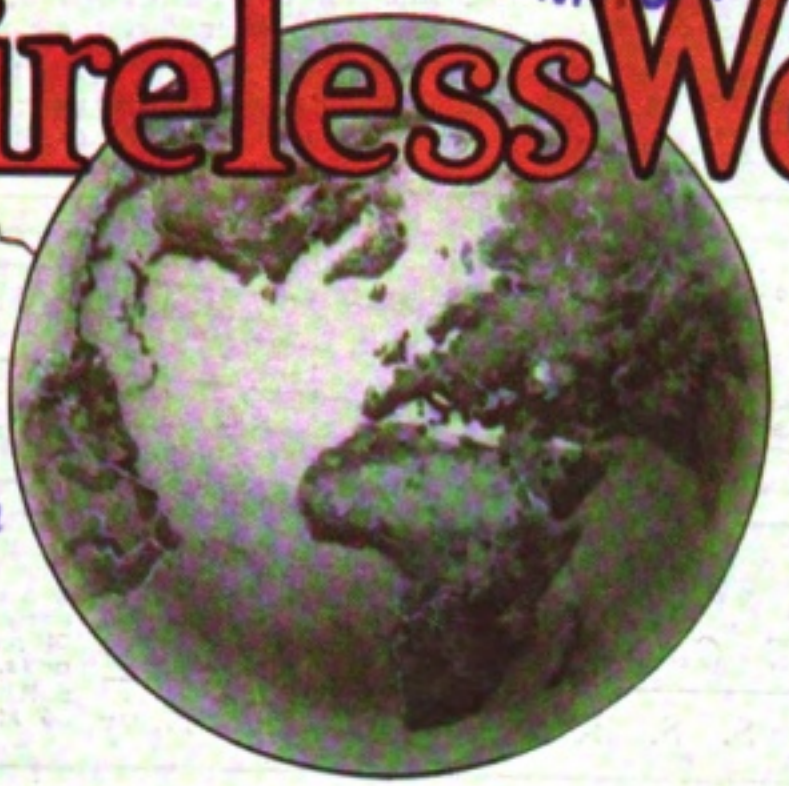
VOL. VI. No. 66. SEPTEMBER · 1

The Wireless World



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The
WIRELESS
·WORLD·

Volume VI. No. 66. SEPTEMBER, 1918.

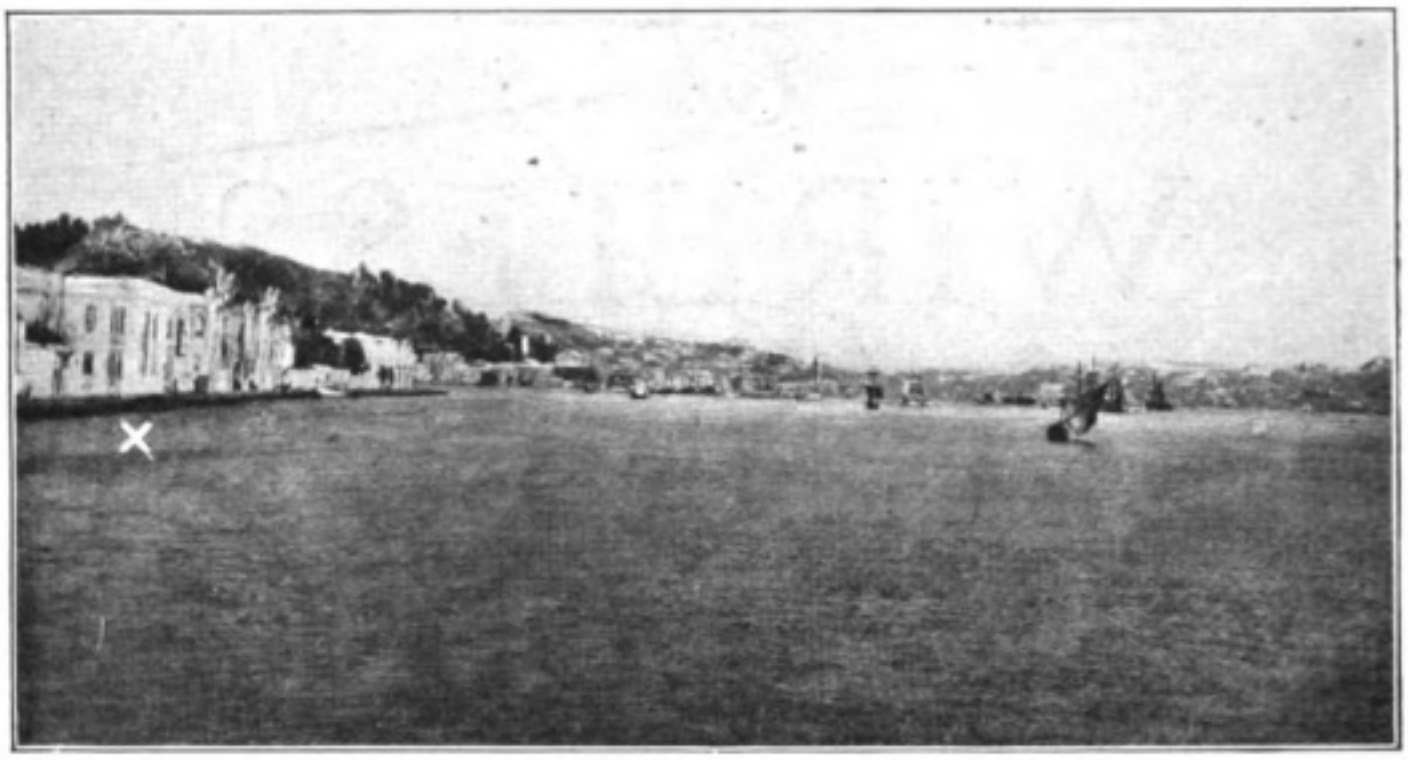
Wireless in Turkey

An Amateur's Experiences

By W. GORDON CAMPBELL

THE wireless station at Constantinople was erected by the Marconi Company a few years before the present war and a description of the installation was given at the time in these pages. I may, however, mention here that the principal set has a power of 20 kilowatts, while a supplementary 3-kilowatt set is used for signalling over short distances. The aerial is of the "umbrella" type and the musical note emitted is of a peculiarly "plaintive" character. This station occupies a prominent position on an eminence overlooking the Golden Horn, known as "Ok Maidan" (arrow place), which indicates that the spot was formerly used as archery ground.

When the Marconi engineers were erecting the station and installing wireless on the Turkish warships I was myself connected with the Admiralty, and had a "teskere" or pass which enabled me to go where I pleased in the arsenal. I also had access to the wireless station. At the request of the British admiral, who then acted as adviser of the Minister of Marine, I was giving a course of advanced instruction in English to officers of the wireless department, who were afterwards to be sent to England to complete their technical studies at the Marconi works. The room at the arsenal in which I gave this instruction adjoined the store and workshop where Mr. W. Beale Cole, of the Marconi Company, was fitting up the apparatus to be used on the warships. It was natural, therefore, that we two Englishmen should foregather together in that foreign land, and it is to him that I am indebted for my first practical introduction to the mysteries of wireless.



ENTRANCE TO THE BOSPHORUS: THE DOLMA BAGHCHEH PALACE, MARKED X, WAS THE LOCALE OF THE ASSASSINATION OF THE SULTAN ABDUL AZZIZ IN 1875.

Mr. Cole, besides being a skilled electrical engineer, has in latter days developed a literary faculty, and his name will be familiar to the reader as the author of several interesting semi-scientific tales and topographical articles contributed to this magazine.

Of the engineers occupied in installing the Ok Maidan station I came chiefly in contact with Mr. James and Mr. Strang. On one occasion I passed a whole night with them at the station and had an opportunity of seeing "how it works" under their able guidance. The Turkish officer in charge had been trained at the Chelmsford works and spoke English fluently.

Mr. Cole occupied a room on the fourth floor of an hotel in Pera, the European quarter, from the windows of which Ok Maidan was clearly visible at a distance of about two miles across the valley of Cassim Pasha. Communication was established between these two places at night by means of lights which flashed out the Morse signals. I was usually present during these conversations and then made my first attempts to master the Morse code. But that was by no means an easy task. I subsequently found, after trying various methods, that the most satisfactory was that adopted on the "Morse made easy" card issued by the *Wireless Press*, in which the long and short signals forming a letter are indicated by the accented and unaccented syllables of a word commencing with that letter. For example, R (.—.) would be represented by such a word as "record'er" or "remem'ber" and other letters in a similar manner. Mr. Cole also fitted up in his room a simple receiving outfit consisting of a multiple tuner and magnetic detector with a few yards of wire attached to the hotel chimney as aerial; but, as the Ok Maidan station was not then working, the only signals we heard were those of the Rumanian passenger steamer in the harbour, which occasionally communicated with Constantza or Bukarest.

It was not until after the departure of the Marconi engineers that I realised how easy it would be to fit up a receiving station. With some difficulty I obtained the necessary wire for my aerial and the tuning coil. The latter consisted of many yards of thin cotton-covered wire wound by hand on a cardboard tube, with two sliding contacts. I also found a low-resistance telephone receiver, and a friendly British mining engineer provided the galena for my detector, but no tinfoil could be discovered anywhere for my condenser. Eventually I observed

that certain chocolate slabs sold at the British stores were wrapped in just the kind of foil that I required. I obtained a quantity of these slabs and after completing my condenser the chocolate came in handy when listening of an evening to the music of the ether. The aerial consisted of four short copper wires, attached to a short pole on the roof, while the earth-wire was fixed to the water-pipe. This first installation involved an outlay of just about one pound sterling. It was afterwards much improved by the substitution of two coupled coils and the addition of variable condensers and two detectors, the one electrolytic and the other a combination of zincite and bornite. I also fitted up a transmitting set with the aid of a 3-inch spark coil, but as there was no other amateur with whom I could communicate it was not of much use.

At the time when my installation was completed, the Bulgaro-Turkish war was drawing to a close and the Turks were in retreat towards Constantinople. A massacre of Christians was feared, and in order to protect their subjects the Powers sent a fleet of about twenty-five warships to the Bosphorus. At the British Embassy a wireless station was established on the roof and kept in constant touch with our two warships. Most of these warships communicated with their bases by wireless in the evening, so that, as may be imagined, there was often a regular pandemonium of sounds in my telephone receiver. But as the messages were almost invariably in code I was naturally unable to understand them. However, the French warships occasionally communicated with one another in plain language and the *Goeben* often transmitted to her consort the German official war news in plain German. Then the Turkish station rarely used code at that time, while the Rumanian passenger steamers always transmitted in ordinary Rumanian or French. All the warships, excepting the French, emitted musical notes of various pitches, the highest being that of the *Goeben*, on which, of course, the Telefunken apparatus was used. The French ships gave out a low cracking sound like that of a machine-gun, which

GENERAL VIEW OF CONSTANTINOPLE, AND THE GOLDEN HORN.

A GLIMPSE OF THE BOSPHORUS.

made it difficult at times to distinguish the dots from the dashes. Even with my small aerial the signals were so strong that they could be read many yards away from the receiver. Sometimes I placed the receiver upside down at an angle inside a glass tumbler, which intensified the sound and gave it a peculiarly penetrating ring. One evening I left the receiver in this position near my bed and was actually awakened in the middle of the night by the "peep-peep" from my tumbler.

The ordinary "continental" Morse was used for all the languages employing the Roman characters, but for Turkish, Greek and Russian it was considerably modified. A Turkish naval officer gave me the ordinary Turkish code, but I had to work out the Greek signals for myself. I jotted down the dots and dashes as they were transmitted and taking for granted that several of the letters or sounds common to both English and Greek would be represented by the same groups of signals I soon made out the complete alphabet. The chief difficulty was with the diphthongs, which have special signals.

The speed of transmission was usually high in the case of the warships, but the Turks tapped out the letters so slowly that one could write down the dots and dashes with the greatest ease and afterwards read the message at leisure. Ok Maidan was mainly engaged in communicating with the Turkish fleet, and also with Adrianople during the siege of that town by the Bulgarians.

With regard to "things heard" by means of my installation it will be seen that there was no want of variety in the languages and "notes" transmitted; but that was counterbalanced by the fact that most of them were signalled in code or cipher. It was monotonous to listen to an interminable array of figures or letters which conveyed no meaning, but there were occasional communications in "clear" language. One morning I overheard the Rumanian steamer in port spelling out a message in French addressed to Bukarest on behalf of the British post office at Constantinople. It was of a private nature, but I carefully wrote it out and on calling that same afternoon upon my friend the postmaster I casually placed it under his nose. His look of blank astonishment was amusing.

ENTRANCE TO THE MOSQUE OF AHMED I.

"Where on earth did you get that?" he asked; "it's private."

"Well," I said, "there is nothing private about the ether from which I picked it up, and if messages are secret they should be sent in code; but, so far as I am concerned, it will not be disclosed to anyone." On another occasion I heard the German liner *Corcovado* in the harbour speaking in English to an Italian passenger steamer, then approaching Constantinople from the Dardanelles, with regard to the family of the American Minister, Mr. Morgenthau. As Germany was then at war with us (although not with the United States) this aroused my curiosity. The explanation, however, was simple. It appears that the American gunboat *Scorpion*, then in port, was trying to find out from the Italian steamer the time of her arrival, as a relative of Mr. Morgenthau was on board, but failed to attract her attention, probably because the *Scorpion's* transmitting power was insufficient. Accordingly she asked the *Corcovado*, which had a much more powerful installation, to relay on the message. But perhaps my most interesting experience at the "listening-post" was on the night when the *Goeben* and *Breslau* reached the Dardanelles after their break-neck race from Messina. I heard the *Corcovado* calling for "AGO," which I knew from the list in the Marconi *Year-Book* to be the call-letters of the *Goeben*, then supposed to be far, far away. The message was in open German, and stated that mechanics would be sent down as requested at once to execute the necessary repairs. Immediately afterwards the *Corcovado* called for "DGL," which I found to indicate the *General*, another German liner then somewhere outside the Dardanelles. A short message was first transmitted in open German, then followed a long communication in code. I suspected that the *General* would try to escape into the Dardanelles. Next morning the arrival of the *Goeben* and *Breslau* was announced in the Turkish papers, and two days later the *General* came into the Bosphorus with a dummy funnel and other disguise.

(To be continued.)

VIEW OF GALATA AND PERA FROM THE STAMBOUL SIDE.

A Notable Personality

LORD PARKER OF WADDINGTON

A Famous Judge and Eminent Authority on Wireless Patents

An Illustrious Jurist

Whose Intellectual Gifts Won Him High Distinction in the Field of Wireless

THE English Bench has in modern days produced no more luminous exponent of its best traditions than Lord Parker of Waddington, who died of heart failure on July 12th last at his home in Aldworth, Haslemere, in his sixty-second year. He was a thinker and student, as well as a lawyer, and some of his judgments are nothing less than epoch-making. One of the outstanding instances thereof profoundly affected the progress of radiotelegraphy. We refer to that which he delivered on February 21st, 1911, in the action brought by Senatore Marconi and Marconi's Wireless Telegraph Co., Ltd., against the British Radio Telegraph and Telephone Co. The subject-matter of the trial involved Marconi's basic patent, No. 7777 of 1900, besides two others filed by the great inventor. It is truly wonderful to read this classical pronouncement, which has formed the basis for numerous subsequent decisions, and to remember that the great lawyer who delivered it had no previous technical knowledge of wireless to guide him. The manner in which he disentangled ether wave telegraphy from that founded on magnetic induction, the lucidity with which he treated Marconi's innovation in the coupling and attuning of a closed oscillating circuit with an open radiating or absorbing circuit, and the clarity of reasoning which disposed effectively of the plea that an auto-transformer in use by the defendants and their possible employment of an inductive shunt relieved them from any onus of infringement, would have been remarkable in the case of an expert highly equipped with technical qualifications. Radiotelegraphy owes him a great debt of gratitude for having, by his remarkable intellectual power and analytical insight, cleared, once and for all, issues of the greatest importance and difficulty. Mr. Justice Parker (as he then was) won so great a reputation by his wireless judgment that, when in 1912 a Select Committee was appointed by the House of Commons to organise the Imperial Wireless Chain, the responsible post of Chairman to the Technical Advisory Committee was filled by him. To him, moreover, was assigned the task of presiding over the Wireless Telegraphy Research Committee, appointed by the Postmaster-General to investigate the most satisfactory methods whereby the State should make provision for research work into radiotelegraphic science. That report was issued in 1914 and resulted in the organisation being established in the form of an experimental establishment at the National Physical Laboratory at Teddington. The son of a Lincolnshire clergyman he "started in life" at Claxby in 1857. His education was conducted at Westminster School and Eton, and consummated at King's College, Cambridge. Called to the Bar by Lincoln's Inn in 1883 he maintained a connection throughout his earlier legal career with Mr. Ingle Joyce, afterwards Judge of the Chancery Division. Lord Loreburn appointed him to a judgeship after the return of the Liberals to power in 1906, and on the death of Lord Macnaghten, in 1913, Mr. Asquith promoted him over the heads of the five Lords Justices to become a Lord of Appeal in Ordinary, and a Peer for life under the title of Lord Parker of Waddington. He was chosen, despite the severe handicap of serious eye trouble, to preside in the Second Division of the Judicial Committee of the Privy Council, constituted in 1916 to deal with appeals from the Prize Court. Right up to the last he showed by his exposition in clear terms of great constitutional doctrine that his brilliant intellect remained undimmed by the tribulations of physical sufferings.

On Valve Characteristic Curves and their Application in Radiotelegraphy

By J. SCOTT-TAGGART, R.E.

I

In the history of scientific discovery there is hardly a better example of applied physics than the use of the vacuum valve in radiotelegraphy. Moreover, there are few cases where graphical results obtained in a laboratory suggest so strongly practical applications of them. One has only to glance at a characteristic curve of a valve to grasp the practical potentialities of this comparatively recent invention. It is proposed in the following paper to enlarge upon the very valuable information we can obtain by the study of a number of such curves, and not only to explain some of the phenomena met with in actual work but to show how we may apply our information in designing apparatus and using the valve to the best advantage.

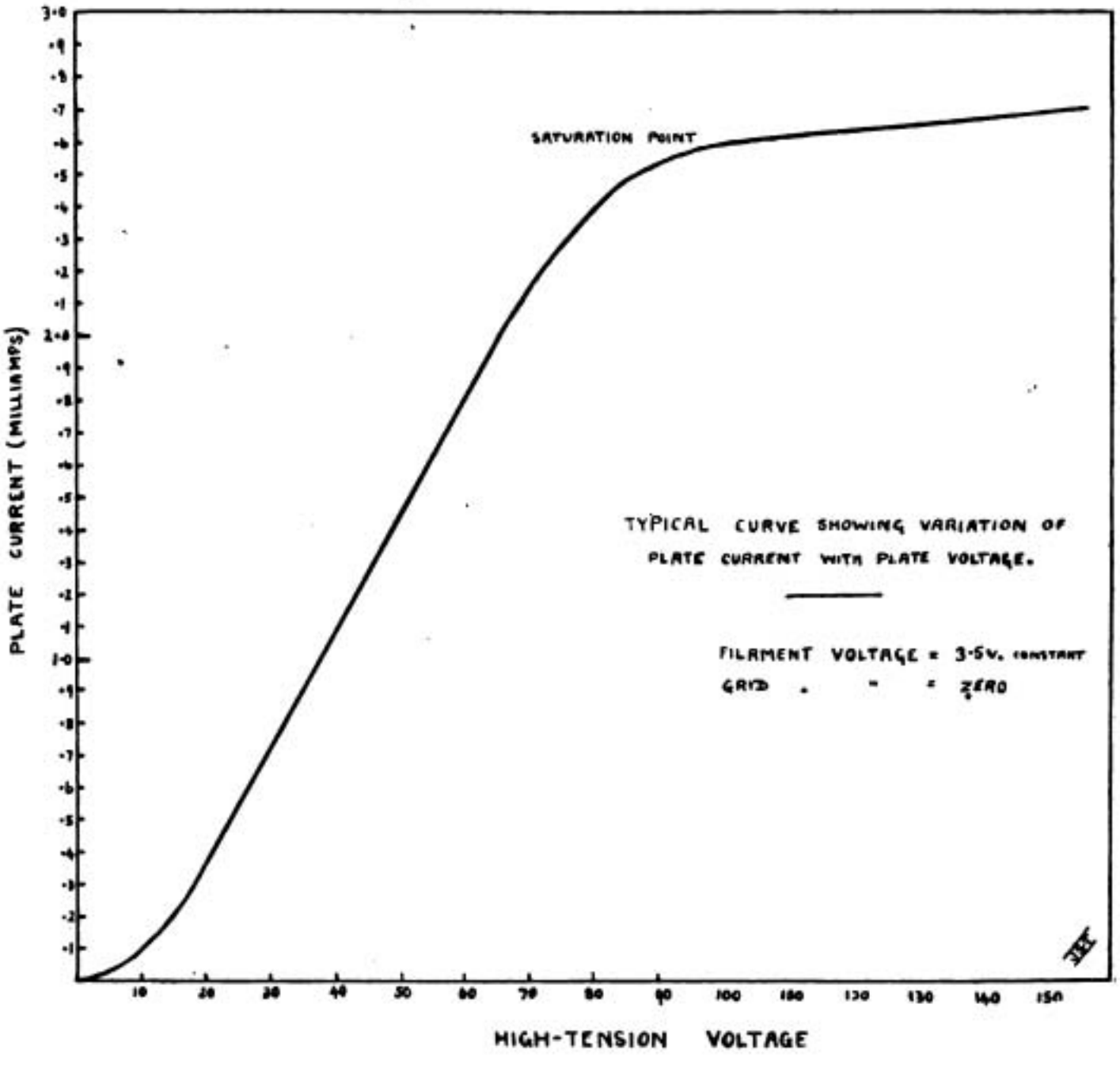


FIG. I.

The curves given have been obtained with a small hard valve, having a very wide-meshed grid, but they may be taken as typical of all hard vacuum valves used in receiving and transmitting circuits.

Let us first briefly summarise the elementary facts concerning valves. On heating the filament of a valve to incandescence, negative electrons are emitted. A further increase of temperature, produced by placing a higher voltage across the filament, results in a great increase in the rate of emission, which depends solely upon the temperature of the filament. If we connect a high-tension battery with its positive side to the plate, or sheath, of a valve and its negative side to the filament, a potential difference will exist between plate and filament, causing the negative electrons to flow to the positively-charged plate. Of the total number of electrons emitted per second only a certain proportion flow to the plate, the number depending upon the high-tension voltage applied. As we raise this voltage so do we increase the electron flow from filament to plate; this flow may be measured by a milliammeter included in the outer circuit.

Fig. 1, the simplest of the characteristic curves of a valve, shows how, by increasing the high-tension voltage, we also increase the plate current. It also shows us that at first the current increases slowly, then more rapidly, until, approaching saturation point, it begins to increase more slowly again, a point being finally reached when a further increase in the high-tension voltage produces practically no increase in the plate current. The plate has now attracted all the electrons emitted from the filament at that particular temperature. We see from this curve, then, that Ohm's Law does not apply in the case of valves. Had the valve acted as an ordinary conductor the "curve" in Fig. 1 would have been a straight line.

The next elementary consideration is the effect of grid voltage on the plate current. A positive voltage on the grid causes an increase in the plate current, and a negative voltage causes a decrease. In the following paper all voltages given will be relative to the negative end of the filament, and this end will be considered as having zero potential. If there is a potential difference of, say, four volts across the filament the potential of the positive end will be called + 4 volts. Sometimes the positive end is called zero and the negative end − 4 volts. It is purely a relative matter. In the following curves the grid is considered as having zero potential when connected directly to the negative end of the filament. Under these circumstances the grid may be considered neutral with respect to the filament. The grid, being at the same potential as the negative end of the filament, will be at a lower potential than any other part of the fi'ament. There will, therefore, be no tendency for e'ectrons to flow to the grid, and produce a grid current, although a few electrons are bound to strike the grid on their way to the plate. If we put a negative charge on the grid it will repel electrons which would otherwise have gone to the plate, and will also form a strong negative space charge round the filament, causing a considerable drop in the p'ate current. If, on the other hand, we place on the grid a positive charge of, say, 2 volts, the potential of the grid will be higher than the potential of any point on the lower half of the filament, assuming the potential difference across the filament to be 4 volts. A small grid current will therefore be set up. If the grid voltage is made + 4 volts, or higher still, the grid will be at a higher potential than any part of the filament, and electrons from every part will flow to the grid. In all cases, therefore, a posit've charge on the grid not only grea'ly increases the plate current but also es'ablishes a grid current

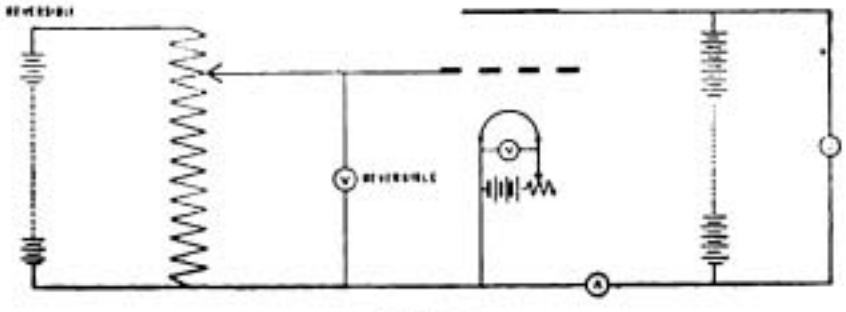


FIG. 2.

of its own. This grid current, which plays an important part in the working of valves, will be discussed later in detail.

The most important characteristic curves of a valve are the ones which show the effect of different grid voltages on the current in the plate circuit. Fig. 2 shows a simple circuit for obtaining tabulated results from which the curves may be drawn. A potentiometer P is arranged so that variable positive and negative voltages may be given to the grid. This potential difference between grid and filament is measured by the voltmeter V. In the plate circuit may be included the 4,000 ohm primary of a step-down telephone transformer, to reproduce working conditions, and also a milliammeter A to measure the plate current. The filament current is variable by means of a rheostat, the exact voltage across the filament being noted for each curve.

