VOL. IV. Registered at the G.P.O. for transmission to Canada by Canadian Magazine Post NO. 41

# THE WIRELESS WORLD



PRICE 6D NET

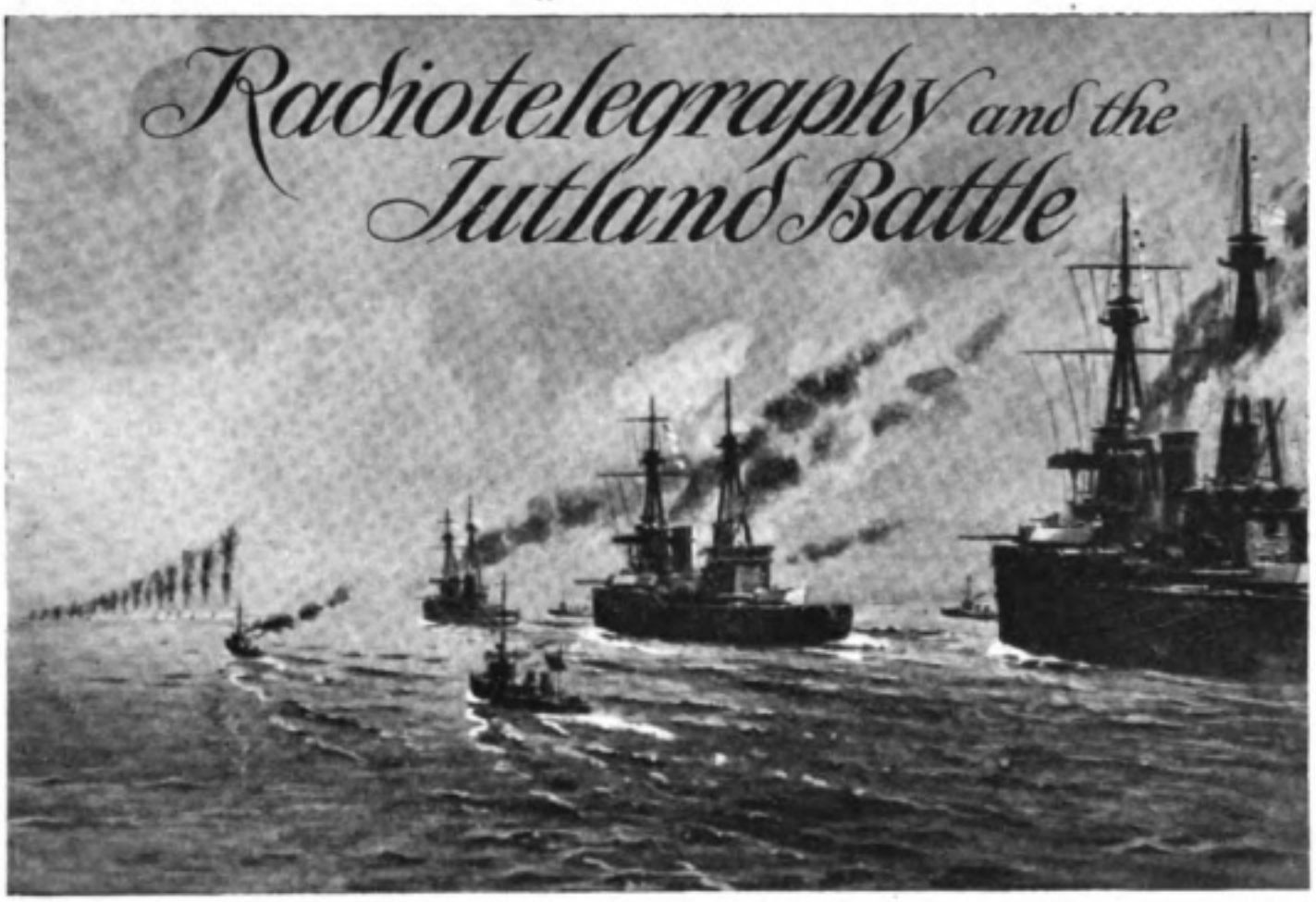
AUGUST 1916

The Jutland Battle

Design of Audio-Frequency Circuit

Wireless in Australasia

**This Magazine can be sent free to our troops abroad by leaving it at a Post Office**



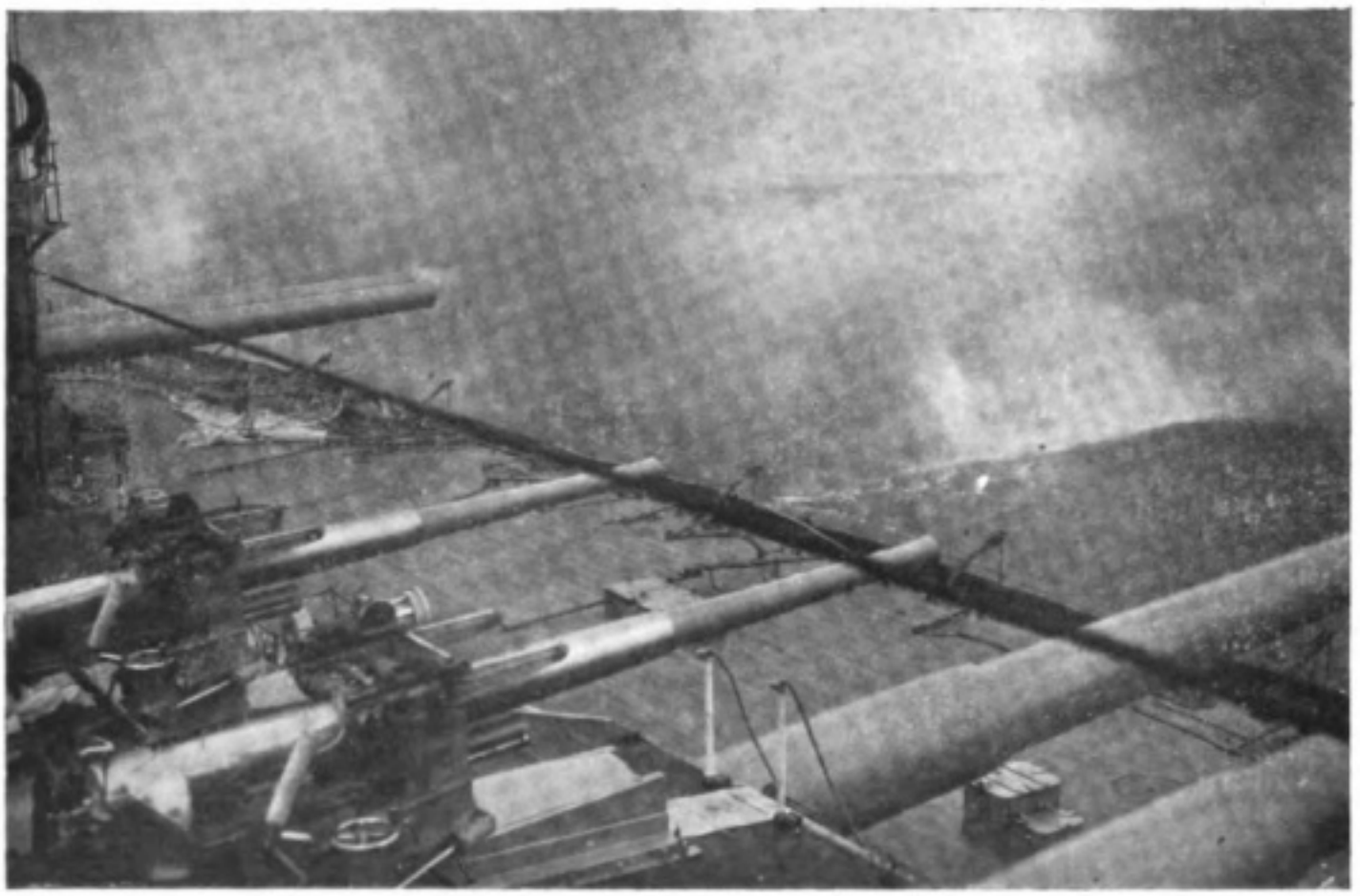

DURING what we may term the "Period of Apology," when everyone was trying to account for the ineptitude of British official news-issue, some of the daily Press represented Sir John Jellicoe as reluctant to use wireless. As we have often pointed out, Sir John Jellicoe is probably one of the greatest users of wireless in the world, and towards the close of his despatch, recently published verbatim, he passes the following high encomium on the working of radiotelegraphy and those engaged in its operation. The British Admiral's words are worth reproducing textually :—

"The high state of efficiency of the wireless telegraphic arrangements of the "Fleet, and the facility with which they were worked before, during and after the "action, is a great testimony to the indefatigable work carried out by Comm. Richard "L. Nicholson. His services have been invaluable throughout the war. A special "word of praise is due to the Wireless Departments in all the ships."

Comment is needless ; our great sailor has sufficiently answered the criticism above referred to.

When Sir David Beatty was cruising on the afternoon of May 31st, 1916, the news of the enemy's approach was first intimated to him from the *Galatea*. In consequence the Admiral ordered Lieut.-Comm. C. G. Robinson, who was in charge of the *Engadine* (the seaplane parent-ship), to send up one of his machines for scouting purposes. Important results were obtained by the observations so made, which, owing to clouds, had to be carried out at an elevation of but 900 feet. The German light cruiser screen was discovered ; the British line of battle was formed, the course altered, and the action started at 3.48 p.m., beginning at a range of 18,500 yards. Now the first reports from the *Galatea* were probably, and those

from the seaplane were undoubtedly, conveyed by wireless. Moreover, an independent account, furnished by one of the signallers who took part, sent to his mother and published in the Press, speaks of their "wireless reports on the sighting of "the enemy on May the 31st." Indeed, the visibility difficulties which were noted at the start of Sir David Beatty's despatch, and which lasted practically all through the engagement, lead us to the conclusion that visual means of signalling were less utilised than usual, so that more absolute reliance had to be reposed in wireless telegraphy, which alone is independent of all such weather conditions. About two hours after the engagement started, the *Southampton* reported the enemy's battle fleet ahead, and was despatched southward, with the rest of the squadron to which she belonged, in order to make observations, carry out scouting duties, and report results. The reports from the *Southampton* are characterised by the Vice-



Admiral as "most valuable"; again the general course of the Fleet was altered, and the Fifth Battle Squadron was advised of the enemy's position. Here we have outlined, in plain official language, a graphic kinema picture. Our mental vision discerns the approach of the British light cruiser squadron to the German leviathans of war, the hail of shot with which they were greeted by the enemy, and the skilful handling of the vessels. This swift manœuvring achieved a double object: (*a*) it enabled our gallant British sea scouts to escape practically unscathed from the German fire, and (*b*) it afforded our men ample opportunity for making the observations they were sent out to perform. And all this was going on to the accompaniment of bursting shells and guns booming; whilst, as the vessels glided swiftly to and fro, wireless messages were being radiated from the aerials of the British vessels for the information and guidance of their chief.


TELEGRAPHIST
CLIFFORD HIRST.

By 5.35 p.m. the battle between Beatty's gallant squadron and the main force of the enemy was in full progress, and the gallant commander communicated the state of affairs to Admiral Jellicoe, still completely out of sight. To quote Sir David's own words: "I made a report to you that the "enemy battle cruisers were bearing south-east." Here again the bad visibility was once more insisted upon. "At this time only three of the enemy "battle cruisers were visible"; and an hour later "the visibility at this time was very indifferent, "not more than four miles, and the enemy's ships "were temporarily lost sight of." The value of wireless telegraphy under such circumstances can hardly be too strongly insisted upon. Just after 7 p.m. the still invisible Jellicoe transmitted a signal to Sir David Beatty informing him that the British main fleet was steering south, and subsequent signals relative to Sir John's position continued to reach the aerials of Sir David's flagship up to 8.46 p.m.

The concluding paragraph of the Vice-Admiral's report contains a series of testimonials to some of the gallant officers of his own vessel, and makes special mention of his Flag-Lieutenant, "Comm. R. F. "Seymour, who maintained efficient communication "under the most difficult circumstances, despite the "fact that his signalling appliances were continually "shot away." It requires no very highly imaginative faculty to draw a mental picture of such conditions, the hail of shot and shell coming so thick and fast as to sever the wireless aerials, the coolness under most trying circumstances of the officers in charge, and the gallant bearing of the men to whom was assigned the task of repairing the apparatus in the midst of such heavy fire.

FIRST-CLASS TELEGRAPHIST
W. H. SMITH.

Sir John Jellicoe's own despatch shows that about a quarter-past six in the evening the British Battle Fleet was meeting and falling in line with their Dreadnought cruisers and the Fifth Battle Squadron. This was an operation requiring the greatest delicacy, and, in the Commander's own words, "great care was necessary to "ensure that our own ships were not mistaken for "enemy vessels." These complicated evolutions were carried out with complete success, and in the course thereof the Wireless Rooms must have been kept busy indeed.

TELEGRAPHIST
KENNETH A. J. MOORE.

All sorts of theories have been put forward to account for what some people were pleased to look upon as delay on the part of the British Admiral in

TELEGRAPHIST
H. B. TOWNSHEND.

transmitting details of the engagement. But it must be remembered that in the course of the pursuit of the beaten foe, whose return to port appears to have partaken of the character of *sauve qui peut*, a number of British units got separated from the main body, and their Wireless reports as to their whereabouts and course of action could not be considered final, until they had been obliged to relinquish all hopes of further contact with the enemy. A significant passage in the course of the despatch states that: "It is not known when the *Black Prince* was sunk, but a Wireless Signal was "received from her between 8 and 9 p.m." It would obviously have been impossible for Sir John Jellicoe to draw a final conclusion, and report the total loss of this vessel without waiting for a proper interval between the receipt of her last Wireless message and the hour at which, judging from that message, she should have reported herself after the engagement was over.

We have no record of the employment of any airship by the British, but Sir David Beatty makes mention of German Zeppelins, whilst Sir John Jellicoe states that "at 4 a.m. (on the following morning) the Fleet engaged a Zeppelin for about "five minutes, during which time she had ample opportunity to note and subse-"quently report the position and course of the British Fleet." It is highly probable that it was largely due to the watchfulness of the enemy, which this means afforded him, and to the Wireless messages they transmitted to the German Admiral, that the British sailors were robbed of the chance of reaping the full fruits of their victory. If this were so, the German Wireless men must have indeed earned the meed of praise which in his own flamboyant style the Kaiser bestowed upon them on his visit to his battered "remnants" at Kiel. Incidentally, we may observe that the presence of this enemy Zeppelin hovering over the British Fleet, and wirelessing its position, shows that the German lying vaunts about their "naval victory" and "occupation of the scene of action" were of the *frigid and calculating* order. They were plainly "sinning against the light."

Various independent reports have been written by Wireless men who took part in the action, and extracts from some of them have been published in the Daily Press. These go to confirm the points made in our commentary on the official despatches, and need not be specially mentioned, except to remark that they all breathe a spirit of cheerful confidence and devotion to duty, besides emphasising, in a manner impossible for official despatches, the magnitude of the German losses, which circumstances have not up to the present afforded a chance of proving by irrefutable evidence, but which will doubtless be so established later on.

It is the fashion nowadays to denominate lists of those who have laid down their lives in the cause of Patriotism and Humanity as a "Roll of Honour,"

TELEGRAPHIST
SYDNEY MULLINS.

FIRST-CLASS TELEGRAPHIST
ERNEST GEORGE NEWILL.

This is no unhappy thought, and, as far as the men themselves are concerned, we need none of us desire a better epitaph. We will not quote the too well-known lines of Lord Macaulay; but it is impossible not to recognise the truth of his idea that we must all pay the debt of nature some time or other, and no one can find a better occasion whereon to pay it than on the stricken field when men fight for their Motherland and those who are dear to them. But the point of view of those left behind differs materially from theirs, and, when we come to make up a list such as those of the Wireless Operators who "died that England might live," our heart goes out to the relatives in their distress. The latter can best seek their consolation in the thought that their sorrow, deep and fitting though it be, only affects their own feelings and their own individuality; those whom they love are beyond the reach of sorrow.

One of the first points to arrest our attention is the extreme youthfulness of these operators. Mr. Ernest Kemp, Warrant Officer of Wireless Telegraphy, appears to have been the eldest radiotelegraphist who lost his life on that occasion. He was in his 37th year, and leaves a widow and a two-year-old son at Portsmouth to mourn his loss. He was a London boy and received his education at schools in Dulwich; whilst his period of service in the Navy extended to twenty years. He died on H.M.S. *Invincible*, and two young colleagues on the same vessel perished with him. These were Walter Leslie Monk and Clifford Hirst. Mr. Monk was the son of an old Navy man, and—we regret to say—the only son. He was brought up by his parents at Chippenham, and educated at St. Paul's School in that town. He was but eighteen years of age, and his home was at King's Langley, in Hertfordshire. The other Telegraphist who perished on the same ship, Mr. Clifford Hirst, was a Yorkshire boy, son of Mr. J. Hirst, of Liversedge. He was educated at the secondary school in the High Street of the neighbouring town of Heckmondwike. He joined the Navy only just before the war, at the age of seventeen, and recently passed brilliantly an examination in Wireless Telegraphy. At the end of April he was home for ten days' leave, and only returned to his sea duties a month before the battle. Mr. W. H. Smith, First-Class Telegraphist on the same vessel, was severely wounded, but escaped with his life. When the war started he was in the employment of a Northampton firm, joined the Navy a year ago, specialised in Wireless Telegraphy, and qualified as a first-class operator. He had taken part in the Suvla Bay landing operations at Gallipoli, and in the final evacuation. He was at that time carried on the books of H.M.S. *Glory*. His brother is a Petty Officer on one of the destroyers attached to the High Fleet.

TELEGRAPHIST
BERNARD G. INESON.

The *Tipperary* was one of the magnificent British destroyers which did such glorious work and paid the price of victory. The parents of Mr. Harold Wilsher were consequently notified that their son was on board

LEADING TELEGRAPHIST
ARTHUR ELWIS.

and must be regarded as having lost his life. In their case, however, subsequent information corrected the earlier evil tidings. We understand that a letter has been received from the young man stating that he was picked up without a scratch, though his vessel was in flames when he left her, and he is now a prisoner in Germany. Although but nineteen this wireless telegraphist has been in the Navy nearly five years, and before joining the *Tipperary* twelve months ago (apparently when she was first commissioned) had served on the *Achilles*. He is a Londoner, educated at Oaklands Road, Hanwell, and his parents are now living in that district. He also has two brothers in the Navy. His senior officer, Mr. Edwin Dymott, Warrant Officer of Wireless Telegraphy on the same vessel, was not equally fortunate and went down with the ship. On the sister destroyer H.M.S. *Turbulent*, which shared in the gallant deeds and fate of the *Tipperary*, there perished Mr. Kenneth A. J. Moore, son of Mr. Herbert Moore, of Foxcote, near Radstock. This was a young man who, although but in his sixteenth year, had given unusual promise during the twelve months which constituted his period of service in the British Navy. An intense lover of animals, he never failed in his letters home to enquire after his pets.

Probably the most serious loss of the British, from the point of view of *matériel*, was that of the superb battle cruiser *Queen Mary*. Mr. H. B. Townshend, wireless operator on board, passed his first examination for wireless when he was only sixteen years of age, and we learn that one of his officers informed him at the time that he was the youngest operator in the Fleet, an honour of which he was justly proud. Recent letters home announced that he had just gone through a further examination, the result of which was to be published at the beginning of June. By that time Mr. Townshend had passed beyond the reach of examiners and laid down his young life upon the altar of his Motherland. A colleague of his who also perished was Mr. Sydney Mullins, a native of Marfleet, seventeen years of age, and formerly a telegraph messenger-boy at Hull Post Office.

A Manchester lad, Mr. Walter Fletcher Gardner was serving on H.M.S. *Hampshire* when he was struck down. His age was seventeen, and his rank that of boy telegraphist. He entered the Navy in May, 1914, and received his training in radiotelegraphy on H.M.S. *Powerful*, having been transferred to the *Hampshire* about twelve months ago. He belonged to an old-established Manchester family, and was the great-grandson of Alderman James Fletcher, a well-known engineer of Salford.

Mr. Ernest Newill died on board the *Indefatigable*. His parents belong to Goodmayes in Essex, and the young man in November, 1914, at sixteen years of age,

LEADING TELEGRAPHIST
CHARLES T. W. HURD.

left his employment in the City, joined the Navy, was sent to Devonport, and started training as a wireless telegraphist. His probationary period was shortened on the outbreak of war, and he was ultimately transferred to the *Indefatigable*. He was educated at Goodmayes School, Ilford, and was very popular both at school and amongst his neighbours. At the time of his death he was between seventeen and eighteen years of age and of fine physique. His brother is serving in the Army.

Another only son was Telegraphist Bernard Grimshaw Ineson, who was killed on H.M.S. *Barham*. The son of a lady in Crewe, he was seventeen years of age, when he was killed by a shell at his post with the instruments attached to his head. He was a clever operator, and his Captain in a letter addressed to his mother stated "he should have had a brilliant career, and was marked out for early advancement." A chum on board also wrote to his mother and dwelt upon the lad's popularity with his messmates.

Mr. Arthur Elwis was Leading Telegraphist on H.M.S. *Defence*, and the son of a signalman on the Great Central Railway. He had been for four years and ten months in the Navy, and had only recently received his appointment to the responsible post which he was holding at the time of his death. He joined the Navy at about sixteen, and came of age in last December. He was educated at Doncaster British School, and after leaving he entered the service of the Great Central Railway as a clerk. He won a school certificate for swimming, and had been choir boy both at St. Jude's and St. Mary's, Wheatley. His brother and his brother-in-law are both in the Army.

Besides those actually engaged in wireless duties at the time of their deaths there are other gallant gentlemen the loss of whom we have to mourn whose interest in and services to Wireless Telegraphy have been notable. Amongst these we must number Commander A. E. Silvertop, of H.M.S. *Defence*. He was one of the earliest experimenters with Wireless Telegraphy in the British Navy and was lent to the Somaliland Expedition of 1903 to take charge of two sets of Marconi apparatus.

On H.M. destroyer *Ardent* perished Leading Telegraphist Charles T. W. Hurd, of Tunbridge Wells. His parents received the intimation of his loss from the Admiralty, their statement being based on the fact that he was not amongst the survivors from that vessel. He was in his twenty-second year, and received his training at St. James's School. The Lieutenant-Commander in charge of his vessel writes that, during a momentary lull in the avalanche of German concentrated fire, Hurd received orders to send his final wireless message, went off to execute his duty and was never seen again.

Warrant Telegraphist Henry Arberry died on H.M.S. *Defence*; whilst included in the "Roll of Honour," though not assigned to any ship, is Acting-Warrant-Telegraphist Henry Burnell. We cannot conclude our list without making mention of Mr. Chas. Clifford Massey, of H.M.S. *Black Prince*, who, after serving his apprenticeship at Crewe Railway Works, joined the staff of the Marconi Works at Chelmsford, and entered the Navy three years ago.

Verily the "Roll of Honour" of wireless telegraphists grows apace. These young men have never failed to display in a remarkable degree that cool courage which we are all rejoiced to realise is still characteristic of our race.

# PERSONALITIES IN THE WIRELESS WORLD

Professor ALFRED N. GOLDSMITH,
D.Sc., Ph.D.

PROMINENT among the younger American scientists who have contributed so much to the progress of radiotelegraphy, Professor Alfred N. Goldsmith, D.Sc., Ph.D., is well known on this side of the Atlantic, through many papers on his favourite subjects.

Professor Goldsmith was born in New York, and also received his education there, graduating from the College of the City of New York and Columbia University. It is interesting to know that of the former place he is now Director of Radio Engineering, and America owes much to the researches which he has carried out in the well-equipped laboratories of that institution.

He is perhaps best known in England as editor of the *Proceedings of the Institute of Radio Engineers*, that admirably compiled publication which is the means of distributing so much useful information to students and research workers alike. In addition to acting as editor of these Proceedings, Professor Goldsmith holds the position of chairman of the Standardisation Committee of this institution, and also has a place on the Board of Direction.

Other societies in which the subject of our biography takes an active part are the American Institute of Electrical Engineers and the American Physical Society, of both of which he is a member. He is the author of *Elements on Physics*, *The Transmission of Canal Rays Through Thin Partitions*, *Radio Engineering at the College and City of New York*, *Engineering Measurements of Radiotelegraphy*, *Radio Telephony*, and other works.

# The Design of the Audio Frequency Circuit of Quenched Spark Transmitters

By JULIUS WEINBERGER

(Including a Supplementary Discussion of "Resonance Phenomena in the Low-Frequency Circuit," by H. E. Hallborg.—WIRELESS WORLD, APRIL-MAY, 1915.)

(*Reproduced, by permission, from the "Proceedings of the Institute of Radio Engineers."*)

A LARGE number of contributions to the literature of radio-telegraphy have been made upon the subject of the so-called "resonance transformer." These have been both experimental and theoretical. The experimental contributions, as a general rule, have been investigations of the resonance transformer under actual operating conditions (that is, with the secondary condenser discharging periodically through a spark gap), while the theoretical contributions have generally assumed a steady state of affairs (the secondary condenser *not* being discharged); in this case the method of treatment has been that employed for two coupled circuits.

In actual practice, such as in the operation of quenched gap sets, the requirement of a clear note involves the discharge of the secondary condenser at the peak of the wave each half cycle. It would seem, therefore, that the transient phenomena in the circuit would be the determining factors of voltage and current, rather than those of the steady state of affairs; that is, conditions would never assume the steady state.

To investigate these conditions, we can reduce the whole resonance transformer circuit to that of a simple inductance, capacity and resistance in series (Fig. 1), as has been shown by Mr. Hallborg. The inductance, $L$, includes all the inductances in the circuit—generator inductance, transformer leakage inductance, inductance of any series choke coils, and so on. The condenser, $C$, is the secondary condenser reduced to the primary circuit by multiplication by the square of the ratio of transformer voltages. The resistance, $R$, includes resistances in the primary circuit and resistances in the secondary circuit reduced to the primary by division by the square of the ratio of transformer voltages.

