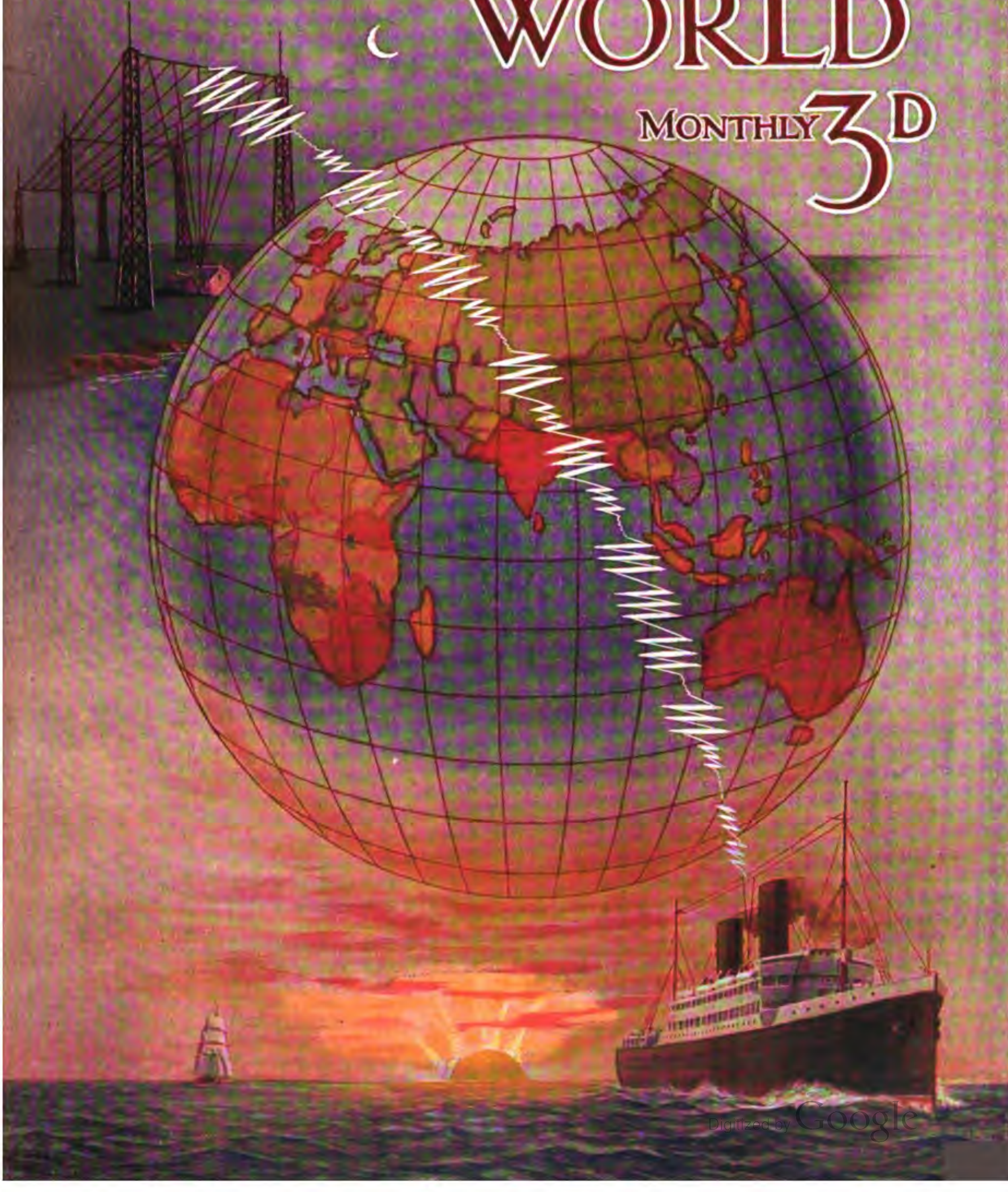
# WIRELESS WORLD

MONTHLY 3D



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THE WIRELESS WORLD

Vol. 3.—No. 30. (New Series) September, 1915. Subscription 5/0 per annum post free. Price 3d. Post Free 5d.

# WHAT WOULD HAVE HAPPENED?

WHAT would have happened during the past year if Germany had not been in wireless connection with America? Mr. Isaacs reminded the shareholders of the Marconi Company in a fine speech, reported elsewhere in this issue, of the fact that within a few hours of the declaration of war Germany's cables had been cut, and it was thanks only to the fact that she had not, like Great Britain, postponed her imperial wireless chain that she owed the preservation of many million pounds' worth of shipping and cargo. If it had not been for her wireless that would have been lost. If it had not been for her wireless the whole of Germany's Press campaign against England in the United States of America would have failed through sheer inanition. The U.S.A. would still have been full of "hyphenated Americans," whose efforts to serve their derelict Fatherland have made them notorious all the world over, but their Press artillery would have been useless for lack of munitions. As it is, these have been all the time provided in one steady unceasing torrent of radio-waves from the Fatherland. Such would have been one of the results of Germany's inability to communicate directly with America, but how about loss of communication the other way round? Let us suppose that Captain Boy-Ed, Count Bernstorff, and the egregious Dernburg had been unable to concoct their apparently innocent messages aimed at the destruction of British commerce. The German Pirate King would have been unaware of the dates of sailing, the routes, the cargoes, the armament, or lack of armament, of his possible victims. It is not impossible that the *Lusitania* might be still afloat, and that diplomatic relations between Germany and the States might not have been in the strained condition which characterises them to-day. We do not blame our cousins across the water; honourable persons like ourselves, they are prone to "think no evil." They, like us, have had to learn the lesson that they are dealing with a nation to whom confidence means not obligation, but an opportunity for villainy and deception. They are "still learning," and their recent action in the case of the Sayville station is one of the "firstfruits" of that knowledge.

Even as it is, with all the aid that wireless and their own duplicity have been able to give them, Germany is far from satisfied with the condition of affairs in which she finds herself. She is straining every nerve to devise fresh ways of communicating with the New World across the seas. Day by day in the American papers we find advertisements announcing that the German Atlantic Cable Co., of Cologne, in connection with the Commercial Cable Co. and the Postal Telegraph Co., offers the most direct cable route to Germany "and countries beyond," *via* the Azores. These routes can take messages by cable as far as Lisbon, but, in order to cross the intervening space into Germany, messages from the Peninsula are obliged to cross France or Italy, gallant Allies, whose territory and people form part of the belligerent forces investing the Teutonic Empire. In order to leap across the intervening space, there can be little doubt that the aid of wireless telegraphy has to be called into operation.

**CAPTAIN W. H. G. BULLARD,
U.S.N.**

# Personalities in the Wireless World

## CAPTAIN W. H. G. BULLARD, U.S.N.

THE recent appointment of the subject of our illustration to take charge of the Sayville (Long Island) wireless station, which has just been taken over by the United States Government, prompts us to believe that a few words concerning the career of this gentleman may be opportune at this juncture.

Captain William Hannum Grubb Bullard was born on December 6th, 1866, in the State of Pennsylvania, U.S.A. He early developed a taste for the life of the sea and his greatest ambition as a boy was to visit every quarter of the globe. In order to encourage this ambition his parents sent him at the age of sixteen years to the United States Naval Academy, and he graduated from that institution four years later (1886) with a brilliant scholastic record.

The next sixteen years of his life saw him on service in the United States Navy, and during that time his work carried him aboard various war vessels belonging to that country. At the end of this period of sixteen years Captain Bullard's sea life ceased, and his Government then commissioned him to look after important shore business in the United States Navy Department, having particular regard to electrical engineering, in which he had specialised throughout his career.

In 1912 the organisation of the Naval Radiotelegraphic service was seriously undertaken by the United States Government, and in November of that year Captain Bullard was appointed to the post of Superintendent of the Naval Radio service. In this position he has been the guiding spirit of the policy in regard to the development of wireless telegraphy in the United States Navy, and upon his department has devolved the responsibility of selecting sites and erecting the numerous high-powered radio stations situated at various points in the United States and its colonial possessions. When, as a direct result of the foundering in mid-Atlantic of the steamship *Titanic*, it was decided to hold an International Conference for Safety of Life at Sea, Captain Bullard was deputed to act as one of the delegates-plenipotentiary of the United States. In this connection he proceeded to London, where the Conference took place in November, 1913.

Reference has been made in the pages of this journal to the series of experiments carried out to determine longitude by means of wireless telegraphy. These trials were conducted between the Eiffel Tower station, at Paris, and Arlington station, in Virginia, U.S.A., and Captain Bullard was in charge on behalf of the United States Navy.

In the August number of our journal we printed an illustrated article on Germany's transatlantic wireless schemes in which it was shown that Germany had deliberately and persistently violated the neutrality of the United States in working this station. Under the care of Captain Bullard the Sayville station will now be worked by the United States naval radiotelegraphic operators, and, no doubt, under these new arrangements it will transact legitimate business and fulfil the uses which will be required of it by its present owners.

He is well known personally to radio engineers in England and on the Continent, as well as in the United States, and he is respected by all in the United States Naval service which he loves so well and serves so devotedly.

# The Influence of Temperature and Pressure on the Sensitivity of the Carborundum Crystal Detector.

By BERTRAM HOYLE, A.M.I.E.E., Assoc.M.S.T., School of Technology, Manchester.

## INTRODUCTION.

THE author has experimented on carborundum and other crystals used in wireless telegraphy, and thinks that a description of some of the results obtained may be of interest. He shows that at the temperature of liquid air carborundum ceases to be useful as a wireless detector; whilst at a high temperature of the order of 500° C. carborundum becomes very sensitive; in fact, more sensitive than under any other circumstances, even without the use of a local auxiliary voltage.

G. W. Pierce,* G. W. Pickard,† and P. Brenot ‡ and others have experimented on crystals of carborundum, and the conclusions arrived at by Prof. Pierce are as follows:

(i.) That the ratio $\frac{I_1}{I_2}$ of the two currents obtained for the same applied voltage in each direction diminishes as those currents increase.

(ii.) That the rectified current for a given alternating voltage is of the order $\frac{1}{2}(I_1—I_2)$ for the same continuous voltage.

(iii.) That there is distortion of the current wave form at or near zero due to $\frac{d\,R}{d\,V}$ being very great.

(iv.) That increasing one contact area and reducing the other gives larger rectification. Apparently, therefore, the rectification is conditioned by the localisation of the energy of the circuit at the high resistance boundary between two different classes of conductor—*i.e.*, the crystal and the metal contact.

[$I_1$ being the larger current.]

The experiments of Pierce (*loc. cit.*) were made at ordinary temperatures, but he makes the suggestion that it would be interesting to see what effect, if any, low temperature had on the unsymmetrical conductivity of carborundum. The author

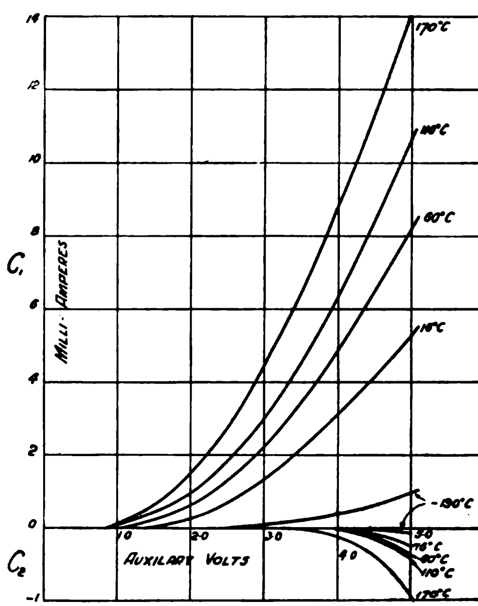


*Fig. 1.*

* G W. Pierce, on "Crystal Rectifiers for Electric Currents and Electrical Oscillations," *Phys. Review*, Vol. 25, p. 31, 1907; Vol. 28, p. 153, 1909.

† G. W. Pickard, on "The Carborundum Wireless Detector," *Elec. World*, N.Y., Vol. 48, p. 994, 1906.

‡ P. Brenot, on "Détecteurs à contacts imparfaits fonctionnant sans source d'énergie auxiliaire," *La Lumière Electrique*, Tome VIII., 2e Série, No. 48, p. 265, 1909.

TABLE I. CURVES 1 AND 2.

| Volts. c.c. and a.c. | Temperatures and Currents. | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | —190° C. Milliamperes. | | | +16° C. Milliamperes. | | | +60° C. Milliamperes. | | | +110° C. Milliamperes. | | | +170° C. Milliamperes. | | |
| | $I_1$ | $I_2$ | $Ir$ | $I_1$ | $I_2$ | $Ir$ | $I_1$ | $I_2$ | $Ir$ | $I_1$ | $I_2$ | $Ir$ | $I_1$ | $I_2$ | $Ir$ |
| 0·5 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 1·0 | — | — | — | — | — | — | — | — | — | ·02 | — | — | ·05 | 0 | ·05 |
| 2·0 | — | — | — | ·4 | — | ·2 | ·62 | — | ·35 | ·95 | — | ·65 | 1·5 | 0 | ·75 |
| 3·0 | ·1 | — | ·1 | 1·5 | — | ·65 | 2·3 | — | 1·1 | 3·0 | — | 1·7 | 4·4 | 0·01 | 2·1 |
| 4·0 | ·4 | ·01 | ·25 | 3·2 | ·04 | 1·4 | 4·9 | ·05 | 2·3 | 6·4 | ·07 | 3·5 | 9·3 | 0·1 | 4·2 |
| 5·0 | 1·0 | ·06 | ·42 | 5·2 | ·26 | 2·3 | 8·3 | ·32 | 3·7 | 10·8 | 0·38 | 5·8 | 14 | 1·0 | 6·7 |

has been experimenting with carborundum and other materials when worked as detectors in wireless telegraphy and has investigated the influence of low temperatures on many combinations.

The method employed was to apply an adjustable known c.c. voltage, first in one direction and then in the other, obtaining the value of the corresponding currents, $I_1$ and $I_2$ In the complete experiments an alternating voltage was also applied, and for the same voltages the mean rectified current obtained was always of the same order as $\frac{1}{2}(I_1—I_2)$ within the limits of experimental error; $\pm 5$ to 7 per cent.

A dash in the above table signifies that the current is less than 0·01 milliampere, and since this is negligible compared with the total range of current employed, and could not be shown on the graph, it has been omitted.

The curves show that at the temperature of liquid air the resistance rises considerably and that the mean unidirectional current obtained ($Ir$) for a given R.M.S. alternating voltage is reduced.

The high-temperature experiments described above were made before the low-temperature ones, since it was found to be very difficult to remove drops of water formed after the crystals had thawed without altering the pressure of setting and, therefore, affecting the constancy of the results obtained. The crackling due to the presence of a drop of water in the hot oil was sufficient to completely upset the constancy of readings obtained at any given voltage and temperature. The values of $Ir$ plotted agree very well throughout with $\frac{1}{2}(I_1—I_2)$, as Prof. Pierce has shown for ordinary temperatures, for carborundum.

The family of curves (Curves 1 and 2) were obtained with a crystal of carborundum supplied for use in the Marconi portable wavemeter; and they show that the effectiveness of carborundum is improved with rise of temperature above normal; apparently because the resistance is thereby reduced.

Employing an auxiliary pressure of four volts, the mean rectified current obtained at 16° C. is six times as great as that obtained at —190° C.; the applied R.M.S. voltage being constant. A further increase in $Ir$, amounting to about three times, takes place from +16° C. to +170° C. Temperatures much in excess of +170° C. could not be investigated without a different construction of apparatus. At +170° C. the oil

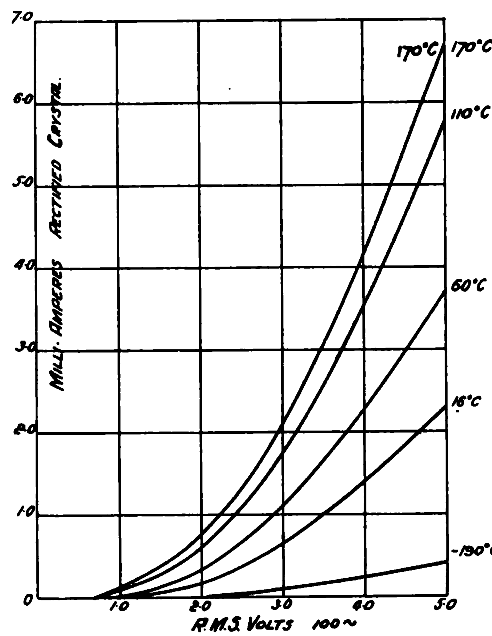

Fig. 2.

employed boiled or distilled off the lighter constituents and at 180° C. the solder or lead used for mounting melts and drops the crystals. On this account a totally different arrangement of crystal holder was devised by the author, whereby the crystals could be heated by radiation from a surrounding steel tube and their temperatures were determined by means of a copper-eureka thermo-junction. The constancy of temperature obtainable at 500°–700° C. was of the order of 5° C. change over a period of one minute, during which time all the necessary readings for one curve could be taken for that particular temperature. The crystal was subjected to an adjustable known pressure applied by means of a lever and running weights.

Various preliminary measurements were made, using an auxiliary voltage in series with the crystal, and the author found that over a wide range of strength of received signal the mean rectified current in the crystal circuit was a maximum for some definite auxiliary voltage, which maximum was a function of both temperature and pressure.

Maintaining the oscillatory current constant while raising the temperature was found to raise the maximum value of the mean rectified current obtained ($I_r$) and to lower the value of the auxiliary E.M.F. at which this occurs—*i.e.*, the optimum auxiliary voltage is reduced.

The following results embodied in Curve 3 illustrate the constancy of the optimum value of the auxiliary voltage for the temperatures. See Curves A and B at 16° C and A and B at 120° C. They also show that increasing temperature lowers this optimum auxiliary voltage; in the case shown from about 1·05 to 0·8 volts.

For Curves A: $V_{R.M.S.} = 0{\cdot}625$ volts. $\sim 0{\cdot}3 \times 10^6$ per sec.

For Curves B: $V_{R.M.S.} = 0{\cdot}3$ volts. $\sim 0{\cdot}3 \times 10^6$ per sec.

TABLE II. CURVE 3.

| V. (aux.) | Mean Rectified Current in Micro-Amperes. Ir. | | | |
|---|---|---|---|---|
| | Curve A. 16° C. | Curve B. 16° C. | Curve A. 120° C. | Curve B. 120° C. |
| 0·0 | 2·4 | 0·95 | 3·2 | 6·0 |
| 0·2 | 2·5 | 1·0 | 4·0 | 8·1 |
| 0·4 | 3·0 | 1·3 | 5·0 | 10·0 |
| 0·6 | 3·8 | 1·8 | 6·1 | 11·3 |
| 0·8 | 4·5 | 2·4 | 6·5 | 11·9 |
| 1·0 | 5·2 | 2·8 | 5·5 | 10·4 |
| 1·2 | 4·5 | 2·6 | 4·0 | 8·0 |
| 1·4 | 3·8 | 2·2 | — | — |

The author found it possible to make this maximum sensitivity occur at zero auxiliary voltage by suitably adjusting the temperature.

The following results embodied in Curve 4 show the type of result obtained; and in this particular case they show that the best temperature is about 500° C.

TABLE III. CURVE 4.

| Auxiliary Voltage. | Micro-amperes Rectified. Ir. | | | | | |
|---|---|---|---|---|---|---|
| | 16° C. | 150° C. | 280° C. | 400° C. | 500° C. | 600° C. |
| 0·0 | 1·05 | 3·0 | 6·4 | 10·4 | 12·4 | 0·2 |
| 0·1 | 1·2 | 3·3 | 6·8 | 12·0 | 14·5 | 0·5 |
| 0·2 | 1·35 | 3·85 | 7·75 | 13·0 | 12·2 | — |
| 0·3 | — | 4·2 | 9·0 | 12·0 | 10·5 | — |
| 0·4 | 1·8 | 4·85 | 9·9 | 10·5 | — | — |
| 0·6 | 2·25 | 6·25 | 9·2 | — | — | — |
| 0·3 | 3·0 | 7·1 | 8·8 | — | — | — |
| 1·0 | 3·35 | 7·1 | — | — | — | — |
| 1·2 | 3·2 | 6·1 | — | — | — | — |
| 1·4 | 2·85 | — | — | — | — | — |

The sensitivity obtained in the present case at 500° C. (optimum temperature) with zero auxiliary voltage is greatly in excess of that obtained at ordinary temperatures using the optimum voltage in the latter case. At any given temperature the sensitivity is a function of the mechanical pressure applied to the crystal contacts. Hence there must be some optimum pressure and temperature with no auxiliary voltage for a given crystal setting, which can be found by trial.

Oscillations having an R.M.S. value of 0·01 volts on the receiving circuit condenser were generated, the frequency of oscillation being 300,000 per sec., and train frequency

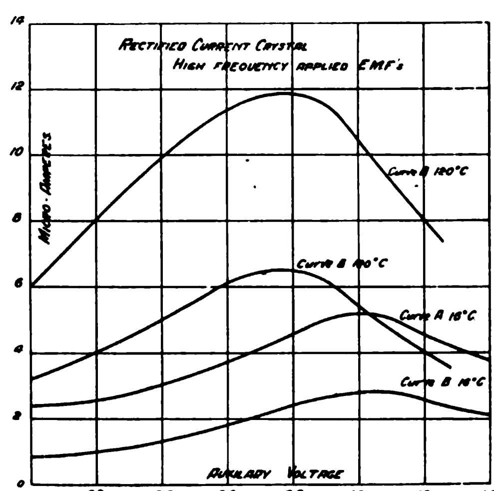


*Fig. 3.*

500 per sec. Readings were taken of $I_r$ at various mechanical pressures for various temperatures, from 16° C. to 550° C. for different grs. load on the crystal.

TABLE IV. CURVE 5.

| Temperature. | Micro-amperes Rectified. $I_r$ for Various Loads. | | | | |
|---|---|---|---|---|---|
| | 5 grs. (*a*) | 16 grs. (*b*) | 33 grs. (*c*) | 66 grs. (*d*) | 100 grs. (*e*) |
| 300° C. | 0·13 | 0·24 | 0·28 | 0·36 | 0·45 |
| 350° C. | 0·4 | 0·54 | 0·58 | 0·65 | 0·65 |
| 400° C. | 0·77 | 0·96 | 1·1 | 1·16 | 0·81 |
| 450° C. | 0·46 | 0·66 | 0·88 | 1·01 | 0·6 |
| 500° C. | — | — | 0·23 | 0·35 | — |
| 550° C. | — | — | — | — | — |

From other curves (not shown) the optimum temperatures and pressures are found to be 425° C. and 55 grs. load on crystal. Experiment on the crystal which had yielded the results expressed by Curve 5. showed that at 16° C. with 55 grs. load the optimum auxiliary voltage was 0·85 volts, at which voltage the mean rectified current was 0·3 $\mu a$ for the same oscillating voltage (0·01 v.) as used for the results given in Table IV. and corresponding curves (5).

Without an auxiliary voltage and at ordinary temperatures, the crystal in question showed no measurable $I_r$ (*i.e.*, not more than 0·01 micro-amp.) for the strength of signal used ($V_{R.M.S.}=0{\cdot}01$). The value of $V_{R.M.S.}$ was calculated, knowing the R.M.S. current, using a Duddell thermal galvanometer in the oscillatory circuit and knowing the capacity and train frequency.

In this case $V_{max.}=V_{R.M.S.}\sqrt{\frac{N}{8nd}}$,

$n$ being oscillation frequency$=300{,}000$,
N being train frequency$=500$,
$d$ being the logarithmic decrement$=0{\cdot}05$.

$$V_{max.} \doteqdot 0{\cdot}01\sqrt{\frac{500}{8\times 300{,}000\times 0{\cdot}05}} \doteqdot 0{\cdot}02 \text{ volts.}$$

Thus it is to be expected from previous characteristics of $I_1$ and V that no appreciable current flows for such a low voltage, Curves 1 and 2.

Another interesting point to be noticed from the results given in Curves 4 and 5 is that there is no rectification current obtained under any circumstances at 500° C. to 700° C. In fact, tests show that at these temperatures crystals of carborundum lose their unsymmetrical conductivity, and begin to obey Ohm's law. It is about 50° C. to

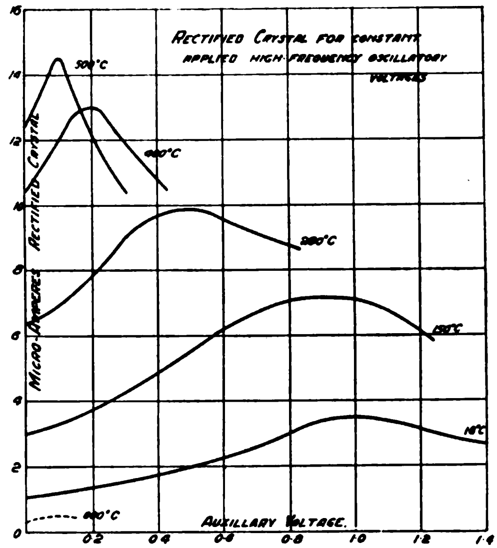


*Fig. 4.*

100° C. below this point that the best temperature is found.

For many radio-telegraphic measurements some form of detector giving a unidirectional current is highly desirable, but it must be constant and sensitive.