In Fig. 3 we have a number of curves showing the relationship between grid voltage and plate current for different values of high-tension voltage, the potential difference across the filament being kept constant at 3½ volts.

Let us look first at the curve obtained when 33·5 volts are on the plate. From this we see that under normal conditions the plate current is ·8 milliamps. By putting a gradually increasing positive voltage on the grid we cause very considerable increases in the plate current until, at about + 12 volts, the plate current reaches a maximum value, and remains constant at about 2·4 milliamps. If, on the other hand, we put a negative charge on the grid, we reduce the plate current. By gradually increasing the negative charge on the grid we will ultimately cut off the plate current altogether. This, as will be seen from the curve, takes place at about − 6 volts. The effect of putting a higher voltage on the plate is to extend the height of the curve until it reaches a certain maximum height, and also to displace the characteristic curve to the left, as will be seen from such examples as the 54 volt, 82·5 volt and 100 volt curves. The curves are still approximately of the same shape and maximum steepness at the different plate voltages given.

It will be noticed also that as we reach the higher plate voltages the value of the saturation current almost ceases to increase. This is to be expected, since the real saturation point of the valve is being reached, when all the electrons emitted from the filament go to the plate. In the case of those curves which lie partly to the right of the vertical line through zero grid voltage, which in future we will call the grid zero ordinate, the grid is given a positive charge. It is the resulting flow of electrons to the grid, and the establishment of a grid current which chiefly prevents the 6 volt curve from reaching the same height as the 154 volt curve. If we added together the values of the grid current and the plate current at the saturation point of the 6 volt curve we would find that the total was approximately the same as the maximum current obtained on the 154 volt curve.

It will be clearly seen that by taking any of the curves of Fig. 3, and by suitably adjusting the voltage on the grid, we can use the valve at any point on its characteristic curve. When we speak of using the valve at a certain point on its curve we mean that the vertical line through the given grid voltage cuts the curve at that point.

Take, for example, the 82·5 volt curve. With no volts on the grid the valve is functioning almost at its saturation point; at − 5 volts the valve is working at a point mid-way along the straight steep portion of its curve; at 12 volts the valve is being used at the bottom bend of its curve. It will be seen later that it is of the utmost importance that we should be able to adjust the valve to that point on its characteristic curve at which it best carries out the function desired of it.

The same object may be achieved by varying the high-tension voltage, varying the filament current, and by varying the two together. Let us first see the effect of varying the high-tension voltage, keeping the grid voltage constant, say, for example, at zero volts. By placing 6 volts on the plate we are using the valve at

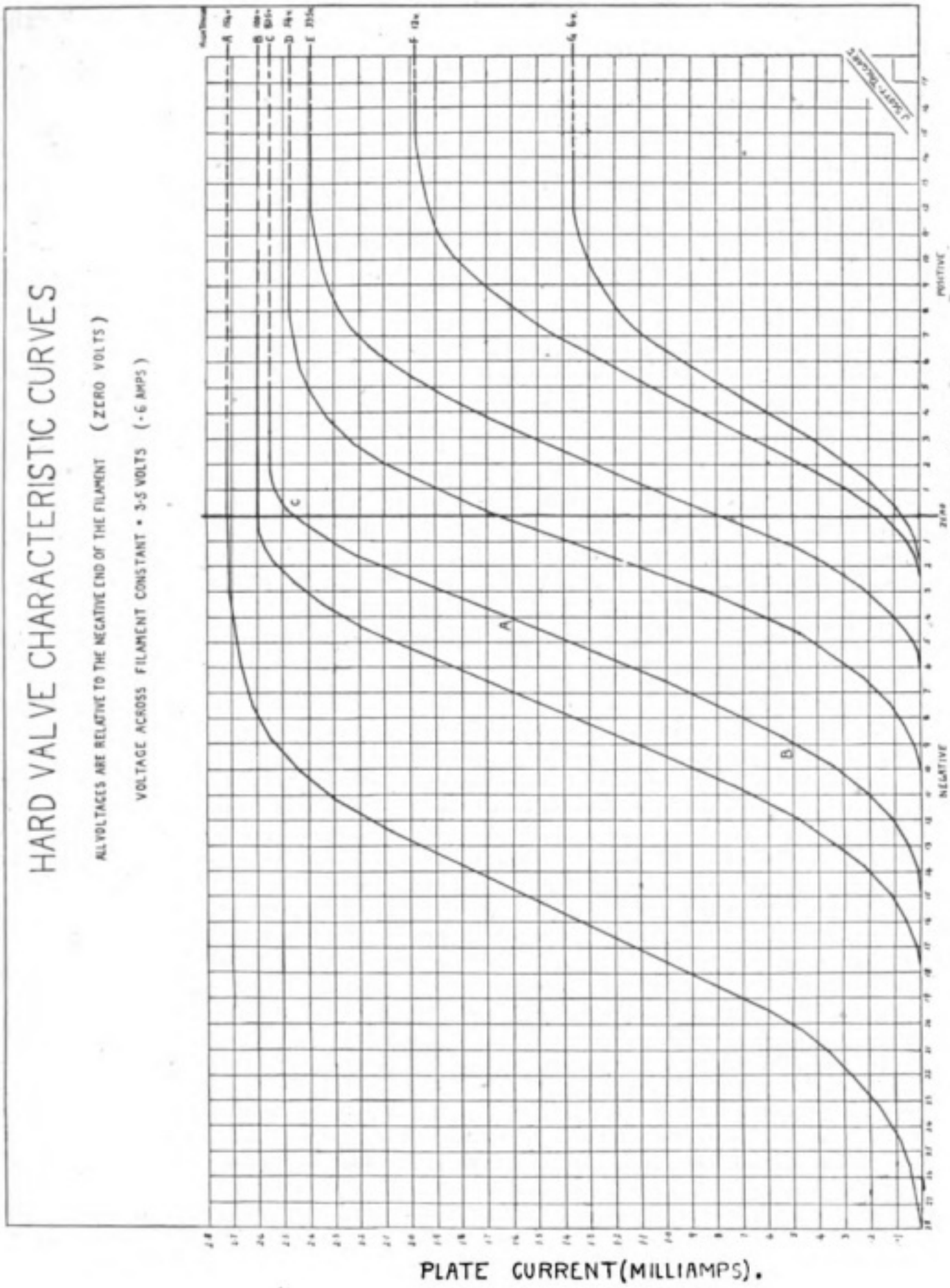


FIG. 3.

the bottom of its characteristic curve. By placing 54 volts on the plate the valve is functioning at about the half-way point along its curve for that voltage. By increasing the high-tension voltage to about 82 volts the valve is functioning near saturation point.

Let us now see the effect of putting a fixed voltage on the plate, say 33½ volts,

and varying the filament current. By drawing a characteristic curve for each value of filament current we obtain the results shown in Fig. 4. They show us that by increasing the rate of electron emission we greatly extend the height of the curve, without actually displacing it bodily to one side as was the case when we varied the high-tension voltage. It will be noticed that all the curves have their lower portions in common.

Although the curve is not actually displaced to one side on increasing the filament current, yet the effect is almost the same as if it were moved to the right. By keeping the grid at zero voltage and using 3 volts across the filament, we are making the valve function at its saturation point. If we increase the voltage to $3\frac{1}{2}$ volts, we will be using the valve on the straight portion of its curve. If, now, we make the potential difference across the filament 4 volts or $4\frac{1}{2}$ volts, we will be using the valve at the bottom end of its characteristic curve. We see, then, from the four curves given, that, by having a rheostat to vary the filament current gradually, we can produce curves of any height within limits, and also arrange to have the valve functioning at any point without having to vary the grid voltage.

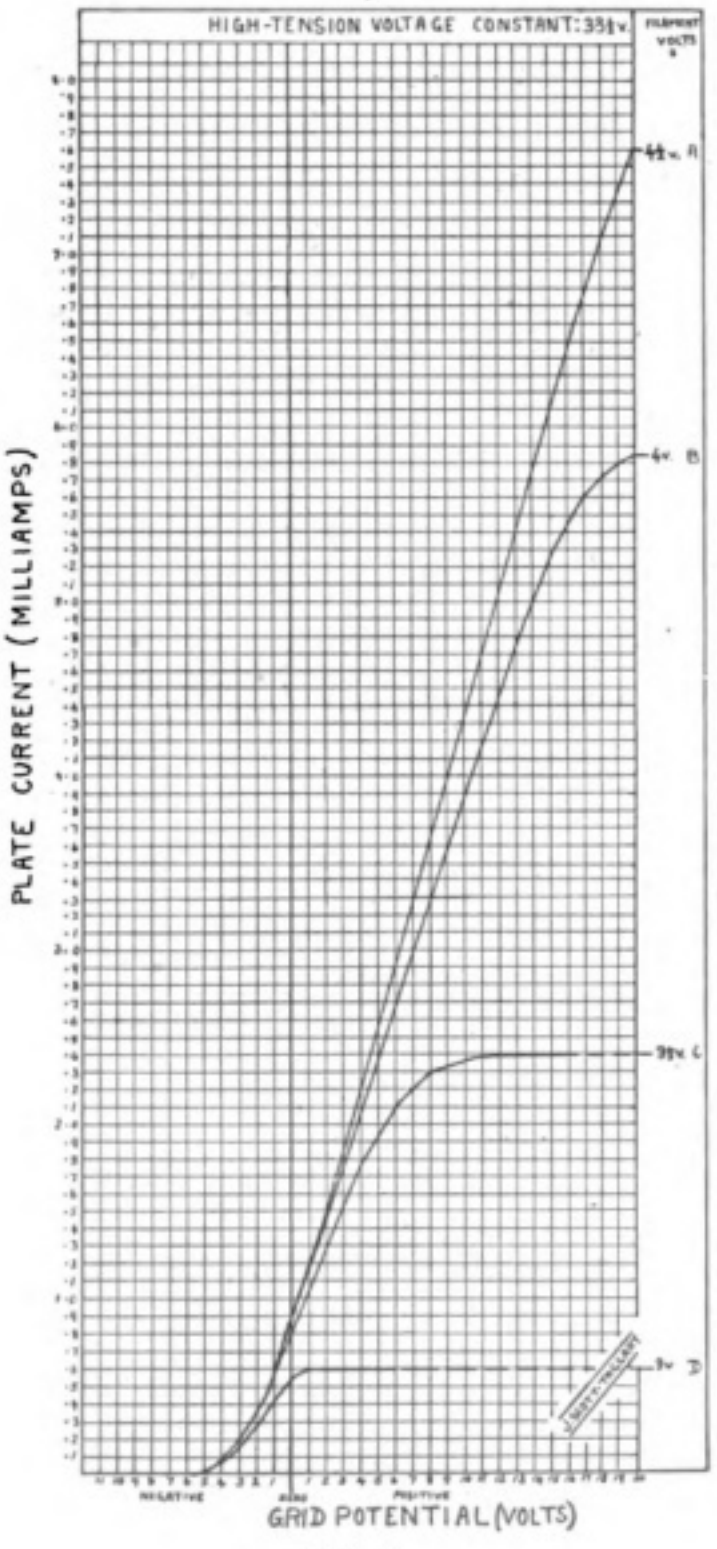


FIG. 4.

By having a variable filament current and high-tension battery we can produce almost any kind of curve, and displace it to either side of the grid zero ordinate to serve our special purpose.

Supposing, for example, we require to reproduce the 82·5 volt curve of Fig. 3 on a much larger scale: if we increase the high-tension voltage, we make the curve very little longer and also displace it to the left; if we keep the 82·5 volts constant, and increase the filament current, we will certainly increase the height of the curve, but at the same time we have done what is equivalent to displacing the curve to the right. The zero ordinate would cut such a curve about half-way up instead of near its saturation point. What we do, therefore, is to increase the height of the curve by using a higher value of filament current, and then to displace it to the left into the desired position, which is completely to the left of the zero ordinate, by using a higher value of high-tension voltage. This increase of voltage also adds to the height of the curve.

(To be continued.)

Digest of Wireless Literature

Weagant's Method for Group Frequency Tuning.

Experiments have shown that when the local circuit of a radio receiving system is fitted with a group frequency or audio frequency tuning circuit a diminution of the strength of signals results. A system has recently been disclosed by Roy A. Weagant, chief engineer of the American Marconi Company, wherein group frequency tuning is possible without the usual loss of signals. The connections are shown in Fig. 1. The primary and secondary windings of the receiving tuner are indicated at 3 and 5 respectively, the shunt condenser at 12, a solid rectifier at 6, and a series condenser at 7. The group frequency tuning circuit includes condenser 7, a variable condenser 11, a variable inductance 10, and the head telephone 9.

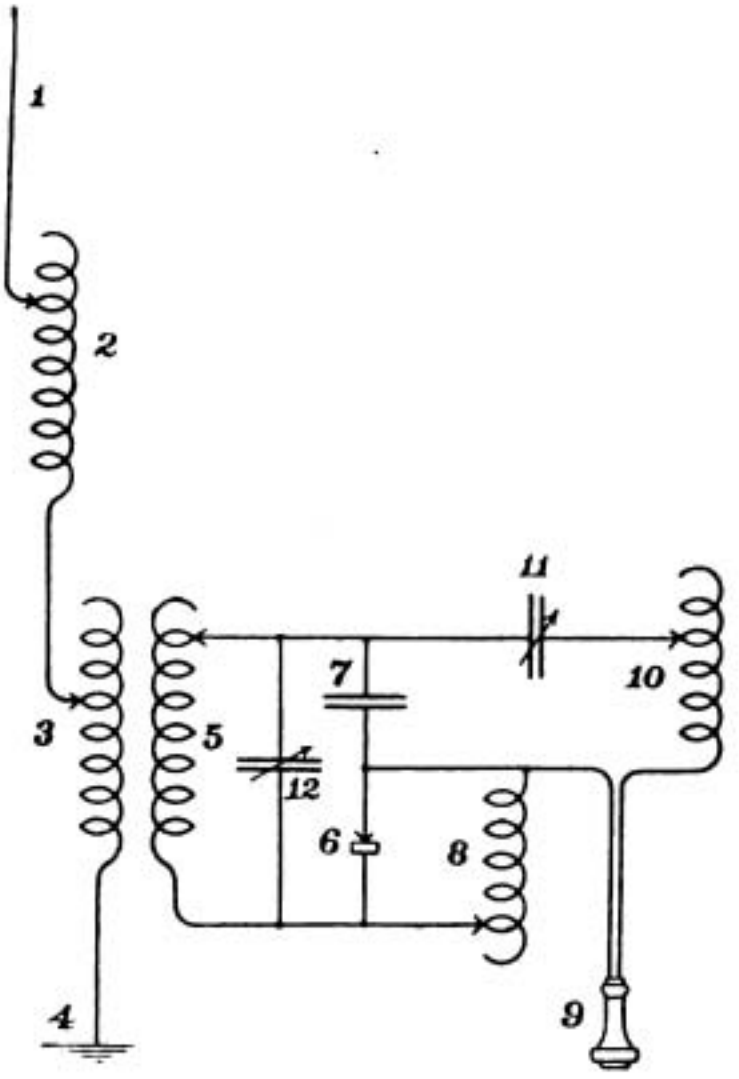


FIG. 1. WEAGANT CIRCUIT FOR GROUP FREQUENCY TUNING.

Detector 6 is shunted by a coil 8, which has the effect of maintaining the signals in the telephone 9 at the strength which would be secured were the group frequency tuner removed. The principle of operation is somewhat as follows: The detector 6, while permitting the passage of impulses in one direction, tends to prevent their passage in the other direction, and thus interferes with the oscillation of the circuit. By placing an impedence in shunt with the detector, however, a path is provided for the passage of oscillations in both directions, thus improving the operation of the circuit. The impedence 8, being of relatively high value, does not, however, interfere with the operation of the detector in the case of high frequencies. Mr. Weagant states that the best results are obtained when the inductances 8 and 10 are substantially of the same order, each of them being about 1,000 times the inductance of the secondary 5.—*Wireless Age.*

CONSTANTS OF RADIO-TELEGRAPHIC STATIONS.

At present there is a lack of simple characteristic constants to define the power of sending and receiving stations in wireless telegraphy. The usual method of defining the antenna of a sending station is by the number of watts calculated from the antenna current and antenna resistance. As this does not take any account of the radiating properties of the antenna, it does not lead to a means of calculating the range of the station. In the case of receiving stations only figures of the most general kind are generally given. The author purposes a system of constants that he has devised in a series of experiments with the help of Zeppelin airships.

It is assumed that the sending station emits undamped waves, that the surface of the earth is a good conductor, and that absorption of the energy in its passage between the stations may be neglected. All constants are referred to a definite wave-length, azimuth and current in the sending antenna.

The "Sending Constant" S is defined as the number of watts that the station sends through a surface of one square mile, perpendicular to the radiation and r km. distant: this would have different values for different azimuths with directive antennæ, or if the earth had different resistance in different directions.

The "Receiving Constant" E is defined as the area in square miles from which the antenna absorbs all the radiated energy. It thus follows that the number of watts γ measured at the receiving station is given by $\gamma = E\,S/r^2$.

According to the sensitiveness of the receiving apparatus there is a lower limit to the power P, at which signals are just audible, given by $\gamma = n\,P$, where n must be greater or equal to unity. If $n=1$, the energy used is just sufficient for the reception of signals, and the stations are at the greatest permissible distance R apart. This distance is $R = \sqrt{(E\,S/P)}$ km.

From the number n of receiving units that are measured at a distance r, the maximum range of the stations may be calculated from the equation $R = r\sqrt{n}$ km.

If the current I in the receiving antenna is measured instead of the watts, we have $I = K/r$, where $K = \sqrt{(E\,S/p)}$ and p is the antenna resistance.

If signals are received from two sending stations the ratio of their sending constants is equal to the ratio of the quantities γr^2 for each of the stations. On the other hand, if two receiving stations measure the power received from a single sending station, the receiving constants of these stations are proportional to the same quantities. Lastly, if two stations are at a variable distance apart, the distance may be calculated from the relations $r_1/r_2 = \sqrt{(\gamma_2/\gamma_1)} = I_2/I_1$.

Corrections are necessary if the waves are damped and if there is absorption of the radiation. The damping constant $B = 8_2/(8_1+8_2)$, in which 8_1 and 8_2 are the decrements of the primary and secondary circuits. The absorption constant K is given by $K = e^{-Ar}$, in which $A = a\sqrt{\lambda}$, according to the formula of Cohen, λ being the wave-length. The conclusions stated above will now hold, if each sending and receiving constant is divided by the corresponding value of B/K.

It will be noted that the absorption correction for S and E will be very small if the distance between the stations does not vary over wide limits. Stations used for measurements of the nature indicated should supply polar curves showing the value of S for different wave-lengths, antenna currents and azimuths. Airships afford the best method of producing such diagrams owing to the absence of earth resistance, and to the fact that they can approach the sending station near enough for the absorption correction to become neglig.ble.—(M. Fieckmann, from "Zeitschrift für Flugtechnik und Motorluftschiffahrt 1914," *Jahrbuch der drahtlosen Telegraphie*, April, 1918).

Range and Best Wave-length for Wireless Telegraphy.

The Austin-Cohen formula is commonly used in designing wireless stations. This formula gives the magnitude of the current in the receiving antenna as a function of the characteristics of the receiving and emitting antennæ, the wave-length, and the distance between the stations. The author transforms the equation, so that the various quantities are involved in a consistent system of units, and then obtains a modified expression for the radio-telegraphic efficiency of the system. The equations are somewhat cumbersome, and graphical methods are given for applying them to obtain numerical results.

The first investigation refers to the range of the station. In calculating the best wave-length to use it is usual to assume that the radiation resistance is small in comparison with the ohmic resistance in circuit at the emitting and receiving stations. The corresponding wave-lengths and distances of transmission are first worked out on this supposition, and subsequently the case is considered in which the above assumptions are not true, such as is the case with short wave-lengths, high antennæ, and good earths. In this case it appears that the efficiency grows with the length of the wave used. As a last case, it is assumed that the radiation resistance is large in comparison with the ohmic resistance at the sending station, and the efficiency of the sending antenna is approximately equal to unity. In the receiving station it is assumed that the earth resistance and the antenna resistance are small in comparison with the equivalent resistance of the detector. On this basis it is calculated that the efficiency of the system, calculated as the ratio of the mean power available at the receiving station to the mean power emitted by the radiating station is given by $n=[(3/8)\ n\lambda/r]^2$ where λ and r are the wave-length and distance of transmission between the stations. Lastly, an abac is constructed, from which the characteristics of operation of a station may be easily read off. The quantities obtainable by its use are the current in the receiving antenna, the range of the station, and the best wave-length to employ.—(L. Bouthillon, *Revue Générale de l'Electricité*, March 23rd, 1918).

Guatemala Joins In.

We notice the announcement in our American contemporary, *The Wireless Age*, that the Republic of Guatemala has "thrown in her lot with her big sister, and declares that she stands by the United States." Although this Central American Republic is little larger in area than the State of New York, and her population is estimated at only about two millions, such action on her part is alike useful and significant. Useful because she possesses a seaboard both on the Atlantic and Pacific Oceans, and this accession on her part will prevent any chance of the establishment of secret wireless stations or German U-boat bases on either littoral. Significant inasmuch as it indicates the moral effect of the action against Germany taken by our American cousins.

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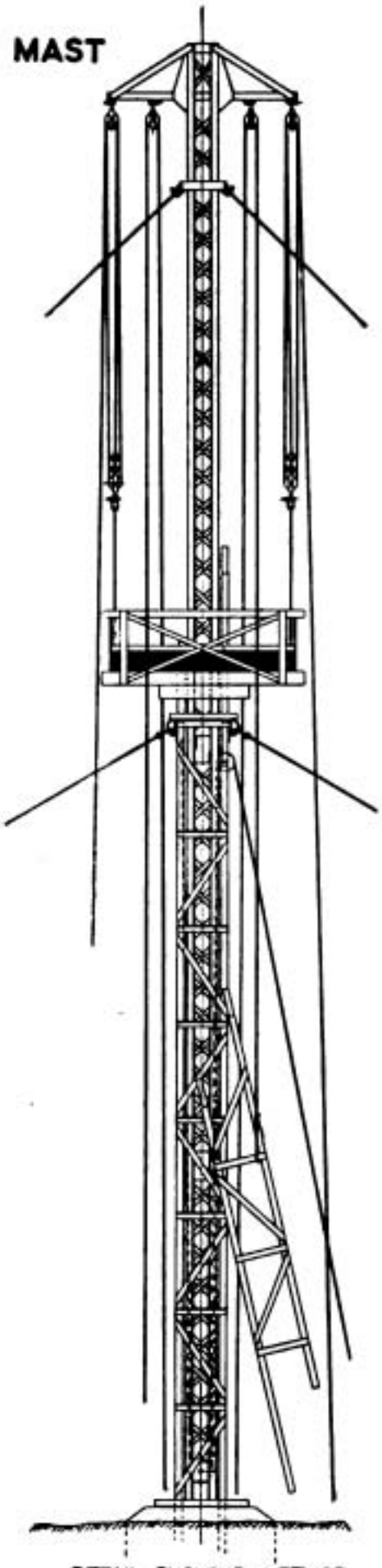

DETAIL SHOWING METHOD
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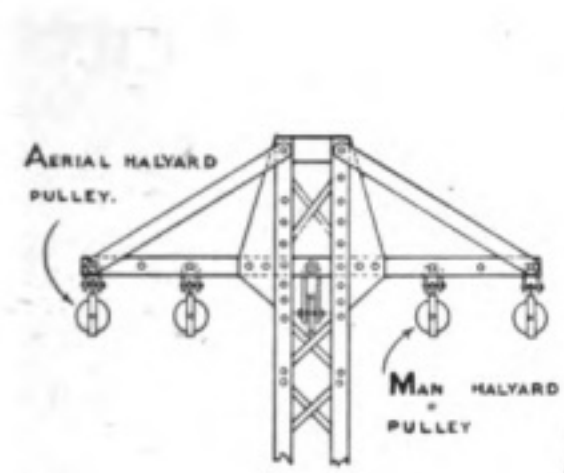

ERECTING HEAD.

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The Home Study of Electricity

An Important New Aid

A certain justifiable distaste for science has arisen in the minds of many students, owing to the dry and uninteresting manner in which text-books are written. Electricity has suffered from such treatment perhaps more than any other science, and it is safe to say that the great majority of electrical manuals have virtually no points of contact with our daily life. Neither, for that matter, do they attempt to clothe the dry bones of the subject with anything approaching a living interest, so that unless the student is prepared to face a dreary vista of frogs' legs, catskin sealing wax, and obsolete apparatus, and to swallow a vast collection of facts unquestioningly, he may as well give up all hope of advancement at the outset.

Far removed from this category must be placed the interesting volume* which it is our pleasure to review this month. With considerable experience as an instructor behind him, Mr. Penrose has not hesitated to throw overboard the accepted conventions surrounding electrical instruction, and as a consequence has produced a book original in treatment and calculated to interest old and young alike.

The keynote of the volume is sounded in the preface. " In departing from the orthodox methods adopted in standard text-books the author in no wise wishes to disparage those methods ; indeed, the ultimate object is to encourage the large body of students who, he knows from past experience, need a stimulated enthusiasm in order to overcome a genuine dislike for mathematical reasoning. If, therefore, in parts, a somewhat severe demand has been made upon the ' Electron ' theory, it must be remembered that these lessons are intended to present facts vividly to aid the non-mathematical mind in following the truths expounded in standard works."

If there is one virtue in the book which shines out above all others it is that difficulties are not avoided, but faced and overcome in a straightforward and lucid manner. Thus, although the book is designed for those who have no previous knowledge of the subject, such matters as the hysteresis cycle and curve, the Wheatstone bridge, ring and drum windings of armatures, and the various problems connected with the electric motor, are all fully dealt with in such a way that few can fail to grasp their purport immediately.

Capacity and inductance are also thoroughly treated, in spite of the fact that most elementary volumes leave these subjects severely alone.

A special word of commendation must be given to the manner in which the book is arranged. The whole volume is divided into fifty lessons, each of these being preceded by a list of inexpensive elementary apparatus by the aid of which the student may test for himself the truth of the assertions made. At the end of each lesson will be found a list of questions to be answered before the next lesson is commenced, and thus the student may test his progress throughout the various stages. The volume is thus particularly suitable for home study, although, of course, it is just as useful for class work.

