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THE WIRELESS WORLD

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British Association Meeting

The Goldschmidt Station at Eilvese

Naval Telegraphists: Their Life & Training

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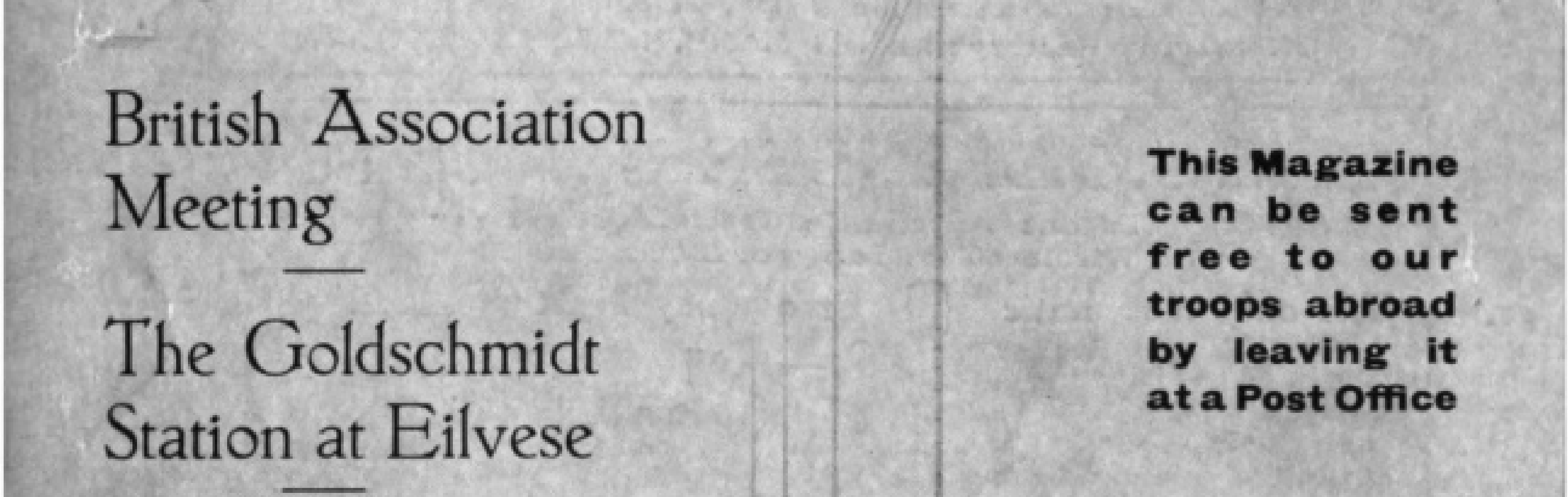
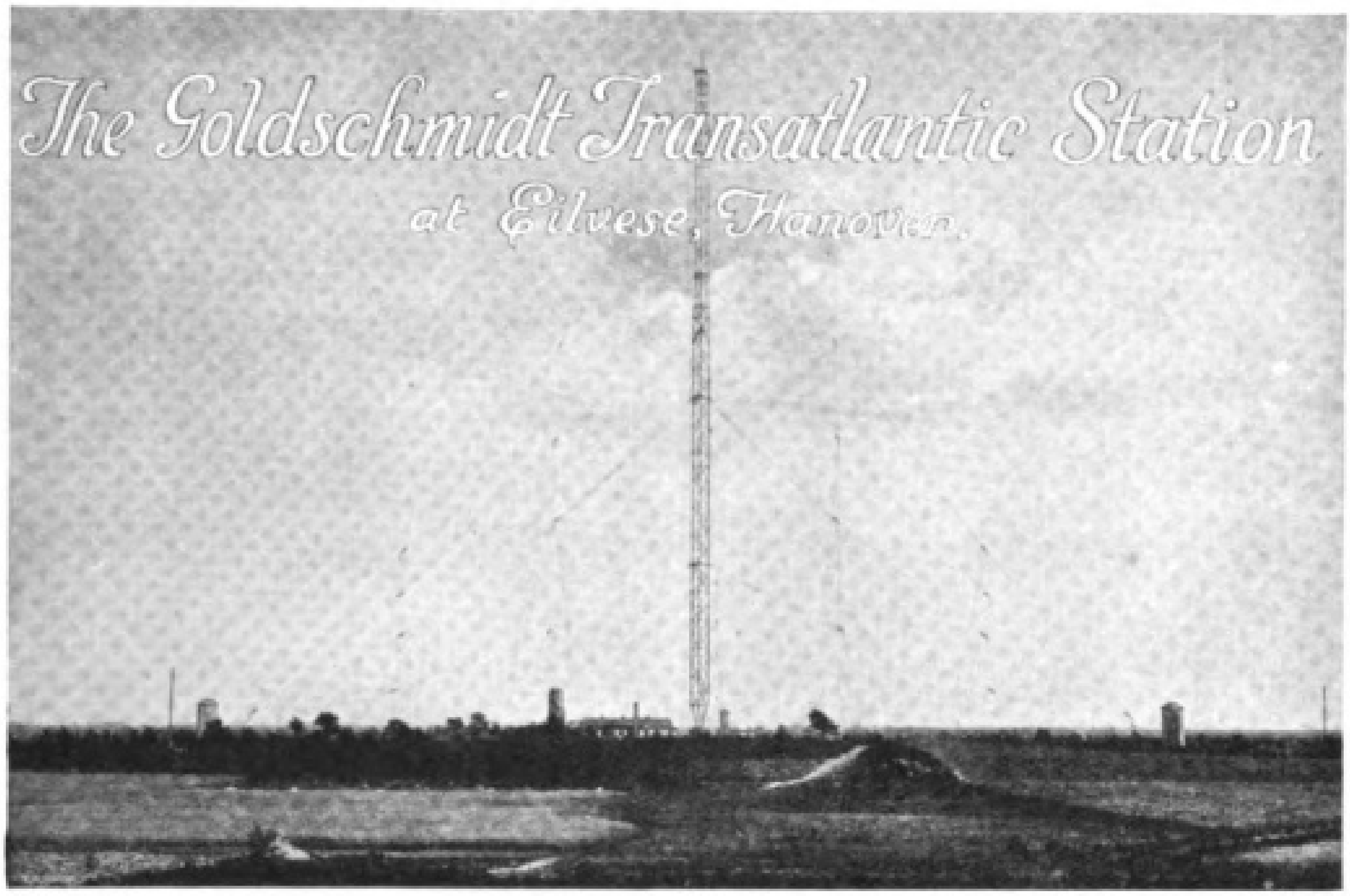
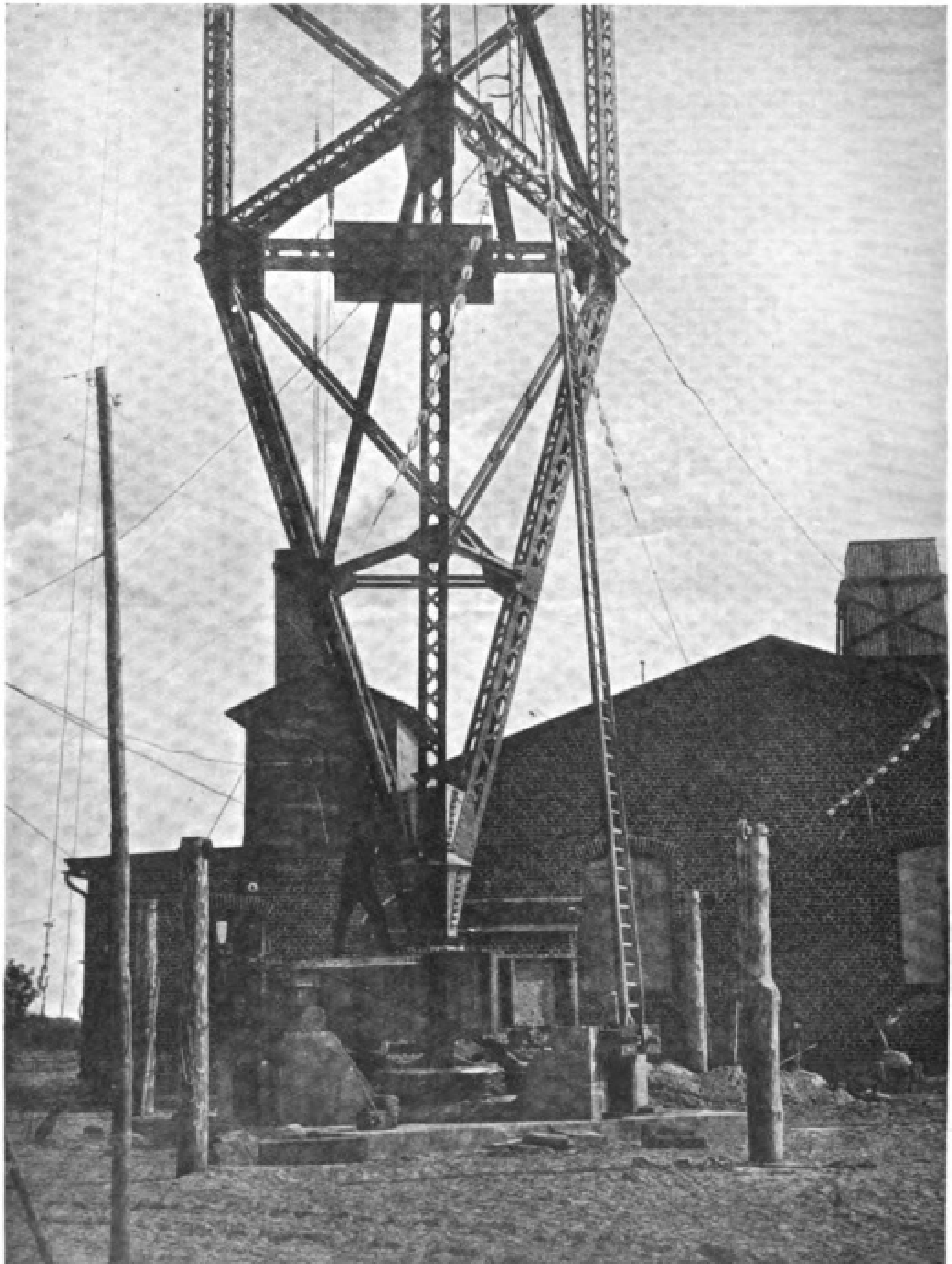




A GENERAL VIEW OF THE HIGH POWER WIRELESS TELEGRAPH STATION AT EILVESE.

AMONG the wireless stations to which Germany has had recourse since the British severed the German cables in 1914, that of Eilvese, in the province of Hanover, holds a prominent place. This giant station, which is situated near Neustadt and not far from the capital town of Hanover, was originally erected for the purpose of demonstrating the inventions of Dr. Rudolph Goldschmidt, including the now famous Goldschmidt High Frequency Alternator and the Goldschmidt Tone-wheel. At the outbreak of war, however, it was taken over by the German Government, and for the past two years has been used to transmit across the Atlantic those telegrams which the Kaiser and his staff consider it necessary that the American people should receive.

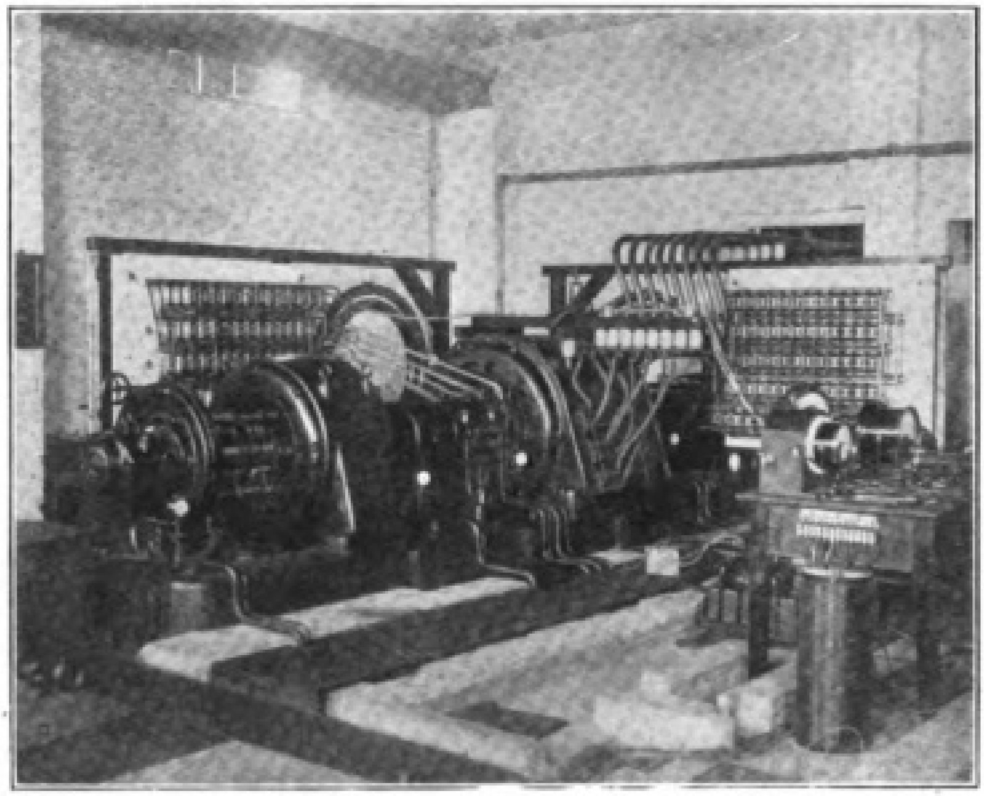
From the engineering as well as from the " wireless " point of view the station has many interesting features. Situated in the midst of country which is flat, somewhat marshy and eminently suitable for the erection of a wireless telegraph installation, the Eilvese Station is a landmark by reason of its giant mast. This rears itself to the dizzy height of over 750 feet, and supports an elaborate antenna of the umbrella type. The appearance of the station as it strikes the German peasant working on the fertile Hanoverian plains will be gathered from the heading of our article, in which the height of the tower seems accentuated by the extreme flatness of the surrounding country. On closer examination the mast reveals itself as a triangular lattice structure of steel, the base being brought almost to a point and resting on a large insulating pedestal. The foot of the mast is supported on a number



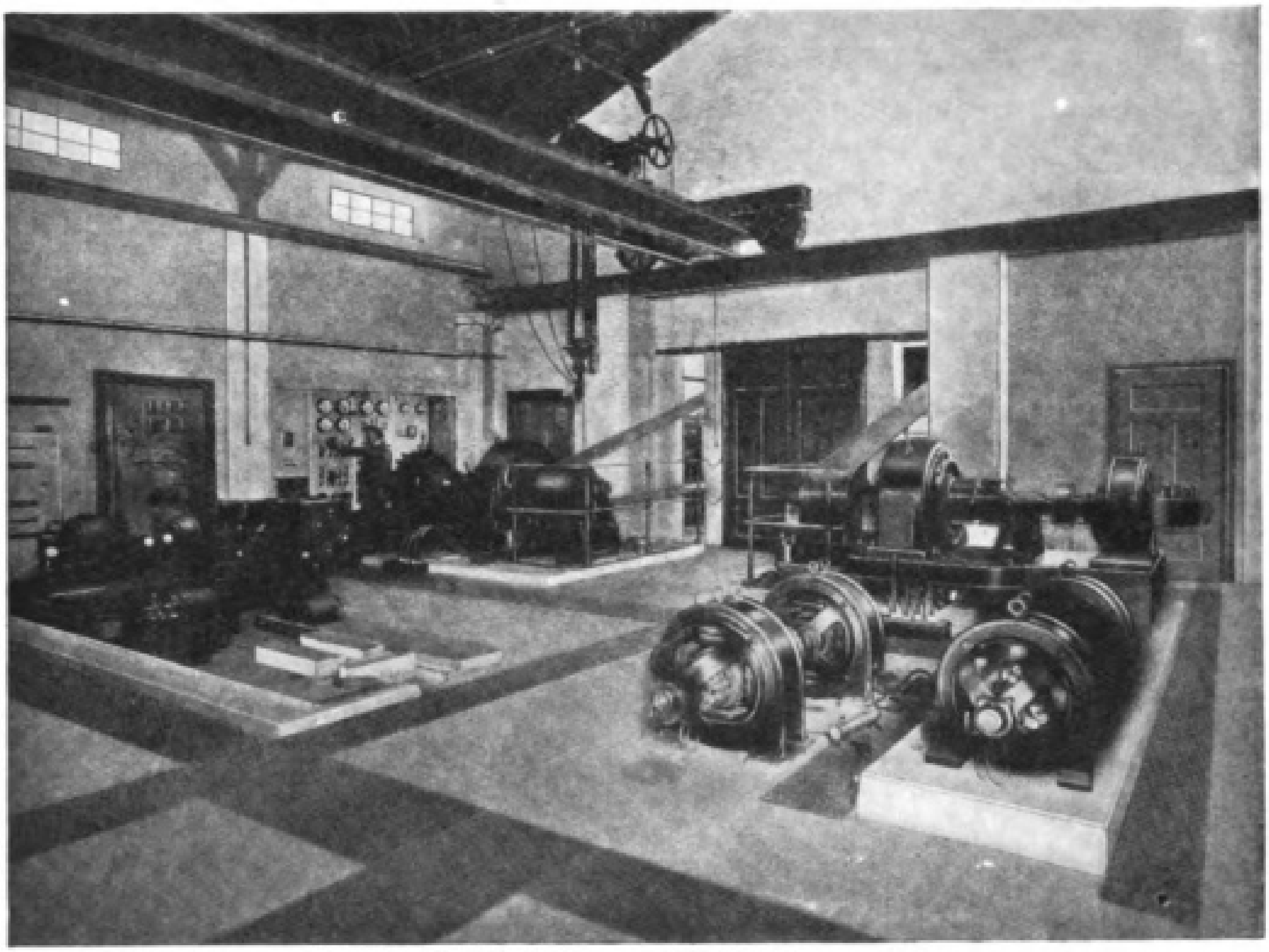
THE BASE OF THE TRIANGULAR STEEL MAINMAST. AT THE TIME THIS PHOTOGRAPH WAS TAKEN THE CONSTRUCTIONAL WORK WAS INCOMPLETE.

of short glass pillars, which, being subject to compression only, form excellent insulators. An insulating joint is also inserted in the middle of the tower. The aerial wires are stretched out to a circle of poles each 40 feet high, the ends of the guy-ropes which support the tower being fastened to reinforced steel beams sunk in heavy foundations. The photograph on page 510 excellently illustrates the staying of the guy-ropes, and the size of the anchoring structure will be realised by comparing it with the figure of the man standing beneath it. Inside the station building we find a 400 h.p. "Wolf" engine, boiler and engine being constructed together. Such an arrangement is economical and occupies a minimum of space. This engine provides the power for running the station.

The most interesting part of the whole installation is undoubtedly the Goldschmidt High Frequency Alternator. The machine here fitted has a normal output of 100 kw. high frequency current, although if necessary its yield can be forced up to nearly double this figure. In the limitations of our space we can only indicate the underlying principles of this machine, which is really one of the most ingenious pieces of wireless apparatus ever invented. Briefly, then, the Goldschmidt machine is a combined generator and frequency transformer. The alternating current which is produced in the rotor creates in the field circuit another alternating current, which in turn serves to produce a higher frequency alternating current in the rotor, and so on backwards and forwards by what is known as the "reflection" principle. Each frequency oscillates in its own tuned circuit possessing carefully arranged capacities and inductances. For reasons into which we cannot enter here, it is desirable that there be not more than four or five reflections in the machine, consequently it is necessary to have an unusually high fundamental frequency. For example, to obtain a wave-length of 6,000 metres—a wave-length frequently used in transatlantic work—a frequency of 50,000 cycles per second is necessary. If not more than five reflections are used, the initial frequency must be 10,000 cycles, and for this a very high rotor speed and a large number of poles are required. Using the best materials and the highest engineering skill, the maximum speed which can be safely maintained on the periphery of the rotor is about 600 feet per



THE GOLDSCHMIDT ALTERNATOR AT EILVESE.



THE DYNAMO ROOM AT EILVESE STATION.

second for a speed of 3,000 revolutions per minute, and for this the diameter of the rotating portion of the machine will scarcely exceed four feet.

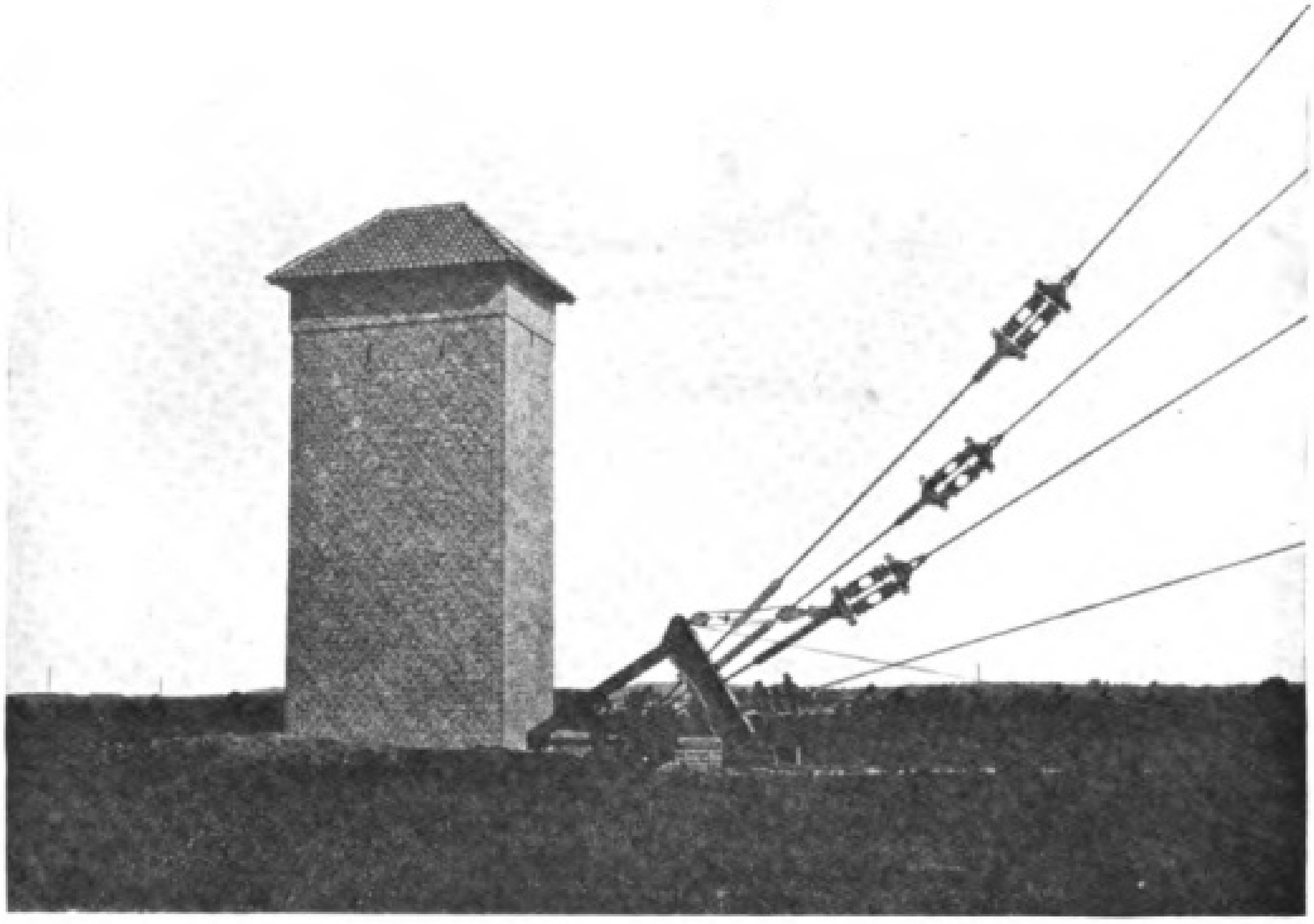
In the machine used at Eilvese the width of each pole is one centimetre, and there is only one conductor in each slot. When such high frequencies are used the iron used in the magnetic field must necessarily be of the very best quality and well laminated. To keep the eddy current as small as possible steel of a thickness of ·05 millimetre is used, insulated by paper about ·03 of a millimetre thick. In this way the body of the rotor and of the stator is more than one-third made up of paper! The clearance between the rotor and the stator is a trifle more than $\frac{1}{32}$nd of an inch, and when we consider that the rotor has to revolve at a peripheral speed of over 600 feet per second, and in addition weighs no less than five tons, we see how carefully the machine has to be made. In the illustration which we give on the previous page the driving motor of the 100 kw. machine is seen on the left of the base plate and the alternator itself on the right. On the racks fastened to the wall will be seen the condensers which are shunted across the various inductances to form the oscillating circuits. On the table are situated the ammeters, voltmeters and other measuring instruments.

With this machine there is, of course, no need for a spark gap, for the alternator can be connected directly to the aerial. In order that the frequency of the antenna may be adjusted to that of the machine a large aerial tuning inductance coil is used, consisting of a large spiral of copper tubing.

The problem of breaking up the large current into dots and dashes is, of course, an important one. Dr. Goldschmidt has overcome the difficulty by placing the transmitting key in the exciter circuit of the alternator, where of course a comparatively small current has to be broken. This method has proved very successful in practice.

The Eilvese radio station works to a similar station at Tuckerton, New Jersey, nearly 4,000 miles away. As both of these stations radiate continuous waves, special receiving apparatus has to be installed. This takes the form of what is known as the " tone-wheel," an ingenious instrument which is really a commutator. The principle of operation is as follows : A simple toothed wheel, acting as a make and break commutator, has such a number of teeth or poles that, at a reasonable speed, its interruptions are synchronous with the incoming frequency. For example, 800 teeth on the wheel would produce a frequency of interruption of 50,000 cycles per second. If this commutator is run at such a speed that the frequency of interruption is exactly the same as the wave frequency it is desired to receive, no sound will be heard in the telephones connected thereto. If, however, the speed of interruption is slightly lower or higher, the received current will not be perfectly rectified and a " beat " effect will be produced. The frequency of this " beat " current will be equal to the difference between the frequency of the incoming waves and the frequency of interruption. Thus, if the wave frequency is 50,000 per second and the interruption frequency 49,500, the " beat " frequency will be 500 per second,

THE 400 HORSE-POWER " WOLF " ENGINE, SUPPLYING POWER TO THE STATION.



ONE OF THE LARGE STRUCTURES TO WHICH THE GUY ROPES SUPPORTING THE MAST ARE ANCHORED.

giving a pleasing musical note. A very slight difference in the wave-length from any interfering continuous wave station will produce quite a different sound in the telephone, and enable the receiving operator to define the signal readily.

Of course, the tone-wheel is not the only means by which continuous waves can be received. The principle of " beat " reception can be applied to several forms of the vacuum valve receiver, and, in fact, this method is largely used at the present time. The " tikker," another continuous wave detector, depends for its action upon the rapid interruption of a circuit, the note received depending upon the speed of interruption. Its main defect is that the note produced is harsh and non-musical, while its sensitivity is not high.

As regular readers of THE WIRELESS WORLD will know, the Marconi Company some time ago and prior to the war acquired rights in Professor Goldschmidt's patents. For further information regarding the high frequency alternator and the tone-wheel we would refer our readers to the " Wireless Telegraphists' Pocket Book," by Dr. J. A. Fleming, published by the Wireless Press, Ltd., and to an excellent article on the Goldschmidt system which appeared in the " Proceedings " of the Institute of Radio Engineers for March, 1914. To this latter source the writer would like to express his indebtedness.

Australian Naval Wireless Service

OUR contemporary, the *Melbourne Age*, recently reported that it had been decided by the Commonwealth Government to transfer all the work of the wireless branch of the Post Office to the control of the naval authorities. A large deputation representing the staff of the Government radio service waited upon the Minister for the Navy to protest against the reorganisation scheme, which places the personnel under naval discipline and conditions.

The deputation was introduced by Mr. Chanter, M.P. The deputation was held in private, but subsequently a statement was issued by the Minister. Members of the deputation pointed out that the wireless staff objected to signing on, under the new scheme, as chief petty officers, as by so doing they would lose the social status they enjoyed as officers of the professional division of the public service, and claimed that they should be given the rank of warrant officer. They also objected to the minimum salary offered. Engineer operators had responsible duties, censoring messages and dealing with secret and confidential matters, and the minimum salary should be for men now in the service £204. Under the Naval Board's proposal many men would receive less than their present total salary. Men entering the service in future should receive a minimum salary of £180. They also asked that increments should be paid annually instead of biennially as suggested, and urged that the allowance for uniform, £7, was not nearly sufficient. They asked also for better hospital conditions, as it was not desirable that officers should have to occupy the same quarters as the coloured population. They objected to working overtime without pay; to the fixing of the retiring age at 57, as against 65 in the public service, and to other conditions pertaining under naval control.

