replied that he was getting into touch with an American light cruiser, which he believed was nearer than the British destroyer, and was therefore likely to give earlier assistance; meantime he could not leave his cabin. As soon as he was able to get his message through to the ship and obtain a satisfactory reply he would take shelter. Within a few moments the submarine abandoned solid shell for shrapnel, and fired a shot which passed directly through the cabin, decapitating the wireless operator. When the captain and officers went later to the wireless cabin they found his headless body sitting in the chair, with the completed message from the American cruiser in front of him. Only the timely arrival of the American vessel prevented the ship from being sunk.

This story, you will agree, is a very sad one, but the outstanding feature of it is this. Had the operator left his cabin, as he was authorised by the captain to do, the ship would probably have been sunk, and it is more than likely that many, if not all, on board would have been lost, but by remaining at his post he obtained the assistance of the nearer ship, and, to use the words of the captain and the officers, "his plucky action in sticking to his post was undoubtedly the means of saving the ship, its officers, and crew, numbering in all 45 souls." This is an example of the conduct of wireless operators on board ships of the mercantile marine. It is a very sad case, and I am glad to say that many who have acted equally bravely have been more fortunate, although, as our report tells you, the list of those who have lost their lives in the past year is again a considerable one. Rewards for bravery in the field have been given, no doubt most deservedly, to a very large number, but, however well-deserved they may have been, I do not think there could be cases of greater bravery and devotion to duty than such a case as I have related (which is only one of a great many), and I trust that due recognition will be given by the authorities to the brave acts of wireless operators as well as to those who have served their country on other fields of battle. (Hear, hear.)

What the Company has Done.

It must be a matter of considerable satisfaction to those shareholders who originally invested their money in this Company, to the Directors who were associated with it many years before I became connected with it, and particularly to our illustrious chairman, Senatore Marconi, to see not only the great and successful development of the Company's business, but also the immense service which the Company, through its world-wide organisation, has been able to render in these anxious and perilous years to the Empire, the Allies, and the peoples of every neutral nation. It is impossible to estimate how many tens or hundreds of thousands of lives have been saved or safeguarded, and it is difficult to say, even approximately, how many millions in pounds sterling of invaluable material and food supplies have been saved and brought to our shores. Primarily, of course, we owe our thanks to our wonderful Fleet, but the Fleet behind the Fleet (as the mercantile marine has been so aptly termed) has also played a great part, to which this Company, its vast organisation, and its splendid staff of wireless operators has very largely contributed. Yet it is but comparatively few years ago—not more than ten—that the Company was installing ships with wireless stations free of cost in order to demonstrate that a wireless telegraph station on board ship could really serve a valuable and useful purpose, and over £100,000 of shareholders' money was expended to convince the public of the great and valuable thing Senatore Marconi, through this Company, was offering to them.

The Value of One Control and Organisation.

Before the war there was a disposition amongst some in this country to complain of what was regarded as something in the nature of a monopoly which this Company possessed. I frequently had occasion to point out how essential it was, to my mind, that a business of this nature should be under one control, one organisation; and if this war has proved anything, it certainly has, I think, demonstrated beyond all question how fortunate and how helpful one control, one organisation, dealing with the whole of wireless telegraphy upon our mercantile marine, has been. Had this business been divided up amongst a number of companies, I think it would have been imperative for the Government to have commandeered them all and brought them under yet one more Government Department. Fortunately, the whole of the business was in the hands of the Marconi International Marine Communication Company (Ltd.); there was an excellent organisation, perfect discipline, and one control—in a word, there was efficiency.

Only those who are interested in, or who are connected with, this Company hear anything about the work it does; the general public hear nothing, and this is explained, to my mind, simply by that one word "efficiency." With inspectors, repair shops, and stores in practically every port of importance throughout the whole world, the 4,000 wireless ship stations managed by this Company and its associated Companies have been thoroughly maintained and in effective operation from the day war was declared.

It was with no small satisfaction that every man in this Company hailed the honour of Commander of the Order of the British Empire bestowed upon our manager, Mr. W. W. Bradfield, by his Majesty the King. (Cheers.)

A great debt of gratitude is owed to him, to Mr. Allen, our Secretary, Captain Daly, Mr. Turnbull, Mr. Cross, Mr. Lewis, to the other officials of the Company, and to the whole of the staff of the Company, not only by the shareholders, but, in my view, by the peoples of the Empire, the Allies, and the neutral countries, for the indefatigable energy they have bestowed upon the very efficient maintenance of this very important national service; and in this connection we must not forget the Italian branch of our business, which has been equally efficiently managed by our representative in Italy, the Marquis Solari.

The Chairman then proceeded to explain the purport of some proposed alterations in the Articles of Association. He moved the adoption of the Report and Balance Sheet, and the resolution—after being seconded by Mr. Alfonso Marconi—was carried unanimously.

The retiring Directors were re-elected and a resolution increasing the fees of members of the Board was put and carried.

An Extraordinary General Meeting followed, at which the alterations in the Articles of Association explained by the Chairman in his address to the shareholders were carried, and the proceedings concluded with a vote of thanks to the Chairman, Directors and Officers of the Company.