The thoroughness of the general treatment, and the particularly clear manner in which inductance and capacity are dealt with, makes this book eminently suitable for those who are entering upon the study of wireless telegraphy, whether for professional purposes or merely as a branch of general education. The volume, which is illustrated with numerous diagrams and figures, contains over 500 pages, with a copious table of contents and index, and is certainly one of the most interesting it has been our good fortune to meet.

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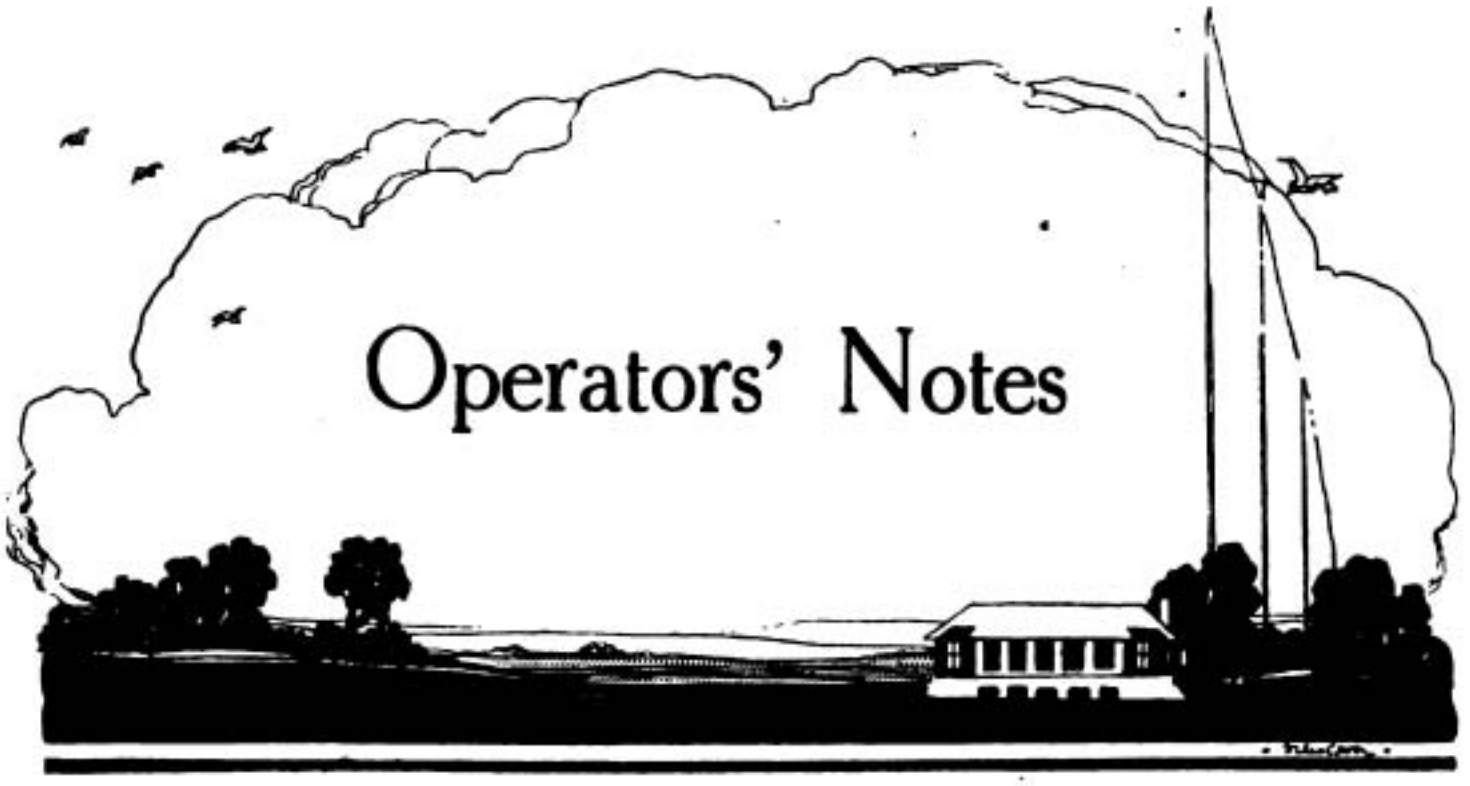
* *Magnetism and Electricity for Home Study.* By H. E. Penrose. London : The Wireless Press, Ltd. 5s. net.



Wires and Wiring (II.)

By ROTAREPO

When joining wires together it is essential that they should make good and constant contact, in other words, the joint must be firm. Loose joints always give trouble, more especially so in wireless receiving gear where the available power is too small to overcome imperfect contacts. These carelessly made joints are the most common source of that tantalising and hard-to-locate fault, "intermittent sigs."

To ensure firm joints solder should be employed wherever possible, though discretion must be exercised in the application of heat. It is well to adopt the rule of using no more heat than is absolutely required. It cannot be too strongly emphasised that excessive heating tends to make the wire brittle, to say nothing of the damage liable to be done to the insulation, both of which tend to greatly reduce the efficiency of the station. It has already been pointed out in these pages that the soldering iron should be used in preference to the blow lamp for wire joints, and the system to be adopted was explained by Mr. Ward in the June issue.

Sometimes it is necessary to make a joint for a "tapping off" lead at some central point of an existing main lead. In this case the procedure should be as now described. Bare and clean a short length of the main wire at the point desired, which length will depend upon the size of wires to be joined—usually an inch will be sufficient. Bare and clean about two inches of end of tapping wire and then bind tightly round the bared portion of main wire, finishing off with solder and insulating tape.

Where the tapping-off wire is composed of more than three strands, a more satisfactory joint is formed by cutting out the core, and then twisting each half of the remaining strands in opposite directions around the main lead. Naturally it will be necessary to bare twice as much of the main wire as would be required for forming the previous joint.

Whenever it is necessary to twist one wire round another always tighten up the turns by the aid of the pliers, taking care, however, not to break the wire.

The foregoing include all the ordinary joints proper which are likely to be required at sea, except, of course, for splicing, which unfortunately defies clear and adequate explanation on paper, and which can only be taught by ocular demonstration; the remainder of this article, therefore, may be fitly devoted to the manner of finishing off ends of wires for "jointing" to apparatus.

The most common "finishing" to wires in an operator's cabin is the lug, of which the two main varieties are those having "eyes"—that is, holes drilled through a flattened end—and those having open ends or large "slots." All types, however, have one tubular end in which the wire is to be affixed with solder. "Eye-lugs" are used for semi-permanent connections such as leads to switchboards, starter, etc., whereas "slot-lugs" are used where wires have frequently to be disconnected—for example, accumulator leads and connectors. Lugs intended for cotton or silk-covered wires are fitted with a removable sleeve, which is slightly longer than the tubular end of lug. The use of these sleeves will be shown later.

To fix a lug on to a wire commence by baring the end for a length slightly longer than the depth of tube of lug. Clean this thoroughly and, if a multiple wire, twist up the strands with pliers. Hold the lug in the vice and place in the tubular end, which should be up, together with a small amount of flux and a little piece cut off one of the solder sticks. Pull back as far as possible the cotton or silk covering, and put sleeve on wire with wide end away from end of wire to be soldered. Then hold the wire in right hand, having dipped its cleaned end in the flux, and heat the lug with flame of blow-lamp until the solder melts. Now, having held the bared wire for a moment or two in the flame, push it slowly and steadily as far as possible down the tube. After a few seconds remove the flame and hold the wire steady until the solder sets, when the lug should be found to be firmly fixed to the wire. If the solder won't "take"—that is, stick to the wire—it is a sign of dirt or insufficient flux. Presuming the joint to be satisfactory, remove the lug from the vice, push back the silk cover of wire and slide the sleeve into its place, which will cover up any small portion of the insulation which may have got scorched in the process.

If lead-covered cable is being used the lead should be removed for about half an inch further than the insulation, because otherwise the metal sheathing might touch the lug, in which case it would become "live" and probably cause a serious short circuit.

Sometimes a lug breaks off the wire, in which case the stump of wire and solder can easily be removed from the tubular end by holding the lug upside down with the pliers and heating it until the solder melts and runs out.

If a lug is not available, but a good joint for a terminal connection is required, all that is necessary is to bend the bared ends of wire, after tightly twisting up the strands, into a loop just large enough to pass over the pillar of the terminal when nut is removed. This loop should be well coated with solder in order that it may retain its shape.

When putting this type or, in fact, any wire on to a terminal put it on in such a manner that the nut, on being screwed up, tends to close the loop and not *vice versa*.

The two ends of aerial down-leads which fit into their appointed terminal holes on the Bradfield will give better contact and wear longer if the strands are twisted up, cleaned, and well soldered.

"Seizing" or "whipping" the ends of aerial wire—that is to say, binding with string or wire to prevent the ends fraying out—is very simple in execution, though, like splicing, defies explanation. However, after watching an A.B. once or twice it is readily picked up.

When connecting wire to lamp sockets, etc., bare about twice as much as is required to pass through the porcelain to screw grip and, having bent this double, twist it up firmly before inserting it in the holder. This gives a better contact, and prevents the screw from cutting through wire if it be too tightly screwed up.

A Distinguished Trio

LINKED BY A SEQUENCE OF ORGANISED SCIENTIFIC WORK

Some attempt to illustrate the Romance of Science from past and present happenings.

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

WAS there ever a more ridiculous piece of crass incomprehension than the legend that Romance and Imagination are alien to science? Yet such an opinion was seriously held by a large number of our immediate forefathers. The humblest scientific student nowadays knows better; but the point cannot be too frequently emphasised, and it is hoped that the following brief account may "point the moral," even if it does not "adorn the tale."

THE GOLD MEDAL RECENTLY AWARDED TO SENATORE MARCONI BY THE FRANKLIN INSTITUTE OF PHILADELPHIA.

In our June issue we announced that the Franklin Institute of Philadelphia had recently awarded their medal to Senatore Marconi. On this side we fear that not a few readers may have asked themselves the question, "What is the Franklin Institute?" and we are certain that quite a number queried "What has the Franklin Institute to do with Radiotelegraphy?" γνῶθε σεαυτόν was inscribed in gold letters over the portico of the oracular temple at Delphi,* and was regarded by the old Greek philosophers as the beginning of wisdom. Assuredly the self knowledge of which the ancient apothegm speaks would require but little stretching nowadays to cover our close blood-relations of the U.S.A. It may therefore be not inapposite under present circumstances to trace the romantic story of this scientific chain in the following brief résumé.

Three great men stand out as the Eponymous Heroes of the tale, triple links

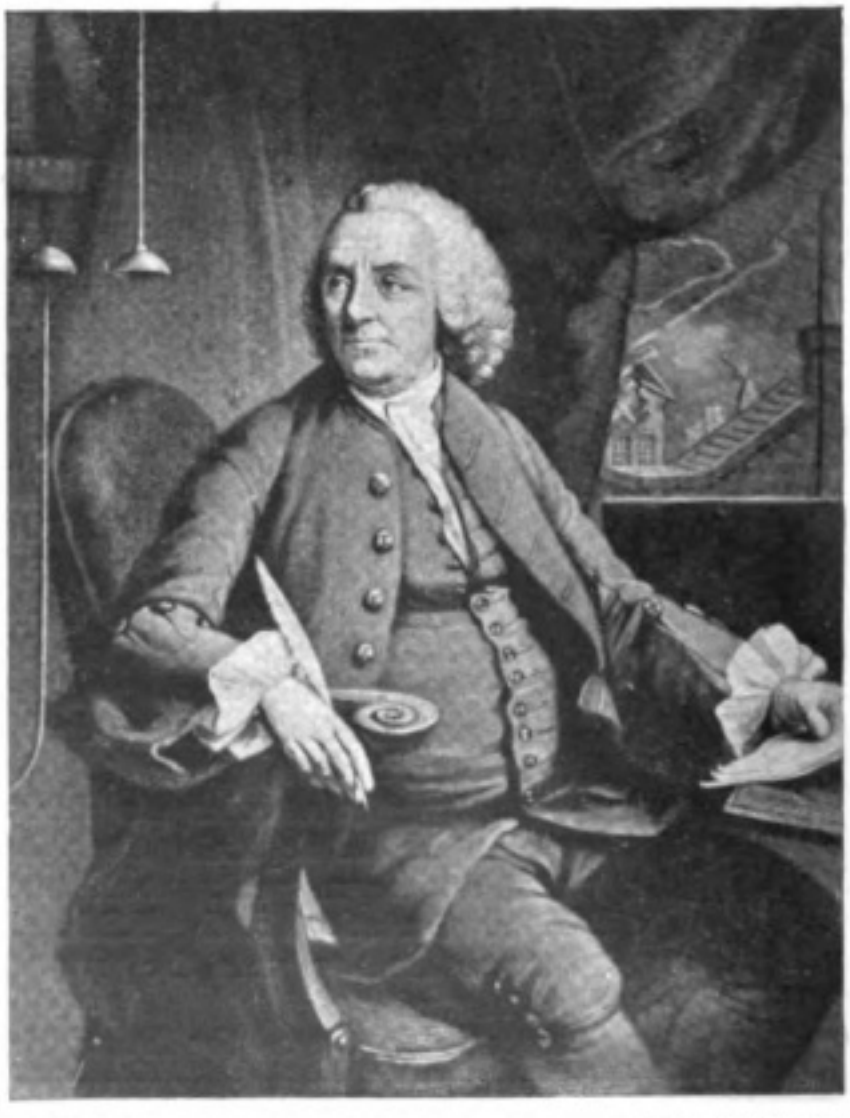
* Or, as Alexander Pope puts it:
"Know then thyself, presume not God to scan;
The proper study of mankind is man."

COUNT RUMFORD (*né* Benjamin Thompson), FOUNDER OF THE ROYAL INSTITUTION.

of the first importance in the sequence of events. These three are Count Rumford, Benjamin Franklin and Guglielmo Marconi. Let us take them in order :—

In 1753, at Woburn, in Massachusetts, there was born—of old Colonial stock—Benjamin Thompson, a man of high ability and catholic interests, with an especial bias towards the physical sciences. Owing to the fact that he chose the side of England, then drifting into conflict against her American Colonies under the guidance of her German Kings, Mr. Thompson was constrained to desert the New World for the Old. For his "loyalty" to the "Ancient Order of Kings" he was awarded the title of Count Rumford by the Elector of Bavaria. He became a Fellow of the Royal Society (London) in 1779, and endowed the two Rumford Medals, which still form notable items amongst the awards of that famous Institution. Not content merely to maintain his connection with the Royal Society, he founded in 1799 the almost equally important scientific organisation known under the title of the Royal Institution. This Institution is devoted to the objects of (*a*) encouraging inventions in mechanics, and (*b*) of furnishing opportunities for the study of applied science. In 1804 he married the widow of Lavoisier, the celebrated French pioneer in chemical research, and died at Paris in 1814.

The Royal Institution Buildings in Albemarle Street, Piccadilly, the home of an organisation which ought to be familiar to every wireless man, constitutes the most enduring memorial possible to the memory of this eminent American. Within its walls Faraday achieved the epoch-making discoveries which lie at the root of many of the manifold applications of electricity that enrich the modern world. The historical apparatus employed by Davy,



BENJAMIN FRANKLIN AS PICTURED BY CARPENTER.

by Faraday, by Odling and by Tyndall find a place within its *enciente*, and for over a hundred years the Society has been applying itself to the noble objects of its foundation, " the promotion, diffusion and extension of science, particularly in the realm of useful knowledge."

Such is the first person in our trilogy, an American of the old Colonial days fired with enthusiasm for practical scientific research. Our second personality resembles him in certain particulars, but differs widely in others.

The youngest son and fifteenth child of a family of seventeen, Benjamin Franklin first saw the light at Boston, Massachusetts, on January 17th, 1706. Much of his early career appears to have furnished material to Mrs. Humphry Ward for her description of the boyhood of *David Grieve*. Franklin's origin was as humble as Thompson's was illustrious, and it took him many years of struggle before, at the age of 40, he was able to commence those fruitful researches in electricity which gave him front rank amongst the most original of natural philosophers. Mr. Carpenter's picture (p. 326) shows his demonstration, by means of a boy's kite, of the identity between lightning and electricity which had—up to his time—been a matter of doubt. Within seven years the Royal Society of London recognised his achievements by a fellowship; but he, unlike Thompson, ranged himself on the side of the American Patriots, and the greater part of his later life was devoted to political objects. Our illustration on page 328 depicts the house in Craven Street, Strand,

THE FRANKLIN INSTITUTE, SEVENTH STREET, PHILADELPHIA.

STATUE OF BENJAMIN FRANKLIN ERECTED AT PHILADELPHIA

a National Memorial to his memory and for the expressed purpose of meeting a demand in America for an organisation similar to the Royal Institution founded by Count Rumford in London 25 years previously. The great American is said to have estimated as the most enduring section of his life work his contributions towards the discovery of physical and natural laws, and more especially the application thereof to the well-being and comfort of mankind.

These are the objects set before itself by the Institution which bears his name, and which recently bestowed its annual medal upon Senatore Marconi, whose achievements in the realm of radiotelegraphy have furthered the cause of humanity to a degree unsurpassed in the annals of science.

Our illustration on page 327 depicts the front of the Institution Buildings, located on the east side of Seventh Street, which formed his residence during his sojourn in Britain's Metropolitan City, his visits to which came to a final termination in the critical year of 1775. Alike as *littérateur*, scientist and patriot, the name of Franklin is venerated throughout the United States, and indeed all over the civilised world, whilst his early connection with the printing craft finds a fitting memorial in the *Saturday Evening Post*, one of the most popular of American weeklies, which owes its foundation to him.

Benjamin Franklin retired from political life in 1785 and spent the remainder of his days in Philadelphia. It was in that famous Quaker city, during the course of 1824, thirty-four years after his death, the Franklin Institute was organised, as

THE HOUSE IN CRAVEN STREET, STRAND, AT WHICH FRANKLIN STAYED WHEN VISITING THE BRITISH METROPOLIS.

Philadelphia (between Market and Chestnut Streets), and which was built from plans furnished by the well-known architect, John Haviland. The corner stone was laid on June 8th, 1825, and the official journal (founded a year later) has proved of invaluable assistance in promoting the development of the Institution, and in perpetuating the distinctive character which it has consistently maintained.

The Gold Medal, of which we furnish an illustration on page 325, is awarded annually from the Franklin Medal Fund, founded on January 1st, 1914, by Samuel Insull, to those workers in physical science or technology, without regard to nationality, whose efforts have done most to advance a knowledge of physical science or its application. Our picture bears witness to its high artistic merit, and it is not unworthy of mention that the intrinsic value of the medallion, awarded to Senatore Marconi, the third person of our trio, amounts to about seventy-five dollars. The great Italian inventor has been too prominently in the public eye during recent years to need any biographical notice here; but it is worthy of remark that, amongst all the many distinctions showered upon him, he values, in no ordinary measure, this award of the Philadelphian Institute.

Although—as we have seen—of but recent foundation, the distinction is both rare and highly prized, numbering amongst its recipients Thomas Alva Edison, the notable American inventor, and Hendrik Antoon Lorentz, the eminent Dutch physicist, whose researches into the nature of light and the ultimate constitution of matter have won for him world-wide renown. Senatore Marconi was in Italy on his country's business when the award was made, and His Excellency Count V. Macchi di Cellere, the Italian Minister at Washington, attended at the Institute on Wednesday, May 15th, and received the medal in the place of his distinguished compatriot from the hands of President Clark, the present Chief of the Franklin Institute. The actual ceremony of presentation was by no means lacking in picturesqueness of detail, and we would refer interested readers to the detailed account published in the *Journal of the Franklin Institute*, No. 1,826, for July, 1918. The President, Mr. Walton Clark, called upon Dr. Harry F. Keller, Member of the Board of Managers, to make the official statement relative to the work of Senatore Marconi and the reasons which prompted the Institute to make the award. Dr. Keller's address was worthy of the occasion, and he made a touching reference to the fact that "the creator of the wireless art has not been spared the experience of unjust and ungenerous attacks upon his claims by envious rivals and competitors." Count Cellere delivered a proper response, the gist of which will be found in THE WIRELESS WORLD for June last. We would only add here a passing reference to the association, touched upon by His Excellency, between the distinguished personalities of Galileo, Volta and Franklin. The reference to the award in the minutes of the Institute runs as follows:—

"In recognition of his brilliant inception and successful development of the "application of magneto-electric waves to the transmission of signals and telegrams "without the use of metallic conductors."

The achievements of the Franklin Society include such important services as the inauguration during 1831 (in concert with the American Philosophical Society) of systematic meteorological observations which have proved of such immense utility to American agriculture. Moreover, without any Federal or State aid the Institution in 1884 held the first great International Electrical Exhibition which produced wide-reaching effects upon the development of that industry, including the initiation of the American Institute of Electrical Engineers.

One of the effects of the present war will undoubtedly consist of a closer union in every field, industrial, scientific, and social, between the British Empire and the great republic overseas. Union implies knowledge and co-working, so that every step towards a fuller realisation of the aims, endeavours, and institutions of the two branches of the Anglo-Saxon race will aid materially the realisation of that fraternal concord which both have so much at heart.

Police Wireless in New York

An Illustration of the Way in which Radiotelegraphy is Used on the Other Side

THE accompanying illustration shows a wireless telephone and telegraph motor truck placed in service by the New York Police Department Signal Corps. This equipment was designed to be kept constantly in commission as an emergency precaution in case of failure of the ordinary means of communication from any cause whatever during the war. The antennæ extend from one high mast on the front of the truck to a shorter mast at the rear of the truck, eight conductors being used for collecting the electric waves for the coherers of the receiving instruments or for transmitting the messages sent from the wireless truck.

NEW YORK POLICE CAR FITTED WITH WIRELESS

A police army several thousand strong may be called into service in the municipality on short notice. Dressed in khaki uniforms and completely armed and equipped, a parade in which the wireless truck was a feature passed in review under federal military authorities from Fort Wadsworth, Staten Island. The parade included, in addition to the battalions of police infantry, a machine-gun detachment, a mounted troop, the wireless and signal corps and a hospital corps.

The wireless motor truck is a most essential part of the signal equipment of every army in Europe and America and it is rendering wonderful service in modern warfare. The establishment of these cars is not only interesting in itself, but constitutes a striking illustration of the way in which wireless telegraphy is permeating every phase of modern life.

Wireless Telegraphy In the War

Aerial Post.

We noticed the other day the following paragraph in one of our daily contemporaries, dated from Amsterdam :—

"According to a statement made by the Director-General of Posts and Tele-"graphs the Dutch postal authorities are negotiating through the Foreign Office "with the British Government concerning the possibility of an aerial post to and "from London."

We do not think that the "dearest friend" of The Wireless World can accuse us of an unsympathetic attitude towards enterprise or innovation. With regard to this very matter, under the heading of "Navigation in the Ocean of Air," we published a short article in our August, 1917, issue, treating with favourable anticipation the idea that the air might furnish us with a means of communication more speedy than any attainable by utilisation of the denser medium of the sea. No doubt the time will come, and that speedily, when express letter mails will be transported, even over long distances, by aircraft of one sort or another. But much will have to be considered and settled ere such a project can be carried into practice, as far as different national entities are concerned, and it is more than doubtful whether such consideration and settlement can be satisfactorily carried through until the present conflict shall have ended. The problems involved would be difficult enough of solution even between countries "pulling in the same boat." It is true that for some considerable time there has been running in America a regular "Airplane Mail Service" between New York, Philadelphia and Washington, but in this case both the point of departure and of arrival are situated in the same country, and the route passes over no territory that is not controlled by the Government which runs the service.* For a belligerent country to allow the establishment of an aerial post between itself and *a neutral*, especially when that neutral is contiguous to, and liable to be bullied by, the arch-enemy of humanity, would be simply "to ask for trouble."

Wireless is so inextricably linked with aircraft (almost indeed as intimately as with navigation at sea) that some of the crucial questions connected with the subject of this development of aerial post centre round the science of ether wave-transmission. Imagine for a moment that an agreement covering an aerial postal service with the Netherlands has been reached, and that Dutch postal aeroplanes are making daily

* It is interesting to note the latest figures published in the Official Bulletin of the U.S.A. wherein the Post Office Department reports that the total possible number of flights during the month of June were 100. Actually uninterrupted, complete flights numbered 88; the flights interrupted from one cause or another were only 8; whilst the total flights defaulted on account of weather amounted to no more than 4. The distances flown ranged between 340 and 450 miles.

journeys. The route to be followed would, of course, be laid down between the two countries. But how are we to feel any certainty that this route would be adhered to? We have no aerial police appointed for the purpose, and our own naval and military machines are none too many for our immediate requirements. Are we prepared to allow neutral pilots, possibly with personal predilections favourable to the enemy, to hover unchecked over our countryside? Moreover, for their own safety, and for the efficiency of the service, these aeroplanes must be fitted with wireless. Are they to have liberty to receive and transmit wireless messages at will, uncontrolled by any British censor, whilst flying over our fields, our cities, and our Fleet? If they are not to be allowed this status of "licensed libertines," how are we to prevent them from assuming it? How about enemy aircraft camouflaged as Dutch?