With good specimens of carborundum working at a high steady temperature with a suitable constant mechanical pressure applied, such measurements could be made with considerable accuracy. Carborundum hitherto has always been worked at ordinary temperatures with an auxiliary applied voltage, and is then of very stable sensitivity. Greater sensitivity, as has been shown, can be obtained by means of high temperatures with the additional advantage that the local auxiliary voltage and attendant apparatus is done away with. Thus it is not so much the experimental apparatus, *per se*, that is on the whole simplified, but a smaller amount of apparatus is in electrical connection with the receiver oscillatory circuit, and this reduces damping due to leakage and charging currents for such auxiliary apparatus.

CONCLUSIONS.

(i.) At the temperature of liquid air, —190° C., the ohmic resistance of carborundum is enormously greater than at ordinary temperatures for currents in both directions, and as a detector of oscillations the crystals become useless.

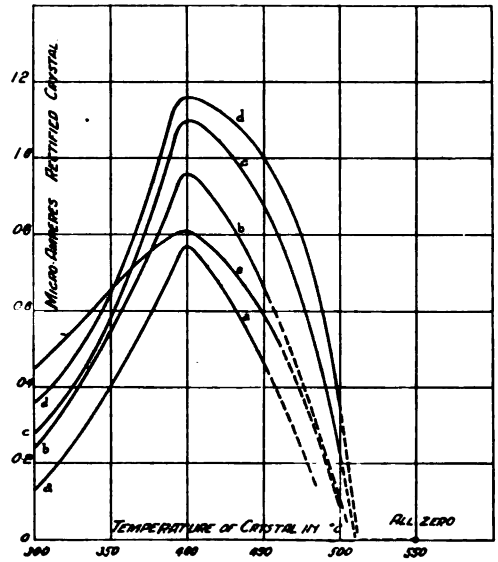


*Fig.* 5.

(ii.) At ordinary room temperatures (15° C.) the characteristic curves showing the relation between current and voltage show no appreciable current until a certain minimum voltage (from 0·5 to 1·5 volts) is exceeded.

(iii.) At ordinary temperatures it is well known that there is some "optimum" auxiliary voltage, and its value is in the neighbourhood where $\frac{d^2i}{dv^2}$ is a maximum.

(iv.) Rise of temperature up to a certain high value (500° C.) increases I*r*, other things being equal, when no auxiliary voltage is applied.

(v.) For a given crystal working at high temperature without auxiliary voltage there is an "optimum" mechanical pressure for the particular "optimum" temperature.

(vi.) By suitably choosing the crystal, the mechanical pressure, and the temperature, it is possible to obtain from ten to fifteen times the value of I*r* that one could obtain at ordinary temperatures without auxiliary voltage and for a given signal intensity.

In conclusion the author desires to thank the Manchester Education Committee for the facilities afforded for carrying out the above experiments at the wireless station laboratory of the School of Technology, Manchester.

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## "SPARKS" FROM THE TROOPS.

That the London electrical engineers are far from being depressed is evident from the cheery tone of their publication, *The Eclipse*, which contains some very amusing matter. The following conundrums, perhaps of a highly technical nature, are culled from the back page of the journal in question :—

Where did the Ammeter ? In the Magnetic Field.

Why do the British Forces offer such good resistance ? Because they are OHMS.

Why did the Voltage ? Because it was told it would Die-in-a-mo.

"You know we are leading a shocking life," remarked the medical coil to his partner, the dry cell.

"Yes, I think we shall have to rest soon," replied the dry cell. "I'm beginning to feel a bit run down."

## WIRELESS OPERATORS MUST NOT SWEAR.

A wireless operator in Massachusetts was recently admonished by the United States Department of Commerce for swearing by wireless, and warned that his licence would be revoked if he were not more careful with his language.

# Digest of Wireless Literature

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

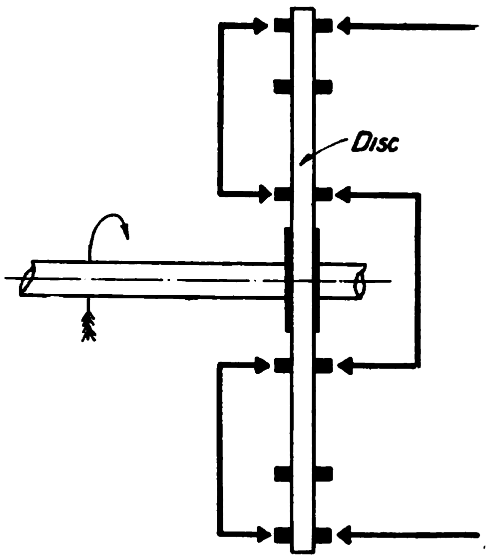
**SPARK-GAPS AND EFFICIENCY.**

In the July number of the *World's Advance* Mr. A. S. Blatterman contributes a paper of considerable interest to amateurs, under the title of "Spark-Gap Efficiency and a New Type Gap." Firstly, Mr. Blatterman refers to the spark-gaps used in the early days of wireless and the difficulties which had to be overcome. The first gaps were merely two brass balls, which rapidly became blackened and pitted by the oxidising and corroding action of the spark. With the introduction of higher powers it was found that this form of gap gave rise to a powerful arc following the first discharge of the condenser, which effectually prevented further oscillations. Various methods were tried for the purpose of overcoming the difficulty, amongst them being the use of a transverse magnetic field and a strong blast of air. Further experience led to the utilisation of resonance in the transformer circuits, the inductance in the circuit preventing the heavy rushes of current necessary for maintaining the arc.

The writer next deals with the subject of spark frequencies. The spark rate of apparatus using the early spark-gap in connection with induction coils, and later with transformers, was very irregular, so that the signals produced in the telephones at receiving stations were of a more or less crackling sound, often difficult to separate from the similar sound effects of atmospheric electricity. Wien, Austin, and others who investigated the subject of spark frequencies found that the telephone receiver as well as the human ear is not as sensitive to low-pitched sounds as it is to those of higher frequency, the best results being obtained with frequencies in the neighbourhood of 900 or so per second. Accordingly experimenters set to work to devise means for producing sparks of this frequency. Mr. Blatterman then refers to disc dischargers and the use of special alternators having a frequency in the neighbourhood of 500 cycles per second. What is required, says the writer, is a rapid, regularly recurring discharge, which is damped out after a few oscillations. An arrangement whereby tight coupling with high efficiency at the oscillation transformer can be utilised and still maintain single wave radiation is much to be desired.

After referring to the quenched gap and its requirements for successful working, the writer states that he has recently built a spark-gap of a rotary form, in which, instead of only two sparks in series, there are eight. By this arrangement the total discharge voltage is distributed over eight gaps instead of two, so that, while the total gap length through the discharger remains practically unaltered, the length of the individual gaps is reduced approximately fourfold. There is, says Mr. Blatterman, a certain peculiar advantage in thus dividing the discharge among several gaps in series. The possibility of arcing is greatly reduced, for the voltage required to maintain an arc in the gaps is approximately eight times that required to sustain the *arc* with a single gap, whereas the voltage necessary to produce a *spark* through the eight gaps is about the same as (and sometimes less than) that required for the single gap.

The construction of the discharger is next described and illustrated by diagrams. It consists of a disc of insulating material $\frac{3}{8}$ in. thick and 12 in. diameter, carrying 24 studs, which are threaded into the disc and clamped with lock-nuts. The fixed electrodes are arranged on each side of the disc, so that in passing from one terminal of the discharger to the other the current has to traverse the disc four times and pass through eight gaps. The manner in which




the gaps are arranged will be seen from the accompanying diagram.

Interesting particulars are given regarding the alloy used for the studs and electrodes. Copper and zinc were both found to have disadvantages, but an alloy of both proved very satisfactory. Finally an alloy was chosen in which copper predominated.

In operation the discharger is found to give excellent results. As far as the aerial current alone is concerned, the use of the eight gaps gives aerial ammeter readings from 20 per cent. to 30 per cent. higher than those obtained with two gaps.

In conclusion Mr. Blatterman states that it has been found that this series gap exhibits properties approaching those of impact excitation. This is due at least in part to the inherent cooling properties of the rotary gap and to the favourable relation of arc voltage to spark voltage in series gaps. The proper selection of a spark-gap alloy is of importance. In this connection zinc is one of the so-called non-arcing metals, and in general its addition to an alloy renders the alloy non-arcing. The series gap in the present case gives an improved power factor on the transformer and an increased overall efficiency into the antenna with lower aerial decrement.

## ELECTRICAL STRENGTH OF AIR.

At the Annual Convention of the American Institute of Electrical Engineers Professor J. B. Whitehead, of Johns Hopkins University, in dealing with the electric strength of air, outlined the experimental basis upon which the modern conception of the structure of the air rests, and described several resultant theories of the nature of high-voltage corona. One of the strongest evidences of the correctness of modern theories of the electrical behaviour of gases is found in their accord with the kinetic theory of gases. The conductivity of the air is due to its having mixed with it electrified particles, or ions—some positive, others negative. With uniform ionisation between two parallel plates and a voltage high enough to produce saturation the current increases with increasing distance between the plates. The current passing through a gas is equal to the difference between the number of new ions formed per second and the number which disappear by recombination and diffusion. One of the most important properties of gaseous ions is their motion through the gas under the influence of an electric field. Values of the velocities of the ions and methods of finding them for different gases were given. The charge on an ion is the same for all gases, its value being that carried by the hydrogen atom in the electrolysis of solutions. The author presented a brief history of the physical researches which led up to the discovery of the electron, following this with a review of conductivity due to electrons. The second half of the paper was devoted to theories of corona formation, including those of Townsend, Russell, and Davis, and developing in particular the first named, which argues that the corona may be explained on the theory of collision.

In the discussion which followed, Professor Ryan remarked that the theory of ionisation by collision is now merely in its infancy, but is rapidly growing. He said that the studies of corona phenomena have not been completed, citing the case of the effect of increase in the frequency upon the sparking distance. With a 15-inch gap only one-fifth as great an increase in the voltage is needed to break down a certain added length of air-gap, with a frequency of 90,000 cycles per second, as with a frequency of 60 cycles per second. This result is attributable probably to the holding over of the ionisation from cycle to cycle (*Electrical World* Report).

# Wireless in Darkest Africa

## *A Visit to the Aden-Berbera Stations*

AFTER having been roasted, broiled, skinned, and at times even driven to the use of bad language, by a burning sun mercilessly beating down out of a cloudless sky, cloudless from year end to year end, a request from the Editor for a few remarks about wireless in "DARKEST" Africa has anything but a stimulating effect.

On certain matters the mind of the native, undoubtedly, is plunged in impenetrable darkness, so in order to more or less justify the heading to these lines, and as an excuse for treating a serious matter lightly, a few remarks about the inhabitants of the particularly brilliantly-illuminated portion of "Darkest Africa" with which I am acquainted may not be out of place. As a rule the language employed to describe articles or phenomena which strike the imagination of the "unsophisticated savage" is full of poetic imagery, but in the case of "Wireless Telegraphy" there does not appear to be any feature which strikes the native imagination, and the Somaliland term "Tahf" applies to telegraphy "wired" and "wireless" alike.

In deference to the opinions of a particular friend of mine, who has been trying to humbug the native for as many years as I have spent months in trying to enlighten him—whose opinions I might add materially differ from anything and everything that has ever been written or said by any recognised authority on the subject—I will not attempt to trace the ancestry of the Somali. Sufficient for the present is the fact that he inhabits, graces or disgraces by his presence, the little known part of Africa whose littoral extends from French Somaliland eastwards along the southern shores of the Gulf of Aden to Italian Somaliland. He is rather a handsome ebony-skinned gentleman with features much more after the European type

*General View of Aden.*

*Natives carrying an extension pole for the Berbera Station.*

than those possessed by the majority of the sons of Ham. He is as proud as Lucifer, and his expression " Every Somali his own Sultan " should be ample justification for this statement. To see the gentleman in charge of the tennis boys of the Berbera Club swagger off duty in his white *tobe*, with his silver-headed ebony walking-stick thrust through his elbows and gracefully resting on his shoulders—practise this position, O ye Gilbertian readers!—is a veritable object lesson in gentlemanly outdoor deportment.

Not less genteel are the many ladies of the bazaar, who in spotless raiment and with ineffably graceful carriage haggle and barter over the fraction of a farthing with the Arab or Indian shopkeeper. When not under the direct surveillance of their lords and masters, the glad, glad eye is often lavishly flashed at the official who is fortunate enough, or unfortunate enough—according to his temperament—to be anywhere in the immediate neighbourhood. More interesting to the susceptible male heart is the picture of a string of burden camels being led by some dusky " gabad " (maiden) towards the open desert, what time her male relatives are lazily cleaning their teeth with a twig from a certain bush always used for the purpose. More often than not the human portion of a caravan carries its sandals swinging from its hands, but as to whether this method of treating footwear is the outcome of economy or comfort I am afraid I must refer the reader to my particular friend mentioned above.

A certain portion of the trading section of the Somali people travels quite considerably, Aden and the ports of the Red Sea and the Persian Gulf, as well as the more distant coast of British East Africa, receiving a fair share of attention. As a consequence electricity in its different manifestations is not entirely unknown to this section of the community, but as a matter of fact amusing incidents do occasionally arise on account of the ignorance of the great majority. I shall not forget in a hurry—and I feel convinced that the subject of my experiment will remember sufficiently well not to repeat his experience except under compulsion—the awe with which I was regarded by a native boatman, whom I invited to touch the sparking plug of a small detachable two-stroke petrol motor with which I had temporarily decorated the stern of his rickety craft. After a little persuasion I induced him to make a further essay, using a large spanner instead of his finger. The first lesson was not sufficient, but after receiving a second shock, in spite of the protecting spanner, and after almost precipitating the two of us into the sharkinfested waters of the harbour, nothing on earth would induce him to have any more dealings with the spirit-haunted machine. He did not appear to be quite sure whether Sheitan himself was in the machine, or whether I was the Evil One in person, but it must be admitted in his favour that he wished me to try on the same game with some of his friends who were loitering about the little jetty on our landing. On obtaining permission to explain matters to his friends, he proceeded with great gusto to enumerate the many delights consequent on contact with the sparking plug, but certainly appeared convinced that I was not exerting my Satanic powers and not playing the game when no result was forthcoming when his friends gingerly touched the now stationary engine.

Naturally, an electric shock, more than anything else connected with wireless telegraphy or electric lighting, creates the greatest impression, and even the educated native requires a practical demonstration before he acquires the slightest respect for high tension current. During the last few years a number of peons engaged as linesmen have become accustomed to slight shocks—mainly due to atmospheric causes—when erecting land lines. Of course, the substitution of wireless stations for land line offices and the policy of coastal concentration led to the rolling up of existing land lines, but during the last few months a new line has been erected into the interior. During the erection of this line, which on account of the dry nature of the country is capable of transmitting messages even when hundreds of yards of uninsulated wire may be lying on the ground, the linesmen were much surprised to receive more powerful shocks than before. When trying to demonstrate that the shocks were harmless I found that they were due to currents induced by the Berbera wireless station when transmitting, and that messages could be read by the sense of touch.

At one of the coast towns where a small wireless station was erected to take the place of a land line office the plain aerial system was adopted as being sufficiently powerful and economical. The original land line operators, who were Somali products of a French Catholic Mission which existed at one time in the country, took over the new station and successfully operated it within twelve hours of its completion. The only difficulties experienced were the adjustment of the spark and the manipulation of the hearer transmitting key. In justice to the European operator, however, it must be mentioned that the old land line was worked on the vibrator system, on which method reception is by means of the telephone headpiece, which reproduces signals of a type practically identical with those received on the Marconi wireless receiver. Further, the Somali operator could not, of course, have passed the qualifying examination for the Postmaster-General's certificate, but the

*Steamer Point and Post Office Pier, Aden.*

incident is mentioned as showing the remarkable aptitude shown by the Somali for tackling innovations. The housing of the instruments in a small wooden office was responsible for the leading in insulator occupying a rather low position. Although warned that contact with the insulator would have unpleasant consequences, the truth of the warning had to be driven home by actual experience. On seeing the operator in charge, who had carelessly touched the insulator with his head whilst transmitting—he insisted on standing up for so doing instead of using his instrument seated in the usual way—frantically holding his head with one hand and clutching the door jamb for support with the other, I was unable to refrain from laughter, and this gave rise to the worst case of disrespect encountered during my stay in the country. The poor fellow, with hair curlier than ever, and showing the whites of his eyes in a manner calculated to drive the cleverest Moore & Burgess corner-man into suicide, declared, "It all right you laugh, sir, but your head not fly in pieces all over the office."

*"Elephant's Back"—near Gold Mohur Valley.*

It has not often been the case hitherto that the introduction of wireless telegraphy into a country precedes that of electric lighting.

In the case of Somaliland, however, the employment of a mechanic to look after the small generating plant at Berbera led to the introduction of lighting plant in that town. A small 15 h.p. high-speed Gardner oil engine is used to supply the necessary driving power to a 9 kw. dynamo, which is utilised for charging up a 480 amp. howr. accumulator battery, the current from this battery being used by the lights and fans of Government House, the hospital, post office, club and bungalows of the European officials. Already various merchants of the Bazaar have asked for the supply of electric light, but the capacity of the plant precludes any possibility of their wishes being fulfilled for the present.

A description of the wireless stations at present under the control of the Protectorate has already appeared in THE WIRELESS WORLD (see issue No. 1 of April, 1913, pp. 7–13), but for the benefit of the more recent subscribers to this interesting monthly it may be as well to state that in addition to the 1½-kw. installations erected at Aden and Berbera in 1910 a third ½-kw. P.A. station has since been built at Bulhar, some 40 miles west of Berbera, for communication between the two latter ports. The Bulhar station does not deal with ship traffic.

It is anticipated that other stations will be erected in the near future, and on account of the interesting and difficult nature of the country the operations in connection with this work should form subject matter for a further interesting and illustrated article on Wireless in Darkest Africa.

The special utility of wireless telegraphy for opening up the difficult Hinterland of countries like Somaliland is admirably described in the account of "Wireless Telegraphy in the Italian African Colonies," contained in No. 12 of Vol. 1 (March, 1914). These regions have proved almost inaccessible even to the intrepid officers of the Italian Navy, but as soon as an expedition could be fitted out with field wireless apparatus, maintaining constant communications with land stations, the problem was solved and Italian peaceful penetration secured.

The cosmopolitan town of Aden forms the point of communication with the outside world. It is a city containing a very miscellaneous crowd of about 45,000 inhabitants, and forms the starting-point from which Europeans make their way into this land of unsophistication, as well as the goal of all returning travellers on their way home. Aden-Berbera have been fully dealt with in THE WIRELESS WORLD, No. 1 of Vol. 1 (April, 1913).

## A PROGRESSIVE CAREER

*A short biographical sketch of Mr. S. Fenn, late Traffic Manager of the Western Union Telegraph Company.*

THE recent retirement of Mr. S. Fenn, of whom we have the pleasure of reproducing a photograph herewith, has suggested to us that a few words concerning his career may be welcomed by our readers. Mr. Fenn at the time of his withdrawal from business held the position of Traffic Manager of the Western Union Telegraph Company, with which the Marconi Company works very closely.

The subject of our illustration gives yet another example of a man who has attained his position by hard work and sheer merit. He joined the London District Telegraph Company in 1866 as a messenger, and a few months later entered the service of the Electric and International Telegraph Company, also as a messenger. In 1868 he obtained his first appointment as operator with the Great Western Railway Company, remaining with them for two years, being stationed at Paddington and Southall stations for different periods. At the time of the transfer of telegraphs to the State in 1870 Mr. Fenn joined the Postal Telegraphs. A part of his service with the Government was spent in the Press division and at the special wire office of the *Scotsman* in Fleet Street.

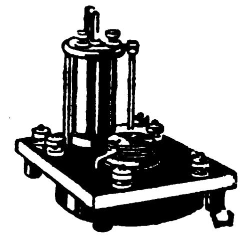
He was one of the first to join the Direct United States Cable Company at its inception in 1874, and was one of four to be first sent abroad to that Company's station at Torbay, Nova Scotia. Whilst serving in Canada, Mr. Fenn rose from the position of junior operator to that of superintendent. In 1910 the then manager of the Direct United States Cable Company died suddenly and Mr. Fenn was summoned to London by the Board of Directors and appointed Manager of the company.

Upon the amalgamation of the Anglo-Western Union and the Direct United States Companies under the title of the Western Union Telegraph Company, he was appointed Traffic Manager, and served in this position for nearly three years, retiring on July 31st last, having attained the age of sixty years.

Mr. Fenn's telegraphic experience extends over a period of fifty years, and altogether he forms an interesting example of "*Palmam qui meruit ferat.*"

*Mr. S. Fenn.*

# The ENGINEERS Note Book



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

## Porcelain High Tension Insulators.

IN a modern wireless telegraph station insulation of the apparatus is naturally of paramount importance, particularly in those parts of the installation which are traversed by high-frequency currents. So much is required of a good insulator that the number of substances that can be used for this purpose is strictly limited, whilst for the high-tension portions of the apparatus which are subjected to great mechanical strain—aerial insulators, for instance—the number of suitable materials can almost be counted on the fingers of one hand.

Amongst these last specially prepared porcelain is one of the most useful, possessing as it does not only a high insulation resistance but high disruptive strength, excellent non-hygroscopic qualities, and ability to withstand corrosive action by the atmosphere and sea-spray. For the benefit of wireless engineers and others concerned with its use we give below a few notes regarding the manufacture of special porcelain used for insulating purposes, in the hope that they may prove of interest.

At the outset it will be as well if we consider what is required of a good porcelain insulator. Firstly, it must be mechanically strong in compression and tension. Secondly, it should be tough, not brittle or fragile. Thirdly, it should be non-porous. Fourthly, it should be without appreciable cracks or flaws. Fifthly, it should have a fair uniform dielectric strength. Sixthly, it should have a permanent glaze free from cracks and roughness. We are not concerned here with the design of insulators; this will be dealt with in a subsequent issue. The reader should bear in mind the above requirements when reading the notes which follow.

The three main ingredients of electrical porcelain are feldspar, clay and silica. Both china clay and ball clay are used, the ball clay being added to the china clay for the purpose of giving the necessary plasticity. China clay itself is not sufficiently plastic for the manufacturer's requirements, as after the raw porcelain is dry it must retain sufficient coherence not only to hold itself together but also the ground-up particles of feldspar and flint.

The silicious constituent of the porcelain consists of powdered flint, quartz, sand or other similar substance, and feldspar is added to provide a flux. The greater the proportion of feldspar the lower is the temperature at which the porcelain will vitrify. The feldspar by its action on the silica dissolves it and forms a kind of glass, which in combination with the clay cools into a solid vitreous mass.

The greatest care is necessary in selecting the various ingredients, for any admixture of metallic impurities may cause a breakdown of the insulator at a much lower voltage than that it is required to withstand. Particular difficulty is experienced with the clay which has to be selected with exceptional care. The methods of refining the clay depend upon the nature of the deposits, but can be stated generally to consist of mixing the crude clay with water and allowing the impurities to settle. The comparatively light clay remains some time in suspension, whilst the sand and other impurities are precipitated with fair rapidity. The water containing the clay in suspension is run off and the clay allowed to settle, after which it is dried and prepared for shipment.

At the porcelain factory the various constituents are ground into an impalpable powder, and after being weighed are thrown into a tank. There they are thoroughly mixed with water so as to form a liquid of the consistency of cream, this liquid being technically known as "slip." After a thorough churning the "slip" is pumped off into filter presses and most of the water expelled under considerable pressure. The resultant cakes of raw porcelain are next hammered with large mallets and then sliced up and thrown into a "pug-mill," which consists of a cylindrical receptacle about five feet high, containing a set of revolving screw blades resembling the propeller of a boat. These blades cut through the plastic mass, squeezing out the air and forcing the material downwards. At the bottom of the receptacle an opening is provided through which the material is squirted, and as it exudes from the orifice it is cut into cylindrical pieces by means of fine wire. The object of the pug-mill is to ensure a thorough mixing of the component parts. It is sometimes necessary to pass the raw porcelain through this machine a second time.

Having been thoroughly mixed in the pug-mill, the plastic mass is next shaped roughly to the form it is intended finally to take. The degree of plasticity at this stage of manufacture is of considerable importance, for the rough "blank" must be sufficiently firm to keep its shape whilst the preliminary air drying is taking place. It must also be strong enough when fairly dry to be packed in the kiln, and in many cases sufficiently firm to be turned in a lathe.

As soon as the blanks are sufficiently air-dried the glaze has to be applied. In this portion of the process the handling of electrical porcelain differs essentially from that of ordinary pottery. In the manufacture of earthenware the glaze is applied after firing, and the process may consist of applying various substances to the red-hot material. In the case of electrical porcelain the glaze is not a different substance, but merely a similar porcelain with a higher proportion of feldspar, and therefore a lower fusing point. The glaze is applied to the surface by dipping the objects to be glazed into a tank containing the glaze material in suspension. The dry surface of the porcelain thus absorbs some of the liquid, and its surface retains a thin coating of the suspended matter. The blanks are then allowed to dry a second time, and fired. During firing the glaze melts and forms an impervious coating over the surface.

The firing process consists in placing the air-dried blanks in rough yellowish earthenware dishes known as saggers. The saggers are generally of cylindrical form, and, of course, have a much higher melting point than the porcelain they have to contain. It should be noted in passing that the blanks are not glazed where they come into contact with the saggers, for if they were the result would be that after firing the blanks would be firmly attached to the saggers by a cement of glaze.