The Minister, in reply, explained the various advantages of the department's proposal, whereby officers who were now in practically temporary positions in the public service were being given an offer of permanent employment in the Royal Australian naval radio service. The salary of no officer was being reduced, and to compensate for the loss of overtime and Sunday pay each officer was being placed on a higher subdivision of salary. In his opinion a generous offer was being made to employés, and they could rely on getting fair treatment in the administration of the new conditions.

It may be pointed out, in connection with the above, that wireless employés are to be ranked in the naval radio service as follows: Lieutenants, £350 to £425; commissioned warrant officers, £255 to £325; warrant officers, £222 to £254; chief petty officers, £156 to £216. They will wear the naval uniform of their rank, and work under general naval discipline and conditions.

PERSONALITIES IN THE WIRELESS WORLD

Photo by] [Paul Thompson

MR. ROY A. WEAGANT

Chief Engineer, Marconi Wireless Telegraph Company of America

THE year 1881 witnessed the birth of Mr. Roy A. Weagant, who was destined to become the Chief Engineer of the Marconi Wireless Telegraph Co. of America. This event took place on British soil—to be precise, at Morrisburg, Ontario, Canada. Mr. Weagant was educated at Stanstead College, Stanstead, Quebec, and at McGill University, Montreal. His aspirations led him to the study of electricity, and he graduated from an electrical engineering course in 1905. He then studied physics under Sir Ernest Brotherford, and it was through witnessing some of his tutor's experiments in Hertzian Waves that his interest in Wireless Telegraphy was first aroused. The time was now ripe for seeking engineering experience. First he joined the Montreal Light, Heat and Power Company, then the Westinghouse Electric Manufacturing Company of Pittsburg, Pennsylvania, and afterwards the De Laval Steam Turbine Co. In regard to wireless work, Mr. Weagant first took this up in 1908 with Professor R. A. Fessenden. He entered the service of the American Marconi Company in 1912, and he is now their chief consultant on all matters appertaining to the engineering side of their wireless business. Mr. Weagant is a Fellow of the American Institute of Radio-Engineers, and holds an honoured position as one of the Directors of that institution. His activities have also been requisitioned in connection with the Standardization Committee of the same Society.

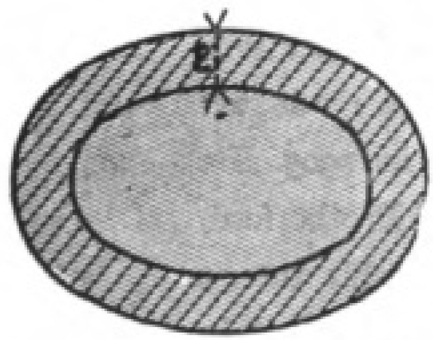
A New Abac for the Calculation of High Frequency Resistance

By C. BAILLIE

THE well known Maxwell and Hertz equations (as well as Kirchhoff theory) applied to a conductor having a conductivity c, permeability μ (electromagnetic units) and conveying a damped high frequency current, give the following results :—

The current is confined to a thin outer layer or skin.

The conductor opposes to the alternating current a certain ohmic resistance which can be defined as the ratio of the heat energy dissipated in the conductor to the mean square value of the current.



Cross section of conductor

To a steady current, the intensity of which is equal to the R.M.S. value of the alternating current, the same resistance would be opposed by a conductor having a cross section s such as the shaded section. As soon as we know this section s we can calculate the required high frequency resistance R by

$$R=\frac{l}{cs}$$

l being the length of the conductor.

It has been shown (Boucherot) that this section has always a very small thickness ϵ given by :—

$$\epsilon=\frac{1}{\sqrt{2\pi\mu c\omega}}$$

ω being the pulsation of the current and equal to 2π multiplied by the frequency n.

Hence we can get s by multiplying ϵ by the perimeter p of the cross section (p in centimetres). Then the required resistance is :

$$R=\frac{l}{cs}=\frac{l\sqrt{2\pi\mu c\omega}}{cp}$$

Introducing the resistivity $\rho=\frac{1}{c}$ and the frequency $n=\frac{\omega}{2\pi}$, $R=\frac{2\pi\sqrt{\mu n\rho}}{10^9 . p}$ ohms per unit-length (centimetre) of conductor.

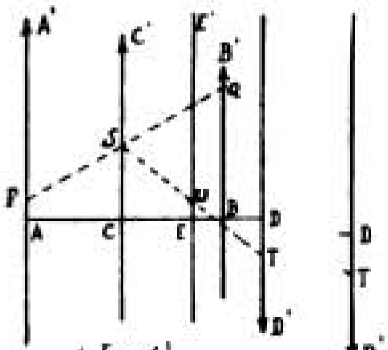
We can express R in terms of the wave length λ meters of the oscillation assuming this last to be travelling at a speed of 3.10^{10} centimetres per second.

Then $R=\frac{2\pi\sqrt{6\pi}}{10^5 . p} . \sqrt{\frac{\mu\rho}{\lambda}}$ ohms per unit length of conductor.

These two formulæ are solved by the " abac " reproduced herewith.

We have assumed the conductor to be of a non-magnetic metal (copper, aluminium, etc.) ; then $\mu=1$.

Let AA^1 and BB^1 be two parallel straight lines (Fig. 1) and let C be the middle of AB. Draw CC^1 parallel to AA^1. Take a point P on AA^1 such as $AP=\log n$, and a point Q on BB^1 such as $BQ=\log \rho$. Then draw the straight line PQ and let S be the meeting of PQ and CC^1.



(Fig 1)

Since $AC=CB$ we have $CS=\frac{AP+BQ}{2}=\frac{1}{2}(\log n+\log \rho)$ or $CS=\log \sqrt{n\rho}$.

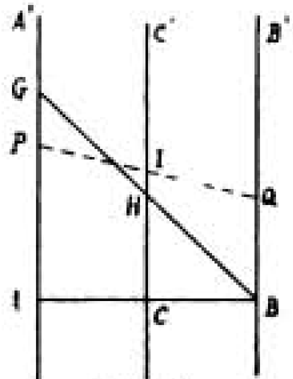
Let DD^1 and EE^1 be straight lines both parallel to AA^1 and EE^1 being equidistant from CC^1 and DD^1. Now take a point T on DD^1 such as $DT=\log p$, the direction DD^1 being opposite to CC^1. Draw ST and let U be the meeting of ST and EE^1. Since $CE=ED$ we have $EU=CS\sim DT$ that is to say, $EU=\log \sqrt{n\rho}\sim\log p$ or $EU=\log\frac{\sqrt{n\rho}}{p}$.

Since $R=\frac{2\pi}{10^9}\cdot\frac{\sqrt{n\rho}}{p}$ we have $\log R=\log\frac{2\pi}{10^9}+EU$, or $\log R=9{,}79818+EU$.

The second formula can be solved in the same way :—

$$\lambda \text{ meters}=\frac{3.10^8}{n} \text{ hence } \log \lambda=8{,}47712-\log n.$$

Take a point G (Fig. 2) on AA^1 such as $AG=8{,}47712$. Then $GP=GA-AP=8{,}47712-\log n=\log \lambda$.



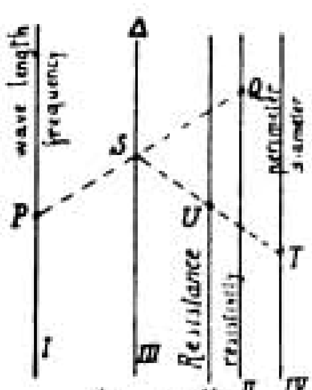
(Fig 2)

Therefore we can graduate the scale AA^1 in wave lengths as well as in frequencies. This has been done on the accompanying abac which supplies the required H.F. resistance by mean of two alignments.

The resistivities scale has been graduated on one side assuming these resistivities to be expressed in electromagnetic units ; on the other side strokes have been drawn in front of usual metals resistivities. The following values have been admitted :—

SPECIFIC RESISTANCE IN ELECTROMAGNETIC UNITS AT 20° CENTIG. (68° FAHR.)

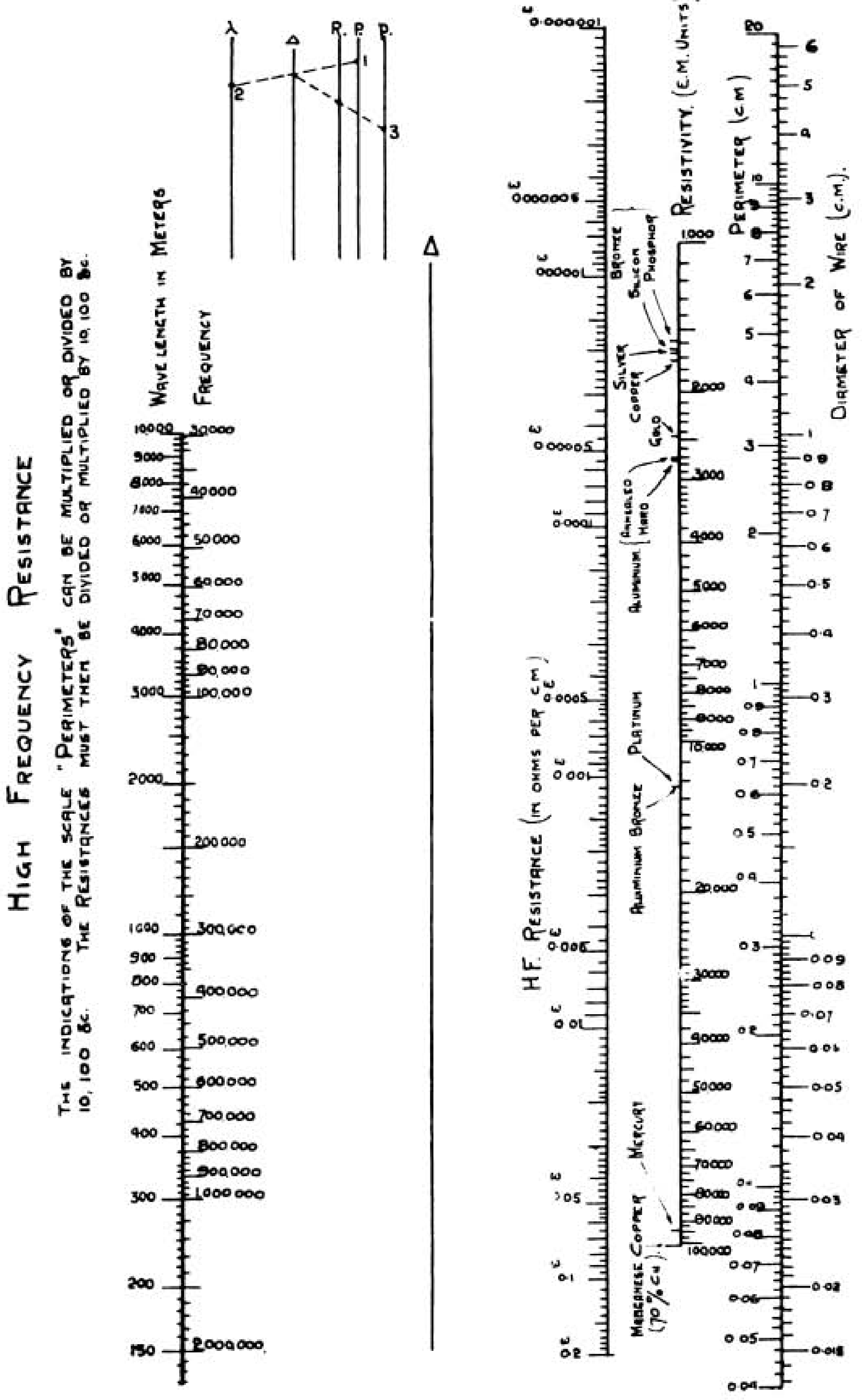
Annealed standard copper (industrial copper)	1,724*
Industrial aluminium, hard	2,732 †
Idem. , annealed	2,708 †
Silver	1,683
Gold	2,462
Mercury	94,070
Pure platinum	12,290
Manganese copper (70 per cent. copper) ...	100,600
Phosphor bronze (telegraphic wires) ...	1,600
Siliceous bronze (telegraphic wires) ...	1,650
Aluminium bronze (10 per cent. aluminium)...	12,310



(Fig 3)

For greater convenience, on the right side of the perimeters scale have been recorded the corresponding diameters of cylindrical wires. The numbers of the perimeters scale may be divided (or multiplied) by 10, 100, 1,000,

* International Electrotechnical Commission, Berlin, 1913.
† According to Pittsburg Reduction Co. measurements.


HIGH FREQUENCY RESISTANCE
THE INDICATIONS OF THE SCALE "PERIMETERS" CAN BE MULTIPLIED OR DIVIDED BY 10, 100 &c. THE RESISTANCES MUST THEN BE DIVIDED OR MULTIPLIED BY 10, 100 &c.
WAVE LENGTH IN METERS
FREQUENCY
H.F. RESISTANCE (IN OHMS PER C.M.)
RESISTIVITY (E.M. UNITS)
PERIMETER (C.M.)
DIAMETER OF WIRE (C.M.)
BRONZE
SILICON
PHOSPHOR
SILVER
COPPER
GOLD
ALUMINIUM ANNEALED HARD
PLATINUM
ALUMINIUM BRONZE
MERCURY
MANGANESE COPPER (70% CU)

etc., provided the numbers of H.F. resistances scale be multiplied (or divided) by 10, 100, 1,000, etc.

Suppose it is required to obtain the H.F. resistance per centimetre length of a copper conductor having a rectangular cross-section 3 cm. long and 0,4 cm. broad, and conveying a current of frequency 300,000. The perimeter is $p = 2 \times 3 + 2 \times 0{,}4 =$ 6,8. Join by a straight line (the edge of a rule) point 300,000 of scale I. to point 1,724 of scale II. (Fig. 3). This line cross scale III. at S. Join by a straight line S to point 6,8 of scale IV. The H.F. resistance will be read at the point U where this line cross scale V.

Pittsburg Patient Uses Wireless Equipment

By FRANK C. PERKINS

THE accompanying illustration shows the wireless equipment of Paul F. Shuey as utilised by him while a patient in the Tuberculosis League Hospital, Pittsburg, Pa. Even though he was confined to a couch on a sleeping porch for several months, the time passed more quickly and pleasantly by the aid of his wireless telegraph apparatus. While a University graduate he was engaged at work on a fellowship at the Mellon Institute for Scientific Research. When he went to the hospital he could not endure idleness, and while in bed continued his electrical studies and rigged up a wireless outfit.

It will be seen that the wireless apparatus was placed on the wall at his bedside, and the aerial was spread from a mast on the roof of the hospital building, the outfit being installed primarily to get the correct time from the United States Observatory at Washington. The enjoyment of picking up messages from the air, however, was great, and he improved his outfit and was able to listen to messages *en route* to the station at Sayville, Long Island, which receives the German war bulletins. The baseball scores were received regularly during the season from the Arlington station, and he has communicated with many amateur wireless operators within a radius of 100 miles of his station.

Photo by] [*Frank C. Perkins.*

MR. SHUEY AND HIS INSTALLATION.

Digest of Wireless Literature

HANDLING THE TRANSMITTING KEY.

MR. CARL DREHER contributes to *The Wireless Age* an article containing many valuable hints to wireless operators in the handling of the transmitting key. It is rather difficult to impress on young operators who are desirous of cultivating a clear, even style of sending, the necessity of following certain definite rules. One reason for this tendency to learn telegraphy in a slipshod manner lies in the fact that many operators habitually violate all the rules of sending and yet manage to be understood.

All operators learning to manipulate a key appear to have certain tendencies in common. Prominent among these are, firstly, a desire to " tap " the key—that is, to exert a force on it only during the down stroke, letting the spring send it up again ; and secondly, the habit of sending almost entirely with the fingers, hardly any use being made of the muscles of the wrist and forearm.

The first of these faults is not very serious, because every operator discards it automatically as soon as he begins to get up speed, and discovers that the only way to do so is to keep hold of the key knob lightly all the time. The habit of " finger " sending is less easily detected and is much more harmful in its results. Finger sending is almost always " choppy " and laboured. This is bad enough, but as a matter of fact the " knuckle-sender " is lucky if he can transmit at all. He is reasonably certain, sooner or later, to fall a victim to the affliction known as telegraphists' cramp—a paralysis of the fingers and muscles which compels the sufferer to turn to some other field of endeavour.

The correct method of sending is with the forearm, the elbow being used as a fulcrum with a small amount of wrist motion and very little finger work for delicate touches. This throws the heavy part of the work on the muscles of the forearm, which are obviously much better adapted for continued strains than the lighter muscles in the wrist and fingers.

Quoting from T. Jarrard Smith's pamphlet on the " Philosophy and Practice of Morse Telegraphy," Mr. Carl Dreher says that the nature of the grip upon the key should be similar to that in seizing a pen. It should be light, gentle, but even and sure. It must be firm enough to secure unquestioning obedience of the lever, but must not be rigid. The worst thing that an operator can do is to attempt premature high-speed transmission. Quite a number of men have acquired permanently jerky, convulsive, ragged sending by attempting high-speed work before they can satisfactorily handle lower speeds. Nothing disconcerts a receiving operator more than constant variations and jumps in the speed of transmission. Good spacing is largely a matter of experience and ear training.

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DIRECT CURRENT TRANSMITTERS.

In the *Proceedings of the Institute of Radio Engineers* for August Mr. Bowden Washington contributes an interesting paper on " Some Direct Current Sets." The

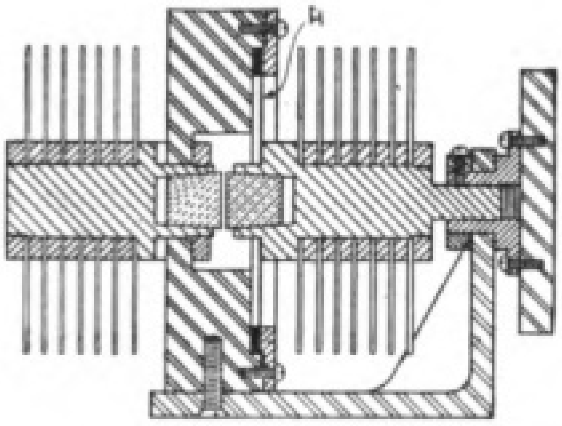

FIG. 1.

apparatus described utilises a special form of discharger invented by Dr. E. Leon Chaffee, of Harvard University, in which the discharge takes place between a copper anode and an aluminium cathode in an atmosphere of moist hydrogen. The accompanying figure shows the gap in section. It has been found extremely difficult to build a gap which is adjustable for gap length and is also hydrogen tight. All manner of threads and stuffing boxes have been tried without success. The total adjustment required is very small, probably never being over $\frac{1}{16}$th inch, so a thin phosphor bronze diaphragm has been adopted as shown in the section at A. This pushes in and out like the bottom of an oil-can, and has been found very satisfactory. The periphery of this diaphragm is clamped against a soft rubber packing by a brass ring, held to the bakelite gap chamber by eight machine screws. The base is a small composition casting. Cooling fins and the adjusting handle are shown. The connections are as in Fig. 2. When the direct current feed circuit is closed the primary condenser, C_1, is charged until a potential is reached which is sufficient to break down the gap. The condenser discharges through the gap in a single loop, or half cycle. The gap then goes out and leaves the secondary circuit free to oscillate at its own period. Meanwhile the condenser, C_1, is being re-charged from the generator. When it has reached a potential almost sufficient to break down the gap again the E.M.F. induced in the primary circuit by the oscillating antenna is sufficient to "trigger off" the gap in the proper phase relation to the antenna; which process continues indefinitely. There is no resonance between the primary and radiating circuits, and to obtain the best energy transfer it has been found advisable to tune the primary to a wave length 1·5 to 2 times that of the secondary.

The capacity and inductance marked C_t and L_t in Fig, 2 constitute what is known as a "tone circuit," the capacity and inductance being of such a value as to give an audible frequency. The effect of this circuit is to give a "beat" effect and to cause the transmitter to emit signals which can be read at the receiving station as a musical note.

These gaps, of course, require a good deal higher potential in starting than the average drop across the gap, which latter is all the generator need supply. To give the additional voltage required for starting, a "starting circuit" has been introduced consisting of an inductance of the order of 0·1 Henry (L_s) a capacity of 0·06 m.f. (C_s) and a resistance approximately equal to the average resistance of the gaps

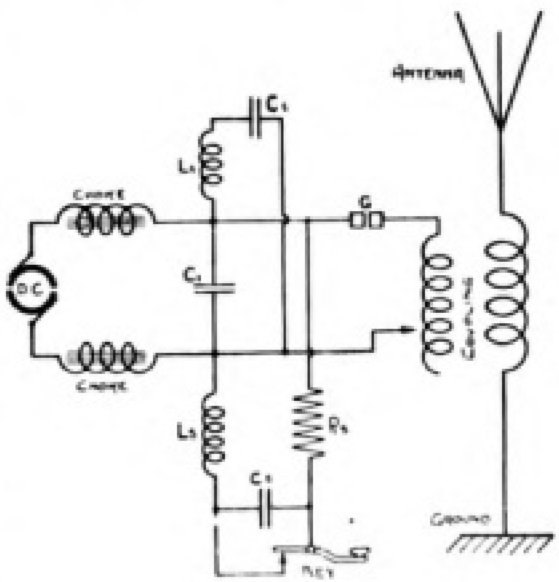

FIG. 2.

(R_s). The key is shunted across this condenser and opens the circuit when depressed. The current from the generator flows through the key, inductance, and resistance. When the key is opened it breaks the current quickly, owing to the condenser, and thus the energy stored up in the choke coils and the "starting inductance" produces a high voltage sufficient to start the gap, which continues to operate in a normal manner. The resistance in this circuit is, by the way, sufficient to keep it from causing a tone effect.

Recently it has been found possible to substitute alcohol vapour for the hydrogen with great success.

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WIRELESS AND THE WORLD'S TIME.

In view of the success attending the "Summer Time Act," says the *World's Work*, why not pursue the revision of the whole system of measuring time to its logical conclusion and bring it more closely into conformity with modern high-pressure methods and life? In other words, why not introduce World Time? Under the Summer Time Act we say that it is one o'clock in the afternoon, but the man at the transit tells you it is only 12 o'clock. Yet both are correct.

Nevertheless no one can maintain that a time-measuring system is commercially correct which says it is noon in London, but 7 a.m. in New York, 11.34 a.m. in Dublin and 2.1 p.m. in Petrograd. The issue is additionally complicated at the moment because some countries have adopted the daylight saving scheme and have advanced their clocks by one hour, while other nations have steadfastly declined to favour the innovation and still refuse to acknowledge aught but local or mean solar time.

Our present system of measuring time was introduced centuries before a thought was given to mile-a-minute expresses, 25-knot steamers, telegraphy, cables, telephony, wireless, and other similar rapid methods of locomotion and communication to travellers. During early railway days in these islands the clocks always appeared to be "at sixes and sevens." The timepieces in Manchester appeared to lag some eight minutes behind those of the Metropolis, while the clocks of Yarmouth would persist in being about eight minutes in advance of London. As the railway and telegraph increased in popularity hopeless confusion arose. The difficulty was finally overcome by declaring Great Britain as a single zone throughout which common time was to prevail, noon at Land's End being coincident with noon in London, although there is a difference of some twenty-four minutes in time between the two points. In America, of course, things became far worse, and as the country developed some drastic action became imperative. The upshot was the division of the country into six zones, each approximately corresponding to fifteen degrees of longitude west of Greenwich, and accepting Greenwich time as the standard. Wireless has rendered our present system hopelessly antiquated. The need for revision was brought home very forcibly during the recent wireless telephonic communication in America. The conversation delivered into the transmitter at New York was received at the station at Honolulu. Now the local time at the latter point is five hours thirty-six minutes behind New York. Upon receiving confirmation of the receipt of the message at such and such an hour Honolulu time, it was necessary to resolve the information into New York time. Such calculations are essential in all experiments concerning long-distance high-speed communication, and they have conduced to error, but if the clocks gave a common reading the necessity for calculations would not arise.

In 1884 a determined effort was made to revise the clock and to establish universal time, but the congress which assembled at Washington to deliberate upon this proposal came to naught. But wireless was not known in those days. Seeing that the greater part of the world is at present in the melting pot and that revolutions are promised in several vital questions pertaining to our future industrial and social life, has not the opportunity arrived to revise our time-measuring system?

Marconi's Wireless Telegraph Company's Educational Classes for Messengers

At the reopening of the above classes on Monday, September 4th, at the Wild Street L.C.C. School, prizes, generously provided by the company as an inducement to greater effort, were distributed to those boys who obtained at least 150 marks out of a possible 180 at the examinations held during the Session 1915–16.

The parents of all the boys received an invitation to be present on the occasion, and several attended.

The traffic manager distributed the prizes, and expressed great pleasure in having such a task to perform. In the course of his remarks to the lads and parents who were present, he urged the former to apply themselves zealously to their studies during the present Session, at the end of which he would be more than pleased to see two or three tables laden with prizes for distribution, and he regretted that the number of awards earned this time was small. However, he was glad to note that the prizes chosen by the boys were books and instruments of a purely educational nature, which should prove of great value to them in the course of their further studies. The value of the classes as fitting the boys for better positions in the Marconi Company was emphasised, and in this connection it may be mentioned that the company is one of the few where the messenger service is not a *cul de sac*, for every boy has a chance of a permanent position on the staff in the direction his abilities point.

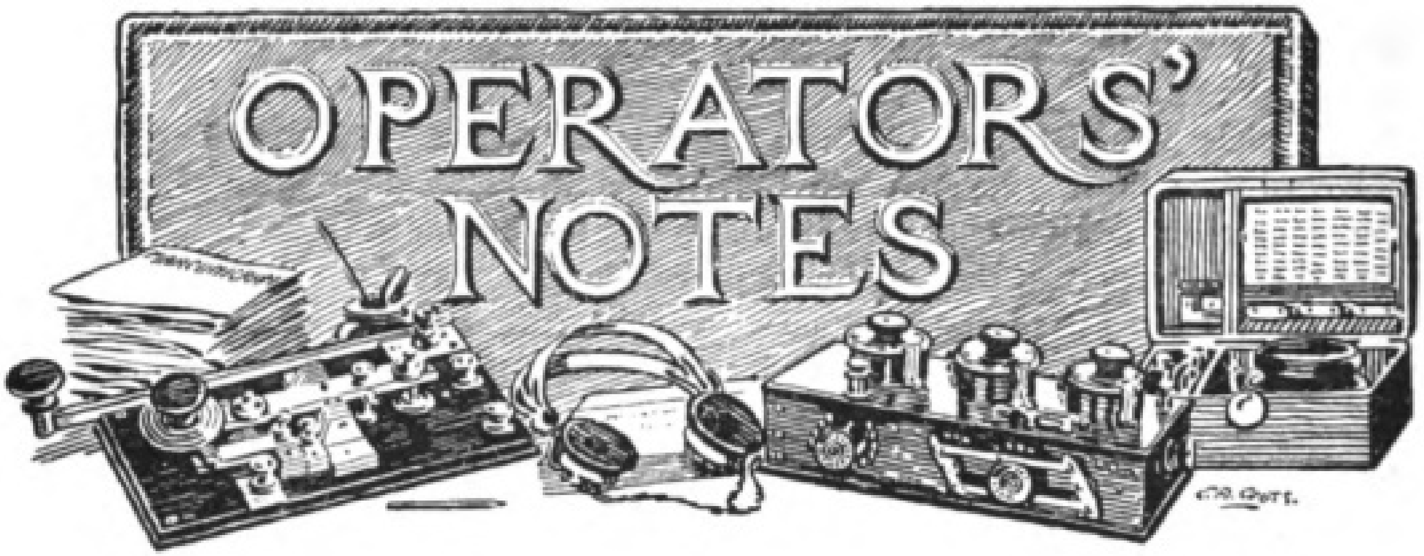
The names of the messengers who merited prizes are as follows:

C. F. Rainbow	1st Prize (177 marks)
G. Wilson and Q. S. F. Mills .. .. each	2nd Prizes (169 marks)
E. Monkhouse	3rd Prize (156 marks)
G. R. Sinfield	4th Prize (151 marks)

In addition, Mr. Matthews, the L.C.C. Responsible Master, very kindly contributed two other prizes to boys who did good work during the Session—viz.:

Messenger F. J. Lloyd — Messenger F. W. Pitfield

The occasion was also marked by the presence of Mr. Godwin, one of the L.C.C. Inspectors, and Mr. Matthews, the Responsible Master, both of whom spoke very encouragingly to the boys.