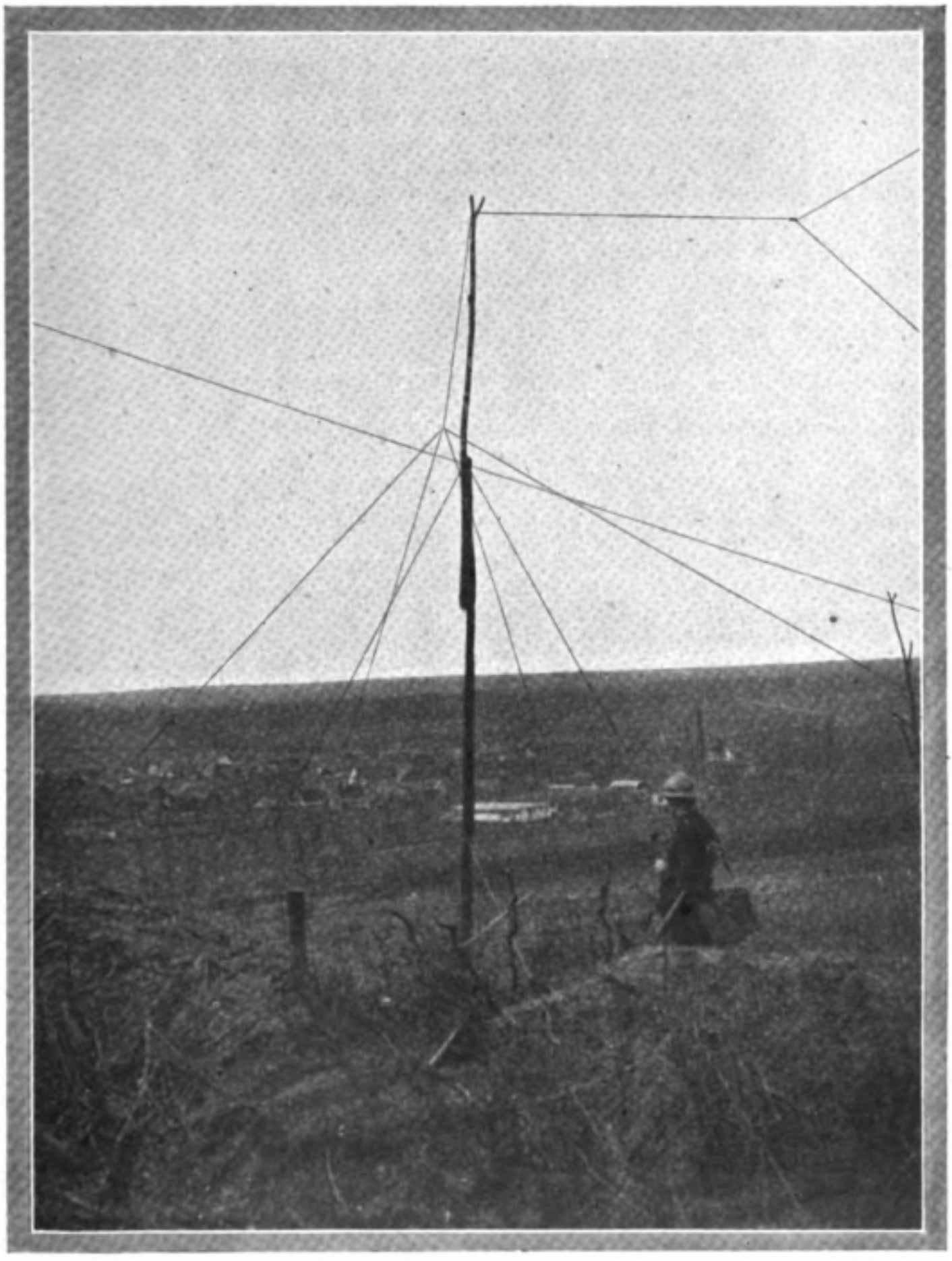
Apart, moreover, from any consideration of the intricate technical, tariff, and other problems with which the proposal bristles, there is the further matter of the iuncture at which the suggestion is being made. Just at the moment when the British people are forcing their Government to take some steps, all too inadequate, to close some of the avenues by which information reaches the enemy, we find such a proposal as this, put forward by a neutral Government which has, in the opinion of some of us, been already allowed to pursue various courses of action none too favourable to British interests. The potentialities of aircraft recently received a striking demonstration when Major-General Davidson, desiring to "take his seat" after election to the House of Commons, left General Headquarters in France in the morning, reached England by aeroplane, motored from his landing place to Westminster, took the oath, sat in the House for a little while, and finally returned to his duty in France again, before the Parliamentary debate he set out to attend had been concluded. This gallant officer belongs to our fighting forces, and is under the control of our military authorities; but had he been of neutral nationality, acting as temporary postman, he could have laughed at any of our Aliens Restriction Acts and set at nought our passport regulations. As the Troelstra incident recently exemplified, there are often delicate matters of diplomacy involved under present circumstances; why magnify their difficulty manifold? Surely in all these matters, as in that of the neutralised alien, we ought to be guided by the motto "give your own Motherland the benefit of the doubt."

AEROPLANES AND WIRELESS.

The ever-increasing closeness of relationship between wireless and aeroplanes is emphasised in the Third Annual Report of the American National Advisory Committee for Aeronautics. This report, which reviews the work of the Committee during the year ending June 30th, 1917, has just been issued. Mention is made therein of the fact that the Committee co-operated in the development of a generator for wireless transmission from aeroplanes intended to satisfy the requirements of the American Army and Navy. The Advisory Committee also instigated investigations into the various methods of receiving wireless signals in aeroplanes on active service, and their report confirms, as a result of the experiments carried on at several receiving stations, the satisfactory results obtained from employing the method of auricular reception.

One of the strong points of wireless in connection with aircraft in war-time is its instantaneity. A recent description contributed to one of our daily contemporaries illustrates this point rather aptly when dealing with a "maiden shoot" with an aeroplane. Mr. Mill Eyron, who contributes the account, makes the comment that the average battery just out from England is exceedingly keen on the prospect of shooting at the Hun, with a friendly eye on the watch, six or seven thousand feet overhead, to report how each round falls and what the target looks like.

After successfully dealing with two targets the observer switches on to a third --a couple of lorries standing in the yard of a farm utilised for a German billet.



Newspaper Illustrations.] [*French Official Photo.*

A FRENCH FIELD WIRELESS IN THE VOSGES.

"The first three rounds went to the right and over. I rattled out the correction, 'asked them to try again, and waited anxiously for the lorries to crawl out of the "yard and back to safety. But nothing happened. The fourth round fell further "away from the target and on our side of it. 'Over-estimated your error,' I "murmured, and sent down a correction which, if followed out to the letter, would "put the next round about forty feet away from the yard where the two lorries "were standing.

"As I touched the key to give the 'Fire!' signal I glanced at the target, and "saw one of the lorries move. That 'Fire' was about the quickest thing I had 'ever done with a wireless key. Almost simultaneously with my signal I caught "the flash of all four guns out of the corner of my eye.

"The second lorry in the back of the yard got it 'in the neck' and disappeared "in a sheet of flame and smoke. The other, blazing like a bonfire, but apparently "only winged, continued moving, then ran into a haystack, which it set on fire, "and the lorry shared its fate. . . . I turned to the key and sent down the equivalent "for a 'bull.'"

A NOBLE MESSAGE.

Radiotelegraphy has to its credit a number of touching messages transmitted through its medium; we have on various occasions referred to some of these in THE WIRELESS WORLD. But few messages transmitted by the ether waves can vie for dignity and altruistic patriotism with one which was recently projected from the wireless stations of the French Government. Readers will remember that patriotic Poles, fired by the promise of freedom for their country, which formed the subject of one of the early proclamations of the late Czar Nicholas, organised fighting forces through compatriots, many of which have performed heroic deeds in the course of the four years of war. After the Treaty of Brest-Litovsk, when the Bolshevik Government betrayed so many of those who had trusted them, a number of officers and men belonging to the Austrian Polish Legion endeavoured to escape from Prussia, in order to fight side by side with the Allies against Germany. These Polish patriots did not succeed and are now being tried by court-martial at Marmaros-Sziger. Polish circles are doing their utmost to save the lives of these splendid fellows; but the Legionaries themselves, fearful lest the cause of their Fatherland may suffer, and the negotiations which have been set on foot, addressed to the Polish Club in Vienna a stirring letter, the text of which has been radiated into the ether from French Government stations. The high-minded tone of these devoted men may be gauged from the following extract:—

WAGON WIRELESS, SOMEWHERE IN THE EAST.

"Our country, enslaved and mar-

" tyred, called upon us to do our duty at the dawn of this world-wide war. It is " with anxiety that we learn now that fear for our fate may weaken the formidable " opposition and the determined attitude of the official Polish representatives in " the Parliaments of the Central Empires. It appears that in order to obtain a " slight alleviation of our yoke the Polish Clubs may be led to limit the opposition " and to make concessions in the sphere of political life in general.

" We appreciate very highly the affection of our compatriots, and we are deeply " touched to see that the country is thinking of us, but we wish to enter an energetic " protest against any commutation of our sentences or any concessions obtained " to the detriment of La Patrie, and by any renunciation of the imprescriptible rights " of the nation."

Truly American.

A certain pungency of flavour frequently characterises the idiom of the young American " knut," and this flavour naturally possesses a good deal of attractiveness for us on this side. We recently noticed in the pages of one of our American contemporaries an account of a wireless operator's submarine adventure which aptly illustrates our point. The breeziness of diction is truly American, and so is the gallantry displayed.

The reporter starts by telling us that "Edwin W. Vogel, the eighteen-year-old boy " who was wireless man on board the *Carolina*, is constructed on the plan of the hour " glass, in that he is wide at the shoulders, lean at the waist, and amply provided " with sand." He was half dressed when his comrade, Harry Werner, brought the warning that a schooner was torpedoed near-by, and he does not shrink from telling us the exact sartorial stage at which he found himself :

" As soon as I got the cups to my ears I caught the schooner's signal over again, " sent Werner to warn the captain and the ship's course was changed right away.

" I had a snack brought up to me, and was sitting eating it and still listening-in, " when a shell plopped across our bows. I squinted out and saw the ' sub ' hauled right alongside. I could hear the passengers bundling up on deck. I yelled to " Werner to go and find out our position from the captain or one of the officers, and " sent our first call out, giving our name and the fact that the Dutchman was shooting. " By the time I had sent it twice, two more shells had gone whistling over us. It " wasn't my business to figure out whether we were to be allowed to leave the vessel " or whether we were to be sunk outright. My job was to send. I kept right on " shooting out the distress message and yelling for somebody to give me the position.

" Presently Werner came in and said that the Dutchman had hailed us by " megaphone and said I must stop sending. I told Werner that I wasn't taking " orders from any skipper but my own and to get me my orders from Captain Barbour. " He disappeared, and after I had sent the signal once or twice over again he came " back with the captain behind him.

" ' You can stop sending, " Sparks," ' said the captain. The cups were still at " my ears and I didn't hear him perfectly, so he shouted it over again, and added, " ' That is an order.' Then I stood up from my chair and stepped away from the " machine, and the captain directed me to leave the house in case a shell might find " its way in on us.

" But even after I had come out on deck a few more shells were sent sailing " over the ship, I imagine, to knock out the aerials if possible. However, they cut " that out by the time the decks were lined with our passengers and crew."

Vogel is a New Yorker and has been a wireless operator two years. His profession has had a fascination for him since he was a child, and when he was a schoolboy he installed an amateur's set on the roof of his home. He studied at the Marconi Institute, graduating two years ago. We have had frequently during the past few years to record the deeds of gallantry executed by our own operators and we welcome the opportunity of recording an instance of the *sang froid* shown by our cousins in times of peril.

Maritime Wireless Telegraphy

A Wireless Bureau for U-Boats.

Towards the latter half of 1916 Lord Northcliffe visited Spain and astounded the British public by his revelations of the success of Hun propaganda in Spain. From the little fortified city of Pampeluna, in the northern section of the Iberian Peninsula, he addressed a series of articles to the *Times*, giving full details of the way in which the Germans utilised their practised skill in "Wireless" (and other) propaganda work to capture public opinion there. The great journalist—for whether we like his methods or not, we must grant him that epithet—produced at the time a considerable effect. But the public memory is ephemeral and the lethargy of Foreign Office officialism is eternal! The ripples of the stirred water died away, and once more, undisturbed by public opinion, Foreign Office officials settled down to enjoy, in the midst of the national crisis, their "superior" ease and devotion to the cult of indifferentism.

* * * * * *

At the beginning of August, 1918, Lord Northcliffe cast a fresh bomb at them. He published in the *Times* an article from his "Special Correspondent" at Santander, one of the principal seaports in Northern Spain. That article set out full details of the visit of the German submarine U56 to Santander at the close of May last, and called public attention to the fact that her captain, Commander Reisser, together with a petty officer and four skilled mechanics, were allowed to remain at large in the city on *parole*. What does *parole* mean to a German? Merely fresh opportunities for committing acts of perfidy. The Teutonic seaman, ex-officer of the Hamburg-American Line, and *ipso facto* familiar with Spanish conditions and officials, hired within a few hundred yards of the submarine a house which possesses the attraction of complete isolation from other buildings. Following on the conclusion of these arrangements, signalling seawards became a matter of frequent occurrence, an "electric projector of great power" was used, and two illicit wireless transmitters were detected continually sending messages in cypher. A crop of murderous outrages of the same type as that of the *Llandovery Castle* immediately developed in the neighbouring seas. The *Times* correspondent further enunciated the deliberate opinion that this German submarine of antiquated type, comparatively useless for active operations, came into Santander and got herself interned on purpose that her skilled commander might, through the tolerance of the Spanish authorities,

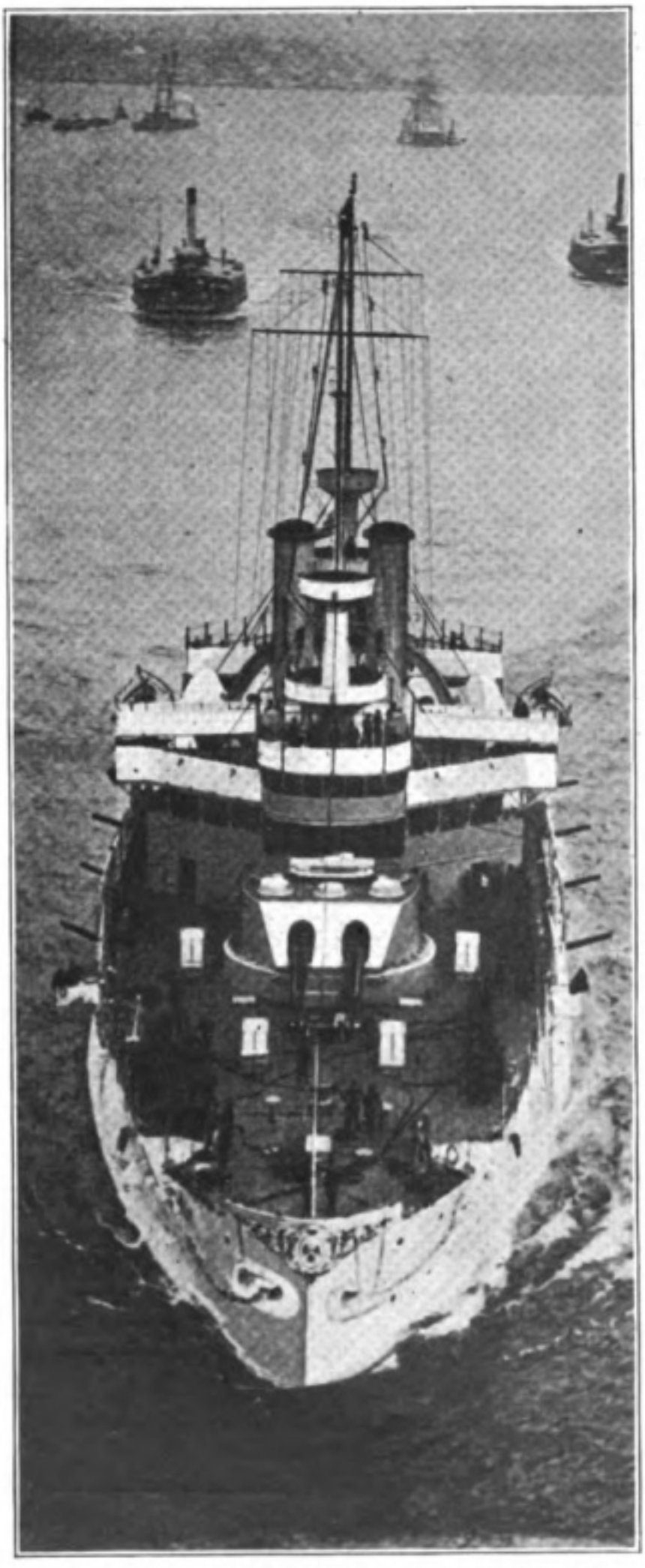
be allowed an opportunity of setting up a wireless bureau of information for the benefit of Hun pirates. The officials of the British Foreign Office were too busily engaged in stifling public opinion and promoting "neutral" interests to trouble about taking diplomatic action on behalf of the nation whom they are supposed to serve, and Lord Northcliffe's correspondent sums up the situation in Spain in the following pregnant phrase :—

"This Santander incident "is only one of many things "which have been, and are "being, bungled or neglected; "millions of British money (to "say nothing of British lives) "involved in our shipping trade "with Santander alone are "allowed to remain in jeopardy, "whilst the German Ambas-"sador takes his family for a "afternoon excursion to see "the submarine, and to con-"gratulate the commander on "the work he is doing for the "Fatherland! It is not the "Spanish Government that is "to blame . . . they quite "naturally follow the line of "least resistance. Hitherto "pressure has all come from "the German side."

There are a number of Spaniards who are perfectly well aware that Spain's interests and development are linked with the cause of the Allies and not with that of the Central Powers. But these people receive no help and little encouragement from British officialdom.

* * * * *

A week after the story from Santander had appeared in the pages of our daily contemporary, together with a



U.S.A. BATTLESHIP IN NEW YORK HARBOUR.

leading article referring thereto, we read the following announcement dated from Madrid :—

" According to a newspaper despatch from Santander, the captain of the " German submarine U56 has left for Madrid to be interned at Alcala de Henares."

Let us hope that the wireless installations and bureau for the information of pirates have also disappeared. But it will be well for those who sometimes rail against what they are pleased to call " Government by Newspapers " to remember this sequence of events when they are contemplating future diatribes on the same lines.

In common fairness we may add that an official announcement has been finally made to the effect that :

" It was owing to the representations made by the British Government that the " captain of the German submarine interned at Santander has been sent to Alcala " in New Castille."

So far so good ; but nowadays, we must remember, the State professes to direct private enterprise, and indeed actually does so in many directions. Certain Departments of State, however, would appear not yet to have broken with the old traditions of being goaded into taking action by the weight of public opinion or by the enterprise of the Press.

RADIOTELEPHONY AT SEA.

A recent report of the British Chamber of Commerce in Spain, quoted by several of our daily contemporaries, narrates details of wireless telephony trials carried out between the steamships *Raimundo Lulio* at Barcelona and the *Rey Jaime* I during the voyage of the latter vessel between Barcelona and Palma, the capital city of the Balearic Isles. Communication was effected a few hours after she had left Barcelona.

The voices of the captain and officer of the *Rey Jaime* I were audible not only on board the *Raimundo Lulio*, but also at land telephone stations in Barcelona. Quite a number of operators at work in wireless stations on Montjuich, Barcelona, as well as those on board the cruiser *Princesa de Asturias*, are said to have been surprised at hearing the human voice breaking in upon their regular Morse Code telegraphy.

These Spanish experiments are interesting, but so far as we can judge from the reports that we have seen, they do not appear to have established anything very novel ; the human voice, transmitted through the medium of ether waves, has obtruded itself upon the attention of wireless operators at considerably longer distances from the transmitting station than those referred to in the report of the British Chamber of Commerce in Spain. It is quite simple for operators manipulating apparatus attuned to the same average wave-length as that employed by the telephony transmitters to receive such ether wave telephonic communications, although absence of specialised apparatus may prevent their responding through the same medium. Conversational wireless of this character might or might not interfere with Morse Code reception ; but anyhow, the latter would make itself heard through the telephonic speech. Dr. Alfred N. Goldsmith, in his recently published volume on radiotelephony (reviewed in THE WIRELESS WORLD for July), deals very lucidly with " selective " problems, devoting specific consideration and exposition to the fairly sharp conflict between the requirement of loud signals and extreme selectivity.

Notes of the Month

Fisheries and Wireless.

A paragraph recently appeared in the *Manchester Guardian* stating that in order "to give their fishermen the best chances of a good catch, the Swedish Government has resolved to fit the fishing boats with a wireless installation at a cheap price." At first, according to our contemporary, it is only intended that receiving apparatus should be supplied, so that fishermen may obtain messages from the Government ship, which mothers the fishing fleet, informing them of the movements of the shoals of their finny prey. Such a vessel has been for some years past engaged in supervising the Swedish fishermen at work off the west coast of Sweden, and it is apparently to vessels engaged in these waters that the above-mentioned measure is intended to apply.

Prior to the war, a start had been made with the fitment of British steam trawlers with wireless, and the experiment had proved a striking success. The mother-boats were able—thanks to their possession of transmitting as well as receiving gear—not merely to supervise the actual fishing, but to keep in touch with their owners on land, and record the result of their operations at sea. Thus, immediately on their return, the packers ashore were ready to handle the catch, and to transport the fish rapidly to market.

With regard to what has happened with the British fishing fleet since the initiation of hostilities, it is impossible to deal; but from time to time the Admiralty allows the circulation of paragraphs dealing with British trawlers, which serve to indicate that the utility of radiotelegraphy to such vessels has been too clearly demonstrated for them to be allowed to lack this valuable means of communication when the days of peace arrive.

U.S.A. War Measures.

In accordance with a recent proclamation issued by President Wilson, the date of July 31st was fixed as that on which the taking over by the U.S.A. Government of the telegraph and telephone cables and wireless system would come into effect. We notice also from the American Official Bulletin No. 357 that Mr. Wilson has delegated to the Governor of the Panama Canal authority to exercise, within the territory and waters of the Canal zone, all the powers mentioned in Section 1, under Title 11, of the Act of Congress approved on June 15th, 1917, and commonly known as the Espionage Act.

Films by Wireless.

Readers will remember that in Volume III. of The Wireless World we published a series of articles from the pen of Mr. Marcus J. Martin on the subject of "Wireless Transmission of Photographs," which have since been issued in book form under the same title. The principle only requires extension to cover the further development of application to film transmission, and it is interesting to note that, speaking at a meeting of the members of the Stoll Picture Theatre Club in London, Mr. Low Warren, one of the pioneers of the cinematograph industry, predicted that ere long this branch of photography would be linked with wireless. Were such a process to be devised, we might see pictorial representations of great events in New York, Johannesburg, Bombay, or Melbourne reproduced on the screen in London the day after they had taken place. Wireless is emphatically *the* wonder-worker of the twentieth century.

A Loss to France.

We notice in the announcements made by the *Journal Télégraphique* a paragraph advising the death of M. Victor Belugon, Chief Engineer of the Telegraphs of France, which recently occurred after a long illness. M. Belugon had represented France at the Radiotelegraphic Conference of London in 1913.

War Calls Off Patent Litigation.

At the request of the Navy Department, litigation in the United States Circuit Court of Appeals in San Francisco, involving the Marconi Wireless Telegraph Company's patents, has been ordered to be suspended for the duration of the war. At the request of Attorney Samuel Knight, representing the Marconi Company, and Hiram Johnson, Jun., appearing for the Kilbourne and Clark Manufacturing Company, which Marconi charges with infringement of patents, the cases were taken from the Calendar. Two days, May 22nd and 23rd, had been set aside by the Circuit Court Judges for hearing arguments in the cases. The Government now is using the Marconi patents.

An Aerogram for Vienna

It is appropriate that the homeland of wireless should have been responsible for a message of truth to the Viennese. The wonderful flight recently carried through by Gabriele D'Annunzio, in one of those aeroplanes the progress of which is so closely linked with wireless telegraphy, constitutes a real triumph for human intrepidity over the obstacles imposed by nature. Seven hundred miles separated the poet and his companions from their goal. The journey involved two crossings of the snowy Alps and a double negotiation of the perilous northern extremity of the stormy Adriatic. Two previous attempts had been given up on account of climatic conditions. In these regions Nature almost seems to have done her best to forbid flying. Nevertheless, animated by the same indomitable spirit which enabled the great scientist to solve the secret mysteries of ether, the poet emerged victorious from a contest with the powers of air. He bore a message the keynote of which is struck in the words :—

GABRIELE D'ANNUNZIO

"People of Vienna, you have the reputa-
"tion of being intelligent, but why have you
"draped yourselves in Prussian uniform?"

And who is Gabriele D'Annunzio? "An embodiment of the spirit of Italy" would be the correct reply. As poet and dramatist, long before the start of the cataclysm of war, he created a new Italian literature, and has affected the language of his country more profoundly than anyone since Dante.* A reckless enthusiast for liberty, he had for a period transferred his home to France. Italy's entry into the war brought him back, aflame with ardour; he has participated in numerous naval dashes on Pola, Austria's greatest naval fortified base, and now, at 54 years of age, he regularly commands a squadron of picked young airmen.

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* His literary abilities, like all other items of his striking personality, have been placed at the disposa of his country. Many of our readers will doubtless recall the two noble prayers, one for citizens and one for soldiers, which he recited at the Scala at Milan, on the occasion of a war-loan campaign, on June 20th, 1916. The magnificence of the imagery and language employed therein ranks these as priceless contributions to the contemporary literature of Italy.

Mechanical Analogies to Inductively Coupled Electric Circuits

By H. M. BROWNING

III.

In the previous articles, experiments with pendulums having equal lengths and bob masses and either lengths or masses unequal have been explained and photographs shown. Also the theory has been given which shows the close analogy between pendulums with equal masses and lengths and circuits having equal periods.

Theory was also given in Article II. (page 256, August, 1918) for pendulums with both masses and lengths unequal, and a curious case was noted when the heavy mass was on the short length. Then, the curve as shown dotted in Fig. 9, Article II., has a minimum at about 5 per cent. coupling—*i.e.*, the number of vibrations in a beat cycle at the beginning would be about 7 and these would increase to 18 at 5 per cent. and then fall off gradually as the coupling increased. It will be shown that experiment upholds this striking prediction of the theory.

This article also describes how tuning is necessary in order to pick up messages sent out by wireless stations.

Experiments with Masses and Lengths both Unequal.