The differential equation for such a circuit is:

$$e=E\cos(\theta-\theta_o)=Ri+x\frac{di}{d\theta}+x_c\int id\,\theta$$

where:

$E$ = maximum generated * voltage.
$x_c$ = condenser reactance.
$x$ = inductive reactance.
$\theta=\omega t$.
$\theta_o$ = an angle to be subtracted from $\theta$ if $e$ is not zero for $t=0$.

* This is *not* the voltage across the generator terminals. If the generator armature has appreciable inductance (in comparison with the rest of the circuit) there will be a drop in voltage inside of the armature and a very much higher voltage will actually be *generated* than that which is measured at the terminals.

The potential difference across the condenser terminals can be found from :

$$V = x_c \int i\, d\theta$$

when equation (1) has been solved for $i$.

Since we are mainly concerned with this, $V$, we will omit writing the solution for $i$, but give that for $V$ immediately :

$$V = \frac{Ex_c}{Z} \sin(\theta - \theta_o - \gamma) + \frac{Ex_c}{Z} \epsilon^{-\frac{R\theta}{2x}} \left\{ \sin(\theta_o + \gamma) \cos \frac{q}{2x}\theta + \left[ \frac{R}{q} \sin(\theta_o + \gamma) - \frac{2x}{q} \cos(\theta_o + \gamma) \right] \sin \frac{q}{2x}\theta \right\}$$
$$+ \epsilon^{-\frac{R\theta}{2x}} \left\{ e_o \cos \frac{q}{2x}\theta + \frac{2Re_o + 4xx_c i_o}{2q} \sin \frac{q}{2x}\theta \right\}$$

where

$Z$ = impedance.

$\gamma$ = phase difference.

$q = \sqrt{4xx_c - R^2}$.

$e_o$ = value of potential difference across condenser terminals at the time $t = 0$.

$i_o$ = value of current through the circuit at the time $t = 0$.

Consider the conditions introduced in the circuit immediately after the condenser has sparked over, at one peak of a cycle, and the spark has ceased. This is the moment for which we take $t = 0$. The important thing to be determined is :—What will be the voltage across the condenser for $\theta = \pi$ (that is, at the next peak of the cycle) ? Will it rise to a sufficient value to cause another discharge ? Or, rather, will it rise to a value equal to that, at least, at which the previous discharge took place ? If not, the requirements of a clear note, of twice the generator frequency, will not be fulfilled. Also, it is this discharge voltage which determines the energy absorbed by the condenser.

Taking the equation given for $V$, we can introduce the following simplifications :

(1) Since we will consider the circuit as being resonant, we have $x_c = x$, and shall substitute $x$ for $x_c$ accordingly, throughout.

(2) Since the circuit is resonant, the current and generated voltage are in phase, hence $\gamma = 0$.

(3) When the condenser discharges, the potential difference between its plates is reduced to zero. Hence, at the moment we are considering, $e_o = 0$.

(4) The spark occurs when the generated voltage is zero. Since $i_o$ is in phase with $e_o$, $i_o = 0$.

(5) Since the circuit is resonance, $Z = R$.

(6) $R^2$ can usually be neglected as compared with $4xx_c$.

Hence $q = 2\sqrt{xx_c}$.

Or, since $x = x_c$

$q = 2x$

(7) In our case $\theta_o = \frac{\pi}{2}$.

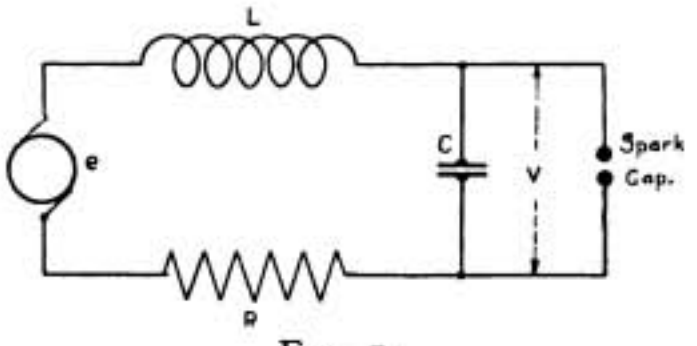



FIG. 1.

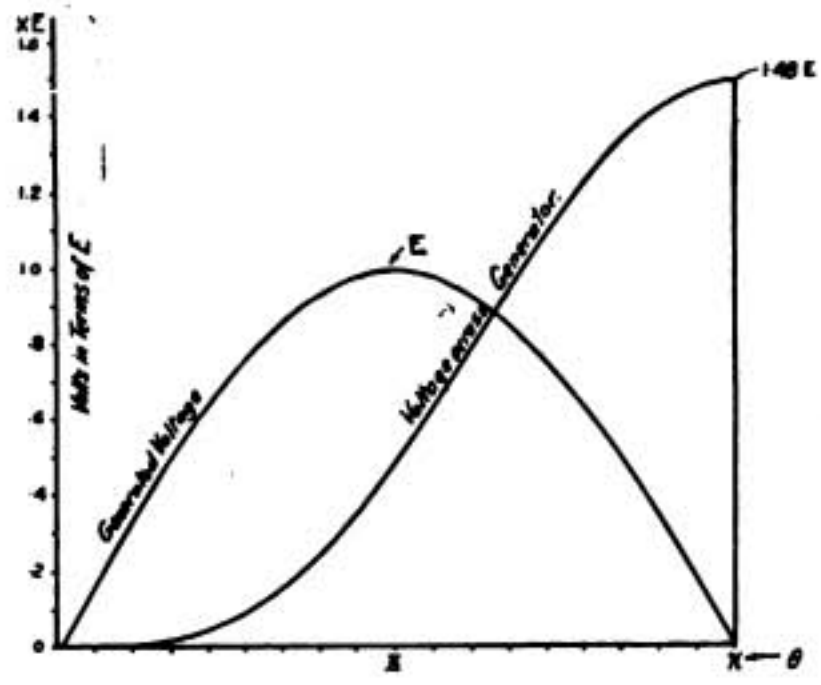



FIG. 2.

Substituting these conditions, we obtain :

$$V=\frac{Ex}{R}\sin\left(\theta-\frac{\pi}{2}\right)+\frac{Ex}{R}\epsilon^{-\frac{R\theta}{2x}}\left\{\cos\theta+\frac{R}{2x}\sin\theta\right\}$$

$$=\frac{Ex}{R}(-\cos\theta)+\frac{Ex}{R}\epsilon^{-\frac{R\theta}{2x}}\left\{\cos\theta+\frac{R}{2x}\sin\theta\right\}$$

To show the general shape of this curve, which gives the voltage across the condenser at any moment after the time $t=0$, it has been calculated for a specific case ($C=20$ microfarads and $R=1$ ohm), and is shown in Fig. 2. In the same figure the curve of generated voltage (a sine wave) is given for comparison.

This condenser voltage, $V$, will reach its maximum for $\theta=\pi$. It will then be :

$$V_{max.}=\frac{Ex}{R}-\frac{Ex}{R}\epsilon^{-\frac{\pi R}{2x}}$$

$$=\frac{Ex}{R}\left(1-\epsilon^{-\frac{\pi R}{2x}}\right)$$

This, then, is the potential at which our "reduced" condenser will discharge. The actual condenser, across the transformer secondary, will, of course, discharge at a voltage which is simply this $V_{max.}$ multiplied by the transformer ratio. In Fig. 3 curves are given for $V_{max.}$ in terms of $E$ (the maximum generated voltage). It will be seen that for ordinary conditions of resistance (that is, $R$ between zero and 1 ohm) $V=1.5\,E$ is a good average value.

To find the R.M.S., or effective value of $V$, is desirable, since this is the voltage that a voltmeter placed across the transformer primary will read, and this is also the voltage for which the transformer primary must be designed when the equation

$$V_{eff.}=4.44\,AB_{mf.}.10^{-8}$$

is used, where

$V_{eff.}$ = R.M.S. volts across transformer primary.
$A$ = cross sectional area of core in square cms.
$B$ = flux density, in lines per square cm.
$N$ = number of turns of primary winding.
$f$ = supply frequency.

This effective value of $V$ is :

$$V_{eff.}=\sqrt{\frac{1}{\pi}\int_0^{\pi}\left(-\frac{Ex}{R}\cos\theta+\frac{Ex}{R}\epsilon^{-\frac{R\theta}{2x}}\left\{\cos\theta+\frac{R}{2x}\sin\theta\right\}\right)^2}$$

It is found* that :

$$V_{eff.} = 0.504\ V_{max.}$$

The design of a quenched gap set to operate under resonance conditions becomes a relatively simple matter. Let us take a numerical example for a 500-cycle, 1 kilowatt set, operating with a 110-volt generator (154 volts maximum).

We shall first find the equivalent primary condenser (i.e. the secondary condenser reduced to the primary circuit), required to absorb 1,000 watts, from :

$$W = nCV^2.$$

Since $V = 1.5E = (1.5)\ (110)\ \sqrt{2} = 233$ volts.

Hence $1000 = 500C\ (233)^2.$

$C = 37$ microfarads.

To tune to 500 cycles with this capacity, an inductance of 2·5 millihenrys is required. This can be made up partly from the generator armature inductance (usually this is between 1 and 5 millihenrys for a 1 kilowatt, 110-volt machine), and the rest obtained either by a transformer having this amount of leakage inductance, or else from a transformer with no appreciable leakage and series choke coils. I believe the latter method to be preferable as it admits of greater flexibility.

The value of the equivalent primary condenser (or, rather, the " reduced " secondary condenser, as I have called it) being now fixed, the actual secondary condenser is determined by deciding on a suitable transformer ratio. The value of this secondary condenser is usually limited by conditions of wave length and also by the discharge current which the quenched gap in use will stand. A large condenser means heavy currents and considerable heating in the gap, while a high discharge voltage and a small condenser would require many gap sections and cause insulation difficulties. It is, I believe, common practice to employ about 0·006 microfarads as a secondary condenser for this type of set.

Having thus determined the ratio of primary to secondary capacities, the transformer ratio is, of course, fixed ; and it is only necessary to design a transformer of the ratio desired—a simple matter with a closed core transformer of negligible leakage. Note should be taken of the fact previously mentioned that when the usual transformer formulas are used, the effective value of $V$ (that is 0·504 $V_{max.}$) should be used as the voltage across the primary.

Practically, the operation of quenched gap sets is at a point slightly "off" resonance. However, it is hardly necessary

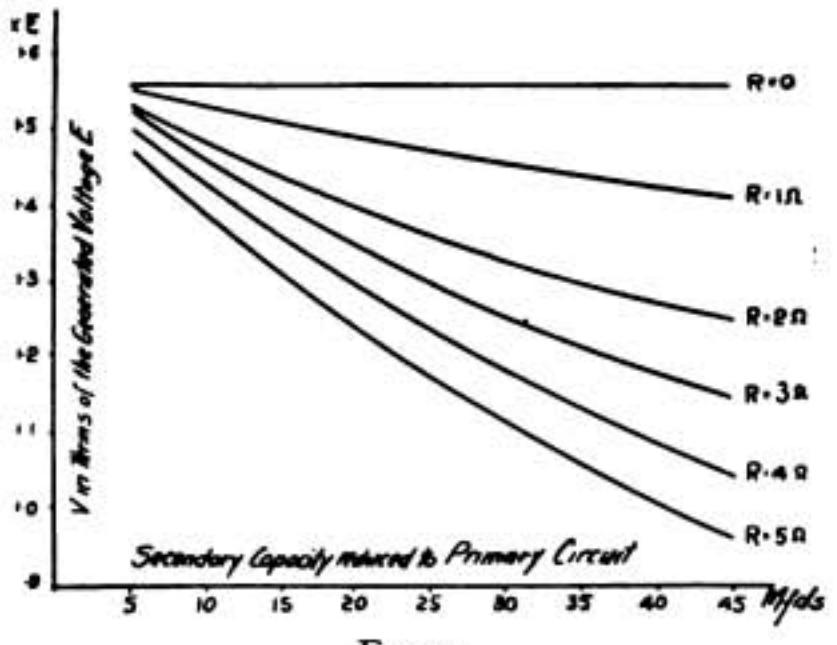



FIG. 3.

* This value was determined graphically, the integration being done by measuring the area of the squared curve with a planimeter.

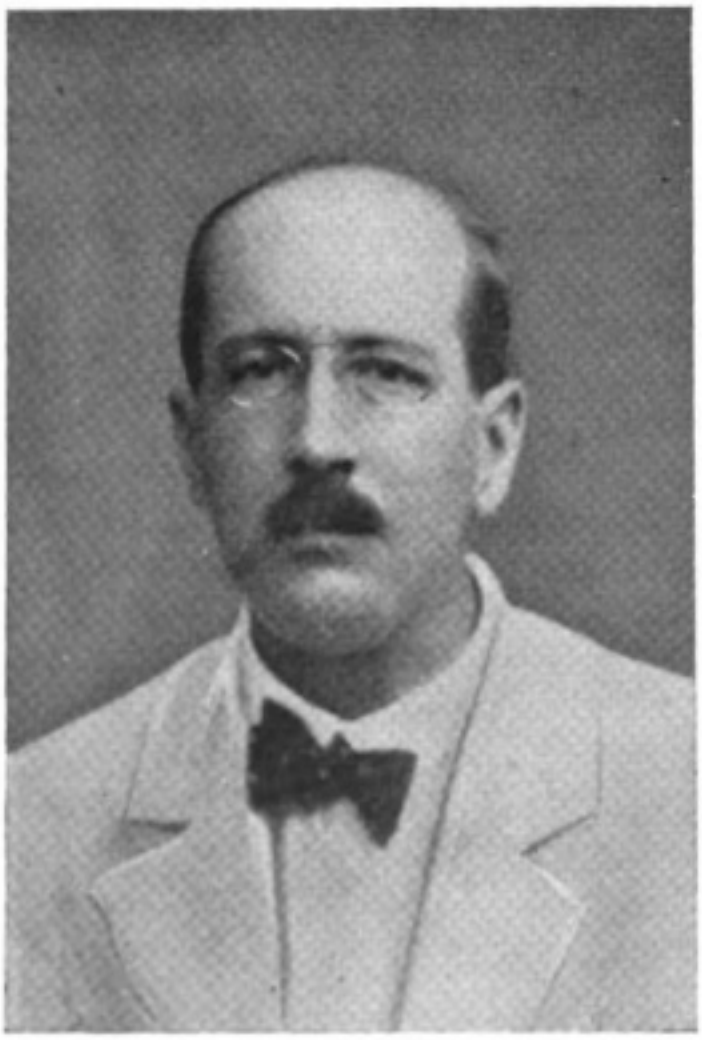
to operate with a condenser as much as 20 per cent. larger than the resonance capacity. The foregoing results can, therefore, be applied as very good approximations to actual practice, and have been found to be quite satisfactory for this purpose.

[Since the above was written I have become aware of an article by L. B. Turner* upon the same subject. Following a somewhat different procedure, Turner reaches practically the same results as given above, with the exception that he neglects the resistance of the circuit. As Fig. 3 shows, however, this would lead to considerable inaccuracies, for large resistances, and is strictly correct only for $R=0$. Turner obtains the result :

$$V=\frac{\pi}{2}E.]$$

# The Late Mr. E. W. Salis

IT is with the deepest regret that we have to announce the death of Mr. E. W. Salis, Brazilian representative of Marconi's Wireless Telegraph Co., Ltd.



The deceased gentleman, who was the third son of the late Major-General Salis Schwabe, C.B., formerly of the Carabiniers and 16th Lancers, was grandson of Lord Justice Sir W. M. James. Born in Ireland in the year 1874, he was educated at Marlborough and at the City of London and Guilds Institute. On the termination of his college career he spent a short time in the business of Messrs. Salis-Schwabe, Ltd., of Manchester, and there became a member of a private Commission sent by the Home Office to Russia. He next started a business in Vladivostock, Siberia, in partnership with his cousin. In 1906 Mr. Salis was appointed manager of the Manaos Harbour Co., and after five years in that position joined the Marconi Company as Brazilian representative. The deceased had been in bad health for some time, and underwent an operation for cancer of the tongue. To this disease his last illness owed its fatal termination.

* L. B. Turner, *Electrician*. Vol. 69, 1912, p. 694 : "Der Schwingungskreis niedriger Frequenz in der Funkentelegraphie," *Jahrb. d. Drahtl. Tel.*, Vol. 9, Heft 2, p. 141.

# Digest of Wireless Literature

## The Resistance of Radiotelegraphic Antenna.

Dr. Louis W. Austin, the well-known Director of the United States Naval Radiotelegraphic Laboratory, has recently published in the Scientific Papers of the Bureau of Standards, No. 257, the following valuable note on the above subject.

According to the theory the portion of the resistance of an earthed antenna due to its radiation is *

$$Rr = 160\,\pi^2\,\frac{h^2}{\lambda^2}$$

which is approximately $1600\,\frac{h^2}{\lambda^2}$

where $h$ is the height from the earth in the centre of capacity of the antenna and $\lambda$ the wave-length, assuming that the earth below the antenna is a good conductor like salt water. As a matter of fact, in most land stations the effective height is less than the actual height, and in many cases not more than one-half of it. In all antennas, however, radiation resistance must, according to the theory, decrease as the wave-length increases and in accordance with the square law.

It was first noted by C. Fischer † that in certain cases the resistance ‡ of antennas increased as the period was increased by introducing inductance. Fischer believed that this indicated an increase of radiation with wave-length.

The whole course of the phenomenon has been studied by the United States Naval Radio Laboratory, and the results published.§

Fig. 1 shows the resistance curve of the antenna used by the Naval Laboratory at the Bureau of Standards and that of the U.S.S. *Maine*. The first is typical of a land station with poor ground conditions, the curve falling rapidly as the true radiation resistance drops with increasing wave-length, and then rising again in a straight line as the wave-length is further increased. The curve for the *Maine* shows the same drop at the shorter wave-lengths followed by a rise which is very slight. Fig. 2 shows the antenna resistance of the high-power station at Arlington, Va., with the towers grounded.

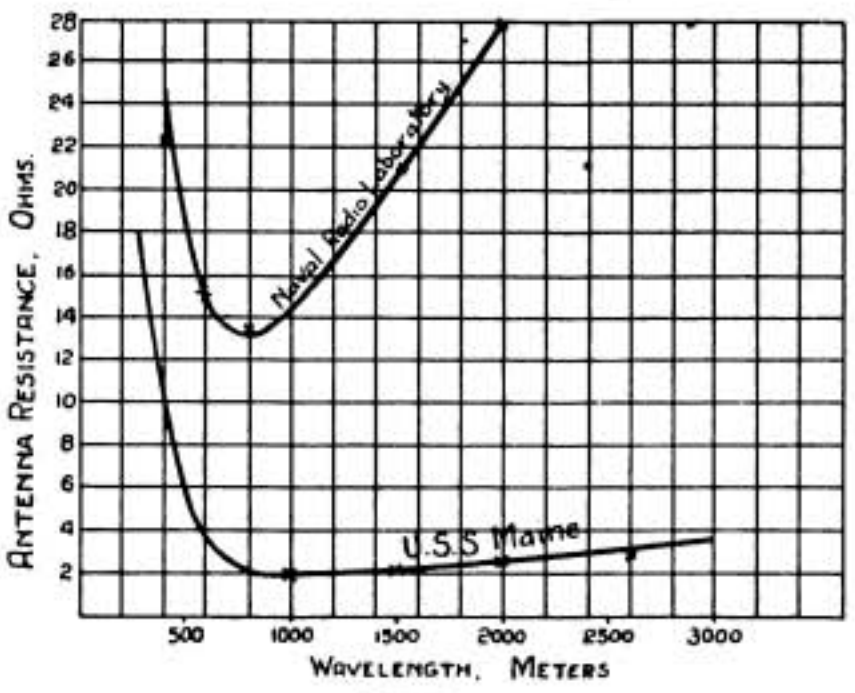



FIG. 1.

* *Zenneck Lehrbuch d. drahtlosen Telegraphie*, 1913, p. 202.

† *Phys. Zeit.* 1911, p. 295.

‡ Leaving out of account the resistance of the inductance coils.

§ *Proc. Wash. Acad.* 1, p. 9, 1911; and this *Bulletin* 9, p. 65, 1912; *Scientific Paper* No. 189.

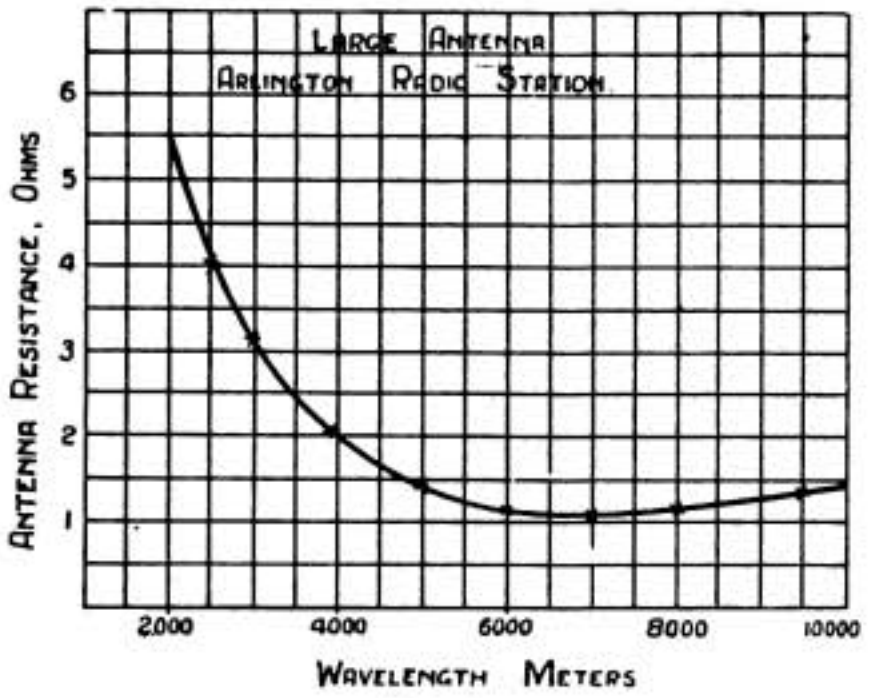



FIG. 2.

Here there is almost no rise as the wave-length is increased, showing how perfect ground conditions can be made by the use of an extensive network of ground wires.

Up to the present there has been no satisfactory explanation of the rise of the antenna resistance curve, although it seems certain that it has something to do with the ground. Experiments by H. True * show, however, that the ground resistance, as indicated by fall of potential methods, is greater at short than at long wave-lengths. If, however, we consider the ground as a dielectric rather than as a conductor, and consider it as a portion of the total dielectric lying between the antenna, regarded as the upper plate of a condenser, and the ground water, regarded as the lower plate, we reach a very probable explanation of the peculiar form of many antenna resistance curves. For it is well known that the equivalent resistance of an imperfect dielectric increases as the wave-length is increased.

As an example † of experiments showing this, the equivalent resistance of a certain glass condenser of approximately 0·002 mf. capacity measured in the Naval Radio Laboratory is shown in Fig. 3. The equivalent resistance of the condenser at the various wave-lengths is determined by placing it in a circuit acted upon by a buzzer-excited wave-meter. The current in the circuit containing the condenser is measured by means of a thermo-element. The condenser under test is then replaced by a variable air condenser adjusted to the

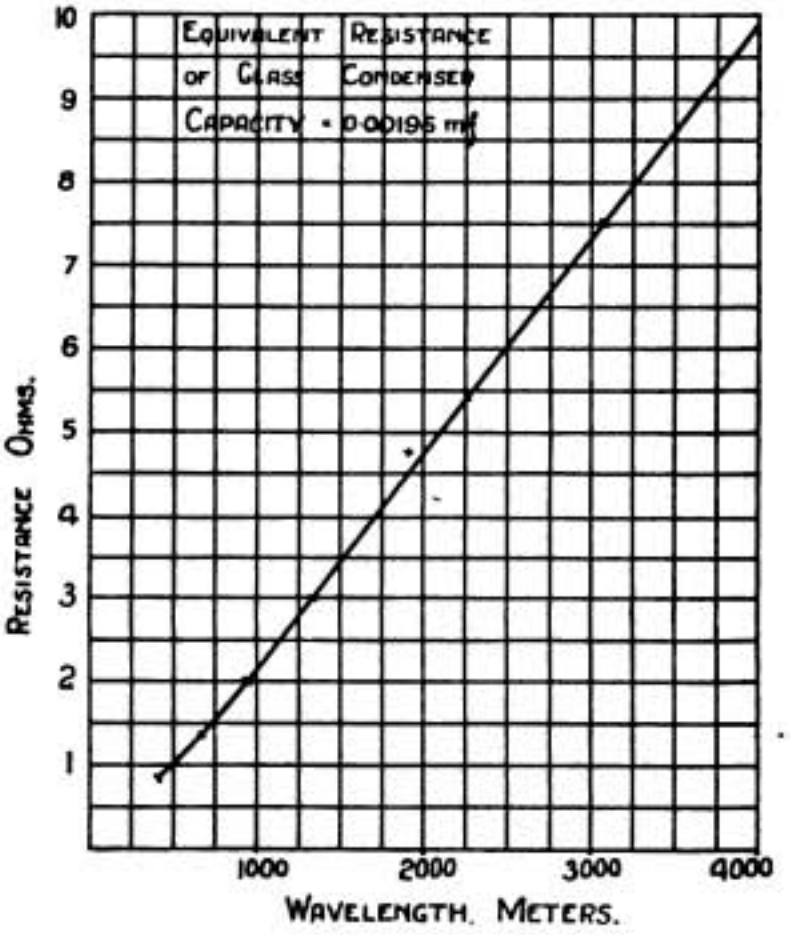



FIG. 3.

* *Jahrbuch d. drahtlosen Telegraphie V.*, p. 125, 1911.