The Preservation of Aerial Insulators.

Every operator, upon taking over a Marconi installation on board ship, will find in his store of spare parts and useful sundries a can of the black liquid known as bitumastic solution. This substance, which has for its base the mineral product bitumen, contains, among other substances, a preparation of indiarubber in a solvent which gives the solution its spirituous odour. Properly used, it is one of the most valuable preservatives for certain insulators which are subjected to rain, salt spray and the general effects of exposure. Improperly used, it may cause a great deal of harm, as many operators know to their cost. Generally speaking, it may be said that the only use to which the solution may safely be put is that of coating the flexible strops which insulate the aerial from the mast.

These strops, with their hemp core, are covered with a flexible rubber compound, which without some protection is liable to deteriorate after prolonged exposure. An untreated strop insulator will in time develop on its surface a number of minute cracks, which considerably lessen its insulating power and enable the moisture to penetrate into the core with disastrous results. At as frequent intervals as are conveniently possible the aerial should be lowered and the strops thoroughly cleaned so as to remove all dirt, smoke, dried salt, and the like, which are liable to accumulate thereon. About once in three months the strops should be cleaned with methylated spirit, if this is available, and a thin, even coating of bitumastic solution applied with the brush. So soon as this coating has dried, and not before, a second painting should be given and the strop hung up to dry. Many operators are able to keep a spare set of strop insulators ready cleaned and coated to replace the set in use at any moment. This is by far the best plan, for it is better to clean and coat the insulators at leisure than to keep the aerial down while the set of strops is being cleaned, painted, and dried. It is, of course, unnecessary to point out that the aerial should never be lowered when there is any possibility of the wireless service being required.

As soon as the painting is finished the brush should be carefully cleaned, and as far as possible all trace of the solution removed, for if the brush is allowed to dry with the solution upon it, it will become as hard as stone and practically useless for any further work. A suitable solution for cleaning should be easily obtainable from the engineers.

With ebonite rod insulators, the Bradfield Tube, the Turnbull insulators, and in all cases where the insulating material is ebonite, bitumastic solution should never be applied, as a thorough cleaning of the ebonite surface is all that is required to maintain perfect insulation. Frequent rubbing with a dry cloth will preserve the Bradfield tube in excellent condition, but if dirt accumulates thereon a paraffined cloth will remove it. The same remark applies to the other ebonite insulators to which we have referred.

The cans of bitumastic solution must be carefully and closely corked to prevent evaporation of the solvent and the consequent spoiling of the contents. Just as much of the solution as it is thought will be required should be poured out each time into a small container, such as an empty cigarette tin, and applied as needed. It is practically useless to leave a quantity of the substance in an open tin for use on some other occasion, as it quickly evaporates and becomes hard.

A Norwegian Reader

Within the last few years the study and practice of Radio-Telegraphy has made an appeal to a large number of amateurs, mostly in foreign countries. The United Kingdom possesses her share of wireless enthusiasts, but the United States probably comes first with many thousands of these scientifically-minded young men. And the cult is worth fostering. The practical utility of wireless has already been more than demonstrated, and a knowledge of its intricacies would form a very important asset to the individual. We have been in communication for some time with a young Norwegian, living at Fjosanger, near Bergen, who, at our request, relates how he first became interested in Senatore Marconi's wonderful invention. He says :—

"I first became interested in wireless telegraphy in March 1913, when my father started receiving The Wireless World. At that time I did not know anything about telegraphy, or in fact electricity, nor did I understand twenty words about English, so you see my knowledge was not very extensive. My father continued to receive The Wireless World every month, and as soon as he had finished with it, I took it, although I was not able to read it. Subsequently I learned some more English, and have ever since been interested in wireless. Whom have I to thank for my interest in wireless? No doubt The Wireless World, or still more yourself, Mr. Editor, as if you had not sent The Wireless World to my father I should not have known anything about wireless now. Therefore, I am very thankful, and will be as long as I live. Perhaps in the future I shall be able to thank you much more, and in better English than I can at present ; but it is from the bottom of my heart I wish you and The Wireless World every success and a very long life. Last year I possessed a small transmitting and receiving station, but I have been compelled to close it down, as the Norwegian law forbids all private persons to have wireless apparatus."

Mrs. Adrian Porter's Biography of Sir John Henniker Heaton, Bart.*

REVIEWED BY H. J. B. WARD, B.A.

It is not easy for very close relations to write a satisfactory biography of an eminent man recently passed away. The nearness of any object is almost bound to prevent the proper realisation of true perspective. Mrs. Porter's life of her father, Sir John Henniker Heaton, suffers a little from this inherent disadvantage; so that, every now and again, we find that we "cannot see the wood for the trees." Having said this, we have finished with any remark in the way of adverse criticism we have got to make, and may proceed to dwell with pleasure upon a few of the many attractive features of a delightful book.

It is not very long ago since, in THE WIRELESS WORLD, we paid a well-deserved tribute of praise to Australia for the service to the Motherland of that most virile colony. We might almost add the life work of H. H. to the credit side of the Australian ledger; for although Sir John spent the first sixteen years of his life (1848-1864) in Kent, the County of England (according to Mr. Jingle) renowned from time immemorial "for cherries and women," he may almost be counted as an "Antipodean." It was in Australia that he built up the iron constitution which stood him in such good stead in later years; it was in Australia that, turning from bush life and gold-seeking to journalism, he made his mark and his money; it was in Australia that he first learned by personal experience and observation of the pitiful shortcomings of the British Post Office. Over and above all, it was in Australia that he met "Rose Lorraine," the wife who through all the years of his strenuous life continued to be his true comrade and "Best Beloved."

Sir John's voyages to and from the land of the kangaroo were very numerous, and he maintained to the last his close connection with the Australasian Colonies. Mr. Joseph Chamberlain, both when he was at the Colonial Office, and after his health-enforced retirement, made him the medium of communication between himself and the Australians. This fact is alluded to in a touching letter from the great British statesman, reprinted in Mrs. Porter's biography.

Amongst the many personal friendships which formed so striking a feature of Sir John's career, a close and prominent part was played by Senatore Marconi, who was in the habit of placing at the disposal of the great Postal Reformer, whenever he went ocean-travelling, the Wireless Service carried by the liners which conveyed him. *Apropos* of this tribute of courtesy, we cannot do better than quote Mrs. Porter's words, culled from her description of an Australian voyage:—"Every morning the news of the world was flashed across the great ocean, and at breakfast the daily bulletin was laid on Henniker Heaton's plate." His daughter and biographer continues by describing her father's reception on April 17th, 1912, when in the midst of the Indian Ocean, of the wireless message conveying intelligence of

* *The Life and Letters of Sir John Henniker Heaton, Bart.* By Mrs. Adrian Porter. London, 1916. John Lane. 10s. 6d. net.

the terrible disaster of the *Titanic*, an occasion which brought home to the world at large the incalculable value of Marconi's invention and led directly to the "Safety of Life at Sea" Convention.

It will easily be understood that a man with a life purpose like Sir John's would necessarily be drawn by the closest bonds of sympathy to the great inventor, who more than any other will bring within the realm of "Practical Politics" Henniker Heaton's idea of *telegrams to all parts of the British Empire at the cost of 1d. per word, with a minimum total charge of one shilling.* This projected reform will be found enshrined in Sir John's sketch of an ideal Post Office on pages 233 to 239 of the biography.

As a matter of fact, apart from their links of sheer intellectuality and common plans for the world's advancement, the two men were united by the closest personal ties and "saw each other almost daily for many years." Sir John stood as godfather to Senatore Marconi's pretty little daughter Degna, and yielded to no one in admiration of his fairylike godchild. On the occasion of the coronation of King Edward VII (August 9th, 1902), Henniker Heaton gave a breakfast party in the House of Commons at which host and guests appeared in full levee costumes. After the breakfast the Postal Reformer and world-famous Scientist were photographed together on the Terrace of the House by Sir Benjamin Stone. This photograph forms one of the most interesting illustrations appended to the volume, and—by the courtesy of Mrs. Porter—we are able here to reproduce the picture.

Photo from] [*Life and Letters of Sir John Henniker Heaton.*

SENATORE MARCONI AND SIR JOHN ON CORONATION DAY, 1902.

As far as Wireless Telegraphy is concerned, H. H.'s faith never faltered from the time of his first coming into contact with the great Italian. He rejoiced in what had already been achieved, and looked forward with high hopes to the accomplishments of the future. "Whenever a new invention or development of a former one had reached a stage suitable for investigation, Henniker Heaton was always one of the first to be consulted, and his sympathetic attention never failed."

In view of this unquenchable interest in Wireless inventions, we may recall the fact that Sir John undertook a long journey, in company with Senatore Marconi, to see an invention of Sir Hiram Maxim's for preventing collisions at sea. And he would have been one of the first to hail with delight the recent announcement made to the Press by Mr. Godfrey Isaacs that the Senatore had recently brought to practical perfection an invention of his own, which is believed to go as far as is possible for human ingenuity in the direction of ensuring against such calamities in days to come.

Amongst his many Parliamentary friends Sir John numbered the Chairman of the Royal Mail Steam Packet Co., Sir Owen Philipps (whose name, by the way, is misspelt in the biography), and under his auspices visited South America with his family in 1910. Mrs. Porter speaks with pardonable rapture of the glories of Rio Harbour, and of the intense interest which every member of the little family party took in the wonderful Ibero-American Continent.

We all remember the famous poem of Leigh Hunt concerning Rabbi Ben Ahmed, who was favoured by the Recording Angel with a peep at the Roll on which he was busily setting down the various claims of different human beings for a place in Paradise. The Rabbi asked, "Write me as one who loves his fellow men." The Angel wrote; and when next the great Jewish teacher saw the Roll, "Abu Ben Ahmed's name led all the rest." Sir John Henniker Heaton belonged to the same noble section of humanity as did Ben Ahmed. He loved his fellow men, and nothing gave him greater satisfaction than to be of service to them, either individually or collectively. Naturally the social side of life "loomed large" in his career. Mrs. Porter's account of her father abounds in incidents illustrating this delightful trait, and the volume before us contains a number of capital stories. A favourite playful hit of Sir John's at enthusiastic philatelists consisted of a reference to the stamp collector whose pursuit of his hobby had resulted in a sad lack of worldly gear. According to Sir John, this stamp collector was reduced to publishing the advertisement "Wanted—to meet a lady possessing a 2d. blue Mauritius stamp, with a view to matrimony." Space will not permit of our making any extensive quotations, and we must refer lovers of anecdote to the volume itself.

The results achieved by a really great reformer like the subject of Mrs. Porter's biography form their best memorial. So long as British postal activities continue, the names of Hill and Heaton must endure. But more than that: "Their works do follow them." When at the close of the war we find 1d. postage established as the best possible commercial link between England and all her Allies, whilst possibly substantial progress be achieved with radio-telegraphic aid towards the "1d. telegram" ideal, we shall recall with profound gratitude and admiration the pioneer work of him whose efficient and persistent sapping enabled the victory to be won.

Promotion for Senatore Marconi

READERS will be interested to hear that Senatore Marconi, who has been acting for some time as a Lieutenant in the Italian Army, has now been promoted to the rank of temporary Captain in the Navy of our gallant Ally. Always fond of the sea, Captain Marconi will doubtless find his new duty very congenial.

Administrative Notes

Bolivia.

RADIOTELEGRAPHIC communication has been established by way of trial between Belem (Pará), Brazil, and Riberalta (Bolivia), this latter being a region which up to now was not connected up with the Bolivian telegraph system.

Messages which the public may be desirous of sending by this means to Riberalta will be accepted at sender's risk, marked *via* "Libres-Radio Belem," and will be charged for at 84 centavos gold per word.

RADIOTELEGRAPHIC TARIFF.

The executive body, by a decree dated November 17th, fixed the following radiotelegraph rates for home and international radiotelegrams of simple category:

Inland Radiotelegrams.	Per Word. Paper $
Coastal station tax	0.15
Ship's station tax	0.10
Total	0.25

International Radiograms.	Per Word. Gold $
Coastal station tax	0.12
Ship's station tax	0.08
Total	0.20

The minimum tax for each message shall be $2.50 paper for inland messages and $2 gold for international messages of 10 words. By inland messages are to be understood those exchanged between fixed stations in the country and ships registered in the country, and by international messages must be understood those exchanged between fixed stations in the country and ships registered abroad.

As the said decree does not give the radiotelegraph tariff charges to be applied to special radiograms, the Direction-General, as per resolution of April 29th last, taking into account the dispositions relating to the international regulations as regards radiotelegraphy, and the way in which the telegraph rates have been fixed for various categories of telegrams, has ordered that inland telegrams, and also international telegrams, shall be subject to the following radiotelegraph rates.

INTERIOR SERVICE.

(*a*) Simple radiogram in Spanish language: $2.50 paper for the first ten words and 25 centavos paper for each succeeding word.

(*b*) Radiogram in a foreign language: double the amount mentioned in paragraph *a*.

(*c*) Radiogram in secret language: four times the amount mentioned in paragraph *a*.

(*d*) Collated radiogram: same rate as under paragraph *c*.

(*e*) Multiple radiogram: plus the radiotelegraph rate to be charged according to category *a* fixed rate of 50 centavos paper for each address less one.

(*f*) Radiogram "urgent" or with "acknowledgment of receipt," the radiotelegraph rate established for a simple message, and

(*g*) "Reply paid" radiogram: besides the radiotelegraph rate corresponding to the message one way, the rate applicable to the reply telegram according to its category.

INTERNATIONAL SERVICE.

(*a*) Simple radiogram written in any of the authorised languages or in secret language: $2 gold for the first ten words and 20 centavos gold for every succeeding word.

(*b*) "Collated" radiogram: a surplus tax equal to one-fourth part of the total of coastal and ship's tax to be added to the tax to be charged, according to the length of the message.

(*c*) "Multiple" radiogram: over and above the message, a fixed fee of 10 centavos gold for each address less one.

(*d*) "Urgent" telegrams and "acknowledgment of receipt" as per the rate given in paragraph *a*, and

(*e*) "Reply paid" messages, over and above the rate charged for transmission one way, the rate will be charged for the reply according to its category.

* * * * * *

Chili.

In a circular which has just been issued, the Chilian State Telegraph Office advises that the tariff for wireless telegrams in any language, or in cypher, for vessels of any nationality, sent from one of the coastal stations is $5.50 gold for the first ten words, and 55 cents gold for every additional word. For radio telegrams sent from one wireless station to another $4 currency will be charged for the first ten words and 40 cents for each additional word. If messages have to pass over the lines of other companies an additional charge will be made. Wireless telegrams for Port Stanley, Falkland Islands, will be charged $6.50 gold, and 65 cents gold for every additional word. Press telegrams will be accepted at half tariff rates.

* * * * * *

Ecuador.

The Republic of Ecuador has recently enacted strict laws pertaining to radio communication within its jurisdiction. In substance they are as follows: All wireless stations situated in the country or in territorial waters are subject to the inspection and vigilance of the Government. No subject of any of the belligerent countries shall be employed in any of the stations. No message in cipher or code from a belligerent nation or vessel shall be transmitted or received with the exception of those referring to the Government service. No belligerent warship may make use of the wireless apparatus while in Ecuadorian waters. The transmission of a wireless message, even in ordinary language, indicating the course of either a belligerent or neutral warship, is prohibited.

* * * * * *

Society Islands.

A radio-telegraph tariff has been issued of 12 cents a word (10 cents wireless charge and 2 cents telegraphic charge from Papeete to the station at Mahima). An additional charge of 24 cents a word is made for relaying via the wireless stations at Apia, Samoa, and Awanui, New Zealand. Tariff rates are also provided between the colony and vessels at sea. All messages must pass through New Zealand to Tahiti, and are subject to war restrictions.

* * * * * *

United States.

The Superintendent of Naval Radio Service has announced that, effective on and after July 1st, it will be obligatory on the part of senders of radiograms to be handled by the Naval Radio Service to indicate in address of the message the class of vessel it is desired to reach by this service, such as S.S. (steamship or steamer), or U.S.S. (United States ship), as the case may be. This order becomes necessary owing to the confusion in proper handling of such traffic because of a large number of names of ships being the same as cities, towns, etc. The extra word will be charged for and counted in the check.

The United States Bureau of Navigation has announced that the following regulation, which is made pursuant to the Act of August 13, 1912, should follow Paragraph 152, Page 66, of the Radio Laws and Regulations of the United States:

" Paragraph 152a, page 66.

" Holders of commercial extra first-grade radio operators' licenses may be " issued renewal of such licenses without examination, provided the service records " on the backs of the licenses properly certify to twelve months' satisfactory service " in a land or ship station open to general public service, at least six months of " which must have been served during the last twelve months of the license period.

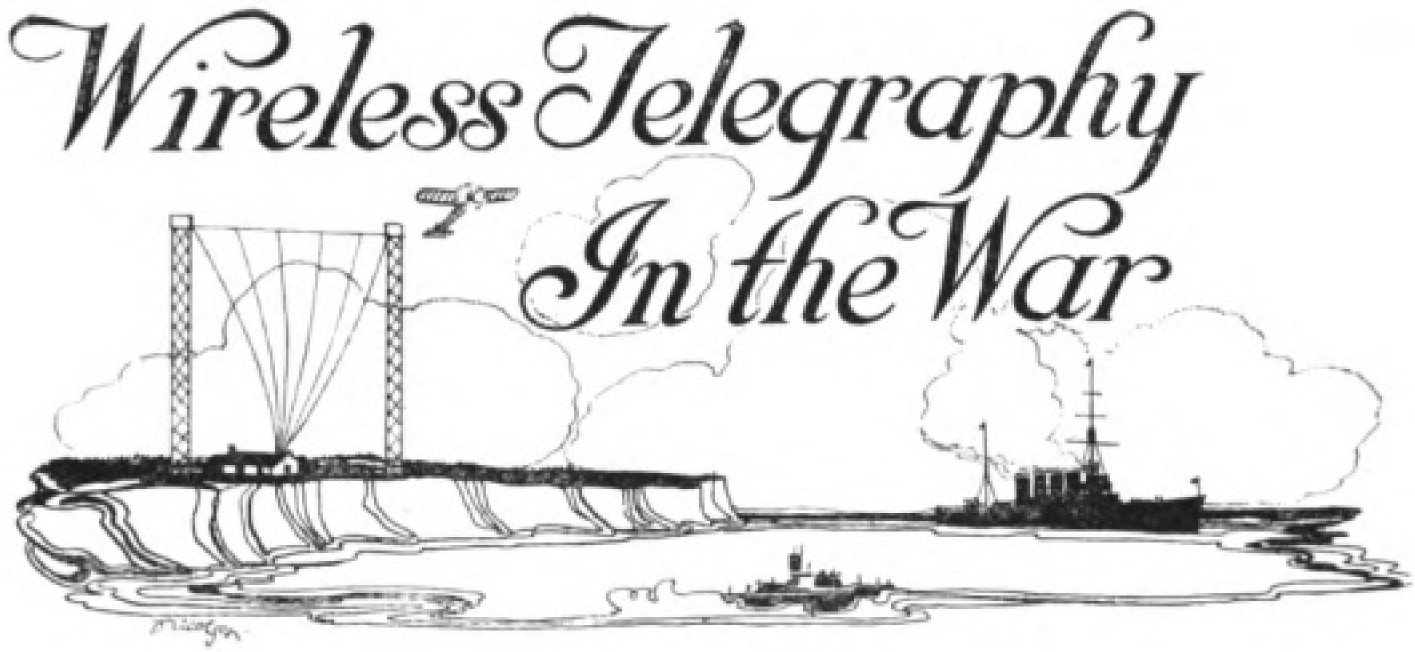
" However, holders of commercial extra first-grade licenses now employed as " radio inspectors, radio instructors, or in similar occupations requiring exceptional " qualifications where the duties require the testing or demonstrating, or otherwise " using commercial radio apparatus and the telegraph codes, may be issued renewals " of their licenses without re-examination, provided, in addition to the above, they " can show satisfactory evidence of such service covering a period of eighteen months " out of the two-year license period. Where the applicant has not used regularly " the telegraph codes, he will be given the code examination required in the original " examination or, if he has used only one code, he will be examined in the code not " used.

" The service record shown on the licenses must be transcribed on Form 756.

" The license may be marked ' Expired ' in red across the face and returned " to the operator, if desired. The action taken should be noted on Form 756.

" Where the record on the reverse side of the license does not show the service " performed, the evidence submitted as proof of such service must be transmitted to " the United States Bureau with Form 756.

" Transcriptions of code tests must be submitted to the Bureau."



FIGHTING THE U-BOATS.

THE thrilling despatches, if such they may be called, which have recently appeared in the Press from the pen of the well-known writer, Mr. Alfred Noyes, have received more attention than most war despatches owing to the fact that their publication has been authorised by the Admiralty. The story was issued to the Press in four portions, and dealt with German submarines and some of the methods adopted by the Allies to combat their ravages. The part played by wireless telegraphy in the elaborate system of defences appears most plainly. Not the least attractive feature of these despatches is the graphic way in which Mr. Noyes deals with his subject. Speaking of the attack on the American steamship *Gulflight*, to which reference has already been made in these columns, the writer quotes the words of the skipper of His Majesty's Drifter *Contrive*. Here is a portion dealing with wireless telegraphy: "Ten minutes later I saw the patrol vessels racing up " for all they were worth, and one of these vessels took half the crew, two of whom " were drowned. The captain of the *Gulflight* died of shock. Soon the four patrol " vessels were on the spot; and three of these vessels put men aboard with wires " in double quick time. The fourth—a big trawler with wireless (which I now know " in naval language as a 'trawler leader') steamed round and round in the vicinity, " keeping a careful watch. In less than two hours the *Gulflight*, her 'Stars and " Stripes' still flying above water, was being towed at a good speed to a port with " the trawlers in attendance." In the third part of Mr. Noyes's article we again have reference to wireless, this time relating to the adventure of the steamship *Van Stirum*, which, upon being attacked, sent out a distress call: "*Van Stirum* " chased by two submarines, position critical, firing shots, and gaining on us." The race between the submarines and the unfortunate vessel was very uneven, and after a while one of the shells brought down the wireless aerial. This, a lucky shot for the Germans, cut the vessel entirely off from the outside world. Such, however, was the vigilance of the patrol craft that although the *Van Stirum* never raised an answering call (her aerials having been shot away), yet the patrol steamers heard the cry and sped to her assistance. Rapid interchange of wireless communication between the patrols of trawlers and other craft also brought three British destroyers on the scene, but by this time both submarines had submerged and bolted.

Hellenic Complications.

Events in Greece towards the end of August and the beginning of September were changing and turning with such dramatic suddenness that very little surprise was occasioned on the announcement that the Allies had taken over the control of the posts, inland telegraphs and wireless communications. At this time it should be remembered that the useful wireless station at Salonica had been held by General Sarrail for some period; under the new *régime* the powerful Marconi station at Athens, capable of radiating and receiving messages over a large range, the stations on the islands of Salamis, Syra and Thasos, and some other installations recently erected, all fell into the hands of the Allies, who will doubtless make excellent use of them.

Readers of our magazine whose memory extends back to the days of the *Marconigraph* will recollect the interesting article from the pen of Mr. Harold Watterson, in the issue of April, 1912, relating to the discovery of ancient vases at the Athens Marconi station. During the excavations for the foundations of that place a number of valuable specimens of Grecian pottery were found, together with skulls and other remains.

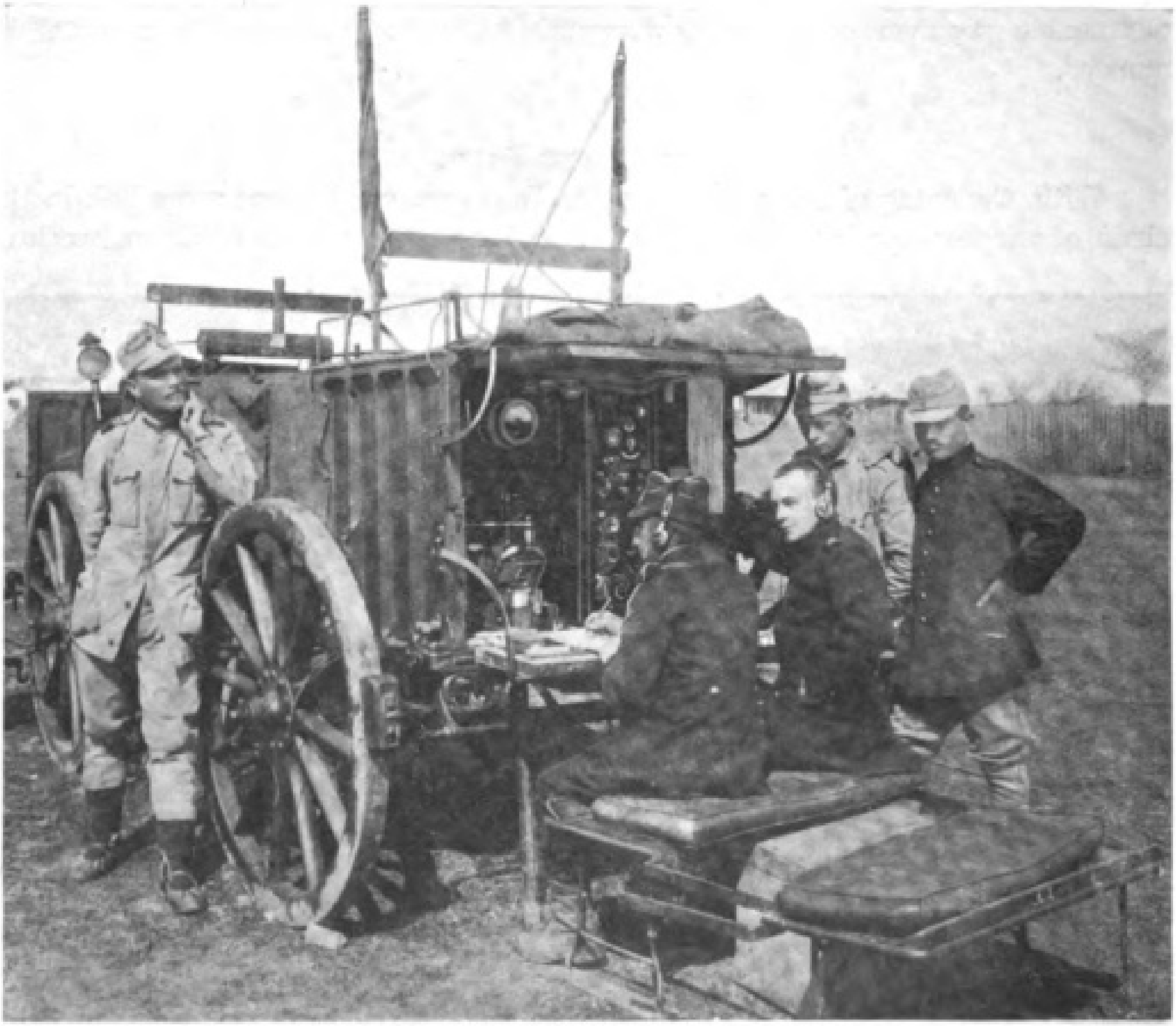
* * * * * *

Our Latest Ally.

With the entry of Roumania into the European conflict one more link in the chain of wireless—perhaps we had better say one more section of the network of

Photo by] [R. A. Bennett

A VIEW OF THE ACROPOLIS, ATHENS. AT ATHENS THE GREEK GOVERNMENT POSSESSES A POWERFUL MARCONI STATION, WHICH HAS NOW PASSED UNDER THE CONTROL OF THE ALLIES. STATIONS AT SALAMIS, SYRA AND THASOS HAVE ALSO BEEN TAKEN OVER BY THE BRITISH AND FRENCH FORCES.



TWO PHOTOGRAPHS OF ROUMANIAN FIELD WIRELESS STATIONS. ABOVE, THE ARRANGEMENT OF THE PORTABLE MASTS AND THE APPARATUS CART CAN BE SEEN; BELOW, ROUMANIAN OPERATORS (ONE WITH HIS CAP ON!) ARE SEEN WEARING THE TELEPHONES AND RECEIVING MESSAGES FROM A DISTANT STATION. NOTE THE COMPACTNESS OF THE APPARATUS (MARCONI SYSTEM).

this communication—will be available to strengthen the Allies in their progress towards victory. Our new Balkan Ally possesses at Bucharest a powerful radio-telegraphic installation by which the Army Headquarters will be enabled to keep in closest touch with members of the Staff in the field, and, what is equally important,

RUSSIAN PORTABLE WIRELESS APPARATUS. MANY OF THESE STATIONS ARE WORKING IN CONJUNCTION WITH THE ROUMANIAN SETS SHOWN ON THE PREVIOUS PAGE. THE ABOVE ILLUSTRATION SHOWS THE PETROL ENGINE CONNECTED TO THE TRANSMITTING DYNAMO.

with the Allies at London, Paris, Rome and Petrograd, not to mention General Sarrail at Salonica. With portable stations the Roumanian Army has been well provided for some years. Now that the Russians have advanced and united with the Roumanians the field stations of both armies will be invaluable.