In order to get traces with pendulums of different lengths, we had to make a rising stool to carry one board. This board had to be narrow and placed so that

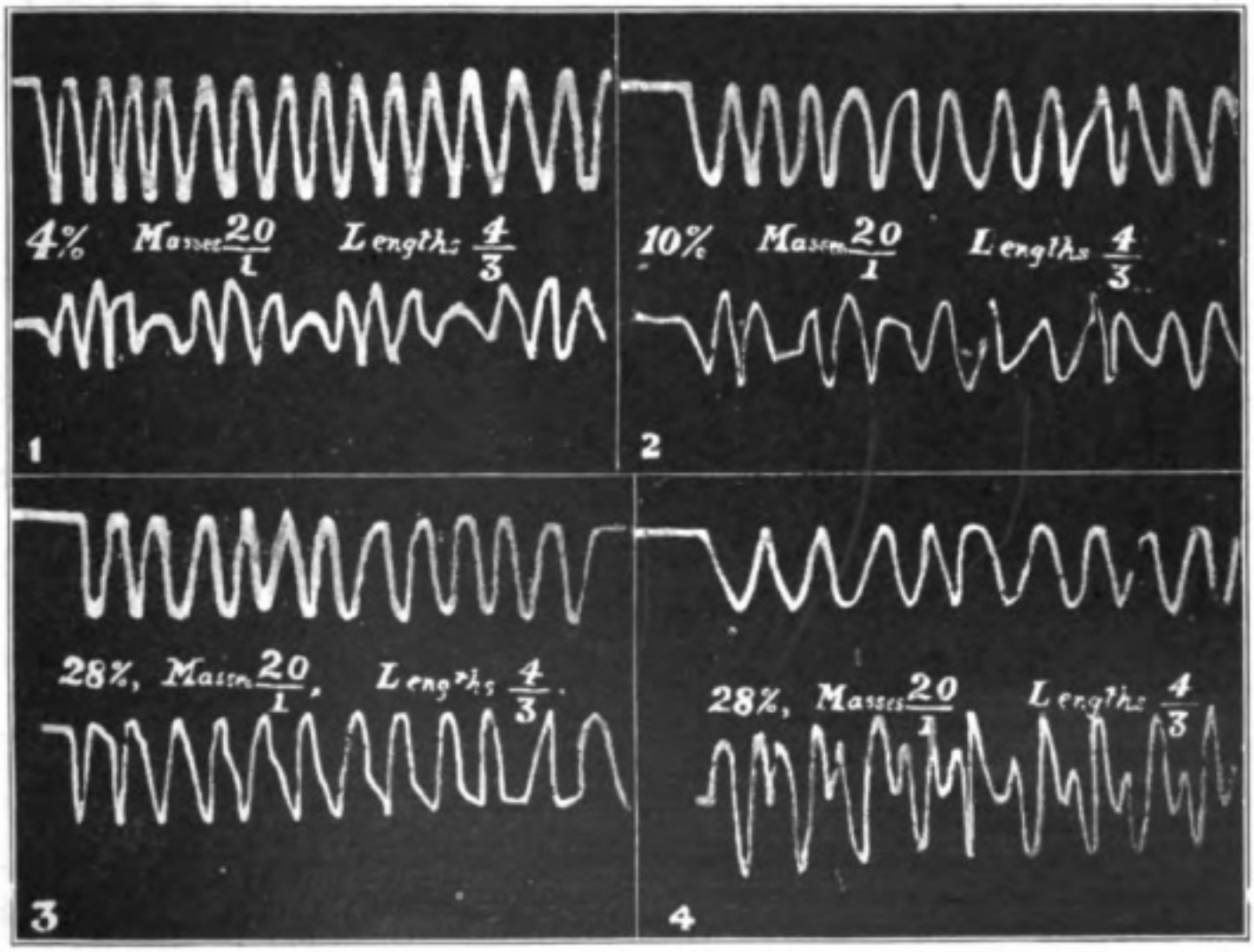

FIG. 13.

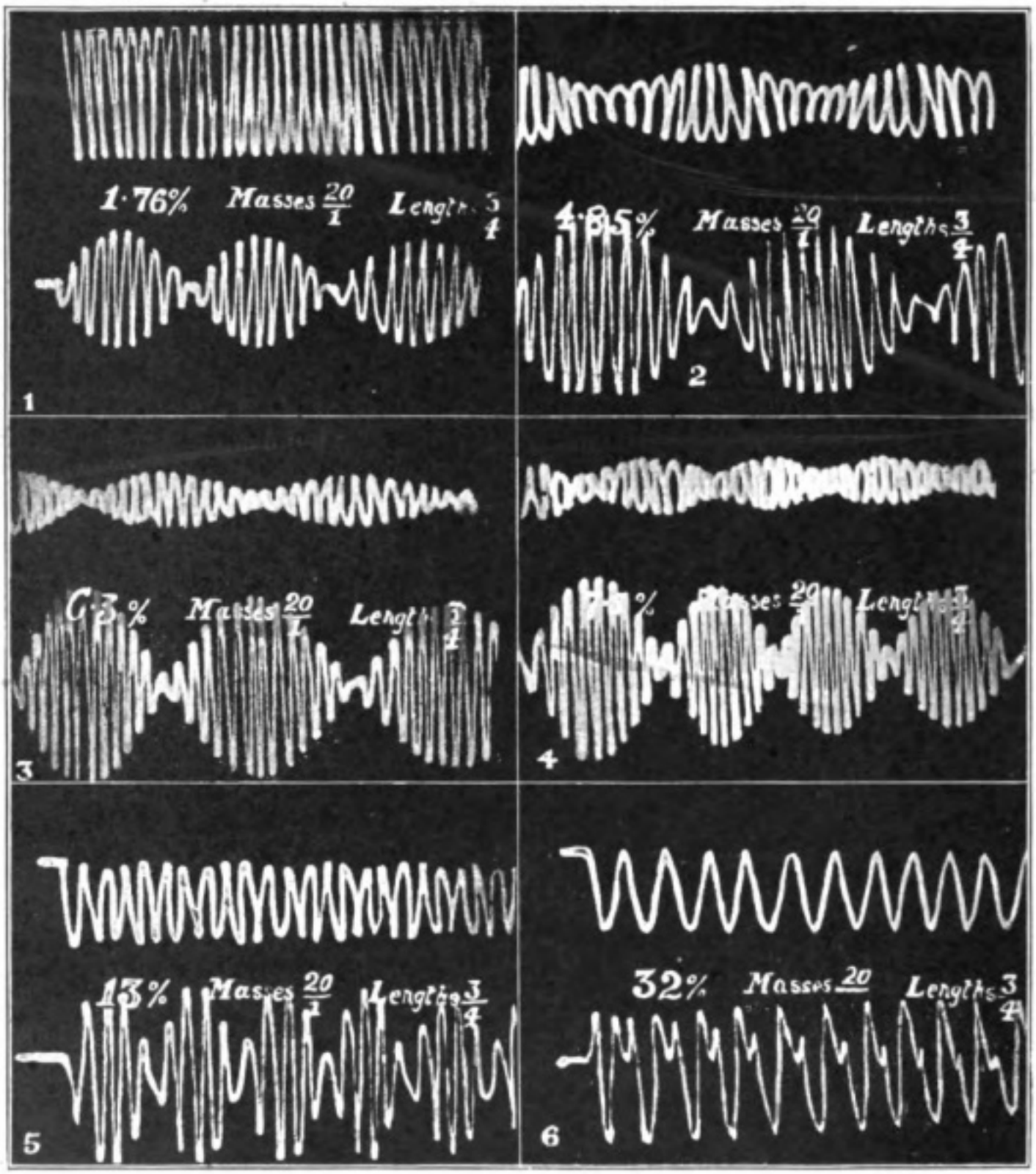

FIG. 14.

the other pendulum did not hit it during its swing. After taking the traces, the stool was carefully removed and the board placed on the lower carriage in the right position and photographed.

In all the experiments the masses of the bobs were as 20 : 1. The lengths of the pendulums were in two cases as 4 : 3 or, to put this in acoustical terms, they were out of tune at the beginning by about a tone and a quarter. In the first case the light bob was on the short length and in the second the heavy bob was on it.

Other photographs were taken with pendulum lengths as 9 : 8 but these have not been reproduced here as they only show an intermediate stage and are of little interest as they only differ slightly from the photographs in Fig. 10, Article II., for traces with pendulum masses 20 : 1 and lengths equal.

Photographs 1–4, Fig. 13, show traces taken with the heavy bob on the long length. It is noticeable that the heavy bob gives little of its energy to the light bob and that the latter's amplitude for loose couplings is not very great and waxes and wanes very quickly. Further, the number of vibrations in a beat cycle rapidly diminishes until at 30 per cent. coupling the ratio of the frequencies is 2 : 1. At this coupling, with lengths equal and the same ratio of masses, the frequency ratio was also 2 : 1 and the curves obtained were almost identical with photograph 4, Fig. 13.

The traces taken with the heavy bob on the short length are obtained when the heavy bob is drawn aside and the light bob either allowed to hang in its more or less displaced position, or held at rest undisplaced. The accompanying table shows the ratio of the frequencies and the amplitudes for couplings up to 30 per cent., as they were obtained theoretically.

Coupling $=\gamma$ Per Cent.	Frequency Ratio $\}p:q$	Ratio of Heavy Bob	Amplitudes Light Bob
0	1·154	α	Indeterminate
1·76	1·106	104·6	−0·809
3·37	1·07	12·9	—
4·85	1·054	2·283	−0·893
6·3	1·065	—	—
7·5	1·09	0·2875	−0·836
12·97	1·243	0·0696	−0·640
31·47	1·952	—	—

It is noticeable that with couplings between 2 and 13 per cent. (see photographs 2–4, Fig. 14), the fluctuations of amplitude of the heavy bob are distinctly marked, especially about 6 per cent. In this case the heavy bob gives up nearly all its energy to the light bob, which then attains an amplitude more than three times that with which the heavy bob was started. For very small or very large couplings there is very little fluctuation of amplitude in the vibration of the heavy bob. This is expected from the table and is shown by experiment in photographs 1, 5 and 6 of Fig. 14.

Considering the question of the ratio (p/q) of the frequencies of the superposed vibrations and the variation of this ratio with coupling, it is seen that when the coupling is zero, the ratio naturally has that value which applies to the pendulums when separate. When the bobs are equal and lengths unequal, or when both lengths and bobs are unequal and the light bob on the short suspension, the value of the ratio (p/q) increases with coupling until it almost merges into the value for the lengths equal (see Fig. 9, Article II.).

On the other hand, when the bobs are unequal as well as the lengths, but the heavy bob is on the short pendulum, a new feature is theoretically predicted (see table). Thus when the coupling is gradually increased from zero, the value of p/q should at first diminish, reach a minimum and then increase. These striking features are to a first approximation upheld by the experiments. For as seen in passing along photographs 1–6, Fig. 14, the number of vibrations in the beat cycle at first increases and then decreases. The maximum number of vibration in the cycle is about 13 and occurs in photograph 3, Fig. 14, for a coupling of 6·3 per cent. As mentioned in the introduction, theory predicted a maximum number of vibrations equal to 18 at about 5 per cent. coupling. This slight discrepancy may be easily accounted for by the presence of the sand in the funnels and the possible error in measuring the lengths of the simple pendulums equivalent to those in use. Photograph 6 shows traces with 32 per cent. coupling, which gives a ratio of p/q almost equal to 2 : 1 or a tone and its octave.

As mentioned in the previous article, this case is analogous to a wireless transmitter with a large self-induction and a small capacity and period and a receiver with small self-induction and large capacity and period. Further, the mechanical case appears to point to the greater efficiency in energy of response of a receiver if bob masses and lengths are unequal and the coupling rightly chosen. For in no other arrangement has the amplitude of vibrations in the receiver reached three times that with which those in the transmitter are started.

A SIMPLE RESONANCE EXPERIMENT.

It is perhaps difficult to understand why a wireless receiver cannot at once pick up any wave which is in the ether; or, on the other hand, how, if the receiver must be in tune with the transmitter, that resonating state can be quickly found. A simple mechanical experiment may be performed to illustrate this. A wire is stretched horizontally between two posts about 5 feet above the ground as illustrated in Fig. 15. Two pendulums are suspended from it, one made by a heavy iron ball on a light cord and the other by a light celluloid or cork bob on a cord with a tightener so that it may be raised or lowered at will. Behind each bob is a horizontal scale, perpendicular to the wire.

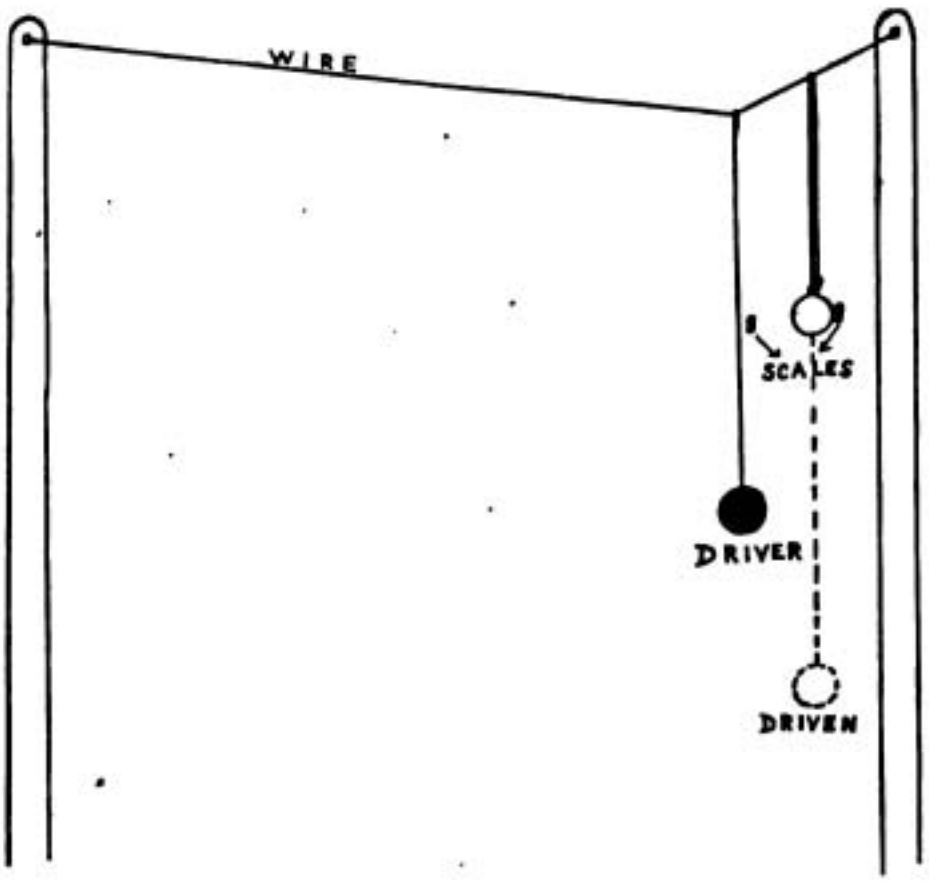

FIG. 15.

The pendulum with the light bob is first made considerably shorter than the one with the heavy bob. The latter is drawn slightly aside and allowed to oscillate in a plane perpendicular to the direction of the wire; this causes the other pendulum to oscillate with, at first, two superposed vibrations. These are to be expected from the theory and experiments explained in the articles on coupled vibrations. The damping, however, is so great that after about six oscillations the quicker vibration has died out and the light pendulum executes simple harmonic vibrations of the longer period only.

When the pendulum with the light bob is swinging with a constant amplitude, its amplitude and also that of the heavy bob are read on the scales, and their ratio is calculated It is noticeable that when the driven is much shorter than the driver the two pendulums are in phase—*i.e.*, they move together in the same direction.

The suspension of the driven pendulum is then lengthened and another set of observations taken. It is found that the ratio of the amplitudes increases, until when the two pendulums are about the same length, the ratio is a maximum, and the phase difference between the vibrations is 90°. When the driven pendulum is further increased in length the ratio of amplitudes again decreases and the phase difference alters until the bobs are moving in opposite directions.

Three types of light bob may be used, a cork ball and large or small celluloid balls, and from tables of ratios of amplitudes, curves may be plotted. The form

of curve obtained would be similar to those shown in Fig. 16. Here, however, the light bob was always kept the same length and the heavy bob altered. The curves show how the bob with greatest damping (small celluloid) has a wide range of resonance but not very great strength. The bob with slight damping has a strong sharp resonance, which, however, quickly diminishes on either side of the maximum.

Thus our two doubts are answered. The receiver can only pick up waves which are near its own frequency, as shown by the cork bob, and can only respond well if the periods are identical. But if the receiver is highly damped it can show some response for a wide range, and so it is easy to get on the borderline of response and then tune to maximum energy.

The experiments described in these articles were done in conjunction with Professor E. H. Barton, D.Sc., F.R.S., of University College, Nottingham,* whose assistance in compiling these papers has been invaluable.

Nottingham, July 6th, 1918.

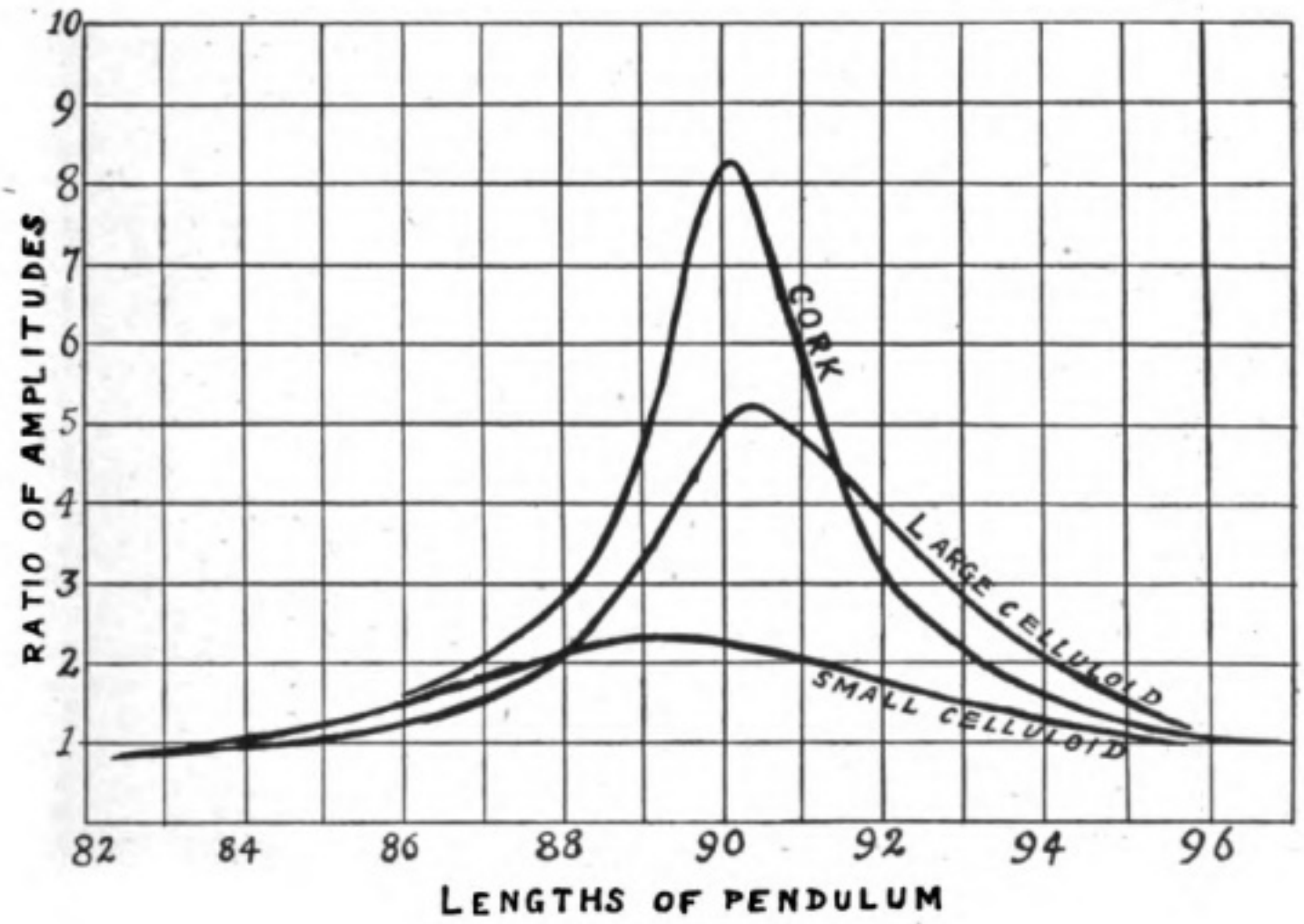

FIG. 16.

Canadian Wireless Extension.

THE trustees of the late Lord Rhondda are contemplating linking-up Peace River, Fort Vermilion and Fort Smith on the Lower Athabasca River, Edmonton, Alberta, by a series of wireless stations at these places. The Dominion Government will be asked for its sanction, and to contribute £9,000 towards the scheme.—*The Contract Journal.*

* For further details see *Phil. Mag.*, October, 1917, January, February and July, 1918.

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 Operators Cunliffe and King, who died from natural causes, and of Operator Crosby, prisoner of war in the hands of the enemy, 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 if these young men, who so nobly upheld the " wireless tradition," the deepest sympathy on their sad bereavement.**

MR. GEORGE ERNEST HAWKES, formerly employed as a clerk by Messrs. Beaufoy & Co., South Lambeth, and later by the Direct Spanish Telegraph Company, was born at Leyton on January 17th, 1897. He was educated at Buckhurst Hill Board School, and Salway College, Leytonstone, and trained at the British School of Telegraphy, Ltd., London, where he qualified for the P.M.G. Certificate, being appointed to the operating staff of the Marconi Company on February 15th, 1914.

Born at London on September 7th, 1899, MR. EDGAR ALLAN DAVIES was educated at "Acland" Central School, Fortress Road, Kentish Town. His experience as junior mechanic at the G.P.O. Factory, Holloway, and later as a messenger in Marconi House, was to his advantage. Trained at Marconi House School, he received the P.M.G. Certificate, and was given an operating appointment by the Marconi Company on August 13th, 1916.

MR. ARTHUR HAROLD TURNER was born at Timperley, Cheshire, on October 30th, 1899, and went to Wadham House School, Hale, Cheshire, and later to Bowden College for his education. Commencing his career with Messrs. Christopher Schorrock & Co., Ltd., Cotton Manufacturers and Merchants, of Darwen, he subsequently underwent a course of training at the City School of Wireless Telegraphy, Ltd., Manchester, and obtained the P.M.G. Certificate. Mr. Turner's service with the Marconi Company commenced in March this year.

A Cambridge man, MR. DONALD RALPH KIRKMAN, eighteen years of age, was a pupil at the Cambridge and County School, and after leaving school was employed by Messrs. Favell, Ellis and Kirkman, Sanitary Engineers, as clerk and typist. His training in wireless telegraphy was given at Marconi House School, where he gained the P.M.G. Certificate, after which he was placed on the operating staff at the end of January in the present year.

MR. EDMUND CUNLIFFE first saw the light at Lees, near Oldham, on August 26th, 1900, and received his education at Derker Council School, Oldham, and the Butts C.E. School, Leigh. He also attended class at the Manchester Evening School of Commerce. The first situation held by him was in the offices of Messrs. Mather and Platt, Ltd., Engineers, Newton Heath, which he relinquished to undergo training at the City School of Wireless Telegraphy, Ltd., Manchester. After he became possessed of the P.M.G. Certificate he proceeded to sea in the Marconi Company's service last March.

Previously employed in the drawing office of the British Thomson Houston Company, Willesden, MR. HORACE ROBERT KINGSCOTE KING was born at Peckham on October 26th, 1899, and educated at Watford Higher Elementary School. He

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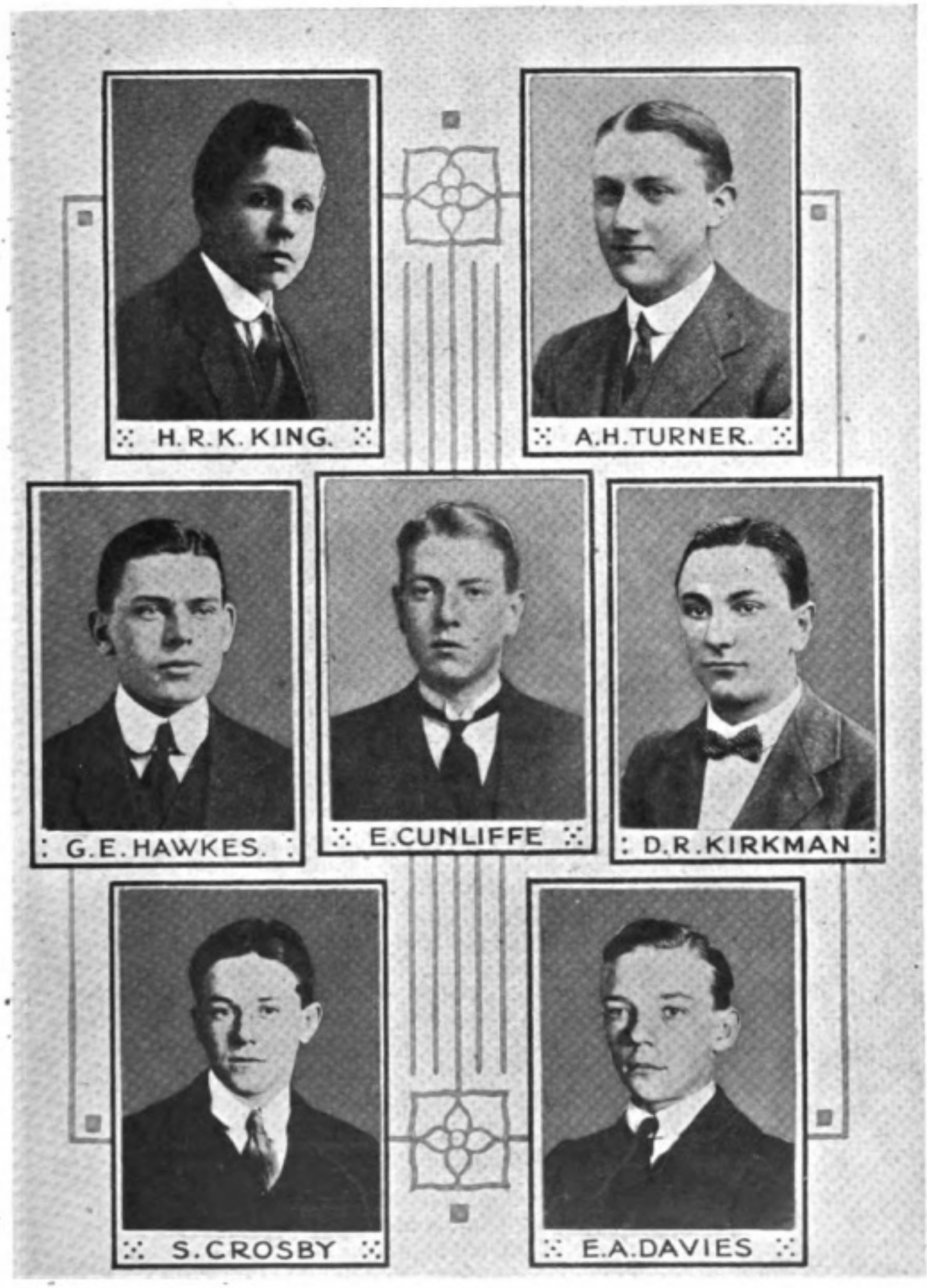
* *A Correction.*—Owing to the initial letter of the Christian name in each case being identical, and the fact that the ship on which each had served was torpedoed, we regret that John Fleming Drummond was, in our August issue, erroneously reported lost. James, his brother, was the one whose life was sacrificed, notice of whom will appear in the next issue.