† *Proc. of the Inst. of Radio Engineers*, I, p. 35, 1913.

same capacity in series with which resistance is introduced until the thermoelement indicates the same high-frequency current as in the case of the glass condenser. The series resistance then represents the equivalent resistance of the glass condenser. Fig. 3 shows that the equivalent resistance of the glass condenser increases in direct proportion to the wave-length, just as does the resistance of the antenna at the Bureau of Standards beyond 1,500 meters.

The rise in the resistance curve of the *Maine*, as shown in Fig. 1, is probably due to the fact that the measurements were made with the ship in dock, as it is impossible to use sufficiently sensitive galvanometers under other circumstances. With the ship in dock, of course, a considerable portion of the field passes through poor dielectric material before reaching the water.

# Lonely Radiotelegraphists

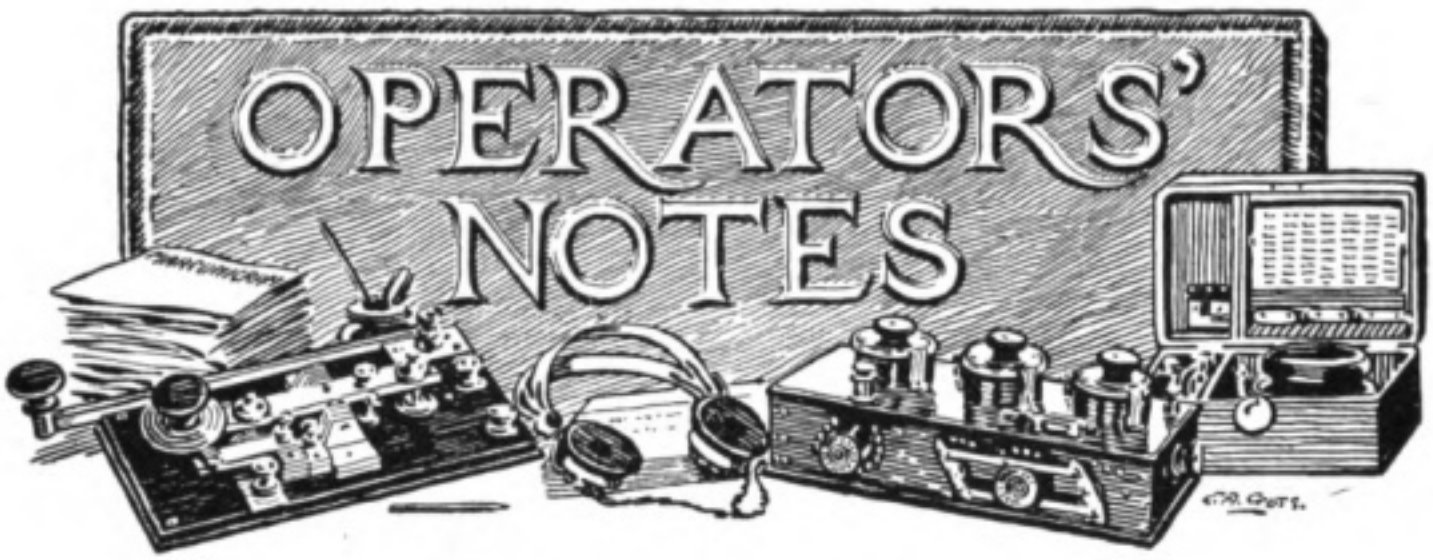
MR. L. B. CLEARY, warrant telegraphist, R.N.R., writes from a naval station in the Seychelles (islands in the Indian Ocean), criticising in somewhat intemperate language a letter which appeared on page 765 of our February issue, from Mr. W. J. Hills, another naval wireless man stationed at Mombasa. The latter had asked any readers who might have a gramophone and records to spare to send them along to his station, " where amusements are practically *nil* and the long evenings very dark " and lonely."

Mr. Cleary informs us that " we at this station here, who hold a similar position " to Mr. Hills, have been able to buy all the necessary things for amusement that we " require, and also subscribe liberally for the comfort of those who are even more " lonely than ourselves."

We congratulate Mr. Cleary on his good fortune, and on his having been able to help in carrying out the good work of which he speaks; but we are bound to confess that our appreciation of his action would have been more unqualified had his letter displayed a less censorious spirit with regard to his colleague. It is usually extremely unjust to condemn anyone else without a very full acquaintance of all the circumstances surrounding the case in point. The pay of a warrant telegraphist abroad is by no means on a scale liberal enough to justify Mr. Cleary's tirade. We ourselves know personally how extremely expensive existence in such tropical stations as Mombasa frequently is, and we can easily understand the circumstances which would fully justify Mr. Hills' request. We can only hope that the latter has received a machine long before this note appears, and that it has proved as efficient as he hoped in enlivening the monotony and discomfort of his lonely station on the coast of equatorial East Africa.

# Wireless Workers at Play

AT the A.A.A. military sports at Stamford Bridge on Saturday, July 8th, the R.F.C. Wireless Section team finished second to the Army Service Corps (M.T.) Grove Park team in the one mile relay race. The winning team was: the Australian sprinter, C. J. Mears, the world's champion, Private W. R. Applegarth, P. Hodge, and S. Wood, while the R.F.C. team was: P. E. Mann, F. Gaby, Saul, and the old Army champion, Sergeant F. Mawby.




## Some Notes on Atmospherics.

The new operator will not be long at sea before he gains considerable practical experience of what are variously known as "atmospherics," "X's," and "static." Although nearly twenty years have passed since wireless came into practical use, and these strange natural signals first recorded themselves on the slow-moving paper tape of the early coherer receivers, the problem of their elimination remains yet to be solved. Numerous means, however, have been incorporated into modern wireless telegraph apparatus, so that nowadays the operator is not so dependent as formerly upon the whims of the clerk of the weather. Sharp tuning, musical notes and balanced receivers enable many trying periods to be overcome, which in the early days would have been "dead" to all wireless communication.

The keen operator, anxious to get the best out of his installation, will observe carefully all that happens during the prevalence of static, and upon the arrival of bad conditions will not give up in despair. It should be remembered that if at one station conditions are so bad that it is impossible to read signals from a station with which one is endeavouring to communicate, it does not follow that the other station is similarly inconvenienced.

The writer of these notes, who at one time had to send a large quantity of important traffic to a station some hundreds of miles away, found that atmospheric trouble was in nearly all cases far worse at his end of the "line." On discovering this he arranged that upon receipt of every message the other station should send for about half a minute a rhythmic series of long dashes. In the event of non-reception a similar series of dots was to be sent. Although conditions were so bad that it was impossible to read any ordinary signals, no difficulty arose in distinguishing these rhythmic signals, and, as a consequence, the traffic, which was practically all one way, was cleared expeditiously.

In tropical and subtropical regions a considerable diminution in strength of static will often be found after sunset, and the quietest periods are frequently between midnight and 3 a.m.

Land station operators working traffic between fixed stations will find it convenient to plot curves of atmospheric and signal strengths, and after a number of these have been prepared, to study them carefully with the view of ascertaining the

best periods of working in bad seasons. Ship operators will also find it most useful to compile information in this way, with a view to finding the best periods.

Whilst writing on the subject of atmospherics, we think it wise to point out to new operators a source of trouble which is often overlooked. An imperfect aerial connection, caused, for instance, by such a thing as a loose terminal, will often cut off completely the reception of wireless signals, although permitting atmospherics to pass if these latter are strong. The reason for this is that strong atmospherics are frequently sufficiently powerful to spark across the tiny gap, whereas signals from another wireless station are rarely of sufficient strength to do this. It will thus be seen that the fact that atmospherics are heard in the telephone is no indication that the aerial circuit is perfect.

In a given area, when static is giving trouble, it will be found that two ships, quite close to one another, are affected most unequally. The ship with a larger and higher aerial will invariably be the worse sufferer, and the smaller ship will sometimes be able to render valuable assistance to the larger vessel from this cause.

Atmospherics are of various types, some coming through as a low dull rumble, others as violent crashes with comparatively quiet intervals, others again yield whistling and roaring noises. One peculiar type which gives a sound closely resembling escaping steam, will almost invariably be found to herald the approach within five minutes of a squall of sleet. The ability of the wireless operator to announce the coming of such a squall has often caused considerable mystification amongst the navigating officers, who do not know "how it is done."

Speaking generally static is far more prevalent in southern waters than in northern, and in summer more than in winter. Certain equatorial districts are particularly bad, and stations situated amongst the tropical forests of Africa and South America are constantly troubled in this way.

A good, clear, pure, and fairly high musical note has been found the most, successful for transmission through static, and where ample power is employed to "break through" the natural noises, communication is seldom interrupted. In some cases static has been found sufficiently strong to give a continuous roaring spark across a gap as large as one centimetre, and, of course, whilst it is of such violence as this (luckily such periods are infrequent) the operator has no choice but to stop work altogether. Such violent periods, however, are seldom of more than a few minutes' duration.

# Plymouth Telegraphist's Retirement

WIRELESS students in the West of England will be interested to hear that Mr. J. Jerritt, who for the last forty-four years has been on the staff of the Post Office, has now been presented by the Plymouth Telegraph Staff and friends with a handsome gold watch on his retirement from the service.

Representing the Wireless Press, Ltd., in the West of England, Mr. Jerritt has long shown a keen interest in the fascinating science, and now intends to turn his wide telegraphic experience to good account by opening a school of telegraphy in Plymouth. In this enterprise we wish him every success.

# Mr. Pidduck's "Treatise on Electricity"*

Reviewed by J. A. FLEMING, M.A., D.Sc., F.R.S.

THE advances in our knowledge of electrical phenomena have been so extensive in the last twenty years or so that it is imperative from time to time to recast the summaries of it to bring them within the compass of books of reasonable size.

Moreover each such book provides, or should provide, for readers of a particular class, elementary, popular, or advanced. Whilst there is no lack of provision for the first two classes the number of books dealing in a fairly advanced manner, but not too mathematically, with the subject are not numerous. The book before us by Mr. Pidduck endeavours to meet the needs of such readers in a text-book of moderate size, covering both the theoretical and practical sides of the subject, and especially some of the most recent advances, we think with success.

The volume opens with a short mathematical introduction explanatory of certain fundamental theorems. It is rather to be regretted that Mr. Pidduck has not embraced the opportunity to illustrate at the outset the physical meaning of these theorems more fully by more explicit electrical illustrations. The physical student approaches the mathematics of the subject from a different point of view to the pure mathematician. The former chiefly desires to have the physical meaning of such theorems expounded. Hence the great advantage of adopting mathematical notations which facilitate it.

Mr. Pidduck adheres to the Cartesian methods. He does not employ the convenient method now so general of representing a vector by a single letter in thick or Clarendon type, and its size or magnitude by a corresponding Roman letter, neither does he devote space to explaining at the start the physical significance of such terms as *divergence*, *curl*, *line*, *surface*, or *volume integrals*, nor avail himself of compact symbolisation for vector and scalar products or operators.

The advanced student who has a small acquaintance with modern vector analysis, such, for instance, as may be obtained from the little book of Dr. J. G. Coffin on Vector Analysis (Chapman and Hall, Ltd., London), will have become familiar with the convenient notation of Willard Gibbs by which the scalar product of two vectors is expressed by a *dot* put between the symbols—*e.g.*, $\mathbf{A}\cdot\mathbf{B}=AB\cos\theta$, where $\theta$ is the angle between two vectors of sizes A and B, and the vector product is expressed by a *small cross*; thus $\mathbf{A}\times\mathbf{B}=AB\sin\theta$. Also with the meaning of Hamilton's important delta operator:

$$\nabla=\mathbf{i}\frac{d}{dx}+\mathbf{j}\frac{d}{dy}+\mathbf{k}\frac{d}{dz}$$

where **i**, **j**, and **k** are unit vectors along the axes, the scalar square of which—viz., $\nabla\cdot\nabla$—is Laplace's operator.

If, then, **E** is any vector quantity, say, electric force div **E**, denoted by $\nabla\cdot\mathbf{E}$, is the divergence of **E**, and signifies the number of lines of electric force which proceed

* *A Treatise on Electricity*. By F. B. Pidduck. Cambridge University Press. 14s. net.

from a unit volume taken in the field, or, perhaps we should say, from an infinitely small volume divided by the volume. The divergence theorem, or, as Mr. Pidduck calls it, Gauss's transformation, becomes then almost a truism because the number of lines of force which proceed outwards normally through any closed space in a field must be equal to the number originating in that volume. In the same notation the curl of a vector quantity **E** is denoted by Curl **E** or by $\nabla \times \mathbf{E}$, and it is seen at once that Stokes's theorem provides us with a criterion by which we can judge when two vectors are related to each other as primary and curl.

Thus, for instance, if the primary vector is electric force, then its curl is the time rate of change of magnetic flux through unit area, because it fulfils Stokes's condition. For the same reason it would have been an advantage if Mr. Pidduck had explained a little more fully why the differential equation,

$$\frac{d^2\theta}{dx^2} + \frac{d^2\theta}{dy^2} + \frac{d^2\theta}{dz^2} = \frac{1}{c^2}\frac{d^2\theta}{dt^2}$$

or as it may be more compactly written—$\nabla^2\theta = \frac{1}{c^2}\ddot{\theta}$ represents a wave motion; because the notions underlying it are fundamental in connection with Maxwell's theory of the propagation of electromagnetic effects through space.

Following on this short mathematical introduction, the subject of permanent magnetism is treated in Chapter I., the magnetic effect of electric currents in Chapter V., and that of induced magnetism in Chapter VII.

The consideration of the magnetic circuit from the standpoint of modern electrical engineering does not appear to be quite adequately considered, but the first chapter is occupied with the effects of permanently magnetised iron or steel and with the conceptions of lines and tubes of magnetic force, and with the absolute measurement of terrestrial magnetic force. The discussion of electromagnets and of the phenomena of magnetic hysteresis is deferred until Chapter VII. is reached.

As the title of the book is "A Treatise on Electricity," and not "Electricity and Magnetism," the discussion of magnetic phenomena is carried only so far as is necessary for the main purpose of the book.

This opens with an examination of electrostatic effects in Chapter III. We are glad to notice that here modern views of the atomic constitution of electricity—viz., the electron hypothesis—are brought to notice early, so that the student is led to interpret electrical effects in terms of it. Then we come to definitions of potential and electric force and Cavendish's important demonstration of the law of the inverse square is given. Various necessary theorems concerning potential and lines and tubes of electric force are then stated in a clear and useful form. A good section on modern sensitive electroscopes such as those of C. T. R. Wilson follows, and Dolezalek's form of quadrant electrometer is described. The chapter concludes with a theoretical discussion of dielectrics, but nothing is said about the important qualities of absorption or energy dissipation or the changes which variation of temperature and frequency bring about.

Chapter IV. discusses electric current, its generation and measurement. Standard cells and galvanometers claim a brief notice, as also the laws of resistance, Joule's law, and the measurement of resistance are then discussed; but we miss

information which might show the student how to calculate the resistance of complicated networks of conductors or how to determine the current in any branch.

This needs nothing but a simple modification of Kirchhoff's laws and a little knowledge of determinants. A short section on the measurement of dielectric constants and one on platinum thermometry conclude this chapter. Chapter V. on the magnetic effect of currents is a well-arranged chapter, containing much useful information. The Einthoven galvanometer is mentioned and the Kelvin current balances.

The fundamental equations of the electromagnetic field are then explained and the meaning of the important quantity called the vector potential elucidated. A very good section is that on the mutual inductance of circular conductors.

Chapter VI. brings us to the subject of thermoelectricity and its laws. The Peltier and Kelvin (Thomson) effects are well explained. We have also a description of thermoelectric ammeters, so essential for the measurement of high frequency currents. In Chapter VIII. the important subject of the induction of electric currents is treated and the principles on which the inductance of electric circuits can be calculated is expounded. This chapter will be particularly useful to radio-telegraphists who are rather apt to be contented with a formula without much thought as to how it is derived. Various methods of measuring inductances are given, and the rules appertaining to circuits containing capacity and inductance. The construction of induction coils is briefly mentioned, and a section devoted to the absolute determination of electrical resistance and capacity as well as the ratio of the electrostatic and electromagnetic units.

Chapter IX. on Applied Electricity imparts elementary information on the subject of dynamos, motors, and transformers.

With Chapter X., on Electrolysis, we enter that portion of the book more particularly concerned with modern views and recent knowledge.

The laws of electrolysis and the motion of ions in electrolytes are concisely explained, and the manner in which experiment can be made to yield information as to ionic velocities. This leads to a discussion of the theory of primary and secondary cells and the conductivity of electrolytes. The student will find this chapter particularly useful as a compendium of recent knowledge.

Chapter XI. introduces the subject of electric oscillations, electric resonance and decrement. The discussion of the subject of resonance curves and methods of and formulæ for obtaining from them a knowledge of the decrement of the circuit is very complete and excellent.

The practical information given here is well up to date, as shown by the fact that mention is made of the portable decremeter of the Marconi Company. The elementary laws of coupled circuits are given and the usual account of Hertz's experiments with the equations of the electromagnetic field round an oscillator.

The theory of electric wave propagation in free space and the electromagnetic theory of light is briefly treated on usual lines. This chapter forms a useful introduction to the scientific side of the subject of wireless telegraphy. The student who has the requisite mathematical equipment to read this chapter carefully will derive from it much valuable information that is not so fully given in other books.

In Chapter XII. we have a very complete exposition of the phenomena of conduction of electricity through gases, and of the nature of the Röntgen rays. This chapter contains an able discussion of the recent important knowledge gained by the transmission of Röntgen rays through crystals. The extremely interesting and pioneer work of Professor Bragg and his son on this subject is very carefully explained, and the reader will find here a fascinating story of physical research unfolded.

We are only at the beginning of the information likely to be obtained as to the constitution of matter by the aid of these rays. The succeeding chapter follows up the subject with a discussion of the phenomena of radioactivity, and these two chapters alone form a storehouse of very valuable information as to recent physical research.

Although the subject of conduction through gases may seem rather remote from the work of the wireless telegraphist, yet there is much in this chapter of Mr. Pidduck's book which is relevant to it. Thus, for instance, the subject of the emission of ions from incandescent solids has great bearing on radiotelegraphy as it is the basis of operation of the Fleming valve receiver and its offspring the audion amplifier, which are of such importance as radiotelegraphic receivers. The Wehnelt cathode relay is another instance. No one is very likely to be able to make an improvement in these devices who has not acquired an advanced knowledge of the physical principles involved, and he will derive considerable assistance in that study from this chapter.

Another matter of special interest to the radiotelegraphist is the subject of sparking potentials, the theory of which is closely involved in that of gaseous conduction generally. It is dealt with as far as space permits in this same chapter. A brief section on photoelectricity has reference to a matter which is also of importance in connection with radiotelegraphy, as the atmospheric ionisation by sunlight brings into operation effects on long distance wireless which have been the subject of much discussion by experts.

The final chapter is devoted to a discussion of the electron theory and the explanation it is capable of affording as to metallic conduction and the propagation of electric effects through space. The Zeemann effect is also discussed and the general character of electrical and optical effects in moving media. Finally we have a brief reference to the theory of relativity and the new conception of quanta of energy introduced by Planck and Einstein.

Although the earlier portions of the book contain much elementary information unnecessary for the reader who has mastered the stock text-books on the subject, yet in the last five chapters Mr. Pidduck has given in a lucid and excellent form a very large amount of well-digested new information which is of great importance.

The book, therefore, can be confidently recommended to advanced students of electrical phenomena who are desirous of having in a compact and accessible form an account of recent additions to knowledge placed before them in a lucid and readable manner. The value of the book, however, would be greatly increased if the index were enlarged and rendered more complete. At present it is all too brief for the size and multiplicity of subjects treated.

C

# Administrative Notes

CHILI.

WE are advised by the Bureau of the International Telegraph Union, Radio Telegraphic Service, Berne, of the opening to public service early last April of the Radio Telegraphic Stations at Valparaiso, Llanquihue, Frutillar, and Punta Arenas.

* * * * * *

PORTUGAL.

The Government have published a decree ordering the service regulations annexed to the International Radio-Telegraph Convention to be put in force in the Portuguese Colonies.

As and from May 1st last the Portuguese Colonies will admit for transmission by their lines only private telegrams and radio telegrams, which are worded in clear Portuguese, French or English, and which contain the signature of the sender. However, the use of the various codes established by special arrangement is maintained for commercial telegrams. These are only accepted at sender's risk, and are submitted to censorship, which may cause delay, and no request for reimbursement will be considered. The use of the Italian language is allowed for telegrams between the Portuguese colonies and Italy, Lybia, and the Italian possessions in East Africa.

* * * * * *

SPAIN.

At the request of the Austro-Hungarian Ambassador in Madrid, as from June 15th in all stations authorised to carry on an international service, press telegrams will be accepted for Austria-Hungary *via* Buda Pest, at a charge of 14½ centimos (1½d.) per word.

# Share Market Report

LONDON, *July 13th*, 1916.

As a result of the issue of the Marconi Company's Report and the Managing Director's speech at the Annual Meeting, the considerable progress which is being made by wireless has been very generally appreciated and has led to an all-round demand by the public for the shares of the various Marconi Companies.

Marconi Ordinary, £3 8s. 9d.; Marconi International Marine, £2 1s. 3d.; Marconi Preference, £2 16s. 3d.; American Marconi, 18s. 9d.; Canadian Marconi, 11s. 6d.; Spanish and General Wireless Trust, 12s.

# Wireless Telegraphy In the War

EXIT THE GERMAN "SPY SHIP."

THE extremely interesting case which culminated in an appeal against the condemnation by a decree of the Prize Court of the s.s. *Ophelia* has recently been concluded. In our issue of June last year we published a picture of Dr. Pfeiffer, the commanding officer of the vessel, in the act of giving his evidence before the Court, presided over by Sir Samuel Evans, and at that time some of our daily contemporaries were referring to the vessel as the "mystery ship."

We may recall to our readers the fact that this vessel was ostensibly a floating hospital and claimed the immunity accorded to such vessels under the provisions of Article X. of the Hague Convention, 1907, which laid down that "ships used solely "with a view to aiding the wounded, sick and shipwrecked, shall be respected and "cannot be captured." Actually she was proved to be a German spy utilising her immunity for signalling purposes. This fact was first brought out by Mr. J. A. Cox, the leading telegraphist on H.M.S. *Lawford*, to whose skill and vigilance the detection of this piece of German treachery was originally due.

After very careful sifting of evidence on the part of Sir Samuel Evans, the vessel was condemned by him, mainly on the grounds that the *Ophelia* never rendered the slightest assistance to any single wounded, sick or shipwrecked man; that her construction and equipment were totally unsuited to the purposes of a hospital ship; and that her officers were constantly in touch with German ships of war, receiving orders from them and carrying out such orders. This judgment was given on May 21st last year, and an appeal against it was carried to the Judicial Committee of the Privy Council, whose final judgment was promulgated on May 8th of this year.

Sir Arthur Channell, in delivering final judgment, emphasised at considerable length the great attention which had been paid to the signalling equipment of the ship, which included a special lengthening of her masts, for the express purpose, and with the actual effect, of extending the receiving capacity of her wireless installation. The learned President was totally unable to accept the ridiculous explanation of Dr. Pfeiffer that the vastly excessive supply of coloured signals, fired from a special kind of pistol, were intended to "illuminate the surface of the sea and assist in searching "at night for shipwrecked mariners or their corpses"! Moreover, their Lordships laid down that the Hague Convention says nothing to justify the transmission of

messages (all of which when sent by a hospital ship must be of an innocent character) in a *secret code* as was done in the *Ophelia's* case. The destruction of the wireless codes, logs and other documents completed the chain of evidence which led the Court to confirm the original decision.

There is a touch of irony involved in the fact that since the original condemnation the vessel had been used by the British Admiralty, and has been destroyed by the Germans themselves.

### DUPLICITY AT EVERY TURN.

Just after the final decision of the Court of Appeal in the case of the German spy-ship *Ophelia* came the trial of the case affecting the Norwegian ship *Bangor*, which was seized by H.M.S. *Bristol* in South American waters whilst acting as a supply ship to the German cruiser *Dresden*.

The story is worth telling, as an illustration of the devious ways which the Germans pursue for effecting their ends. The first act of the drama dates as far back as Christmas Day, 1914, when the *Bangor* sailed from Copenhagen on an apparently perfectly innocent voyage to New York. Once arrived in the United States, chameleon-like she changed her skin to suit her surroundings, and adopted the American name of *Seattle*. From New York she went to Baltimore, where she was joined by three men of German origin, one of whom was a wireless operator, who fixed up an installation as soon as the vessel was fairly at sea. The wireless code served out for use and generally employed was German, and the super-cargo, rejoicing in the name of Vielmetter, received, through the agency of the ship's wireless, instructions as to what course the captain was to take. Over and above the regular signal book there was a supplementary German secret private code.

As soon as H.M.S. *Bristol* had taken possession of the vessel—the capture being located not far off the Straits of Magellan—Vielmetter got rid of the codes by throwing them overboard, whilst one of his assistants, who had kept a record of the wireless messages received, destroyed the message register together with most of his other secret papers by fire. Vielmetter openly acknowledges that he understood the cargo on the *Bangor* (alias *Seattle*) to be intended for use by a vessel in the German Auxiliary Fleet, and said that he received his instructions both as to where to join and what procedure to follow from a Mr. E. Nordmann, an agent of the German Naval Attaché in New York. The owners of the vessel defended the case, not by denying the fact that she was a supply-ship for the *Dresden*, but on the grounds that the waters in which her capture was effected were territorial waters.