There is perhaps no harm, now that it has been announced that the Allies have been arming Roumania for some time, in stating that the Marconi Company at the same time were making portable wireless stations for that country. These are now ringing out their messages from the battlefield on the plains of Transylvania, under the care of Roumanian operators.

We are able to reproduce in these pages photographs of Roumanian and Russian portable apparatus, which it will be seen is compact to the last degree. It may well be that the actual installations shown are now interchanging telegrams ; in any case, the sets in use are practically identical with those shown.

* * * * * *

Exit a Sunspot.

Dar-es-Salaam, the capital of the district known in pre-war days as German East Africa, and the last town of importance in that colony to fall into the hands of the

British, possessed a powerful and, for the Germans, highly useful wireless station of the conventional Telefunken type. To this station in the happy days of peace the German merchantmen trading on the eastern coast of the great continent were accustomed to send messages announcing the time of their arrival, and many British operators will remember the piercing "mosquito" note of its spark. Five days after the outbreak of hostilities a British warship, by a few happily placed shells, blew up the station and quenched its spark for ever. Many of us will wonder why twelve months had passed before the town itself was occupied, but in the words of an American advertisement—"There's a reason!"

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The station at Dar-es-Salaam was only one of several which the Germans put up in their East African Colony. On the western shore of Lake Victoria Nyanza at Bukoba they had another installation of considerable power and usefulness, but this soon fell under the gunfire from British armed ships operating on the lake and has been silent for many months.

Apropos of these lake engagements, a Naval correspondent, writing in the *Evening Standard* recently, says: "In the operations the Navy, under the direction "of the Commander-in-Chief of the Cape Station, has also been able to afford assist-"ance in the offensive against the forts, wireless stations, and supply bases on the "coast and in similar work on the lakes. A blockade has been in progress since "February, 1915, and this has not been entirely restricted to preventing the ingress "of military supplies."

We can well imagine the wireless operator on the British vessel listening to the working of the station on the lake shore and then suddenly noticing a dead silence when a shell from our ship "gets home."

Photo by] [*Topical*.

THE FIRST GERMAN WIRELESS STATION AT DAR-ES-SALAAM. SOME TIME AFTER THIS STATION WAS ERECTED THE GERMAN AUTHORITIES REPLACED IT BY A MORE MODERN STATION WITH A TALL STEEL MAST AND UP-TO-DATE APPARATUS. THE BRITISH SMASHED IT TO PIECES BY GUNFIRE EARLY IN THE WAR.

Photo by] [De Lord. Zanzibar.

A NATIVE BAZAAR, OR SUK, AT ZANZIBAR.

Incidents in Zanzibar

Some Experiences in a Wireless Operator's Life

By F. L. DENNIS

It was a dull, cold day in December, 1914, when I received instructions to prepare to proceed to Zanzibar. The thought of being again *en route* to a spot where the sun shines was the most cheerful part of the proposition, but I was to experience sun in more ways than one before my stay in the East African Protectorate terminated

It was soon evident after the commencement of hostilities that Zanzibar wireless station was to play an important part in the operations. The German station at Dar-es-Salaam, however, did its best to " jam " our communications. This went on till one of His Majesty's ships fired a few 6-inch shells on it, after which the *Königsberg* was the only station to interrupt. X's in this part of the world are bad at all times, but between April and September the atmospherics roll in between sunset and sunrise like a veritable bombardment. The aerials being of a balanced-capacity type, care had to be taken during bad storms to earth the aerial or switch in a high-resistance lightning arrester. Most of the operators had shocks at different times, the cure for which was, in their opinion, a day off. This caused a growl amongst those who had to do their watch, but I found everything comes to those who wait, even a friendly X. The niggers thought the lower wires of the aerial a fine clothes line till they happened to be hanging out at the same time as the operator was transmitting, and then—well, some of the attitudes I have seen them in would do justice to a comic artist. Once we ran short of crystals, so hunted the island over for some pyrites. Some pieces gave very good results, but, being rather soft, soon lost their points through X's. I found that a good carborundum crystal of fair size, on a steel disc, stood up in these fierce atmospherics better than any other combination known out here. A point of interest lies in the fact that this is one of the few places where wireless has been used for communication between Britain and her enemies. Previous to the destruction of the *Königsberg* that ship used to send messages to the Admiral saying they wished to send letters from British prisoners of war if we would call for them. The Admiral used to reply that he would call, bringing letters for British prisoners of war and also to fetch letters of German prisoners interned in India. At times some quiet slaves used to come from the *Königsberg*. In reply to our invitation to come out and fight, she said she was " always at home when we chose to call." It is the custom of the British never to refuse a polite invitation, so the *Severn* and *Mersey* called, with what result you all know. On one occasion after we had done a little " strafing,"

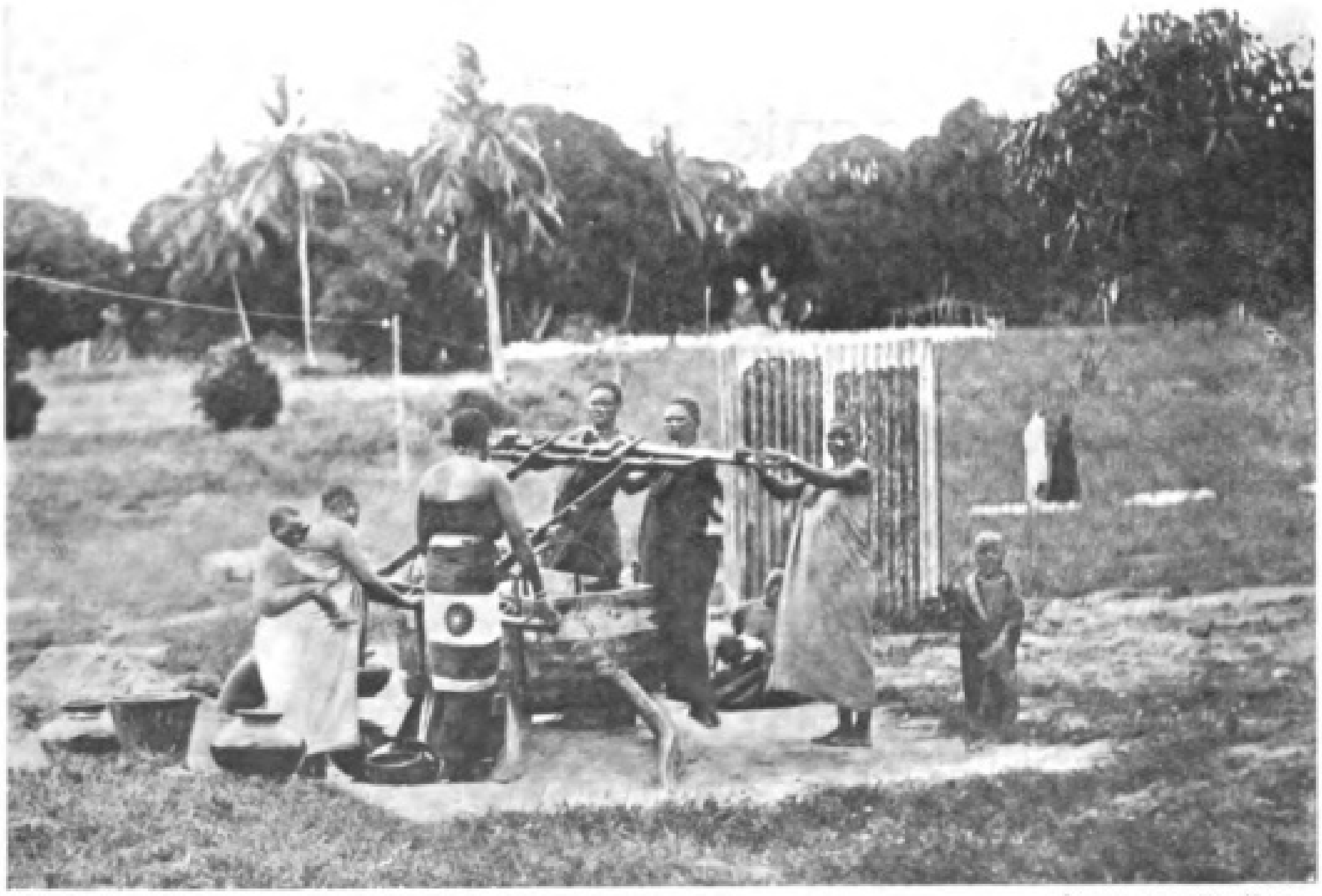
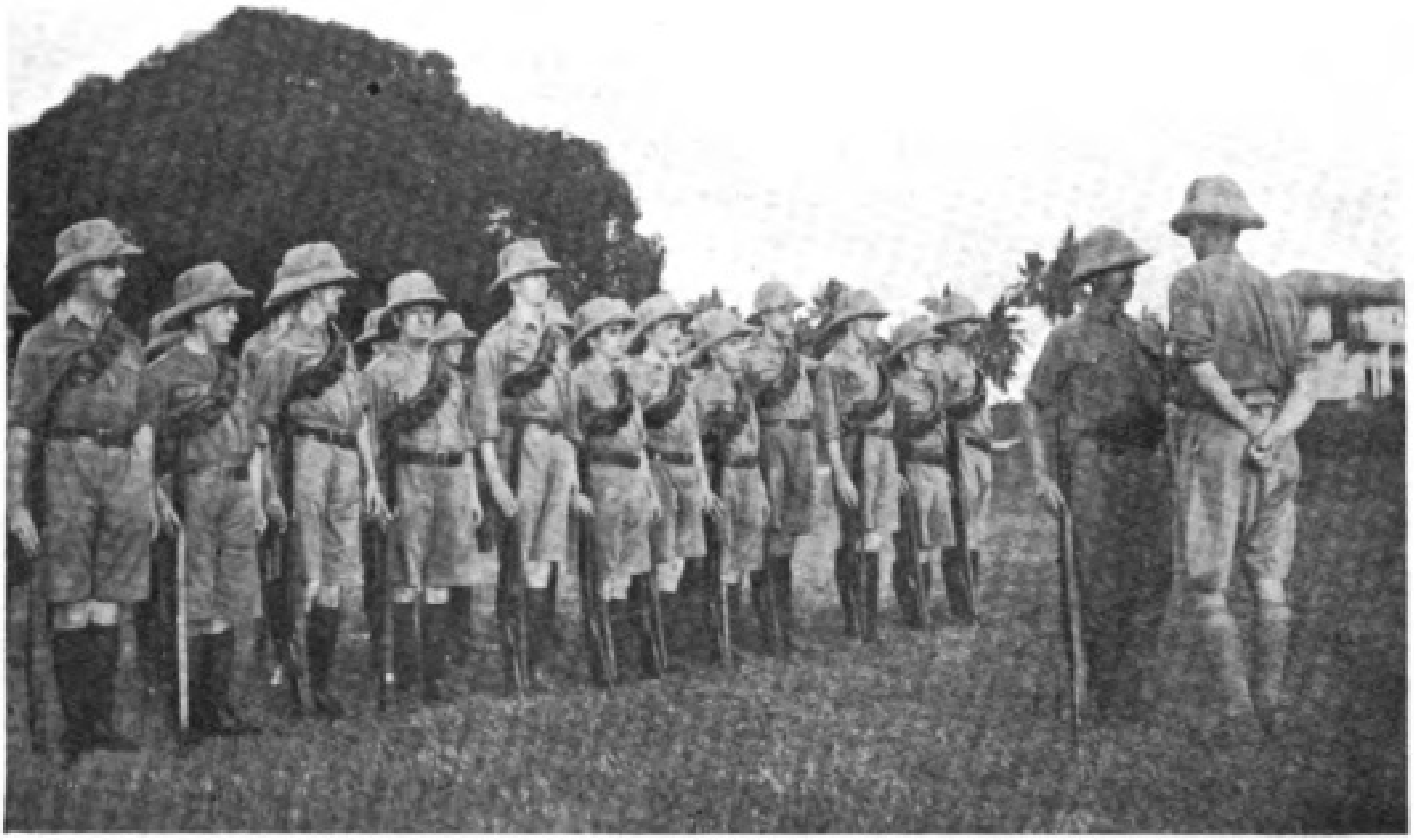


Photo by] [*De Lord, Zanzibar.*

NEGROES MAKING "TEMBI" (NATIVE BEER). THE CONSUMPTION OF THIS BEVERAGE HAS NOW BEEN PROHIBITED.



ZANZIBAR DEFENCE CORPS. THE AUTHOR OF THIS ARTICLE IS THE SECOND FIGURE FROM THE LEFT IN THE FRONT RANK.

the Telefunken note came through saying, "Result of your bombardment, one monkey and fourteen cocoanuts."

I should like now to quote one or two incidents that happen to all officials who are "carrying on" in these outposts of Empire. As is usual in this part of the world, the staff ranges from the ordinary African negro, through the various Arab and Indian castes, to the pure-white official from home: the last being rarely met with. On arrival in Zanzibar it did not take long to concur in the general opinion that the climate was exceedingly bad. A resident of some years' experience informed me that there were two seasons: one hot, and the other "d—— hot." I had not been many days in the Protectorate when I was "raked in" as a member of the Zanzibar Volunteer Defence Force, along with the other British residents on the island. Lieutenant-General Smuts had not arrived, and at this time things were not too rosy in East Africa, so we were doing our bit in helping to hold on. Most of our spare time was spent in drill; and in order to appreciate what sun and heat are like, combined with a Turkish bath humidity, I should advise a visit to Zanzibar and a couple of hours' field exercise in full marching order. Our stations and defences were guarded by companies of the King's African Rifles; I might mention that there are no better coloured fighting soldiers than the members of this famous regiment. Officered by men picked from home, they are a credit to British rule and civilisation.

To all who have had dealings with oil engines in the tropics the question of lubricating is of the highest importance. For various reasons I had to use a light black cylinder oil in place of the brown oil previously used. Now, one of the nigger engine drivers when the old oil gave out had a look round the store and saw only black oil. In his mind this could not be right, so he got hold of a drum of linseed oil and, as it looked the same colour, started to use this. The kicking and back-firing from the engine nearly woke the island till the bearing "chewed out." He now started up the next engine, which developed the same trouble, so the operator shut down and telephoned me. The second engine driver could not stand two engines going wrong at the same time, so he bolted. It was a clear case of the "shitarn" or devil. The "shitarn" in this part of the world involves a very serious question, and is not to be ignored. It got so serious here at one time that it threatened to upset the whole station, for no messengers could be induced to take messages from the station to the town. The "devils" were bound to be met on the road. I say devils, for by now their number had increased. Even some of the Indians began to think they could see things, so I thought the question needed investigation. The kindly old Arab judge, with whom I had a chat in the Sultan's Court, was just as amused as I was over the matter, but he advised me to quiet the folk by calling in the "medicine" man to chase the ghosts away. I told him that three had previously tried without success, but if he sent his pet charmer along I would be pleased to see what he could do. True enough, the "native doctor" came the next day, and decided it was a case for the killing of a goat and ten chickens. I could see this was going to be an expensive business for me, but, however, the ceremony took place, and after every nigger had eaten till he could only sleep afterwards, the medicine man came and told me the devils had been chased, and demanded five rupees "backsheesh." He got one rupee and the toe of my boot, and was told

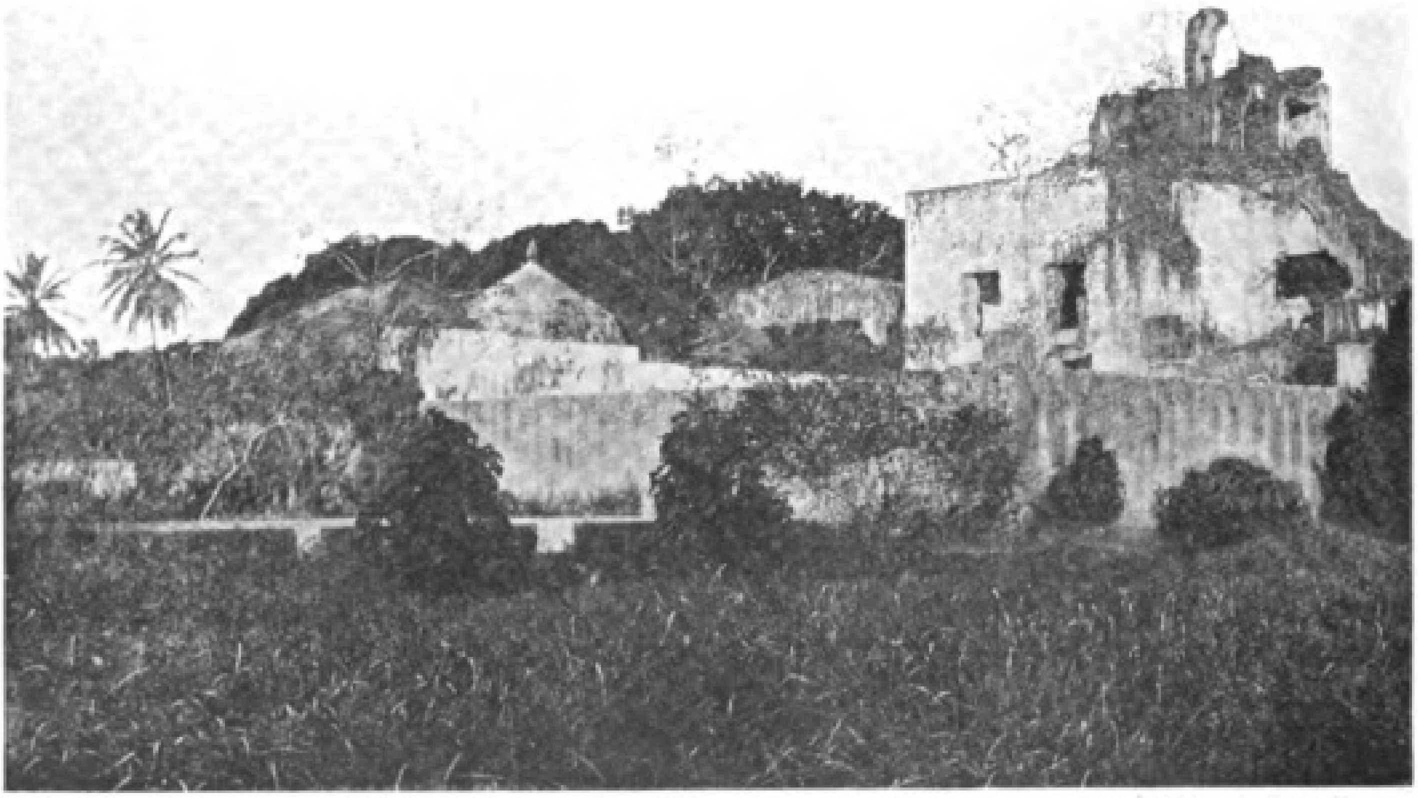


Photo by] [*De Lord, Zanzibar.*

RUINS OF THE OLD PALACE OF A FORMER SULTAN OF ZANZIBAR.

Photo by] [*De Lord, Zanzibar.*

THE LOCAL TRAIN FROM ZANZIBAR PASSING THROUGH THE JUNGLE.

to betake himself off. The same evening I met the Arab judge again, and gave him an account of the proceedings. He smiled in his kindly way, for he was noted for his sense and reason in dealing with purely native matters. He whispered a few quiet instructions to me in the name of " Allah, the Compassionate, the Merciful," gave me a quiet handshake and the parting Arab salute " Onahari," touching his forehead and breast over the heart with the tips of the fingers of his right hand. These quiet salutations in the East mean much. The result was the next day I bought a new " kiboko," called the boys together, and told them the devils had been chased.

One of the windows of Zanzibar Cathedral bears underneath an inscription, an extract from which reads : " To the memory of Livingstone and other men good and true," and a little farther along is a tablet to one of the officers who lost his life on H.M.S. *Pegasus*, sunk in Zanzibar Harbour by the *Königsberg*, in the early days of the present war. No less " good and true " are those other men, amongst whom must not be forgotten the wireless operators who, in various spheres of activity, carry on without a break in all kinds of weather, and amid the ravages of fever, the watch of empire. Many of these men in civil life are operators in the mercantile marine, but they are now doing their bit amidst the tropical scenery of Zanzibar.

NOTES OF THE MONTH

WILL the Secretaries of all amateur societies which have not been suspended owing to the present war kindly forward full particulars of their societies to the Editor, in order that suitable notice may be inserted in the 1917 edition of the *Year Book of Wireless Telegraphy and Telephony*?

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The report of the Advisory Committee for Aeronautics for the year 1915–1916 states, in so far as meteorology is affected, that the experimental work of the year has mainly concerned arrangements for the automatic recording of lightning flashes, and ascertaining by wireless telegraphy the position of distant thunder storms, with the object of giving warning of their approach to those interested. The Admiralty have arranged for the co-operation of the Naval Wireless Department, and the assistance of observers of weather in various parts of the country has been secured.

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In the day engineering college of the Northampton Polytechnic School, London, full day courses in the theory and practice of civil, mechanical and electrical engineering commence on October 2nd. The courses in civil and mechanical engineering include specialisation in automobile and aeronautical engineering, and those in electrical engineering include radiotelegraphy. The entrance examination takes place on September 26th and 27th. Three entrance scholarships of the value of £52 each will be offered for competition at the entrance examination. The courses include periods spent in commercial workshops and extend over four years. They also prepare for the degree of B.Sc. in Engineering at the University of London. In the technical optics department there are full and part-time courses in all branches, in specially equipped laboratories and lecture rooms. An Aitchison Scholarship (value £50) will be offered in this department at the entrance examination. Particulars as to fees, dates, etc., can be obtained at the Institute or on application to the principal, Dr. R. Mullineux Walmsley.

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The session 1916–1917 of the Royal Technical College, Glasgow, began on September 26th. The diploma of the college is granted in civil, mechanical and electrical engineering, mining, naval architecture, chemistry, metallurgy, etc. There are also full courses of instruction in the schools of navigation and wireless telegraphy, and both day and evening classes are held. The diploma courses extend over three or four sessions, and the average fee is £12 12s. per session. The college is affiliated to the University of Glasgow, and the degrees of the university in engineering and applied chemistry are open to its students. Prospectuses may be obtained from the Director, and the calendar is published at 1s. (post free 1s. 4d.).

Naval and Military Wireless Telegraphists

Their Status and Conditions of Training

In August, 1915, in response to the demand made by a large body of correspondents, we published an article under the title of "How to Become a Wireless Operator." The subject-matter was mainly confined to civilian employment, but the interest taken in the wireless branches of the fighting services has induced us to deal with this side of the matter, and we trust that the following remarks will be found interesting not only by those who want to make practical use of the particulars given, but also by the much larger public who desire to take an intelligent interest in the gallant Britishers who have won so much distinction in this sphere of warfare. Necessarily, there are some particulars which it is undesirable in the public interest to publish; otherwise we have endeavoured to make the information given as complete as possible.

The Editor takes this opportunity of saying that nothing gives him greater pleasure than to be of practical service, either to young men who desire to consider the question of a wireless career for themselves, or parents who contemplate the possibility of putting their sons into the way of following wireless telegraphy as a career. He will at all times be pleased to answer questions as far as possible through the medium of the Magazine.

We purpose taking the two great branches of the King's fighting forces and dealing with them *seriatim*, so that our attention is first directed to the Navy.

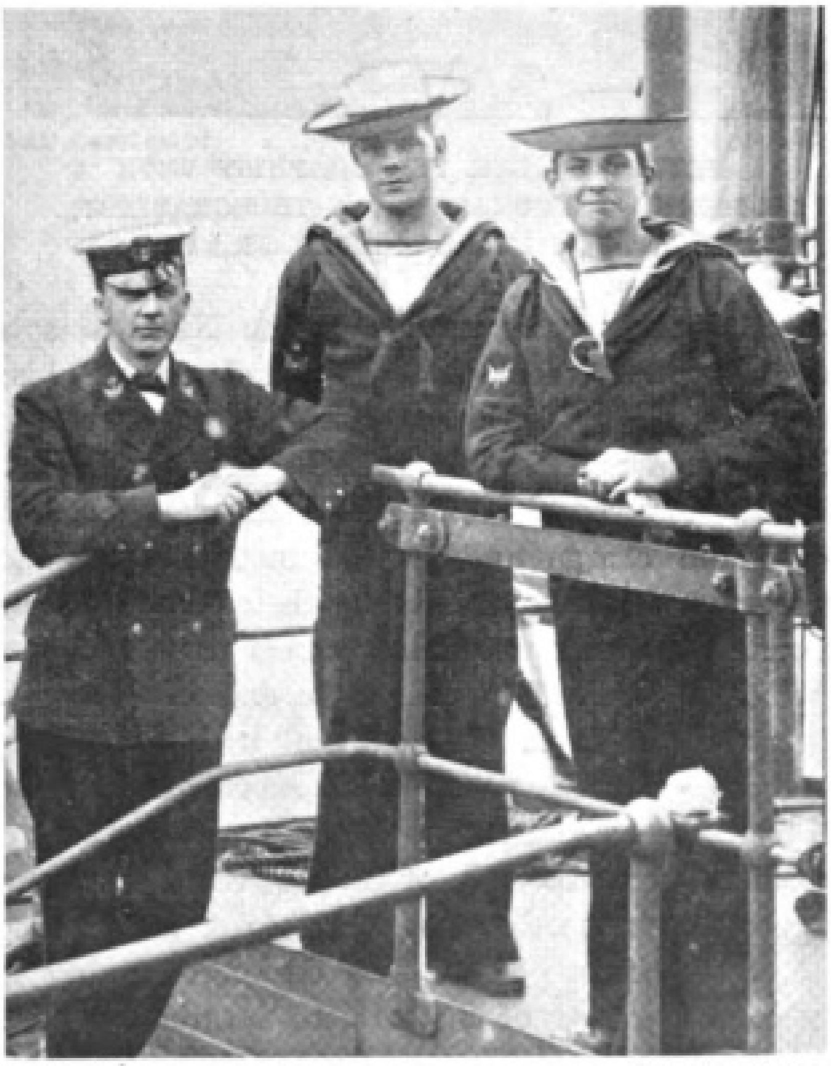

Photo by] [*Stephen Cribb.*

A GROUP SHOWING A CHIEF PETTY OFFICER TELEGRAPHIST, A TELEGRAPHIST, AND AN ORDINARY TELEGRAPHIST.

Photo by] [*Stephen Cribb.*

A PETTY OFFICER TELEGRAPHIST WITH A LEADING TELEGRAPHIST, A TELEGRAPHIST, AND AN ORDINARY TELEGRAPHIST.

RADIO-TELEGRAPHISTS IN THE NAVY.

Wireless operators serving in this branch of His Majesty's service may be classified under three headings :—

(1) Active Service Ratings.
(2) R.N.R. Ratings.
(3) R.N.V.R. Ratings.

We will consider them in order.

Active Service Ratings.

(1) The British Navy has always preferred "catching them young." An ancestor of the present writer fought at Trafalgar on board the *Victory* as a midshipman of fourteen At the present day lads are received on board training ships and establishments at the age of sixteen, and it is not possible for any boy entering the regular service of the Navy to specify as to the particular object of his employment that he shall devote his years of service to wireless telegraphy. He must enter in the regular way and take the general course of instruction, enlisting for twelve years' continuous service, with an optional extension of ten years. Certain lads are selected from those deemed suitable by the officer in charge and trained in signalling, one of the branches being radio-telegraphy. After completing their course in accordance with the Service regulations, they enter upon their career as *boy telegraphists*, receiving the wage of 7d. per day. They then rise to be *ordinary telegraphists*, and their pay is increased to 1s. 3d. per day. The next rank is that of *telegraphist*, whose pay starts at 1s. 11d. and rises after six years' man's service to 2s. 2d. per day, if he has not previously been rated as leading telegraphist. The rating of *leading telegraphist* comes next in order, with the pay of 2s. 6d., rising after one year's service (if he passes the approved standard) to 2s. 10d. After this, promotion means entry into the ranks of petty officer. Those who desire to qualify for this promotion must undergo a special course of instruction, terminating in a stiff examination. As far as wireless telegraphy is concerned, the junior rank is *petty officer telegraphist*, whose wage amounts to 3s. 4d. per day, with an increase (if recommended by the Commanding Officer) after one year's service of 3s. 8d., and after three years of 4s.