ROLL OF HONOUR.



was admitted to Marconi House School, where he took the course of training in wireless telegraphy, and was granted the P.M.G. Certificate by examination. Mr. King was placed on the sea-going staff on September 30th, 1917.

We regret to hear that MR. SYDNEY CROSBY has been captured by the enemy, and is now a prisoner in Germany. Mr. Crosby is a Warrington man, and has been in the service of the Marconi Company since June 23rd, 1913. It is possible that he may be interned in the same camp as other of the Marconi Company's operators are detained, and, if so, he will be amongst friends though surrounded by enemies.

The R.N.V.R. Wireless and Signals Club

An Interesting New Venture and Its Journalistic Adjunct.

DOVER is the centre of many activities which it would for the present be indiscreet to attempt to describe. But it is also the scene of an organisation which may become the pioneer of an important movement. Everyone knows the vast developments which have taken place in the organisation of wireless since the start of the war; but not everyone realises the numerical magnitude of the staff engaged in working it. The growth of the Dover patrol caused many of the young men located there to realise the inadequacy of social relaxation and recreation available to them. The result has been the organisation of an R.N.V.R. Wireless and Signals Club, located at 33, Liverpool Street, Dover, the inaugural ceremony of which was conducted by Vice-Admiral Sir Roger Keyes on Tuesday, July 16th last. The club premises contain a large and well-furnished recreation room, billiard room, library, etc. Although a large part of the credit of organisation belongs to the Wireless Section, membership is not confined thereto, all men of the Dover Patrol being eligible.

A quite remarkable amount of energy and enthusiasm has been thrown into the new movement, and one might have thought that the achievement of establishing such a club would have sufficed; but, no! they must run a magazine also. In its present stage, the latter (which appears monthly) is worked off on the Roneo and has only a circulation of 200; but it is hoped that by Christmas, 1918, it may be possible to collect a number of the best drawings and articles in the magazine and make them up into a printed Christmas souvenir number of everlasting interest to R.N.V.R. men. The Editor, who has favoured us with specimen copies, would like prospective contributors or subscribers to communicate with him at the above address. Poetry seems a strong point of the new venture, and the August number contains a happy travesty on the well-known song of "The Rosary," the opening verses of which run:

"The hours I spent tuning your spark
Are as a thousand years to me;
With so much lag or so much lead,
My Rotary—my Rotary.

The product of Marconi's brain
Oh wonderful thou art to see.
I love to list to thy refrain,
My Rotary—my Rotary.

Thy note had cadence, sweet and high
In giving G, or merely D,
And if required, an I.M.I.,
My Rotary—my Rotary."

Instructional Article

NEW SERIES (No. 6).

EDITORIAL NOTE.—Below we give the sixth 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.*

ENERGY.

As he reads about wireless telegraphy the student will constantly come upon references to energy—the energy of a charged condenser, the energy in the aerial, and so on. What *is* this intangible thing called energy which is so carefully considered by the engineer? From the standpoint of physics it is probably the most important quantity in the world—namely, **the ability to do work.** In an earlier article it was stated that for the physicist there are but two real *things*, matter and energy, because these only are conserved. By this is meant, of course, that we *know* of only two such entities. The law of conservation as explained in the case of matter applies equally to energy, which cannot be created or destroyed, its sum total remaining constant, although its nature suffers change according to the conditions obtaining in any particular system. It is, perhaps, difficult to dissociate from one's mind the idea that if anything has physical existence it must be *material*, but such an idea springs from too narrow an interpretation of the word physical. An attempt should be made to regard energy simply as a constant natural agent, changeable but indestructible, which is perceptible by its effects and which, in most cases, is measurable as work or capacity for work. There is no *direct* proof of its existence for the simple reason that our senses permit us to be *directly* aware of matter only.

In any case of the transformation of energy from one form to another, or, what is the same thing, any case of work, we lose some energy in the process. For example, in the case of a motor car some of the chemical energy of the explosion is changed into the mechanical energy which moves the car; nevertheless a certain amount of the energy of the explosion is changed into heat which often may be instrumental in *stopping* the car. *Energy lost is not destroyed but has been converted into forms in which, generally, it is no longer available for useful work.* It still plays its part in the economy of nature but is not at our immediate disposal.

We defined energy as the ability to do work, and, as it is measured in units of work, energy and work may be considered as practically interchangeable terms, so that "work done" may be read as "energy transformed."

Potential Energy.—This is the name given to energy which is due to *position*. The commonest example of this is that possessed by a body which has been raised to a height. The elevation of the body is the result of work being done on it—by a man's muscles, for instance; as a result of this the body has **potential energy**—that is, it is capable of giving back the work done on itself. It can be caused to actuate a clock or to draw up a bucket of water, or, if allowed simply to fall back to earth it will do work on the air and on that part of the earth which it strikes. A stretched elastic body is a good example of the storage of potential energy.

When a boy fires a catapult the work he does on the elastic when he stretches it is in turn done by the elastic on the bullet. In the case of an elevated body—

$$\text{Potential energy} = mgh,$$

m being its mass, h the height to which it is raised, and g the acceleration. When the body falls mgh absolute units of work will be done.

The energy in a charged condenser is measured in terms of the *work done by raising the potential difference between the plates*, the formula being $\mathbf{E = \frac{1}{2}QV}$ **ergs,** where Q is the charge expressed in electrostatic units and V the potential in e.s. units. It should be noted in comparison that the *capacity* of a condenser is quite a different quantity—namely, the ratio of the amount of electricity stored in it to the potential at which it is stored; or $C = \frac{Q}{V}$. The capacity of a given condenser is constant but the energy in it is directly proportional to the square of the charge and inversely proportional to the capacity.

A charged condenser, then, possesses electrostatic (or potential) energy by virtue of the work done in charging it, and in order that the system can give back work the charge *must move*; when it does so the electrostatic energy is transformed into electrokinetic energy.

Kinetic Energy.—This is the energy due to motion. A rifle bullet in flight, for example, has kinetic energy, its work being done on the air and on whatever it strikes. If a force F displaces from a position of rest a mass m through a distance d, the work done by F is Fd. (See section on Work.) If this work is not done against any external resistance, we can say that it is stored in m as kinetic energy. $\mathbf{F = ma}$, hence the kinetic energy of the mass after displacement is mad, which can be shown to be equal to $\frac{\mathbf{mv^2}}{\mathbf{2}}$, the kinetic energy of a body in absolute units.

The C.G.S. unit of energy is the erg. (See Work.)

The **dimensional unit** of energy is the same as that of Work, being as shown above, Force × Displacement or $[\mathbf{ML^2T^{-2}}]$.

It is particularly relevant to the study of wireless telegraphy to note that potential energy is convertible into kinetic energy, and *vice versa*. When a body falls from a height its potential energy (which it possesses by reason of its elevation) is changed into kinetic energy which increases proportionately to the decrease of the potential energy. When the body strikes the earth the kinetic energy is transferred to its component particles and to those of the immediate region where it strikes, because its impact causes an increase in the velocity of these particles; in other words, the energy is transformed into heat. In the reverse case of a body being thrown to a height its energy changes from the kinetic to the potential form, the former decreasing as the velocity decreases, and the latter increasing as the kinetic energy decreases.

The oscillatory discharge of a condenser should be familiar as an example of rapid cyclical changes of electrical energy from one form to another. While the condenser is charged its energy is electrostatic but immediately its positive and negative terminals are connected through an inductive circuit of low resistance this energy commences to change into the kinetic energy of the moving charge. By virtue of the inductance of the circuit oscillations are set up so that the condenser is quickly discharged and then recharged with the original positive plate now negative, and at this point the energy has again assumed the static form. This alternating process continues until all the energy has been used up, some in the form of heat and the rest as radiated electromagnetic waves.

RESISTANCE.

It has been pointed out that although energy is capacity for doing work in no case are we able to utilise the whole energy of a body or system. This is because of the resistance against which the work is done. Resistance in its various forms

dissipates energy and if on this account it is an evil it is at the same time, generally speaking, a most necessary evil and must not be regarded as the enemy of man even though his existence under present conditions depends upon available energy. Were it not for the resistance of the air a falling raindrop could kill a man as surely as a bullet; without resistance the electric filament lamp and electric heating would not be present possibilities and brakes on wheels would be useless.

The relation of energy to resistance can be summed up by saying that **where there is no resistance there can be no work done,** which makes it clear that although resistance appears to waste energy it is only by virtue of it that energy can be utilised. Just as friction is really a friend in disguise—without it we could not even walk—so resistance in an electrical circuit is essential to the employment of the current. In the case of a steady E.M.F. applied to an inductive circuit, if the resistance of the circuit were zero, the current would grow infinitely slowly, whereas by an increase of the resistance it would be enabled to reach its final value much quicker, although with any increase of resistance the final value of the current is lowered. In the **induction coil** there is an example of a circuit which is required to be rapidly responsive to "make and break" of current, and, as the inductance is large, we have to make the *resistance as great as possible* in order that the current may reach its final value in a minimum of time; the resistance is, however, limited in actual practice to some value which will enable us to obtain the necessary current for working. $\left(\mathbf{C} = \frac{\mathbf{E}}{\mathbf{R}}\right)$

INERTIA.

This has already been defined as that property of matter which opposes change of movement, and which, once movement has begun, opposes its acceleration (positive *or negative*) and cessation. For more advanced studies, especially in connection with the electron theory, clear ideas about inertia will be found particularly helpful. A sharp distinction exists between resistance and inertia although in certain of their effects they may appear to be alike. Resistance *wastes* energy whereas inertia *stores* energy, and, which is equally important, delivers it up again, not in an irrelevant and harmful form such as heat, but in the same form and to the same body or system. By the loose employment of the word in everyday speech there has become largely current the idea that inertia is akin to laziness and that it only opposes a change from rest to motion. On the contrary, inertia is a tendency towards *uniformity of motion*. When a train begins to move the propelling force has to overcome the inertia of the *mass* of the train, which is opposing the start. When it is necessary for the train to stop and the steam is shut off, it continues to move for a considerable time, because **energy is being delivered back** to it by reason of its inertia. When, as is generally the case, there is enough of this stored energy available to carry the train past the platform some method has to be used in order to divert some of it into another system; this is accomplished by the application of the brakes, and the surplus energy is literally thrown away in the form of the heat of friction—another example of the fact that resistance, although a waster of energy, is extremely useful on some occasions.

The statement that a body has inertia may be understood to mean that before the body can move it must be endowed with energy and before it can stop moving that energy must be taken from it.

In considering the phenomenon of self-induction we can push our ideas of inertia a step further. Self-induction is often defined as electrical inertia and in the light of what has been written above this definition would seem to imply that electricity is considered to be a form of matter, inasmuch as if it exhibits the property of inertia it must possess mass. To a certain extent this conclusion is correct though it is perhaps better to say that scientists regard *all* mass as electrical. The student should bear in mind that our sole avenues of direct approach to the study of nature

are the five senses and he must not adopt, even for the rigorous demands of exact science, the point of view that only those things exist which are discoverable to his senses ; physics often calls for *a posteriori* reasoning. When we see like effects it is safe to assume like causes. We do not ascribe the fall of a meteorite to a certain cause and that of an autumn leaf to another, nor do we imagine that iron and lead sink in water for entirely different reasons. Similarly, if the properties of two bodies are identical in number and nature, we conclude that both are composed of the same material.

Inertia is one of the properties of mass which are common to matter in all its forms, whether solid, liquid, or gaseous, whether we consider a single atom or the Pyramids ; in fact, inertia is so fundamental that no form of matter, as we understand matter, can be thought of as existing without it. If, then, we observe in some system *effects* similar to those of inertia, but no sensible movement of matter, we may at least infer that there exists in that system something the *inertia* of which produces the observed effects. When an electric current flows through an inductive circuit, we find opposition to the *starting and stopping* of the current, opposition to an *increase or decrease* of current, the *storage and subsequent release of energy*, and a time effect which certainly cannot be accounted for by the joulean resistance alone. The conclusion is that there is associated with the circuit when an E.M.F. is applied to it something *moving*, which has inertia and therefore mass, but which is not material in the ordinary sense of the word, but *ultra-atomic*. We have arrived at that point where we are confronted with the idea of mass without matter.

The student knows that all round a moving charge of electricity (*i.e.*, a current) there is a field of energy, and he also knows that when the charge ceases to move the field of energy disappears. Putting this into the words we used above we can say that before a charge can move it must be endowed with energy and before it can stop that energy must be taken from it. This, as explained above, is what is meant by the possession of inertia.

This subtle entity which has mass and inertia but which is not matter is called an *electron*. Here we must leave the subject, having purposely introduced ideas a little in advance of the general nature of these articles in order to demonstrate the value of elementary physics as an aid to the study of electrical theory and to suggest to the reader a new angle from which to view the phenomena of electromagnetism.

STRESS, STRAIN, ELASTICITY.

STRESS.

This is a quantity referred to chiefly in mechanical work but to which there is an analogy in electricity. We can clear the ground by giving it the more familiar name of force. In mechanics, then, there are recognised, amongst others, forces or stresses which tend to elongate, to compress, to bend, or to twist the material to which they are applied. A stress which tends to elongate, such as a longitudinal pull on a rope or an aerial wire, is called a **tensile stress.** When materials are tested in order to find out how much *pull* they will stand before breaking it is their **tensile strength** which is measured. The other three forms of stress mentioned do not seem to need further explanation.

Note that an electrically charged body exerts **electric force** in the space surrounding it, and that in the region of a magnetic pole there is a field of **magnetic force.**

Units.—Stress is measured by such units as **one pound per square inch** or (C.G.S.) **one dyne per sq. cm.,** or generally, by the **force per unit area ;** hence the **dimensional unit of stress** is

$$\frac{\text{Force}}{\text{Area}}=\left[\frac{MLT^{-2}}{L^2}\right]=\left[\frac{MT^{-2}}{L}\right]=[\mathbf{ML^{-1}T^{-2}}].$$

STRAIN.

Strain is produced by stress. When a body is subjected to a mechanical stress and undergoes an alteration of size or shape the alteration per unit dimension is a measure of the strain in it. To take a simple case, suppose a piece of rope is stretched; its length is increased and the strain in the rope is *the ratio of the alteration in length to the original length.* The strain in this case is longitudinal, as it would also be in the case of a body acted upon by a force which caused it to become *shorter.* If a body is subjected to an uniform stress over its entire surface the resulting strain is volumetric.

$$\text{Volumetric strain} = \frac{\text{Change in volume}}{\text{Original volume}}.$$

Up to a certain limit strains are proportional to the stresses which produce them (Hooke's Law), the stage at which the law breaks down being followed in the case of ductile materials by one at which a small increase of stress produces a large increase in the strain.

Strain has **no dimensions.**

ELASTICITY.

If a rod of steel and a piece of rubber of equal dimensions are stretched so that each becomes a millimetre longer the stretching force exerted on the steel will have to be much greater than that exerted on the rubber. Now, the elasticity of a material is measured by the ratio of the stress which has to be applied to it in order to produce a certain strain to the strain produced.

$$\text{Elasticity} = \frac{\text{Stress}}{\text{Strain}}.$$

Strain is the alteration per unit dimension and in the case we took is represented by a change in length of 1 mm., so that if for the sake of clearness we assume that the force applied to the steel rod is 400 times greater than that applied to the rubber, we have

Rubber.	Steel.
$\frac{\text{Stress}}{\text{Strain}} = \frac{1}{1} = 1.$	$\frac{\text{Stress}}{\text{Strain}} = \frac{400}{1} = 400.$

It should be apparent from this result that steel is far more elastic than rubber. Calling elasticity e, stress S and strain s, if $e = \frac{S}{s}$ then the strain is proportional to the stress, and inversely proportional to the elasticity; hence to produce a certain strain the greater the elasticity of the material the greater is the force required.

In the case of a longitudinal alteration—*i.e.*, increase *or decrease* of length—the ratio of stress to strain is known as **Young's modulus,** being a constant for a given material. The following is a complete explanation of how it is calculated.

$$\frac{\textit{Stress}}{\textit{Strain}} = \frac{\textit{Force applied} \div \textit{Area of cross section}}{\textit{Alteration in length} \div \textit{Original length}} = \frac{\textit{Force} \times \textit{Original length}}{\textit{Area} \times \textit{Alteration in length}}.$$

Young's modulus is expressed in convenient units of stress per unit area and a few interesting examples are here given.

Indiarubber,	Young's modulus	=	32	tons per	square inch
Steel (mild)	,, ,,	=	13,500	,,	,,
Phosphor-bronze	,, ,,	=	6,000	,,	,,
Copper	,, ,,	=	6,200	,,	,,
Glass	,, ,,	=	4,000	,,	,,
Brass	,, ,,	=	5,700	,,	,,
Wood	,, ,,	=	700	,,	,,

The outstanding property of an elastic body is that any deformation it suffers under stress disappears when the stress is removed provided that the latter has not increased beyond a certain limit. If this **elastic limit** is passed the body may break or will not perfectly re-assume its original shape or size. It will be seen that as a rule the more elastic materials such as steel or phosphor-bronze have much lower elastic limits than the less elastic substances like rubber or wood.

In considering stress and strain in electrical actions, we are led first to the subject of electrostatics which is outside our present scope. We will, however, deal briefly with a few points of interest to that class of student for which these articles are specially written.

From the statement that a charged body exerts electric force in the space around it, it follows that *the seat of the strain* produced by that force or stress *is the medium across which inductive action takes place.* Hence, if a charged conductor were caused to induce another charge in a second conductor we should expect some form of strain to exist in the space between the two wires. A *moving* charge does *not* exert electric force but gives rise to a field of *magnetic flux*, the direction of which is at right angles to that of the motion of the charge. Therefore, if the static charge in the first conductor should move we ought to find that *the dielectric strain disappears as the electric force is removed*, **because of the elasticity of the dielectric.** By the time the potential energy of the static charge has become wholly transformed into the kinetic energy of the moving charge *all* the strain in the dielectric should have disappeared. Also, if the electric force should be such that it strains the dielectric beyond its elastic limit that dielectric should demonstrate the fact in some way or other. At this point it is necessary to have recourse to diagrams and special conceptions.

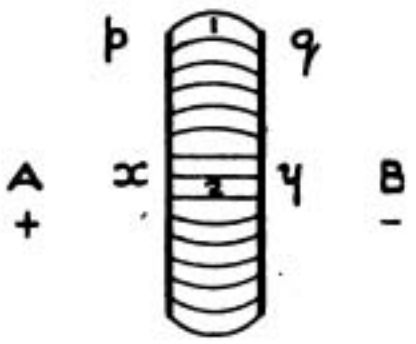


FIG. 27.

It is customary to represent the field of a charged body or the field between two charged bodies by a number of lines, some of them straight and perhaps some curved, as in Fig. 27, in which the plates *A* and *B* are oppositely charged.* Now it is really important to realise that these lines exist only on paper—that is, they are not physical things, a phrase which the reader ought to appreciate fully after what has been written previously about conservation. In view of certain facts scientists may have admitted that the question of the objective existence of such lines admits of discussion, but the acquisition of a working set of ideas about electric and magnetic fields would be rendered more difficult if we were to attempt to follow the discussion. The lines are not filaments in the æther but just imaginary lines made visible for the purpose of assisting the mind to grasp the theory of the part played by a dielectric in the storage or transference of energy. It would be quite legitimate to represent the force of gravity acting on a suspended weight by lines drawn from the weight to the earth, but the lines would only represent the direction in which the force acts and not any peculiar state of the air or other medium.

In most diagrams in any book the number of lines shown bears no special relation to the number which would be considered to exist theoretically, unless the contrary is stated ; further, it must be understood that in diagrams such as Fig. 27 only one *plane* is shown, whereas the actual field cannot be limited in practice to a single plane.

Let us fix our attention upon the line *xy* in Fig. 27. It is typical of all the other straight lines and represents *the direction in which a free positive charge placed at any*

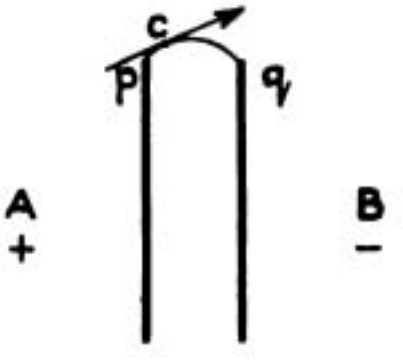


FIG. 28.

* The figure shows only the edges or side elevations of the plates.

point on it would tend to move. It stands for nothing else. In this particular case such a free charge would be urged towards the plate B, in a direction normal to the surface of A—*i.e.*, $x \rightarrow y$. If the charges on the plates were reversed so that A became negative the *direction* would remain the same but the sense would be reversed and a free positive charge would tend to move towards the plate A—*i.e.*, $y \rightarrow x$. In the case of a curved line such as pq the direction of the force at any point on it is given by the tangent of the curve at that point. Fig. 28 illustrates this, the *direction* of the force at the point c being that of the tangent, the *sense* being shown by the arrow. The reason why some of the lines are curved will appear later.

Up to this point we have considered the field between A and B as a field of force, taking into account only its action on a free positive charge; hence while we are dealing with this aspect of the field the lines are called **lines of force.** There is, however, another way of regarding the field, in which the *strain* in the dielectric is brought into prominence. The function of the dielectric in a case such as Fig. 27 represents, where we have static charges only, is to store energy. We say that for a certain applied force there occurs a certain displacement of electricity across the dielectric; the greater this displacement the greater the strain—*i.e.*, the charge on the plates is, for a given dielectric, a measure of the strain in the intervening medium, and also of the stored energy. If the charge is sufficiently increased the dielectric breaks down under the strain and some of the strain-energy is transformed into light and heat. Such a breakdown takes place when the potential difference between the electrodes of an induction coil reaches a critical value and a spark passes. In this case the dielectric, air, is self-restoring, but in a condenser with glass plates the rupture of the dielectric is an inconvenience which the practical wireless man studies to prevent.

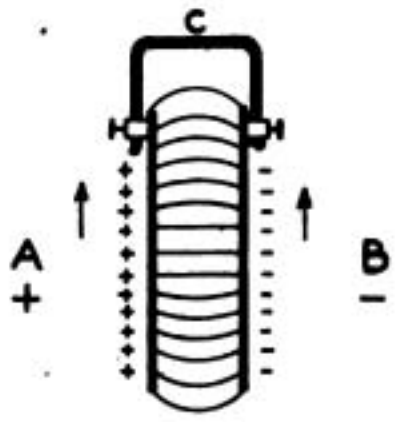


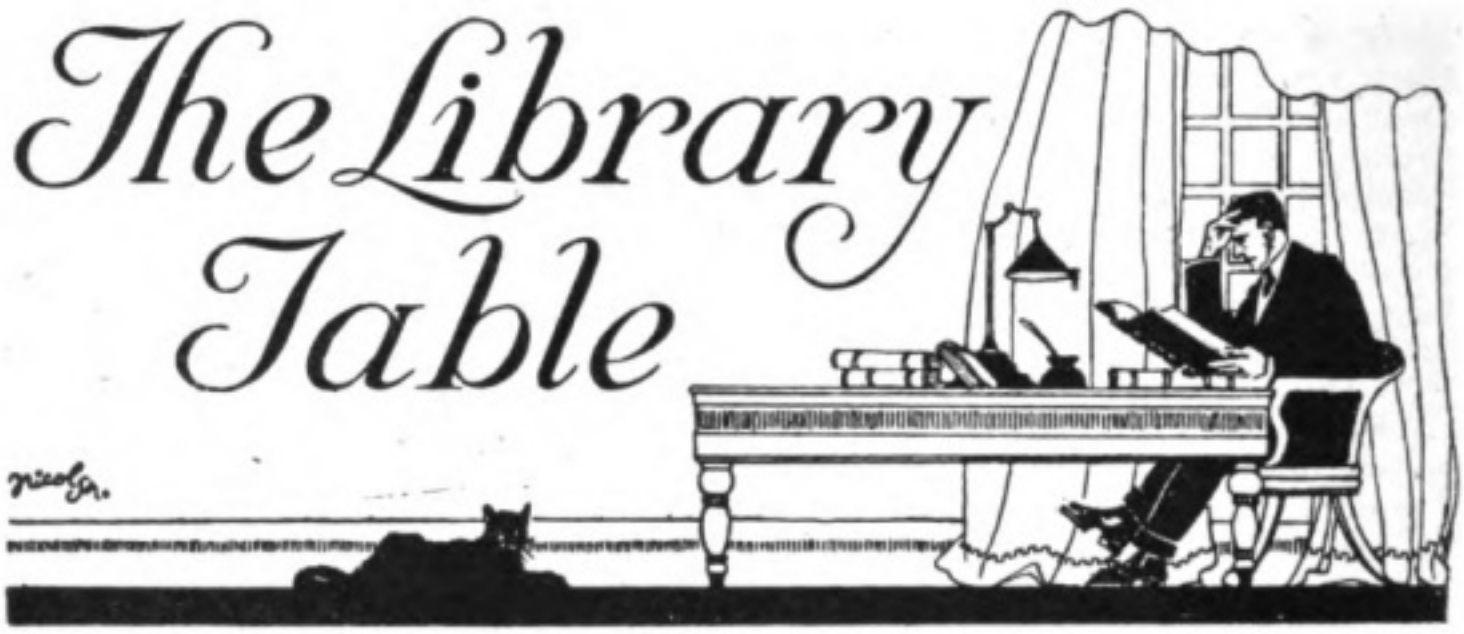
FIG. 29.