* * * * * *

### ALPINE WARFARE.

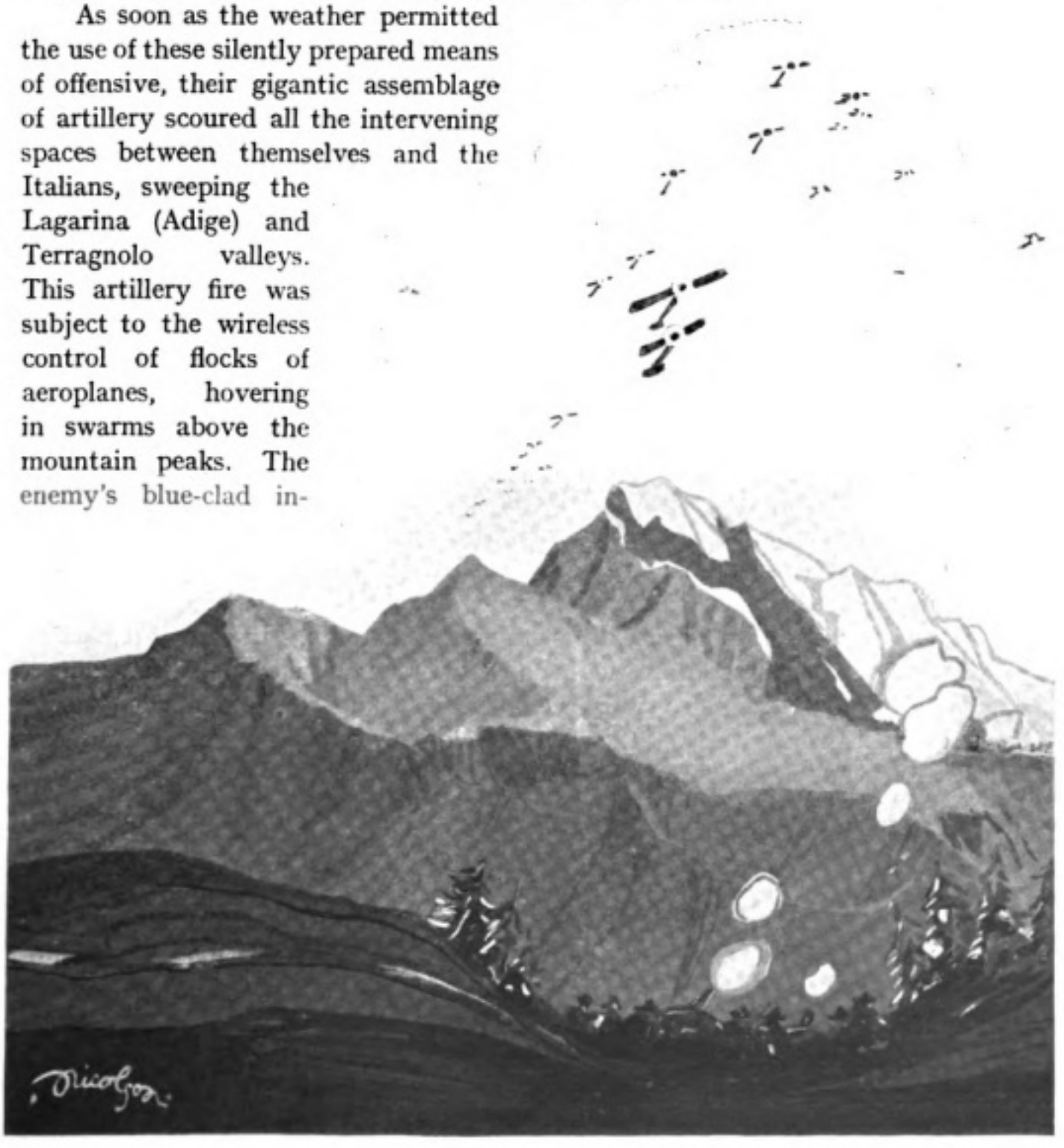
Imitating their Allies on the Western front, the Austrians, doubtless led by officers from the nation with whom Italy is even yet not technically at war, hurled themselves upon the Italian advanced positions. Our gallant Allies, after a long and gallant struggle against the natural obstacles imposed by their unnatural frontier, had begun to impress them with the realisation of a serious menace, hence their elaborate winter preparation for an overwhelming offensive on the Mackensen-Hindenburg model. There is something extremely picturesque in this warfare

amongst the mountains, whose contours are in this district particularly abrupt and rugged. The almost total absence of roads renders peculiarly difficult the task of keeping the various hill-perched positions supplied with rations and munitions, whilst the nature of the terrain necessitates a reliance for communication upon wireless telegraphy almost to the exclusion of any other.

As might be expected from the army of the Motherland of Senatore Marconi, the Italian military forces are particularly well supplied and organised in this respect, and the enemy was obliged to counter the Italians' radiotelegraphic equipment before they could make headway against them.

The winter months were evidently extremely well utilised by the Austrians in this theatre of war, for their offensive revealed a massing of heavy guns upon craggy heights, on a scale not unjustly described as colossal.

As soon as the weather permitted the use of these silently prepared means of offensive, their gigantic assemblage of artillery scoured all the intervening spaces between themselves and the Italians, sweeping the Lagarina (Adige) and Terragnolo valleys. This artillery fire was subject to the wireless control of flocks of aeroplanes, hovering in swarms above the mountain peaks. The enemy's blue-clad in-



fantry, after the way had been prepared for them by this hail of shells, swept on in thick formation and paid an enormous death toll at the mountain barriers. The Allies here, as on the French frontier, adopted the common-sense tactics of allowing the less easily held positions to fall *at a price*. That price was an extremely heavy one; it has been paid, and now the time has arrived when the dearly fought positions are once again being reft from them. Thanks to the brilliant Russian offensive and the gallantry of the Italian troops the Austrians are being obliged to evacuate what they had won at a much faster rate than they gained it.

* * * * * *

### A Corner of the Veil Lifted.

The Censor has lifted a corner of the veil covering British submarine exploits. Rudyard Kipling's articles on "The Trade" (as it is called) will be read by everyone, and the following narrative, contributed by Miss Jane Anderson, forms a fitting pendant to his stirring yarns.

A British submarine after contact with an enemy mine had to perform a 300-mile voyage before reaching port. It had suffered so severely from the resulting explosion that every man on board had been thrown upon his face, whilst the glass protecting the dials was shivered to pieces and rattled in splinters on the floor. One of the officers interviewed made the remark, "It was fine, d'you know, to see the "crew. They got on their feet and were at their stations before the commander "had time to give the order." Just as a man after a bad fall feels his corporal entity *seriatim* limb by limb in order to prove whether "anything is broken," so on board the submarine first one piece of machinery was tested and then another. As soon as the C.O. found that his motors would be able to bring him to the surface and had started them on the task his first care was to see if the wireless was working.

As our British "submariners" were slowly rising, their quickened ears strained to catch every sound, they could distinctly hear in the silence room "the noise "of the wireless sparking." The operator was testing it in preparation for possible use as soon as the surface of the sea was reached. The bow plating was buckled, two out of the three bow bulkheads were gone, and the rudder twisted awry. The man-of-war had become as defenceless as an unarmed tramp. In case of danger or distress their only resource lay in the hope that wireless would be able to summon help. But with true British grit no help was asked for; they pounded along "awash" under their own power, the waves breaking over the bridge and hammering on the solitary bulkhead. "And so," ended the officer, with a smile, "we came "home."

* * * * * *

### Wireless Aid in Tropical Warfare.

In a few pregnant words a newspaper correspondent with General Smuts draws one of those pictures which seem to impress themselves at once on the imagination. He is describing a sweeping movement being made across the plains, hills and forests through which the British forces from Rhodesia are advancing against German East Africa. The journalist who is accompanying this section of the expedition describes the chagrin of the British Imperial troopers at the fact that the German enemy abandons one position after another almost without fighting. The chief

difficulty lies in the fact that the way forward has to be "cut through untravelled "bush, where the spoor of the latest armoured motor-car mingles with the footprints "of the ostrich and the eland. Men and animals all seem on the march together. "Overhead hover the aeroplanes, which keep within wireless call of the columns toiling "through the forest primeval."

In a recent issue we referred to the fact that enemy wireless was discovered in the midst of a North African desert, and discovered through the medium of scouting British aeroplanes in constant radio touch with one of our flying columns. In the above extract we have drawn for us a sketch of operations in East Africa under totally different conditions. *There* the forces of Nature set themselves against the growth of any kind of plant life; *here* the conditions are so favourable that plant life luxuriates in stupendous abundance. Under each condition man finds considerable difficulty in making his way, although for totally different reasons. But in each case invaluable aid is rendered him by his latest means for overcoming natural obstacles. In each case the advancing column, crawling painfully over the soil which seems to attempt to bar his progress, is watched over by soaring airmen, continually in touch with their less fortunate comrades below, by means of wireless. 'Tis an interesting chapter in the eternal struggle between man and nature.

# War Notes

*Kitchener's Wireless.*

It is sometimes forgotten that the late Lord Kitchener received his appointment as Minister of State for War through the instrumentality of a wireless message, which reached him when he was actually on board a steamer bound for Calais. This message brought his lordship back to London to assume the direction of the British War Machine, which owes so much of its efficiency to him.

* * * * * *

*A Naval Nickname.*

The British Navy has long reduced signalling to a fine art, and now that wireless telegraphy has become so indispensable a feature in sea operations of every description, the British Tar has stamped his acceptance of the new science by endowing the "Chief Yeoman" of Wireless Signals with a nickname. This, which, in the first instance, was "sparker," has now evolved into "ferics," which is the navyese for atmospherics.

* * * * * *

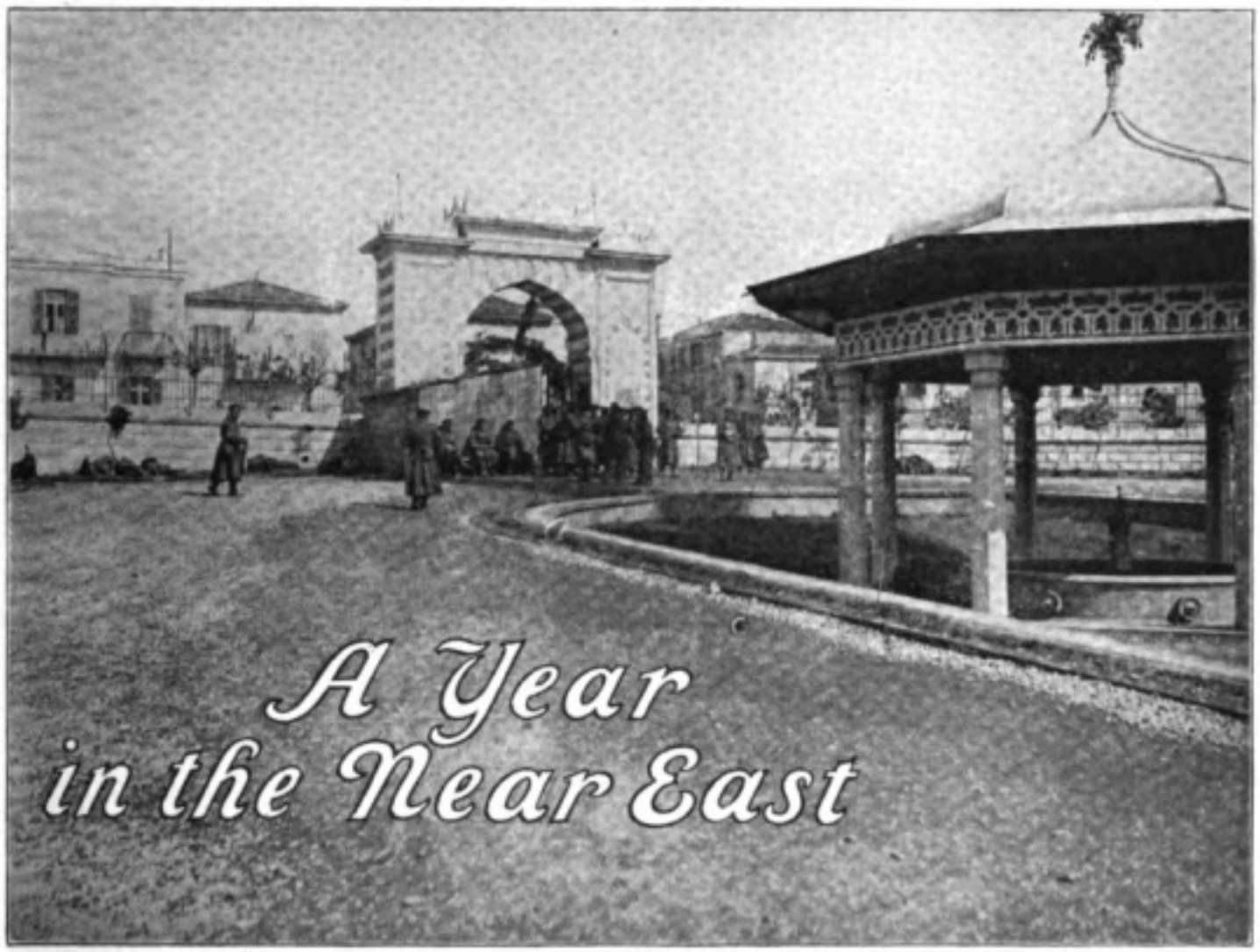
*Faith.*

It is a curious fact that only "Landlubbers" were depressed by the first Admiralty despatch concerning the Jutland battle. As compared with sailors, we are "men of little faith"! The wireless operator on one of the units of England's Mercantile Marine reports that on handing his first wireless message to the Commander with the Admiralty text correctly rendered, the latter refused to publish it. His faith in the British Navy was not to be shaken, and only when a second wireless message came along with the later information, did he realise that the fault did not lie with the news, but with the somewhat inept expression thereof.

# A Wireless Army Car

*Photo by*] [*Brown Bros., New York.*

AUTOMOBILE WIRELESS SET IN USE BY THE UNITED STATES ARMY. ITS CHIEF UTILITY LIES IN THE FACT THAT IT CAN BE MOVED RAPIDLY FROM ONE SPOT TO ANOTHER.




# Some Recollections of Wireless Service on the Egyptian State Yacht

By PERCY W. HARRIS

*With Illustrations by the Author*

(*Continued from p.* 289.)

WRITING of guns and brigands reminds me of another little adventure when I found myself in a miniature hail of bullets. At the time we were lying off Thasos (the birthplace of St. Paul the Apostle) and I had received, the previous night, a message from Port Said saying that Janina had fallen. Thinking that the news would interest the islanders, an official had sent ashore to tell them, with the result that before long the inhabitants (mostly Greeks) were wild with excitement and joy. Guns were fired in the air, cheers arose in volleys and people could be descried running hither and thither on every side. Suddenly I heard whistling sounds around me; little splashes in the water showed that these were caused by bullets. It was evident that either by accident or malice guns were being fired at the yacht and it can be imagined that I lost no time in seeking cover!

NOTE.—Our headpiece photograph represents Bulgarian soldiers in the courtyard of a mosque in Salonika.

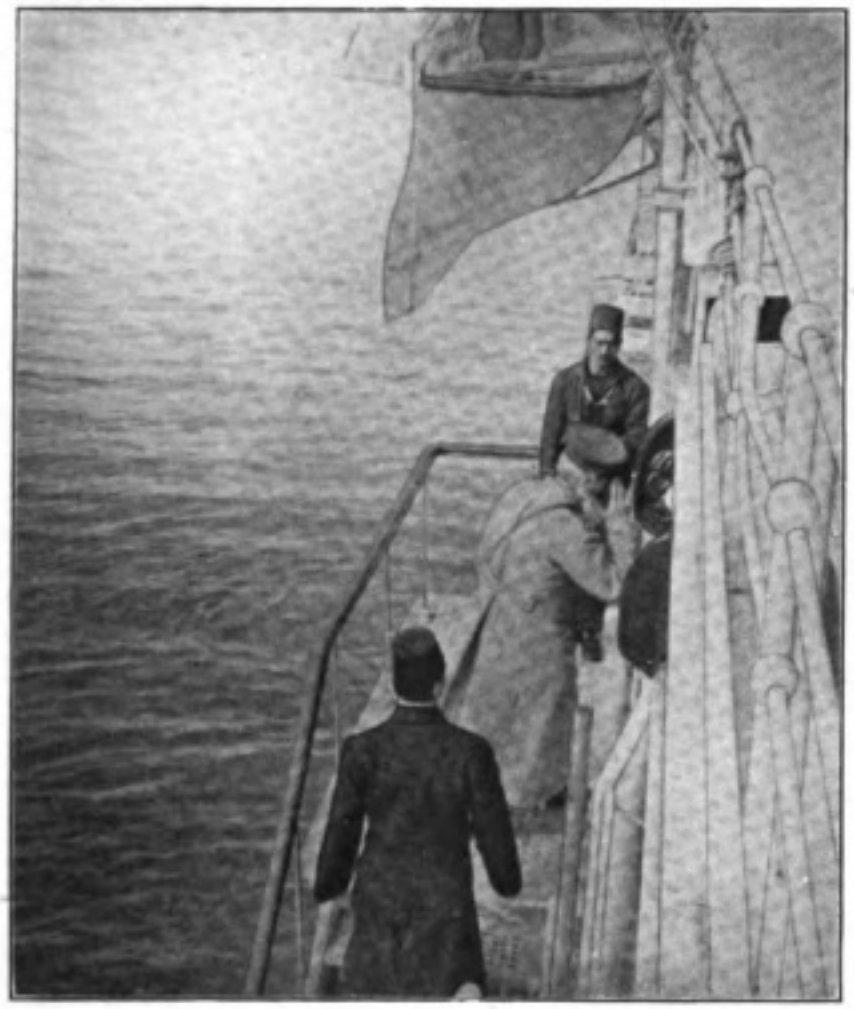
The Balkan War to which I have referred will almost have been obliterated from the minds of most of my readers by the events of the stupendous struggle through which we are now passing. But in its way it was a big affair, involving Turkey, Greece, Bulgaria and Serbia, the last three being Allies then! I was in Constantinople when the Turkish Army was mobilised and saw thousands of Turkish soldiers in khaki march off to the war never to return. Later, I was much closer to the firing line at Salonika.

The Turkish inhabitants of Albania and parts of Thrace soon suffered terribly from the invading hordes of Greeks, Bulgarians and Serbs, and their brother Mohammedans in Egypt, hearing of their distress, begged the Khedive to succour them. With this object the *Mahroussa* was sent loaded with flour and provisions to Kavalla, now a Greek port but then in temporary possession of the Bulgarians. Kavalla had a particular interest for the Khedive as his famous ancestor Mohammed Ali, first

"KAVALLA . . . THEN IN TEMPORARY POSSESSION OF THE BULGARIANS."

Khedive of Egypt, was buried there; and further, he owned large estates in the neighbourhood. On arrival at the port some delays arose in obtaining permission from the Bulgarian authorities to land our cargo, and after a while the Commander of the port himself came out on a visit of inspection. I was fortunate enough to secure a snapshot of him just as he saluted our Commander at the top of the companion ladder.

Enquiries made by the officials of the Red Crescent Society, whom we carried with us (the Red Crescent Society is the Egyptian equivalent of our Red Cross), showed that hundreds of families were encamped on the seashore, having been driven out of their villages and their homes burned. It was necessary to do something at once, for Kavalla could not hold them all and many were suffering severely from exposure. The Greek priests were doing much for them, and after an interchange of telegrams it was decided that we should bring as many as we could away. Thenceforth we became a "rescue" ship and made several journeys to Kavalla, conveying



THE BULGARIAN COMMANDER'S VISIT AT SALONIKA.

Bearing this in mind, think of the misgivings which filled the hearts of the British members of the crew when hundreds of refugees with their personal effects were brought out from the shore in barges and commenced to scale the ladders at the ship's side. Barge after barge, packed with wretched humanity, arrived at the ship and a continuous stream of men, women and children loaded with bales and packages poured on to the decks. Swarthy Albanians in baggy trousers and bright-hued shirts, with wide scarves wound about their waists and knives of murderous appearance protruding; veiled Turkish women

the refugees either to Chanak in the Dardanelles, or else down to Dalamon and Egypt. On one of those expeditions we came perilously near shipwreck.

In England, Board of Trade regulations prevent a ship putting to sea overloaded or in a dangerous condition, but for the *Mahroussa* there were no regulations save those of the Khedive—and he was not particular. We had no lifebelts on board and the lifeboat accommodation barely sufficed for the officers, staff and crew. Further, we were not designed to carry cargo, the yacht being ballasted with concrete so as to keep her trim with the normal complement of passengers and crew—in all, two hundred.

HUNDREDS OF REFUGEES WERE BROUGHT FROM THE SHORE IN BARGES.

"BY MIDDAY ALMOST EVERY FOOT OF THE DECK WAS OCCUPIED."

draped in funereal black, children of twelve or thirteen, glancing timidly about them and trailing still younger brothers and sisters—in truth, a motley crowd, jostled one another up the ladders. As they set foot on deck all underwent a cursory examination by an Arab doctor and suspicious cases were turned aside for further inspection by other doctors on board. One side of the ship was set apart for the women and the other for the men. The luggage was tipped into the hold or piled fore and aft, and the men soon made themselves comfortable by sprawling on deck on the rugs and blankets they had brought with them, whilst the women huddled together in groups and squatted, Turkish fashion, wherever they could find shelter. By mid-day almost every foot of the deck was occupied and the pile of luggage on deck had grown to formidable proportions. Picking my way among the evil-smelling crowd, I sought out a Turkish official who was superintending the embarkation and enquired how many refugees had been taken aboard.

"Between seventeen and eighteen hundred," he answered. "We shall stop now."

Between seventeen and eighteen hundred souls besides officials and crew! Counting these we had fully two thousand. And this on a yacht designed to carry but two hundred people!

To make matters worse, outside of the harbour a heavy swell was running and a gale of wind sprang up directly we put to sea. Loaded almost to the water

line and with a distinct list to port the *Mahroussa* staggered through the waves, great seas washing over her bows and drenching the terrified passengers, many of whom had never left land before. I have sailed in many ships on many seas and have stood the buffetings of the North Atlantic in its most angry winter moods, but never before had I experienced such a storm as howled around us that night, or such pitching and rolling as we endured. Sitting in my cabin through the night, and even with the telephones gripped tight to my head, I could hear groans from the poor refugees outside intermingled with the howling of the wind and sea. I expected every moment to have to send out the call of distress, but fortunately there was no need.

Three children were born on board that night.

When day dawned the storm abated somewhat, and the refugees were fed, but the seas were heavy and still drenched all those who were crowded together forward. An inspection revealed the loss of two boats and portions of the deck structures, whilst two ladders were found smashed to matchwood. Some of the rigging had also been carried away, but fortunately the aerial remained intact, to my great relief.

In due course we came to the Dardanelles and took shelter there, landing many of our passengers at Chanak. That night I slept as I had not slept for months, secure in the thought that we were once more anchored in calm waters.

After a few trips to Kavalla we were dispatched to Salonika on a similar errand of mercy, this time having to deal with the Greek authorities. Salonika is a wonderful old city (the Thessalonica of the Bible, as most readers will know), and had not long

SOME OF THE REFUGEE CHILDREN.

been captured from the Turks. It yielded, as a matter of fact, with scarcely a struggle—but even the mosques were occupied by military guards. Some of the larger mosques were Byzantine churches from which the Mohammedans had removed the Christian emblems, and when we arrived they had just been changed back to Christian use. In one, the Church of St. George, I found the Greek priests officiating at hastily constructed wooden altars, covered with white sheets and guttering candles. In one corner I came across the tomb of a saint revealed through a hole in the wall opened that morning after having been bricked up four hundred years.

Late one afternoon, sitting "listening-in" to what might be happening in the surrounding ether, I heard a piping note like that of the Salonika Station but with a slightly different pitch. It grew louder rapidly and soon had reached that intensity in which the note ceases to be musical and changes to a violent pounding noise in the telephones. I then guessed that the signals must proceed from some neighbouring ship just arrived, and a step out on deck confirmed my belief. Within a couple of lengths of the *Mahroussa* lay another yacht, her hull also painted white, but differing from our ship in having pure white funnels. She proved to be the Greek royal yacht *Aphrodite*, bearing the King of Greece on a visit of inspection to his newly captured city.

The town was gaily decorated in honour of his coming, and we watched a launch take the royal visitor across to the quay. A day or two later, when the king was ashore and his yacht lay idle at anchor, the *Mahroussa* cast off her moorings and left for Egypt. And within an hour or so the triumphant king, after a brief taste of the joys of conquest, lay dead—shot through the heart by a cowardly assassin.

I left the *Mahroussa* shortly afterwards, at the expiration of my year's contract, as I had more than a suspicion that the Khedive disliked the British and all their ways. Later events showed how well founded was my belief.

# Engineers and the War

ONE of our contemporaries, the *Electrical Times*, made in a recent issue a comment on the subject of the Jutland naval battle and the Honours List: two items which appeared in the Daily Press side by side. The Editor called attention to what we all know—namely, that upon the British Fleet depends the existence of our Empire, and he reminds his readers that the navy of to-day is the creation of engineers, that it is run mainly by engineers, and that thousands of these men heroically perished in order to bring the battle to a successful issue. Yet the Honours List in which a number of Tory "Tweedle-dums" were balanced with a number of Radical "Tweedle-dees" contained, "if we except a couple of Government and dockyard contractors, not an "engineer on the list." Seeing that three engineers (Col. C. F. Close, Lieut.-Col. N. M. Hemming and Capt. Riall Sankey) have received appointments as Companions of the Order of the Bath, the latter statement is perhaps a little too sweeping. But the substantial justice of our contemporary's remarks remains unaffected.

# NOTES OF THE MONTH

In our "Wireless and the War" columns for June we adverted to the naval disadvantage imposed upon Great Britain in her pre-war policy of totally neglecting the construction of rigid airships of the Zeppelin type. We showed how in connection with their radio-telegraphic apparatus these machines have proved of inestimable value to the enemy for scouting purposes. Our readers may have noticed that in the debate in Parliament on the occasion of the announcement by the Government of the formation of a new Air Board under the presidency of Lord Curzon, Mr. Winston Churchill, whose magnificent achievements in the administration of the Admiralty during the most critical phases of the war give him an unequalled authority, confirmed our views by speaking contemptuously of the Zeppelin as an instrument for war over land, but admitted that it "had unrivalled power for long-sustained reconnaissances at sea."