(A.) BADGE WORN BY PETTY OFFICER TELEGRAPHIST AND CHIEF PETTY OFFICER TELEGRAPHIST.

These men may qualify (by service) for the next rank and rise to become *chief petty officer telegraphist*, attaining the scale of pay of 4s. 4d. per day, rising to 4s. 7d. after three years, and 4s. 10d. after six years' service. The method by which petty officer telegraphists gain promotion to the rank of *warrant telegraphists* is by securing the approval and recommendation of their Commanding Officer and selection by the Admiralty, besides undergoing a further special course of instruction.

Royal Naval Reserve Ratings.

(2) Men may be engaged (between the ages of twenty-one and forty) who hold a first-class Postmaster-General's certificate, and who are experienced in wireless telegraphy. They must qualify for the Royal Navy (over and above their present qualifications) by a sea experience of not less than six months, and then enter as *wireless telegraph operators of the second class*, ranking as chief petty officers and receiving pay at the rate of 3s. per day, rising after a minimum of two months' service in the Navy (if passed and recommended by their Commanding Officer) to become *wireless telegraph operators of the first class* with the pay of 5s. daily. Certain of these men have been selected for the rank of warrant telegraphist, R.N.R. Promotion to warrant rank may be secured by men selected from amongst the wireless telegraph operators of the first class, and it must be always remembered that there are no warrant telegraphists, R.N.V.R. Any promotion from the R.N.V.R. men to warrant ranks involves transference to the R.N.R. A case in point occurred towards the beginning of the war when certain operators in civil employment received the rank of warrant telegraphists, and were thereby incorporated with the R.N.R., instead of being enrolled in the ranks of the R.N.V.R.

(B.) BADGE WORN BY LEADING TELEGRAPHIST.

(C.) CAP BADGE WORN BY WIRELESS MEN OF THE ROYAL NAVAL RESERVE.

Royal Naval Volunteer Reserve Ratings.

(3) R.N.V.R. wireless operators are men who, being eligible for military service and having enrolled in the R.N.V.R., are selected to serve in the Navy as wireless telegraphists. They receive their training in naval establishments. During this probationary period their remuneration is 1s. 3d. per day, and they enter the service as *ordinary telegraphists* with a pay of 1s. 3d. per

day, rising to the ranks of *telegraphist* (1s. 11d. to 2s. 2d. per day) and *leading telegraphist* (2s. 6d. to 2s. 10d. per day). The question of higher ranks does not occur in their case; for the period of the war is not likely to extend their service to a sufficient length for such promotions to come within their range.

There is a further section of the R.N.V.R., consisting of wireless engineers and operators in private service before the war began, some of them stationed at home and some abroad. These men are the *personnel* of existing stations which have been taken over complete by the Admiralty. They are called the Shore Wireless Section of the R.N.V.R. There have been of late very few additions to their number. With the exception of certain operators to whom reference has already been made at the close of our remarks above concerning the R.N.R. ratings, these normally civilian wireless operators admitted to Government service for the purpose of the war have been included in the R.N.V.R., S.W.S. ratings. In the case of important stations the engineers in charge have received the rank of lieutenant R.N.V.R., their assistants ranking as sub-lieutenants. In the case of the less important stations, where only a single engineer is employed, he ranks as sub-lieutenant. Operators attached to such stations have become petty officers R.N.V.R., S.W.S., whilst the principal operators rank as chief petty officers. With regard to these shore engineers and operators the pay is regulated in accordance with the special circumstances attending each case, and nó general rule can be set forth.

A similar procedure has been followed in the case of the Wireless Staff of the British P.O. In normal times of peace an ever-increasing number of P.O. employees are engaged on radio-telegraphic duties, and these are for the most part recruited from officials already employed in other departments of the Post Office. As soon as the war commenced this normal peace establishment of the G.P.O. Radio Staff was largely increased by the addition of temporary wireless operators drawn from the Inland Telegraph section. Thus augmented, the G.P.O. Wireless Staff has been, almost without exception, included in the special Shore Wireless Section of the Royal Naval Volunteer Reserve, whilst those who are not so enrolled are engaged in special work for the War Office.

Under the present war conditions, then, Commander Loring, R.N., Inspector of Wireless Telegraphy to the Post Office, stands as immediate senior officer to a number of Lieutenants and Sub-Lieutenants who assist in the control of the Post Office wireless service. The operators enrolled have all received the rank of Petty Officers, and in some cases Chief Petty Officers, their pay remaining on a normal civilian basis.

All men, whether they belong to the R.N., R.N.R., or the R.N.V.R. sections, have to pass the established medical examination. The R.N.R. and R.N.V.R. men are allowed to wear glasses, the R.N. are not. The R.N.R. and R.N.V.R. ratings are entered (as far as the vast majority are concerned) for the duration of the war only.

General Remarks.

With regard to *promotion* from non-commissioned to commissioned ranks, it may be pointed out that the most senior Warrant Officers in the Navy are called Chief Warrant Officers, and from these a few are from time to time selected for commissions as Lieutenants. The system of promotion to mates forms the main avenue by which the younger men can obtain commissions as Sub-Lieutenants, whence the majority of them become eligible for advancement for all ranks in the usual course.

With regard to *badges* we append three illustrations :

(A) The badge worn by Petty Officer Telegraphists on their right arm. This same badge is worn by Chief Petty Officer Telegraphists, only carried on the collar instead of the right sleeve.

(B) The badge worn by leading telegraphists on their right arm is the same as the badge worn by telegraphists, with the difference that the latter carry only the star above the winged sign. Ordinary telegraphists and boy telegraphists wear the winged sign only with no star either above or below. In each of the three cases leading telegraphists, telegraphists and ordinary and boy telegraphists, the badges are worn on the right sleeve.

(C) The cap badge worn by wireless men of the R.N.R.

There are no distinctive badges allotted to wireless men of the R.N.V.R., who wear the same badges as the Active Service men.

(To be continued.)

Chief Operators

THE first duty of a chief operator is to see that the operators under him perform their obligations towards the company, and keep the business moving. In the performance of this duty chiefs employ different methods of attaining the end, their object being to get the work out of the men with the least friction. Here is where a knowledge of human nature becomes of practical value. Some chiefs, unfortunately, become unpopular because of their too intense insistence in keeping business moving, which is irritating to many natures, and the moment an operator becomes irritated or annoyed in his work, his efficiency is at once lowered. Chief operators should make a special study of human nature so as to enable them to get the full amount of work out of each individual without incurring any ill-will. One rule will not apply to the mass ; each case requires different treatment, just as in a case of illness. The disposition of the patient and other factors must be considered in order to proceed to bring about a cure. So with a man at work. Stern discipline and firmness is necessary in some cases, and in others gentleness will accomplish the best results.

Every chief operator, no doubt, has given much thought to the problem of getting the best work out of the men, but the principal factor of success in every case is a consideration of individual characteristics, and the application of proper means to achieve the desired result.

(From the " Telegraph and Telephone Age.")

Maritime Wireless Telegraphy

SPANISH SHIP SUNK.

A WIRELESS message recently came to hand from San Sebastian stating that a Spanish ship had been torpedoed, either by an Austrian or a German submarine. No further details have been received, and it is, therefore, presumed that all hands have been lost. A subsequent message from Paris stated that the scene of the tragedy was in the Mediterranean, and that it was a German submarine which was responsible for the act.

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SEIZED OR SUNK?

The Stockholm *Tidning* reports that the German ore steamer *Desterro* has probably been either seized or sunk by a submarine. A wireless message stated that the steamer was chased by a submarine. The vessel had a pilot on board, from whom later nothing could be heard. According to a further wireless message received by a Swedish station, another German ore steamer was captured.

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A STEAMER AFIRE.

Whilst the steamer *La Blanca* was proceeding in the South Atlantic Ocean a fire broke out. She immediately sent a wireless telegraph to Monte Video announcing the occurrence and stating that she was proceeding with all speed to that port. She subsequently wirelessed that she was badly on fire and would require help immediately on arrival. When she reached the port the fire apparatus was brought into play and the flames were speedily subdued.

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SHIPS' MOTOR LIFE-BOATS.

Nearly all large passenger ocean liners now carry motor life-boats fitted with wireless telegraphic apparatus in addition to the original hand-propelled boats. There has recently been completed at Saltney a double-ended motor life-boat for one of the liners of the Canadian Pacific Ocean Service, Ltd. She is constructed on the double skin diagonal plank system, which gives great strength and stiffness. The propelling machinery, which is installed amidships, is a three-cylinder 25 B.H.P. paraffin set, fitted with petrol starting and coupled to a reverse gear. Wireless telegraphy is fitted in a small cabin directly forward of 'midships.

British Association for the Advancement of Science

MEETING AT NEWCASTLE.

In Section G (Engineering) of the British Association Meeting on Thursday, September 7th, two papers on Wireless Telegraphy were read.

The first paper was contributed by Professor G. W. O. Howe, and was entitled "The Calculation of the Capacity of Aerials, including the Effects of Masts and Buildings." Our readers will remember that this is a subject to which Professor Howe has devoted considerable attention, his paper on similar investigations read at last year's Meeting being reproduced in THE WIRELESS WORLD for October last. A full reprint of this year's paper will be found on another page.

Upon the conclusion of the paper a short discussion was opened by Mr. Campbell Swinton, who expressed his appreciation of the admirable way in which the Author had in his previous papers gone on from step to step, from the elementary form discussed at Sydney to such complicated arrangements as were dealt with in the

Photo by] [*Valentine.*

A VIEW OF NEWCASTLE, WHERE THE BRITISH ASSOCIATION MEETING WAS HELD THIS YEAR.

paper read that day. Professor Marchant, of Liverpool University, also spoke in praise of the paper.

The second paper dealt with "Some Characteristic Curves of the Poulsen-Arc Generator," and was read by Mr. N. W. McLachlan. This we hope to reproduce in full in our November issue. The brief discussion on the paper was opened by Professor Marchant, who called attention to the non-inductive resistance employed by the Author in his experiments. Professor Howe also expressed great interest in the Author's work.

Patent Record

5202. April 10th. H. Munro. Method of determining direction from which sounds proceed and the distance at which they originate.

5391. April 12th. Allmanna Svenska Elektriska Aktiebolaget. Continuous current generator. (Convention date, Sweden, May 5th, 1915.)

5445. April 13th. E. C. R. Marks (for Goldberg). Electrical control apparatus.

5458. April 13th. Société Française Radio-Électrique. Wireless Telegraphy and Telephony. (Convention date, France, December 28th, 1914. Patent No. 100,281. *Open to Public Inspection.*)

5466. April 13th. Société Française Radio-Électrique. Wireless Telegraphy and Telephony. (Convention date, France, March 1st, 1915. Patent No. 100,282. *Open to Public Inspection.*)

5471. April 13th. Société Française Radio-Électrique. Wireless Telegraphy and Telephony. (Convention date, France, March 9th, 1915. Patent No. 100,283. *Open to Public Inspection.*)

5631. April 17th. R. F. Bossini and H. R. Wilding. Sound detector.

5634. April 17th. R. F. Bossini and H. R. Wilding. Sound detector and transmitter.

5807. April 20th. A. H. Dykes, W. Duddell, H. W. Handcock and C. Oliver. Distance-operated mechanism and signals connected to electrical supply system.

Share Market Report

London, *September 13th*, 1916.

Business in the Share Market has been fairly active during the past month and there has been considerable demand for the shares of the various Marconi issues. The closing prices as we go to press are :—

Marconi Ordinary, £3 3s. 9d. ; Marconi Preference, £2 11s. 10½d. ; Marconi International Marine, £2 6s. 3d. ; American Marconi, 19s. 3d. ; Canadian Marconi, 10s. 3d. ; Spanish and General Wireless Trust, 12s.

The Calculation of the Capacity of Radio-telegraph Antennæ, including the Effects of Masts and Buildings

By PROFESSOR G. W. O. HOWE, D.Sc., M.I.E.E.

Paper read before the British Association for the Advancement of Science at Newcastle, 7 September, 1916

UNTIL quite recently the calculation of the capacity of radiotelegraph antennæ, except in the simplest cases, was looked upon as an impossibility, and one of the leading text-books on the subject stated that, " In the case of multiple-wire aerials, the only way to determine the capacity is to measure it." This is no longer the case, however, and it is shown in this Paper that, even for aerials of complicated design, it is a relatively simple matter to pre-determine the capacity and to calculate the effects of the earth, the masts and anything else in close proximity to the aerial. The accuracy obtainable is more than sufficient for all practical purposes.

The principle of the method employed by the author has already been described,* and in the present Paper the method is extended and applied to a number of concrete examples. Some tests are also described, the results of which indicate the accuracy of the calculated values.

The principle of the method is briefly as follows : It is assumed that the charge is uniformly distributed over the surface of the whole antenna, and the average potential of the antenna under this fictitious condition is then calculated. Formulæ have been worked out by means of which the average potential can be easily determined even in the case of complicated antennæ. The assumption is then made that this average potential differs but little from the actual potential which the antenna would have at every point if the same total charge were no longer uniformly distributed, but allowed to have its own natural distribution.

In the original Paper, read before the British Association at Sydney, formulæ and curves were given for flat multiple-wire antennæ with any number of wires from 1 to 12, and also for four-wire aerials with the four wires at the corners of a square. Formulæ and curves were given for wires meeting at various angles, and it was shown that two equal wires meeting at an acute angle, like the sides of a letter V, have the same average effect on each other as if they were parallel at a distance equal to 0·36 of the perpendicular dropped on one wire from the end of the other. The effect of the earth on both horizontal and vertical wires was considered, and some numerical examples of the application of the method to actual antennæ were given. It was shown that, when applied to an example quoted by

* "The Capacity of Radiotelegraphic Antennæ," Brit. Assoc., Sydney; WIRELESS WORLD, February, 1915. "The Capacity of Aerials of the Umbrella Type," Brit. Assoc., Manchester; WIRELESS WORLD, October, 1915.

Dr. Louis Cohen (*The Electrician*, February 21st, 1913), the method gave results in good agreement with the measured value, whereas the method described by Cohen himself gave an error of 20 per cent. In September, 1915, the author published formulæ and curves by means of which aerials of the umbrella type can be readily calculated.

In his *Principles of Electric Wave Telegraphy*, Professor Fleming gives a number of measured capacities of actual aerials of various types to serve as a guide in estimating the capacity of any other aerial. Some of these measured values agree fairly well with the calculated values, but others show a wide divergence; it was in seeking to explain these discrepancies that the author was led to devise a method of calculating the effect of masts and buildings. Although the data given with regard to the method of supporting the aerials are too meagre in most cases to allow of accurate calculation, it will be seen that the assumption of probable data leads in some cases to calculated results differing but little from the measured values. The discrepancies are most marked when the aerial consists of a very large number of wires; for instance, "25 vertical (?) wires 0·1 in. diameter, 200 ft. long, arranged fan shape with top ends about 2 ft. apart = 1,640 micro-microfarads." Now, this is considerably greater than the calculated value, even if the wires were everywhere 2 ft. apart and not brought together at the lower end. Unless there is some error in the data, this can only be due to masts or buildings, or some factor which is not mentioned.

In the original Paper the curves and formulæ were not carried beyond 12 wires, and we shall now extend them so as to include this multiple antenna of 25 wires. It was shown on page 859 of *The Electrician* (September 4th, 1914) that the capacity of a multiple-wire antenna with n parallel wires in one plane is given by the formula,

$$C = \frac{16{\cdot}94n}{n\left(\log_e \frac{l}{d} - 0{\cdot}31\right) + \log_e \frac{d}{r} - B} \times 10^{-6} \text{ mfd. per foot,}$$

where l is the length of the antenna, d the distance between adjacent wires, and r the radius of the wire. The constant B is the average value of $\log_e (\underline{|n-m}\ \underline{|m-1})$ for all values of m from 1 to n. The work of finding this average value is considerably lightened by remembering that $\log \underline{|x}$ is equal to $\log \Gamma(x+1)$, the values of which are tabulated in Dale's Mathematical Tables, p. 77. For $n=25$ we get $B=44{\cdot}75$. The values of B for any number of wires up to 25 can be read off the curve (Fig. 1), which is an extension of Fig. 6 in the original Paper. For any value of n greater than 15 it is seen that $B = 2{\cdot}44\ (n - 6{\cdot}7)$. If, instead of

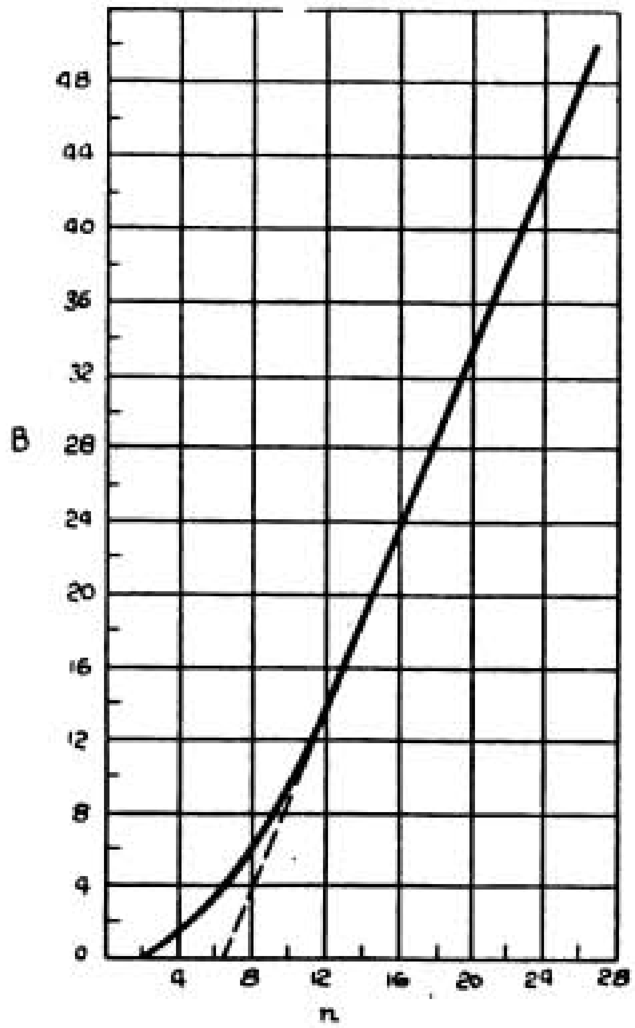

FIG. 1.

the capacity, we wish to find the average potential of the antenna when uniformly charged with unit quantity per centimetre of wire, we have

$$V_{av.} = 2n\left(\log_e \frac{l}{d} - 0{\cdot}31\right) + 2\log_e \frac{d}{r} - 2B,$$

or if n is greater than 15

$$V_{av.} = 2n\left(\log_e \frac{l}{d} - 0{\cdot}31\right) + 2\log_e \frac{d}{r} - 4{\cdot}88\,(n - 6{\cdot}7).$$

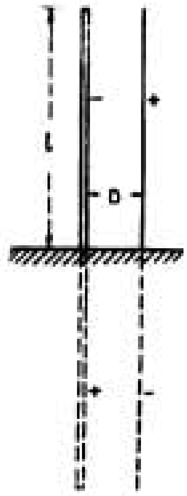

FIG. 2.

Now, in the example quoted above, if the 25 wires had been parallel and 2 ft. apart, we should have

$$\frac{l}{d} = \frac{200}{2};\ \log \frac{l}{d} = 4{\cdot}6;\ \frac{d}{r} = \frac{24}{0{\cdot}05};\ \log \frac{d}{r} = 6{\cdot}16.$$

$V_{av.}$ due to its own charge $= 214{\cdot}5 + 12{\cdot}3 - 89{\cdot}5 = 137{\cdot}3$. The total charge is $25 \times 200 \times 30{\cdot}5 = 152{,}500$, and were it not for the earth the capacity would be $1{,}234 \times 10^{-6}$ mfd. The negative potential of the aerial due to its image in the earth will be approximately $\frac{152{,}500}{200 \times 30{\cdot}5} = 25$, thus lowering its resultant potential from 137·3 to 112·3, and increasing the capacity to $1{,}510 \times 10^{-6}$ mfd.

It was shown in the original Paper that fan-shaped aerials could be calculated as parallel wires with a value of d equal to 0·365 of the actual distance at the widest point (strictly, of the perpendicular dropped from the end of one wire on to the other); hence l/d and d/r should be taken as 274 and 175 respectively. Repeating the calculation with these values, we get a resultant capacity of $1{,}054 \times 10^{-6}$ mfd., whereas that given as the measured value is $1{,}640 \times 10^{-6}$ mfd.

Another actual example for which the measured capacity is given is that of "160 wires, each 0·1 in. diameter and 100 ft. long, arranged conically with bottom ends together 10 ft. above the ground, and top ends 2 ft. apart = 2,685 micro-micro-farads." The circumference of the circle formed by the upper ends of the wires is 320 ft., giving a radius of 51 ft., and since each wire is 100 ft. long it must make an angle of 30 deg. with the vertical. If we assume each wire to have unit charge per centimetre of length, the average potential of any wire

due to its own charge	= 19·55
,, the next wire	= 9·3
,, the 40th wire	= 2·695
,, the opposite wire	= 2·2

By plotting these values, the potential due to any wire can be found, and thus the average value, which is found to be 3·28. Hence, the potential

due to its own charge	= 19·55
,, the other wires	= 521 (= 159 × 3·28)
,, the earth image	= −160 (approx.)
The total potential	= 381

Hence

$$C = \frac{160 \times 100 \times 30{\cdot}5}{381 \times 0{\cdot}9} = 1{,}423 \times 10^{-6} \text{ mfd.}$$

which is only 0·53 of the measured value given for this antenna.

It has been assumed that each wire is insulated at its upper end. This is improbable, and it is interesting to consider the effect on the capacity of supporting the 160 wires from a horizontal cable of, say, 0·5 in. diameter. This cable will form a circle with a circumference of 320 ft., and since it has five times the diameter of the antenna wires, and is more advantageously placed, it will require a much greater charge per centimetre of length to raise it to the same potential. We shall assume that it has a charge of 12 units per centimetre.

It is necessary now to find the potential of this cable due to the various charges.

(1) The Potential of a Circle of Wire Due to its Own Charge of 1 Unit per Centimetre.

The potential at any point P on the axis of the wire is due (*a*) to the charge on the wire in its immediate vicinity which may be considered linear, and (*b*) to the charge on the remainder of the circle.

(*a*) This may be confined to the wire subtending a small angle θ_1 on each side of P (*see* Fig. 5), and may be calculated as a cylindrical conductor of length $l = 2\theta_1 R$. In the present example $R = 51$ ft., and if θ_1 be taken as 4 deg., $l/r = 342$. The potential at the mid-point $P = 2 \log_e l/r = 11\cdot 67$.

(*b*) The potential at P due to the remainder of the circle

$$= 2\int_{\theta_1}^{\pi} \frac{R\,d\theta}{2R \sin \theta/2} = 2\left[\log \tan \frac{\theta}{4}\right]_{\theta_1}^{\pi} = -2 \log \tan \frac{\theta_1}{4}$$

$$= -2 \log \tan 1^\circ = 8\cdot 1.$$

Hence the total potential at P due to the charge on the ring $= 11\cdot 67 + 8\cdot 1 = 19\cdot 77$. This applies to any circle with $R/r = 2450$, and a charge of 1 unit per centimetre. It is interesting to note that if this wire were straight its average potential would be 6 per cent. lower, so that its capacity is decreased this amount by being bent into a circle.

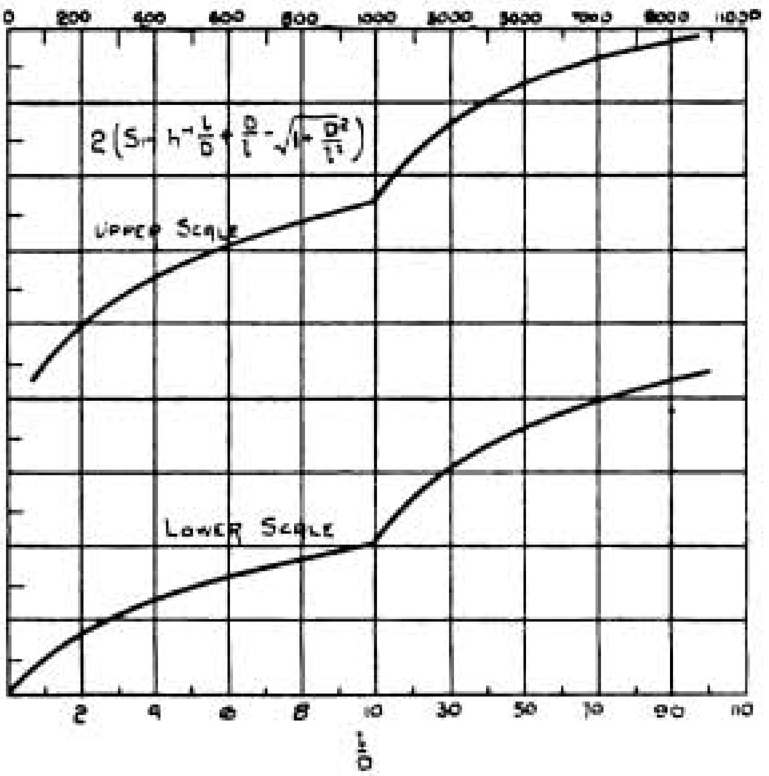

FIG. 3.

In our example, with a charge of 12 units per centimetre, the potential will be 237.

(2) The Average Potential of the Horizontal Suspension Wire Due to the Antenna Wires.

From Fig. 24 in the original Paper it is found that the potential at F, due to the diametrically opposite wire OP of the cone, is 1·0, at E 1·05, at D 1·2, at C 1·7; thus the average over EF is 1·025, over DE 1·12, CD 1·4, while from Fig. 23, the average over $PC = 2\cdot 6$. Hence the average potential over the whole circle due to the charge on one antenna wire = 1·54, and that due to the whole 160 wires, 246.

Hence the potential of the suspension wire

due to its own charge	=	237
,, antenna wires	=	246
,, its own image	=	− 20
,, image of 160 wires	=	−106
Total	=	357

The potential previously calculated for the 160 antenna wires will be modified by the presence of the charge on the suspension wire.

We will here make use of an important theorem: The average potential over a surface of area A, due to a charge uniformly distributed over another surface of area B, is equal to the average potential over the second surface due to the same charge uniformly distributed over the first surface. If the charges are not equal in the two cases, the potentials vary in direct proportion to the charge. To prove this theorem let l be the distance between two elements δA and δB of the surfaces; then if the area B have a uniform density σ_b, the potential of the element δA will be $\sigma_b\int\frac{dB}{l}$, and the average potential over the whole of the surface A will be obtained by integrating over the surface and dividing by its area thus

$$(\sigma_b/A)\int\int\frac{dBdA}{l}=\frac{Q_b}{AB}\int\int\frac{dBdA}{l}$$

where Q_b is the total charge on the area B. Similarly the average potential of B, due to the charge on $A=\sigma_a/B\int\int\frac{dAdB}{l}=\frac{Q_a}{AB}\int\int\frac{dAdB}{l}$.

If $Q_a=Q_b$, the average potentials are equal.

Now since we have calculated the average potential of the circular cable, due to one wire of the cone, we can write down at once the potential of the latter due to the charge on the former. It is

$$1{\cdot}54\times\frac{320\times12}{100}=59.$$

The average potential of any wire of the cone which was previously calculated to be 381, will therefore be increased to 381 + 59 by the presence of the charged suspension cable; the earth image of the latter will, however, reduce this by 25, giving a resultant of 415.

On the cone we have 16,000 × 30·5 units at a potential of 415, and on the suspension cable 3,840 × 30·5 units at a potential of 357, giving a total charge of 19,840 × 30·5 units at an average potential of 404.

$$\text{The capacity}=\frac{19{,}840\times30{\cdot}5}{404}=1{,}500\text{ cm.}$$
$$=1{,}670\times10^{-6}\text{ mfd.}$$

This is an increase of 17 per cent. due to the suspension cable, but the actual increase will be greater, since, the calculated potential of the cable being less than that of the wires of the cone, it is evident that the density on the cable is greater than has been assumed. All faulty assumptions as to the distribution of the charge give values below the true capacity. A recalculation shows that to give the same potential in all the wires, the charge on the cable should be 16 units per centimetre of length, and not 12, as has been assumed; this increases the capacity to $1{,}680 \times 10^{-6}$ mfd., which is 18 per cent. greater than that calculated without the suspension cable.