*Porcelain Compression Insulators.*

In the kiln the saggers are stacked one on top of the other in tall columns, space being left between the columns for the heat to circulate. The usual kiln is bottle shaped, and the furnaces for heating it are arranged round the base. After the fires are started the temperature is very gradually increased, until after a number of hours a maximum temperature of 1,310 to 1,360 degrees centigrade is reached. This is maintained for a number of hours, and then the kiln is allowed to cool even more gradually than it was heated. The whole process occupies several days, depending on the size of the kiln. When all is cool the kiln is opened, the saggers unstacked and the porcelain parts taken out and examined for flaws. Those which on visual inspection seem perfect are passed on for the elaborate electrical tests to which all electrical porcelain is subjected before issuing from the works.

It is the aim of all manufacturers of such porcelain to avoid making the product porous. Porous porcelain will absorb moisture, sometimes in considerable quantity, and as a result its insulation value will be greatly decreased. Porosity may result if the proportion of flux is too small, but, on the other hand, if too much flux is included the porcelain will be over-vitrified and brittle. Only very careful selection of materials and accurate proportioning of parts will avoid the difficulty.

A second aim of the manufacturer is to obtain homogeneity of structure. Unless the raw porcelain is perfectly homogeneous on leaving the pug-mill it will tend to develop flaws through unequal drying, and separation into laminations and local spots which are not fully vitrified together.

Great care is also required in the process of air drying. If a number of articles composed of raw porcelain are set to dry in a room where the temperature and atmospheric conditions are not satisfactory, it is likely that too rapid drying may occur and the objects become subjected to severe internal mechanical strains. Still another critical stage occurs in the kiln at the commencement of firing. At a temperature of 400 to 500 degrees centigrade the water of composition of the clay is thrown off and a considerable decrease in weight occurs. It is evident that the removal of a considerable amount of water from the clay in a comparatively short time must be accompanied by no small internal change in the green porcelain, and great care has to be exercised to prevent too rapid a rise in temperature, which may cause the objects to be warped and puffed up. If air-dried porcelain is placed directly into a hot electric furnace it will be reduced to a powder.

Vitrification, like every other stage in the preparation of the porcelain, is attended by certain risks. It may briefly be stated to depend not only on the temperature to which the porcelain is subjected but also to the duration of the high temperature.

In a further article we hope to deal with some points in the design and testing of porcelain insulators. Readers who are interested in the subject are recommended to obtain the Proceedings of the American Institute of Electrical Engineers for May, 1915, where a lengthy and exhaustive paper by Mr. E. E. F. Creighton is reproduced, and which has provided us with many of the particulars contained in the present article.

# Administrative Notes.

## HOLLAND.

THE following is communicated by the Netherlands authorities regarding meteorological radio-telegrams from Scheveningen, and emphasises one of the varied uses to which wireless telegraphy is put :—

"On and after July 1st the station "of Scheveningen Harbour will send at "11.15 a.m. and p.m. (Greenwich time) a "meteorological radio-telegram in Dutch "and French, followed by a storm signal "whenever necessary, and also a notice to "mariners in Dutch and English."

The meteorological radio-telegram will be preceded by the letters KNMI, and will consist of four sets of two groups of five figures each for the stations Helder, Flushing, Gris Nez, and The Hague ; and, further, of four sets of two groups wherein one group will have five and the other group will have four figures each for the stations Yarmouth, Shields, Skudnaes, and Sylt, according to the scheme BBBWW SHTT(G). In this scheme BBB stands for the atmospheric pressure in tenths of a millimeter, omitting the 700, WW indicate the direction, and S the force of the wind ; H gives the condition of the sky and weather ; TT the temperature in centigrade degrees, 50 being added to temperatures below 0° C ; G indicates the condition of the sea, all being according to the scales given below.

Following the above will come, if deemed important, first, the storm signal, *e.g.*, warning signal, signal of shifting south-east storm ; second, the notice to mariners preceded by the letters NBAZ, *e.g.*, wreck, mouth Hook of Holland.

The scales according to which the above information is reported are as follows :—

Every observation that is missing for each station is replaced by an appropriate number of X's.

Examples of meteorological radio-telegrams from the first and the fifth of the eight sets of two groups KMNI are 69010–21541 and 57316 – 4405 ; their translations follow :

| HELDER. | YARMOUTH. |
|---|---|
| Barometer, 769.0 mm. | Barometer, 757.3 mm. |
| Wind direction, E.S.E. | Wind direction, south. |
| Wind force, very light. | Wind force, moderate. |
| Sky, slightly cloudy. | Sky, overcast. |
| Temperature, 4° C. | Temperature, 5° C. |
| Sea, very fine. | |

| Wind. | | | | Conditions of sky and weather. | | Condition of Sea. | |
|---|---|---|---|---|---|---|---|
| Direction. | | Force. | | | | | |
| WW. | Significance. | S. | Significance. | H. | Significance. | G. | Significance. |
| 00 | Calm ... ... | 0 | Calm ... ... | 0 | Clear ... ... | 0 | Smooth. |
| 02 | N.N.E., etc. ... | 1 | Almost calm ... | 1 | Slightly cloudy ($\frac{1}{4}$) | 1 | Very fine. |
| 06 | E.N.E., etc. ... | 2 | Very light ... | 2 | Cloudy ($\frac{1}{2}$) ... | 2 | Fine. |
| 08 | E., etc. ... ... | 3 | Light ... ... | 3 | Very cloudy ($\frac{3}{4}$)... | 3 | Slightly rough. |
| 12 | S.E., etc. ... ... | 4 | Moderate... ... | 4 | Wholly overcast... | 4 | Rough. |
| 16 | S., etc. ... ... | 5 | Rather high ... | 5 | Rain ... ... | 5 | Swell. |
| 20 | S.W., etc. ... ... | 6 | High ... ... | 6 | Snow ... ... | 6 | Heavy swell. |
| 24 | W., etc. ... ... | 7 | Very high ... | 7 | Mist ... ... | 7 | Heavy sea. |
| 28 | N.W., etc.... ... | 8 | Violent ... ... | 8 | Fog ... ... | 8 | Very heavy. |
| 32 | N., etc. ... ... | 9 | Storm ... ... | 9 | Storm ... ... | 9 | Violent. |

# Wireless Telegraphy in the War

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

THE recent sinking by a British submarine of the Turkish battleship *Hairredin Barbarossa* again calls attention to the Turkish Fleet, which, never a large one, is rapidly approaching the stage of non-existence. Purchased from Germany in the summer of 1910, this recently torpedoed battleship was of about 10,000 tons displacement, mounting six 11-in. guns and fitted with modern equipment. Our illustration shows the Turkish wireless operating staff on board, and the apparatus standing on the table in front of them consists on the one side of Marconi instruments and on the other side of Telefunken. It is to be supposed that, in view of the grabbing of all power in Turkey by the Teutonic candidates for world domination, only the Telefunken apparatus now remains. The Turks make quite good operators of a mechanical kind, and the practice which they had during the Balkan War increased their efficiency in a marked degree. British operators on ships trading in the Mediterranean during the Balkan struggle well remember the clear ringing spark which characterised the Constantinople station calls when working with Adrianople and the Turkish Fleet in the Dardanelles.

* * *

Dispatch-Rider Relf Gurney, son of a Hereford Alderman, in a recent letter home, describes very vividly the way in which wireless aids the fighting man right at the front.

"I'm sitting in a hole," he writes, "with the wireless operator and the telephonist. The wireless man removes his cigarette from his lips, carefully puts it out, places it behind his ear, and bends over his instrument. He then starts to scribble on his message pad.

"I lean over, and read the words 'Just leaving. Shall be with you in four minutes.' The telephonist transmits the message to the gun, and almost immediately a white speck appears on the sky, and the drone of a powerful engine is heard. The operators adjust their instruments for the last time, and fit their earpieces more firmly on their heads.

"'Pre-

*Wireless Staff on the "Hairredin Barbarossa."*

pare for action,' writes the wireless man. The message is duly transmitted, and I stuff cotton-wool into my ears. 'He will get it in a minute,' mutters the telephonist; and, sure enough, as he speaks, a huge white ball of smoke appears to the left of our machine.

"The flying man makes a graceful detour with his machine, and then takes up his original course once more. The wireless man stiffens again, stoops, and writes; this time, a jumble of figures and numbers, or so it appears to me, and, as they are transmitted, the huge barrel of the gun moves slowly, and at length comes to rest. The gun team stand clear, the lanyard is pulled, and the gun runs back 'midst a huge cloud of dirty smoke. It is immediately followed by a deafening roar, whilst the projectile is heard screaming away over the enemy's lines.

"While the gun is being re-sighted for a second shot, we in the 'dug-out' anxiously await the wireless message from the skies, telling us the effect of the shot. 'Fifty yards short,' says the operator. 'Fifty yards short,' repeats the telephonist. With great care, the gun-sighting is corrected, and again a shell is sent hurtling towards the target. The anxious wait follows; our wireless man taps impatiently with his pencil; I light a cigarette to while away the seconds. 'Good!' the operator exclaims, 'direct hit; fire six more.' Thus he writes down the message from our air craft. And, as the gun is again re-sighted, its smoking muzzle seems to smile at the sheer pleasure of the gunners at their wonderful work."

* * *

*Senatore Marconi.*

We print an excellent photograph of Senatore Marconi in his Italian uniform, perhaps one of the neatest and most artistic of any active service uniform in the world. At a period of national crisis, such as that which is being shared with Great Britain by Italy, the possession of a man like Guglielmo Marconi constitutes a national asset of no mean importance, of which the King and people of Italy are well aware, and in this case, at all events, we have a contradiction of the popular proverb, "A prophet is without honour in his own country."

* * *

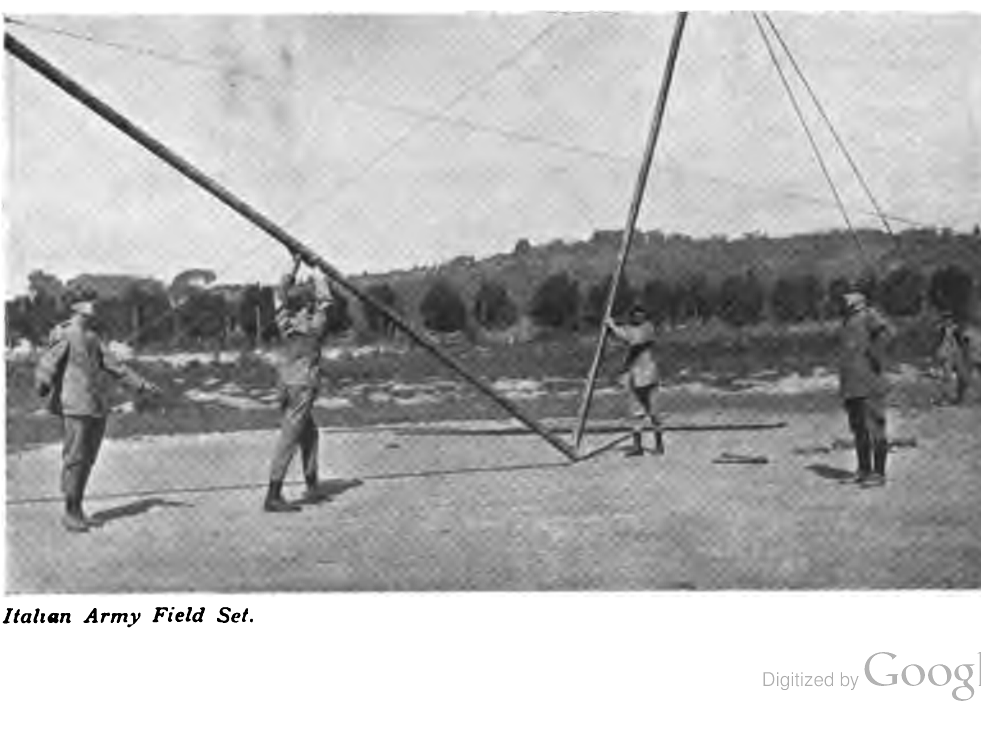
A long and interesting account was recently published by our contemporary the *Southport Visitor* dealing with life on an armed merchantman. Lieutenant Boothroyd, who tells the story, was called out as a reservist at the beginning of the war, and has only just recently been allowed home on leave. As might have been expected his account was full of the utility of wireless. These cruisers practically rely not only for their information, but for their actual directions from headquarters, on their wireless equipment. The sinking of the *Kaiser Wilhelm der Grosse*, the depredations of the *Konigsberg*, etc., were all reported through this medium. The destruction of the German wireless at Swakopmund is referred to as one of the most important factors telling in favour of the British for hundreds of miles radius, whilst his account plainly indicates that the powerful inland wireless station at Windhoek operated and influenced proceedings far out at sea, until its activities were destroyed by the British Boer Army under General Botha.

* * *

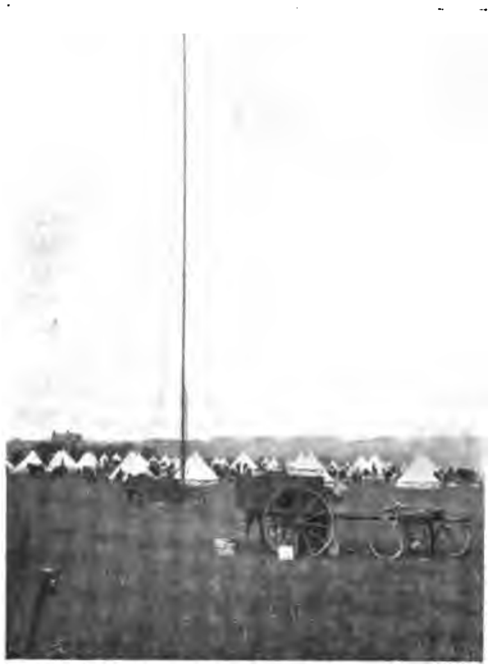
Our illustration shows a picture of the Italian Army radio-telegraphic engineer in the course of erecting one of the wireless stations which now form an inseparable part of operations in the field. The army led by General Cadorna is particularly well equipped in this respect, and the Italian field telegraphists are second to none in smartness of erection and working.

*Lt.-Gen. Cadorna.*

The interest taken in wireless operations starts nowadays at a very early age, and we find that the press which specially caters for youth contains articles of wireless. A



*Italian Army Field Set.*



*Royal Engineers' Field Set.*

very informative and well written account is given in the *Boy's Own Paper* current issue, from the pen of Mr. Raymond Raife. The field wireless which is being so freely used by all sides in this terrible world-conflict figures prominently in the article, which should give lads a very adequate conception of its scope and utility. The work of the Royal Engineers (whose field wireless installation figures in our illustration) is graphically described by means of an extract from a letter written at the front by one actually engaged in the operation, whilst the various graphic episodes of the war, like the "God save the King" message sent out by Admiral Sturdee, the destruction of the *Emden*, etc., are narrated in a way likely to appeal to the heart of every English boy.

* * *

Mr. Bonar Law recently emphasised in detail the same moral as that more briefly emphasised by Mr. Godfrey Isaacs—namely, that from a national point of view the importance of wireless far exceeds that of its cable rivals; not only is it infinitely superior from the point of view of economy, as valuable from the point of view of efficiency, but its superiority from the point of view of vulnerability has been demonstrated not by words but by the stern logic of actual experience.

* * *

The slice of Belgian territory still remaining under the jurisdiction of King Albert is small in extent, but its activities have adjusted themselves in inverse proportion. Nieuport, whose wireless station forms the subject of our illustration, consists of two parts, Nieuport Bains and Nieuport Ville, the former being situated on the coast and the latter about two miles from the sea. The history of the mast in our illustration is somewhat eventful as masts go. It was originally erected at La Panne, but at the time when experiments were being made with regard to wireless messages to the Belgian mail-packet boats the mast was removed from La Panne and erected at Nieuport Bains. Its distance from Ostend is but twelve miles, and the station lies sufficiently close to the German lines to form a target for their artillery. There has been, therefore, some uncertainty as to whether it would not be well to take down the mast for the second time.

*Nieuport Wireless Station.*

# NOTES OF THE MONTH

THE Press has recently contained some references to the connection between X-ray outfits and that of wireless telegraphy. Wireless telegraphy uses very large induction coils, and X-ray operators also use very large coils, far bigger even than for wireless intsallations. Hence there comes the difficulty: "Shall the Postmaster-General confiscate all the coils?" He has the right to remove every part of a wireless apparatus, but where will his officials end their labours? Of course, no one imagines for a moment that there will be a raid on the huge induction coils that do the X-ray work in our great hospitals, but what about the little installations of the country doctors, who have endeavoured to help their patients by having their consulting rooms up to date? The power of the "coil" possessed by a private practitioner may be very small when compared with that used in a town or city hospital, but it represents something he has paid for and would be very sorry to part with.

The Postmaster-General is doubtless worried enough, but there are already complaints about the way his instructions are being carried out. The British constable may be the best in the world, but it is no part of his duty to distinguish between an X-ray apparatus and a wireless installation. It would be a comparatively simple matter to register each X-ray operator in the country—as there are not so many of them after all. But until this registration is carried out all attempts to cut out private wireless installations will either be futile or harmful. They will be futile so long as they leave a single X-ray apparatus in a house inhabited by an enemy, and they will be harmful if the X-ray diagnosis and X-ray heating is taken out of the hands of medical practitioners.

An X-ray installation, although having nothing to do with wireless telegraphy, could be turned into a wireless station by a clever operator in about ten minutes. Should every doctor who has an X-ray outfit surrender it to the Government? It seems so.

* * *

Among the eminent gentlemen who have been asked to sit on the Committee presided over by Lord Fisher of Kilverstone, we note Sir Oliver Lodge, F.R.S., the Principal of Birmingham University and an authority on electricity, wireless telegraphy and mechanics; Mr. W. Duddell, F.R.S., a leading authority on electricity and wireless telegraphy, whose portrait and biography appeared in our April, 1915, issue; and Sir William Crookes, O.M., F.R.S., LL.D., who has interested himself fairly considerably in radio-telegraphy. These gentlemen are members of the Inventions Board, which was established to assist the Admiralty in co-ordinating and encouraging scientific efforts in relation to the requirements of the naval service during the war.

* * *

The Archbishop of York, who recently paid a pastoral visit to the Grand Fleet, strangely enough makes no mention of the pastors serving permanently with the Fleet. The duties of this individual are manifold. We do not hold a brief for him, but from what can be gathered it appears that he is very hard worked and very inadequately paid. Apart from his spiritual functions, which we maintain should receive his first consideration, he is expected to undertake all sorts of general work which apparently cannot be imposed on a layman. These include the censoring of letters and parcels, acting as schoolmaster and instructor, fulfilling the office of sea-lawyer, and coding and decoding wireless messages. Although we think that because a man happens to be a priest it should not be assumed that he should do no material work; yet we certainly feel that, to take the example which interests ourselves (that of coding and decoding wireless messages) he should be excused. After all, naval telegraphists are appointed for that special work.

* * *

In its issue of July 31st the *Nation* publishes a letter from Sir Laurence Gomme, who queries whether "the Welsh Fairies" once upon a time knew the secret of wireless telegraphy. Of course, it is very open to question whether there were any fairies at all, but for the sake of argument let us assume that such creatures once existed. Sir Laurence writes:

"A great deal of so-called magic was "the result of a comprehension of natural "phenomena which we are slowly dis- "covering by the operations of science. "... But direct proofs are not readily "forthcoming. I have collected some of "these possible proofs, but I do not think "any of them are quite so remarkable as "the following passages from the Mabinogion "Welsh traditions of the tenth century, "which seem to point unmistakably to the "operation of wireless telegraphy:

"'1. Three plagues fell on the island of "'Britain. . . . The first was a certain "'race that came, and was called the "'Coranians; and so great was their "'knowledge that there was no discourse "'upon the face of the island, however low "'it might be spoken, but what if the wind "'met it, it was known to them.

"'2. The two brothers Lludd and "'Llevelys took counsel together to dis- "'course on the matter otherwise than thus, "'in order that the wind might not catch "'their words nor the Coranians know what "'they might say. Then Llevelys caused "'a long horn to be made of brass, and "'through this horn they discoursed. But "'whatsoever words they spoke through "'this horn one to the other, neither of "'them could hear any other but harsh and "'hostile words. And when Llevelys saw "'this, and that there was a demon thwart- "'ing them and disturbing through this "'horn, he caused wine to be put therein "'to wash it. And through the virtue of "'the wine the demon was driven out of "'the horn. . . .'

"These passages occur in 'the story of "'Lludd and Llevelys,' and they seem suf- "ficiently curious to warrant a request for "some criticism of my suggestion from the "technical science side. Sir John Rhys "kindly tells me that the translation from "the Welsh text is quite accurate. He has "alluded to these passages in his 'Celtic "'Folklore,' vol. 1, pp. 195-6, where he "draws attention to an account of Welsh "fairies, printed in 1813, in which it is stated "that 'the fairies knew whatever was "'spoken in the air without the houses, not "'so much what was spoken in the houses.'"

These assertions are certainly very remarkable, although we feel inclined to believe that they are due to those mysterious influences from the realms of legend. Anyhow, we give them to our readers for what they may be worth.

* * *

The following appeared in a recent issue of the *Times*:—

"Lord R. Cecil, in answer to a question in "the House of Commons with regard to the "neutrality of the Colombian Government "and the question of the wireless telegraph "station at Cartagena, said His Majesty's "Government were convinced that the "measures taken by the Colombian Govern- "ment to control the use of wireless tele- "graphy in Colombia would, if effectively "and adequately carried out, be sufficient "to prevent the abuse of this means of "communication in the interest of our "enemies. The Government of Bogota had, "moreover, caused a preliminary inspection "by a neutral wireless telegraph operator "of the station of Cartagena, in order to "ensure the efficient local execution of their "instructions; and they had further stated "that a competent neutral would be invited "to inspect this station and report upon the "adequacy of the measures taken, so that no "doubt might remain that their instructions "had been effectively carried out by the "local authorities."

# Maritime Wireless Telegraphy

OUR readers will recollect the account of a fire which occurred on board the s.s. *Benalla* off the south-east coast of Africa, towards the latter part of July last. This ship had 800 emigrants aboard when the fire was discovered, and consequently the aid of wireless telegraphy was sought. The operator of this ship sent out the distress signal, and in response thereto the *Otaki* went to her assistance. It transpired that the cargo in No. 1 hold was ablaze. The *Otaki* was 150 miles off when she picked up the wireless call, and immediately changed her course. The fire was eventually "got under" and both ships arrived safely in port. The *Benalla* belongs to the Peninsular and Oriental Steam Navigation Co., and is a vessel of 11,118 tons gross, built in 1913.

* * *

How useful Senatore Marconi's invention is in such vast wastes of ocean as the Pacific was recently demonstrated in connection with the loss of the British cable ship *Strathcona*. This ship belonged to Auckland, New Zealand, and was wrecked in the South Pacific near the Fiji Islands. The crew took to the boats, and the cable layer *Iris*, which was in company with the doomed vessel, essayed to rescue the survivors. It was here that wireless telegraphy was brought into use. The *Iris* found one boat load, and was able to keep the islanders at Suva (Fiji) closely in touch with her doings and the result of her attempts.

* * *

Some months ago we recorded an instance of how medical aid was requisitioned by wireless at a Mexican-Atlantic port. In the instance which we recount now a Tampa doctor diagnosed the sickness of a sailor on board a tug. The sailor complained of a pain in his left arm, which began to swell, and a high fever developed. All sorts of suggestions were made for relieving the man, but no rules could be found in the first-aid book. As a last resort the wireless operator sent a wireless message, and the doctor sent the following prescription:

"Make saturated solution boric acid in "water. Wrap arm from shoulder to "hand. Keep it soaked in hot solution. "Get man ashore as quickly as possible. Is "blood poison. If boric acid unobtainable, "make solution one five-thousandth bi-"chloride mercury in water."

Unfortunately these medicines were not available on board, and so the ship immediately made for the nearest port. The operator kept in wireless touch with the shore, and a tug was despatched to meet the steamer. The man was landed, and, although he had been in a position of extreme danger, the tide turned in his favour, and he eventually became completely cured.

* * *

Seldom indeed are the magnificent vessels belonging to the Canadian Pacific Railway, which ply between Canada and Japan, to be seen on this side of the Atlantic, but war

*Deck of "Empress of Asia."*

*Ss. "Empress of Asia" and "Empress of Russia."*

upsets all arrangements, including the itineraries of steamship companies. It is due to this fact that the *Empress of Asia* and the *Empress of Russia* have been ploughing the waves of regions not their own, engaged in duties which it has been found necessary to allocate to them, and therefore the hopes and appreciation of travellers must be deferred until peace once more reigns over the blood-stained fields of Europe. These magnificent vessels feature an innovation for large passenger steamers. This is the "cruiser stern," and our photograph above well illustrates it, especially that of the vessel on the right. These steamers are fitted with the standard 1½ kw. set. Our small illustration (see previous page) shews the deck of the *Empress of Asia*. Unfortunately, the Marconi cabin is not visible.

* * *

We have just received a copy of the *Musen Dempo Shimbun* (the Pacific Wireless Daily News). This interesting little journal is published on board Japanese steamers, and is of the same nature and category as the wireless ocean newspapers published on board a number of the larger steamers having European ports as their home terminal points. The general scheme of these newspapers is that of supplying passengers on board the modern ocean greyhounds with the latest and most up-to-date news of the world's happenings whilst they are temporarily "lost" on the ocean. The journals are filled with interesting matter ashore, but several pages in the centre are left blank, and it is on these that the news received by wireless telegraphy is printed.