* * * * * *

We understand that the Post Office Provincial Superintendents and the Headquarters Staff of Traffic Managers have now been amalgamated into one establishment. This will be under the control of Mr. R. A. Dalzell, who will bear the title of Chief Inspector of Telegraph and Telephone Traffic. His two principal assistants will be Mr. L. Harvey Lowe, late Deputy Controller of the London Telephone Services, and Mr. J. Lee, with the title of Deputy Chief Inspector of Telegraph and Telephone Traffic. Mr. W. A. Valentine, late Provincial Superintendent, has been appointed Deputy Controller of the London Telephone Service.

* * * * * *

Apropos of the world-wide nature of our circulation, a reader-correspondent in Sioux City, Iowa, U.S.A., has sent us an interesting cutting from a newspaper in Omaha describing an American Amateur Radio Station. Messrs. W. C. Reinhardt and B. M. Bryce are the makers, as well as owners and manipulators of the installation, which claims a radius of nearly 1,000 miles. To use an appropriate Americanism, this is "some" station, and speaks eloquently of the skill, as well as of the enthusiasm, of the young telegraphists.

* * * * * *

The determination of the difference in longitude between Paris and Washington with the aid of wireless telegraphy, which has been in progress since October, 1913, has been completed. The distance between the stations is 6,175 km. The result, expressed in terms of time, is 5 hours 17 minutes 35·67 seconds, and has a probable accuracy of the order of 0·01 second.

# To Our Readers

CHARLES KINGSLEY introduces into one of his novels a character of a somewhat dubious status who when interrogated by a personage in authority proclaimed himself as "a man of no country." The interlocutor justly avowed himself as intensely suspicious of anyone who so classifies himself. The period during which Kingsley was writing saw the rise and growth of the "Manchester School" with its contemporaneous cult of "Internationalism." The "narrow boundaries which separate race from race" were to be swept away, and patriotism was to be coterminous with the orbit of the inhabited world. The aim of civilisation was to be directed towards destroying national peculiarities, towards bringing people of every clime to the same dull level, towards forcing every human being into an identical mould. Thank heaven, these ideals have vanished! With all its vicious tendencies, the *Deutschland über Alles* of Germany is better than such Internationalism. Of course, this precious doctrine bore within it its own destruction. Your Internationalism can no more turn an Englishman into a Frenchman, or a Frenchman into an American Indian, than it can turn a woman into a man by merely robing her in the garments of the sterner sex. A sane patriotism has taken its place, and one of the strongest points in favour of the Allies is the co-operation for a common end of the Latin, Slav and Anglo-Saxon races, each with its own national peculiarities, national aims and national ideals.

The sciences owe much to the fact that their eminent men focus upon their labours not only the attributes of their own personality, but those of the race to which they belong. No science has attained its present condition solely on the initiative and investigations of pioneers belonging to any one nation. Take, for instance, Radio-telegraphy. A Danish investigator, Oersted, first showed the connection between electricity and magnetism; Ampère, Faraday and Henry, belonging to France, England and America respectively, extended the principles of the combined science. Clerk-Maxwell and Hertz, working the one in England, the other in Germany, demonstrated the relation between electricity and light. Professor Branly, of France, Sir Oliver Lodge, of England, and Professor Righi, of Italy, followed upon similar lines. The science was ultimately brought to a practical issue by the crowning discoveries of Senatore Marconi. The latter, himself partly of British and partly of Italian parentage, has divided his labours between an English and an Italian *milieu*. Internationalism in the Manchester sense is not responsible for any of this; Radio-telegraphy is the product of the combined working of the choicest brains of separate nations and

dissimilar races. It is hardly too much to say that had it not been for these variations the results obtained would have fallen far short of the progress actually made. This is patriotism *in excelsis* as opposed to Manchester internationalism.

At various periods mistaken enthusiasts have endeavoured to introduce a single international language to take the place, for certain purposes, of the various tongues employed by people of different races. The idea is as old as the story of the tower of Babel, but it is none the less erroneous. The peculiarities of the national spirit of the various races find far more assistance than hindrance from using a language specifically adapted to its own needs. The fact that Latin was employed as a world-wide medium during the Middle Ages furnishes really but a false analogy. The more highly educated moderns can understand most of the leading languages sufficiently to comprehend the main drift of any printed exposition. But when an applied science begins to make a really wide appeal it becomes necessary to make provision for the general reading public. Such a stage has now been reached in wireless telegraphy, and the appeal made by our magazine has become so wide that we find ourselves met with a demand for its appearance in other than an English form. The interest taken in the subject by Spain, Portugal and the great Ibero-American Republics of the New World has induced us to make a start by issuing THE WIRELESS WORLD in Spanish and Portuguese as well as in English. All the preliminary steps have been taken, and not many weeks are likely to elapse before Spanish and Portuguese readers will find our new monthly issues available in their native tongue. The Editorship will be undertaken by the well-known *littérateur* Señor Enrique Perez, and the edition will contain all the important items of the English magazine, together with some special features of its own. Such a step in the " piping times of peace " would have constituted a bold and enterprising venture : this terrible world-war adds immensely to our difficulties, and nothing but an overwhelming sense of the urgency of the demand would have induced us to take such action under present conditions. We feel sure that we may reckon on the co-operation of our readers for giving the maximum amount of publicity possible to our new venture, and launch our enterprise in certain reliance upon that kindly co-operation to which in the past we ourselves have owed so much.

The Editor

# Maritime Wireless Telegraphy

BROKEN SHAFT REPAIRED IN MID-OCEAN.

A WIRELESS message received recently at Sydney, New South Wales, from Rabaul records the fine work performed by the officers and engineers of the steamer *Pukaki*, which was adrift in the Pacific Ocean with a broken tail shaft for a period of forty-two days. By improvising his sails the captain managed to navigate the vessel into the Doldrums in order to obviate the chance of drifting on to one of the numerous islands. Fortunately the steamer had a spare tail shaft on board, and when the weather was fine enough the engineers began their task. It was found, however, that the spare shaft was a misfit, and there was no alternative but to set to work with hammers, chisels and files to reduce the shaft to the required size. Eight days elapsed before it was put in position and the propeller fitted on, which enabled her to reach the port of Rabaul.

* * * * * *

FRENCH SCHOONER SUNK.

Wireless telegraphy is steadily fulfilling its uses. The Portuguese steamer *San Miguel* sent the following wireless message : " French schooner *St. Louis* (ex *Johanna*) was sunk on May the 28th. Crew landed." Thus through the medium of the ether, not only were the owners advised of the loss of their ship, but the relatives of the crew were informed of the safety of their friends.

* * * * * *

A LINER TO THE RESCUE.

When the passenger ship *Eugène Pereire* arrived at Algiers recently she reported that during the crossing she received a wireless message from a British steamer saying that it was threatened by a submarine, and asking for assistance. The captain altered his course and proceeded to the spot indicated, at full speed. On arrival, however, the captain of the British steamer advised him that the submarine had not carried out its threat, having doubtless understood the danger which it would run if the *Eugène Pereire* arrived.

### SPAIN RECORDS A CALL.

Quite recently the wireless station at Cape Finisterre reported that it received a wireless call from a ship, whose initials, apparently, were British, demanding help, as she was being pursued by a German submarine. Her position was 10.31 West and 43.18 North—that is, about 25 miles off Cape Villano. She was bound southward, her speed being twelve knots. At two o'clock the same afternoon the steamer reported that she had escaped from the submarine, which fired three shots without doing any damage, and then disappeared. It is an interesting fact that, by the aid of wireless telegraphy, throughout the whole course of her trouble she was able to keep in touch with land.

* * * * * *

### U.S.S. *Tennessee*.

Many of our readers will no doubt recollect reading of the Pan-American Conference recently held at Buenos Aires. The United States Commission returned from the Conference in the battleship *Tennessee*, which proceeded home *via* the West Coast of South America. It will be remembered that the members of the Commission refused to land at Callao, Peru, on account of the alleged existence of the bubonic plague at that port. This incident was the more regrettable in view of the fact that the Peruvian Government had spent a considerable sum of money in making preparation for the welcome of their guests. Our contemporary, the *South American Journal*, quoting the *West Coast Leader*, of Peru, states " if the plea of sanitary conditions is " to be regarded as valid . . . then a highly reprehensible error was committed " in the failure of the *Tennessee* to secure full information regarding the state of the " port before arrival. The cruiser was constantly in wireless communication with " Lima from the time she sailed from Valparaiso."

* * * * * *

### ANTARCTIC RELIEF EXPEDITION SHIP.

An Uruguayan steam trawler built in 1906 for the North Sea fishing fleet was fitted out, and manned with a crew of twenty-six including a doctor, as a relief ship for the members of the Shackleton Expedition marooned on Elephant Island. The trawler, which is named *Instituto Pesca*, was lent by the Uruguayan Government, and was accompanied as far as the Falkland Islands by the British auxiliary cruiser *Macedonia*, one of the latter's officers accompanying the expedition to Elephant Island. The auxiliary cruiser stationed herself midway between the Falklands and Elephant Island, in order that wireless communication might be maintained with the expedition. A wireless telegram has been received at Monte Video from the Falkland Islands announcing that the trawler had arrived there and proceeded immediately to Elephant Island. We are sorry to say that the relief expedition has been a failure. The *Instituto Pesca* got to within twenty miles of Elephant Island, but she then encountered such a large quantity of dense pack-ice that she was forced to turn back. Sir Ernest Shackleton, who accompanied her, stated that it would require a wooden ship of greater resistance and different build to successfully cut a way through the ice. The captain of the whaler, however, sent a wireless to the Uruguayan Government announcing his decision to continue his efforts in the work of rescue. The damage to his boat is to be first repaired.

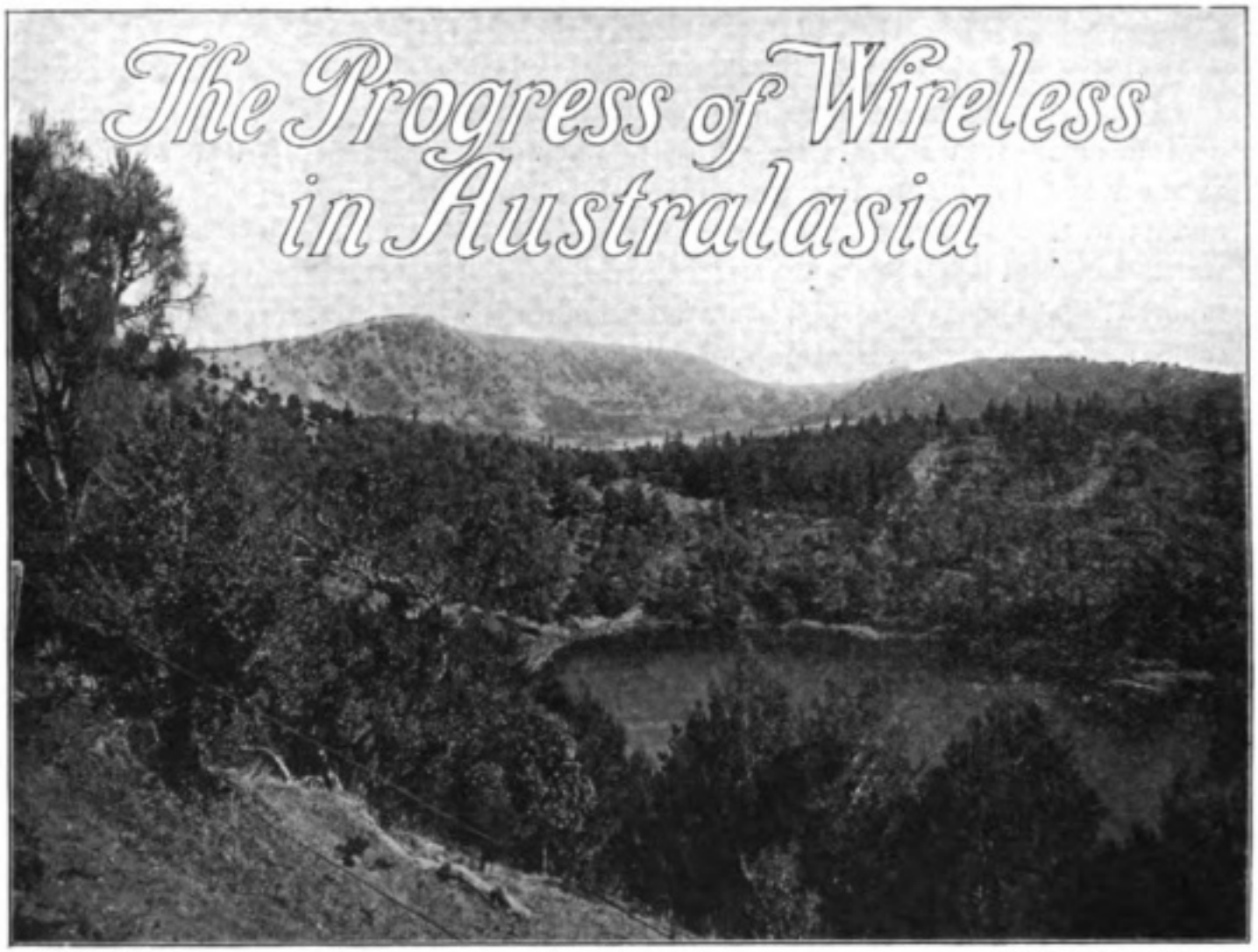



*Photo. by]* *[Giles' Photo Agency.*

THIS PHOTOGRAPH GIVES A GOOD IDEA OF THE TYPE OF BUSH COUNTRY IN AUSTRALIA.

## A Story of Troubles Overcome.

The introduction and development of wireless telegraphy in Australasia have been accompanied by exceptional difficulties, and have taken that part of the Empire through troublous times. The story of those difficulties and the manner in which they have been overcome is unique, and as it has not been related before, we believe it will interest our readers.

The first attempts to introduce the benefit of Senatore Marconi's invention in Australasia were made entirely upon the initiative and at the expense of the Marconi Company, who, in 1905, sent out a representative in the person of Captain Walker, accompanied by two assistants, Messrs. H. M. Dowsett and H. Densham.

Captain Walker, upon arrival, introduced himself to the Governor and the Ministers and officials of the Australian Government, who were all keenly interested in the achievements of Senatore Marconi up to that time, and immediately saw the possibility, as well as the necessity, of Marconi communication in the Antipodes.

In order that the Government and the people of Australia might have practical evidence of the possibilities of this form of communication, Captain Walker proceeded with the erection of two Marconi installations, which had been sent out from England. One of these stations was erected at Point Lonsdale in Victoria, and the other near Devonport in Tasmania. Communication was established and maintained with perfect ease. The reasons for selecting these points for the

demonstrations were probably the importance of communication between Tasmania and the mainland, the fact that the Tasmanian cable lies on troublesome ground, which gives additional difficulties in maintenance, and that Point Lonsdale in Victoria was close to Melbourne, the seat of government.

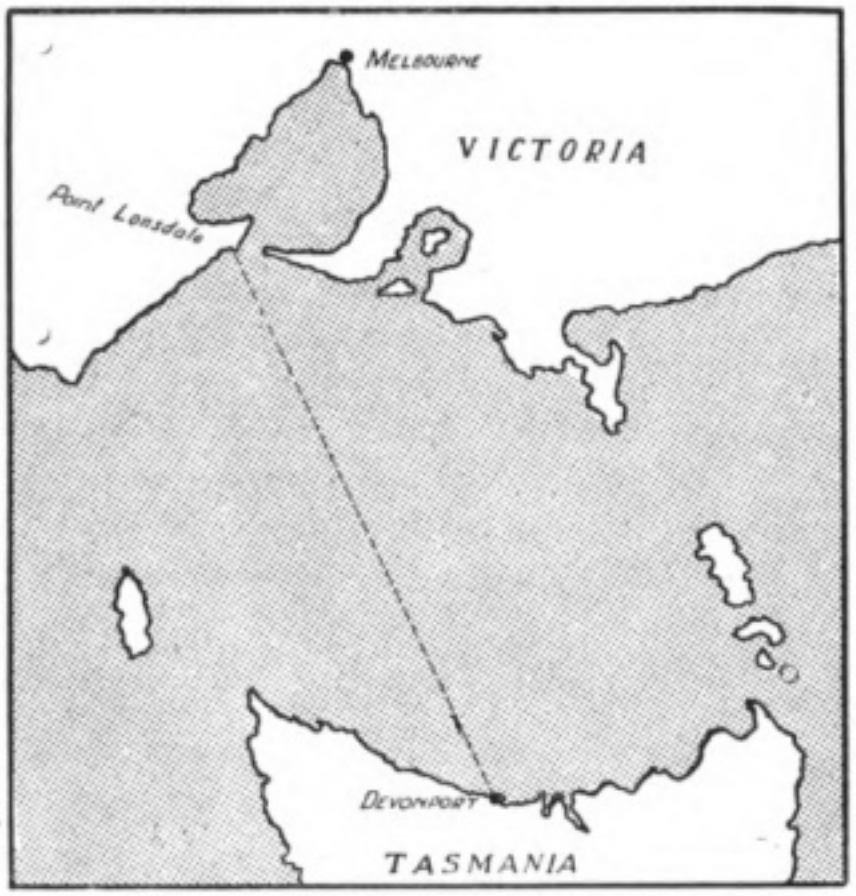
Captain Walker also proceeded to New Zealand, in which country the Australian demonstrations had been followed with great interest. He thoroughly discussed the possibilities with the New Zealand Government, and the Marconi Company, expecting that its apparatus would be required, left the stations standing idle in Victoria and Tasmania.

The next scene opens with a conference in Melbourne in the year 1909, at which a resolution was carried to the effect that a comprehensive scheme of wireless communication for Australia, New Zealand, and the surrounding islands should be drawn up and proceeded with. But alterations of policy occurred before the scheme was put into operation.

Australia and New Zealand were still unprovided with the means of wireless communication; but the former once more made a start when Admiral Sir Reginald Henderson was called in to investigate and report upon the naval defence of the country. Admiral Henderson's report was published a few years ago, and therein will be found a complete scheme for wireless communication for Australia, both

*Photo. by]* [*Hardie.*

A PANORAMIC VIEW OF SYDNEY, LOOKING FROM THE HOTEL AUSTRALIA. THE **BUILDING WITH THE TOWER, ON THE LEFT, IS THE GENERAL POST OFFICE.**




SKETCH MAP SHOWING THE POSITIONS OF THE FIRST TWO MARCONI INSTALLATIONS.

from the naval and commercial standpoints. Although Admiral Henderson's scheme has not been closely followed, the location of some of the existing stations appears to be based on his recommendations.

We now come to the Imperial Conference which was held in London in 1911, at which a proposal was brought forward for providing wireless communication between all parts of our Empire. The proposal was favourably received at the Conference, but the Prime Minister of Australia stated that he could not commit his country to any definite plan; if a chain of Imperial Stations were established they would provide a station in Australia to connect with the chain.

About this time, a step, which appeared to be based on the recommendations of Admiral Henderson, was taken both in Australia and New Zealand, and was the first serious attempt to provide the long-delayed facilities. The Australian and New Zealand Governments called for tenders for the erection of two medium-power wireless stations in each country. There were but two companies capable of undertaking such work—one British and the other German: the former, of course, was the Marconi Company of London, and the latter the Telefunken Company of Berlin. The German company apparently had cast longing eyes in the direction of Australasia, and decided to secure that contract at all costs. Knowing German methods as we know them now, it is not difficult to understand what happened. The Telefunken Company tendered such a low price that the British Company was unable to compete.

The German tender was accepted in both countries, and the stations were erected of German material by German engineers who assisted in selecting the sites.

In the meantime a company had been formed in Australia, with Australian capital, to purchase the rights of the German system. This company installed Telefunken apparatus on a few local ships and erected a small station in Sydney, which it operated under licence from the Government for communicating with ships at sea until such time as the high-power stations were completed. At the same time the Marconi Company had sent a representative to reside in Australia and watch its interests, whilst a number of local vessels were equipped with Marconi apparatus under his direction. The Marconi Company, considering that its patents were being

infringed by the use of the German system, commenced a series of actions in the Australian and New Zealand Courts.

While the medium-power stations were being erected and the rival claims of the British and German systems were being placed before the Government, the Australian Government decided to engage a radiotelegraph engineer as its expert adviser. Unfortunately, in so doing further complications were introduced. The successful applicant had been engineer and technical adviser to a company which had recently been convicted in the High Court of Justice in England of infringing Marconi patents. On his arrival in Australia negotiations commenced for settling the difficulties with which the Government were faced ; but these received a sudden check when the Government announced that its new engineer had produced a system of wireless telegraphy which was to be employed by them and was to make them independent of the patents of other systems. Hence the position became more complicated, particularly in view of the fact that before leaving England the Government Engineer had made a statement to the effect that from the year 1900 the whole of the subsequent development of wireless telegraphy was due to Senatore Marconi's invention, and all so-called systems of wireless telegraphy utilised his principles.

In view of the fact that the Marconi patent had been strongly upheld in the English and American Courts, and in face of the statement referred to, the Marconi Company notified the Government that its new system would be an infringement, and subsequently commenced an action in the Australian Courts.


*Photo. by]* [*Hardie.*

BOURKE STREET, MELBOURNE, FROM THE GENERAL POST OFFICE TOWER. THE LARGE BUILDING AT THE FAR END OF THE STREET IS THE FEDERAL PARLIAMENT HOUSE OF THE COMMONWEALTH GOVERNMENT.

The Government, however, maintained that such was not the case, and proceeded to erect stations at several points round the coast of Australia. The first, opened at Melbourne in February, 1912, has some historical interest in being the beginning of a chain of low-power coastal stations encircling the entire island continent. The Melbourne station was opened officially by the Governor-General, Lord Denman, in the presence of the Ministers and officials of the Government and a large number of private guests, among whom were the representatives of the Marconi and Telefunken systems.

After this matters became more and more complicated between the Government and the Marconi Company, the Government and the Telefunken Company, and between the Marconi Company and the Telefunken Company. The Marconi Company's action proceeded very slowly, as for a period of over twelve months a preliminary action had to be fought, first before a judge in Chambers, then before the High Court of Australia, and finally before the Privy Council in England, before the Marconi Company secured the right of an ordinary litigant to inspect the defendant's apparatus. It is interesting to recollect in this connection that the Government, on the advice of its engineer, endeavoured to prevent this inspection on the ground that it would be prejudicial to the naval and military defence of the Commonwealth of Australia. Although such a contention could not be upheld before the Court, it delayed the action for at least twelve months.

The inspection was finally made, and the Marconi Company decided that its claim of infringement was justified. However, the Government subsequently called in another expert adviser, who said there was no infringement! Thus the position was not relieved on either side, and the action proceeded; but subsequent negotiations enabled a solution to be arrived at just prior to the outbreak of the


*Photo. by]* *[H. J. Shepstone*

LAMBTON QUAY, WELLINGTON, NEW ZEALAND.

*Photo. by]* *[Valentine.*

**GENERAL VIEW OF WELLINGTON FROM THE WHARF. THE LARGE BUILDING IN THE CENTRE OF THE PICTURE IS THE GENERAL POST OFFICE.**

European war. The Government acquired the right of user for certain purposes of existing Marconi patents, while the company withdrew its actions and received a payment of £5,000 under the agreement.

In the meantime the medium-power stations were being completed by the Telefunken Company, and the New Zealand Government had erected also two low-power stations at Wellington and Auckland.

Another development had now arisen in the formation of a new Australian company, which purchased the whole of the existing and future rights in Australasia of the Marconi Company and the Australasian Wireless Company. This new company adopted the name of Amalgamated Wireless (Australasia), Limited, and carries on the work of the two previous companies. It has a capital of £140,000, of which originally half was to be British and half Australian; but, in order to relieve certain financial obligations of the Australian Wireless Company, the Telefunken Company became a shareholder to the extent of 8 per cent. of the capital, which, therefore, was distributed in the following relation: 50 per cent. British, 42 per cent. Australian, and 8 per cent. German. The last fortunately has now been entirely removed with the aid of the Government.

With the formation of this new company and the settlement of the Marconi action against the Government, the wireless position was very much relieved, and Australia is now fortunately placed in having in the hands of an Australian company the whole present and future developments of the world's leading systems, and particularly in having secured itself against the further intrusion of a German company.


*Photo. by*] [*H. J. Shepston.*

THE POST OFFICE, AUCKLAND. THE MAST SUPPORTING THE WIRELESS AERIALS CAN JUST BE SEEN ON THE CUPOLA AT THE RIGHT OF THE BUILDING.

During the time with which we have been dealing the nucleus of the Australian Navy had been established and developed to the point at which the Commonwealth became the possessor of a first-class battle cruiser, three light cruisers, three torpedo-boat destroyers and two submarines.

The wireless telegraphic requirements of the Australian Naval Service were attended to by a branch of that service which worked independently of the other Government service, and it is worthy of particular notice that the naval branch, while steadily progressing along its own lines, did not become embroiled in any of the troubles and difficulties which surrounded the other wireless ventures.

Upon the outbreak of war in August, 1914, the Naval Department was called upon to extend its wireless telegraphic service very rapidly. This extension demanded hurried mobilisation of all its resources, and the closest co-operation with other wireless telegraphic organisations in the country. The Naval Department found the Amalgamated Wireless Company ready and willing to assist to their utmost, and it was largely due to the good relations which had always existed that all obstacles were overcome, and the extraordinary demands of war service were rapidly filled.

About the same time the Government had appointed a Commissioner to examine and report upon the business working in the various branches of the Postmaster-General's Department. Dealing with wireless telegraphy, this Commissioner found that the service was burdened with difficulties which arose from the antagonism of that branch of the Postal Department to the wireless telegraphic companies, and some friction which existed between it and other Government Departments. In the Commissioner's report he pointed out also that there was duplication of

expense in having wireless telegraphy under the divided control of the Navy and the Post Office; in view of the supreme importance of naval work, and of the fact that the naval branch had not suffered disabilities in other directions, he recommended that the two wireless organisations should be combined and placed under the control of the Naval Board. This change was effected shortly afterwards, and subsequently the engineer who had acted for the Postal Department retired from the Government service.