Again, another example consists of "four vertical parallel wires 110 ft. long and 0·1 in. diameter, spaced 6 ft. apart at the angles of a square = 583 micro-micro-farads." This type of antenna was considered in the original Paper (*see* Fig. 18), and since $l/D = 18{\cdot}3$ and $d/r = 1{,}440$, the capacity will be about 3·85 per foot, or 424×10^{-6} mfd. in total. This neglects the effect of the earth, which is determined as follows: The potential of the antenna

due to its own charge = 35·2
,, its earth image = − 4·0 approx.

The resultant potential = 31·2

Hence the capacity will be increased in the ratio of 35·2 to 31·2—*i.e.*, 13 per cent.—which gives a total capacity of 478 micro-microfarads, which is only 82 per cent. of the measured value. That these discrepancies are due to such disturbing factors as masts and buildings, particulars of which are not given, is proved by the fact that the calculated and measured values agree very well even in the case of very complex arrangements of wires, if the disturbing factors are carefully eliminated or calculated and allowed for.

THE EFFECT OF MASTS.

The method of calculating the effect of masts and buildings will now be considered, commencing with the simple case shown in Fig. 2, where a single vertical wire runs parallel to a cylindrical mast.

Let l = the length of mast or wire, r = radius of wire, r_m = radius of mast, D = distance between wire and mast.

If the wire be assumed to have a uniform charge of 1 unit per centimetre of length, it will induce on the mast a negative charge of a units per centimetre, which we assume to be also uniformly distributed. Their images in the earth will be equally and oppositely charged. The value of q can be determined from the fact that the resultant potential of the mast must be zero, since it is connected to the earth. Having determined q, the potential of the insulated wire can be found and thus

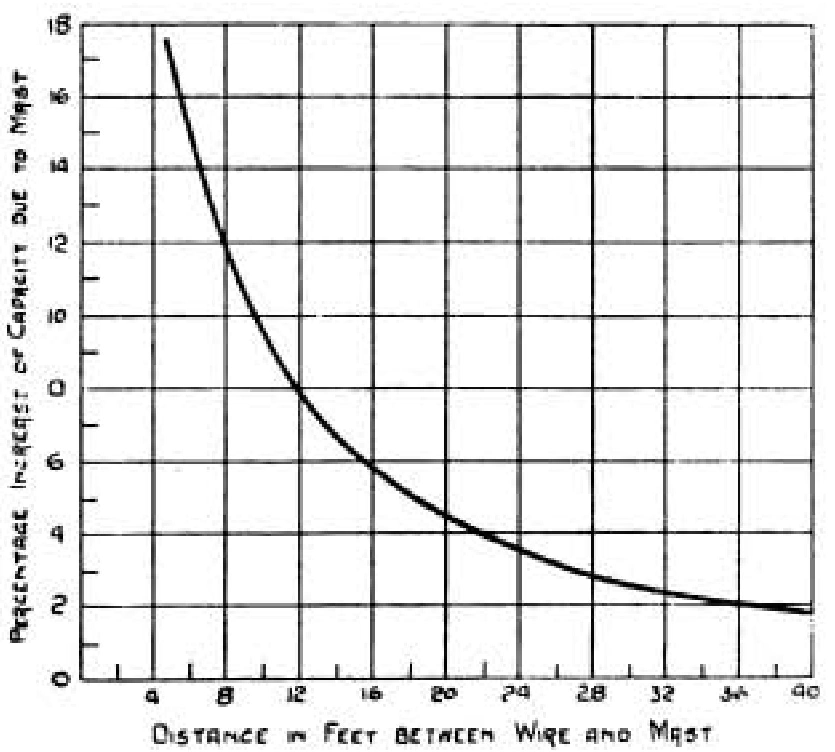

FIG. 4.

also its capacity. In most cases the value of l/D will not be large enough to enable the approximate logarithmic formula to be used, and it will be necessary to employ the accurate formula for the potential of one conductor due to the charge on a parallel conductor—viz. (*The Electrician*, Vol. LXXIII., p. 859):

$$V_{av.} = 2\left(\sinh^{-1}\frac{l}{D} + \frac{D}{l} - \sqrt{1 + \frac{D^2}{l^2}}\right).$$

On substituting r for D this formula can also be employed to find the potential due to the charge on the conductor itself, even if the ratio of its length to its radius is not exceedingly great. The values of this expression for different values of l/D are given in the following table and are plotted in Fig. 3.

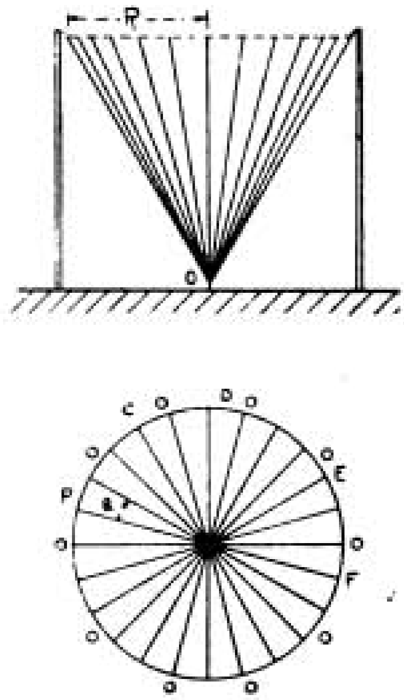

FIG. 5.

l/D.	$V_{av.}$	l/D.	$V_{av.}$	l/D.	V_{av}	l/D.	$V_{av.}$
1	0·936	15	4·93	100	8·62	1,300	13·72
2	1·648	20	5·48	200	9·98	2,000	14·58
3	2·196	30	6·27	350	11·1	4,000	15·97
5	2·986	40	6·81	500	11·81	8,000	17·18
7	3·554	50	7·26	750	12·62	—	—
10	4·186	75	8·05	1,000	13·20	—	—

In our example (Fig. 2), let $l = 200$ ft., $r = 0{\cdot}05$ in., $r_m = 6$ in., $D = 10$ ft.; so that $l/r = 48{,}000$; $l/r_m = 400$ and $l/D = 20$.

The potential of the mast

due to its own charge		$= -11{\cdot}34\,q$.
,,	its own image	$= +\ 1{\cdot}38\,q$
,,	the charge on wire	$= +\ 5{\cdot}48$
,,	the image of wire	$= -\ 1{\cdot}33$

Of these four component potentials, the first and third are read off the curves in Fig. 3, the second was determined on page 907 of the original Paper, while the fourth is found from the following considerations. If the wire and mast were both twice as long—that is, as long as themselves plus their images—l/D would be increased to 40 and $V_{av.}$ to 6·81. This would be the average potential of the whole, or of either half of the 400 ft. mast due to the 400 ft. wire; hence it is the potential of the actual 200 ft. mast due to the 400 ft. wire. Now the potential of the actual mast due to the actual 200 ft. wire is only 5·48, and the difference—viz., 1·33—must be due to the charge on the image of the wire.

Seeing that the mast is earthed, its resultant potential must be zero, and therefore

$$5{\cdot}48 - 1{\cdot}33 - (11{\cdot}34 - 1{\cdot}38)q = 0,$$

or $q = 0{\cdot}417$ units per centimetre of length. Hence the potential of the wire

Due to its own charge	=	20·9 (*see* Fig. 3 in original Paper)
,, its own image	= −	1·0 (*see* Fig. 21 *et seq.*)
,, charge on mast	= −	2·28 (=0·417 × 5·48)
,, image of mast	=	0·56 (=0·417 × 1·33)
Resultant potential of wire	=	18·2

Hence the presence of the mast lowers the potential of the wire from 19·9 to 18·2, thereby increasing its capacity 9·3 per cent. The effect of altering the distance between the wire and the mast is shown in Fig. 4.

(*To be continued.*)

Pocket Wireless Outfits

AMONG the lesser horrors attributed to the great war must be included the publicity given to pseudo-inventors whose products may be imagined to have possible military application. Doubtless many of the devices worked out by these untrained inventors are in some degree applicable to the services for which they were intended. News of the few which possess startling merit ultimately reaches the ears of the various imperial commissions or other bodies which have the power and the desire to investigate and utilise the inventions. But the wheat of valuable plans is so nearly smothered by numbers of chafflike schemes that the true worth of the better ideas is likely to be overlooked. This is all the more probable because astounding claims, even though untrue, tend to overshadow conservative statements of demonstrated facts.

In the past few years a dozen or two "inventors" have put together compact receivers for wireless telegraphy, shown that by their use they could receive messages from powerful stations at moderate distances, and then announced loudly that they had produced "new" wireless systems which completely eliminated tall aerial structures, bulky instruments, and what not! The absurdity of such contentions as based upon any such performance is only too evident to the technical man; to the lay mind, however, there appears always to be something particularly appealing in the alleged solution of a great problem by an inventor who has attended only the "school of experience." It seems unnecessary that the curriculum there pursued by him should have been either effective or extensive!

Truly, the sensitive and selective wireless receiver which is small and light enough to be easily portable has many uses, not the least important of which are on the field of battle. Similarly, reception of messages from considerable distances by the use of ground wires, and without tall aerial masts, is often advantageous. Both of these possibilities are made use of in practical radio-telegraphy, and have been utilised for many years. The production of vigorous radiated waves from low antenna wires, and the design of powerful transmitting apparatus of so little bulk and weight that it is not hard to transport, however, are vastly different problems. The difficulties of producing the ideal aeroplane motor are combined with those of leading large currents through slight conductors, and of restraining high voltages with flimsy insulation. Our earnest reporters of the daily press would do well to scrutinise the claims of new inventors without losing sight of the conservation of energy.

(*Electrical World.*)

A Personal Page

Photos by] [*Val L'Estrange, Alfieri, and P. W. Harris.*

Top left.—SENATORE MARCONI'S BEAUTIFUL CHILDREN, MASTER GIULIO AND MISS DEGNA MARCONI.

Top right.—SENATORE MARCONI'S CHILDREN RIDING IN ROTTEN ROW, WITH THEIR "ARMLETTED" TUTOR.

Bottom.—EAGLEHURST, NEAR SOUTHAMPTON, FOR MANY YEARS SENATORE MARCONI'S HAMPSHIRE RESIDENCE.

Among the Operators

SAD DEATH FROM PNEUMONIA.

WE regret to announce the death from pneumonia of a member of the Marconi Company's Marine Operating Staff, Mr. Duncan Roy MacDermid. Mr. MacDermid, who was but eighteen years of age and one of the most recent recruits to the wireless service, was born in Dumbarton and spent most of his life in Glasgow. Upon leaving school he entered the service of the Glasgow newspapers *The Bulletin* and *The Evening Times*, where he was engaged in the process and engraving department. Taking an interest in wireless telegraphy, he undertook a course of training at the Royal Technical College, Glasgow, and entered the Marconi Company's School in June of this year. After a short finishing course he was appointed to the Cunard liner *Andania* as assistant operator, and had been but a few days at sea when he was taken ill. On arrival at New York Mr. MacDermid's condition was so serious that he had to be immediately removed to a hospital ashore, and passed away shortly after his admission to that institution. We offer our sincerest sympathy to the late Mr. MacDermid's parents in their sad bereavement. The loss is a particularly sad one as Mr. MacDermid's elder brother, Sec. Lieutenant Donald Russell MacDermid, H.L.I., was killed in action at the end of June.

* * * * * *

A GALLANT OFFICER.

We further regret to announce the death, on the field of honour, of Sec. Lieut. Hubert Patrick Fisher, of the Shropshire Light Infantry. Lieutenant Fisher left the service of the Marconi Company in the spring of 1915, and obtained his commission shortly afterwards. Lieutenant Fisher was drafted into the Gloucesters owing to the shortage of officers. Whilst leading a platoon of the latter regiment into the front trenches he met his death, and his body lies buried in a little cemetery in the vicinity. It was in October, 1914, that the late officer, who was but twenty years of age and hailed from the town of Galway, joined the Marconi Company, and shortly after taking up his duties was appointed to some special war work. Later on he was given charge of the wireless on the s.s. *Pembrokeshire*, upon which vessel he was serving when he left. The deepest sympathy of all who knew this gallant young man will be extended to his mother and father in their terrible loss.

THE LATE OPERATOR MACDERMID.

* * * * *

AN ADMIRALTY AWARD.

Hearty congratulations to Operator John McMillan, who has just received from the Admiralty a gold watch in recognition of

OPERATOR J. MCMILLAN.

his services on the torpedoed s.s. *Wayfarer.* Our readers will remember that in our May issue of last year we dealt with this case and pointed out the important part played by wireless telegraphy in the incident. Mr. McMillan is twenty-four years of age, and has served in the Marconi Company since June, 1913, when he entered the London School from the Post Office. His first ship was the s.s. *Andania,* and from this he transferred to the s.s. *Haverford,* afterwards serving on s.s. *Hesperides* and s.s. *Scandinavian* before being appointed to the s.s. *Wayfarer* in March, 1915. Escaping from the disaster which overtook that ship, he next joined the s.s. *Whakarua.* In addition to the watch from the Admiralty, Mr. McMillan has received a gift of money from Messrs. T. & J. Harrison, owners of the *Wayfarer.*

* * * * * *

S.S. "MASCOTTE."

This ship, which was mined in September, carried as its operator Mr. John Strang. Mr. Strang, who is a Scotsman and nineteen years of age, joined the Marconi Company in July, 1915, having received his P.M.G.'s first-class certificate at the North British Wireless Schools, Glasgow. After making his first voyage on the s.s. *Cameronia,* he was appointed to the s.s. *Cassandra,* on which ship he remained for a considerable time. He was appointed to the s.s. *Mascotte* at the beginning of August, a month before the ill-fated vessel met with her accident.

OPERATOR JOHN STRANG.

Wireless Telegraphy on Aeroplanes

ACCORDING to American reports, what is claimed to be a record in wireless telegraphy from aeroplanes was recently established by Captain Culver, of the U.S. Army Aviation Corps. During a flight from San Diego to Santa Monica, 114 miles away, he is stated to have kept in touch with his station by sending wireless messages every three minutes. The power for the transmission set is derived from a generator placed on the lower wing section of the aeroplane, and driven by a two-bladed propeller. Aerial wires are suspended from the "fuselage" of the machine, with an insulated counterpoise hung from the wings to the tail of the aeroplane. The complete transmission set is stated to weigh less than 40 lb.

American Letter

New York, August 28th, 1916.

THE closing of the summer season marks the resumption of the activities of the Institute of Radio Engineers, and its first meeting after the summer vacation is to be held on Wednesday evening, September 6th, at 8.15 p.m., Room 2 of the Engineering Societies Building, 33 West 39th Street, New York City.

There will be presented two brief papers by Mr. Leonard F. Fuller on "A Brief Technical Description of the New San Diego Pearl Harbour, and Cavite High Power Naval Radio Stations" and "A Few Experiments with Ground Antennas." In addition, there will be presented a paper by Prof. Charles A. Culver on "Notes on Radiation from Horizontal Antennas."

Much interesting and practically important material is included in these papers.

As you will recall, the Institute meetings were previously held at Fayerweather Hall, Columbia University, but owing to the central location of the Engineering Societies Building and the increased interest shown by electrical engineers in the radio art it has been arranged to hold meetings hereafter at the Engineering Societies Building, where greater facilities are obtained.

Among the most important activities of the Institute may be mentioned the work of the Committee on Wave Length Regulation, which has been appointed to carefully study the existing conditions and to suggest such improvements as are deemed advisable. This, as you will understand, is a considerable task when it is remembered that recommendations, to be of practical value, must embrace conditions which exist internationally as well as in the United States. It is also necessary to take into account the fact that thousands of ship and shore stations already equipped with radio apparatus and which have accommodated themselves to operate in accordance with existing rules and regulations, will be affected by new regulations. The work of this Committee and its recommendations will probably be submitted at the next international radio telegraph convention. The members of this Committee consist of the following:

John Stone Stone (Chairman).

E. F. W. Alexanderson.
Edwin H. Armstrong.
Louis W. Austin.
H. Boehme.
William H. G. Bullard.
George S. Davis.
Lee deForest.
Melville Eastham.
Lloyd Espenschied.
Leonard Fuller.
Alfred N. Goldsmith.
John L. Hogan, Jun.
Frederick A. Kolster.
Ralph H. Langley.
Fritz Lowenstein.
Emil E. Mayer.
Greenleaf W. Pickard.
Samuel Reber.
David Sarnoff.
Frederick Simpson.
T. Lincoln Townsend.
Roy A. Weagant.
Arthur G. Webster.
Leonard D. Wildman.

In the field of long distance communication, interest in the United States is now centred on the tests being conducted between the Marconi Stations at San Francisco, Calif., and Honolulu, Hawaiian Islands, and the Japanese Government station at Funabashi. The tests so far have been successful and the establishment of a commercial service between the United States and Japan by the Hawaiian station is expected shortly.

The American Marconi Company is now offering to license manufacturers and others selling radio apparatus for experimental purposes, under its tuning patent, on a royalty basis. Contracts have been closed by the Marconi Company with the Clapp-Eastham Company, a well-known amateur apparatus concern of Boston, Mass., the William J. Murdock Company of Chelsea, Mass., and also with the Sears-Roebuck Company, of Chicago, Ill. The last mentioned concern is the largest mail order house in the world. The Sears-Roebuck Company have established a wireless department, issuing a catalogue of amateur radio apparatus now licensed under Marconi patents.

As indicating the interest shown by electrical journals in the development and operation of radio apparatus, I might quote from *The Electrical World* issue of August 12th, 1916, where it devotes editorial space to a unique case, the circumstances of which are as follows:

The operator in charge of a wireless station installed on a vessel left his cabin for a few minutes, during which time an unscrupulous person entered the radio cabin and purloined the crystal detector from the tuner, as well as the spare crystal detectors which were lying in a box on the operating table. The ingenuity of this particular operator was not all that could be desired, and as a result the vessel was unable to receive wireless signals for a period of two and a half days. Says *The Electrical World:*

" EMERGENCY RADIO SERVICE ON SHIPBOARD.

" A few weeks ago the Department of Commerce which controls the federal " inspection of wireless telegraph stations, issued a circular letter calling attention to " the need of providing spare parts for use in case of breakdown. An instance was " cited in which a coastwise vessel was forced to go two and a half days without " radio service because of the lack of a detector crystal for replacement. The letter " from the Department of Commerce points out further that the operator was unable " to improvise a detector from the materials at hand.

" A condition in which the operation of a wireless telegraph outfit must be " entirely suspended on account of the lack of a spare bit of carborundum is not " healthy. That it can exist reflects no credit upon either the operator himself, the " company which trained and employed him, or the naval examiners who granted his " licence certificate. This is quite over and above that part of the responsibility of " the operator to construct a temporary detector of at least enough sensitiveness and " reliability to keep the ship radio in operation.

" It is a notable fact that the operating personnel of our merchant ships, or at " least a large part of it, is constantly changing. New operators are being licensed " daily; they are trained to understand the workings of modern radio apparatus, "but have as a rule practically no knowledge of the older instruments which have "been displaced. Their training, furthermore, is usually of the kind directed "toward obvious and mechanical results of various manipulations, rather than toward "the true functional performance of the several instruments in their charge. All "this is unfortunate, for it leads to just such failures in emergency as that outlined by "the Department of Commerce.

"Had the operator, who was forced to sit idly by his dead receiver because the "crystal had been stolen, known a little of what expedients were made use of in the "early years of wireless telegraphy there would have been no failure to protect his "ship by radio service. Two needles and a pencil, a knife-blade and a broken "incandescent lamp, a piece of dry-cell carbon and an iron wire—any of these could "be used as a microphonic detector which would take the place of the crystal and "receive signals from fifty to one hundred miles. Surely these simple materials were "available to the stranded operator, and certainly the receiving range to be obtained "by their use, even though limited, was worth striving for. The student of the "literature of wireless telegraphy would never be at a loss for a simple but useful "detector; the man who recognises not only effects but also the reasons for them is "needed as much in the practice of radio-telegraphy as in other fields of applied "science. Wireless operators on ships should have better training; their instruction "should be carried on beyond the point which permits them barely to secure a "Government licence to hold a position."

The Electrical World, in its editorial comment, apparently overlooks the fact that spare crystals were provided in this case, but that the intruder was entirely without a conscience. DAVID SARNOFF.

This is the Life

BY OUR IRRESPONSIBLE EXPERT.

A YOUTH who has a P.M.G. most usually proceeds to sea, and thereupon at first thinks he, the life is simply grand. But when a day or two has passed, and England's shores are fading fast, he looks across the ocean vast and wishes for the Strand. It isn't that he feels unwell—oh, no, he's sound as any bell—but something that he's eaten: well, it wasn't quite the thing. So from the cabin watch him go, he says to change his tie, you know, and while the stormy winds do blow, he tries in vain to sing. Until the dreaded Bay is crossed he thinks his little life is lost, as while the ship is tempest tossed he doesn't care to eat. But in a day or two the sea has settled down quite normally, and now as brave as brave can be he welcomes tropic heat. The dimly-veiled Canary Isles, across the water many miles, appear like nature wreathed in smiles as to the rail he hies. And all the girls on deck delight to see him strutting morn and night in uniform a dazzling white—a sight for weary eyes. His seediness has passed away, he welcomes now each coming day—this is the life! he says, hooray! This is the job for me! No nasty working in a store, no racing for the seven four, no! Nothing nasty any more. I'm absolutely free!

An American Transmitter and Receiver

THE photographs on this and the next page show a wireless receiver and transmitter recently produced in the United States and placed on the market for the benefit of wealthy amateurs who prefer to buy their installations ready made and in compact form. The detectors shown in Fig. 1 are of the three-electrode vacuum-valve type, and one or other of them can be switched into circuit at will. The receiver is inductively coupled, and contains in the aerial circuit a variable inductance, condenser, and a coupling coil. In the secondary circuit we find an inductance shunted by a variable condenser, the detector being connected to this oscillating circuit in the usual way. The handle controlling the variable primary condenser, which is of the semi-circular plate type, will be seen at the top left-hand side of the case, the secondary condenser occupying a similar position on the right-hand side. Beneath the primary condenser will be seen a three-finger switch by which the condenser can be placed either in series or in shunt with the aerial tuning inductance. This last is varied by the double switch immediately below the left-hand detector, one set of studs being connected to unit turns and the other to larger sections of the coil. In this way any number of turns can be brought into circuit at will. The two small two-way switches on the left of the inductance are arranged to cut out sections not required, so as to avoid what is known as the "dead-end" effect. Beneath these switches will be seen the aerial and earth terminals. The voltmeter between the two detectors can be used to test the voltage across the filament, between the filament and the grid, or between the filament and the plate, by means of the two-finger switch beneath the secondary condenser, whilst the resistance in series with the filament itself is controlled by the switch beneath the voltmeter. The coupling is varied by sliding backwards or forwards the handle seen protruding from the slot on the right hand of the instrument, the handle itself forming a switch which can be used for varying the secondary inductance. Four terminals are seen at the bottom right-hand corner of the case, the telephones being connected to the outer of these two and the battery to the inner two. A safety gap for protecting the apparatus from high voltage is provided in the centre of the front panel immediately beneath the central switch. The only switches remaining to be mentioned are, that on the extreme right beneath the secondary condenser, for adjustment of the filaments, and that on the extreme left beneath the primary condenser, called the "telephone regulator."

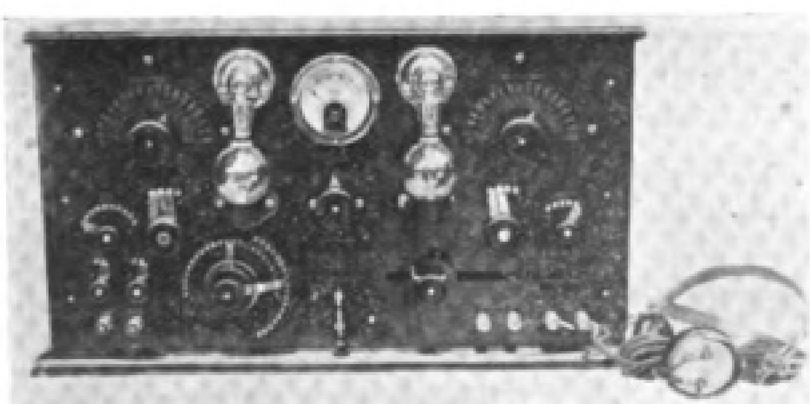

Photo by] [*Frank C. Perkins.*

FIG. 1.

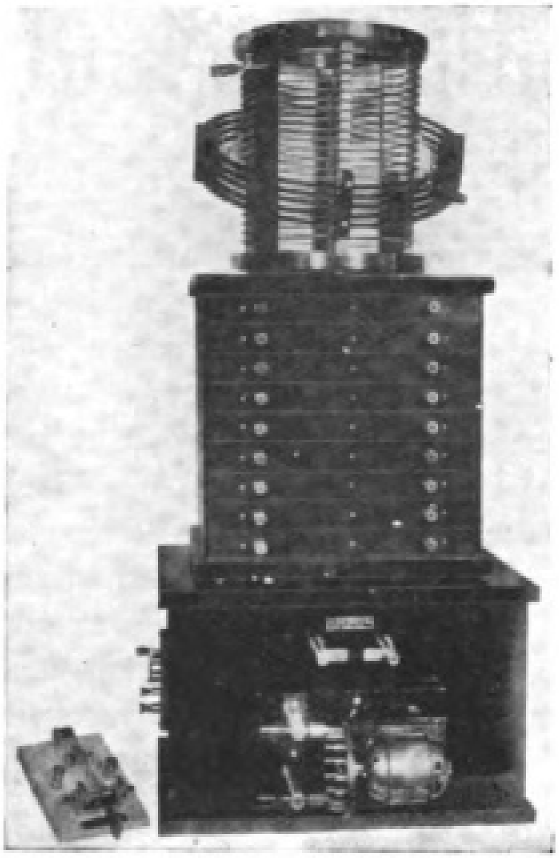

Photo by] [*Frank C. Perkins.*

FIG. 2.

The transmitting apparatus calls for little remark (see Fig. 2). The transformer is contained in the lower case, and various windings can be brought into circuit by means of the switch seen on the left. The condenser, in sections, will be seen in the top case, on which stands the oscillation transformer. This consists of a primary of five turns of flat copper strip, the amount of inductance included in the circuit being controlled by the clip shown. The secondary contains a much larger number of turns, also of copper strip, any amount of which can be included in the aerial circuit by varying the upper clip. The primary is pivoted in such a way that coupling can be loosened by rotating it through an arc of a circle. The discharger, which is of the rotary type driven by a small electric motor, needs no explanation, the photograph showing its details admirably. Finally, we would call attention to the transmitting key shown on the left of the photograph and mounted on a marble base. A novel point about this key is that it is operated *sideways*, and not up and down as is usual.

Radio-Telegraphy and American Preparedness

UNDER the above heading an American contemporary, remarks :

" The importance of radio communication in war is so great that any attempts " to support the proposition by argument would be supererogatory. Moreover, the " nation which shall have brought the development of radio-telegraphy to the " highest pitch before the outbreak of war will, other things being equal, possess a " great advantage over its enemies, in so far as relates to long-distance communica- " tion with and between its fleets at sea.

" Obviously, therefore, the best methods of being prepared against hostilities " in the field of radio communication is to have plans prepared for the prompt " occupation and utilisation of all coast radio stations at the first outbreak. There " should, on the declaration of martial law, be complete and speedy mobilisation " of all radio activities by the military and naval forces. But, on the other hand, " there should be the minimum of interference by the government with commercial " radio communication during times of peace. Radio communication is still a very " young art. It hardly goes back to the beginning of this century. Much capital " has been honestly invested in it. There is an enormous field for the development " of the range, precision, cheapening, and improvement of radio signalling. The "best way to encourage that development is to give fair play, and free play, to all "inventors, business men and industrial forces, whereby, for gain and commercial "advantage, it may be possible to enlist the interest and industry of the greatest "number of workers in this field. On the other hand, the surest way to discourage "the art, science and engineering of radio communication is to convert the whole "field, during peace times, into a monopoly of some department of the government, "civil or military. To place all radio signalling in the hands of, say, the navy "department, during times of peace, would be to hamper all progress and hinder "all development, thus tending to keep America in the background of radio communi- "cation, for any purpose peaceful or warlike. This is, of course, no reflection on "naval officers or the navy, who in their own field are the pick of the nation and "worthy of all our support. It goes without saying, however, that such officers "are necessarily too busy with their immediate routine duties to spend much time "and money in invention and development in radio engineering. Any monopoly "of a great business inevitably leads to lack of competition, to lack of stimulus "and to stagnation. Progress comes from holding open the avenues of success to "individual talents, industry, and enterprise. Let us hope that the progress and "wealth of the nation, in so important and all-pervading a field as radio communica- "tion, in time of peace may be fostered by keeping it out of the deadening clutch "of government monopoly."