The Norwegian Salvage Company has just had delivered to it the new large salvage steamer *Salvator*. She will be stationed for some time at Ecort near Archangel in the White Sea. She is in every respect well equipped for the work likely to be required of her. Strong winches are situated on the fore-deck and one of smaller capacity aft, together with powerful salvage pumps capable of dealing with an aggregate of 4,000 tons of water per hour, and she is capable of travelling at a speed of about twelve knots. Her fittings comprise a wireless telegraphic installation having an actual radius of 250 miles, which will no doubt be of great use to her in her work.

* * *

An unique feature of the expedition undertaken by Sir Ernest Shackleton to cross the Antarctic Continent is the arrangement made for a service of news messages to be despatched by the Port Stanley (Falkland Islands) station. This is made possible by the loan by the Marconi Company to the expedition of a complete installation for the reception and transmission of messages, and by the action of the Falkland Islands Government in arranging the service clear of all charges.

It can easily be imagined the source of pleasure this will be to the expedition, who are now wintering somewhere in the vicinity of the Weddell Sea. The installation is in charge of Mr. R. Jones, physicist attached to the party, who is to transfer the set to a shore station in the South. A directional aerial is to be erected towards Port Stanley. Naturally the service will

*The "Endurance."*

not be extensive, a short message being despatched broadcast at 2 a.m. on the first and fifteenth day in each month. The arrangements were made by letter, and before a reply could be sent to Sir Ernest the expedition had sailed from Buenos Aires. Otherwise a weekly service would have been arranged. Unfortunately, the *Endurance* did not call at Port Stanley as originally arranged, but proceeded instead *viâ* South Georgia. This was owing to the naval situation then prevailing in the southern waters.

Apart from this use of the installation, much valuable work will be carried out in the observation of wireless phenomena in the South. Probably the Port Stanley station will be greatly observed, being one of the most southerly stations in the world, and at the same time the nearest to the base of the expedition. The distance is roughly 1,100 miles.

Another great advantage will be the observation of time signals emitted by the Argentine Government station at New Year Island every Saturday night at midnight G.M.T. This will enable the observers to define accurately their position, and in consequence be able to chart the coast with far greater precision than has hitherto been possible with chronometers, owing to their unknown ratings in extreme cold.

No endeavour is to be made to communicate with Port Stanley, as the power supply is not considered sufficient to cover the distance, but perhaps under favourable conditions it will be possible, owing to the great range of comparatively small stations in the Far South, and also the remarkably good receiving practice at Port Stanley.

It is to be deplored that more complete arrangements were not made, with the view of obtaining a definite programme, as with a greater mutual understanding much could be done in the way of direct communication if it is at all possible. As things stand, it is doubtful if the observers know what range of wave-lengths are available at Port Stanley, and it is, of course, almost impossible for them to pick up one of the longer waves, as the chances are all against their being on watch on a particular wave at a time when that wave is in use. Also it is impossible for the operators at Port Stanley to know if the signals are being received at any particular time.

Consequently the service is not as full as it might have been, and is being carried out on a wave-length of 600 metres.

The terrible calamity which recently appalled the minds of the civilised world exceeds in its magnitude the loss of life in other nautical disasters. The facts were given in the press at the time, but it might be well here to recall the outstanding features of this terrible accident. The ss. *Eastland* had just taken aboard a huge crowd of 2,500 " picnicers," employees with their wives and families of a large electrical company in Chicago, when she capsized. Several accounts of the cause of the disaster are given, and many theories advanced as to why the vessel turned turtle. Some say that the water-ballast had been pumped from the hold as the passengers went aboard in order that more of the latter might be carried, others that the vessel stuck in the mud and failed to free herself when the engines were started, thus causing her to list, and that the large crowd on board increased this tendency so that she could not right herself. It was also learned for the first time that the *Eastland* had given evidence of " crankiness " on at least one other occasion and had nearly capsized. It is useless, of course, to speculate; suffice it to say that this hideous accident caused the deaths of a large number of innocent pleasure-seekers. Every known life-saving appliance, including wireless telegraphy, was installed on board this ship; she was lying alongside the land, moored to a quay, and yet all this was of no avail. Her wireless installation was fitted by the Marconi Wireless Telegraph Company, of America, her call signal letters were " W F M "; and she was operated by that company. She was built in 1903, and possessed a gross tonnage of 1,961 tons.

* * *

Yet another instance of medical aid being requisitioned by radio-telegraphy has arisen. The captain of the steamship *Bradford*, which arrived at Philadelphia, Pa., from Tuxpan, Mexico, reports that when his ship was two days out a seaman was taken ill. The vessel carried no doctor, and the wireless operator swept the sea in search of one; a British warship answered. The symptoms of the man's illness were given to the ship's doctor by wireless, and he diagnosed the case as pneumonia, prescribing accordingly. So satisfactory were the measures taken that the ship's officers were able to sustain life for some days. The patient, however, eventually succumbed.

* * *

As instancing a further use of wireless telegraphy on the high seas we may cite the following:

A wireless message was recently received at the Browhead signal station belonging to Lloyd's that the British schooner *Gypsum Queen*, from Halifax, Nova Scotia, for Preston, lumber laden, was abandoned on July 31st. That ship is now a derelict, being tossed hither and thither at the mercy and will of the wind and sea, and constitutes a very real danger to navigation. The position of the spot where she was abandoned may now be flashed by those self-same wireless waves to all ships in the actual neighbourhood or likely to pass the *locale*.

* * *

Two fine new steamers have recently been fitted with wireless telegraphy, and have been placed in commission for service on the Pacific coast between San Francisco and Astoria, Oregon. They are named respectively the *Great Northern* and *Northern Pacific*, and have the distinction of being the largest turbine-driven steamers so far constructed in the United States. Their designed speed is 23 knots, and they possess accommodation for 856 passengers, and capacity for 2,185 tons deadweight of cargo. Under favourable circumstances they make the voyage between the two terminal points in 25 to 26 hours, thus equalling the time now required for travelling by the overland route from Portland, Oregon, to San Francisco. The wireless cabin is situated on the boat deck and is contiguous to the officers' quarters. Altogether they are graceful ships and should prove very comfortable.

# Instructional Articles and the Examination

THE Thirteenth Instructional Article, published in the last issue, marks, as will be noted, the close of this valuable series. It was originally intended that immediately upon the cessation of the articles an examination should be conducted and prizes given to the successful students. The outbreak of war, however, materially altered the outlook. Our readers will remember that in April, 1914, when announcing the series, we indicated that the examination would be open to members of the Territorial Force, Cadet Corps, Boys' Brigades, Church Lads' Brigades, Boy Scouts, etc., and also to general readers. Now, after twelve months of war, a large number of those who commenced to study the articles have joined His Majesty's Forces, and are therefore unable to devote time to the subject. For this reason we feel that by holding an examination at the present moment we should exclude a number of our most ardent readers, and so, after mature consideration, it has been decided to postpone the examination until the conclusion of the war.

In order to sustain our readers' interest, and to enable those who intend to enter for the examination to continue their studies on suitable lines, we have arranged to conduct a third series of Instructional Articles dealing with the "Mathematics of Wireless Telegraphy." These articles, the first of which appears in this issue, are designed to assist those of our readers who have not devoted much time to mathematical study, to understand better books and articles which deal with wireless telegraphy from this point of view.

# CARTOON OF THE MONTH

## TEUTON WIRELESS IN TURKEY.


*No. 1.—What are the wild (wireless) waves saying?*
*No. 2.—" Liza comes to stay"!*

# The Destruction of the "Königsberg."

### *An Episode in the Life of a Wireless Operator*

*WE have received the following account of the destruction of the "Königsberg" from the wireless operators on s.s. "Trent."*

"After a slow but necessary voyage, we "arrived at Mafia Island, off German "East Africa, on June 2nd, having brought "out the two British monitors, H.M.S. "*Severn* and *Mersey*, which did such "brilliant work last year on the Belgian "coast.

"It will be remembered that the German "commerce raider *Königsberg* took refuge "in the Rufigi River, German East Africa, "about six miles from the mouth.

"Her hiding-place was discovered by "H.M.S. *Chatham* in October last, but on "account of her great draught this ship "was unable to proceed up the river. She "withdrew, after sinking a collier at the "mouth, thus preventing the *Königsberg* "from escaping into the open sea. She "could, however, be still used in con-"junction with the German land forces.

"The monitors had the advantage of "drawing very little water—only 6½ ft.—

*Up the River Rufigi.*

*Village scene near the River Rufigi.*

"which enabled them to get closer to the "*Königsberg*, whereas the *Chatham* could "not. It may here be mentioned that "the *Königsberg's* wireless was working "a few days before the action.

"The operations commenced on July 6th. "The *Trent* was used as a temporary "hospital ship, and, of course, anchored "in a safe position while the operations "were in progress. The monitors entered "the river, H.M.S. *Severn* leading. They "were met by a hot fire from the shore "batteries; the return fire was, however, "hotter, and eventually they took up "positions to bombard the *Königsberg*.

"The winding nature of the river, coupled "with the thickly wooded surroundings, "rendered range finding difficult. An aero-"plane was therefore used to denote fall "of shot, which by a certain signal made "by wireless to the monitors enabled them "to get over this difficulty.

"The German method of range finding "was accomplished by means of a 'look-out' "tower, which was undoubtedly in com-"munication with the *Königsberg*. The "monitors fired at this tower, destroyed "it, and moved their positions. The "enemy's shot continued to fall at the "place they had just vacated. It was now "getting dark, and orders were given to retire.

"On Sunday, July 11th, another attempt "was made, resulting in the complete "destruction of the *Königsberg*. A loud "explosion was heard which was either "the result of the monitors' fire or the "Germans purposely blowing it up them-"selves, which, however, remains to be "proved. A wireless message was inter-"cepted, stating that the *Königsberg* was "completely destroyed.

"During the operations an aeroplane "was hit, and fell to the ground. It is "interesting to note that the aeroplane's "wireless operator was transmitting as "the machine was falling. The monitors "added further honours to 'Britain's "'First Line,' and also avenged the fate "of the *Pegasus*, thus bringing their day's "work to a successful issue."

# The Influence of Atmospheric Ionisation on the Propagation of Electro-Magnetic Waves

By H. M. DOWSETT.

IN last month's WIRELESS WORLD the writer gave a rough sketch of the electrical conditions prevailing in the earth's atmosphere, which showed that the air in bulk possesses more the qualities of a leaky dielectric than of a perfect insulator.

In consequence of this it has been generally recognised that electro-magnetic waves transmitted through the atmosphere must suffer attenuation due to absorption, and certain other possible results on speed and direction of propagation have been subjects of general discussion during the last few years.

But all the effects of atmospheric ionisation on transmission have not yet been studied.

The writer proposes in the present article to refer to some of these neglected effects, which suggest on examination that they may play an important part in electro-magnetic transmission.

To begin with, it is admitted that there must be a difference in the velocity of the waves through the earth's crust and through the air, due to the difference in dielectric constant of the two mediums. But because the air in contact with the surface of the earth is ionised, one would expect a certain speeding up of the waves through the earth's crust at the expense of the energy of the waves through the surface air, in very much the same way as the speed of an electrical operation along a submarine tele graph cable is increased by lowering the insulation resistance of its covering.

This result in its turn would tend to reduce the intensity and alter the phase of the Sommerfeld surface waves, whose existence is due to the difference in speed between the air and earth waves.

Also, as at every earthed aerial receiving station, the tendency is to change the whole of the earth wave energy by means of ground plates or wires into a surface wave so that it can be used in the aerial-earth circuit—an ionised ground atmosphere at the receiving station, by reducing the surface wave, will therefore tend to reduce the strength of received signals.

To proceed further. The air in the lower atmosphere—exclusive of charged clouds which affect strictly local conditions—is not only ionised, it is polarised, so that it conducts best in a definite direction. The potential gradient is normal to the earth, so that the air conducts better normal to the earth than parallel to it. How this is likely to affect transmission is roughly illustrated in Fig. 1.

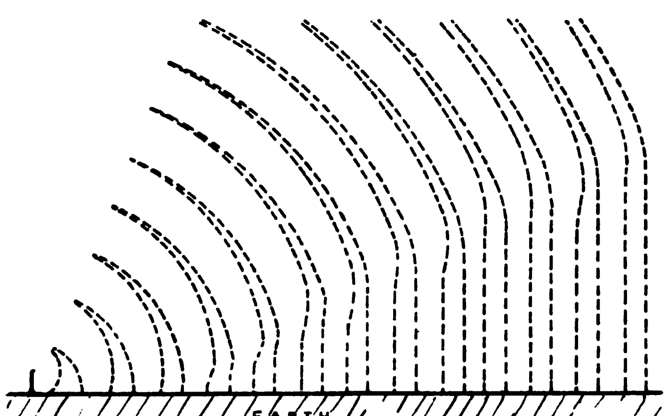



*Fig. 1.—Effect on lower part of wave of potential gradient normal to the earth's su·face.*

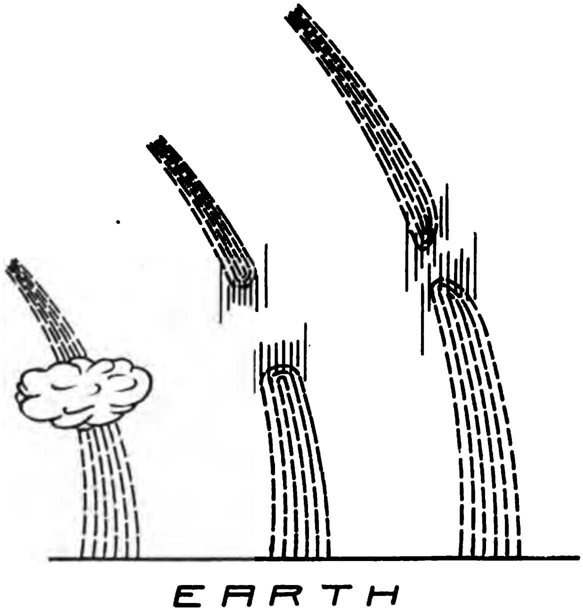



*Fig. 2.—Potential gradient assisting the repair of a wave.*

The wave front at ground level, being parallel to the line of potential gradient, will add a small potential difference to that already existing, which will tend to set up additional minute currents normal to the surface of the earth spreading both up and down the lines of potential gradient, and this deflected wave energy will reduce the effective velocity of the foot of the wave so that the wave-front will gradually lose its spherical character and become perpendicular to the earth for some distance up.

It is obvious that the less the wave-front is parallel to the lines of gradient the less will it be distorted in this way, and rays having a greater inclination to the earth than, say, 60 degrees may scarcely be affected.

The rectification of the wave-front will not take place at the transmitting station, as the wave intensity there will be great enough to swamp any effect of potential gradient, but as the wave front expands with increase of distance from the source, and the intensity in consequence diminishes, the relative value of the gradient will increase and so will the rectification.

The perpendicularity when once established will tend to maintain itself as the wave bends round the earth if the potential gradient and absorption generally is greater at the foot of the wave than some distance up, which actually appears to be the case. In fact, the top part of the wave may even obtain a bend forward as the distance travelled over the earth increases. If the ionisation of the lower atmosphere is continuous for some 12 miles up, the perpendicular front of the wave may extend well above the cloud region where most local absorption takes place.

Suppose that part of the wave loses energy in passing through a cloud. Then fresh energy will tend to flow into this region from the other parts of the wave not directly attenuated by the cloud until wave equilibrium is once more restored.

But it is clear that this flow will be considerably influenced by the direction of the potential gradient. The repair of the wave will be assisted if this direction is parallel to the wave-front—Fig. 2—and impeded if the wave-front and potential gradient are at right angles, Fig. 3—for in the last case the gradient will provide a grain of conductivity in the air which will tend to prevent the wave expanding back through it.

Fig. 3 actually shews in section a hole made through the top of a spherical wave. The growth of several such holes would finally lop off the top of the wave. It is possible this may often occur, and within ten miles of the transmitting station—short waves, owing to their smaller wave volume, suffering more in this respect than long waves.

Suppose absorption occurs near the ground, due, for instance, to a sudden rise and fall in earth level—a hill, or a ground fog of negatively charged air which will produce a somewhat similar effect—then there may be no

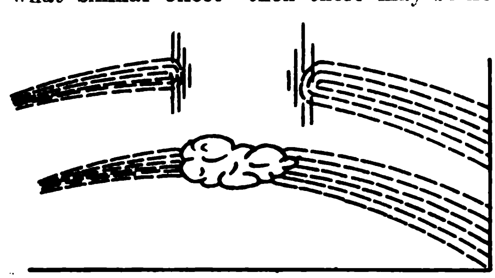


*Fig. 3.—Potential gradient impeding the repair of a wave.*

wave energy to work up from below after the obstruction has been passed, but there is still a supply available to work down from above by normal expansion—as every part of a wave can be regarded as a new centre of disturbance by creeping round the obstacle—and also by leakage currents down the lines of potential gradient until the wave is once more in touch with the earth and travelling with wave-front normal to it.

Next to be considered is the influence on wave propagation of ionisation in the region known as the permanently ionised layer.

As at this level there is no vertical temperature gradient and therefore no wind, the other forces at work are better able to make their presence felt. It is reasonable to suppose that this region, like the lower atmosphere, has a potential gradient normal to the earth, but the free gaseous ions are subject to another influence besides electrical stress—that of the earth's magnetic field.

Positive and negative molecular ions will not be much affected by the magnetic field, but electrons will be strongly affected, and their movement will probably constitute the principal gaseous movement at this level.

The electrons will be made to follow paths at right angles to the magnetic lines of force. They will move from west to east round the earth, describing spirals round the lines of force—Fig. 4—also round the earth and to and from the poles always west to east—Fig. 5—and again to and from the poles by spirals along the magnetic lines without going round the earth, Fig. 6. This last variation of electron movement is not of immediate interest to us, as it will occur principally in the outer atmosphere. The electron movements at the beginning of the permanently ionised layer—that part which comes first in contact with earth-generated electro-magnetic waves—will be mainly those illustrated in Fig. 4 and Fig. 5, which together give the resultant effect of a

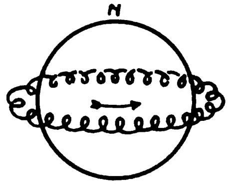



*Fig. 4.*

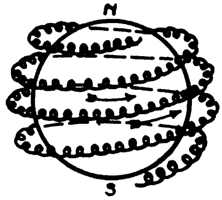



*Fig. 5.*

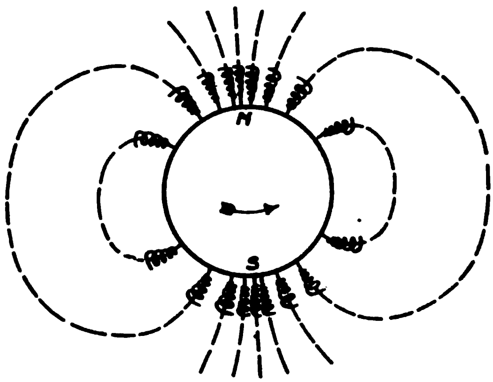



*Fig. 6.—Section of earth's magnetic field shewing paths of election through the outer atmosphere.*

spheroidal shell of electron currents enclosing the earth and rotating in the same direction. Consider the effect of this shell on an electro-magnetic wave. In the first place, the principal part of the wave-front to reach it will be the almost horizontal part which has escaped the rectifying process of the vertical potential gradient in the lower atmosphere. If this is parallel to the electron currents—that is, if it has a wave-front east and west—it will influence these currents, it will be more or less absorbed by them, and no doubt some of the wave energy will be reflected.

The absorbed wave energy will run along this conducting grain in the atmosphere,—Fig. 7—in much the same way as it behaves near the earth, and will thus complete the perpendicular rectification of the wave-front travelling east and west, which the curvature of the electron shell will also help to maintain.

As regards reflection, this must depend on the degree of conductivity and also on the sharpness of change in conductivity the wave meets with on entering this layer, conditions which will determine the depth of penetration before the wave is completely absorbed. The writer doubts whether the normal reflection from this layer is of sufficient importance to affect very much wave propagation round the earth.

Absorption by this layer, on the other hand, must be of importance, as energy flows in where it is used up, and the wave in the lower atmosphere must become weakened in consequence.

Consider now the wave-front north and south. As this is at right angles to the

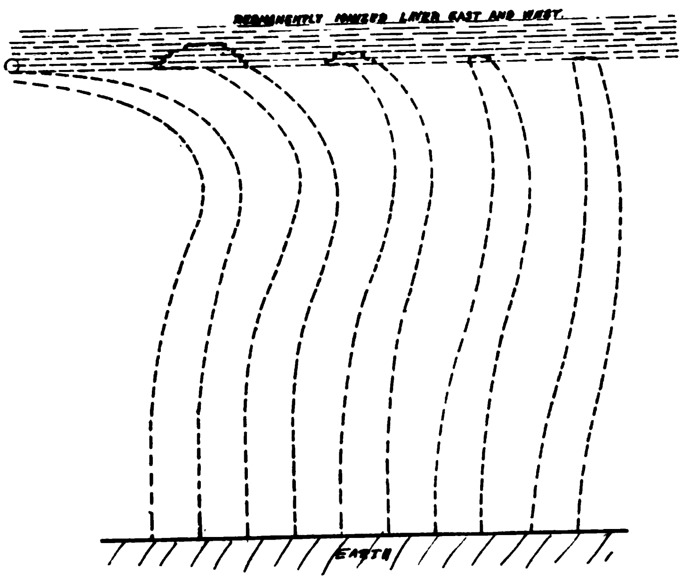



*Fig. 7.—The absorbing and rectifying effect of the permanent ionised layer on waves travelling East and West.*

electron currents and also at right angles to the potential gradient, it will tend to pass through the layer and continue to expand upwards with a minimum of absorption and reflection. In consequence, this part of the wave will not need to tap the wave energy in the lower atmosphere to the same extent as the part travelling east and west. The wave taken as a whole below the permanently ionised layer will tend to restore its own homogeneity, but the total result must leave it stronger north and south than east and west.

We may also note that, should any wave energy emerge through the electron shell it would be polarised north and south. The night conditions for wave propagation are thus summarised above. In the daytime the "diurnal layer" introduces new conditions. When the ultra violet rays of sunlight first affect the atmosphere a wave of ionisation runs down from the outer to the inner layers, splitting up the neutral molecules into positive and negative ions, growing weaker as it advances downwards, and finally ending when the whole of the ultra violet light has been absorbed. At the front of its advance the medium will be in active erratic gaseous commotion capable of absorbing wave energy and reflecting it, but in a state of disturbance which would make it difficult for an electromagnetic wave to permeate through it. It will be least permeable when ionisation is beginning and is, therefore, most active, and also when the ionised condition is disappearing, and much more permeable at the final lower limit of the diurnal layer where the last of the ultra violet light energy has spent itself. Above this lower skin the diurnal ions, under the impulse of the potential gradient, will gradually assume more orderly movement, the positive ions moving up and the negative ions moving down. How will the diurnal layer affect transmission ?

First we may note that the ions will screen the electron shell of the permanent layer, and so will stop its polarising effect on the waves. If there is any difference, therefore, in transmission north and south from transmission east and west, during daylight, it cannot be put down to this cause.

During the processes of ionisation and deionisation at sunrise and sunset, the waves will be subject to considerable reflection, which may result in a considerable strengthening of signals, but in the mid-period of full daylight, when there is little reflection from the indistinct boundary of the layer, and much more permeability, the wave energy will enter the layer and dissipate itself in the potential gradient currents, which, being parallel to the wave-front normal to the earth, will exert a strong weakening influence on the lower part of the waves by causing their energy to feed up into the diurnal layer to replace the energy absorbed. If these potential gradient currents are stronger than those just above the earth's surface, the top of the wave may again be bent back, thus increasing the radiation upwards and therefore away from the earth, Fig. 8. In this manner can one explain the weaker signals of full daylight.

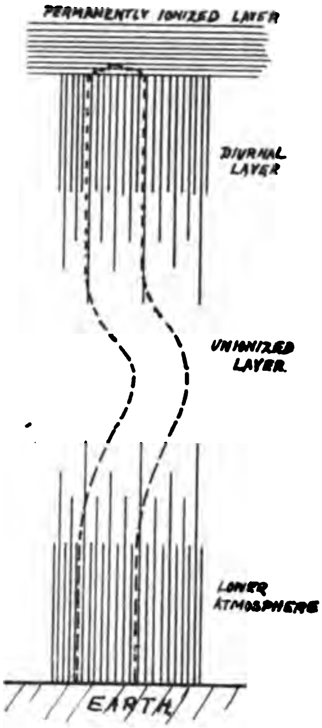



*Fig. 8.—The effect of the diurnal layer on shape of wave.*

Atmospheric ionisation therefore appears to be able to provide a satisfactory explanation of the principal effects of wireless transmission without it being necessary to introduce the wave acceleration theory of Dr. Eccles.

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## SENSELESS.

HE was a wireless operator,
She was a thoughtless maid,
Out on the grassless lawn together,
Under the treeless shade,
Playing a game of netless tennis,
This with a bounceless ball,
When from their dineless middle regions
Echoed a soundless call.