From the foregoing it can be seen that wireless telegraphic development in Australia has been hampered by many complications, but that most of the difficulties have been overcome, and the changes which have taken place have removed the cause of the greater troubles, now leaving the field clear for development along progressive lines. With proper co-operation between the Government and the companies (which have been largely instrumental in bringing this great and useful art to its present valuable stage of development), Australia should advance along lines of steady progress in radio communication.

In a later article we propose to deal in detail with the wireless stations in Australasia.

*Photo. by]* *[Exclusive News Agency.*

A GENERAL VIEW OF THE BEAUTIFUL HARBOUR OF SYDNEY.

## Captain M. P. H. Riall Sankey, C.B., R.E.

CAPTAIN M. P. H. RIALL SANKEY, who was recently created Companion of the Order of the Bath, is a well-known figure in engineering and wireless circles. He is a member of the Institutions of Civil Engineers, of Mechanical Engineers and of Electrical Engineers, and on the Councils of the two former. For many years he was a Director of Willans & Robinson, Ltd., and on his retirement from his position with them, he became a consulting engineer with offices in Westminster. During recent years he has acted as Consulting Engineer to the Marconi Companies, and holds a prominent position on the Board of the "Wireless" and "International" Companies, besides being a Director of the "Wireless Press." Since the beginning of the present war he has, as Staff Captain, rendered valuable services both at home and on the Continent.

# Correspondence

SIR,—Your May edition of THE WIRELESS WORLD has just come to hand. In it I notice "Redax" when between Port Said and Malta has been unable to exchange signals with the former station, though he could pass signals to stations at a greater distance. When I was in charge of the s.s. *Canfield* in the Gulf of Mexico I had a lot of traffic to get through at night-time from Tampico, Mexico. Most of it was put through Tampa, Florida, about 1,000 miles away. Galveston, Texas, was only 400 miles away, but I could never get him, although I used to work to the ships in the Pacific. It was always a puzzle to me why this should be. The difference between "Redax" and myself was, I could work to the west and not to the north, while he could not work to west. I would very much like to know if it is possible to find out why this should happen. (Signed) "PUZZLED."

---

SIR,—I was very much interested in Mr. H. W. Pope's article in the May WIRELESS WORLD upon "How to Repair a Broken Magnetic Detector Spring." No doubt his valuable article was also appreciated by some of our other colleagues who have at some time or other had the misfortune to break the spring and have experienced great difficulty in repairing same.

I am one who has had the misfortune to break the spring, though the method I adopted in repairing it was slightly different from the one adopted by Mr. Pope.

The spring having broken I detached the mechanism, and with a pair of pliers I pulled out the broken spring. I found the end of the spring which is attached to the hook of the hub torn away to about ten inches. With a cold chisel I snapped the broken part off and punched a fresh hole in the spring, filing it oval shape to the size required, refixing it again on to the hook of the hub. I then unscrewed two of the fan-barrel pillars and placed the looped end of the spring over one of the remaining pillars. Having got the spring into position, I gripped the end of the hub to which the ratchet wheel is attached in the vice and, with the other end firmly secured, I turned the vice around, which had the effect of drawing the spring in until I was able to replace the two pillars I had previously removed. I released the vice gradually until the spring was bearing against the four pillars. This part of the operation was not effected without a good deal of physical exertion, due to the strength of the spring. Replacing the brass plate (with screws out) and placing ratchet wheel on top, together with the rest of the mechanism, I started to wind up, but found it necessary to remove one of the main pillars (C) owing to one of the barrel pillars catching against it. I then successfully wound up the spring, and as the barrel slowly revolved around I screwed down the brass plate with the four screws, passing the screws through the oval-shaped hole, which is placed near the ratchet wheel and pawl. Unwinding the spring again and removing the mechanism once more, I replaced the remaining main pillar (C) and, lastly, reconstructed the clockwork. Though I lost about ten inches of spring, I found the clockwork to run for about ninety minutes, having the satisfaction of repairing the spring with the whole mechanism complete. (Signed) L. C. RHODES.

# The Methods Employed for the Wireless Communication of Speech (v)

By PHILIP R. COURSEY, B.Sc.

(Read before the Students' Section of the Institution of Electrical Engineers, on February 2nd, 1916.)

## Summary of Results Achieved.

Before concluding, it may be as well to briefly summarise the most important results that have been achieved :—

About 1906 Fessenden telephoned wirelessly over distances up to about 20 miles, with successful results, employing a small H.F. alternator for generating the oscillations. (It has been stated that he covered much greater distances by the same method at a later date.) Since then numerous tests have been made from time to time, mainly with various forms of arc generator, and some fairly considerable distances have been bridged, the most notable being :—

Poulsen's communications over a distance of about 150 miles in 1908.

Majorana's over distances of about 250 miles, and recently Vanni's between Rome and Tripoli, about 600 miles.

In most cases, however, up to the present, the apparatus employed has hardly been in a fit state for commercial use, owing largely to the considerable amount of skilled attention that is required for its operation, accompanied by the difficulty in most cases of relaying the transmitting microphone on to the existing land lines, so as to enable it to be made use of by ordinary telephone subscribers.

Although up to the present time the various forms of arc generator have proved to be the most successful means of generating the required oscillatory currents, more especially when large powers have to be employed, they require on the whole much more attention in use than do the other methods.

Although high frequency alternators (including the Goldschmidt reflection alternator and similar machines) require little attention in running, beyond that usually given to moving machinery, and in spite of their being essentially a " power proposition " of the type one would think suitable for the results required, yet their great cost of construction and installation will most probably mitigate against their extensive adoption on a commercial scale, especially in view of the frequent and extensive repairs which, up to the present, have proved necessary in all machines of this type which have been constructed.

On the whole, the most promising pieces of apparatus yet devised seem to be the new " valve " or " vacuum " generators of the " Pliotron " type, as no care or attention whatever in maintenance should be required, and the constructional and installational cost should compare very favourably with machine generators—whether they will yet be available for larger powers of several hundred kilowatts remains to be seen—but, apart from actual constructional difficulties, there would seem to be little against their use for such outputs.

Their employment in wireless telephony is at present limited to the use of a large

number in parallel, as has already been described. They have, however, enabled the record for long distance wireless telephone communications to be completely broken by the recent Transatlantic communications, and also those between Arlington and Honolulu (5,000 miles).

The employment of this type of apparatus should lead to considerable simplification of both transmitters and receivers, and would tend to make the apparatus suitable for use by "unskilled" persons, as practically nothing requires to be done beyond the initial switching on of the transmitter, while, in addition, the "microphone" problem of successfully modulating the radiated energy would be largely solved, as their very nature permits of such ready control of the oscillatory output by means of the potential of the "grid" electrode, and of the heating current of the filaments, as has been shown in the long distance communications referred to above, when the transmitter was relayed on to the land lines from New York.

As at the receiver the same type of instrument is available for amplification purposes it should easily be possible to relay the received speech on to land lines—an advantage which would be of considerable commercial value in connection with long oversea transmission.

One great difficulty that will have to be overcome if these generators are to be made for large powers is the disintegration of the filaments by the large oscillatory currents passing to and from it; but it is yet too early to speculate as to what effect this may have on the development of these oscillation generators.

In conclusion, wireless telephony, although an extremely interesting and important development of wireless signalling, will probably never have the extensive application that wireless telegraphy has already attained, but, nevertheless, it has a sphere of utility of its own when the apparatus can be rendered sufficiently "commercial" and reliable in form to be left in unskilled hands, just as can an ordinary wire telephone instrument. Probably its most important application will be to long distance oversea communications which cannot be carried on by submarine cables, its great advantage being that there is no *distortion* of the speech with distance (as in ordinary line transmissions) but merely *attenuation*. Its other important field will be in ship to ship and ship to shore communications for emergency, distress and similar purposes where the rapidity of communication of the desired intelligence (such as the position of a ship in distress, etc.) is all-important. For general communication purposes, however, between ships it is doubtful if it will ever supplant the wireless telegraph, but will remain as an auxiliary to it, for use on such occasions as above.

Finally, I should like to add that it has not been possible, in the limited time available, to do more than sketch out the merest outline of the subject before us; and also to take the opportunity of expressing my best thanks to the Marconi Company for the loan of photographs illustrating their apparatus, and to Messrs. Crosby, Lockwood & Co., for permission to reproduce certain illustrations appearing in their publications.

## APPENDIX I.

### CALCULATIONS FOR ALTERNATOR FOR THE DIRECT GENERATION OF CURRENTS OF WIRELESS FREQUENCY.

Suppose we require to generate a current having a frequency of 200,000 cycles

per sec., which corresponds to a wave-length of 1,500 metres. Assuming an alternator of the usual type, we have: frequency = (revs. per sec. of the rotor) $x$ (number of pairs of poles), so that if $D$ is the diameter of the revolving rotor in feet, and $P$ is the maximum permissible peripheral speed in feet per min. consistent with mechanical stability; we have $N$ = revs. per min. $= \frac{P}{\pi D}$; if $p$ is number of poles, and $\tau$ is the pole pitch in inches, or distance between adjacent poles measured round the circumference of the rotor, we have the frequency of the generated currents

$$n = \frac{P}{60.\pi.D} \times \frac{p}{2} = \frac{P.p}{120.\pi.D} \text{ and pole pitch } \tau = \frac{\pi.D.12}{p}, \text{ whence } n = \frac{P}{10\tau}$$

hence we see that the frequency is independent of the diameter of the armature and of the number of poles, and depends merely on the maximum peripheral speed and on the pole pitch. Returning to our example, we have for a frequency of 200,000 cycles, $\frac{P}{10\tau} = 200{,}000$ or $\tau = \frac{P}{\cdot 2 \times 10^6}$. For ordinary slotted revolving armatures, with the conductors fastened in the slots, the maximum possible value of $P$ may be taken as about 10,000 feet per min. Hence we have $\tau = \frac{10^4}{2 \times 10^6} = \frac{1}{200}$ ins., which can be seen at once to be quite out of the question for practical construction, at least, for anything more than microscopic outputs.

## APPENDIX II.

### Electric and Magnetic Deflections of Electrons in Valves.

If we have a particle of mass $m$, carrying a charge $e$, and moving with a velocity $v$, and subject it to the action of a magnetic field $H$ at right angles to its direction of motion, the particle will be acted upon by a force $F = Hev$, which is at right angles to both its direction of motion and to the direction of the magnetic field. This will cause it to be deflected from its original direction of motion by an amount $= \frac{1}{2}Ft/m$, where $t$ is the time that the particle is under the action of the force—*i.e.*, $t = 1/v$ where 1 = distance travelled. F = above force.

If now we apply an electrostatic field $E$ the particle will be acted upon by a force $= Ee$, hence since the deflection that this produced depends merely on this force, and other constants, it is evident that the ratio of deflection produced by the magnetic field : deflection produced by electric field $= Hv/E$—that is to say, the greater the velocity of the electrons the greater will be the deflection produced by the magnetic field, as compared with that by the electric field; hence, if we have electrons of low velocity, the electric deflection will be more important, as compared with the magnetic, than it will be in the case of high velocity electrons.

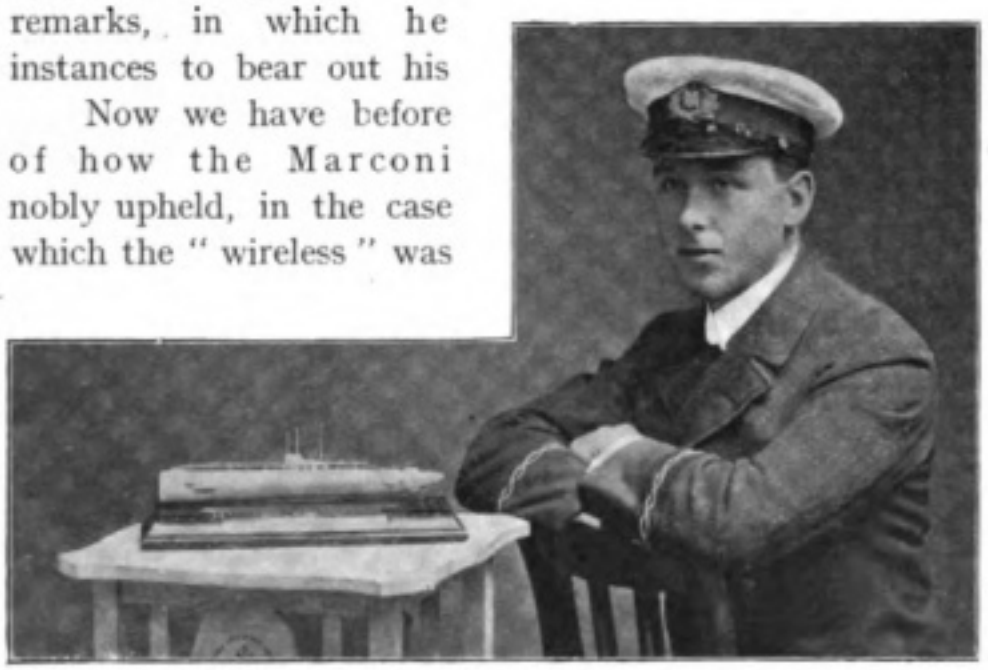
Since, however, the electron is merely a charged particle of mass $m$ and charge $e$, its velocity will depend on the voltage applied to the valve between the filament and the plate, and will increase with that voltage, since the force on a charged particle, as above, is $Ve/d$, where $V/d$ is the potential gradient (volts per cm.), therefore it is to be expected that in valves in which the voltage applied between plate and filament is small (as is usually the case) the electric deflection of the electron stream will be the most useful one to employ.

# Among the Operators

" Gentlemen, I cannot close without reminding you that we have in our employ " in these perilous times some 2,000 young men almost continually on the seas, " and I think it speaks volumes for the great inherent qualities of our young men " from the moment they are given serious occupation and responsibility that in " no single instance has one of them been found wanting in the moment of peril."

Such were the words of Mr. Godfrey Isaacs, presiding at the recent annual meeting of the Marconi International Marine Communication Company, Limited. This tribute will come as no surprise to those who are acquainted with the staff of young men to whom has been allotted the task of handling the wireless apparatus on board the ships of the British mercantile marine. Almost daily we hear of deeds which in peace time would call forth praise in every newspaper, but which in the pressure of war news are frequently overlooked. On another page will be found a full report of Mr. Isaacs's subsequent remarks, in which he quoted a number of instances to bear out his previous statement.

Now we have before us a further instance of how the Marconi tradition has been nobly upheld, in the case of the *San Melito*, on which the " wireless " was in charge of Mr. Owen Chick. We think we cannot do better than quote the following extracts from a special report which appeared in the *Westminster Gazette* for the 28th of June :—



OPERATOR OWEN CHICK WITH THE SILVER MODEL.

" An extremely " interesting and " touching little func- " tion took place yesterday at the Great Eastern Hotel, Liverpool Street, at which " the services of some members of the mercantile marine, that mighty service " whose silent labours and modest courage—so seldom publicly proclaimed, but " withal so vital to the nation's very existence—will stand out in bold relief " amidst the countless gallant deeds of the present war, met with well-merited and " tangible reward.

" The guests of honour were the captain and officers of the *San Melito*, one of " the great tankers of the Eagle Oil Transport fleet, launched at Jarrow in March, " 1914, and possessing an over-all length of 1,550 feet with a total dead-weight " carrying capacity of over 16,000 tons. On August the 21st last, whilst making " a journey to Mexico for the purpose of loading a cargo of oil fuel, she was suddenly " attacked in the Channel by a German submarine, which at a distance of 250 to " 300 yards opened fire on her without warning. The captain was struck by the " flying splinters of a shell which had struck the lower bridge and stunned for some

" moments. But he gave the orders to ' Away, full speed ! ' notwithstanding the " fact that the submarine was flying the signal ' Abandon ship immediately.' For " full forty minutes shells flew all around the *San Melito*. But by consummate " skill and calm courage the crew, who stuck manfully to their post—especially " the chief officer, Mr. Piper, who took the wheel, and to whose steering the escape " was largely due—managed to save their boat.

" Such was the simple story of heroism—typical only of that which the whole " mercantile marine has displayed during the past twenty months—which was " unfolded yesterday to those who were privileged to be present at the Great " Eastern Hotel, when Captain J. D. Jackson and his gallant officers were each " presented with a cheque and a silver inkstand, wrought in the form of the model " of a German submarine, as a memento of one of the most desperate hours of their " lives, the money having been jointly subscribed by the Eagle Oil Transport Co., " Ltd., the Anglo-Mexican Petroleum Products Co., Ltd., Lloyds, and the War " Risks Clubs."

Mr. Chick in a report to the Marconi Company states : " I was very agreeably " surprised when asked to accept, in addition to a cheque, a beautifully executed " model in silver of an early type of U boat mounted on an ebony base bearing the " inscription : ' Mr. O. Chick, wireless operator, presented by the Eagle Oil Trans- " ' port Co. and the Anglo-Mexican Petroleum Products Co. as a memento of the " ' escape of the s.s. *San Melito* from a German submarine after being shelled for " ' forty minutes, August 21st, 1915.' "

Mr. Chick has been in the service of the Marconi Company since November, 1913, when he came up to London from his home at Boscombe for the purpose of joining the training establishment at Marconi House. He is twenty-four years old, and prior to his taking up present employment he held a position in the Traffic Department of the Bournemouth Corporation Tramways. After his appointment to the operating staff in January, 1914, he made his first voyage to sea on the s.s. *Mesaba*, of the Atlantic Transport Line, on which ship he remained for two trips. His appointment to the *San Melito* dates from April, 1914, so that by this time he is well acquainted with the ship on which he had such an exciting experience. On behalf of the readers of this magazine we tender him our hearty congratulations upon his fortunate escape.

* * * * * *

### S.S. " EL ARGENTINO."

This ship, another victim of the German submarine campaign, was sunk recently, but the operator, Mr. John Tyler, was lucky enough to escape unhurt. Mr. Tyler, whose home is at Forest Gate, is 20 years old. His preliminary wireless training was received at the East London Telegraph Training College, and from this college he proceeded to the Marconi Company's school in the Strand. Upon appointment to the staff he sailed on the s.s. *Tuscania*, transferring later to the s.s. *Pomeranian*, and thence to the s.s. *Mississippi*, *Missouri*, and *El Argentino*. Mr. Tyler was so little affected by the disaster that he has been able to take duties upon another ship, and is now at sea again.

# The Special Problems of Aircraft Wireless—VIII

By H. M. DOWSETT, M.I.E.E.

INSULATION ON AIRCRAFT.

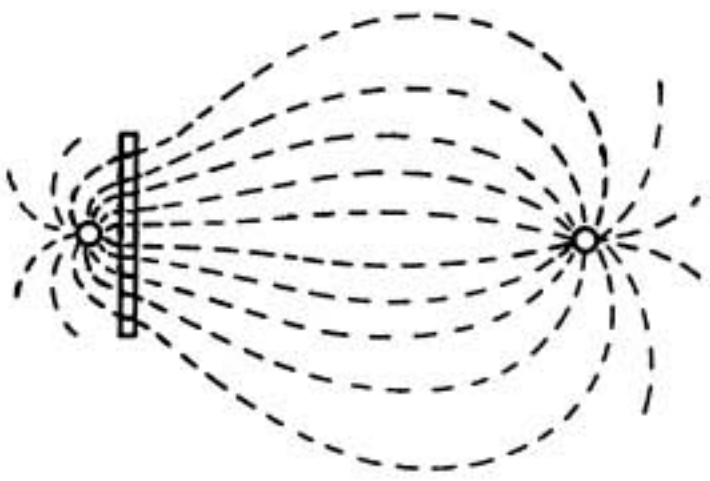


FIG. 4.

section between which there exists a certain potential difference. The conditions at the surface of each wire being the same, they will tend to brush at the same P.D. above space. But suppose a sheet of ebonite is placed between and close against one of them (Fig. 4), then the intensity of

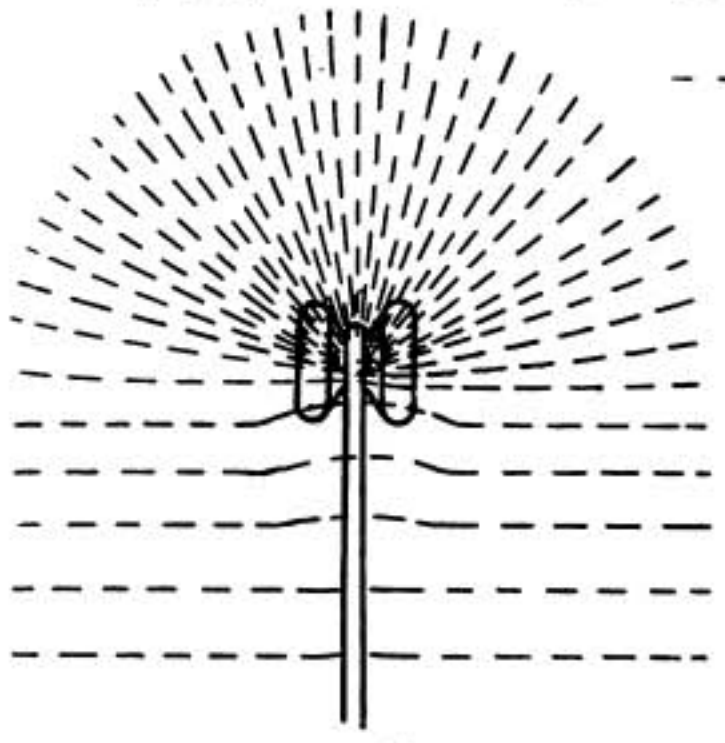


FIG. 6.

IT is not only the neighbourhood of a conductor carrying H.T. current which may create brushing on a thin insulated wire, but the neighbourhood of an insulator under certain conditions may lead to the same result.

Take the case of two wires of equal

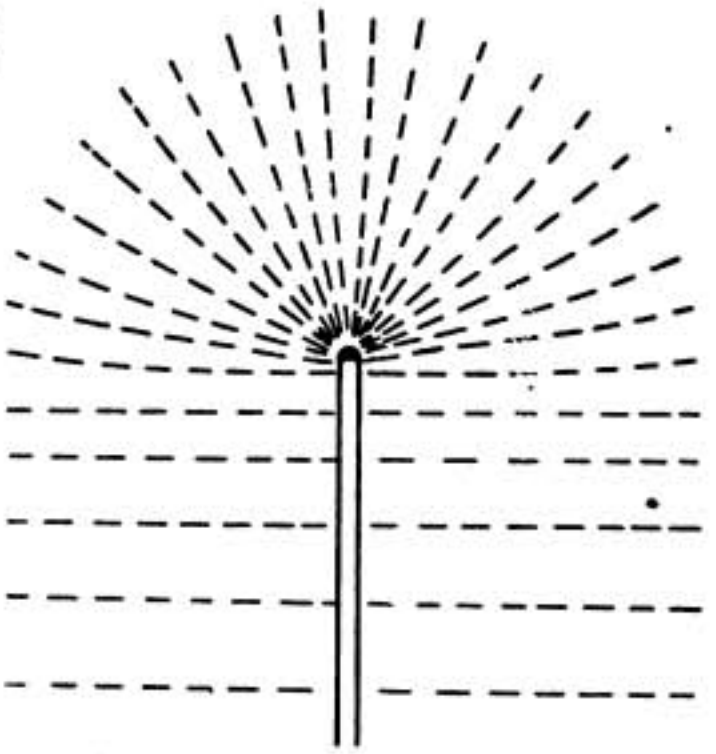


FIG. 5.

the electric field through the ebonite owing to its higher dielectric constant, will be greater than through the same space when filled with air, and, owing to its closeness to the conductor, almost the same intensity of field will exist on the surface of the near conductor as in the ebonite itself. Then, as the brush discharge starts on a given size of wire always at the same intensity of field, the critical voltage on the wire near the ebonite will be much lower than

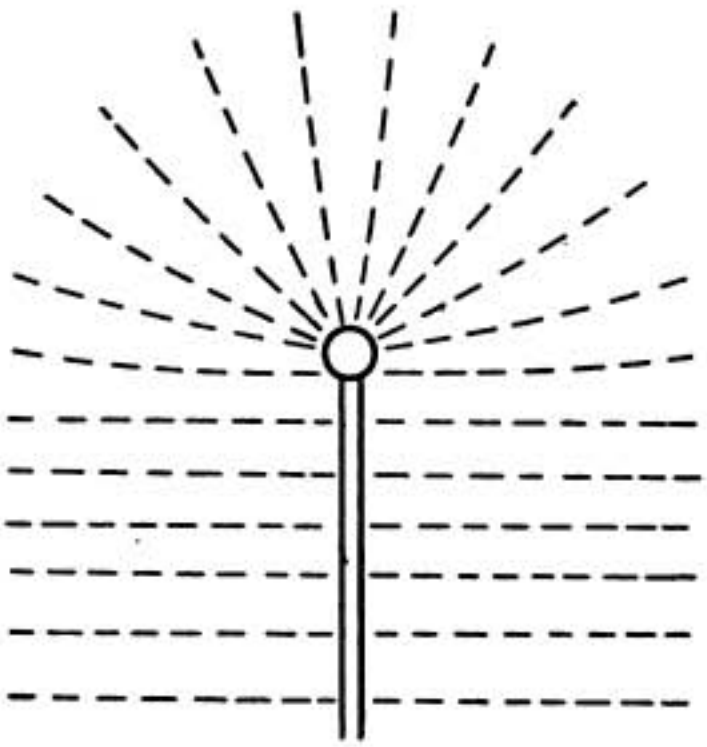


FIG. 7.

on the wire farthest away. If, for instance, the dielectric constant of the ebonite is 2·5 and the critical voltage on the far wire is 7,500 volts, on the near wire it will be about 3,000 volts. Thus, a good insulator used in a faulty manner, or an insulator which is badly designed, may precipitate a danger it was intended to remove.

We now have the reason for the failure of the porcelain insulators used to support the wires in the Alexanderson tests *; the electric stress—which is always strongest at the end of a wire—was made more intense by the use of insulators having a higher dielectric constant than air, so that the energy used up by the brush discharge on their surfaces and by the dielectric resistance or hysteresis of the porcelain material itself, was quite sufficient to break them down. The following diagrams may help to give a clearer idea of the connection between design of insulator and the electric stress.