Wireless at Chatham Islands

ANENT our remarks on the Chatham Islands in a previous issue an article appears in our New Zealand contemporary, *The Katipo*, from which we extract the following, which we think may interest our readers:—"Owing to the fact that "steamer service to Chatham Islands is somewhat erratic, residents find it necessary "to keep a close watch on the 'larder,' but, in spite of such precautions, something "is usually omitted from the mail order, and consequently the wireless service is "utilised as the only resort: it being better to spend a few shillings on 'radio' to "ensure that goods will arrive by next steamer than to wait many weeks.

"Though the station has been open for traffic only since September, 1913, "there has never been an occasion on which communication has not been effected "with Radio—Wellington. On many occasions the station has done good work, the "most recent case happening on March 23rd last, when the operator on duty at "Chathams was the first to distinguish the calls of the *Aurora* (Shackleton Expedi- "tion), which was calling New Zealand stations with urgent traffic. There was a "great deal of interference due to statics and 'jamming' at the time and the call "was apparently not distinguished at the New Zealand stations immediately. "Radios, Wellington and Awarua, being informed by Chathams that the *Aurora* "was calling, the Awarua station immediately engaged that vessel and succeeded "in working her successfully, though her signals at the time were very weak and the "interference considerable."

Foreign and Colonial Notes

CANADA.

WE see from *The Electrical World* that Mr. Philip E. Edelman, of St. Paul, Minn., has been engaged by the Canadian Government as electrical engineer to plan a system of radio-communication to protect and secure communication in the vast Dominion parks in Western Canada. A chain of wireless stations of new design will be installed to prevent forest fires and poaching, and for general park work in the Canadian Rockies, covering a territory 7,000 square miles in extent. Mr. Edelman is an engineering graduate of the University of Minnesota, and has installed a number of large radio plants. He is also the author of *Experimental Wireless Stations, Experiments,* and *Inventions and Patents.*

* * * * * *

NEW ZEALAND.

According to the Annual Report of the Post and Telegraph Department for the year 1915, wireless communication on long waves between Awanui and Apia, Samoa, a distance of 1,550 nautical miles, established shortly after the capture of the Samoan group by the New Zealand Expeditionary Force, on behalf of the Imperial Government, on the outbreak of war, continues to be satisfactorily maintained.

* * * * * *

The wireless station at Awarua recently served a useful purpose that is unusual in these waters. The chronometers of the *Aurora* had not been checked since that vessel's departure for the southern seas. The vessel was returning damaged, and required correct time to check the chronometers. Arrangements were made by which, at the three consecutive hours of 11 a.m., noon, and 1 p.m., the Observatory clock at Wellington was connected direct to a land-line circuit to the Awarua wireless station. The length of this circuit was approximately 650 miles. The ship was on the look-out for a wireless signal, which was despatched by preconcerted arrangement practically simultaneously with its receipt over the land circuit. The result was found to be highly satisfactory.

* * * * * *

UNITED STATES.

The adoption of wireless telegraphy by societies and other corporate bodies is becoming more and more marked as time goes on. An agitation is afoot by members of the Iowa National Guard to obtain a wireless installation. They are ready to organise a wireless corps aerial division if the Government will permit it. So far their efforts have been fruitless, but in course of time, no doubt, their wish will be gratified and a wireless station established similar to that at Omaha.

* * * * * *

As briefly reported in our last issue, the National Amateur Wireless Association is in camp at Birchwood Lake, Monticello, N.Y. Through the kindness of the American Marconi Company a complete 2 kw. Marconi set has been lent to the Association for use in camp.

* * * * * *

What is said to be the only wireless plant in existence operated to keep a moving picture company in communication with the mainland is that of the Santa Cruz Islands in the Pacific Ocean, where a company is filming a new play. Arrangements were made for a daily wireless service during the stay of the company on the Islands. No other means of communication exist except a launch which makes the 40-mile trip to the mainland once a week.

* * * * * *

At the request of the Weather Bureau, arrangements have been made by the United States Bureau of Lighthouses for taking weather observations on the light vessels at Nantucket Shoals, Mass.; Diamond Shoals, N.C.; Frying-Pan Shoals, N.C., and Heald Bank, Texas. These light vessels are all equipped with wireless apparatus by means of which observations may be transmitted to any point desired.

* * * * * *

The wireless station at Fort Riley, Kansas, has been closed until further notice. This, we understand, is on account of the small force stationed at that point. The station will be reopened for operation when the troops are returned for permanent occupation.

* * * * * *

What is hoped will become an annual custom was inaugurated recently in New York. The American Marconi Company placed a wreath on the monument erected in Battery Park in that city to the wireless operators who have given up their lives to the call of duty. The monument itself was dedicated on May 12th, 1915, with impressive ceremonies, of which a full description was given in our July, 1915, number.

* * * * * *

The United States Naval Observatory states that the difference in the time signal between the Isthmus of Panama and the Arlington station is about ·02 second, and a lag of 0·27 second between the Isthmus and Key West, the latter being due to the various relays used in the commercial telegraph lines over which the signal passes from the Naval Observatory. The error in the time signal sent from the radio station is usually less than 0·1 second.

* * * * * *

The Marconi Wireless Telegraph Company of America will allow half pay until January 1st, 1917, to those of its employés who are members of the militia and are called upon by the Government for service, and will keep their positions open during that time. After January 1st the matter will receive further attention.

Employés of over one year's service temporarily transferred to Government service will continue to be protected under the Marconi Company's life insurance plan, and such absence from the company will not interrupt the continuity of the employés' service and seniority benefits.

The company will waive the usual fee charged students in its wireless school and will instruct them without cost until January 1st, 1917.

* * * * * *

Some months ago we mentioned that a new wireless station was to be erected at Port Isabel, Texas. We understand now that this installation is almost ready to be placed in commission. As far as is known at present, it will handle commercial traffic.

Instructional Article

NEW SERIES (No. 14).

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

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93. One slightly different type of simultaneous equation is that in which one equation is of the first degree and the other of a higher degree. For example,

$$3x+y=5 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (i)$$
$$x^2-4xy+7=0 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (ii)$$

In this case it will be found impossible to juggle with the two equations so that either x or y will cancel out altogether; and we therefore adopt a substitution method.

We know that $3x+y=5$, and from this we find that $y=(5-3x)$. Now substitute this value of y in the second equation—

$$x^2-4xy+7=0$$
$$\text{becomes } x^2-4x(5-3x)+7=0$$
$$\text{or } x^2-20x+12x^2+7=0$$
$$13x^2-20x+7=0.$$

Therefore, applying the formula

$$x=\frac{-b\pm\sqrt{b^2 4ac}}{2a},$$

we get

$$x=\frac{-(-20)\pm\sqrt{(-20)^2-4(13)(7)}}{2\times 13}=\frac{20\pm\sqrt{400-364}}{26}$$
$$=\frac{20\pm\sqrt{36}}{26}=\frac{20\pm 6}{26}=\frac{26}{26} \text{ or } \frac{14}{26}=1 \text{ or } \frac{7}{13}.$$

Putting $x=1$ in the equation $3x+y=5$, we get $3+y=5$ or $y=2$.

and putting $x=\frac{7}{13}$ we get $\left(3\times\frac{7}{13}\right)+y=5$ or $y=5-\frac{21}{13}=5-1\frac{8}{13}=3\frac{5}{13}$.

Thus we get the solution—

$$x=\begin{cases}1\\ \text{or}\\ \frac{7}{13}\end{cases} \qquad y=\begin{cases}2\\ \text{or}\\ 3\frac{5}{13}\end{cases}. \quad \textit{Ans.}$$

Examples for Practice.

Solve the following simultaneous equations—

13. $\begin{cases}6x-2y=2\\ x^2 3-xy+y^2=1.\end{cases}$ 14. $\begin{cases}2y-17=3x\\ 2x^2+xy=6.\end{cases}$ 15. $\begin{cases}4x+1=-6y\\ x^2+xy=28.\end{cases}$

94. We have now dealt with the following cases of the solution of equations:

(1) One equation and one unknown;
(2) Two equations and two unknowns;
(3) Three equations and three unknowns.

We will now deal with

(4) Two equations and three unknowns.

The best we can do in this case is to find the *ratios* of the three unknowns.

We can do this if we have two equations of the following general form:

$$a_1x+b_1y+c_1z=0 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$
$$a_2x+b_2y+c_2z=0 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Here x, y and z are, as usual, the unknowns, and a, b and c are constants.

First of all divide by z all along both equations.

Then $$a_1\left(\frac{x}{z}\right)+b_1\left(\frac{y}{z}\right)+c_1=0 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

and $$a_2\left(\frac{x}{z}\right)+b_2\left(\frac{y}{z}\right)+c_2=0 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

We must now consider $\left(\frac{x}{z}\right)$ and $\left(\frac{y}{z}\right)$ as two new unknowns, and set to work to evaluate them.

As in our previous work, we juggle with one of the equations so as to enable us to cancel out one of the unknowns when adding or subtracting the two equations.

Let us alter equation (4) so that we can cancel out $\left(\frac{x}{z}\right)$. To do this we must multiply all along by $\left(\frac{a_1}{a_2}\right)$.

$$\left(\frac{a_1}{a_2}\right)\times a_2\left(\frac{x}{z}\right)+\left(\frac{a_1}{a_2}\right)\times b_2\left(\frac{y}{z}\right)+\left(\frac{a_1}{a_2}\right)\times c_2=\left(\frac{a_1}{a_2}\right)\times 0$$

$$a_1\left(\frac{x}{z}\right)+\left(\frac{a_1b_2}{a_2}\right)\left(\frac{y}{z}\right)+\left(\frac{c_2a_1}{a_2}\right)=0$$

But $$a_1\left(\frac{x}{z}\right)+b_1\left(\frac{y}{z}\right)+c_1=0. \quad \text{[Equation (3)]}.$$

Subtracting, $a_1\left(\frac{x}{z}\right)$ will cancel out, and we have left

$$\left\{\left(\frac{a_1b_2}{a_2}\right)\left(\frac{y}{z}\right)-b_1\left(\frac{y}{z}\right)\right\}+\left\{\left(\frac{c_2a_1}{a_2}\right)-c_1\right\}=0$$

or $$\left(\frac{a_1b_2}{a_2}-b_1\right)\left(\frac{y}{z}\right)+\left(\frac{c_2a_1}{a_2}-c_1\right)=0$$

Therefore $$\left(\frac{a_1b_2-a_2b_1}{a_2}\right)\left(\frac{y}{z}\right)=-\left(\frac{c_2a_1-c_1a_2}{a_2}\right)=\left(\frac{c_1a_2-c_2a_1}{a_2}\right)$$

and $$\left(\frac{y}{z}\right)=\left(\frac{c_1a_2-c_2a_1}{a_2}\right)\left(\frac{a_2}{a_1b_2-a_2b_1}\right)=\frac{c_1a_2-c_2a_1}{a_1b_2-a_2b_1}.$$

Similarly, by making $\left(\frac{y}{z}\right)$ cancel out, we get $\left(\frac{x}{z}\right)=\frac{b_1c_2-b_2c_1}{a_1b_2-a_2b_1}$.

Notice here that the denominators are the same in both cases.

Now suppose, for the sake of a simple example, that we had found $\frac{x}{z}=\frac{1}{4}$ and $\frac{y}{z}=\frac{3}{4}$, then we should say immediately that x, y and z were proportional to 1, 3 and 4 respectively. This could be written in various ways—

$$x : y : z :: 1 : 3 : 4$$
$$x : y : z = 1 : 3 : 4$$
or
$$\frac{x}{1}=\frac{y}{3}=\frac{z}{4}.$$

In our case, however, instead of 1 we have $(b_1c_2-b_2c_1)$
" 3 " $(c_1a_2-c_2a_1)$
and " 4 " $(a_1b_2-a_2b_1)$

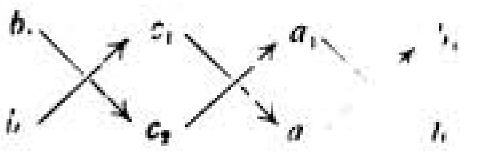
Therefore we can write—

$$\frac{x}{(b_1c_2-b_2c_1)}=\frac{y}{(c_1a_2-c_2a_1)}=\frac{z}{(a_1b_2-a_2b_1)}.$$

95 *Cross Multiplication.*

A convenient short cut to the solution of this type of problem is as follows.

Write down in order the two sets of coefficients of x, y and z, *starting with the coefficients of y.* Then draw arrows across diagonally between the coefficients, making them point towards the right, as shown. Next multiply across where the arrows occur, putting the products in pairs as the arrows are in pairs. Make the "downward" product positive and the "upward" product negative; thus—



$$(b_1c_2-b_2c_1)\ ;\ (c_1a_2-c_2a_1)\ ;\ (a_1b_2-a_2b_1).$$

The three quantities thus obtained are proportional to x, y and z in this order.

Thus $$\frac{x}{(b_1c_2-b_2c_1)}=\frac{y}{(c_1a_2-c_2a_1)}=\frac{z}{(a_1b_2-a_2b_1)}$$ as before.

Example.

Find the ratios of x, y and z from the equations—

$$2x-3y+5z=0$$
$$5x+y-3z=0$$

Set out the coefficients and arrows—

Then $$\frac{x}{(-3)\times(-3)-(1\times5)}=\frac{y}{(5\times5)-(-3)\times2}=\frac{z}{(2\times1)-5\times(-3)}$$

$$\frac{x}{9-5}=\frac{y}{25+6}=\frac{z}{2+15}$$

or $$\frac{x}{4}=\frac{y}{31}=\frac{z}{17}.$$ $x : y : z = 4 : 31 : 17.$ *Ans.*

Examples for Practice.

Find the relative values of x, y and z from the following equations—

(16) $3x+2y-z=0.$ $2x-y+5z=0.$

(17) $x-3y=0.$ $2x+5y-z=0.$

(18) $x=2y+z.$ $3y=5z-4x.$

Trigonometry.

96. It is often very convenient to be able to calculate an unknown trigonometrical ratio from a known ratio of the same angle, and when simplifying formulæ it is sometimes very helpful to express one ratio in terms of another; for example, calculate the cosine of an angle from the known value of its sine. Let the angle A of the triangle ABC (Fig. 83) be the angle θ with which we are dealing. Angle B is a right angle. We are supposed to know the value of $\sin\theta$, or $\frac{CB}{CA}$, and we want to find the value of $\cos\theta$, or $\frac{AB}{AC}$.

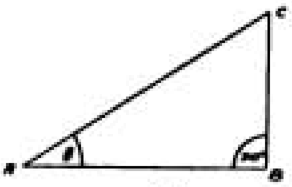


FIG. 83.

Obviously $(\cos\theta)^2$ or $\cos^2\theta=\frac{AB^2}{AC^2}$.

But as the triangle is right-angled it follows that $AB^2=AC^2-CB^2$.

Therefore
$$\cos^2\theta=\frac{AB^2}{AC^2}$$
$$=\frac{AC^2-CB^2}{AC^2}$$
$$=\frac{AC^2}{AC^2}-\frac{CB^2}{AC^2}=1-\left(\frac{CB}{AC}\right)^2$$

But $\frac{CB}{AC}=\sin\theta$, and so $\left(\frac{CB}{AC}\right)^2=\sin^2\theta$.

Therefore $\cos^2\theta=1-\sin^2\theta$.
or $\cos\theta=\sqrt{1-\sin^2\theta}$.

Another way of putting this is: $\sin^2\theta+\cos^2\theta=1$.

We can now quite easily calculate $\cos\theta$ if we know the value of $\sin\theta$. For example, if $\sin\theta=\frac{1}{2}$, then

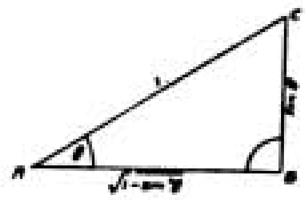


FIG. 84.

$$\cos\theta=\sqrt{1-\sin^2\theta}=\sqrt{1-(\tfrac{1}{2})^2}$$
$$=\sqrt{1-\tfrac{1}{4}}=\sqrt{\tfrac{3}{4}}=\frac{\sqrt{3}}{2}.$$

97. A quicker, though somewhat artificial way of dealing with this matter is the following:

In the triangle ABC (Fig. 84) we *know* that the ratio $\frac{\text{side } CB}{\text{side } AC}$ is equal to $\sin\theta$. Therefore let us *call* the side CB—"$\sin\theta$," and call the side AC—"1." Then we have $\frac{CB}{AC}=\frac{\text{"}\sin\theta\text{"}}{\text{"}1\text{"}}=\sin\theta$, which is correct.

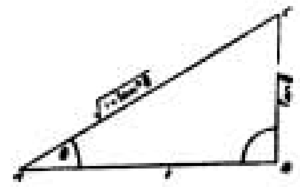


FIG. 85.

Now $AB^2 = AC^2 - CB^2$
And so $AB = \sqrt{AC^2 - CB^2}$
$= \sqrt{(1)^2 - (\sin\theta)^2} = \sqrt{1 - \sin^2\theta}.$

Thus $\cos\theta = \frac{AB}{AC}$
$= \frac{\sqrt{1 - \sin^2\theta}}{1} = \sqrt{1 - \sin^2\theta}$ as before.

Similarly $\tan\theta = \frac{CB}{AB} = \frac{\sin\theta}{\sqrt{1 - \sin^2\theta}}$, or, as $\sqrt{1 - \sin^2\theta} = \cos\theta$, then $\tan\theta = \frac{\sin\theta}{\cos\theta}$.

In the same way as $\tan\theta = \frac{CB}{AB}$, we can call CB—"$\tan\theta$," and call AB—1. (Fig. 85). Then $AC^2 = AB^2 + BC^2$, and $AC = \sqrt{AB^2 + BC^2}$
$= \sqrt{1 + \tan^2\theta}.$

Then $\sin\theta = \frac{CB}{AC} = \frac{\tan\theta}{\sqrt{1 + \tan^2\theta}}$

$\cos\theta = \frac{AB}{AC} = \frac{1}{\sqrt{1 + \tan^2\theta}}$, and so on.

One important relation is obtained by expressing $\sec\theta$ in terms of $\tan\theta$.

We have $\sec\theta = \frac{1}{\cos\theta} = \frac{1}{\frac{AB}{AC}} = \frac{AC}{AB} = \frac{\sqrt{1 + \tan^2\theta}}{1}$.

Squaring we get $\sec^2\theta = 1 + \tan^2\theta$,
or $\tan^2\theta = \sec^2\theta - 1$.

We can thus express any ratio of an angle in terms of any other ratio of that angle.

Example.

Express $\operatorname{cosec}\theta$ and $\cot\theta$ in terms of $\cos\theta$.
In this case we put $AB = \cos\theta$.
and $AC = 1$ (Fig. 86), so that $\frac{AB}{AC} = \frac{\cos\theta}{1} = \cos\theta$.

Then $CB^2 = AC^2 - AB^2$
or $CB = \sqrt{AC^2 - AB^2} = \sqrt{1 - \cos^2\theta}$.

Thus $\operatorname{cosec}\theta = \frac{1}{\sin\theta} = \frac{1}{\frac{CB}{AC}} = \frac{AC}{CB} = \frac{1}{\sqrt{1 - \cos^2\theta}}$

and $\cot\theta = \frac{1}{\tan\theta} = \frac{1}{\frac{CB}{AB}} = \frac{AB}{CB} = \frac{\cos\theta}{\sqrt{1 - \cos^2\theta}}$ or $\frac{\cos\theta}{\sin\theta}$.

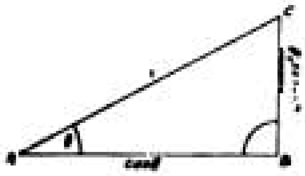


FIG. 86.

In this particular case our previous knowledge would have enabled us to arrive at these results much quicker. For $\operatorname{cosec}\theta = \frac{1}{\sin\theta} = \frac{1}{\sqrt{1 - \cos^2\theta}}$

and $\cot\theta = \frac{1}{\tan\theta} = \frac{1}{\left(\frac{\sin\theta}{\cos\theta}\right)} = \frac{\cos\theta}{\sin\theta} = \frac{\cos\theta}{\sqrt{1 - \cos^2\theta}}$.

Examples for practice.

19. (*a*) Express $\sin\theta$ in terms of $\cot\theta$
(*b*) ,, $\tan\theta$,, $\cos\theta$
(*c*) ,, $\sec\theta$,, $\sin\theta$
(*d*) ,, $\cot\theta$,, $\operatorname{cosec}\theta$.

20. If (*a*) $\sin\theta = 0{\cdot}6$; find $\cos\theta$.
(*b*) $\tan\theta = 4$; ,, $\sec\theta$
(*c*) $\operatorname{cosec}\theta = 10$; ,, $\cot\theta$
(*d*) $\tan\theta = 0{\cdot}01$; ,, $\cos\theta$ and $\sin\theta$
(*e*) $\cos\theta = -1$; ,, $\tan\theta$.

Solutions to Examples in Article (13).

1. $\frac{2}{x+2}+\frac{1}{x+1}$.
2. $\frac{2}{x+7}+\frac{3}{x-2}$.
3. $\frac{2}{x+2}+\frac{3}{x-2}$.
4. $\frac{5}{9(x-5)}+\frac{4}{9(x+4)}$.
5. $\frac{2x+3}{x^2-7}+\frac{1}{x+1}$.
6. $\frac{3}{(x+2)^2}+\frac{2}{x+2}+\frac{5}{x-1}$.
7. $x=5, y=2$.
8. $x=-3, y=2$.
9. $a=2, b=-7$.
10. $p=3\tfrac{1}{2}, q=2\tfrac{1}{4}$
11. $x=2, y=9$.
12. $x=11, y=2$

Wireless in the Courts

An interesting case recently came before the Magistrate's Court at Gisborne, which town is on the east coast of the north island of New Zealand, when a 16-year-old boy was charged with erecting a wireless plant without the consent of the Government. The boy's father also was charged that "between January and June, 1916, he did aid his son in committing the above offence." Evidence was called showing that the plant, if properly fitted up, could send messages a short distance and could receive from Auckland and Wellington. Counsel for the defence said the offence was admitted as far as a technical breach was concerned, and the defendants regretted the matter and gave the assurance that the apparatus was quite incapable of receiving or transmitting any message. The boy said he never sent or received any message. With the necessary crystals it might have been possible to receive from a short distance but not without them, and crystals were quite unprocurable.

The Magistrate, after hearing the evidence for the defence, said the junior defendant would be fined £2 and 7s. costs, and the father would be fined £10 and 7s. costs.

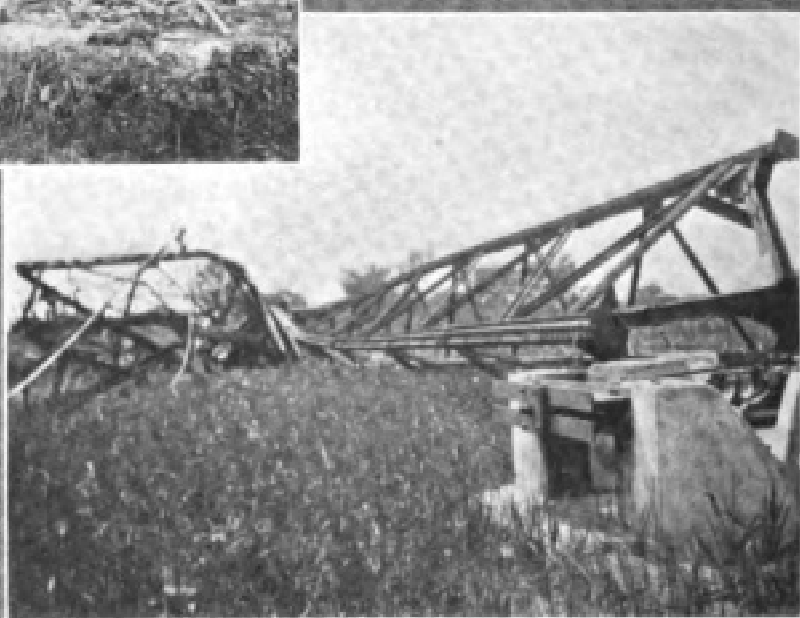
Additional Premises

We are requested to state that Messrs. Self & Son, the well-known Marconi outfit suppliers, have opened additional premises at Railway Approach, facing Fenchurch Street Station, London, E.C.

The Wireless Station at Kamina, Togoland

WHEN, in 1914, the Allied Forces imposed upon themselves the task of defeating their German enemy in Africa, not everyone thought it would take so long. With their peculiar tenacity of purpose, which the Allies have learnt by bitter experience, the common foe is still holding out in one portion of the "Dark Continent." Togoland, however, was lost to them quite early in the campaign. On August 24th, 1914, under pressure from the advancing Allied Forces, the Germans blew up the giant wireless station at Kamina, to prevent its falling into the hands of the British. Like most German wireless stations, it was built by the Telefunken Company, of Berlin. It possessed that well-known feature by which Telefunken stations are identified—the tall triangular steel mast. Our two illustrations will give a very fair idea of the destruction wrought to the station by its former owners. The top picture shows the remains of the Power House after the explosion, whilst the lower one depicts the tangled and twisted remnants of one of the steel masts lying prone upon the ground. This ignominious position of the German mast would seem to be prophetic of that which awaits the Prussian junkers in Berlin.

REMAINS OF POWER HOUSE, KAMINA.



Photos by] [*Underwood.*

WRECKED WIRELESS MAST, KAMINA STATION.

Togoland is the smallest of the four erstwhile German African colonies, and its coastline forms part of the northern boundary of the Gulf of Guinea on the west coast of Africa. It has been under German protection since 1884, and so prosperous has it become that for the last ten years or so no contribution has been required from the Imperial Government. It is hoped that the country into whose care Togoland is committed, at the settlement, will succeed in developing its resources as successfully as the Germans have done hitherto.

A Bridal Garland

We reproduce here a picture which we think will considerably interest our readers. It represents a garland of evergreens strung up on the wireless aerials of a battleship on the occasion of the wedding of one of the ship's officers. This custom has been in vogue in the "King's Navee" from time immemorial and affords one of the best evidences of comradeship—the most cherished heritage of the British Navy.

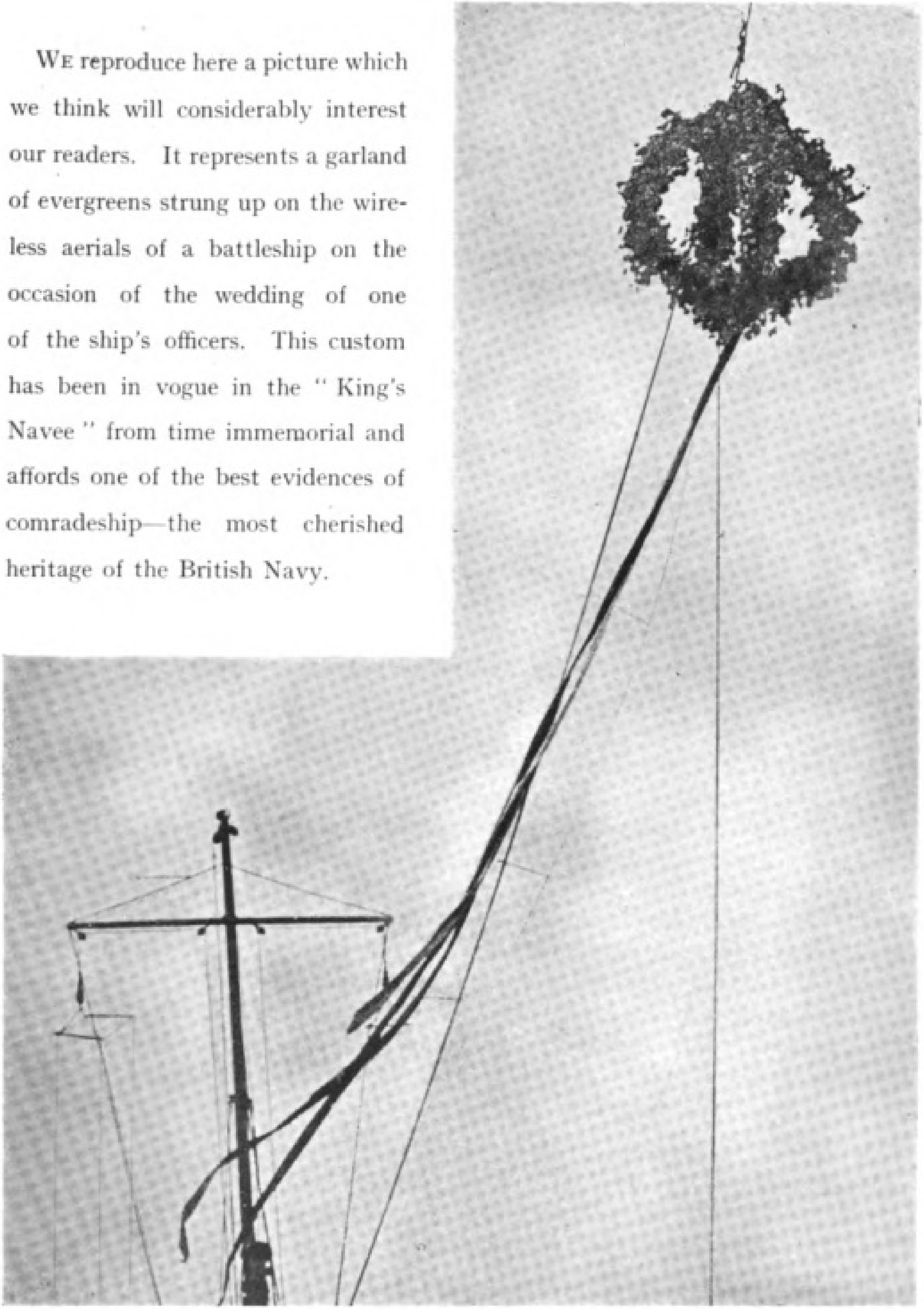


Photo by] [*Newspaper Illustrations.*

The Library Table

"Fleets of the World, 1916." Illustrated. London: Eveleigh Nash & Co., Ltd. 6s. net.