We can represent the strain by a diagram similar to Fig. 27, with the lines of induction coinciding with the lines of force, the difference in the name being an indication of the way in which we are dealing with the field. The nature of the strain is generally considered to be such that these lines tend to contract longitudinally—that is, to become shorter and thicker and to repel each other laterally. Besides explaining the phenomenon of mutual attraction between the plates this brings us to the explanation of the reason why some are drawn curved. It should be clear that the line xy (Fig. 27) tends to remain straight because it bears an equal pressure or repelling force on both sides of it,* whereas the outlying lines, notably pq, having more pressure on one side than on the other, bulge outwards. The student is warned not to accept in too material a sense explanations and diagrams relating to what are only conceptions. He should devote his attention to the significance of the lines as drawn and to the reasons why they are drawn in certain ways. For example, it is important to see that as the lines succeed each other outwards in Fig. 27, and become more curved, *there are fewer of them passing through an unit area of the field*, because the field near 1 (see fig.) is weaker than in the region of xy at 2; also, near 1 the field is not uniform. At every point on the line pq there is a different *direction*. Now the curvature and distribution of the lines in the figure graphically express the facts contained in the two latter sentences.

(*To be continued.*)

* We say *both* sides because we are considering a single plane—that of the paper.

The Library Table



WIRELESS TELEGRAPHY AND TELEPHONY. By W. H. Eccles, D.Sc. Second Edition. London: Benn Bros., Ltd. 22s. net.

Dr. Eccles's excellent handbook, which was first published in 1916, has gained a well-deserved popularity, and the new edition, which now appears after considerable delay, will be welcomed in many quarters. Following in the main the lines laid down in the previous edition, the new volume shows evidence of careful revision and will be found to contain a considerable proportion of new matter. Thus the thermionic valve, which has come into such wide use in recent years, is now treated much more fully, both in relation to its use as a detector and as a transmitter. Other additions include descriptions of the Arlington and Darien stations of the American Government (taken from the *Proceedings* of the Institute of Radio Engineers) and some further details regarding the Marconi and Telefunken systems. The excellent paper of Dr. de Groot (already published in THE WIRELESS WORLD) is also drawn upon, and the section devoted to High Frequency Generators has been augmented. Under "Wireless Telephony" some new matter regarding valves has been added, thus bringing this section into line with modern progress.

The Glossary, to which barely half a dozen terms have been added, might, we think, be improved by the addition of a number of terms now in common use. For example, we find no reference to "dynatron" and "pliodynatron," instruments to which reference is made in other parts of the book; and although Dr. Eccles may be strictly accurate in his definition of "Motor Generator" as "a motor-driven dynamo taking D.C. at one voltage at the motor terminals and delivering it at another voltage at the generator terminals," it should be pointed out that this term is largely treated as synonymous with "Motor Alternator." The definition of "key" might also be happier.

In respect of a minor matter it may perhaps be worth while to call the attention of the publishers to a slight discrepancy. In the description of the Marconi system the diagram on p. 389 shows a crystal detector used with an intermediate circuit, although this arrangement is not used in any standard Marconi receiver; and a few pages before this, under "The Marconi Transmitter," the transformer leads are shown taken to the condenser. This method has not been used for some years, the leads being now taken to the discharger, thus placing the inductance of the chokes in series with the jigger and tuning inductance, when charging.

The publishers are to be congratulated on the new "format" of the volume, which is now made up as an ordinary textbook. The previous edition, with its semi-limp cover and rounded corners, had the appearance of a pocket-book without

its portability. Now that this "make up" is discarded the book falls well in line with other similar publications.

It is unfortunate that the photographic illustrations are so poorly reproduced. This is apparently due to worn blocks, from the previous editions, being used. Otherwise the book is very well printed.

FLIGHT WITHOUT FORMULÆ. By Commandant Duchene. Translated from the French by John H. Ledeboer, B.A. London: Longmans, Green. 8s. *net.*

Although this book has been on the market for some little time, it is yet particularly welcome at the moment, when popular interest in aviation has reached such a high level. The schoolboy of to-day is no longer content to speak of monoplanes, and biplanes, as such—to refer to aircraft in these terms would be looked upon as a proof of ignorance. One has only to listen to popular conversations of the day to see how widespread is the detailed knowledge of the subject. A speck in the sky will be identified as a Handley-Page, by the beating note of the engine, the observer remarking in casual tones that his taste lies in the direction of a Bristol Scout. Heated debate may then follow on the merits or demerits of a Sopwith "Pup." Such popular knowledge, however, is usually rather shallow, and although many people can distinguish the differences in type, there are few others than "professionals" who understand the basic principle of flight.

The approach to this branch of the subject is usually barred to those without considerable mathematical knowledge. The average aviation textbook is a mass of formulæ and equations, but formidable as these may seem to the uninitiated, they are yet nothing but the "shorthand" of calculation, and rapidly lose their fearsomeness on approach. The fact remains, however, that many people have a distaste for mathematics, and more lack the requisite knowledge. To this large class the book under review is dedicated.

Although throughout the work not one single formula appears, the author has yet been able to explain in clear and easily understandable language the whole of the underlying principles of the subject. Speed, Power, Lift, Longitudinal and Lateral Stability, the effect of wind, the principles of the propeller, and every other branch of flying theory, are handled in a masterly manner; the use of mathematics (except in a carefully disguised fashion) being avoided to a degree which will come as a shock to those who believe that nothing worth mentioning in aviation theory can be taught without a mass of formulæ.

The immense debt which aviation owes to M. Eiffel is well brought out in this book. Scarcely a page can be turned without finding some reference to this great French investigator's work, and we are glad that this acknowledgment is so fully given.

We can recommend this volume to all who, while wishing to acquire a somewhat deeper knowledge of flying than can be gathered from the usual popular textbooks, are yet loth to have recourse to mathematical studies.

Share Market Report

LONDON, *August 20th*, 1918.

BUSINESS has been very active in the shares of the Marconi Group during the past month. The very satisfactory meeting of the Parent Company brought in large investment buying, and all classes of shares show a marked advance in price. The closing prices as we go to press are: Marconi Ordinary, £4 3s. 9d. (*ex. div.*); Marconi Preference, £3 11s. 3d. (*ex div.*); American Marconi, £1 10s.; Canadian Marconi, 14s. 9d.; Spanish and General Trust, 11s. 9d.; Marconi International Marine, £3.

Personal Notes

Messengers' Prize Day.

The Third Annual Distribution of Prizes in connection with the London County Council Classes for the Marconi Company's Telegraph Messengers took place at the Wild Street Schools, Kingsway, on Friday, July 19th, 1918, at 2 p.m. Mr. Beresford Ingram, Chief Inspector of the London County Council Educational Department, who was introduced by Mr. C. Metcalf, Responsible Master, occupied the chair. He opened the proceedings by a short address to the lads, congratulating them on the standard of their work during the past session, and expressed the hope that they would make an increased effort during the ensuing session. In the absence of the Manager, W. W. Bradfield, Esq., C.B.E., who found it impossible to be present owing to pressure of business, Mr. Rochs, Traffic Manager of Marconi's Wireless Telegraph Company, Limited, distributed the prizes. He also congratulated the boys on their progress and expressed the hope that they would show their appreciation of the efforts of their teachers, of what the Company was doing, and of the opportunities given to them, by showing every attention at classes, and benefiting to the greatest possible extent, of the educational facilities at their disposal. It was satisfactory to note that at least six of the lads obtained 100 per cent. of marks in Arithmetic and that History and Geography, recently added to the curriculum, had found favour with the boys, as no doubt did also the Debates, Lantern Lectures, the Magazine, Cricket and Football Clubs which their teachers had organised.

Mr. Rochs then distributed prizes to fifteen successful students, Messenger A. Whybrow being at the top of the examinations.

Mr. Ingram, in proposing a vote of thanks to Mr. Rochs, mentioned that the lads should consider themselves fortunate in serving a Company taking so keen an interest in their general and educational welfare. The lads responded heartily to this, as well as to a vote of thanks to Mr. Ingram, proposed by Mr. H. C. Gee, Master, who spoke highly of the work done by the boys, and also impressed on them the necessity of improving results next session. After remarks by Mr. A. Law, Inspector, who also urged the boys to respond to the efforts of their teacher, the proceedings terminated. Mr. J. H. Timms, Inspector, Mr. B. H. Matthews, Principal of the Kennington Commercial Institute, and Mr. A. Bisping of the Marconi Company were also among those present.

Obituary.

Second-Lieutenant A. Noel Ealand, R.A.F., who was accidentally killed on July 15th while flying at the Front, was the son of the late Charles Winn Ealand, of Kirkby Lonsdale. He was educated at Shrewsbury and became a solicitor. At the time of his death he was in partnership at Thetford, Norfolk. After serving for two years with the Red Cross in France, he obtained a commission in a Dragoon regiment, but subsequently transferred to the R.A.F. Wireless Section. He married in 1910 Miss E. Augusta Horwood, daughter of Lieut.-Colonel T. Horwood, of Aylesbury, and leaves a widow and three sons.

We regret to announce the death of MR. ALFRED S. WILLIAMS, Deputy-Chairman of the Royal Mail Steam Packet Company.

Official news has been received by the parents of the death of RICHARD HOLDSWORTH, senior telegraphist (wireless operator), R.N.V.R., of 97 Healey Wood Road, Burnley. When last seen he was trying to rescue his captain, who was badly wounded, and he sank before the rescue boat could reach them. A commander wrote to the parents: "You will find some consolation in the knowledge your "son met his death so nobly."

AWARDS.

The Military Cross has been awarded to TEMPORARY SECOND-LIEUTENANT E. W. PARKIN, R.E. He first served in the ranks of the Royal Horse Guards, and is now attached to the wireless section of the British Mission to the French Army. For two hours under heavy enfilade bombardment Lieutenant Parkin proceeded up and down the front line trenches. It was owing to his gallant conduct that the line was held until reinforcements arrived, when a counter-attack was launched, with the most successful results.

PRIVATE R. D. DAVIES, wireless operator, R.F.A., has been awarded the Military Medal. He obtained his wireless training whilst at Nantyffyllon.

The D.S.O. has been awarded to CAPTAIN AND TEMPORARY MAJOR NOEL HANS HAMILTON, who in civil life was an electrical and wireless engineer.

WIRELESS OPERATOR CHARLES E. MATHER, R.N.V.R., 264 Mulgrave Terrace, Swinton, has been awarded the D.S.M. for distinguished service rendered on a minesweeper which was mined last November. He has since been incapacitated for sea service.

PRISONER OF WAR.

SECOND AIR MECHANIC AND WIRELESS OPERATOR A. K. BOSTOCK, R.A.F., of Hull, missing since May 27th, has now advised his parents that he is detained in a German prison camp, and that he is well and comfortable.

IN ITALY.

MESSRS. DALGETTY NICHOLSSON and A. M. GEO. LESTER, the two wireless operators of the Royal Air Force shown in the accompanying photograph, are doing duty somewhere in Italy. Long hours and discomforts, notably from the effects of lachrymatic gas, do not prevent them from keeping fit and well, and carrying on.

CAPTAIN S. B. BALCOMBE, late of the Traffic Department of Marconi's Wireless Telegraph Company, Limited, lately paid a call on his friends in Marconi House, prior to leaving for the Italian front.

MR. DALGETTY NICHOLSSON AND MR. A. M. GEO. LESTER

Company Notes

Marconi's Wireless Telegraph Company, Limited

Mr. Godfrey Isaacs on the Recent Action

SHAREHOLDERS' VOTE OF CONFIDENCE

SUBSTANTIAL INCREASE IN THE PROFIT.

THE 21st Ordinary General Meeting of Marconi's Wireless Telegraph Company (Limited) was held on July 31 at the Cannon Street Hotel, under the presidency of Mr. Godfrey C. Isaacs, the deputy-chairman and managing director, who was received with cheers on taking the chair.

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

The Chairman, who was again cheered on rising to address the shareholders, said:—Ladies and gentlemen, in the first instance, I want to tell you that Mr. Marconi extremely regrets that he is unable to be here to-day. Important duties detain him in Italy at the present moment, and he asks you, therefore, to excuse his absence. Our colleague, Mr. Saunders, I am sorry to say, is not in good health, and is thereby prevented from being present. He also asks that he should be excused.

MR. GODFREY ISAACS'S OFFER OF RESIGNATION.

Before proceeding with the ordinary business of the meeting, I wish to express to you my great regret that you should have been inconvenienced last Wednesday by the necessity for the adjournment of this meeting for a week. In sending out the reports and accounts, we had supposed that the action in which I was engaged would have lasted at most three or four days, and, therefore, in fixing the meeting for the 24th, I had contemplated being able to preside. I need not tell you that the possibility of losing this action had never entered my mind, and I will not attempt now to minimise the gravity of the verdict. I have served notice of application for a new trial, which I have every hope of obtaining. You will understand that in these circumstances it is not right that I should now further express myself on the subject of the trial and the verdict. Meantime, I must face a very painful ordeal, but truth has a habit of prevailing, and I feel confident that in the end it will prevail in this case. (Cheers.) For the present, however, I must recognize the position as it now is, and do what I think is right and honourable in the circumstances. I am bound by an agreement to the company to act as its managing director until the end of December, 1925, and the company by that agreement is equally bound to me. I do not think it would be fair or proper on my part to take advantage of that period, and I therefore, before proceeding with the ordinary business of this meeting, unreservedly tender to you my resignation, and offer to terminate my agreement forthwith. (Cries of "No.")

THE BOARD AND THE MANAGING DIRECTOR.

Captain H. RIALL SANKEY, C.B., R.E. (Retired).—Ladies and gentlemen, I beg to move:—"That Mr. Godfrey Isaacs's resignation of his office as managing director of the company be not accepted, and the shareholders present at this meeting, having complete confidence in his honour and integrity, request him to withdraw the same." (Hear, hear.) In support of this resolution, I would tell you that at a board meeting the following resolution was passed: "Resolved, that the board beg leave unanimously to express their sympathy with Mr. Godfrey C. Isaacs as the victim of a totally unexpected verdict, and to affirm their complete confidence in his honour and absolute integrity." (Cheers.) Some years ago, namely, in January, 1910, Mr. Marconi came to me and told me he thought that, at last, he had found the right man to be managing director, and asked me if I would go to see him. I did so, and recommended to Mr. Marconi that Mr. Godfrey Isaacs should be invited to become the managing director of the company. At that time, as the older shareholders will know, the company was in a very difficult position. The overdraft at the bank was £50,000, and I well remember that on one occasion I had to advance the sum of £250 to pay wages. Mr. Isaacs soon made himself felt, but at first he met with great difficulties. He overcame them one by one, and the rate of progress can be judged by the successive annual reports and accounts; and, ladies and gentlemen, if you compare the statement now before you with the condition of things I mentioned at the beginning of these remarks, you will have a true measure of what Mr. Godfrey Isaacs has done for the company and for the shareholders. (Cheers.) The directors and the staff, having every confidence in Mr. Godfrey Isaacs, have backed him to the best of their ability, and they still desire to do so.

A VOTE OF CONFIDENCE.

At all material times both the directors and the staff were fully conversant with all the matters which have recently been before the public, and it is because of that knowledge that they wish to be identified in future with Mr. Isaacs as your managing director. (Cheers.) I will now read the resolution once more, and I shall be glad if some shareholder will then second it:—"That Mr. Godfrey Isaacs's resignation of his office as managing director of the company be not accepted, and the shareholders present at this meeting, having complete confidence in his honour and integrity, request him to withdraw the same."

Mr. G. H. WEST.—Ladies and gentlemen, as a comparatively small shareholder, I have the greatest possible pleasure in seconding this resolution. I may say, and I feel sure that all those present will share that view, that I have, and have always had, the greatest confidence in Mr. Godfrey Isaacs. (Hear, hear.) It is hard enough to find a man to carry on successfully an undertaking like this, but we have happily done so. We have in Mr. Isaacs a man whom it would be impossible to replace, and

we have every confidence in him, and as there has been no reflection on his honour I have the greatest possible pleasure in seconding the resolution, and I ask you all to support it. (Cheers.)

Mr. J. W. HAMILTON.—In view of the serious charges which were levelled at Mr. Isaacs in the recent action, I maintain you should be told the exact facts brought against him. (Cries of "We have read them" and "Sit down.") I do not wish to say anything to prejudice Mr. Isaacs. (Laughter and "Oh!") He has maintained that he is not guilty, although the jury have given a verdict against him. (A voice.—"What on?") I move that Mr. Isaacs should withdraw from the board until such time as his character is cleared. (Cries of "Vote" and "Sit down.")

THE MANAGING DIRECTOR'S REMUNERATION.

Mr. WALTER KINNEAR.—I do not rise to second the amendment just moved. I feel sure the shareholders have the utmost confidence in Mr. Godfrey Isaacs, our managing director. I, as a shareholder in this company for 16 years, and holding a considerable number of shares, can bear testimony to the very valuable services which he has rendered to the undertaking. The shareholders are under the very greatest debt of gratitude to him, and we are only doing our duty in not making up our minds on the question until he has prosecuted an appeal, as he intends to do, in the matter recently before the Courts. I wish to make only one further observation: Inasmuch as the resolution has the effect of continuing the appointment for a further period of seven years, and in view of the statement which has already been made with regard to the rather handsome terms on which it is alleged the managing director holds his appointment from this company, and also in view of the very large sums of money due to this company for war services during the past four years, apart from the very considerable sum which must come on account of the departure from the "wireless chain," I suggest that before this resolution is passed the shareholders ought to be informed specifically of the terms on which the managing director holds his office.

The HON. D. O'BRIEN.—I should like to say, with reference to what the last speaker said, that I cannot quite see that that has anything to do with the resolution before the meeting. The resolution is, as I understand it, that Mr. Isaacs remains managing director. How has that got anything to do with the resolution before the meeting?

The CHAIRMAN.—Referring to the penultimate shareholder, I should like to state at once that when I agreed with Mr. Marconi to take over the managing directorship of this company, and gave up my business, I agreed to do so on the following terms:—That I should receive a salary of £5,000 per annum, and in addition 5 per cent. on the net profits of the business in each year, whatever they might be. I may just add that at the time I took over the managing directorship there were no profits. ("Hear, hear," and cheers.)

Mr. R. A. SMITH.—I think, after the statement that Mr. Isaacs has made, it will not be necessary for us to go any further into the matter of his remuneration. We have heard from Captain Sankey that when he came into this company the company had an overdraft of £50,000, and you see by the report what its condition is to-day. I suggest it is time the company ceases to be made a sort of Aunt Sally or cockshy of every disgruntled place seeker or unscrupulous politician. (Laughter and cheers.) As a humble shareholder, I most heartily endorse the position the board has taken up with regard to Mr. Isaacs's appointment. (Cheers.)

A "PRACTICALLY UNANIMOUS VOTE."

Captain SANKEY.—I now beg formally to put the motion. (Hear, hear.) You have heard it read twice.

The resolution was carried, amid cheers, with only one dissentient.

Captain SANKEY.—It is very gratifying to have this unanimous, or practically unanimous, vote—only one shareholder against it, and that is also the number of shares he holds in the company. (Laughter.)

The CHAIRMAN.—Ladies and gentlemen, I deeply appreciate this expression of confidence. (Loud and prolonged cheers.) I want to be allowed to add one word more, and I hope you will not consider it ungracious—I think I deserve it. (Cheers.) Now, before proceeding, ladies and gentlemen, I ought to tell you—I think it is due to all of you to know—that Mr. Hamilton, whose is the only dissentient voice, used to be in the employ of the company, and that he is the holder of one share. (Laughter, and cries of "Shame.") Now, gentlemen, I think we might proceed to the business of the day.

Mr. HAMILTON.—That is an improper statement to make. You know that I represent a large number of shareholders.

The CHAIRMAN.—I have no such knowledge; there is no evidence of it.

SENATORE MARCONI'S MESSAGE TO MR. ISAACS.

In the course of the Chairman's subsequent address to the shareholders he was handed the following cable from Senatore Marconi, which he read to the meeting:—"Most deeply regret and deplore verdict. You have my most sincere sympathy, and I can assure you of my firm belief in your honour and integrity." (Cheers.)

The CHAIRMAN.—We will now proceed to the business of the day. Dealing, in the first instance, with figures, there is, if you will look to your balance-sheet, little which calls for comment. The capital account is unchanged. There is a small difference in bills payable and sundry creditors which arises from ordinary fluctuations in the business. The reserve account stands at £1,000,000, which you approved at the last meeting, and to this will be added a further £100,000 if you adopt the recommendations of the board to-day. On the other side there is an increase in the sundry debtors, etc., which is only proportionate to the business of the year. The same remarks apply to stock. The mortgage on one of the freehold works has been further reduced by the annual payment of £1,000, and, therefore, the property stands as an asset at £1,000 in excess of the figure last year. Our other freehold properties have been increased by additional buildings and material amounting in all to some £20,000. The long-distance stations figure at some £8,000 less this year in consequence of the amount written off for depreciation. We then come to the very important item of shares in associated companies and patents. This figure we always bring into our balance-sheet at cost price. It shows an increase over last year of some £95,000. The par value, however, has increased by £210,000. This is a very big item in the accounts, and one which at the present time in particular it is extremely difficult to value, but I can tell you this—it is worth very substantially more than the figure at which it stands in the accounts. In support of this statement I might tell you that shares in three companies which represent a par value of approximately £900,000, or about one-third of our total holdings, are worth to-day substantially over one and a-half millions sterling. (Cheers.) It must not be inferred from this that our remaining shares are of equal value. They, however, represent a

very considerable sum, and will, I trust, show material improvement with time. The amount represented by patents is included in the figure of £1,400,000; therefore, their total cost is also covered by the shares in the three companies which I have mentioned. Many of the patents are old, but their depreciation is more than compensated for by a large number of new patents.

Turning to the profit and loss account, there is nothing which calls for any comment except that the balance, being profit for the year, shows a substantial increase over last year, and no doubt will be regarded by you as highly satisfactory. (Hear, hear.) If you approve the resolutions which we shall put before you later with regard to the payment of dividends and reserve account, we shall carry forward to next account approximately the same figure as was brought forward from the preceding year. I do not think there is anything else in the matter of accounts which calls for explanation, but I shall later give any shareholder an opportunity of asking questions upon any point on which he may desire further particulars.

The Post Office and the Imperial Chain of Stations.

Now that our action against the Post Office in respect of the Imperial chain of stations has been disposed of in the Courts, I think it is my duty to review shortly the history of this unfortunate contract. You will all remember that it originated by my proposing to the Colonial Office at the beginning of 1910 that they should give us similar rights to those which are given to the cable companies, enabling us to erect for our own account on British soil a chain of stations, eighteen in all, around the world. Had this request been granted, what a sea of trouble the company would have escaped, and what an asset such a chain of stations would have been to the Empire! (Cheers.) However, the Government of the day, whilst approving of my proposal, felt that the stations should be Government owned, and we were invited to build them in partnership with the Government. We, therefore, abstained from building these stations upon foreign soil and gladly accepted the Government's invitation. The Imperial contract was the result. It was completed only after a very long negotiation, and was eventually reduced to six stations. It was, as you know, the subject of attack in the House of Commons, and it was only in August, 1913, that the final contract was entered into and ratified by Parliament. For some unexplained reasons the company was hindered from proceeding with the erection of those stations, and when war broke out in August, 1914, three of them only had been commenced. In September, 1914, there was talk of accelerating the construction of the stations and work was to proceed day and night. At that time the company held that the Government had abandoned the contract, but, having regard to the fact that we were at war, we placed ourselves unreservedly at the disposal of the Government to build the stations with all possible speed, or do whatever the Government desired of us, without wasting time to discuss terms. We were prepared, and so offered to leave ourselves entirely in the hands of the Government to do what was fair.

"A Disingenuous Offer."

For some unexplained reasons, these negotiations were discontinued, and on December 30th, 1914, we were informed that the Government were not going to proceed with the stations at all, as they were no longer required. We had spent, in the meantime, £140,000 odd upon them, and had had a great deal of work and had engaged preparatorily a large staff; further, we had made our whole programme abroad subservient to the Government programme in connection with the Imperial chain of stations. We then asked the Government what it was proposing to do with regard to reimbursing us the very large amount we had expended and agreeing the compensation we should be paid. This resulted in our being offered, three weeks later, the reinstatement of the contract to build the six stations, which, three weeks earlier, the Government had informed us were no longer required. (Laughter, and a voice—"Shame.") It was a disingenuous offer, and one which we could not treat as being honestly made, nor could we believe that it would be honourably carried out. In the circumstances, we felt that the consequences to the company might have been extremely serious, and we were not disposed to take the risk. We were, however, most anxious to avoid the unpleasantnesses which might follow, and therefore proposed that we should enter into a new contract with the Admiralty. Negotiations were accordingly opened, and the Admiralty made us an offer which they stated represented to us the equivalent of the repudiated contract of the Post Office. We were not of that opinion, but so anxious were we to avoid any friction that we agreed to the terms. The draft contract was to be submitted to us immediately. A month later, however, Mr. Asquith's Government gave way to a Coalition Government, and presumably the instructions to the Admiralty were not renewed, for no draft contract was ever forthcoming, and it became clear in the month of November, 1915, that the Admiralty did not intend to proceed with the stations. We had thus lost the best part of a year and were no further, but we were still out of our money. We were obliged eventually to have recourse to a Petition of Right. This we deferred acting upon in consequence of further negotiations, which were commenced with a new Postmaster-General in the hope again that we might be able to agree on terms of a new contract to take the place of the old one. Long negotiations followed, and, although we received an offer, it was one which, acting on your behalf, we did not feel we were justified in accepting. We were willing and even desirous of making a substantial concession for the sake of peace, but we did think we were entitled to, and were bound to insist upon, something approaching what we regarded as a fair arrangement. But this was not forthcoming.