Then through the pathless walk they ambled,
Each with a stepless gait,
Into the flyless room for dining,
Each to a foodless plate ;
Each with a smileless face then settled
Down in a seatless seat,
" Ah, what a tasteless taste ! " he muttered
" Oh for a biteless eat ! "

First 'twas a meatless meal they ordered,
Topped with a crustless pie ;
Next o'er an iceless ice they dallied,
Each with a blinkless eye. . . .
Ah, what an endless end I'm reaching—
End of this wordless drool—
He paid the check with a centless dollar
Earned in the Marconi School.

(From *The Wireless Age*.)

# Doings of Operators

*Operator Healy.*

WE have often referred to the brave deeds daily performed by wireless operators in the course of their duty. In a previous number we also published a little poem entitled "The Merchant Service Man." To this latter our thoughts immediately turned on hearing of the sinking of the ss. *Jacona*, a merchant vessel owned by Messrs. Cairns, Noble and Co., and of some 3,000 tons. There seems little heroism in sitting at the key in a small wireless cabin on board a merchant steamer quietly ploughing its way through the water, but it must be remembered that at any moment a periscope of some German submarine may appear in the vicinity. Should this happen, much needs to be done in a little time, for by skilful navigation and prompt call for assistance the pirate foe may be eluded. That an almost uncanny cleverness is daily shown by the brave commanders and officers of the British mercantile marine in "dodging" the semi-submerged craft is grudgingly admitted by the Germans, for did not the famous Captain Perseus state recently that the results of their efforts with a submarine blockade were "only modest." The wireless operator on the *Jacona* was Mr. Maurice Healy, a comparatively recent recruit to the Marconi Company's operating staff. Mr. Healy hails from Ireland, having been born at Earlville, Aghinagh, co. Cork. After an education at Rusheen, Ballyvogane, and Macroom, he entered for wireless training at a school in Cork, and in February of this year crossed to London and joined the Marconi Company. After a short finishing course in the Company's London school he was appointed to the staff and joined the *Jacona*, on which ship he remained until the event above referred to. It is much to be feared that Mr. Healy, who was still quite young, has lost his life in the wreck, for at the time of writing he is among the missing and little hope is entertained. We take this opportunity of expressing, on behalf of our readers, the deep sympathy that is felt for the parents of Mr. Healy in their time of trouble.

* * *

On the 13th August, and the day that the confirmatory news came through regarding the sinking of the Turkish battleship *Hairredin Barbarossa*, a brief announcement

*Warrant Telegraphist Lovett.*

from the Admiralty gave the information that H.M. auxiliary cruiser *India*, whilst on patrol duty in the North Sea, had been torpedoed by a German submarine. Twenty-two officers and one hundred and nineteen men were at the same time reported saved.

Three wireless telegraphists were carried by the *India*, which in peace time was well known to Eastern travellers as a large P. & O. liner. The three were warrant telegraphists, R.N.R.: Frederick John Lovett, John Leonard Revell, and Andre Simon Read Akerman. Messrs. Revell and Akerman were fortunately saved, but Lovett is reported missing, and it is to be feared that he has lost his life in the service of his King and country.

Warrant Telegraphist Frederick John Lovett, who was twenty-six years of age, was born at Southwark Park, and educated at Keetons Road Higher Grade School, Bermondsey, the Boutcher School, and at King's College, London. He joined the Marconi Company three years ago and served successively on the ss. *Cestrian*, *Milford Hall*, *Arabia*, and *Egypt*. On behalf of our readers we offer to Mr. Lovett's parents our deepest and most sincere sympathy in their great bereavement.

*Warrant Telegraphist Revell.*

Warrant Telegraphist J. L. Revell, who, as above stated, is among the saved, was born at Clacton, Essex twenty-two years ago. He went to school in his native town, and later erected an amateur station with which he gained some experience. In July, 1913, he joined the Marconi Company as learner in the London School, and two months later received his appointment to the operating staff. Warrant Telegraphist Revell, prior to the war, served on board the ss. *Danube*, *Minnehaha*, *Dunluce Castle*, *Geelong*, *Highland Scot*, and *Normannia*. We congratulate him upon his lucky escape.

Warrant Telegraphist A. S. R. Akerman, who is twenty-one years of age, although born at Bordeaux, is a British subject and makes his home at Hayes, Kent. After an education at St. Dunstan's College and Margate College he trained for wireless telegraphy, and entered the service of the late United Wireless Telegraph Company, which, it will be remembered, was absorbed by the Marconi Company after the famous law case for patent infringement. He has served on board the ss. *Tagus*, *City of London* and *La Negra*, having made on this last a large number of trips. He also is to be congratulated on his fortunate escape.

* * *

The quiet, yet magnificent, work that is daily being performed by wireless telegraphists in both the Naval and Mercantile Services is perhaps not fully realised by the "man in the street." It requires some practical acquaintance with actual working conditions to picture in one's mind the wireless man intently listening through long watches, day and night, for signals which may change the ship from a quiet and peaceful vessel slowly swinging at anchor with the waves gently lapping at her side to the throbbing ship of war, thrusting her nose through the blue-green water, each gunner at his post and eager to fire the first shot at an enemy target—signals which a moment's inattention might lose entirely, signals which may bring succour to some quiet ocean tramp but five minutes ago

*Warrant Telegraphist Lemon.*

plugging her way along the Channel, but now cramming on every pound of steam and nearly bursting her old boilers in the effort to save her crew and cargo from the pirate enemy—signals, in short, which may set in motion almost any train of events that may be thought of in connection with the great ocean highway.

Now and then, of course, some passenger vessel buffeted by the elements, or perhaps with fire eaten into her holds, may use her wireless to gather help from all quarters in her great extremity. Then the journalistic searchlight throws its beam upon the wireless men, who blink in its glare and sometimes tell their story. The value of wireless in ocean disasters is thereupon discussed for a day or two, and then the flitting public attention moves off to other fields. Five tense minutes at the instruments are often sufficient to gain what is required in the perils of a wreck; five long months at the instruments on a war vessel may be needed to achieve even a little in times of peril for a nation. Who shall say which of the two cases may mean the most?

After the war, and round a winter fireside, much truth will filter out. Not the least interesting of the stories to be told will be those which tell of great deeds quietly performed.

Here and there we find a decoration awarded to mark some special case. Unlike Germany, Great Britain has never awarded decorations indiscriminately; when they *are* awarded it is for real merit. It is for meritorious work on the high seas that the Distinguished Service Cross has been awarded to Samuel Lemon, of H.M. patrol ship *Alsatian*. On behalf of the readers of this magazine, we herewith offer him our heartiest congratulations.

A native of Fleetwood, Lancashire, Samuel Lemon is but twenty-three years of age. Like many operators, he came to wireless from the railway telegraph work, having entered the services of the London and North-Western Railway as a boy. In April, 1911, he joined the Marconi Co.'s school at Liverpool, and soon after made his first trip to sea on the Allan liner *Virginian*. From this ship he passed to the *Teutonic*, and later to a number of other vessels trading on the North and South Atlantic. For some time prior to the outbreak of war he was serving on the *Alsatian*, so that by now he must be very well acquainted with her.

Warrant Telegraphist Lemon's award is the more noteworthy in that it is the first D.S.C. to be awarded to a warrant officer of the Royal Naval Reserve, with the exception of two awards to skippers of mine-sweepers for gallantry in the course of their duties. Wireless telegraphists are therefore very proud of their confrère, and we hope his example will stimulate many others to put forth their utmost efforts for the welfare of their country.

# Wireless in the Newspapers

*A Jocular Jockeying of some Contemporaries.*

*By E. BLAKE.*

SOME months ago there appeared in this journal an article entitled "Wireless in Fiction." It was an attempt to demonstrate that the ideas about wireless held by the guinea-grinders who jig the puppets on the story magazine stage are turgid with ignorance, and that the gaudy paint with which these writers try to hide their lack of exact knowledge is only too easily licked off. Nevertheless, a writer of fiction is under no obligation to "draw it mild"; so that when Montmorency casts the aerial into the sea ("as quick as thought Montmorency seized the aerial and threw it," etc.) and electrocutes by wireless the villain who is in the act of marooning the long-suffering maiden, we can pass on to weightier matters, murmuring "Great is fiction if it have a sale"—to parody the Latin phrase found at the end of the dictionary. We can examine, for example, what the newspapers say about wireless—a really serious and important investigation. By this it is not implied that newspaper men in contradistinction to the fictioneers are obliged or even expected to adhere to the truth. Such obligation would limit their output, their usefulness, and (shame upon us readers!) their circulation. No, their stuff is supposed to contain, at least, a nucleus of the truth; just enough to license the mass of speculation, "fine writing" and journalese which covers it.

At this game the American reporter stands alone, pre-eminent, unbeatable. I once had the grave misfortune to arrive in New York. During the voyage something interesting had happened about which I knew as much as most people, plus. . . . So at 2 a.m. a reporter entered my cabin, armed with a fountain pen and a mouthful of what looked like golden teeth. He wore a check suit which could have smitten a Chicago baseball crowd dumb. The following commercial dialogue took place:

Reporter: "Saay, what about it?"
Myself: "How much?"
Reporter: "Aw, fer nixes. No dollars this trip."
Myself: "Nothing doing. Mind the step."

The interview then ended and he left the Presence Chamber. Next day I found that he had written me up to the extent of three-quarters of a column, giving a description of my personal appearance, my views on America, my opinions relative to the voyage incident, my favourite occupation and my ideas concerning the state of the green wax-insect trade on the Lower Yang-tse. . . .

What the newspaper men do not know about wireless would fill volumes. What they write about it would fill the Editor's waste-paper basket. In fact, it is safe to say that the story-writers owe many of their quaint wireless fictions to the sharp-nosed men of shorthand who "do" the shipwrecks from the point where "all was calm and bright" to where "the ill-fated vessel with its human freight plunged sullenly beneath the waves."

Let it be supposed that a disaster has occurred, and the *Pommonia* has sullenly plunged. What happens is this: The special correspondent of *Spillikin's Weekly* rushes to Queenstown and espies a wretched survivor wambling wetly along the quay, clad in one pyjama-leg and a cork jacket, his stokehold awash with a quart and a half of best guaranteed Irish Sea. This poor creature, who is vainly endeavouring to recall the words of the Hymn of Hate, or wondering whether it is possible to get Scotch whiskey in Ireland, is button-holed (or

*" Saay, what about it?"*

pyjama-legged) by the man with the note book, and asked for his account of the tragedy. Naturally, the result as it appears in print is after the manner of the following:

" Mr. Charles P. Schnitzelbaumer, an American peanut dealer, hailing from Snooper's Butte, Pa., who is one of the survivors of the ill-fated *Pommonia*, said he was standing on the second-class saloon companion—or it may have been near the bar—when the explosion occurred. He noticed Mr. Justus K. Schoebheimer standing near, calmly helping the women into the boats. He himself was hurled some distance by the force of the explosion, and told Mr. Julius Brown, the famous chameleon-fancier, that he thought they had been torpedoed. He saw the torpedo coming, and thinks it must have struck the ship. The Marconi operators had by this time luckily succeeded in calling for assistance. He distinctly heard the senior operator say 'Sausages and Onions, Sixpence,' and his companion laughed. Both were wet through, and their coolness was amazing. Soon after the explosion the dynamos burst with a loud report and the Marconi operators had to work the wireless batteries from their emergency switches. He would suggest that in future ships should carry spare lighting mains; the wireless could then be run on to these when the dynamos blew up. Mr. Schnitzelbaumer also said he thought that in time of danger the overhead cables might be coiled round the masts, as by so doing the risk of breakage would be minimised. He further said that there was no panic on board, and that he saw the captain distributing cigars amongst the coal-trimmers and nuts to the children. One lady coolly stepped up to a piano and struck a few notes. He could not say which notes as it was only a second-saloon piano. He then fell overboard. He is certain the vessel was attacked by a hostile submarine, as the whole affair was a complete surprise to all on board."

In one newspaper it was stated that soon after the *Lusitania* was torpedoed a passenger went to the wireless cabin where "the Marconi operators were getting ready to send out the distress signals." What were they doing? One imagines them putting on clean collars and brushing their hair. Or perhaps they were rolling up their shirt-sleeves, moistening the palms of their hands, and praying for a successful call. The impression conveyed is one of strenuous, unhurrying labour amongst whizzing machinery in an inferno of sparks; whereas, at the most, all that needed doing was the screwing up of a few terminals and the closing of a switch.

Recently there appeared in a well-known journal edited by one who is seldom caught napping, a letter from a ship's officer, in which it was stated that owing to the majority of British vessels carrying the Marconi system of wireless they are unable to pick up messages from German stations. This is a grave defect of the Marconi system which I trust will be remedied at once. Either the German electromagnetic waves must be naturalised or British antennæ must be attuned to German Kultur.

Dealing with Mr. Marconi's connection with the Italian wireless service, another paper has it on record that he has instituted "the transatlantic wireless service between —— and ——," both places being on the Mediterranean seaboard. Just fancy a station powerful enough to carry westwards across the Atlantic, the American continent, the Pacific Ocean, Asia and a large slice of Europe! And all in order to reach an aerial not so very far to the eastward. A directional aerial should be useful in this case; or they might shift the station right about face, thus avoiding the long Atlantic trip.

The commercial advent of wireless is perhaps the biggest stroke of luck which has fallen to the newspapers within living memory, always excepting the War and Bombardier Wells. Given a fair mastery of the more lurid adjectives, a knowledge of Fleet Street flapdoodle about "the wizardry of science," and a few blurred photographs of any old ship—and they can do almost anything with wireless. One is tempted to believe that the Editors gathered together and said one to another, "Times are slack. Not a decent murder for months, and novel reviewing is becoming overdone. But here is a thing about which nobody knows anything, and which looks extraordinarily rummy. Let us work it up and excite the imagination of the proletarii. What we do not know we can guess at, and then fill up with chunks from 'The Boy's Own Book of Wonders.'"

So wireless was boomed from the viewpoint of romance and mystery. Myopic little hack-writers invented the wireless hero and made the operator's life at sea a misery by investing his cabin with a glamour which would be worth thousands were it applied to the right place—namely,

*"The public have regarded the wireless cabin as a cross between a sorcery shop and a firework factory."*


*" D-do you hear words ? "*

a Bond Street palmist's den. Until recently the public have regarded the wireless cabin as a cross between a sorcery shop and a firework factory. Yet beside the mystery which surrounds the wine trade wireless is as simple as plain sewing. In any case, its mysteries are high and holy, being revealed only to the elect. The newspaper reporter who, having peeped into a wirelesss cabin, goes off into wordy paroxysms about the sparks (that wretched obsession of the lay mind), what does he know of the true mysteries—of the Spark who would not, of the Insulator who didn't, of the Condenser-plate who was not so much a dielectric as a circuit-breaker, of Terminals that Pass in the Night, and of the Mysterious Mr. X. ?

The lady passenger who wants to send a message to Hoxton when the ship is halfway between the Cocos Islands and Colombo, and says, " D-do you hear words, or does a bell ring ? " is more sinned against than sinning, for she has only been guilty of sitting at the feet of the Special Correspondent of *Spillikin's Weekly*, who wrote those articles on " The Conquest of Time and Space," with the help of two invaluable aids to science, " The Electromagnetic Theory of Light," by Clerk Maxwell, and " Half-hours with Electricity," by the author of " Pastime with Pithballs," etc.

And the inventions which are reported! Wireless installations which will see through walls, up chimneys, into pork-pies and round corners! Scarcely a month passes but what Mr. Marconi, or Edison or Tesla is said to have produced a machine which will peel onions, smoke twopenny cigars, correct inebriated coal-heavers, pay the legal fare to taxi-men, or tell lies about " a cheque next week " to landladies—all at a safe distance—by wireless.

" It's wonderful what they do think of nowadays," remarked Pharaoh as he idly thumbed a few slabs of the *Egyptian Daily Era.* " Here are these Israelites making bricks without wire."

## A "DOG" IN WIRELESS.

THE *Scarborough Pictorial* recently contained an interesting illustrated page entitled "A Canine Coastguard." It appears that the Scarborough wireless station has a faithful watchdog named " Bob," of whose intelligence the men in whose service he is are justifiably proud. The Government premises, more so now than ever, are forbidden ground to the ordinary civilian, and this fact " Bob " realises as much as anyone. In one of the pictures illustrating the page of our contemporary, " Bob " is seen with receivers affixed to his ears, and his paw poised on the operating key. His conception of the idea he was intended to convey while the photograph was being taken is indeed remarkable. Not until he heard the camera " click " did " Bob " remove his paw from the instrument. Of the other pictures of him his ladder-climbing exhibition is also unusual. " Bob " can negotiate the rungs with sureness and safely, a feat not very easy for a dog. Such entertaining, faithful, and serviceable companions as " Bob " contribute in no small measure to the more cheerful performance of the " wireless " men's duties. " Bob " is the proud possessor of an Iron Cross, which he wears round his neck. It was conferred on him for " extinguished " gallantry on the morning of the bombardment, when, unable to defend himself, he retreated to the Racecourse!

# A Book that Marks an Epoch

## *Professor Fleming's latest contribution to Wireless Literature.*

TIME flies! Nineteen years have passed since Senatore Marconi, then but a young man, packed up his primitive wireless apparatus and came to the hospitable shores where so much of his life-work has been done. Nineteen years is not so very long as history goes, yet in that time much has been achieved. Nineteen years ago no heavier-than-air flying machines had ever crossed the skies, and even automobiles were in the earliest experimental stage. It is hard for us to-day to realise that when the first announcements of Senatore Marconi's invention appeared in the Press thousands of otherwise well-informed people laughed at the idea, whilst scientists by the score gave vent to weighty opinions regarding the impossibility of commercial wireless communication. Even those, and they were few, who believed that the young Italian had something practical to demonstrate shrugged their shoulders when mention was made of possible commercial telegraphy by the new means.

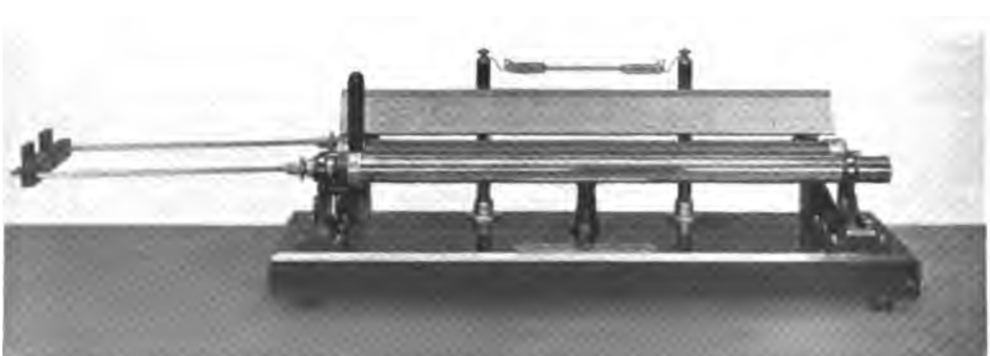
Nineteen years ago Senatore Marconi and his little group of helpers had no easy task before them. Of "wireless" theory practically nothing was known. Apparatus had to be evolved by trial and experiment, not from theoretical deductions. It had not even been discovered that the height of the aerial had an important bearing on the distance of communication.

Now, in 1915, matters are on a totally different footing. These years of experiment and study have been so fruitful that radiotelegraphic theory is by now well advanced, multitudinous formulæ enabling the worker to achieve results with a minimum of labour.

One of the first scientists to place whole-hearted faith in the young Italian inventor was Dr. J. A. Fleming. For many years prior to 1896 he had been closely connected with advanced electrical work, and was therefore of great assistance in designing much of the power plant required in the early stations.

But it is chiefly by his monumental treatise *The Principles of Electric Wave Telegraphy and Telephony* that Dr. Fleming is best known in the world of wireless telegraphy. We can safely say that this volume is on the bookshelf of practically every serious student of the science, and is in every way truly a standard work.

A new book on wireless telegraphy from the pen of such an eminent expert will, we are sure, be welcomed enthusiastically in



many quarters. We have before us as we write a copy of *The Wireless Telegraphist's Pocket Book of Notes, Formulæ and Calculations,* Dr. Fleming's latest contribution to the subject, and the book which suggested to us the thoughts upon which we have just dwelt. Although it is modestly entitled a "Wireless Telegraphist's" Pocket Book, its scope is really much broader. Wireless telegraphists, wireless engineers, engineers whose work but rarely touches radio-telegraphy, tutors, technical students—in fact, all who are concerned with the application of electricity, will find the little volume not only of interest, but of constant value as a book of reference. Information often needed, and which, prior to the publication of this book, was only to be found by searching through a number of volumes, is now obtainable for the first time in compact form. To indicate but slightly the value of the little volume, let us place ourselves in the position of a serious wireless student, and see how Dr. Fleming ministers to our needs.

Mathematics, of course, plays an important part in the study of radiotelegraphy, particularly in the more advanced stages. Chapter I., entitled "Mathematical Notes," will serve to provide our student with the necessary "tools." Many who have had a thorough training in this subject will find the chapter of great value for polishing up knowledge which has become "rusty." Chapter II. will often be referred to for definitions and information on units, dimensions, and systems of measurement. Unless these be clearly understood no real progress can be made by a young student. What, for instance, is the use of the wireless amateur knowing that 746 watts make one horse-power when he is not clear in his mind about the watt itself? Chapter III. —one of the most valuable in the book as far as wireless engineers are concerned—deals in masterly style with high-frequency resistance and inductance measurement. The difference between high-frequency resistance and steady resistance, the calculation of high-frequency resistance of wires, self and mutual inductance with its calculation and measurement—these are subjects of the greatest importance, and the numerous formulæ provided will be found of the greatest use. Further chapters, the contents of which are so valuable that we are sorry not to have space to enumerate them more fully here, treat of high-frequency current and voltage measurements, capacity measurement and predetermination, methods of measuring wave-lengths and decrement, and numerous other vital subjects.

The much-discussed electric radiation from aerials has a full chapter to itself, and is considered from many standpoints. Here will be found much practical information on the determination of aerial resistance, radiation resistance and other work which comes the way of both wireless engineers and advanced amateurs. The practical man, amateur and professional, will welcome the concise particulars in Chapter IX. regarding transmitters and transmitting circuits. Arc transmitters, the Goldschmidt high-frequency alternator, and other interesting apparatus, all receive treatment. A feature of particular interest is the "Energy Balance Sheet" on page 221, showing losses in particular parts of an experimental installation. No less than twenty-two pages of the book are devoted to receiving circuits and detectors, the formulæ to be used in their calculation, and descriptions of receivers of every type. That the information is right up to date is evident from the inclusion of the Goldschmidt tone wheel, a detector for continuous oscillations which has a number of points of interest.

Wireless operators will welcome the practical information on the maintenance of apparatus in Chapter XI., and all interested in radio-telegraphy will find much help from the excellent glossary of terms which appears in the same chapter. Had we more space at our disposal, we could indicate numerous other valuable features, but in conclusion we must not omit to mention the sixty pages of mathematical and physical tables, which alone are sufficiently valuable to warrant the appearance of the volume on the bookshelf of every "wireless man," whether he be professional or amateur.

# The Wireless Student's Friend

### *A new and revised edition of Hawkhead's "Handbook."*

WHEN, not so very long ago, the first edition of *The Handbook of Technical Instruction for Wireless Telegraphists* appeared on the market, the reception which it was afforded gave little room for doubt that such a book had long been needed. Written by a practical man essentially for practical men, it had no superfluous matter, no padding to bring the book up to a reasonable size, and, above all, no lengthy mathematical proofs of matters which can only interest the advanced theorist. In short, from cover to cover there was little else but what was necessary to the acquirement of proficiency as a practical operator.

New books are seldom entirely free from error and omission, particularly in cases where, as in Hawkhead's book, new ground has to be broken. Then, again, progress is made in all subjects, in wireless telegraphy particularly. These considerations are some which have led the publishers of the well-known "Handbook" to arrange for a new and revised edition, and the resulting volume will be available to our readers by the time this magazine is in their hands.

Unfortunately, it was impossible to arrange for the original author to undertake the revision, for Mr. Hawkhead is now Superintendent of Telegraphs in the distant protectorate of British Somaliland. In passing, we may mention that an article from Mr. Hawkhead's pen will be found on page 365 of this issue. The work of revision and amplification has, therefore, been undertaken by Mr. H. M. Dowsett, whose interesting and instructive articles on the "Physical and Electrical State of the Atmosphere" appear in the August and present numbers. That the reviser has carried out his task in a most excellent manner is at once evident on perusing the new volume before us.

Profiting by the many kind criticisms in the technical press and in numerous letters of appreciation, the opportunity has been taken of re-writing a number of portions of the book, and of amplifying the matter where necessary. No less than 88 diagrams have been re-drawn and 19 new ones added, whilst the other illustrations have been added to by the introduction of no less than 28 new photographs. Particular attention is drawn to the chapters dealing with the various transmitting installations, these chapters being considerably enlarged and augmented by much new matter. The disc discharger apparatus is particularly well treated.

Crystal detectors, the opposed valve and crystal receiver, for eliminating atmospherics, and numerous other matters, are either treated for the first time, or else brought thoroughly in line with current practice. The chapters dealing with the practical side of wireless are also thoroughly modernised. Altogether, we can safely say that nothing of any importance has been omitted, and the Handbook becomes by the revision even more indispensable than before to the practical student.