Nothing could be more indicative of final victory for the Allies than a perusal of this book. A comparison of the navies of the allied nations with those of the Central Powers shows without a shadow of a doubt on whose side the ultimate gain will rest. Apart from the lists of vessels belonging to the navies of the world, there is included a short glossary of naval terms, comparative tables of the guns and projectiles used by the great fleets, and a list of the ships lost in the great war from August 5th, 1914, to May 1st, 1916. The book was in print at the time of the great Jutland battle, but nevertheless the publishers have been able to insert a slip showing the comparative British and German losses. The book does credit to the publishers.

* * * * * *

"Tales of the Flying Service." By C. G. Grey. London: George Newnes, Ltd. 1s. net.

This little book, which has already reached a second impression of the first edition, records some adventures and humours of aerial warfare. Mr. Grey is just the man who should have written such a book. He is the Editor of our contemporary *The Aeroplane*, and in that capacity he probably has access to more definite and reliable information than would be the case with outsiders. Moreover, we have the satisfaction of feeling that every side of the subject receives fair treatment. Wireless telegraphy and aviation are so inextricably bound together that it is difficult to read of the one without thinking of the other. The book is worthy of more than a paper cover.

* * * * * *

"Map of the West Indies." Obtainable at the West India Committee, 15 Seething Lane, London, E.C. Price, 10s. 6d. mounted and varnished on rollers, 7s. 6d. in sheet form. Carriage and packing extra in both cases.

Since the opening of the Panama Canal the importance of the islands in the Caribbean Sea has enormously increased. A part of the ocean which in past years was a *cul-de-sac* has now become one of the main avenues of modern maritime trade. The significance of this is ably demonstrated by the fact that the majority of the islands and countries on the adjacent mainland have hastened to equip themselves with wireless stations of varying power. On the map under review these wireless stations are indicated, whilst the principal railways, sea distances in nautical miles, and coaling and oil stations are also shown. It is a clear and useful map, and does credit to the producers.

* * * * * *

"ELECTRICAL APPARATUS MAKING FOR BEGINNERS." By Albert V. Ballhatchet. London: Percival Marshall & Co. 2s. net.

Those amateur wireless enthusiasts who are in the habit of constructing their own apparatus are well aware of how much interest and sound instruction is obtained from the making of the various instruments. In the handbook before us the author describes how a large number of different pieces of electrical apparatus, such as the various types of primary cells, galvanometers, electro magnets, solenoids, electric bells, telegraph instruments and the like can be made. The instructions given are in every case thoroughly practicable, for all the pieces of apparatus described have, without exception, been constructed by the author in the manner explained. A number of excellent photographs afford a valuable aid to the reader and make clear those parts of the apparatus which cannot well be explained in the text. Students of wireless who cannot at present occupy themselves with their favourite hobby will be well advised to obtain this little book and attempt the construction of some of the apparatus described therein. We would particularly draw their attention to the measuring instruments, the understanding of which will greatly help them in their wireless work when the present restrictions are removed.

* * * * * *

"ALL THE WORLD'S AIRCRAFT, 1916." London: Sampson Low, Marston & Co., Ltd. 21s. net.

This is the seventh year of issue of this famous annual, and the publishers are to be congratulated on being able to place it upon the market at so difficult a time as the present. The book is divided into three sections: (1) Aeroplanes and Airships of the World, (2) Historical Ships of the Last Fourteen Years, and (3) the World's Aero Engines. The outstanding section is probably that dealing with the historical growth of aeroplanes and aviation generally. The book is profusely illustrated, and in addition a list of aviators who have received certificates granted by the Royal Aero Club of the United Kingdom is given, together with the date granted, the make of machine used, and the place where the airman qualified. Wireless telegraphy now forms so important a part of the equipment of the modern "flying machine" (either lighter or heavier than air) that we feel that our readers would do well to possess themselves of so exhaustive an epitome.

* * * * * * *

"AN INTERMEDIATE TEXT-BOOK OF MAGNETISM AND ELECTRICITY." By G. F. Woodhouse, M.A. Sedbergh: Jackson & Son. 6s. net.

This book, which claims to be intermediate between the many elementary and advanced text-books on the subject, possesses no particularly novel features, and has probably been based upon the experience gained by the author while acting as Senior Science Master at Sedburgh School. It is divided into three parts: Magnetism, Electricity and Electrostatics, and on the whole the subjects dealt with are clearly explained. In the portions devoted to wireless telegraphy, however, there are one or two points to which we would like to draw attention.

On page 169, in speaking of the work of Hertz, the author says "he used a coil "and spark gap as oscillator." This is not correct, as the coil formed no part of the oscillator, but merely afforded a source of high-pressure electricity. It cannot be too clearly impressed on students that the induction coil is not traversed by the oscillatory currents which flow across the spark gap. On the following page the diagram of the magnetic detector shows a number of totally unnecessary twists in the aerial and earth wires and in the telephone connections. These do not make the diagram any clearer, and are apt to lead the young student to think that no electrical connections can be made without first twisting the wire round a lead pencil to give it a curly appearance. On page 171 the following paragraph appears:

"Later improvements consisted in including a transformer or jigger, the "inductance of which is variable and allows tuning. In some systems the two "coils of the jigger (one in aerial circuit, the other in transmitting or receiving "circuit) are separate, as in a coil. In other systems the auto-transformer principle "is used. Variable condensers are also used, giving further opportunities for "tuning."

From this paragraph one would gather that the object of the transformer was merely to provide variable inductance in the aerial circuit; certainly there is nothing to indicate that it effected an improvement in allowing the energy to be passed from a closed oscillating circuit into an open radiating circuit. Altogether, from a learner's view-point, the paragraph is decidedly obscure.

In Appendix II, which claims to give practical details for the construction of a small wireless outfit, we find a description of a crystal detector which in practice would be found far from satisfactory; while the diagram of the receiving circuit on page 225 is not one which calls for high praise. In this the receiving transformer or tuning coil is shown to have no less than four sliders, the lower two of which are totally unnecessary. The variable condenser C, which from a remark on the previous page one would think was necessary for tuning, is placed in an apenodic circuit where no resonance effect is possible. With regard to the telephone receivers, it is said "in using crystal detectors, high-resistance telephones should be used, "about 4,000 ohms will be suitable." We agree that telephones of such a high resistance would work excellently; but few amateurs can afford to buy 4,000-ohm telephones. Splendid results can be obtained with a 2,000-ohm pair, which are quite good enough for use with the crude apparatus described. These, of course, can be obtained at a much lower price.

In the diagram of transmitting apparatus shown on page 223 there are two sliders shown on the auto-jigger, one of which is unnecessary.

From the above remarks the reader will see that wireless matters in this book are not so clearly dealt with as one would expect.

Personal Notes

THE *Irish Times* recently contained the following paragraph :—

"The Earl of Meath, His Majesty's Lieutenant for the County of the City of "Dublin, has appointed Mr. John Mooney, C.V.O., J.P., of Eastwell, Palmerston "Park, Rathmines, in the County of Dublin, a Deputy Lieutenant for the County "of the City of Dublin."

Mr. Mooney was one of the early Directors of Marconi's Wireless Telegraph Company, and no doubt many of his old friends and acquaintances will be glad to learn of the promotion afforded to him by the Earl of Meath. We congratulate Mr. Mooney on being thus honoured.

* * * * * *

A month or two ago we reported that Mr. J. Jerritt, the Wireless Press representative in Plymouth, had been appointed lecturer and examiner to the Boy Scouts Association of that district. Mr. Jerritt now informs us that he has received the further appointment of examiner to the Mount Edgcumbe Training Ship.

* * * * * *

We have received news of the marriage of Mr. W. L. Cormack, who is stationed at a wireless station near Aberdeen, to Miss C. M. Bone, only daughter of Councillor R. H. Bone, J.P., of Scotsburn, Kildary, Ross-shire. Mr. Cormack will no doubt be remembered by many of our readers on the operating staff, having joined the Company's service at the beginning of 1910. Mr. Cormack has thus seen nearly seven years' service, six of which were put in on foreign service in Peru and India. On coming to England in January last Mr. Cormack entered the R.N.V.R., when he was posted to his present station. We offer Mr. and Mrs. Cormack our congratulations on the happy event.

* * * * * *

We have had a letter from Mr. A. E. Brown, who before the war was a wireless operator in Marconi's Wireless Telegraph Company, Limited, and who is now doing duty as a wireless operator in France. Mr. Brown has had a busy time, having been engaged on all classes of work, from heavy permanent lines to buried cable work.

* * * * * *

We have received a notice from Mr. J. R. Stapleton, the wireless operator at Welikada, near Colombo, Ceylon, Radio Station, of his marriage on July 29th last to Miss Myrtle Natal Borland, which took place at St. Peter's Church, Fort, Colombo. A wireless apparatus was erected on one side of the verandah, and Corpl. Dinwiddie had charge of it. It worked quite satisfactorily, and throughout the afternoon wireless messages were exchanged with the wireless station at Welikada. Mr.

Stapleton has been a good friend and constant reader of our journal since its inception, and we are sure all our readers join with us in wishing Mr. and Mrs. Stapleton a long and happy life. A photograph of Mr. Stapleton and his staff appeared in our May, 1915, number.

* * * * * *

We regret to announce that the death took place recently in the naval hospital at Deal of Mr. George William Henderson. Death was due to pneumonia following a brief illness. The deceased, who was but twenty years old, was a first-class wireless operator attached to the Royal Naval Air Service at Dover. Shortly after war broke out he took up the study of wireless telegraphy and qualified at a naval college in Glasgow. He joined the R.N.A.S. in November, 1915, and after three months' training at Wormwood Scrubbs was posted to Dover. We offer our sincere condolences to his bereaved parents.

* * * * * *

We are sorry to record the death of Second Air Mechanic Albert Spencer, of Crawshawbooth, Lancashire. Mr. Spencer, who attained his twenty-fourth birthday whilst on active service in France, was a wireless operator when he received the wounds which proved fatal. He enlisted on September 21st, 1915, and left for France on March 18th last. Our sympathies go out to his young wife in her great bereavement.

* * * * * *

We regret to announce that Lance-Corporal W. A. Waterman, of the Essex Regiment, has been killed in action. He was a very smart man, and acted as advice clerk at the Chelmsford Works of the Marconi Company. He joined Kitchener's Army in December, 1914. He only married in the early part of last year.

* * * * * *

As we go to press we learn with deep regret that Private R. W. R. Fletcher, of D Co. Machine Gun Section, 17th Middlesex (Footballers), has died in France from wounds received in action. It seems that he was wounded by an explosion of a shell as his gun team was going through a trench in the advance of July 28th, and died two days later. Private Fletcher was a member of the Wireless Press staff—the third to lose his life in the war. Great sympathy is felt for his parents in their sad loss. We hope to give further particulars next month.

* * * * * *

Lieutenant Balcombe, late of the Traffic Department of Marconi's Wireless Telegraph Co., Ltd., continues to be very active on active service. He has now been appointed Lieutenant and Adjutant to his regiment—a very responsible position. For the benefit of readers who have not followed Lieutenant Balcombe's career, we would mention that this promising officer rejoined the Army as sapper at the outbreak of war, and has won his promotion step by step to the important position he now holds.

* * * * * *

We have to announce that Capt. W. H. G. Bullard, U.S.N., who has been Superintendent of the Naval Radio Service of the United States, has relinquished that position, and has been placed in command of the U.S.S. *Arkansas*. Commander D. W. Todd, U.S.N., has been appointed to succeed Capt. Bullard as Superintendent.

We hope in a future issue to give a photograph and some biographical particulars of the latter gentleman.

* * * * * *

A general parade was ordered at the Wormwood Scrubbs Depot recently, when Captain Owen, R.M.L.I., Executive Officer, presented the Distinguished Service Medal to Petty Officer L. T. N. Sanderson, of the Wireless Telegraph Department. "Sandy," as he is affectionately known among his comrades, did the work of wireless operator at Anzac, and earned the decoration for operating there under practically continuous heavy shell fire during a period of five months. His coolness and courage attracted official notice, of which the ceremony was a fitting sequel. The Commanding Officer, in presenting the medal to P.O. Sanderson, said he was proud to make the presentation, and Petty Officer Sanderson's devotion to duty was a credit to the Service and also to the Section to which he was attached. We, in our turn, offer him our sincere congratulations.

* * * * * *

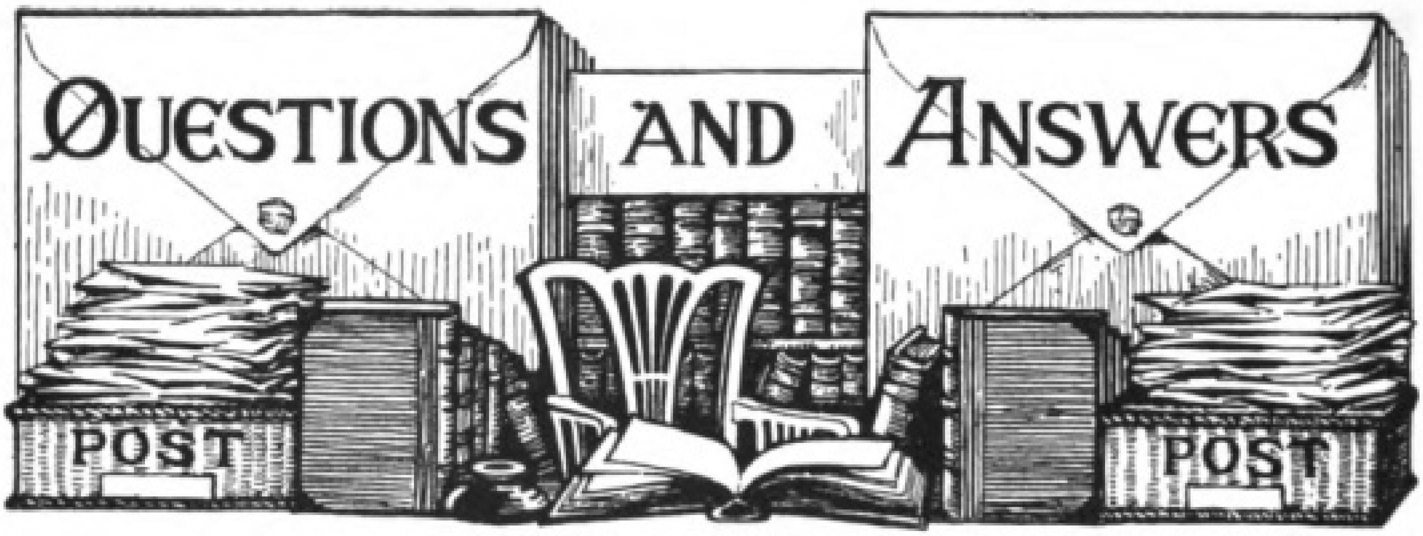
One of the saddest of the many sad incidents of this terrible war is the following: A lad named Cole, of Horsham, joined the Navy some time before the outbreak of war, and for four years served on board H.M.S. *Queen Mary*. When this ship was lost in the Jutland battle his relatives regarded him as lost. Judge of their joy, however, when a few days after the action a letter arrived from their son stating that he had been ashore for examination when the battle was fought. Unfortunately the parents' happiness was short-lived, for a notification was received from the Admiralty of the death of their son. Since writing to his father and mother he had been appointed to H.M.S. *Hampshire*, and with Lord Kitchener and nearly all the crew was lost off the Orkney Islands. By this accident a promising career was cut short, as young Cole had just satisfactorily passed his final examination in connection with wireless telegraphy.

* * * * * *

An unsurpassed deed of heroism has met with its due reward. No. A 24155, Private J. G. Hood, of the 3rd (formerly 5th) battalion (attached wireless section Canadian Corps H.Q. Sig. Corps), has been awarded the Distinguished Conduct Medal for conspicuous gallantry and devotion to duty. When his signalling station was wrecked he went with another man and assisted in serving the guns of a defence section of artillery which had had several casualties. Later he returned to his signalling station and destroyed the wireless instruments and codes in face of the advancing enemy, but unfortunately he was wounded by shrapnel. We offer him our sincere congratulations on the high honour bestowed on him.

* * * * * *

We are pleased to mention that Private H. F. Gill, of the wireless section, 4th Corps, has been awarded the Military Medal for good work at Vimy Ridge. Towards the end of May last all the land-lines gave way under the heavy bombardment by the Germans, and wireless became the only means of keeping communication open. Private Gill, who was in charge of the forward station, had his mast blown down twenty times through the night. The following day the Brigadier sent for him and expressed his pleasure at the way in which they had "carried on." Since then he has been presented on parade with the Military Medal Ribbon.



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.

POSITIVELY NO QUESTIONS ANSWERED BY POST.

NOTE.—*In view of the large number of questions which now reach us from readers, we regret that we cannot undertake always to answer queries in the next issue following the receipt of letters. Every endeavour will be made to publish answers expeditiously.*

R. T. (Portsmouth).—The question you ask is quite outside of our province, but we would suggest that you apply to the shipping company in which your cousin is a captain, mentioning that you would like to obtain a position on the purser's staff, and asking whether they have any vacancies. There is usually a large waiting list for such positions.

"SPARKS" is informed that we cannot answer any queries unless the full name and address of the writer is forwarded as well as the *nom-de-plume*. If he will write to us again, giving the necessary particulars, we will be pleased to answer his queries.

J. E. H. (Bury).—After a student has gained his Postmaster-General's certificate, he should apply to the traffic manager, Marconi International Marine Communication Co., Ltd., Marconi House, Strand, London, W.C., stating his qualifications and asking whether there is any vacancy which can be offered to him. If the application is accepted, he is placed in the Marconi school for a period depending upon the extent of his knowledge, for a finishing training.

M. H. I. (Barnet).—(1) The di-electric constant of ebonite varies. Dr. Fleming, in his Pocket Book (page 339), quotes Rosetti as authority for the figure 2·05; Boltzmann for 3·15, Schiller for 2·21, and Elsas for 2·86. For general purposes it can be taken as about 2·5. (2) The resistance of Nr. 26 S.W.G. Eureka wire is 264·5 ohms per 100 yards, and of Nr. 28 S.W.G. 391·4 ohms per 100 yards. Thank you for your appreciation of our paper.

W. S. (Lennoxtown).—(1) An excellent book on elementary mathematics is that by Frank Castle entitled *Practical Mathematics for Technical Students*. This you can obtain from our publishers for 3s. 10d., post free. (2) It does not follow that if you join the Royal Flying Corps as a wireless operator that you would be taught aviation. Only a certain number of men are trained as pilots. (3) See the article which appears in this number on the training of radio-telegraphists for the Army and Navy. (4) This is a matter you should decide personally. (5) Applicants are not accepted for the marine operating staff of the Marconi Company above the age of 25.

M. B. (Alford).—There is an article in this issue which will give you all the information you require.

A. G. J. (Brisbane).—Many thanks for your letter, for the cutting enclosed, and your appreciation of our magazine. In reply to your query, arsenical compounds have been used in conjunction with crystals for wireless detectors, and with silicon especially, have given good results. We have not personally tried the combination of bismuth with silicon or pyrites, and are interested to hear that you obtained good results with it.

C. G. (Macao).—(1) The set which you mention cannot have been tuned at the time of installation, and if you get a 610 metre wave with the variable high-frequency sliding inductance at its lower value, the capacity of the condenser must be too large. This will have to be reduced. (2) The reason for the sparking between the protective points of the disc discharger, when you change over to a

300 metre wave, is that the phase adjustment of your discharger is wrongly set for this wave. Try rocking the frame, holding the fixed electrodes. A slight movement in one direction or the other will put you right. (3) It is difficult to give the reason for the sparking at the micrometer gap of your receiver without inspecting the installation, but we should think that you are getting an inductive effect from the earth lead. Look to see whether any of the wires leading to the receiver run parallel with this lead, or with any part of the aerial circuit. An alteration of the position of the receiver and wiring may improve matters, but in any case, so long as you keep the micrometer gap very small, no harm should result.

E. R. (H.M.S. ——).—The automatic transmitter at Clifden can be set for any speed required within wide limits.

W. O. (Treorchy).—We are glad to hear that you are so interested in the science of wireless telegraphy. We are afraid the defect you mention would debar you from service with the Marconi Company's operating staff, and as this company controls the wireless apparatus on the great majority of British ships, including pleasure steamers, cross-channel steamers, and private yachts, you would stand little chance of obtaining employment as a wireless operator. Very few steamship companies employ their own wireless operators; they are mostly obtained from the Marconi Company. Thank you for your good wishes for our magazine.

G. T. B. (H.M.S. ——).—Have you the new edition of "Hawkhead's Handbook" revised by H. M. Dowsett? In this you will find the ½-kw. set and the balanced crystal receiver dealt with very clearly. There is no other book which contains so much information about the apparatus mentioned. It is dealt with much more fully in the second than in the first edition.

O. R. (Wolsingham) writes: "The peripheral speed of the rotary discharger on a 5-kw. apparatus is, I believe, very high, therefore the time taken for one of the studs to pass a fixed one—*i.e.*, the duration of the spark—must be very short, allowing only a few violent and highly damped oscillations to take place. The energy will be quickly transferred to the secondary circuit, but since the primary is no longer continuous, the spark surfaces having been widely separated, none will be retransferred to it by the secondary, hence most of the energy will be radiated into space. This being so, I fail to see the advantage of a *loose* coupling; on the contrary, it seems to me that a tight, or even direct, coupling would mean a decided gain in efficiency."

Answer.—Whilst it is true that the peripheral speed of this disc discharger is very high, it is not sufficiently high to open the circuit after one or two oscillations, when short waves are used. With the very long waves an especially high-speed disc is used by the Marconi Company for their Transatlantic working, and in their high-power stations for long-distance communication this "cut-out" effect is found, and as a consequence a tighter coupling can be used. We are sorry we have not any figures available at the moment to show the percentage of power radiated in the various sets you mention; a great deal depends upon the aerial and the earth, and whether the set is adjusted to give the best results. In reply to your third question we do not think the defect in your left eye is sufficiently serious to debar you from joining the Marconi Company as an operator. This would have to be decided upon your examination by the Company's doctor if you were accepted.

A. C. (Deauville).—(1) Inductively coupled receivers are used practically always in commercial wireless apparatus. With crystal detectors and comparatively short waves, such as are used for ship and shore communication, it is impossible to obtain enough inductance in the aerial circuit to make direct coupling satisfactory. This also applies to the valve and electrolytic detectors. The magnetic detector can be placed in series with the aerial and still give good results, as it is a current-actuated detector, but in this position sharp tuning is impossible. Where the magnetic detector is fitted, arrangements are made for placing it in series with the aerial when the operator is listening for general calls, and in an inductively coupled circuit when he desires to tune his receiver. (2) By far the most sensitive detector is the three-electrode vacuum valve, a modification of the well-known Fleming valve. (3) A coherer receiver properly made and suitably adjusted should enable signals to be recorded at the distance you mention from a powerful station, as the signals would be very strong. A much more reliable method, however, would be to use an S.G. Brown relay with a crystal receiver, or better still, two of such relays in series if a very powerful current was required. We regret that during the period of hostilities we cannot describe in detail how such circuits should be arranged. (4) The arrangement shown in your diagram would not be at all satisfactory. The purpose of the detector D. 1 is simply to rectify the current. The detector D. 2 in the second circuit, having no oscillatory current to rectify, would merely act as a needless resistance and reduce the strength of signals.

"Di-electric."—We have searched our books of reference carefully, and cannot find any reference to tests of the di-electric value of the material you mention. If we are able to obtain any figures, we will make mention of them in this column.

J. C. (s'Gravenhage) asks for the correct formula to find the mutual inductance between two coils by measuring the inductance when they are connected in series, and then one reversed. The formula given in *The Wireless Year Book*, page 727, *i.e.*, $\frac{M=L_1-L_2}{2}$ is wrongly printed. When the two coils (say *A* and *B*) are joined in series with the currents flowing in the same direction, the total inductance of the circuit is L_A+L_B+2M. If the connections of one be reversed, the inductance is L_A+L_B-2M, so that the difference between these values is $4M$, according to the formula quoted by you from "Hawkhead's Handbook." When the coils are joined in series with the currents in the same direction, there will be a certain magnetic flux linked with *A*, due to its own current, which will be proportional to L_A, the self-inductance of the coil. There will be a certain flux due to the current in *A*, which is linked with *B*, which will be proportional to the mutual inductance between *A* and *B*. Similarly, for the current in *B* there will be a flux linked with *A*, equal to that linked with *B* due to *A*, so that the total flux in the combined circuit must be proportional to L_A+L_B+2M. On reversing *B*, the fluxes in the two coils due to their own currents are linked in the same direction relative to them as before, but the fluxes due to the current in the other coils will be linked in the opposite sense, or the total flux must be proportional to L_A+L_B-2M.

A. W. (Telegraph Department, Paddington) has worked out the value of the aerial tuning inductance of the plain tuner, and obtains a value of 580 microhenrys instead of 680 as engraved on the switch. The fact that you get the same result using three formulas shows that your working is correct. You have, however, taken a wrong value for the diameter of the former. It is not 6 centimetres, but 5·6 cm. (nearly) over the wire. Using this figure, the inductance of one coil becomes 920 microhenrys, or the two in parallel will give 460 microhenrys, neglecting the effect of mutual inductance between them, which would increase the total self-inductance. An actual measurement gives about 480 microhenrys, and hence the mutual inductance is almost negligible. The engraved value is therefore incorrect. Probably the winding on some occasion has been altered without the engraving being altered at the same time. The later instruments of the plain tuner type are now fitted with an aerial tuning inductance similar to that used in the multiple tuner, the value of which is approximately 4,000 microhenrys. (2) You are correct in assuming that in the example in Dr. Fleming's Pocket Book, on page 97, the second term in the brackets should be $\frac{4}{9{\cdot}425}\times\frac{1}{20}$, and not $\times\frac{1}{400}$ as printed.

C. G. W. (Balham) has made certain calculations with respect to an aerial which he had before the war, and asks to have them checked. Your calculation of wave-length and capacity of the aerial are approximately correct, although it would be instructive to obtain the latter value from the formulæ given in Professor Howes' articles in the December 1914, January 1915, and February 1915 numbers of THE WIRELESS WORLD. The inductance of an aerial is, however, given by the formula

$$\lambda_m = 1200\sqrt{L_0 C_0} \text{ and not}$$

$\lambda_m = 1885\sqrt{L_0 C_0}$, as is explained in the article, "The Calculation of Wave-length of Aerials," in the March 1916 number. The inductance will therefore be 23·5 microhenrys instead of 15 microhenrys. With regard to the inductance of the tuning coil required to tune the aerial to 2,500 metres, since the ratio of wave-length of aerial by itself to the required wave-length = 130/2,500, or nearly 1 to 20, the ordinary formula may be used as explained in the article referred to. The result, 5,490 microhenrys, is therefore correct. The tuning coil has been designed to have a much larger inductance than this, the value given by you being approximately correct, but a better method of calculation is given in the Instructional Article, No. X., on the Receiving Circuit. We make the inductance 24,260 microhenrys. Owing to the long wave which you were attempting to receive, it would have been wise to design a coil which was nearer the required value of inductance, using thicker wire in order to reduce the resistance as much as possible.