Fig. 5 shows the intensity of the electric field on a wire to be greatest at the end; Fig. 6 the increase in intensity due to the use of a porcelain suspension insulator; Fig. 7 the reduced intensity at the end of a wire if it terminates in a knob; Fig. 8 the similar result which follows if a metal cap, plate, or shed is used; Fig. 9 the influence on the stress affecting a porcelain insulator supported by cotton or other insulating line of a metal shed fitted to the end of the wire. Fig. 10 indicates the stress acting on a porcelain insulator supported by wire, metal sheds being used above and below the insulator to decrease the stress and also to protect it against arcover. Fig. 11 shows two parallel metal plates in air, and the effect of inserting an insulator of high dielectric constant between them and transverse to the field. The field is more concentrated on the surface of the insulator, and this encourages a brush discharge and sparking round the edge of the insulator. In Fig. 12 the insulator being inserted parallel to the field does not encourage brushing.

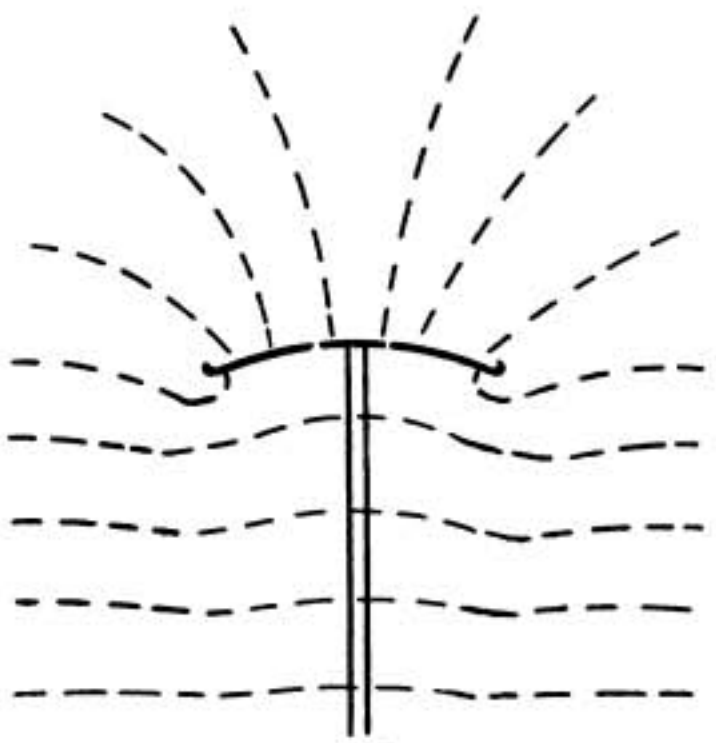


FIG. 8.

* WIRELESS WORLD, July, 1916, p. 300.

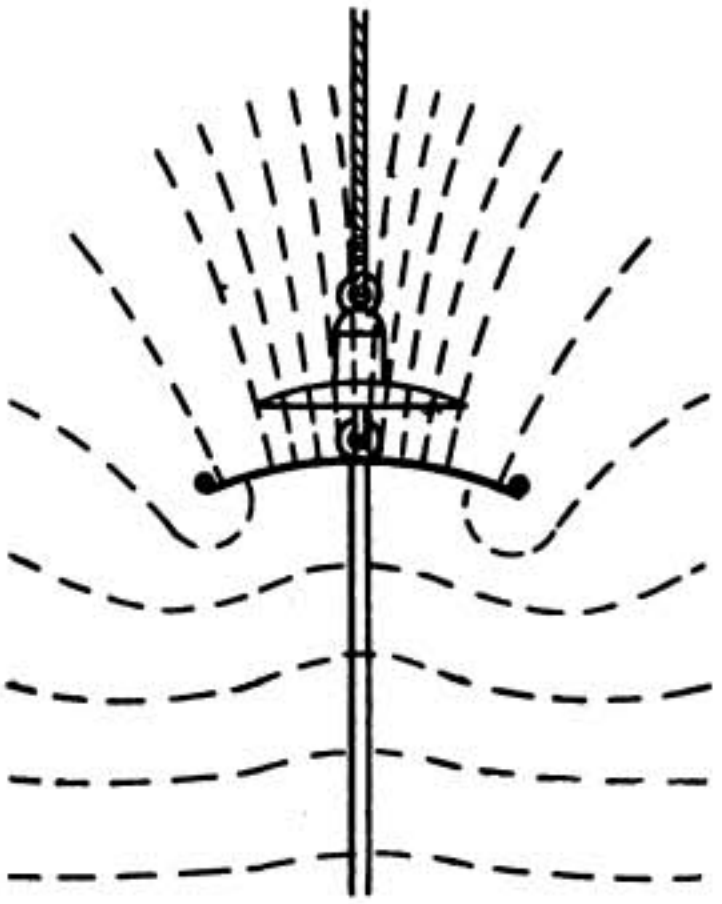


FIG. 9.

Partition insulators can be discussed from a similar standpoint. Fig. 13 shows the field in air between a rod, *R*, and a metal plate, *P*, the rod being fitted through a clearance hole in the plate; Fig. 14, the distorted field which results when the hole is bushed with a parallel insulating sleeve having a high dielectric constant. If the sharp edge of the hole in Fig. 13 is fitted with a spun metal ring (Fig. 15) the stress is considerably reduced. Fig. 16 shows a form of insulating bushing fitted to the metal ring and shaped so that its surface in air is parallel to the electric field, in order that—as in Fig. 12—it shall not increase the tendency to brush. If such an insulator, however, were used in a high frequency circuit and on high tension, its capacity might lead to appreciable loss, and besides would encourage surface sparking; for, whereas the sparking voltage between two conductors in air has almost a straight line relation with the distance, the *surface* or *flash-over* voltage on an insulator having a high dielectric constant has more nearly a cubic and sometimes a fourth-power relation with the distance.*

A rough design for a partition insulator constructed on the model of Fig. 16, but with the capacity reduced as much as possible, is shown in Fig. 17, where *M* is a metal ring, *P* the insulator shell, *C* the insulator cap, and *L* metal lock nuts. Obviously it is a good point if the insulating material used has a low dielectric constant, *provided always that this is not accompanied by higher dielectric hysteresis and low dielectric strength*, which is very often the case. The lower the dielectric constant, the less will the insulator distort the

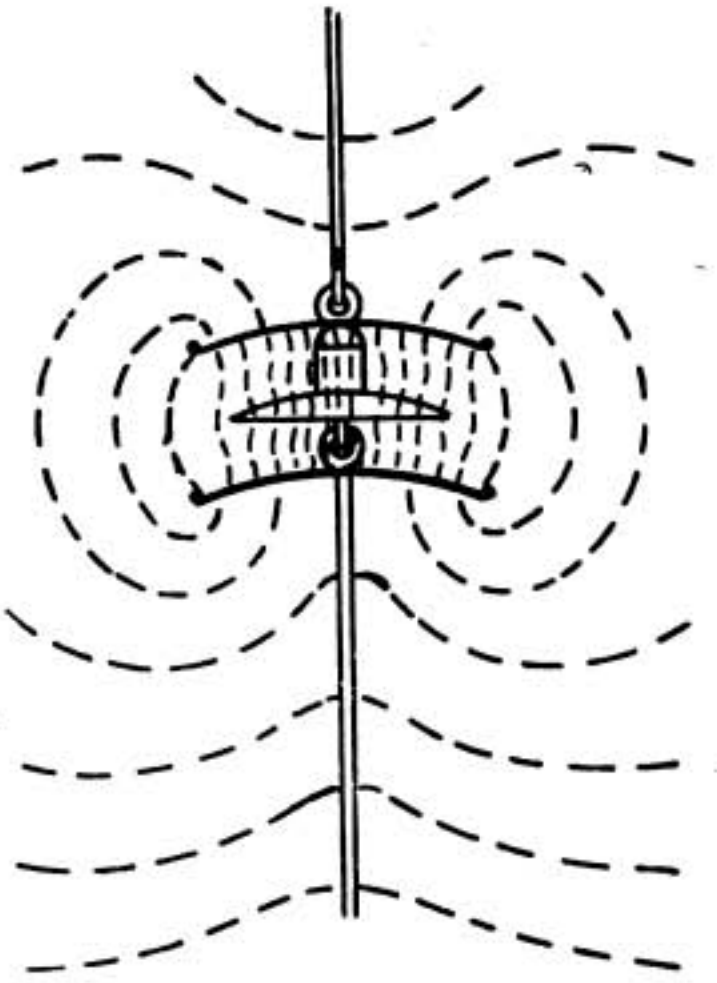


FIG. 10.

* Lustgarten, *Journal Institution of Electrical Engineers*, Vol. 49, No. 214, p. 276.

field, and the less particular one need be therefore as to the shape of the insulator. Fig. 18 shows the modification in the shell which should accompany the use of metal sheds $S$, the outline curve of the insulator being made to agree with the curvature of the strain lines in the electric field between the conductors as before. Metal sheds limit the voltage which can be applied to an insulator, and thus determine what its minimum dielectric strength should be.

Strain insulators, such as are shown in Fig. 19, are often fitted with

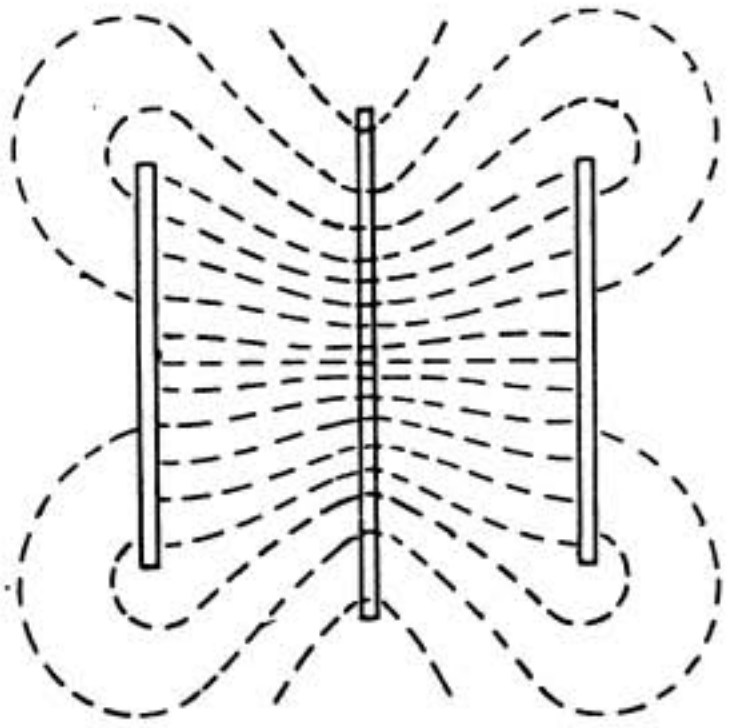


FIG. 11.

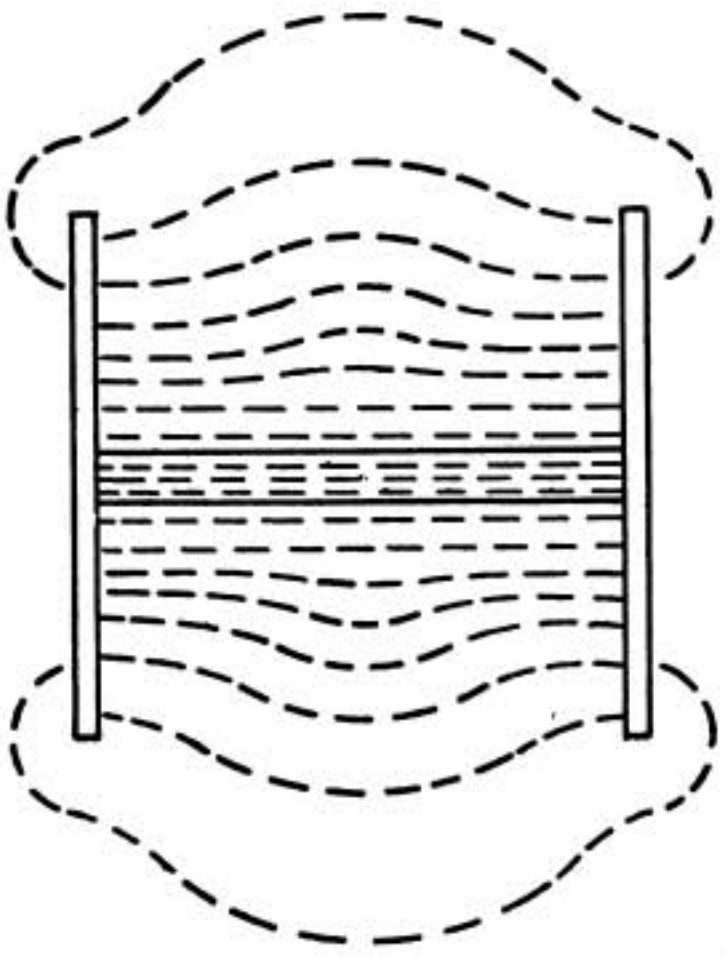


FIG. 12.

wire strops or loops. Strong brushing may result in the grooves or holes in or through which the wire is laid. This brushing may be considerably reduced even if it is not entirely stopped by lining the grooves or holes with metal foil.

## The Conditions Necessary to Ignite an Explosive Gas.

A study of the fire risks to which aircraft are liable would be incomplete without some reference to the conditions necessary to ignite an explosive gas; for it has been pointed out that the glow discharge and moderate brushing will not necessarily cause ignition, and even strong brushing induced on a thin wire may fail to do this. The subject has received careful attention during the last few years,

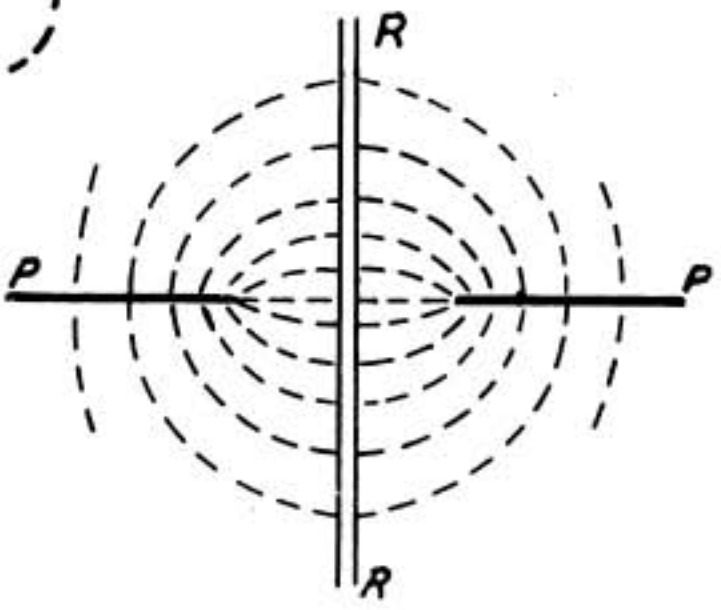



FIG. 13.

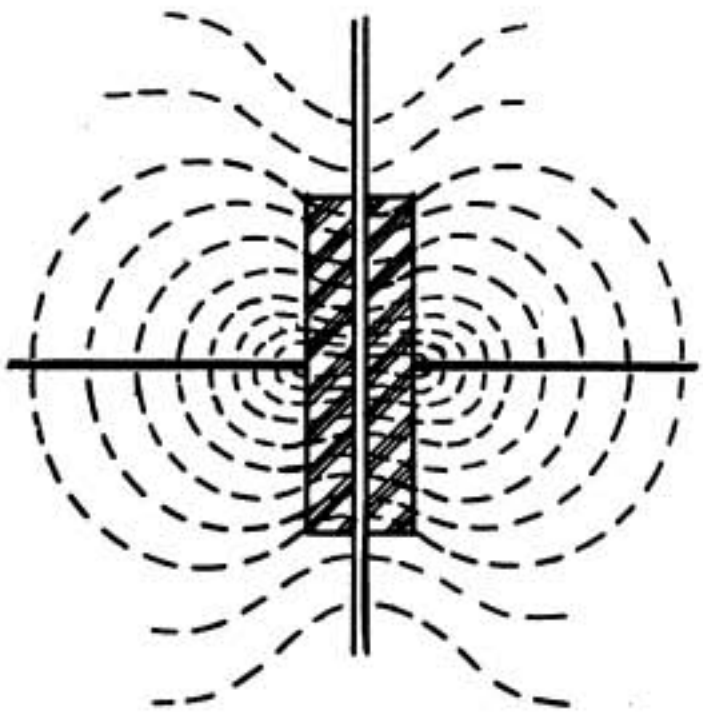


FIG. 14.

the one is not a measure of the other, although there may be a more or less regular relation between them when certain physical conditions are kept constant. Ignition seems to depend on the ionisation caused by the spark. During the interval of sparking the ionisation may be rapidly dissipated or neutralised. If the neutralising action

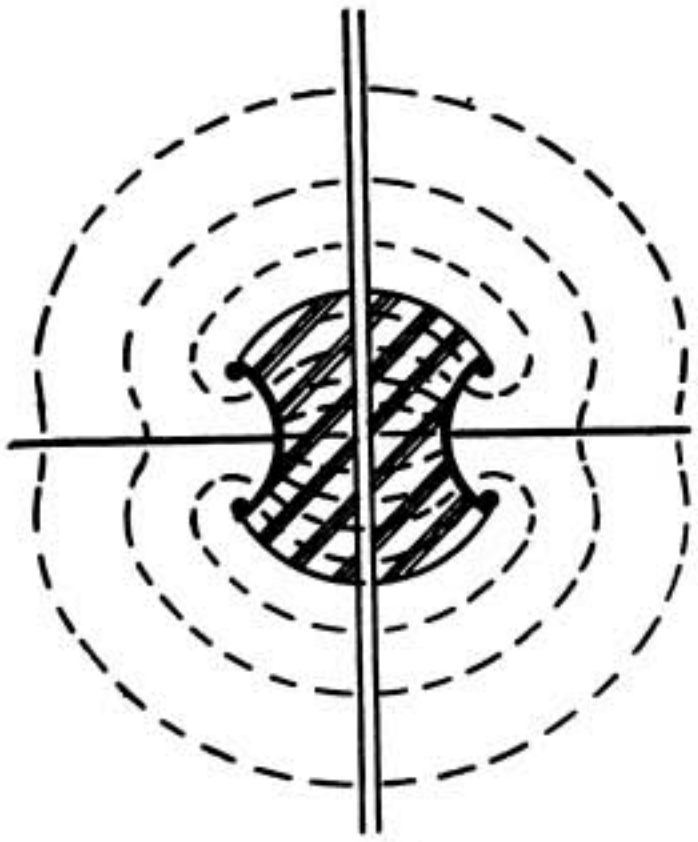


FIG. 16.

mainly in connection with the safe use of electric bells and signalling systems in coal mines.

In an able paper J. D. Morgan * points out " that it is necessary to distinguish between the energy which produces a spark and that quality of the spark termed by him 'incendivity,' which enables the spark to cause ignition; and that the magnitude of

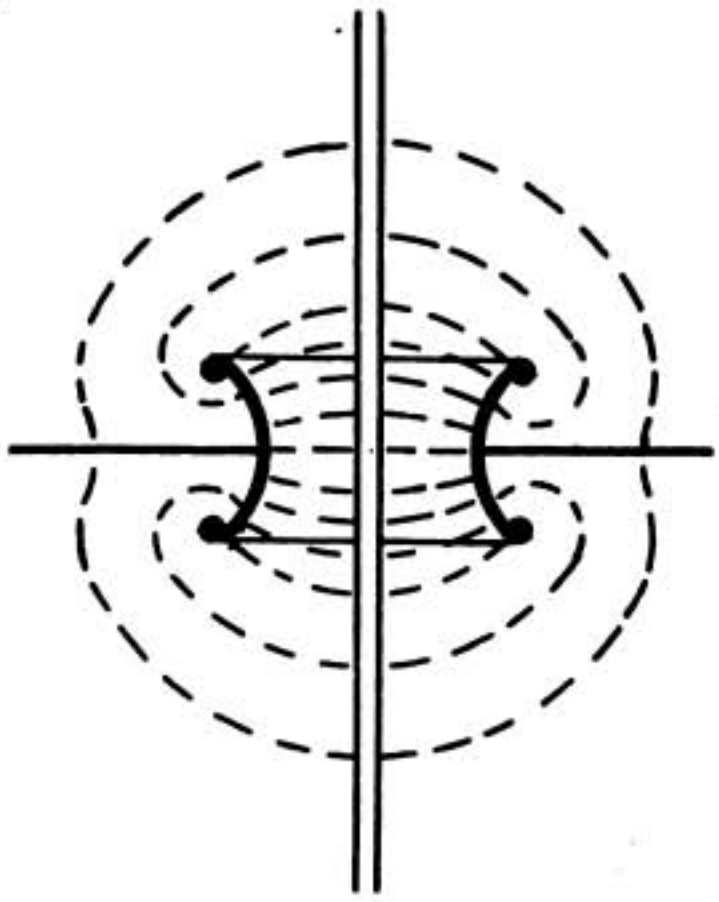


FIG. 15.

predominates there is no ignition of a gas mixture. If there is little or no neutralising action ignition occurs immediately. Between these two limits there are a variety of intermediate conditions."

To produce ignition the temperature of the igniting means must be above a certain definite value, but if the temperature is not accompanied by a sufficient quantity of heat ignition will not occur. The temperature of

* *Journal Institution of Electrical Engineers*, January 1916, p. 203.

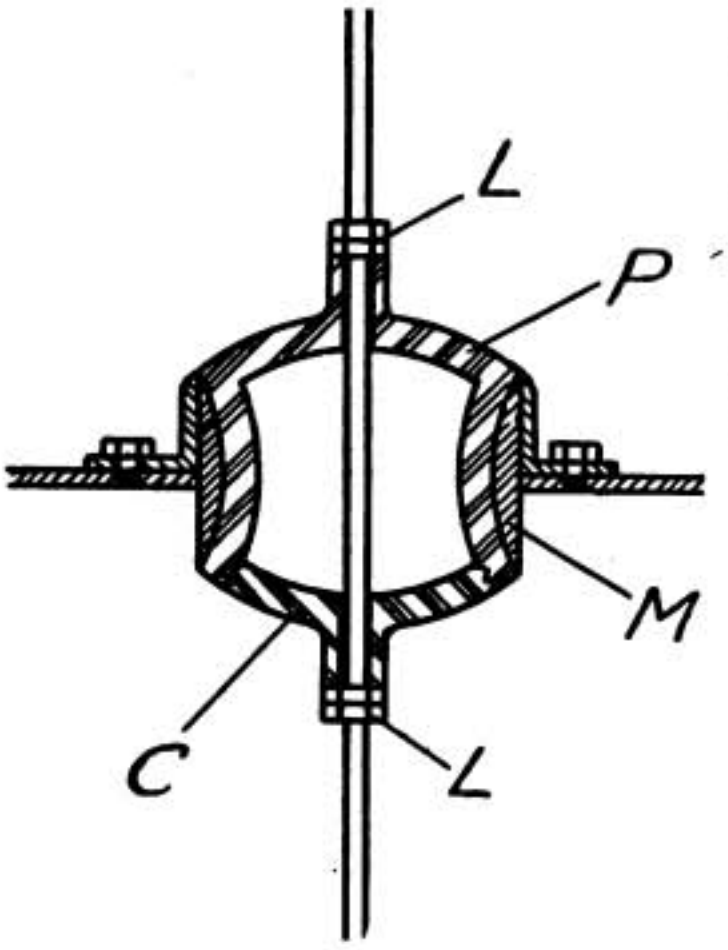



FIG. 17.

continuous current over the disc of a charged electroscope, the temperature at which it ignites an explosive gas is identical with that at which it steadily discharges the electroscope, and it has even been experimentally proved "possible to ignite a cold explosive mixture by the incidence of X rays on a platinum surface in it." *

The outstanding conclusion is that

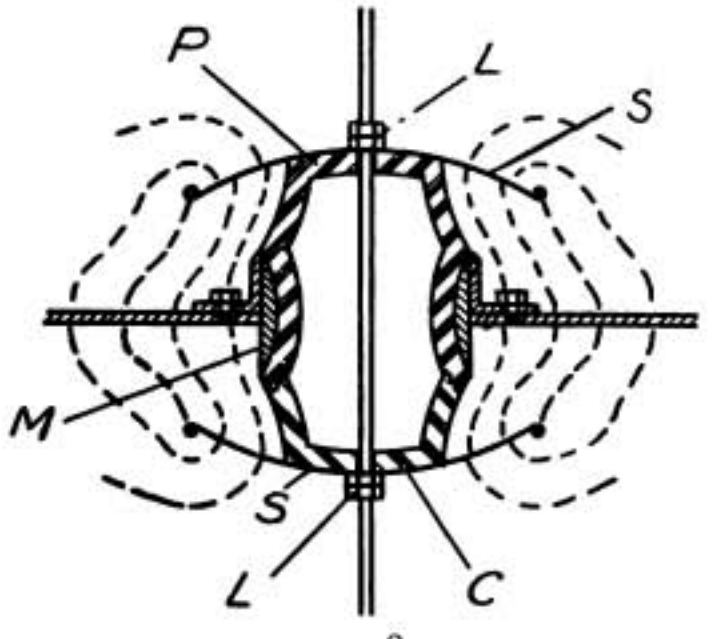



FIG 18.

some small electric sparks may be well above the ignition temperature of a highly inflammable gas, yet they will not ignite it. Again, the amount of heat energy required depends on the way it is produced. Thus a spark from a direct current will ignite a gas easier than a spark from an alternating current. And, further, it has been found that if an iron wire is heated by

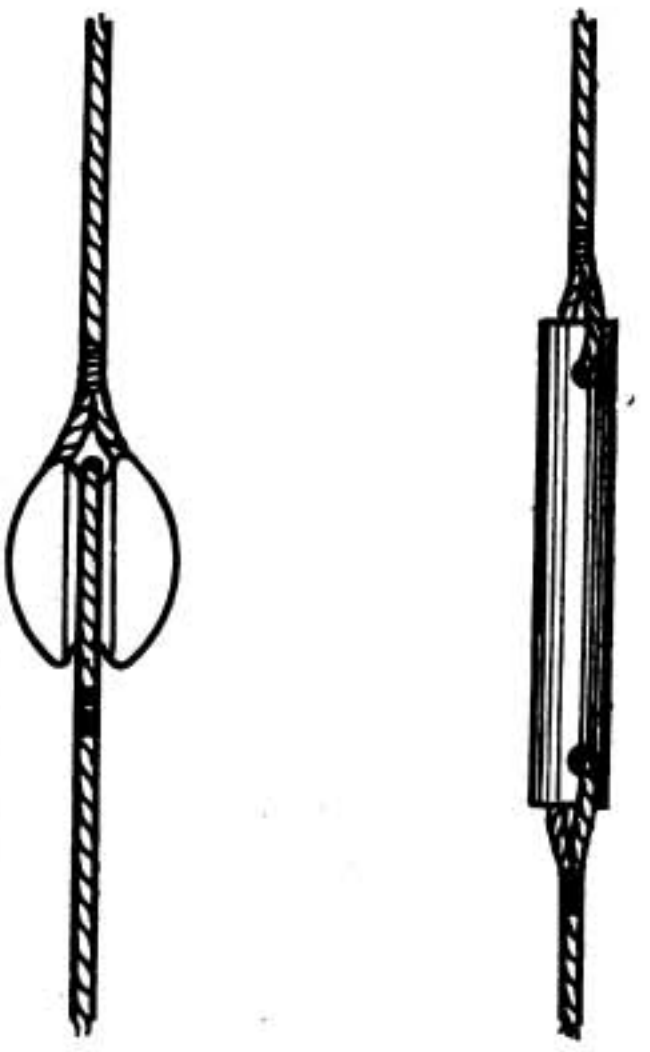


FIG. 19.

ignition depends primarily not on temperature, nor on heat, but on ionisation. This is most important. Thus a small wire may brush and produce small ionisation and be safe, but the least amount of brushing on a wire of large section produces sufficient ionisation to make it unsafe. Also it makes one

* J. R. Thomson, quoted by W. H. Thornton, "The Electric Ignition of Gaseous Mixtures," *Proc. Roy. Soy.* A. Vol. 90, p. 272, 1914.

question the advisability of using metals such as aluminium, zinc, tin, etc., which have strong photo-electric properties for any electrical purpose in a place where an explosive gas may collect, unless they are painted or covered with some material which will protect them from the action of ultra-violet light.