## SHARE MARKET REPORT.

*London, August 17th,* 1915.

The market in the various Marconi issues has been very active since the publication of the Annual Report of Marconi's Wireless Telegraph Company, Ltd. There has been considerable buying for investment, and the prices show a decided improvement. Marconi Ordinary, £1 18s. 9d.; Preference, £1 15s.; Canadian Marconi, 6s. 6d.; American, 18s. 9d.; Spanish Trust, 5s. 9d.; Marconi International Marine, £1 5s.

# The Future Welfare of the Messenger Boy

***A few notes concerning an innovation at Marconi House.***

IT has been frequently said that a messenger is engaged in a *cul-de-sac* in commercial life. But the Marconi Company have done a great deal to demonstrate that this is far from being an actuality. The messenger boy in an ordinary commercial house fares badly, and the unfortunate fact exists that many a lad who has outgrown his duties finds himself thrown on to the street at an age when, in the ordinary course, he should have begun to "feel his feet." The Marconi Company, having the welfare of their staff at heart, decided to obviate this unhappy position, and made arrangements with the London County Council for a trained instructor to attend at Marconi House and give lessons in English, Commercial Arithmetic, and Shorthand during the very important years of a lad's life—*i.e.*, from 14 to 16 (see photograph). The classes possess a distinct advantage in that they are held on the Company's premises, and, as attendance during the day time is obligatory, real educational progress is to be expected. Account is taken of the periodical reports on the attendance and progress of the lads when vacancies for commercial and telegraph clerks arise in the various departments of the Company's service. The Company desires to attract intelligent and industrious boys into their employ, and, by providing facilities for continuing their education, to give them opportunities to equip themselves for positions of greater responsibility.

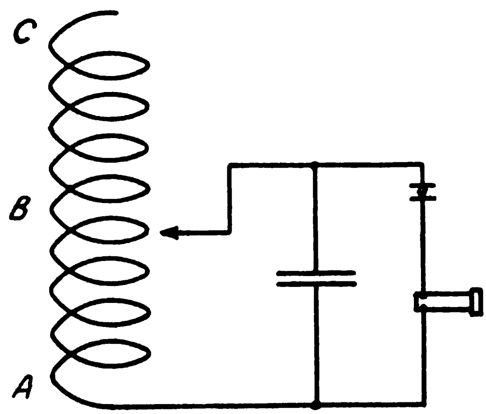
# QUESTIONS AND ANSWERS

*Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study to the Editor,* THE WIRELESS WORLD, *Marconi House, Strand, London, W.C. Such questions must be accompanied by the name and address of the writer, otherwise they will remain unanswered: and it must be clearly understood that owing to the Defence of the Realm Act we are totally unable to answer any questions on the construction of apparatus during the present emergency.*

F. S. T. (Birmingham).—We are obliged by your pointing out the error. The statement *re* damped and undamped waves at the foot of page 58 in the April number should read "be made to reach an accuracy of within 2 per cent. We are very glad to hear you like Mr. Martin's articles.

J. P. (Rijswijk, Holland).—Fifteen thousand ohm telephones are rather costly instruments compared with those of lower resistance. You would, however, get better results with them than with telephones of lower resistance in the case of the electrolytic detector.

E. R. (Vendee).—Many thanks for your letter and the table which you have calculated. Whilst we cannot publish this at the present, we shall no doubt be able to make use of it after the war, and have therefore placed it on file. With regard to your questions, the auxiliary voltage necessary to bring a carborundum crystal to its most sensitive state depends on the particular specimen with which one is dealing. It is usually in the neighbourhood of two volts. The Fleming valve requires a voltage somewhat higher than this, and the electrolytic detector a lower voltage. Question 2.—In all secondary circuits which are designed for use with potentially operated detectors such as carborundum, the Fleming valve, etc., the inductance should be made as large as is possible with the particular wave-length that it is desired to receive. When a condenser is shunted across the secondary for tuning purposes, this should be kept very small, or the object of having a large inductance—to get the greatest possible e.m.f. impressed on the detector—will be largely defeated. On the other hand, with the magnetic detector, which is current-operated, the aim should be to have the maximum *current* in the secondary, and this can well be achieved by using a small inductance and large condenser. Question 3.—The self-capacity of an inductance coil depends on many factors, amongst these being the dielectric value of the material forming the insulating covering of the wire and the spacing of the turns. We are not aware of any simple method of calculating the self-capacity of such a coil. The effect on wave-length of the capacity of the telephones and crystal depends on the design of the circuit. In your fig. 1 there would be less effect than in fig. 2, but in neither case would much difference be noticed. Question 4.—We scarcely understand your fourth question. The primary of the jigger is designed to provide a magnetic field which will affect the secondary. The greater the current, the stronger the field will become. There is no object in having a high potential in the primary. Question 5.—The idle portion of a tuning inductance not only adds useless capacity, but has a detrimental effect in absorbing energy, particularly on some wave-lengths. For instance, in the diagram reproduced, the whole inductance A-C has a natural period of oscillation, which we will suppose for the moment to correspond to a wave-length of 300 metres. The inductance A-B, together with the condenser, will also have a certain frequency of oscillation. If now this latter frequency chances to be the same as that of the whole inductance A-C, only a part of the energy will be available for the detector, the remainder being wasted in the inductance A-C. In modern receivers where it is desired to have a large variable inductance in the detector circuit, means are adopted for cutting out the inductance not in use, either by breaking the inductance




A-C at B, or by providing separate sections of inductance which can be added or taken away as required.

H. L. (Longsight, Manchester).—(1) See reply to E.R. on this page. (2) In the Marconi high resistance crystal receivers the value of the inductance in the detector circuit is kept as high as possible. A "billi" condenser of very small capacity is shunted across the inductance so that a certain range of wave-lengths can be obtained. If, for instance, the value of inductance is such that with the billi condenser set at zero the wave-length obtainable is 250 metres, the maximum value of this condenser will give a wave-length of about 750 metres. To obtain greater wave-lengths extra inductance is added. In reply to the second part of your Question 2, the shorter wave would probably be obtainable, but it should not be forgotten that the crystal itself has a certain capacity.

R. R. H. (Woburn Sands) finds difficulty in understanding several points regarding the S. G. Brown relay and the note with reference to it which appeared in this column recently. He says, "You say the relay does not work by virtue of any variation in resistance of a *contact*, but by alteration in the resistance of a microscopic *gap*. If there is a *gap*, how can 1½ volts pass—*i.e.*, if there is no current flowing how can it indicate in *H* winding, as I suppose it is by the flow of the current being arrested or otherwise that operates the telephones?" He also asks six other questions, which are too long to reproduce here, but with some of which we will endeavour to deal.

Firstly, our correspondent has not clearly understood our previous explanation. If he will read it again carefully he will see that we explained that with the microscopic gap the current *continues to flow.* There is really a minute spark at the gap the whole time that the relay is working, and it is the idea of varying the length of this spark which constitutes the novel feature of the instrument. Further, the current is not *made and broken*, but *varied.* In reply to another question, the current in the winding *K* varies in accordance with that in the winding *H*, but is, of course, much stronger. If there are sixty little alterations of current per second in winding *H*, there will be sixty bigger alterations of current in winding $K$. This means that the *note* heard in the telephones is of exactly the same tone as would be heard without the relay, if the received current were sufficiently strong. R. R. H. in other parts of his letter says the points of interruption are *carbon* not platinum, which leads us to believe that he is confusing this type of relay with another also invented by Mr. S. G. Brown, in which carbon contacts are used. In the relay with which we have been dealing the points are, as stated previously, of platinum. In conclusion, we think that most of our correspondent's trouble is due to the fact that he has not realised the difference between this relay and one which operates by virtue of alteration in resistance of a contact.

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We have received from W. A. (Liverpool) the following query arising out of the Instructional Articles which have appeared in our pages. The query is printed in full for the information of those of our readers who are interested in inductance calculations.

"If we take a length of wire 640 $\pi$ centimetres long and "wind it 20 turns per cm. on different formers so as to "get coils of varying ratio $\frac{l}{d}$ say with a length and diameter "of

"2 and 16, 4 and 8, 8 and 4, 10.$\frac{2}{3}$ and 3 "respectively, and then from the given table take the "values of inductances, tabulate them, and then take a "length of wire 360 $\pi$ cm. long and wind it to produce "coils whose $l$ and $d$ are respectively 2 and 9, 3 and 6, 4 "and 4$\frac{1}{2}$, and again take the inductances from table, the "following is the result :

| $\frac{l}{d}$ | $\frac{1}{8}$ | $\frac{1}{2}$ | 2 | 3$\frac{5}{9}$ |
|---|---|---|---|---|
| 1 | 2 | 4 | 8 | 10$\frac{2}{3}$ |
| $D$ | 16 | 8 | 4 | 3 |
| Inductance | 478·2 | 531·5 | 413·1 | 337·4 * |

* From inductance of coil $l=32$ $d=9$ divided by 27.

| $\frac{l}{d}$ | $\cdot\dot{2}$ | $\cdot\dot{5}$ | $\cdot\dot{8}$ |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
| $D$ | 9 | 6 | 4$\frac{1}{2}$ |
| Inductance | 218 | 224·1 | 211·875 † |

† From inductance of $l=8$, $D=9$, divided by 8.

"The maximum inductance in each case is obtained "somewhere about the ratio $l = \cdot 5$.

"If in the formula mentioned in paragraph 754 ($L=\pi^2 d^2 n^2 lK$), the complete table of the factor $K$ were given, "the determination of the position would be a very easy "matter.

"Inductance $= \pi^2 d^2 n^2 lK$

$$= \frac{\pi^2 d^2 n^2 l^2 K}{l} \quad \text{length of wire } \pi dnl,$$

"so that inductance

$$= \frac{K\,(\text{length of wire})^2}{l}$$

$$= \frac{K}{\sqrt{\frac{l}{d}}} \times (\text{length of wire})^2 \times \frac{\sqrt{\frac{l}{d}}}{l}$$

$$= \frac{K}{\sqrt{\frac{l}{d}}} \times \frac{(\text{length of wire})^2}{\sqrt{Dl}}$$

"For a given length of wire, $Dl$ is a constant, so that "$\sqrt{Dl}$ is a constant also. The maximum inductance for "a given length of wire wound the same number of turns "per centimetre will therefore be obtained when the "proportions of a coil are such that the ratio $\frac{K}{\sqrt{\frac{l}{d}}}$ is at its "maximum value. If, from the table of inductances any "given value of inductance in cms. is divided by $\pi^2 d^2 n^2 l$ of "the particular coil to which it corresponds, the result wil "be the factor '$K$' for that ratio of $\frac{l}{d}$. Taking the values "below '$K$' is found to be as follows :

| $\frac{l}{d}$ | $K$ | $\frac{l}{d}$ | $K$ |
|---|---|---|---|
| 2/5 =·4 | ·4717 | 4/8 =·5 | ·5257 |
| 5/12=·416 | ·481627 | 5/9 =$\cdot\dot{5}$ | ·55125 |
| 3/7 =·4287 | ·48851 | 9/16=·5625 | ·55244 |
| 7/16=·4375 | ·49374 | 4/7 =·57143 | ·55795 |
| 4/9 =$\cdot\dot{4}$ | ·497385 | | |

"The following values of '$K$' are taken from a large "curve drawn from above values to show the variation "of '$K$' with $\frac{l}{d}$ and in the third column the ratio $\frac{K^2}{\frac{l}{d}}$ is "shown worked out for each value.

$\frac{K^2}{\frac{l}{d}}$ (the square of $\frac{K}{\sqrt{\frac{l}{d}}}$)

"has been taken, as it is a more convenient ratio to work "out and the square of a quantity will reach its maximum "at the same time as the quantity.

| $\frac{l}{d}$ | $K$ | $\frac{K^2}{\frac{l}{d}}$ |
|---|---|---|
| ·4 | ·4717 | ·55625 |
| ·42 | ·4839 | ·55754 |
| ·428 | ·4887 | ·558 |
| ·43 | ·4897 | ·55769 |
| ·44 | ·4951 | ·5571 |
| ·45 | ·5005 | ·556667 |
| ·47 | ·5104 | ·55427 |
| ·5 | ·5253 | ·55188 |

"It would appear, therefore, that the maximum induc-"tance is obtained from a given length of wire (with "turns per centimetre equal) when the length of coil is "about ·428 of its diameter. Is this correct ?

"$\frac{l}{d}$ = about 3 was given in Vol. 2, Jan.

"$\frac{l}{d}$ = 4 was given in Vol. 2, March."

*Answer.*—The fact that the inductance of a given length of wire is a maximum when it is wound into a coil with a diameter about 2$\frac{1}{2}$ times its length is well known, but although I have consulted several well-known text books on the subject, I have been unable to find any reference to it. Working on the lines adopted in the enquiry, but using the more exact figures to be found in the works quoted in the "Instructional Article," *paragraph* 754, the following are obtained :

| $\frac{d}{l}$ | $\frac{l}{d}$ | $K$ | $\frac{K^2}{\frac{l}{d}}$ |
|---|---|---|---|
| 2·3 | ·43478 | ·491782 | ·556254 |
| 2·4 | ·41667 | ·481591 | ·556632 |
| 2·5 | ·40000 | ·471865 | ·556642 |
| 2·6 | ·38462 | ·462573 | ·556332 |

from which it is seen that the coil of maximum inductance has a ratio $\frac{l}{d}$ between ·4 and ·417.

The above result is only true for a coil for which the inductance given by the formula is correct—*i.e.*, for which the correcting term mentioned in paragraph 755 is negligible. It is as well in designing a receiver to arrange for the coils to have a ratio of the above order, although if the gauge of wire required to give the proper number of turns is small, it is worth while making some calculations to see whether a larger wire wound into a longer coil would give less resistance in the circuit, which, of course, is the principal point at which to aim.

# Instructional Article

*The following series, of which the article below forms the first part, is designed to provide wireless telegraphists, amateurs, and technical students generally, with clear and precise instruction in technical mathematics, in order that they may be enabled to read and understand the more advanced technical articles which appear from time to time.*

## *Our New Instructional Articles.*

IN the August issue of our magazine we took the opportunity of emphasising the need for theoretical study on the part of those who, through lack of opportunity for practical work, are likely to allow their hobby to be forgotten. We have also received from various sources communications which indicate that many of our readers are handicapped in theoretical study by a lack of suitable mathematical knowledge. In view of this, and because those of our readers who have diligently studied the previous instructional articles are now in a position to benefit by a little more advanced fare, we have arranged to publish monthly the following series of MATHEMATICAL INSTRUCTIONAL ARTICLES. Although these articles will perhaps not be quite so interesting at the outset as those which we have previously published, yet their importance should not be underestimated, for by their aid students will be introduced to broad fields of interest which previously have been barred to them. The ability to read and benefit from the more advanced technical articles which appear from time to time will, we are sure, be much appreciated by many who at present can only glance over them and pass them by.

The preparation of the series has been placed in the hands of an expert wireless engineer who is daily occupied in research and other work of an advanced nature, and therefore in the position to know exactly what is required in such a series. Logarithms, the Slide Rule, Trigonometry, and many other subjects will be clearly dealt with, and, provided the series is carefully studied, we can promise to all who take up the new work a considerable and lasting benefit.

## I.—Logarithms.

It will often occur, in the course of wireless work, that we have several quantities to be multiplied together and divided into each other, quantities which may each consist of half-a-dozen or more figures. Operations of this description, tedious as they are when carried out by ordinary or contracted arithmetical methods, may be very easily performed by means of logarithms.

To explain what a logarithm is, we will take a few very simple examples. We know that $100=10^2$. Now 2 is called the logarithm of 100 to the base 10, as 10 has to be multiplied by itself " 2 times " in order to obtain 100. This can be written " $2=\log_{10} 100$ "; but as 10 is used as the base in the case of ordinary or " common " logarithms we omit the suffix 10, and simply write $\log 100=2$.

Now $100{,}000=10^5$

therefore $\log 100{,}000=5$.

$100=10^2$

therefore $\log 100=2$.

$10=10^1$

therefore $\log 10=1$.

$0{\cdot}01=\frac{1}{100}=10^{-2}$

therefore $\log 0{\cdot}01=-2$ or $\bar{2}$.

$0{\cdot}00001=\frac{1}{100000}=10^{-5}$

therefore $\log 0{\cdot}00001=-5$ or $\bar{5}$.

and so on.

We see from this that the logarithms of all numbers from 10 to 99·99999 will have a logarithm of something between 1 and 2. That is, any number consisting of two figures in front of the decimal point has a logarithm of " one decimal something." Similarly, any number consisting of six figures before the decimal point has a logarithm of " five decimal something "; any number consisting of a decimal point followed by three noughts and then some

LOGARITHMS.

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 1 2 3 4 | 5 | 6 7 8 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 49 | 6902 | 6911 | 6920 | 6928 | 6937 | 6946 | 6955 | 6964 | 6972 | 6981 | 1 2 3 4 | 4 | 5 6 7 8 |
| 50 | 6990 | 6998 | 7007 | 7016 | 7024 | 7033 | 7042 | 7050 | 7059 | 7067 | 1 2 3 3 | 4 | 5 6 7 8 |
| 51 | 7076 | 7084 | 7093 | 7101 | 7110 | 7118 | 7126 | 7135 | 7143 | 7152 | 1 2 3 3 | 4 | 5 6 7 8 |
| 52 | 7160 | 7168 | 7177 | 7185 | 7193 | 7202 | 7210 | 7218 | 7226 | 7235 | 1 2 2 3 | 4 | 5 6 7 7 |

other figures will have a logarithm of "minus four decimal something," and so on.

Thus we see that log 50 will be equal to "one decimal something." All would be plain sailing if the "something" was 5, so that log 50=1·50, and in the case of 20 the "something" was 2, so that log 20=1·20, and so on; but, unfortunately, things are not arranged quite so conveniently for us. If we look up books on mathematics we shall find that the calculation of logs is quite a formidable business, and is a matter necessitating a knowledge of mathematics beyond the scope of these articles. Luckily, however various kind gentlemen have gone to a lot of trouble to calculate for us the logarithms of all numbers from 1 to 99,999 and even beyond that, tabulating their results in a convenient form.

Above is a portion of a table of "Four-Figure Logarithms."

Looking opposite 50 and in the column headed 0, we find the figures 6990. This is the *decimal* part of log 50, which we want, or log 50=1·6990. If we look opposite 51 and in the column headed 3, we see that the decimal part of log 51·3 is 7101, or log 51·3=1·7101. If we add to this the figure 6 found in the same horizontal row, but in the small column on the right headed 7, we shall get log 51·37=1·7101+·0006=1·7107. Thus we can find from our tables the logarithm of any number we wish, though we must remember that these particular tables are limited to the first four significant figures. For instance, if we require the log of 794·285 we can only find the log of the nearest four-figure value —*i.e.*, log 794·3=2·9000.

The whole number portion of a logarithm is called the index or characteristic, and the decimal portion the mantissa.

It is most important to remember that the values given in the log tables are the *decimal portions only*; the characteristic must in every case be supplied separately, and its value depends entirely on the position of the decimal point in the original number.

We have just found that log 51·3=1·7101, therefore

log 51300=4·7101
log 513·0=2·7101
log 5·13=0·7101
log 0·513=$\bar{1}$·7101
log 0·00513=$\bar{3}$·7101, and so forth.

It will be noticed that in the first three cases the characteristic is one less than the number of figures and in the last two cases that the value of the characteristic is negative, and is greater by one than the number of noughts following the decimal point in the given number.

We can, of course, use our log tables to perform the reverse operation, that of finding a number which has a given value for its log. This, however, will be found on trial to be rather inconvenient, and so we generally find, in company with log tables, another set of tables, headed "Antilogarithms." For instance, we have found that the value of log 51·37 is 1·7107. If we look up the mantissa ·7107 in our antilog tables in exactly the same way as we looked up our log we shall find the figures 5137. These figures give, to four significant figures, the number whose log is ·7107. Now, just as when looking up our log we put 1 as characteristic *because* the number was 51·37, so in this case we put down the figures as 51·37 *because* we had 1 as characteristic. It will also be noticed that, on looking up the antilogs of 3·7101 and 1·6990 we get 5130 and 50 respectively, the numbers we started with originally.

Now that we can, with a little care, find the log or antilog of any number it is time to explain how we can use them for calculations. For the purpose of this explanation we will construct the simplest possible tables of logs and antilogs :

ANTILOGARITHMS.

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ·69 | 4898 | 4909 | 4920 | 4932 | 4943 | 4955 | 4966 | 4977 | 4989 | 5000 | 1 | 2 | 3 | 5 | 6 | 7 | 8 | 9 | 10 |
| ·70 | 5012 | 5023 | 5035 | 5047 | 5058 | 5070 | 5082 | 5093 | 5105 | 5117 | 1 | 2 | 4 | 5 | 6 | 7 | 8 | 9 | 11 |
| ·71 | 5129 | 5140 | 5152 | 5164 | 5176 | 5188 | 5200 | 5212 | 5224 | 5236 | 1 | 2 | 4 | 5 | 6 | 7 | 8 | 10 | 11 |
| ·72 | 5248 | 5260 | 5272 | 5284 | 5297 | 5309 | 5321 | 5333 | 5346 | 5358 | 1 | 2 | 4 | 5 | 6 | 7 | 9 | 10 | 11 |

LOGARITHMS.

| | |
|---|---|
| 0·001 | $\bar{3}$ |
| 0·01 | $\bar{2}$ |
| 0·10 | $\bar{1}$ |
| 1·0 | 0 |
| 10·0 | 1 |
| 100·0 | 2 |
| 1,000·0 | 3 |
| 10,000·0 | 4 |
| 100,000·0 | 5 |

ANTILOGARITHMS.

| | |
|---|---|
| $\bar{3}$ | 0·001 |
| $\bar{2}$ | 0·01 |
| $\bar{1}$ | 0·10 |
| 0 | 1·0 |
| 1 | 10·0 |
| 2 | 100·0 |
| 3 | 1,000·0 |
| 4 | 10,000·0 |
| 5 | 100,000·0 |

Now $10\times1{,}000=10{,}000$

Also log $10+\log 1{,}000=1+3=4$, and antilog $4=10{,}000$.

Similarly $100{,}000\times0{\cdot}001\times10=1{,}000$, and $\log 100{,}000+\log 0{\cdot}001+\log 10=5+\bar{3}+1=3$, and antilog $3=1{,}000$.

Thus we can multiply numbers by adding their logs and taking the antilog of the sum. The method depends, of course, on the principle that

$$10^a\times10^b\times10^c\times10^d=10^{(a+b+c+d)},$$

where $a$, $b$, $c$, $d$, etc., are the logarithms of the various numbers we wish to multiply together.

EXAMPLE I.

Find the product of $17{\cdot}62\times0{\cdot}972\times0{\cdot}00076$.

Log $17{\cdot}62=1{\cdot}2460=1+{\cdot}2460$

Log $972{\cdot}0=2{\cdot}9877=2+{\cdot}9877$

Log $0{\cdot}00076=\bar{4}{\cdot}8808=\bar{4}+{\cdot}8808$

Adding ............ $\bar{1}+2{\cdot}1145=1{\cdot}1145$

Antilog $1{\cdot}1145=13{\cdot}02$.—*Ans.*

Note that when adding the logs the characteristics are treated separately from the mantissæ, and that the mantissæ are *always positive*; these points are of great importance.

EXAMPLE II.

Multiply 37·62 by 0·000859.

Log $37{\cdot}62=1{\cdot}5754=1+0{\cdot}5754$

Log $0{\cdot}000859=\bar{4}{\cdot}9340=\bar{4}+0{\cdot}9340$

Adding $\bar{3}+1{\cdot}5094=\bar{2}{\cdot}5094$

This must be taken as $\bar{2}+0{\cdot}5094$, and so the result is greater than antilog $\bar{2}$, and less than antilog $\bar{1}$—*i.e.*, it lies in value between 0·01 and 0·10. Looking up ·5094 in our antilog tables we see that the answer is 0·03231.

# The LIBRARY TABLE

"THE INSPECTOR AND THE TROUBLEMAN." By Stanley R. Edwards and A. E. Dobbs. Chicago: Telephony Publishing Company. London: S. Rentell & Co., Ltd. 4s. 6d. net.

The troubles of telephone electricians are many, and although books on telephony are numerous, it is frequently a difficult matter to get practical men to learn from any experience but their own. A man who has been out all day tracing line troubles is not often inclined to spend his evenings in studying books, particularly if they are at all "dry." For this reason a volume which contains practical information presented, not merely in a lucid fashion, but also in an interesting way, should make a special appeal to many.

The book under review can well be placed in this category, consisting as it does of a series of imaginary dialogues between practical telephone men engaged in working a telephone system in a small town. Originating in the United States, the volume is naturally full of Americanisms, some of a very "advanced" nature, but after a few pages one becomes used to them, and they certainly do not detract from the clarity of the explanations.

The purpose of the authors is to deal in an elementary but thoroughly practical manner with the problems which are encountered in magneto exchanges. This they can well be said to have accomplished. Spread about the book there is also a great deal of valuable information on the theory of telephone work in general, and clear diagrams are given when it is thought they are needed. Altogether it is a handy and well-written book, which should be of great help to telephone linesmen and many others concerned with the practical problems of transmitting speech by wire.

* * *

THE WORLD-WIDE ATLAS OF MODERN GEOGRAPHY. With an introduction by Dr. J. Scott Keltie, Edinburgh and London, 1915. W. & A. K. Johnston, Ltd. 7s. 6d.