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Questions & Answers

NOTE.—*This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless telegraphy. There are no coupons to fill in and no fees of any kind. At the same time readers would greatly facilitate the work of our experts if they would comply with the following rules:* (1) *Questions should be numbered and written on one side of the paper only, and should not exceed four in number.* (2) *Replies should not be expected in the issue immediately following the receipt of queries, as in the present times of difficulty magazines have to go to press much earlier than formerly.* (3) *Queries should be as clear and concise as possible.* (4) *Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. This will save us needless duplication of answers.* (5) *The Editor cannot undertake to reply to queries by post, even when these are accompanied by a stamped addressed envelope.* (6) *All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom-de-plume."* (7) *During the present restrictions the Editor is unable to answer queries dealing with many constructional matters, and such subjects as call letters, names and positions of stations.*

J. B. G. (Huddersfield) asks for "full particulars" about the Wireless Section of the Mercantile Marine. As we have dealt with this subject on many previous occasions, we can only refer our correspondent to back numbers, particularly the January, 1917, issue. There is one point of importance, however, which we should like to indicate. *No student should commence the study of wireless telegraphy with a view to becoming a wireless operator in the Mercantile Marine if he is older than 17 years and 3 months.* Save in the case of men who commenced their studies prior to April last, exemptions will no longer be granted to students after they reach the age of 18 unless they obtain their certificates and employment as operators on board ship before that date. Many men complete their course in six months, but nine should be allowed in order to be on the safe side.

F. F. (Hull).—(1) The present demand for operators is fast being supplied from men already in training. We cannot say what future requirements may be. Certainly those men who did not avail themselves of the Marconi Free Training Scheme (now closed) missed a golden opportunity. (2) Yes, the men are taken for permanent positions. (3) Physical fitness and general suitability for sea life. (4) This depends on circumstances. Many men have taken charge after one trip as junior. (5) Operators are promoted to higher positions as vacancies arise. Depot Superintendents are invariably promoted from the ranks of the senior inspectors, and in order to qualify for these latter posts it is necessary to pass an examination. Vacancies for Depot Superintendents do not often arise, as the number of such posts is limited.

"VALVE" (Cornwall).—It is highly improbable that a man would be released from the R.N.V.R. or other branch of His Majesty's Service in order to take up such a position as you mention. It would be necessary for you to wait for your discharge in the ordinary way.

D. J. F. (Carrick-on-Suir) asks (1) "What is the maximum voltage developed in the secondary circuit of a Marconi 10 in. coil to the primary of which 25 volts pressure is applied?"

Answer.—With the hammerbreak well adjusted the coil will give a stream of sparks between its two secondary terminals with the discharge balls removed. Every coil has to pass this test before leaving the works. It is difficult to give the exact voltage as no two authorities seem to agree on what voltage is required to give a 10 in. spark between points. Very approximately the voltage may be called 100,000. (2) The greater the amplitude of the wave the greater the effect produced. (3) An intermittent unidirectional current, the pulses of current being equal in frequency to the sets of waves, or "wave trains," received on the aerial. The current is not oscillatory as it has been rectified into pulses by the detector. (4) From the way you put this last question it is evident that you do not understand the principles of transformation. We would advise you to study this subject in *The Elementary Principles of Wireless Telegraphy* which you possess. Turn up pages 80 and following in Part II.

J. E. J. (Lowestoft).—Are the leads from the dynamo cased in lead? If so, make sure that the casing is earthed. If this is ineffective try earthing one of the terminals of the telephones.

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This is sometimes but not always effective. The dynamo brushes may also be sparking—a frequent cause of trouble. Keep the coupling of the receiver as weak as you can without unduly reducing the strength of signals. Please note that we cannot deal with queries through the post.

W. A. B. (Castleford).—On breaking the circuit the current of self-induction charges the base condenser,* which promptly discharges through the primary and completes its demagnetisation. Its main purpose is to increase the suddenness of the break. Is this the information you require?

W. S. (Blackheath).—As stated above, the Marconi Free Training Scheme is closed. (2) *Electricity and Magnetism for Home Study*, by H. E. Penrose (see our advertising columns). (3) Not to the best of our knowledge. It merely shortens his period of training in the R.N.V.R.

Many thanks to the correspondent in Edinburgh who sends us an account of his experiences with a postal course. In his opinion, the time at the practical work is very little shortened by taking a correspondence course—not sufficient, he says, to justify taking one. Perhaps some other readers have been more fortunate.

E. M. (Newport Pagnell).—Brick being to all intents and purposes an insulator (except when wet) there would be no practical difference between the two arrangements. In any case, the effective height would be from the *top* of the earth lead, any conductivity of the brick merely affording a parallel path to earth.

J. F. (Leek).—(1) Seventeen years and three months. (2) Yes, precisely the same. It does not matter whether a man is trained free by the Marconi Company or pays fees at a private school. When he is appointed to the staff he gets the standard rate of pay. (3) None in Staffordshire. In any case the free training scheme is closed. (4) *The Elementary Principles of Wireless Telegraphy*, by R. D. Bangay, and the *Handbook of Technical Instruction*, by J. C. Hawkhead and H. M. Dowsett (see advertising columns). Thank you for your good wishes and appreciation.

L. J. W. (Shepherd's Bush).—You might take a course at one of the wireless colleges advertising in our magazine and apply for a position as soon as you obtain a First Class Certificate. If there are vacancies at that time your application will be given consideration. (2) This depends on the Army requirements at the moment. (3) The nearest recruiting office could give you this information better than we can. (4) Depends on yourself. If you have no knowledge of telegraphy you should reckon upon four to six months.

SAPPER J. H. G. (B.E.F.).—(1) The purpose of the high voltage battery is to supply the energy to the telephones. The small current in the "grid" circuit "triggers off" the larger current in the sheath circuit. (2) You cannot consider the electrons apart from the current. A flow of electrons can be looked upon as a positive current in the opposite direction. Electrons flowing from the filament to the sheath give the effect of an electric current from the sheath across the space to the filament. (3) No, not at present. We hope to publish some more shortly. Have you read all the recent valve articles in THE WIRELESS WORLD?

SPECIAL NOTE.

THE MARCONI FREE TRAINING SCHEME IS NOW CLOSED.

Correspondents who wish to train as Wireless Operators should apply to the nearest Wireless Training School or College.

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