The Petition of Right.

We were still anxious, however, to avoid the Petition of Right going to the Court, and so we offered to go to arbitration provided that the letter of January 21st, 1915, offering the reinstatement of the contract, should be withdrawn. This letter should never have been written, and if it stood would have reduced the damages—and the object of it was to reduce the damages—to which we should have been entitled to such loss as had been occasioned us for the three weeks' delay between the date of the repudiation and the offer of reinstatement. We felt, pending the withdrawal of the letter, this was a matter of such importance that it could only be settled in a Court of Law. The Government, however, could not see its way to withdraw that letter of January 21st, 1915, and consequently the Petition of Right came into Court. There appeared, on behalf of the Crown, the Attorney-General, the Solicitor-General, and Mr. Walter, K.C., and two Treasury juniors. As you now know, after counsel on behalf of the company had opened the company's case for two days, the Attorney-General announced

that the Government did not propose to proceed with the defence and agreed to the withdrawal of the letter of January 21st, 1915. (Laughter.) I may tell you that no new fact transpired during the proceedings in Court which was not perfectly well known to the Post Office months before we were compelled to go into Court and when we offered arbitration. Why this letter could not have been withdrawn when we made the proposal and the whole matter referred to arbitration a year sooner we are at a total loss to understand. (Hear, hear.) Great waste of valuable time and public money could, and should, have been avoided. Explanations have been given in the House of Commons of the course adopted by the Crown. They appear to have been regarded as satisfactory, and, therefore, I suppose that we are among the exceptions in being totally unable to appreciate them. Judgment, as you know, was given for the company, and the matter has been referred to a referée to assess the damages. A learned Judge has been appointed for this purpose, but I am sorry to say that his time has been so fully occupied that he will not be able to sit until the month of October. There is, however, at last a fair prospect of the matter being disposed of before the end of the present year. I want to assure you that it always has been, and is even now, the desire and wish of your directors to arrive at a reasonable and friendly settlement of this matter, by which the nation could benefit by the stations sooner than pay a very large sum of money in damages with nothing to show for it. (Cheers.) Even at this eleventh hour any reasonable and fair offer would be most willingly accepted by the company. (Hear, hear.)

The Government and the Company's "Invaluable Services."

The position with regard to the other sums due from the Government remains just as it was when we met last year. (Cries of "Shame.") No remuneration or compensation has been received in respect of the invaluable services which the company has rendered. There have been some negotiations, but so far no offer even approaching the sum which the company could reasonably accept has been forthcoming, and one almost begins to despair of being able to obtain a settlement by negotiation and agreement. It does seem to your directors extraordinary that whereas millions and millions of public money have been spent, perhaps not always usefully, for fair remuneration for such valuable services as this company has rendered not one penny piece is forthcoming. Our inventions and patents continue to be used on an immense and ever-increasing scale by the Admiralty, the War Office, and the Royal Air Force. Their incalculable help to the Allied cause is unquestionable—(hear, hear)—but not one farthing in respect of them has the company received. It is true, no doubt, that each of the Government Departments has its hands as full as they can be with matters of far greater consequence, and, therefore, it has not been possible for them to devote time to the adjustment of accounts with the company, and I would be the last to complain of this, but inasmuch as the sums due, even were they calculated at prices substantially less than those agreed upon and actually paid to us in cases where the company has manufactured and supplied, would represent very many hundreds of thousands of pounds, I do think that in common fairness the Government could, and should, have made to the company a substantial payment on account in respect of each of the three Departments concerned, leaving final figures for adjustment, if they will, to the end of the war. (Hear, hear.) But how long are we to wait? When will be the end of the war? Must we wait till then? Without knowing what our financial strength is we cannot, of course, give full scope to our future programme. This disadvantage alone is of considerable consequence, for it quite prevents our shaping a course abroad which we otherwise might do, enabling us the better to prepare to meet enemy competition after the war.

The Absence of Government Co-ordination.

We have to look ahead, as it behoves every British industry to do, and I think we might receive the consideration which is due to us and so help us instead of causing us unnecessary difficulties. But this is not the only way the Government could assist us. I am making no complaint against any particular Government Department or individual. But I do very much complain of the system, or the absence of system. (Hear, hear.) Although wireless is to-day, and will be perhaps more so in the future, a subject of extreme importance, there is, unfortunately, no Government policy, no central authority, no co-ordination between Government Departments, nobody in a position to speak or act on behalf of the Government. What concerns the Foreign Office has no interest for the War Office; what is important to the Admiralty is quite ignored by the Colonial Office. There is, in a word, a total absence of co-ordination and no authority to whom one can apply for any guidance whatsoever. (A voice—"Shame.") Can one conceive such a state of things existing in Germany? One would have thought that after the experience of four years of war it would be recognised that some organisation was imperative, and a definite policy adopted. I am afraid that these remarks may meet with some disapproval, and even perhaps censure from some quarters, but I think it my duty to make them, just as I have thought it a duty to speak on other occasions without paying any heed to the possible consequences to myself. A little plain speaking may be productive of some good resulting both to the country and to the company. (Cheers.)

The Company's Interests in America and Canada.

On the other hand, our interests abroad, on the whole, continue to develop in a satisfactory manner.

In the United States of America a new company has been formed, with the approval of the United States Government, by the Marconi Wireless Telegraph Company of America, with the title of the Pan-American Telegraph and Telephone Company. The object of that company is to erect stations for the purpose of creating a commercial service of wireless telegraphy between North, Central and South America. The shares of the company are held as to 40 per cent. by the Marconi Wireless Telegraph Company of America, as to 20 per cent. by the Federal Telegraph Company, the owners of the Poulsen system interest in the United States of America, and as to 40 per cent. by this company. It is intended to proceed immediately with the erection of high-powered stations. It is satisfactory to know that the Marconi Wireless Telegraph Company of America has declared a dividend of 5 per cent. for the past year, and it is understood that their works have been considerably increased in order to cope with Government orders. The whole of their long-distance and coast wireless stations are under the control of the United States Government for the duration of the war upon terms which have been agreed, and which are regarded by the management as reasonable, and monthly payments are regularly made. (Cheers.)

The Marconi Wireless Telegraph Company (of Canada) (Limited) has made good progress during

the past year and a fair profit resulted. Before, however, the company can be expected to pay dividends some reorganisation of its capital will be required. This company, as you will remember, was formed a great many years ago with a capital of five million dollars, and practically no working capital was provided. The directors of the company have long desired to reconstruct the company and make certain arrangements with us which would put them in a sound position. We are in full sympathy with them, and are desirous of meeting them in any reasonable proposal. Had it not been for the outbreak of war I should myself have visited Canada some few years ago with this object in view. The matter, however, should not, I think, be longer delayed, and we have invited the Canadian company directors to submit their suggestions. We expect to receive their proposals very shortly, and as soon as they come to hand they will receive early consideration. They already have our good will. (Hear, hear.)

THE AUSTRALIAN, ARGENTINE, SPANISH AND RUSSIAN COMPANIES.

The Australian company, Amalgamated Wireless (Australasia) (Limited), is making excellent progress under the managing direction of Mr. E. T. Fisk and a reconstituted board. I am confident that that company will substantially and successfully develop its business under able management. The Argentine company, the Compañia Marconi de Telegrafia sin Hilos del Rio de la Plata, in consequence of the war has necessarily stood still. The Spanish company, the Compañia Nacional de Telegrafia sin Hilos, is conducting a very substantial telegraph business, and has made excellent arrangements in other directions which give us every reason to hope that the company has now turned the corner and has in front of it a far more satisfactory prospect. (Hear, hear.) The Russian company, the Société Russe de Télégraphes et Téléphones sans Fil, has, of course, been passing through very difficult times. The latest information we have is by letter dated the middle of April of this year. They have, naturally, suffered severely from the difficult labour conditions, but, as far as we gather, have suffered no other harm, and having regard to the importance of wireless telegraphy in Russia, no matter what the Government of the day may be, there are fair grounds for supposing that importance will always be attached to a business such as that of the Russian company. In these and other circumstances which I cannot speak about to-day we have not thought it necessary to make any special reserve in respect of the very considerable sum of money we have invested in Russia.

The Belgian company, the Société Anonyme Internationale de Télégraphie sans Fil, notwithstanding the prevailing conditions, has continued to conduct its business satisfactorily. It has, however, been impossible for the board, other than Captain Sankey and myself, to meet, and therefore no dividends can be paid until circumstances change.

FRENCH AND ITALIAN BUSINESS.

The French company, the Compagnie Française Maritime et Coloniale de Télégraphie sans Fil, has continued to do a good business and has substantially increased its dividend. The Cie Universelle de Télégraphie et de Téléphonie sans Fil, in which we were so largely interested, is now in course of liquidation. The whole of its tangible assets have been sold to a new company, entitled the Cie Générale de Télégraphie sans Fil, a company with a capital of Fcs.12,500,000, the whole of which has been subscribed in cash by about 20 shareholders, amongst which are the French Cable Company (with the approval of the French Government)—I should say that the French Government is interested in the French Cable Company, and it has approved of the French Cable Company taking a substantial part in this new wireless company—the Banque de Paris et des Pays-Bas, Banque Française pour le Commerce et l'Industrie, Banque Transatlantique, Crédit Mobilier Français, Messrs. Jacques Gunsburg et Cie Société Centrale des Banques de Provence, and, again with the approval of the French Government, Marconi's Wireless Telegraph Company (Limited). It has been agreed that we should subscribe for 40 per cent. of the total capital, and this we have done, representing the sum in round figures of Fcs.5,000,000. The liquidation of the Cie Universelle, when complete, will produce to us a sum of approximately Fcs.11,000,000. This is a most satisfactory settlement of one of the most troublesome and difficult positions with which I have ever had to deal. (Hear, hear.) I am confident that under this new *régime* the 40 per cent. of the capital which we now hold in this new French company will produce to us, right away, excellent returns and far more than we ever should have secured through our much larger holding in the Cie Universelle.

I need scarcely say anything with regard to the Marconi International Marine Communication Company (Limited). Every shareholder will have had an opportunity of reading quite recently of the general meeting of that company and will have learned what substantial and satisfactory developments have succeeded each other year after year. Our Italian business has again been of a highly satisfactory nature and most ably directed by the Marquis Solari, our respected representative in Rome.

The Relay Automatic Telephone Company (Limited), in which we have a very large interest, has had its sphere of action very considerably restricted in consequence of the war. It has, however, been able to do some business, notably that of installing its system at Australia House, amongst other large establishments, where it is working to perfection. This company, when war closes, in my opinion, has a great future in front of it; unquestionably automatic telephones will be the order of the day when circumstances change, and there is, I believe, no automatic system so excellent as that of the Relay Automatic Telephone Company (Limited).

"WIRELESS" AND LONG-DISTANCE CABLES.

We have many important negotiations in many parts of the world of which it would not be wise of me to speak to-day, but I think one may fairly contemplate that the business of wireless telegraphy will be no less important when peace comes than it has been during the war. (Hear, hear.) In speaking with a very eminent officer of the United States Navy Department a day or so ago he told me that, although before the war he was of a very different opinion, he has now come to the conclusion that no new long-distance cables will ever again be laid; that, in his view, wireless telegraphy is thoroughly efficient for all telegraphic purposes. It would not be, perhaps, altogether advisable for me to express such views, but I think you will be glad to hear those of a practical man holding such an important position in so great and progressive a country as the United States of America. (Hear, hear.)

It remains for me now only to express my sincere thanks to my colleagues, managers, and the whole staff of the company for the loyal and wholehearted support which all, without exception, are ever ready to afford me. I now move "That the report of the directors submitted, together with the annexed statement of the company's accounts to December

31, 1917, duly audited, be received, approved and adopted." (Cheers.)

Captain H. RIALL SANKEY:—I have much pleasure in seconding the resolution.

The CHAIRMAN, having put the resolution to the meeting and declared it carried unanimously, said:—I am sorry I omitted to give you the opportunity of asking questions, but it is not too late now. If anybody would like any further information, or to put any questions on the accounts, I shall be glad to answer them.

THE DISCUSSION.

The HON. D. O'BRIEN.—Can you tell the shareholders, Sir, in comparison with the treatment this company has received from the British Government in respect to a settlement for the use of its stations in the United Kingdom, what the treatment by the American Government has been of the American company, and particularly how many months elapsed from the entry of the American Government into the war before they came to a settlement with the American company?

The CHAIRMAN.—I think I have already answered that question, in part, in my speech. I have told you that the American Government have completed an arrangement with the American company on terms which the American company thought reasonable, and that the American Government are making their payments under the agreement monthly. I believe I am right in saying that an agreement was come to within a month or two of America joining in the war. (Hear, hear.)

The HON. D. O'BRIEN.—Thank you. That is all I wanted to know.

Mr. LANHAM.—It seems to me, with regard to these meetings, which I have attended for some years, that more or less the same things are said each time, and with regard to the delay of any settlement by the Government, of course we have all got used to that. I myself have bequeathed anything I may get out of it to my grandchildren. (Laughter.) We must not overlook the fact that at these meetings the statements from the chair are *ex parte*, which, I believe, means one-sided only. If I am wrong, the chairman will correct me, as I know he knows Latin words. (Laughter.) Now, it seems to me—although I am afraid little good will be gained by my remarks, because it is too late—that if our directors had tackled the problem on the same business lines that the American directors have done, instead of talking more or less sheer patriotism, to give it a good name, because I think that was the idea when they allowed the Government without any arrangement to make use of the company's stations—a thing which I venture to say no other business concern in this country has done, as far as my knowledge goes from reading the papers—instead of fixing up a business agreement they said, in effect, "We are willing to help you; take what you like from our stall, there is no price on anything, we will arrange the price afterwards." (Laughter.) Well, gentlemen, that is very generous, but the directors here represent a vast deal of shareholders' money, and the lack of an arrangement at that time, although patriotic and generous, and to a certain extent highly meritorious, was not business as we understand it to-day. I think that that is the reason for the gigantic claim, the beginning of it, which we are making to-day. It is practically the cause of the whole trouble, and I certainly think it should have been avoided.

The CHAIRMAN.—Will you put your question, sir?

Mr. LANHAM.—I am putting the other side of the case.

The CHAIRMAN.—I wish to hear your question, if you have one, as that is what I am desirous of dealing with at the moment.

Mr. LANHAM.—Yes, I know, but I am trying to put my view of the matter.

The CHAIRMAN.—I am not complaining, but I offered to answer questions.

Mr. LANHAM.—I am rather a "high-priced shareholder," and I am expecting some day to get my money back. I am not a holder of one share. One other point to which I want to refer is this: You told us that the non-receipt of this large sum of money has retarded your programme and ideas of progress in other parts of the world. If you intend to use that money when you get it for the benefit of your large projects, how do we stand? If the shareholders present will throw their mind back a few years they will remember, I think, that you told us that when this sum, which two years ago was very near—last year it was practically being served over the counter, and this year it is practically safe—you told us that when that amount was received it would to a large extent, not the total perhaps, be distributed among the shareholders. (Hear, hear.) Now, which of those hypotheses or statements is correct? They cannot both be. It must be one or the other, and I should like you to tell us whether your statement of two years ago, or the inference I draw from what you have said to-day, is correct.

CHAIRMAN'S REPLY TO QUESTIONS.

The CHAIRMAN.—In reply to the first part of the question I would like to tell you in a few words what took place. You will remember that on August 4, 1914, war was declared. There were innumerable things that the Marconi Company was called upon to do, and to do immediately, and its staff remained at work night and day to do those things. (Hear, hear.) I do not think there is a single shareholder in the company who would have approved of the managing director saying, "No; tell us what you are going to pay us before we do these things so important to the country." We proceeded without question of remuneration, and did whatever was asked of us, and we did it well, and we are looking for fair treatment. I think every man in the country has a right to look for fair treatment from the Government, acting on behalf of the rest of the community. On the question of what we shall do with the moneys we receive, let me say that a bonus will be paid. I have no reason to change the statement I then made. (Hear, hear.) But the moneys which we are entitled to receive from the several different Departments, and for different purposes, are very considerable, and a very substantial sum would certainly be available for the purpose of cementing our future abroad, and it will be used for that purpose. There will also be plenty, I think, to satisfy the most avaricious shareholder. (Hear, hear.)

Mr. HAMILTON, speaking amid repeated cries of "Sit down," said.—I wish to tell you that I have a large interest in this company. I represent also hundreds of shareholders. Let me say, too, that Mr. Isaacs's criticism of the Government is unwarranted. The whole trouble with regard to your negotiations with the Government is the absolute mistrust of many of the Government Departments of your managing director. (Cries of "No, no," and "Nonsense.")

The CHAIRMAN.—I need not tell you, gentlemen, that Mr. Hamilton is speaking without authority from the Government (hear, hear), and when the Government chooses to take up that attitude it will tell you.

Mr. JOHN WEBB.—I think I am one of the oldest shareholders in this company. I still hold 300 shares, which I acquired some years ago when the company was in very low water. Some of you may

remember that I then asked the shareholders to bear with the directors and expressed the belief that we should see this company a great success. Now, to-day, Mr. Chairman, we have to thank you and the other directors for all you have done for us. (Cheers.) I confess that, although I hold shares in other companies, there is no company in which I hold them with greater pleasure than in this one, because I believe that Marconi's Wireless Company is a great benefit to humanity. (Hear, hear.) I believe it is doing great good in the world, and saving much life. There is one thing I should like to ask you, and that is not to "pile up" the reserves too heavily, but allow us shareholders to get a little of the benefit of the company's prosperity. We want it, because some of us have bought our shares at a very much higher price than they stand at now. All the same, I am thankful to you and to the directors generally for the splendid results you put before us to-day. (Cheers.)

SENATORE MARCONI'S CABLE OF CONFIDENCE IN MR. ISAACS.

Mr. HENRY W. ALLEN.—Mr. Chairman, ladies, and gentlemen, I have just received the following telegram from Senatore Marconi:—"Most deeply regret verdict in Isaacs case. Please express my sympathy to Mr. Godfrey Isaacs and inform him and the general meeting that I heartily associate myself with the resolution of the board, and that he has now, as during the eight years of his association with me, my entire belief in his honesty and integrity. His evidence, as reported in newspapers which have reached me, is identical with his account of facts as related to me before any case was contemplated. Sincerely hope retrial may be granted." (Cheers.)

The CHAIRMAN.—I have now to move:—

"That a final dividend of 15 per cent., equal to 3s. per share, less income-tax, upon the Ordinary Shares now issued and paid up, be and the same is hereby declared for the year ended 31st December, 1917; that a final dividend of 10 per cent., equal to 2s. per share, less income-tax, upon the Cumulative Participating Preference Shares, be and the same is hereby declared for the year ended 31st December, 1917; that the said dividends be payable on the 14th August, 1918, to shareholders now registered on the books of the company, and to holders of share warrants to bearer."

Mr. ALFONSO MARCONI.—I have pleasure in seconding that.

The resolution was unanimously agreed to.

Mr. MAURICE A. BRAMSTON.—I beg to move:—"That the directors, Mr. Alfonso Marconi, Captain H. Riall Sankey, and Mr. Henry William Allen, who retire in accordance with Article 81, be re-elected directors of the company."

Mr. SAMUEL GEOGHEGAN.—I second that.

The resolution was unanimously carried.

The CHAIRMAN.—Will some shareholder now kindly move the resolution with regard to the auditors?

Mr. A. B. CROFT.—I move:—"That Messrs. Cooper Brothers and Co. be re-elected auditors for the ensuing year, and that their remuneration for auditing the accounts to the 31st December, 1917, be 600 guineas."

The HON. D. O'BRIEN.—I second that with pleasure.

The resolution was carried unanimously.

The CHAIRMAN.—I think, ladies and gentlemen, that concludes the business of the day. (Cheers.)

The proceedings then terminated.

"Sea, Land and Air"

IN the "Library Table" of our June issue we reviewed the first number of the new Australasian magazine entitled *Sea, Land and Air*, and a recent mail from the Antipodes has brought us two subsequent issues. The subject matter therein treated attains fully as high a standard as that in the maiden issue, whilst the presentation and format show a marked improvement. The two covers, particularly that of No. 2, are both striking and pleasing.

Amongst the many items of interest included in the new issues will be found one which must arrest the attention of every reader; we allude to "The Submarine Destroyer," an article specially contributed to this enterprising Journal by Ernest Osborne. Though a description of actuality, the article appears in narrative form, and is artistically framed in such a way as to arrest readers' attention from the moment that the wireless operator is instructed to rig up his wireless mast to the time when the destroyer crashes into the observation structure of the German craft and sends the great sea wolf to its doom 12,000 miles from home.

Issue No. 3 contains a remarkable series of exclusive photographs, telling the story of the excitements and adventures of Australian flying men in the Holy Land, and the six pages of illustrations convey a more vivid impression of the warfare and conditions of life in the Holy Land than could be imparted by twice the space devoted to descriptive text. The same issue contains an article devoted to an account of the work of Australian wireless signallers attached to our fighting forces. This article appears under the heading of "The Nerves of the Army" and has been specially written for *Sea, Land and Air* by Lieut. Horace J. Firth, A.I.F., a writer who has been on active service with various signal units since August, 1914, first in German New Guinea, and afterwards in Egypt, Gallipoli and France; who had the good fortune, moreover, to be at the landing at Anzac with a wireless section which was there and in action on the heels of the first attacking party.

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.*

R. R. (Southsea).—Rightfully, the Marconi uniform should only be worn by wireless operators in the employ of the Marconi Company. The company's students may only wear this uniform when authorised by the company's representative after passing certain tests. With regard to the transport badge, only those operators who are actually on the articles of His Majesty's transports are entitled to wear it. No matter how long an operator has been in the service of the Marconi Company he is not entitled to wear a transport badge if he is not so employed. Students and others who improperly carry this badge are rendering themselves liable to very serious consequences.

M. L. (Letchworth).—(1) You are quite right, it also depends upon the number of turns of wire. (2) The product of the volts and amps is roughly equal in both primary and secondary circuits, although owing to losses in resistance, etc., the secondary output is bound to be less than the primary input. Assuming no losses as above, the amperage in the secondary would be 8 milliamperes (0·008 ampere).

F. R. P. (Gillingham).—We are making inquiries regarding your case, and will let you hear further by post.

PRIVATE P. K. L. (Birmingham).—(1) You are partially right. Aeroplanes can now receive messages in flight, and while the engine is running. They do not use the magnetic detector, however! Further particulars we must not give. (2) Yes, a few, but only in a very limited way. After the war you may expect to see enormous strides in wireless telephony. Thanks for your good wishes; they are very welcome in these times of difficulty.

P. O. (Cliveleys).—So far as we know, yes, if other circumstances were favourable. Why not apply to the authorities and find out? They can tell you whether present conditions permit of it.

E. S. B. (Guildford).—(1) The receiver of a wireless installation can be tuned to many degrees of fineness. That is to say, it can be made sensitive either to a certain definite wave-length (this is called "sharp tuning"), or to a wide range of wave-lengths. Thus, if the operator at a station wishes to listen for any signals which may be about, he adjusts his receiver so that the tuning is not sharp. Then, when he hears a station on a certain wave, he tunes his instrument to be sensitive to that wave-length only. (2) No, not all stations. Ships of the Mercantile Marine are limited for certain reasons to two wave-lengths only: 300 and 600 metres. If more than two ships wish to work at the same time, and they are liable to interfere with one another, they are allotted priority according to certain rules. Land stations use a large variety of wave-lengths, some as long as 12,000 metres. The tendency is to increase wave-lengths for long distance working. (3) This is too large a question to be answered here. Briefly, by adjusting his transmitter to the wave-length of the other ship and endeavouring to overpower or "shout him down." How near he may need to be depends on the

powers of the two ships. A powerful installation can "jam" from a greater distance than a feebler one. (4) No. It can do both. German submarines make frequent use of wireless telegraphy in both transmitting and receiving. They sometimes wish they had not when a depth charge goes off!

RADIO (Falkirk).—Height, 5 feet (minimum). Chest measurement not defined, but must not be abnormally low.

H. H.—Articles on this subject written by authorities appeared in the issues of November, 1914, and January, February, March and April, 1915.

L. H. (Liverpool).—We cannot give the range of stations of 5 kw., 1½ kw., ½ kw., ¼ kw. and 10-inch coil installation without knowing: (1) Dimensions and shape of aerial; (2) ship or shore station; (3) if the latter, nature of surrounding country and form of earth connection, and about a dozen other factors. In reply to your second question, as you do not say for what purpose the aerial is used or the spacing between the wires in each case, it is impossible to give the information you require. Generally speaking, the longer aerial would be much superior. We cannot give any constructional details in wartime.

G. W. (Crystal Palace).—We believe a general commission is necessary.

C. H. P. (Harrogate).—One of the best books we know on the subject of small power transformers is *The Construction of Small High-Tension Transformer*, by T. E. Austin, price 4s. net. Our publishers will be pleased to obtain this for you. It is exactly what you require, and can be confidently recommended.

CALCULUS (Portsmouth).—The machine you mention is of patented construction, and has a winding quite different from that in use on most machines. Space will not permit of our describing it in detail.

N. B. X. (Glasgow).—Marconi operators do not have to wear swords, nor are they permitted to do so. Swords are only worn by certain officers in His Majesty's Army and Navy, and then not on all occasions. They are mostly ornamental in these days.

"SPARKS" (Belfast).—(1) There are normally only two grades of Postmaster-General's certificate, first class and second class. As a temporary measure, two other grades have been introduced—*i.e.*, temporary officer-in-charge and temporary assistant operator. The examination is the same in all cases, and which certificate is allotted depends upon the knowledge displayed by the candidate. The last two mentioned certificates are only issued in certain circumstances, and may no longer be issued when the present conditions alter; (2) this depends on the requirements at the time; (3) it is certainly a help; (4) the Marconi Company require an applicant to sign an agreement to serve at least one year. We are glad you like our magazine, and trust it will continue to be helpful.

C. L. B. (H.M.S. ——).—These questions are rather outside our province. We would suggest that you write to the Institution of Electrical Engineers.