War constitutes perhaps a better instructor in political and physical geography than all the text-books which have ever been published on that subject. The holocaust which is now devastating half Europe has created a demand for up-to-date Atlases, such as that under review. The publishers have deemed it advisable under present circumstances to present to the public a revised edition (the eighth) of their well-known standard atlas, which has been found so useful to those who want really accurate maps. The excellent introduction on geographical discoveries and territorial changes from the beginning of the nineteenth century, written specially by Dr. Keltie, the secretary to the Royal Geographical Society, has been considerably amplified, and includes the re-arrangement of territory subsequent to the war between the Balkan allies in 1912–13, which resulted in the almost complete abolition of the Ottoman Empire from Europe. The maps, generally (of which there are 128 plates), are beyond reproach, although, whilst in the map of the Balkan States the territorial changes above referred to are shewn, yet in the map of Europe, which is printed in the beginning of the volume, this re-arrangement is not indicated—the Turkish Empire being represented as stretching from the Black Sea in the east to the Adriatic Sea in the west. A very comprehensive index, running into 98 pages, is added, together with frontispieces of the flags and time of all nations, and plans of cities. In view of the increasing number of radio stations all over the world, a copy of this atlas should be in the hands of everyone interested in the science of Wireless Telegraphy.

* * *

"ELECTRICITY." By W. H. McCormick. London, 1915. T. C. & E. C. Jack. Price 3s. 6d.

The aim of this book appears to be to satisfy the demand that Science should be placed before the general public in popular form. A real need exists nowadays that the "man in the street" should be acquainted with, at any rate, the less technical side of the sciences, and in order to place him *au courant* with progress in the scientific world the excellent plan was conceived of putting these "popular" books on the market. Mr. McCormick begins by going to the root of the whole thing. He devotes his first chapter to tracing the history of electricity, and shews that although the science is of comparatively recent date, electricity itself has existed from the beginning of the world. He points out that probably man's first acquaintance with it was through the natural phenomenon, known to all the world as a thunderstorm. The author discourses on the fundamental uses of the Leyden jar and shews that the electrical capacity of even a small jar is surprisingly great. He also speaks of electricity in its relation to the atmosphere, and shews how the latter is charged with the former in varying degrees. This part of the book might almost be considered a preamble, and the author now plunges seriously into his subject by describing firstly the various pieces of electrical apparatus, and secondly the different uses to which the power is put. The harnessing of electrical current and its deviation into the channels of usefulness are strongly emphasized. The use of electricity in locomotion has become so regular a feature in the lives of most of us that we are apt to look upon it as a mere commonplace. In reality the application of the electric current to the tramcar or the train represents a degree of skill of the highest order. This is only an example, but Mr. McCormick shows how electricity has been employed for lighting, heating, for working clocks, bells and lifts, for electro-plating and electro-typing. In medicine the special boon which it represents is exemplified in the Röntgen Rays apparatus. In the realm of electricity represented by the telegraph and telephone special opportunities have manifested themselves. Were it not for electricity the marvels of wireless telegraphy and its life-saving efforts would never have been known to mankind. The author devotes two special chapters to wireless, the first of which he opens by saying, "Wireless telegraphy is probably the most remarkable and at the same time the most interesting of all the varied applications of electricity." He describes in some detail the apparatus and its workings which produce the etheric waves, and reproduces several diagrams and photographs. In his second wireless chapter he explains the practical application of wireless telegraphy, and enumerates several of the more important radio-telegraph stations of the world. Altogether the book is well written, the subject has been pleasingly handled, and we commend it to those who desire more than a passing acquaintance with that most wonderful of all sciences, Electricity.

* * *

"ALSACE AND LORRAINE." By Ruth Putnam. New York and London, 1915. G. P. Putnam's Sons. 5s. net.

Miss Putnam's own words in her preface make a good introduction to our review of her excellent book. "The war of 1914," she says, "exciting interest in past problems as well as in a stormy present, has turned the attention of the general public to the make-up of European nations." Comparatively speaking, how few in number are those who really take an interest in the study of the history of states other than their own. This may be gauged from the appalling ignorance generally exhibited by the Englishman in connection with anything outside his own country. But the sad thing about it is that he is conscious of this ignorance, and has no shame in excusing and attributing it to his insular position. It is a recognised fact that the Englishman (or woman) is probably the worst linguist of all the civilised peoples. There may be a shred of justification in this excuse, but surely it behoves every individual to leave no stone unturned to acquaint himself at least with a rudimentary knowledge of things extra-British. Miss Putnam's book should therefore make a particular appeal at this juncture. The knowledge that the average "man in the street" possesses concerning Alsace and Lorraine is that they are two provinces stolen from the French by Germany at the close of the Franco-Prussian war of 1870–1. The author traces the history of both provinces from the earliest times and gives detailed accounts of the trials and worries which beset the inhabitants. To those interested in wireless telegraphy this book should make a peculiar appeal. Metz, the strong German fortress, is situate within the confines of Lorraine, and it is here that the Germans have established a high-power wireless installation. In this connection it may be of interest to remark that it is said it is only by sufferance of this big apparatus at Metz that the French frontier wireless telegraph stations at Verdun and other places are allowed to work. In fine, the book is well worth reading, and the author has apparently lavished no small amount of care on its production. We trust that it will receive the hearty reception which it deserves.

* * *

"THE SPECTROSCOPY OF THE EXTREME ULTRA-VIOLET." By Theodore Lyman, Ph.D. Longmans, Green & Co. 5s. net.

From the distant period when Newton first performed his classic experiments with a prism and a sunbeam filtering through a shutter in a darkened room, the science of spectroscopy has exercised a powerful fascination over physicists of all nations. For some time after Newton's investigations there was so much to occupy attention in the spectrum normally visible to the eye that very little consideration was given to what might lie in the regions immediately beyond the visible red and violet. Then gradually, as the science developed, research was undertaken in this direction, with the result that we now have an ever-growing store of knowledge regarding these regions which are known respectively as the infra-red and the ultra-violet.

It is with this latter part of the spectrum that Dr. Lyman deals in the book before us. Principally the volume treats of a certain part of the ultra-violet spectrum known as the "Schumann" region, in honour of the great scientist who first revealed its presence. The limit of violet light observable with the ordinary form of spectroscope appears to the normal eye in the neighbourhood of wave-length 4,000 (Angstrom Units). Comparatively early in the history of spectroscopy Ritter showed that chemically active rays existed beyond the visible violet limit; and later Becquerel, by means of a Daguerreotype plate, succeeded in tracing the spectrum down to about wave-length 3,400. Later investigators, substituting quartz for glass in the prisms, and introducing other improvements, were able to reach a wave-length of 1,850, and finally Schumann, with fluorite in place of quartz, succeeded in photographing the spectrum as far as wave-length 1,200. Dr. Lyman, in the introduction to his book, deals briefly but nevertheless in an interesting manner with the history of ultra-violet research. Chapter I. has for its subject Photometers, and treats, among other things, of the special photographic plates which are needful in spectroscopic work. Subsequent chapters are devoted to the consideration of the Absorption of Solids and Gases, Apparatus and Methods of Investigation, Emission Spectra, and Photo-Electric and Photo-Abiotic phenomena.

Many readers will be interested in the short account of Schumann's life which appears on pages 29 and 30. Schumann was more than forty before he gave up commercial life, and devoted himself entirely to scientific work. Practically his whole life from this time forward was occupied in spectrum analysis, and our knowledge of the extreme ultra-violet is chiefly due to his researches.

In the concluding pages of the book are printed a number of valuable tables, a bibliography, a list of Schumann's published papers and an appendix dealing with the manufacture of special dry plates for ultra-violet work. Both the student of spectroscopy and those members of the scientific public whose work has not led them to specialise in this particular branch of physics, will find this monograph of considerable value and interest.

* * *

"PRINCIPLES OF FLIGHT." By Algernon E. Berriman. London: Offices of *Flight*. 2s. net.

The rapid and astonishing development within the last few years of machines for navigating the air, together with the important part these are playing in the prosecution of the war, are causes which may well stimulate the curiosity of the géneral public regarding the principles upon which such machines are based. Most of us, when we see an aeroplane cleaving its way across the sky, are desirous of knowing "how it works," and it can safely be said that an afternoon at Hendon or any of the other aerodromes is rendered much more enjoyable by at least some knowledge of the main principles of flight.

Mr. Algernon E. Berriman, an expert, who, as former technical editor of a well-known aeronautical journal, is eminently qualified to write on the subject, in the volume before us describes in a readily comprehensible manner the principles and working of flying machines, both heavier and lighter than air. The first few pages are perhaps the most interesting in the whole book, for they give a short history of flying from the time when Leonardo da Vinci conceived the idea of attaching wings to the human body, down to the period when the Wright brothers emerged from their obscurity and showed themselves veritable masters of the science and art of aerial navigation.

After a brief chapter on lighter-than-air machines, the writer devotes the remainder of the book to the consideration in detail of a modern aeroplane—a British-built Deperdussin monoplane being taken as typical.

In addition to clear line drawings interspersed in the text, sheet diagrams which open out much larger than the book itself assists the reader to understand the explanations given.

Constructional details are largely dealt with, but there are also chapters dealing with the angle of incidence, the cambered wing, resistance (not the electrical variety), propellers and stability. Careful study of these is essential to a proper realisation of the problems of aviation. A final, but highly interesting and important chapter treats of petrol engines, particularly the "Gnome," the popularity of which in the world of aviation is at present outrivalled by no other. Here, too, excellent sectional diagrams are given.

For those who wish to commence the study of aeronautics and for the general public who desire to grasp the main principles of aviation we can strongly recommend this book. By its modest price (2s. net) it is brought within reach of practically everybody, and we are convinced that it will appeal to a very large public.

* * *

"ARITHMETIC OF ALTERNATING CURRENTS." By Ellis H. Crapper, B.Eng.M.I.M.E. London: Whittaker & Co. 1915. 2s. 6d. net.

The study of alternating currents is one in which the student can proceed but a very short distance without the aid of mathematics, and the practical electrician may also be severely handicapped if he lacks the necessary knowledge regarding the quantitative relationships between the various factors of the A.C. Circuit. This little book is intended to serve as a companion to the many text-books on alternating current theory, and will be found of use to many of our readers. Of particular value are the numerous worked examples by the aid of which the student can obtain a clear insight into the methods of solving the problems. Suitable exercises are also provided, together with their answers.

* * *

"THE TEACHING OF ELECTRIC LIGHT SWITCHING." (Third Edition.) London: A. P. Lundberg & Sons. Post Free.

This little pamphlet, already well-known in electrical circles, has now reached its third and enlarged edition. As its title implies, it deals with instruction in electric light switching—a very important and much neglected subject—and will be found of great use to heads of electrical engineering departments, lecturers on electric lighting, etc. Messrs. Lundberg will be pleased to forward the pamphlet post free to all who are concerned with such instruction.

* * *

"MONTHLY WEATHER REVIEW." Vol. 43, No. 4. April, 1915. Government Printing Office, Washington, U.S.A.

We have received from the Weather Bureau of the U.S. Department of Agriculture a copy of the April issue of the above. It contains contributions of the research work of the Weather Bureau, and deals with climatic, aerologic, meteorologic and seismologic conditions generally in the United States, whilst several tables, diagrams, and charts are appended.

## THE BRITISH ASSOCIATION.

THIS association has just compiled and issued the programme of its meeting which will take place at Manchester from September 7th to 11th, under the presidency of Professor Arthur Schuster. In consequence of the war, and as has been already announced, the meeting will confine itself wholly to the technical side, the usual social arrangements having been eliminated.

The sectional meetings have been arranged as usual, Section G (Engineering) having for its President Dr. H. S. Hele Shaw, F.R.S. The following are the electrical papers to be read in this section : "The Heating of Iron when Magnetised at Very High Frequencies," by N. W. McLachlan ; "Some Experiments to Determine whether there exists Mutual Induction between Masses," by Professor Miles Walker ; "The Eddy Current Losses in the End Plates of Large Turbo-Generators," by Professor Miles Walker ; "Electric Oscillations in Coupled Circuits—a Class of Particular Cases," by Dr. W. H. Eccles and Mr. A. J. Makower ; "The Capacity of Aerials of the Umbrella Type," by Professor G. W. O. Howe ; "The Calculation of the Effect of Masts and Buildings on the Capacity of Aerials," by Professor G. W. O. Howe.

A number of matters in other sections may also be mentioned. In Section B (Chemistry) there will be a discussion on "Smoke Prevention," and in Section L (Educational Science) a discussion will take place on "Education and Industry." A report of the Committee on Industrial Fatigue, to be presented to Section F (Economic Science and Statistics), may also produce some points of interest, whilst a discussion in the same section on the production of industrial harmony will attract attention having regard to recent happenings in the labour world.

## AN APPRECIATION.

SOME time ago we received the following letter from an Ecuadorian reader, but, owing to pressure of space caused by the insertion of interesting matter dealing with the war, we were compelled to withhold its publication until the present moment. We trust that all our readers derive as much pleasure and instruction from the perusal of our pages as does our friend in far-off Guayaquil.

"DEAR SIRS,—I duly received and have "been punctually receiving the important "magazine WIRELESS WORLD during the "past year, which is highly instructive "and meritorious. It is a treasure, and a "source of wireless instruction ; its lessons "in 'marconigraphy' are so clear and "comprehensible on account of the excellent "drawings, and I have found data which "I have not seen in many modern text-"books which I possess. Your magazine "is the guide to the student, as well as to "the expert operator. As long as I live "if I can I shall be a continuous subscriber "to THE WIRELESS WORLD.

"(Sgd.) RICARDO MORAN PEREIRA."

# Foreign and Colonial Notes

### Brazil.

The offices of Marconi's Wireless Telegraph Co., Ltd., in Rio de Janeiro have been removed to 37, Rua Visconde de Inhauma, immediately opposite the headquarters of the Ministry of Marine and quite close to the offices of the Royal Mail Steam Packet Company.

* * *

### China.

During the last few months a number of wireless telegraph stations have been established on the Chinese coast. It is expected that they will be of great value to shipping in that neighbourhood. New stations have been opened at Canton, Wusung (near Shanghai), Foochow and Hankow. The general range of these stations is about 700 nautical miles. The power of the old station at Hong-Kong is to be increased to the same range.

* * *

### Japan.

Long distance wireless telegraphy is slowly but surely spreading its feelers over all the globe. Communication by this means has just been established between Funabashi, Japan, and Honolulu, in the Hawaiian Islands, a distance of about 4,000 miles.

* * *

### Portugal.

Three wireless installations fully equipped with Morse apparatus have been found in different parts of Lisbon. One wireless station was discovered on the fourth floor of a house in the town. Five arrests were made of persons, who confessed to having erected three other stations in different localities of Lisbon. They were apprehended by order of the Government. Further information goes to show that the Germans are at the bottom of the matter.

### Sweden.

The exactions of the British censorship during the war have unfortunately raised difficulties for the authorities in neutral countries. If they wish to communicate with other neutral countries they must avoid the cable passing through British territory. This is particularly emphasised in the case of the Scandinavian kingdoms. A Swedish Committee has just been formed to discuss the erection of a wireless station at Karlsborg, Sweden, for direct communication between Sweden and America, thus escaping the censorship of their communications by the British. The Chairman of the Committee is the general manager of the Swedish State Telegraph Company.

* * *

### United States.

It is very interesting to note the latest experiments to be undertaken by the Weather Bureau of the United States. They contemplate the sending of the weather forecasts by wireless telegraphy at a speed slow enough to accommodate the majority of amateur operators.

* * *

We are indebted to our American contemporary, *The Wireless Age*, for the following paragraph:

"How the news of the outbreak of the European war reached the Russian naval officer, Vilkitsky, an Arctic explorer in Behring Strait, is told in a newspaper dispatch from Petrograd. Vilkitsky, who has been heard of by wireless, left Vladivostok, planning to attempt the Arctic passage from east to west. He was not aware that hostilities between the Allies and Germany had begun and obtained the information from a wireless source somewhere in Behring Strait."

# Marconi's Wireless Telegraph Co., Ltd.

## *Account of General Meeting.*

THE Eighteenth Ordinary General Meeting of Marconi's Wireless Telegraph Company, Ltd., was held on July 26th, 1915, at the Whitehall Rooms, Hotel Metropole, W.C., Senatore G. Marconi, G.C.V.O., LL.D., D.Sc., Chairman of the Company, presiding.

The Secretary, Mr. Henry W. Allen, having read the notice calling the meeting and the Auditors' Report,

The Chairman, who was warmly received, said:

I propose, with your approval, to take the Report as read. I have little doubt that the Statement of Accounts which has been submitted to you will be regarded in all the circumstances as satisfactory.

If you will refer to the Balance Sheet you will find on the Debit side, Capital remains practically unchanged, Bills Payable show a slight increase, and Sundry Creditors somewhat less than the figures of the preceding year.

The Reserve Account now carries with it the Share Premium Account which, as we have advised you, we have transferred. On the credit side the Cash at Bankers and in hand requires no explanation, while the amount to the credit of Temporary Investments and Loans against securities represents monies for which we had no immediate need, and which therefore have been lent against or invested in first class securities earning a better interest than could be obtained by placing the money on deposit at our bank.

Sundry Debtors shows an increase approaching £250,000 over the figure of the preceding year; practically the whole of this increase was in respect of Government work, and nearly the whole of it has since been received.

The amounts invested in Freehold and Leasehold Properties do not call for any special comment. They have been reduced by sums set aside for depreciation, according to our custom.

Shares in Associated Companies, as stated in the Report, shows an increase of some £60,000, the greater part of which is represented by an increase in our holding in the Russian Company, by reason of the growth of their business and the increase of the capital of which we took our proportion. The par value of our total shareholding is now close on 2½ million sterling, but the figure appearing to the credit in the Balance Sheet represents, as usual, the actual cost to the Company.

Turning to the Profit and Loss Account, there is little which calls for comment; on the Debit side, there is the substantial balance amounting to £232,716 8s. 11d. Profit carried to Balance Sheet. This figure shows a marked increase over the profit of the preceding year, proportionate, of course, to the increase in contracts, sales, and trading account.

I do not think that the figures need any further explanation; but, as I have already said, I am satisfied that you will regard them in all the circumstances as highly satisfactory. They exclude, however, as you have been told in the Report, any remuneration from the Government for the use of the Company's high-power stations since the beginning of the war, and numerous other services which the Company has rendered. As no basis for remuneration has yet been settled, we have thought it better to make no estimate of this amount, but have left the whole item to be dealt with in the accounts of the current year. All that I can be permitted to tell you is that the amount of work which has been done and the services rendered are considerable, and we have very little doubt that the remuneration which will be awarded the Company in due course will be proportionate to the value of the services rendered and the work done.

We all realise that we are passing through most exceptional and serious times, and everybody, I am sure, will appreciate that the outbreak of hostilities at the beginning of August of last year must have caused very considerable disturbance to a world-wide business such as ours.

As was to be expected, wireless telegraph apparatus was promptly declared contraband of war, and for the time being, therefore, our work in many parts of the world practically came to a standstill. Some of our negotiations had to be completely abandoned and many others deferred. Our programme has consequently undergone complete dislocation, and it is quite impossible at the present moment to say to what extent, or in what way, it will be affected eventually. We can only bide our time and await events.

On the other hand, our factory has been kept very fully occupied in carrying out the very important orders which we have received both from home and abroad in consequence of the war. The greater part of this work, however, will figure in the accounts of the present year.

Very naturally the businesses of our associated Companies in some cases have also been very much disturbed.

The American Company have been deprived of the use of their Transatlantic Station owing to the stations on this side being required for other purposes. It is hoped, however, that in due course they will receive fair compensation. Their high-power stations, however, of San Francisco and Hawaii have been completed, and a telegraphic service is being conducted very satisfactorily. We are daily awaiting information with regard to the opening of the service through to Japan. Arrangements have been made with the Japanese Government for the conduct of a commercial telegraph service, which they contemplated to inaugurate ere this.

The Canadian Company has continued to make progress, but the changes which we informed you last year were contemplated have not yet been able to be carried out owing to the war.

The Argentine Company have had to defer for the present work upon their high-power station.

The Belgian Company continues to conduct its business from our office in Marconi House under the direction of the English Directors of that Company, Mr. Godfrey Isaacs and Captain Sankey. The business is progressing satisfactorily, but it has been quite impossible to make up any balance sheet.

The French Company has continued to do a satisfactory business, and has paid for 1914 a dividend similar to that of 1913.

The Marconi International Marine Communication Company, Ltd., has continued to show satisfactory progress, although it has not been altogether free from loss directly arising from the state of war.

Our Russian Company had a very good year, and has paid a dividend of 15 per cent. as compared with 6 per cent. for 1913. They have a considerable amount of work in hand, and are doing a very satisfactory business.

The Spanish Company's negotiations with the Spanish Government, to which reference was made last year, were not facilitated by the outbreak of war. They have, however, continued to make progress, and we are now advised that they are assured of an early and satisfactory termination.

The development of the Automatic Telephone Company has not made much commercial progress in consequence, of course, of the war. The name of the Company has been changed to that of "The Relay Automatic Telephone Company," as the Swedish name under which it traded was liable to be mistaken, which would not have been to its advantage.

We have signed an important contract with the Italian Government, which we contemplate will be put into operation in the early future.

With regard to the Imperial chain: you will remember that in their Report of last year the Directors informed you that they were permitted to make but slow progress with the erection of the six high-power stations for which they had contracted with His Majesty's Postmaster-General, and the Company's interests were being seriously prejudiced thereby. Within a few days of our General Meeting war was declared, and at the end of the year the Postmaster-General informed the Company that, owing to the altered circumstances resulting from the war, the Government had decided not to proceed with the Imperial wireless chain. We were further informed that the governing factors in determining the Imperial Scheme would be better met by means other than the construction of stations of the character and in the situations contemplated by the contract for the Imperial chain, and that the amounts disbursed by the Company in respect of the contract would be refunded to us.

Subsequently, in February, negotiations were entered into with His Majesty's Government for the erection of certain stations on conditions differing from those contained in the original scheme. Negotiations are proceeding on a basis which, if agreed to, would represent to the Company a reasonable equivalent of the terms of the 1913 contract. Nothing, however, has yet been definitely decided.

Since I last addressed you there have been some important developments in the art of wireless telegraphy, and we have applied for several new patents. It would be inadvisable, however, for me to give any further information upon this subject at present.

I should like to be able to give you a full account of the very important part which your Company has played since the outbreak of war; but, unfortunately, this would not be permitted me, nor would it be in the interests of anybody for me to attempt to do so at the present moment. All I am able to say is that the Company has received more than one letter of appreciation from the Lords Commissioners of the Admiralty in respect of the work they and members of their staff have done. It will interest you to know that from our Companies some 1,100 men are employed in the forces on active service or on special duties, apart from the very large number at the Head Office and Works who have been requested to remain at their posts, where by so doing they could render great service to the country.

On behalf of my co-Directors and myself I wish again to place on record our high appreciation of the services rendered to your Company, and I might also say to the British nation and her Allies, by our Managing Director, Mr. Godfrey Isaacs. He has continued untiring in his work and activities, and it would be difficult to overestimate the value of his services. As I said last time I had the honour of addressing you, I believe it to be an indisputable fact that it is very largely due to him that wireless telegraphy has become, and has remained, a great British industry—I might also say a great British enterprise—of perhaps greater value to the nation during war-time than in peace.

You will perhaps remember that I said last year: "The value of wireless telegraphy may one day be put to a great practical and critical test; then, perhaps, there will be a true appreciation of the greatness of the work." I have full confidence that when the war is over, and the facts can be made public, the appreciation to which I referred will not be lacking.

I have now to move: "That the Report of the Directors, together with the annexed Statement of the Company's Accounts at December 31st, 1914, duly audited, be received, approved, and adopted." I will call upon Mr. Godfrey Isaacs to second the motion.

The Managing Director (Mr. Godfrey C. Isaacs), who was warmly received, said: "Ladies and Gentlemen,—In rising to second the resolution I had not contemplated much to add to what our Chairman has already told you; but, in view of his last remarks, I must, in the first place, thank him very sincerely indeed for the terms in which he has expressed himself of the work which I have done for the Company, and I propose, in the circumstances, to take advantage of this opportunity of telling you something about the Company and the competition which it has experienced—circumstances which at no other period has it ever been possible for me to speak about. I want to remind you that I joined the Company, at Mr. Marconi's personal invitation, on January 25th, 1910. At that time the Company had an issued capital of £547,299. It had practically no cash resources whatsoever, and it had no credit. It had been extremely difficult to find money in this country for wireless telegraphy. Mr. Marconi had personally made great efforts to find the necessary money to conduct the business of the Company, and he only succeeded by going to Italy and obtaining there a substantial subscription to the Preference issue which was at that time made. But for that fact—but for his being able to obtain that money in Italy—there is little doubt, I think, that the Marconi Company would have then come to an end.

When I joined in 1910 Mr. Marconi personally lent to the Company the sum of £12,000, and he then proceeded to Canada upon the Company's business. Within a very few weeks of his absence I had to draw a cheque on my own banking account to pay the salaries which were due on the Saturday morning for the preceding month. To-day, ladies and gentlemen, we have a capital issued of somewhere approaching one and a half millions sterling, and I think you have but to refer to the Balance Sheet to be satisfied that we are in a very sound financial position, and that our Balance Sheet is a very sound Balance Sheet, and that our assets are very sound assets. We have to-day nearly one million sterling to the credit of our General Reserve Account, and we have very large assets in the shape of cash, Realisable First-Class Securities, Freehold Property, Leasehold Property (and in speaking of Leasehold Property I would like to tell you that although it appears in the Balance Sheet at cost, less depreciation, we could dispose of it to-day—and we have had more than one offer for it—at a very handsome profit); and we have, in addition, a large number of shares in our Associated Companies, most of which have to-day a very substantial value, and all of which we hope in the future will have a very big value. Now, ladies and gentlemen, I want to tell you something of the reasons why the business did not prosper in the first years. I think it is advisable—I think it is desirable—that you should have an insight into the history of this Company, which heretofore has of necessity, for reasons which you will all understand, been a closed book. Very soon after Mr. Marconi provided the Company with this very valuable invention, the methods obtaining abroad were adopted with regard to this science, and the very valuable patents which were then this Company's property, and the property of this Company alone, were imitated in Germany, and with the great ability of the German people, and their great foresight, a big German Company was created. This German Company was created by the German Government. It had for its direction the most, or some of the most, eminent and able commercial men in Germany—men who were then the Directors of some of the biggest commercial industries of that country.

It had, further, the great advantage of the financial aid of some of the principal German banks, and it had, finally, a very large subsidy from the German Government. Now, ladies and gentlemen, that was the opposition Company against which the Marconi Company for many years, up to the time when I joined it, and subsequently, had to contend. Mr. Marconi personally, with the aid of his Managers, had for many years succeeded—and, in my opinion, marvellously—in maintaining something of the position of the English Company, notwithstanding this very powerful opposition of the German Company; and I think that it was very largely due to the magnificent support given to the Company—and, perhaps, it would be more correct to say to Mr. Marconi personally—by the Italian Government, notwithstanding the fact that they were the ally of the German Company's Government, that the Marconi Wireless Telegraph Company was able to continue in existence. The German Company, no doubt, under the direction, to a large extent, of the German Government, proceeded to create powerful agencies in pretty well every country in the world, and they made great headway. With the exception of Italy, France, and this country, they had, I think, obtained the preponderating position in this industry in practically every part of the world, and that was the position which I found in 1910. Wherever one went, whatever negotiations one had with a foreign Government, one was always in competition with the powerful German agency; but that was not all. We had not only to contend with the German agents, but we had also to contend with the German Ambassadors, and we eventually found that our position was so impossible under such conditions that I returned from a journey abroad and made an immediate appeal to Sir Edward Grey, and placed these facts before him; and from that time forward I obtained the support of the British Ministers abroad in our different negotiations with foreign Governments, and from that time also we commenced to make substantial progress until we reached the preponderating position in the industry throughout the world.

It is easy to understand that to a company like this German Company, which had the support of the German Government and conducted the greater part of its business under the direction of the German Government—always with the aim of obtaining the contracts or concessions for the construction of wireless telegraph stations in foreign countries, having in view the importance which they one day would play, and with the prospect where a German station was built that German hands would work that station—it mattered little or nothing to the German Company, with the German Government behind it, at what price, or in what conditions, it entered into contracts for the construction of those stations. In those circumstances, I think you will agree that it was not easy for the Marconi Company to maintain its own. Within three months of my joining the Company it was evident to all of us that the future of our Company lay in the commercial wireless telegraph service round the world, and we adopted the policy of creating such a commercial telegraph service; and one of our first acts in April, 1910, was to apply to the British Government for the right to erect high-power stations in all the British Possessions, we stating at the time that we had determined to create this telegraph service—that we had determined to create that service on British soil, if possible, but that we had made up our minds that the stations were to be built and the service created. Unfortunately, the Government did not see its way to grant us that right, although we had asked for no money. We had merely proposed that we should, at our own expense, build these stations and work a commercial service in peace time, and in case of war hand over the whole of the stations to the Government for Government purposes. It is regrettable that we were not enabled in 1910, when we made that proposal, to proceed with our programme. Out of it was born the Imperial chain.

As you will remember, when that was mentioned in Parliament it received most hostile criticism, on the ground that it was alleged that the Company was receiving terms far too favourable to it. Immediately the matter was mentioned the German Government resolved to build a chain of wireless stations in all German colonies. The matter was not discussed in Parliament. The stations were immediately proceeded with, and they were built. I am informed—and I think I am correctly informed—that the price which the German Government paid for each of those stations was three times the price which we had asked of the British Government. Besides that price, which provided for a very handsome profit, there was a subsidy which represented in amount far more than we ever contemplated we would get in any year from the royalty which we were to receive upon the Imperial stations, and that subsidy was to be paid, not for eighteen years, but for twenty-five years. Those stations, ladies and gentlemen, were built, and, I believe, cost the German Government two millions sterling. In the light of what has subsequently happened you will probably say that it was a very bad investment, but you would be mistaken.

You will remember that this country declared war on Germany at 12 o'clock midnight on the 4th August last. At 5 o'clock in the afternoon of August 4th last Germany sent out a message to all its wireless stations, which passed that message on from one to another, and each station sent it out to sea, covering a radius of something like 2,000 miles or more, to this effect: "War declared upon England; make as quickly as you can for a neutral port." By that message, which occupied but a few minutes, Germany contrived to save the greater part of its mercantile marine. If it had but saved one of its big ships, the *Vaterland*, or any one of that class, it would have paid for the whole cost of its wireless stations. We all know that it did a great deal more than that, and that it did a great deal more than sending this message to its mercantile marine, but I do not think I am permitted to go further, or to tell you any more than what I have told you already with regard to the saving of the mercantile marine.

Ladies and gentlemen, I have given you this information because, as I said before, I think it right that you should understand a little of what the Marconi Company has had to contend with in endeavouring to maintain its position in the world in this industry, and I have also given it to you because I want you to understand —or, perhaps, better understand—the reasons for the conservative policy which the Board has determined upon at this time. We contemplate that when this war is over, in consequence of the very big value which wireless telegraphy has proved itself to be during this war, there will be a very considerable business to be done with a great many foreign countries. But, ladies and gentlemen, we are mindful that when that time comes it is possible that, owing to the financial stress which may reign for a period, many foreign Governments would defer entering into the engagements which they otherwise, in my opinion, would be only too willing to do, if we were not able to some extent, and for some little period, to finance the work which we may undertake for them. I do not know what is likely to be the position of our competitors when the war is over. I do not know whether they will have the same facilities financially, or in other respects; but, in any case, we do not propose to take any chances.

We contemplate so harbouring our resources that when the time comes we shall be able to undertake the business which will be offered to us, and we shall be able to undertake it far more profitably by reason of our having the means at our disposal to give such temporary assistance in carrying out the work as will be required. Further, we must recognise that it may be possible that we may be called upon for some financial assistance for a period to some of our Associated Companies, and there is no doubt that the Mother Company will have to be prepared to be their bankers in case of need. In these circumstances we feel sure you will agree with us that we are adopting a far wiser policy in paying a smaller dividend and in making all the provision which we contemplate the future may require from us. In giving you the account which I have done of the work which the Company has had to do in maintaining its position in the world in this industry I want to add one thing. I never could possibly have succeeded in the work I have done had it not been for the loyal support and help I have had from Mr. Marconi personally, and from every single member of my Board, and very particularly from our Manager (Mr. Bradfield) and our Assistant Manager and Secretary (Mr. Allen). I cannot exaggerate the immense help they have been to me throughout all these five years of work. I must also refer to our staff of engineers —to our Head Engineer (Mr. Gray), to our Mr. Vyvyan, and to a number of others that I cannot name now, who have all done magnificent work for the Company, and have shown a loyalty which I do not think has ever been surpassed anywhere. Ladies and gentlemen, I am quite sure that it must have given you all a great deal of satisfaction to see Mr. Marconi, who has been able to return for a few days to this country, to preside over us. In his work in Italy as an officer supervising all matters electrical for the Army and Navy I am sorry to say that he has been nearer to Austrian and German shells than I like to think about, but I am very glad, at all events, that we see him safely home, none the worse for his experiences.

Ladies and gentlemen, I also want to tell you that although he has been employed in the capacity which I have just named for his own country, he has, nevertheless, been able to give to us during all that time all the direction and all the assistance, and has been able to watch over this Company's affairs, and to work in the interests of this Company, just the same as he has always done. There is only one thing more I want to mention before I sit down—I ought to have told you sooner—that the five Balance Sheets of this Company published since 1910 show a net profit of close upon one million sterling, and I think, in face of the difficult conditions under which we have had to work, that is not a bad result. It only remains for me now to second the Resolution which has been proposed by the Chairman.

The Chairman: I think we are all grateful to Mr. Godfrey Isaacs for the very clear and interesting history which he has given us of what this Company has done, what it has had to contend with, and the difficulties which it has encountered in the past. I think we are all very glad that he has been able to give us this *résumé* of the history of the Company. I am very grateful indeed to him for what he said in regard to myself personally, and I thoroughly endorse everything he has said with regard to the Staff of this Company. I will now ask any Shareholder who has any question to ask upon the Balance Sheet and Report to please do so now.

A Shareholder: Mr. Chairman, may I ask whether in the item appearing in the Profit and Loss Account, under the heading of "Profit for the year as per Account, £232,716 8s. 11d.," is included the dividends received from the Associated Companies in respect of our holdings ?

The Chairman: Yes, certainly.

Mr. Lanham: Mr. Chairman, before you put the Resolution to the Meeting, as nobody seems to be inclined to say a few words, I would like to do so. Last year we had, if anything, perhaps a little too much talking; but to-day we have had a very momentous speech, which in a few minutes will be on its way to our Colonies and elsewhere throughout the world. It is a speech which has been most illuminating to us all as to the methods which our British industries have to contend with. I just wish to say a word or two, from the point of view of a small Ordinary Shareholder, of appreciation on behalf of the whole of the Shareholders present to-day, and nothing by way of any cantankerous talk. When I came here I had two pleasant surprises. The last I heard of our gallant Chairman was that he was on his way across the Atlantic. I do not know whether it was inside one of the boilers of the ship, or something of that sort; but it is a great pleasure to us all, sir, to see you here looking not much the worse for that experience. Then, in the second place, I do not think any of us will regret the time we have spent here to-day by the pleasure afforded us not only from our Shareholding point of view, but from the pleasure which we have received in the intellectual speech which we have had from Mr. Godfrey Isaacs. This is the first time I have been with him. I was not with him last year, but then, like a great many other Shareholders, I did not know; but I think, sir, in the course of a few minutes, probably with the assistance of this very wireless telegraphy which we here represent, that speech, as I say, will be filling others with the same admiration and interest with which it has filled us here in London. As regards the Balance Sheet, I should only like one little bit of information. We have an asset which, it appears, no one knows anything about—that is to say, as to what its ultimate value will be—namely, what we have to receive from the British Government. Now this must, I should say, be a somewhat large amount. I do not know whether, so far, anything has been received on account, but it is one of those things which I think places our Directors in perhaps a rather invidious position as regards we poor ordinary provincial Shareholders, because there will come a time when negotiations will be begun in regard to what this amount will be. If it is a large sum it will be a very useful thing to know in the nick of time. And I think, sir, that you should, if possible, give us the amount. All these things have been known in the past. I wish I had known as much in February, 1914, as I know to-day. I am speaking, to a certain extent, as a Stock Exchange man, and I have known that inside knowledge is rather useful. I think, therefore, if you could give us some slight idea of what the eventual payment will amount to——whether it be thousands or millions—we shall then, to some extent, be all in the same boat. Personally, I will hand over to anyone to-day one thousand times the amount of profit I make out of my shares if they will pay me one-half my losses. That wants thinking about. In conclusion, I am sorry to have detained you; but I feel that this has been an exceedingly interesting meeting, and although there has not been quite so much fun this year, as I may say we had last year, it is intensely more satisfactory.

Mr. Jordan: May I ask a question of Mr. Isaacs ? If our Government had given one-half the support to the development of wireless telegraphy which the German Government gave to its subjects, should we be likely to have lost the *Good Hope* and the other vessels which were sent to the bottom by German ships ?

Alderman J. Ford (Cork): Before you answer that question, I would like to make one remark following upon what my friend here said. I would suggest that when this money is paid to the Company, it will be communicated at once to the Shareholders—that it will not be allowed to hang fire. I really think that some expression of opinion should come from this meeting that when the negotiations come to a close, the Shareholders should be informed of what has transpired. Up to the present we have had nothing but kicks and cuffs from the Government, and I really think that now is the time for reparation on their part, to do the handsome, and when they are about it to consider what money has been lost by the Shareholders in the past.

Mr. Godfrey Isaacs: In reply to Mr. Jordan's question, I am afraid, sir, that I must not give you any answer. I do not think that, personally, I could with any assurance do so, and if I could, I do not think I would. With regard to the second question put by Mr. Ford, I cannot form any estimate at the present moment of the sum which the Company will receive, because the services which the Company is rendering to the Government, and for which we have received remuneration, still continue. As regards publishing the sum which we may receive, directly the matter may be settled, if it be possible, it shall be done—it shall be done immediately. With regard to the question of the information getting through to some before it gets to others, to the advantage of some, so far as the Company is concerned, we do our very utmost to prevent any information going out of the office until it is sent out by circular to the Shareholders; but in a business like ours, where we have to do with a great many people, I want everybody to bear in mind, before he allows himself to listen to wild charges thrown at the Company and its officials, that there is a very large number of persons, not in the Marconi Office, who know what is going on, and who, perhaps, know sooner what is going to happen than the Marconi officials themselves.

The Resolution was then put to the meeting, and carried unanimously.

The Chairman moved, Capt. Sankey seconded, and the Resolution was unanimously approved, "That a dividend of 10 per cent., equal to 2s. per share, less income tax, upon the 1,222,688 Ordinary Shares numbered 1 to 500,000, and 750,001 to 1,472,688, be and the same is hereby declared for the year ended December 31st, 1914; that the said dividend be payable on August 31st, 1915, to the Shareholders now registered on the Books of the Company, and to holders of Share Warrants to Bearer."

Mr. Godfrey Isaacs moved, Mr. Alfonso Marconi seconded, and the Resolution was unanimously approved, "That the retiring Directors, Mr. Henry S. Saunders and Mr. Samuel Geoghegan, be re-elected Directors of the Company." Mr. Isaacs said: I have already told you, ladies and gentlemen, that I have always received the most loyal support from all my Directors, and all my Directors have been on the Board longer than I have. I feel, therefore, that you will not hesitate to re-elect them.

The Chairman then remarked: Before I go on to the next Resolution I wish to say a word or two with regard to the Directors generally. We have suffered a very great loss by the death of General Albert Thys, who was for many years connected with the International Company, with the Belgian Company, and then with our English Company. He helped us very efficiently and very devotedly all through our difficulties in the past. I must also mention the death of Major Flood Page, which occurred some months ago. He was also one of the Directors who assisted this Company, and assisted me through all the difficult times in the past. I think he was a Director of the Company for over twelve years. Speaking personally, and for my co-Directors on this Board, we feel the loss of these two gentlemen very deeply. I will now ask a Shareholder if he will please move the reappointment of the Auditors?

Mr. Foat moved, Alderman Ford seconded, and the Resolution was carried unanimously, "That Messieurs Cooper Bros. & Co. be re-elected Auditors for the ensuing year, and that their remuneration for auditing the Accounts to December 31st, 1914, be 500 guineas."

The Chairman: I now have to propose the following Resolution:—

"That the Articles of Association of the Company be altered in the following manner:—

"(*a*) By cancelling the second, third and "fourth lines of Article 78 commencing, 'If "'without the sanction,' and ending with "'Departmental Manager.'

"(*b*) By inserting after Article 78 a new "Article to be numbered 78A, to the following "effect:—

"'78A. A Director may hold any other "'office under the Company in conjunction "'with the office of Director, and on such "'terms as to remuneration and otherwise as "'may be determined by the Directors.'

"(*c*) By cancelling Article 110 and substituting "the following Article therefor, namely:—

"'110. Notwithstanding anything in these "'Articles contained the Directors may from "'time to time out of accrued or accruing "'profits pay to the members such interim "'dividends as in their judgment the position "'of the Company justifies, and for this "'purpose any payment to Preference Share-"'holders in or towards satisfaction of any "'fixed preferential dividend for the time "'being payable on their Shares shall be "'deemed to be an interim dividend.'"

I will ask Mr. Godfrey Isaacs to second the Resolution and to explain it.

Mr. Godfrey Isaacs: I rise to second the Resolution. I would like to explain, with regard to the first part of the Resolution, that we are suffering something of an anomaly in our Articles of Association at the present moment. I think you can easily understand what is the object of the proposal. I need not give any better instance than that of our Chairman, Mr. Marconi. Mr. Marconi is our Chairman, and he is also our Scientific Adviser; but, strictly speaking, under the Articles as they at present exist, he has no right to hold the position of Scientific Adviser, and for such a reason naturally it is desirable that this Article be immediately changed. With regard to the second Article, it is merely a case of facilitating the payment of interim dividends whenever we find it desirable to do so. I do not know that any further explanation is required, and I beg to second the Resolution.

The Resolution was unanimously adopted.

The Chairman: I would remind the Shareholders that the confirmatory meeting will be held at Marconi House, Strand, on Wednesday, August 18th, 1915, at 11 a.m. I think that concludes all our business, and I have to thank you very much for your attendance and for the support which you have given us.

Alderman Ford: I think we would be wanting in our duty if we did not propose a vote of thanks to the Chairman and his colleagues. I think it would be a grave dereliction of duty on our part if we did not convey to the Chairman our hearty expression of our pleasure at seeing him here to-day in our midst, and also for the very able manner in which he has discharged his duties as Chairman of this meeting. Last year there was a certain amount of friction; but to-day we are all a happy family. We are all one, and I hope next year, when our meeting comes round again, we will all be in equally good form, and that our Chairman will be in as robust health as he is to-day. I think the least we can do is to express to him our deep debt of gratitude for the manner in which he has conducted our proceedings here to-day.

The Resolution was carried with acclamation.

The Chairman: I thank you very much. I am very grateful indeed for the support which you have given us, and for the kind things you said about myself, Mr. Godfrey Isaacs, and the Board generally.

The proceedings then terminated.

# Russian Company of Wireless Telegraphs and Telephones.

THE Annual General Meeting of the Russian Company of Wireless Telegraphs and Telephones (Russian Marconi Company), was held in Petrograd on June 13th, Vice-Admiral Bostrem, Chairman of the Board, presiding. The directors' report and accounts for the year ending December 31st, 1914, record a largely increased turnover in the business of the Company, mainly due to orders received from the Russian Government. The Company declared a dividend in respect of the year 1914 at the rate of 15 per cent., which was payable on July 13th. The retiring directors, Messrs. Godfrey C. Isaacs and P. I. Balinsky, were re-elected, and the meeting passed a vote of thanks to Messrs. Balinsky and L. M. Eisenstein and the staff for their work in connection with the affairs of the Company

# Institute of Radio Engineers.

## *Notice of Meeting.*

ON Thursday and Friday afternoons, September 16th and 17th next, joint meetings of the Institute of Radio Engineers and the American Institute of Electrical Engineers will be held at the Native Sons of the Golden West Hall, Panama-Pacific Exposition Grounds, San Francisco. Two papers for the Radio Engineers will be presented, one on each day. Thursday afternoon Prof. Harris J. Ryan will read the results of investigations on the "Sustained Radio Frequency High Voltage Discharge," by Mr. Roland G. Marx and himself, taking up the flame and brush types of discharge obtained from conductors when a powerful arc generator is used to apply voltages up to 50,000 at frequencies as high as 200,000 cycles per second. On Friday Mr. Robert H. Marriott will read a paper on, "Radio Development in the United States," giving special attention to Pacific Coast conditions.

# PERSONAL PARAGRAPHS.

Mrs. Greenaway, the mother of F. Greenaway, who worked for Marconi's Wireless Telegraph Co., Ltd., for about six years, and who will no doubt be well remembered, has received from his captain and adjutant a letter, of which the following is a copy, describing the good work her son has done at the Front. This will no doubt be interesting and pleasing not only to all who remember him, but also to readers of THE WIRELESS WORLD.

"*June 5th*, 1915.

"To MRS. GREENAWAY,—I am writing this note in connection with your son, who is on the staff of the brigade to which I am adjutant. So much is done in this war which deserves more than the brave man who did it ever receives that I think it is everyone's duty to bring to light the acts (that otherwise may pass unnoticed) which help to bring this war to a successful conclusion. I, therefore, write to tell you of your son's good work under very dangerous and unnerving conditions of which I am sure you will be glad to hear. I did not witness the deeds of pluck personally, as I was not with your son, but a special memorandum has been received about him. At the time to which I refer he was doing duty of linesman at artillery headquarters, which meant that he was responsible for the maintenance of the telephonic communications between that place and his brigade headquarters. The telephone line ran over a zone constantly swept by very heavy shell fire, which meant the frequent cutting of your son's line. He had consequently to go out each time to repair it, and the General sent a special letter to say that he wished to very warmly commend your son's pluck, grit and promptness in going out under very heavy shell fire to do his duty, not once, but frequently. I am sure your son's behaviour and example are an example of what is required for success in the Army. I feel sure, too, a mother is always glad to hear of her son's bravery, and that is why I have written.

"Everyone cannot get a prize, but it is to be hoped in the future occasion will arise which will bring him some tangible recognition of his good work.

"(Signed) Capt. & Adjt. ROBERTSON,
"118th How. Brigade."

* * *

Hearty congratulations to Lieutenant Hake, who was gazetted on July 21st last. Lieutenant G. E. Hake joined the Marconi Company in September, 1911, as learner in the London School, and early in the following year was appointed to the operating staff, subsequently taking service on board a number of vessels. After some time at sea he was promoted to the inspecting staff, and later received an appointment as instructor in the London School. Lieutenant Hake, who previous to joining the Marconi Company had served some years in the Army, at the commencement of the war rejoined the Forces as corporal in the Northumberland Fusiliers. After a short period in England he was drafted to the Front and saw some of the most sanguinary fighting in the early days of the conflict. On November 1st last Lieutenant Hake received a head wound from a flying splinter of shrapnel, and returned to England for treatment. Upon recovery he received a transfer to the Wireless Section of the Royal Engineers, where, of course, his experience in commercial wireless telegraphy stood him in good stead, and on the date mentioned above received his commission.

* * *

Many of our readers among the operating staff of the Marconi International Marine Communication Co., Ltd., will recognise in the photograph below George Dewdney, who for more than a year was attached to the staff of the Marconi House school as boy assistant. Dewdney, who was an active member of Major Masterman's Own Stockwell Scouts, spent most of his spare time when at Marconi House in studying signalling and wireless telegraphy, the latter in both theory and practice. At the outbreak of war, through the influence of Major Masterman, he became attached to the Welsh Regiment as Boy Scout, and a little later was proud to join the regiment as private. By his skill and good conduct he soon marked himself out for promotion, with the result that on March 10th he was raised to the rank of lance-corporal. Further promotion has since been awarded him, and he

*Corporal Dewdney.*

now proudly serves his King and country as Corporal Dewdney, Signalling Instructor. We take the opportunity of heartily congratulating Corporal Dewdney on his splendid progress, and are sure that many other boys of 16 (for Dewdney is just that age) will be inspired by his fine example.

* * *

We learn from Manchester that Mr. John Welsh, who was at one time employed as a wireless operator at the Marconi station in Honolulu, and Miss Gerta Neilson were recently married as the result of a romance which began on the ill-fated voyage of the *Lusitania*. The acquaintance, which started early in the voyage, soon ripened into friendship, and before the "hunnish" attack they became engaged. When the vessel sank they were rescued together. Both lost all their savings in the wreck.

* * *

We are pleased to make mention in these columns of the marriage of Sapper Fred Archer, a member of the Essex Fortress Engineers stationed at Landguard Fort, Felixstowe. Before the war broke out he was employed at the Marconi Works at Chelmsford, and from the employees there the happy couple received as a present a dinner service, a tea service, and a set of cutlery. His wife was Miss Kitty Carlton, of Chelmsford, and the ceremony took place at St. John's Church, Moulsham, the bride being given away by her father. We wish them every happiness in their future life.

*Lieutenant McEwen.*

The many friends of Lieut. McEwen, the secretary of Senatore Marconi at his London office before the war, will be very gratified to learn that his name was mentioned in the last despatch sent by Sir John French to the Secretary of State for War. Lieut. McEwen offered his services to the Intelligence Branch of His Majesty's Army, and his deeds well merit their honourable mention. We hasten to convey to him the hearty congratulations of our many readers and ourselves.

* * *

It is with pleasure that we learn of the marriage on July 13th last, at Errismore Church, Ballyconneely, Clifden, Ireland, by the Rev. Thomas Nee, M.A., by special licence, of Mr. W. G. Groves, a member of the operating staff at the Clifden station, to Miss Elsie E. Tear, the youngest daughter of Mr. Richard Tear, of Hampstead, London. We take this opportunity of wishing them all happiness in their new sphere of life.

* * *

Mr. E. J. Nally, the general manager of the Marconi Wireless Telegraph Company of America, accompanied by Mr. G. S. De Sousa, traffic manager, and Mr. E. B. Pillsbury, general superintendent, has returned from an inspection of the Marconi property in the states of New Jersey and Massachusetts, including the station on the Island of Nantucket.