### THE RISK OF FIRE FROM THE TRANSMITTING PLANT.

Finally one may refer briefly to the fire risks introduced by the transmitting plant in the aircraft car, which are necessarily less than those due to the engine exhaust and are equally capable of being kept quite under control.

Two principles require to be kept in view :

(1) To ventilate amply all places where an explosive gas can collect ;

(2) To prevent explosive gas coming in contact with sparking apparatus, by enclosing or screening the apparatus, or those parts of it where sparking occurs, from general communication with the surrounding atmosphere.

By " ventilation " is not meant a rush of air which drives the explosive gas into corners where it can eddy with the gas and increase the tendency of the mixture to take fire—as far as practicable there should be no such corners, and certainly no misdirected draught.

Discharger sparks in nearly all types of quenched spark sets are already protected ; rotary dischargers are always boxed in ; the transmitting key contacts, also the buzzer contacts, should be enclosed.

The energy in the spark at the key on break is proportional to the energy commuted in the circuit, or to $LI^2$. If the key contacts are shunted by a condenser which takes up this energy, the potential at the contacts is reduced, and the spark is, therefore, also reduced ; or, alternatively, the spark can be weakened by means of a non-inductive shunt resistance to the manipulating key, but even the smallest spark remaining should be suspect if it remains unscreened.

## An Appreciation

THE gist of a large number of appreciative letters has been crystallised by our Irresponsible Expert as follows :—

I love this Wireless Magazine, it makes me feel so frightfully keen. It tells me things I ought to know and places where it's nice to go. And as beside the babbling brook I read it with enraptured look, absorbing mental nourishment, and getting value every cent, I clean forget my heart is sore and read of " Wireless and the War," or let my fancy wander free o'er " Maritime Telegraphy." When evening drives me in the cottage to read the charming works of Nottage, I gaze into the western sky and think of Dowsett's Aircraft high. Oh, yes, I am an ardent lover of every word within the cover, so now away to peaceful slumber and dreams about the coming number.

# Foreign Notes

### Newfoundland.

The free entry of material for installing wireless telegraphy on board ships engaged in the trade and fisheries of Newfoundland was among the proposals made by the Minister of Finance and Customs in his Budget speech of April 18th. The Act embodying this proposal was passed on May 4th.

* * * * * *

### United States.

The Bureau of Navigation, Department of Commerce, has issued the 1915 edition of *Radio Stations of the United States*. This list shows that there are now 5,073 wireless stations in the United States, an increase of 1,139 since 1914. They are classified as follows: Government and commercial land stations, 224; Government and commercial ship stations, 895; special land stations, 118; general and restricted amateur stations, 3,836.

* * * * * *

To test the efficiency of its portable wireless telegraph instruments and to conduct experiments with its wireless field telephones, the headquarters detail of the Second Battalion Field Artillery, Illinois National Guard, recently went on a two-day hike from Chicago to Willow Springs and back. The detail consisted of twenty-eight men, and included two wagons to carry instruments, and the wagons of the commissary department.

* * * * * *

The lists of United States electrical exports for the month of February last are just to hand. The value of telegraph instruments, including wireless, was $2,542, as against $5,589 for the corresponding month of last year.

* * * * * *

According to word from Louisville, Kentucky, the Harlan Coal Mining Co. and Lick Branch Coal Co. are preparing plans for a wireless telegraph service between the several coal-mines in Harlan County, Kentucky, and the main offices in Louisville. The sending apparatus will be located in the Black Mountains, Harlan County, where the Cumberland range reaches its highest elevation in Kentucky. The receiving end, it is stated, will be on the Starks building, Louisville. The distance on an air line is about two hundred miles, and by rail nearly three hundred miles.

* * * * * *

According to our contemporary, *The Electrical Experimenter*, a Bellini Tosi Direction Finder has been installed at the Naval Radio Station at North Truro, Cape Cod. With it the bearings of a ship from the station can be ascertained by the wireless waves, and the direction can be found, thus affording a new aid to navigators in determining their position. In tests the direction finder has been found correct within about two degrees. All merchant ships fitted with wireless apparatus are requested by the Government to aid in the experiments whenever within range of the station, by requesting their bearings from the station, and stating how such bearings compare with the ship's observation.

We learn that a wireless telegraph plant is being installed at the Police Headquarters in New York, as part of the great scheme for "general preparedness" which has recently been initiated. About 20 members of the Home Defence League (which has been organized to take the place of policemen called away for riot or other duty) have wireless apparatus on the roofs of the buildings in which they reside; they will, therefore, be in touch at once with headquarters in any emergency. The Police Commissioner also intends to make arrangements whereby the police will be in wireless communication with the harbour and coast defences, and even with vessels of the Navy at sea.

* * * * * *

In order to have a practical test of the nation's preparedness for communication in time of war, a telephonic, telegraphic and radio demonstration was arranged by which the Navy Department at Washington was put into instantaneous touch with every naval station on the Atlantic and Pacific coasts, as well as with the battleship *New Hampshire* at sea. During a period of 40 hours the Navy Department was conducted on a simulated war basis.

Chiefs of the Navy Department carried on all their business with the important naval stations by telephone, while the Secretary of the Navy, the Naval General Board, the Office of Naval Intelligence, and the Chief of Naval Operations, received at the same time from the *New Hampshire* wireless telephonic reports of her search for imaginary enemies.

The test was arranged at the request of Secretary Daniels.

* * * * * *

President Wilson recently opened the Philadelphia "To-day and To-morrow Civic Exposition" by wireless telegraphy from the White House. This is not the first time the President has availed himself of wireless telegraphy as a means of fulfilling duties when he is unable to be present in person.

# Wireless Telephony "with a Vengeance"

ACCORDING to an American scientific journal, it will not be long before England and America will be able to converse with one another by means of the wireless telephone. There are certain individuals to-day who cling to the conviction that the telephone was simply the invention of a man who had a grudge against humanity. What will they now say of the wireless telephone? There is this much to say. It will be much better than those cheap wire telephones, the wires of which are so apt to snap if you don't pay up your subscriptions. With the wireless telephone it may be that you will receive a second demand note for payment, but there will be no man with a pair of wire-cutters in his pocket to bring the third and last demand note and cut you off if you do not pay at once. It is going to be very exciting when we get those wireless telephones in full working order. Just imagine yourself stepping into a call box in Victoria Street and asking for "45678, Broadway, NewYork City." While the young lady is waking up New York you just sit down and read a few chapters from your Shakespeare or Bacon—according to which school you belong. But it will test your temper when the young lady tells you that you are through, and will you please drop three hundred and sixty-five pennies in the slot and "turn" the handle after each, please."

# Instructional Article

NEW SERIES (No. 12).

*The following series, of which the article below forms the twelfth 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.*

## Rate of Increase.

84. In Fig. 75 we have an irregular but smooth curve, $AB$. If this represents section through a hill we know, from merely looking at the curve, that if we walked from $A$ to $B$ we should start off downhill from $A$, then climb the hillside, and, finally, walk a short distance downhill again to reach $B$.

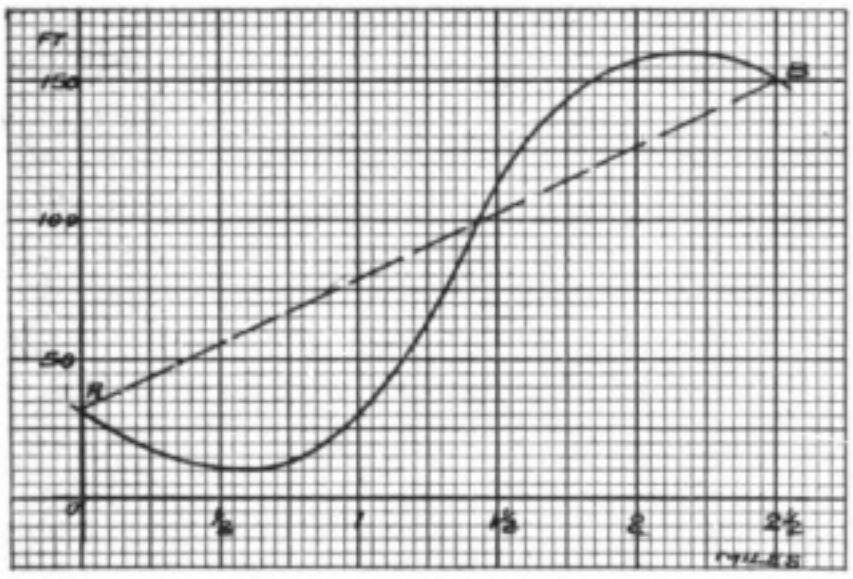



FIG. 75.

Now, to the scale of this diagram, the *horizontal* distance between $A$ and $B$ is $2\frac{1}{2}$ miles, and the *vertical* distance—or difference in height—is (150—33) = 117 ft. Thus, in traversing $2\frac{1}{2}$ miles *along* we move 117 ft. *up*, and so the *average rate* at which we rise is $\frac{117 \text{ ft.}}{2\frac{1}{2} \text{ miles}} = 46\frac{3}{4}$ ft. per mile. This can be expressed as the average *rate of increase of height with respect to distance*, or the *rate at which height varies as distance varies.*

This slope is shown geometrically by the straight line $AB$.

But obviously most of the hillside we have to climb is much steeper than this; parts near the summit and near the valley bottom are less steep; and other parts again are actually downhill. Thus the average slope, obtained as above, is no guide whatever to the slope at intermediate points.

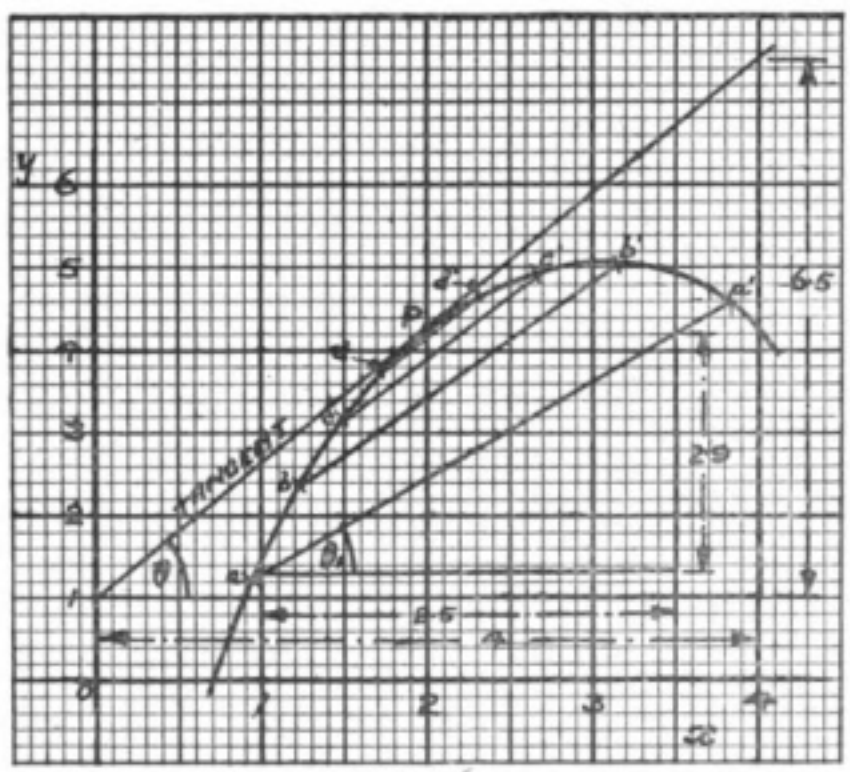



FIG. 76.

85. In Fig. 76 we have another curve, and we will set to work to find the slope of the curve at a certain

point, $P$. By this we do not mean the average slope over a part of the curve which includes $P$, but the actual slope *at* the point $P$ itself.

With P as centre draw a few circles of differing radii, thus marking off various pairs of points $a\ a^1$, $b\ b^1$, . . . on the curve, equidistant from and on opposite sides of $P$.

Now the straight line $a\ a^1$ gives us the average slope between $a$ and $a^1$, $b\ b^1$ gives us the average between $b$ and $b^1$, and so on.

From a consideration of these lines, $a\ a^1$, $b\ b^1$, $c\ c^1$, and $d\ d^1$ we see that the nearer to $P$ we take the two points, the more accurately does the line joining the points show the true slope at $P$. Thus to get an absolutely accurate representation of the slope at P, we must take the two points at no distance whatever from $P$, or, in other words, we must draw a straight line which touches the curve only at the point $P$. Thus we must draw the *tangent to the curve at the point P*, and the slope of this tangent will be the true slope of the curve at that point.

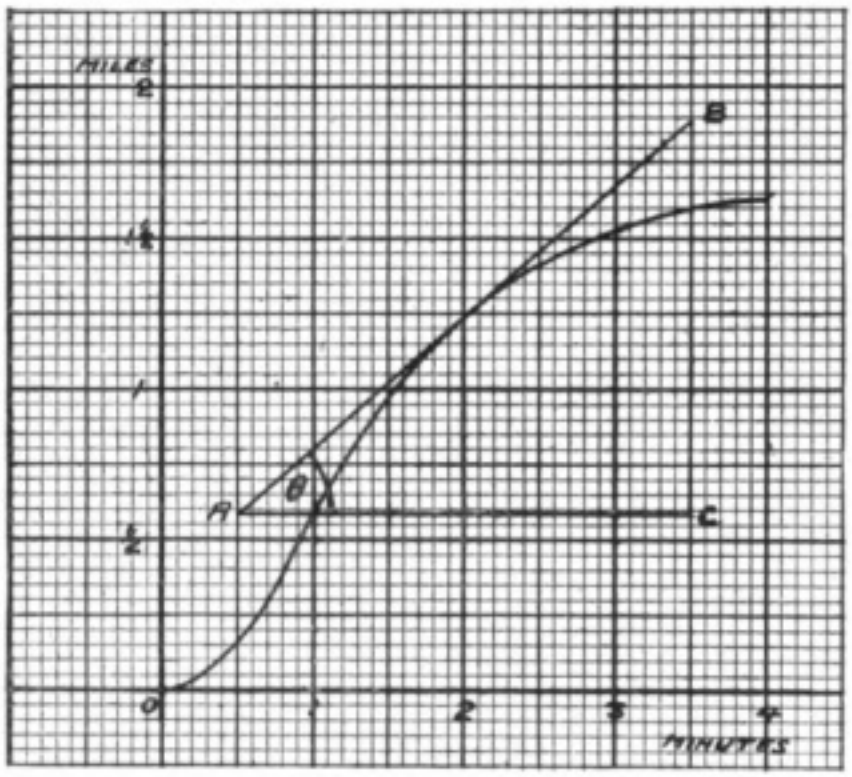



FIG. 77.

Now the slope of this tangent is given, as we know already, by tan θ, where θ is the angle the tangent line makes with the horizontal. In this particular case

$$\tan\theta = \frac{6{\cdot}5}{4}$$
$$= 1{\cdot}625.$$

The *average* slope between $a$ and $a^1$ is $\frac{2{\cdot}9}{2{\cdot}5}$
$= 1{\cdot}16$, quite a different value.

86. Let us now consider, rather more fully, exactly what we get when we go to the trouble of drawing this tangent and measuring its slope.

In Fig. 77 we have a curve which gives us the distances travelled by a train at various times after starting its run. To get the slope of this curve at 2 minutes from the start we draw a tangent $AB$ as shown, complete the triangle $ABC$, and measure off $BC$ and $AC$.

Then the slope of the curve $= \frac{BC}{AC} = \tan\theta$.

But $BC = 1{\cdot}885 - 0{\cdot}58$
$= 1{\cdot}305$ miles,
and $AC = 3$ mins.

Therefore $\tan\theta = \frac{1{\cdot}305 \text{ miles}}{3 \text{ minutes}} = 0{\cdot}435$ *miles per minute* or 26·1 *miles per hour.*
This value is a *velocity.*

Thus the slope of this distance-time curve at any point gives us the velocity of the train at that particular time. Velocity is, of course, the rate at which distance changes as time changes, or the *rate of change* of distance.

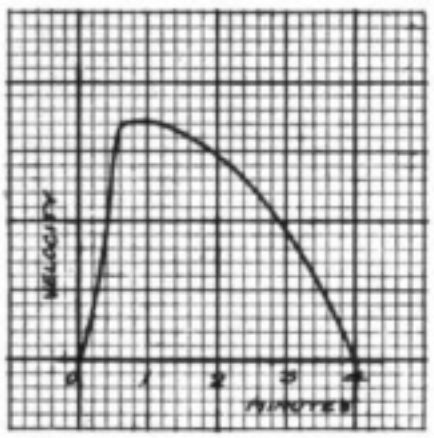


FIG. 78.

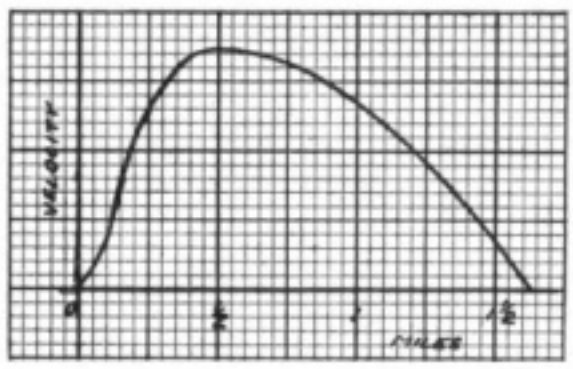


FIG. 79.

If now we measure the velocity in this way at a number of points along the curve, we can plot two further curves—we can plot either a velocity-time curve (Fig. 78) or a velocity-distance curve (Fig. 79). [These two curves are not drawn to scale.]

Going a step farther, it will be easily understood that we can now draw tangents to the curve of Fig. 78, the slope of each of which will give us the value of the *rate of change of velocity* or *acceleration.* Another curve, such as Fig. 80, can now be drawn, and if we care, we can draw tangents to this curve so as to find the *rate of change of acceleration,* and so on indefinitely.

Notice that the acceleration is zero at three points :

(*a*) Just before starting ;

(*b*) About one minute after starting, when the speed has reached a constant value, and

(*c*) When the train has stopped at the end of its run.

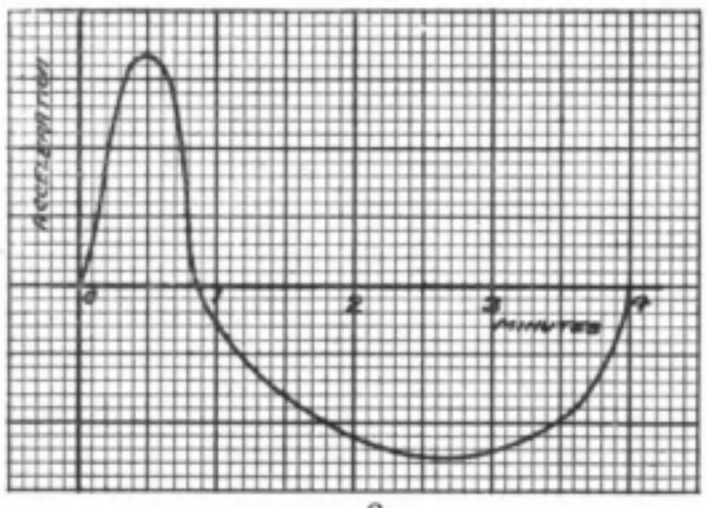


FIG. 80.

87. In Fig. 81 we have part of the curve of $y=x^2$. From the point (1, 1) is drawn the horizontal line $AB$, and perpendiculars $C_1D_1$, $C_2D_2$, etc., are drawn from the curve on to $AB$ at the successive whole-number values of $x$ —as shown.

The average slope of the curve between $A$ and $C_4 = \frac{C_4D_4}{AD_4}$

The average slope of the curve between $A$ and $C_3 = \frac{C_3D_3}{AD_3}$,

and so on.

Now it is quite obvious from this that the smaller we make the interval $AC$, the nearer the resulting ratio becomes to the value of the slope at $A$, and so we should expect that if we were to take the *smallest imaginable* distance $AC$ we should

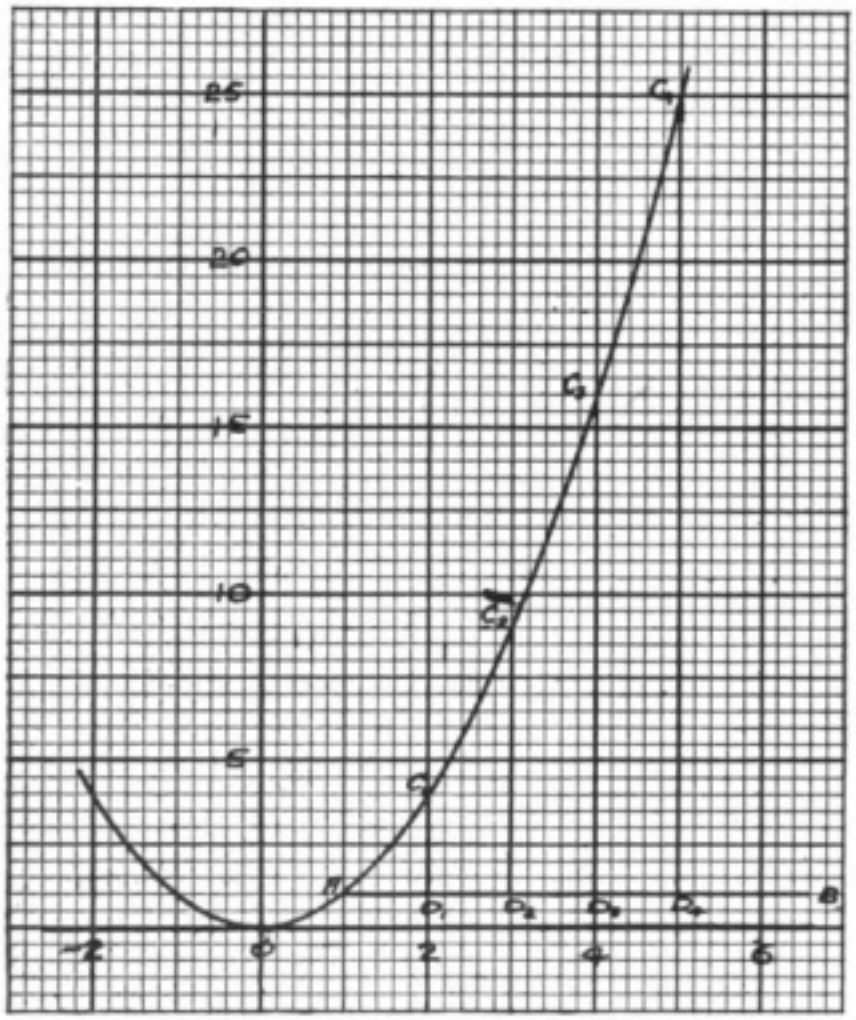



FIG. 81.

obtain a ratio which would be the true value of the slope at $A$.

The trouble is that when we get to dealing with such exceedingly minute quantities we can no longer carry out the operations of drawing a part of the curve and measuring off the lengths. We can, however, *if we know the law of the curve, calculate* this rate of increase. In other words, leaving out the now unnecessary curve, we can calculate the rate of change of one quantity with respect to another quantity if only we know for certain the law connecting the two quantities.

Returning for a moment to Fig. 81 we see that, reckoning for our initial point $A$, the numerator of our fraction, say $C_1D_1$, is a *small increase of* $y$, and the denominator $AD_1$, the *corresponding small increase of* $x$. We now have to consider the ratio between two similar corresponding increases of $y$ and $x$, but of very much smaller value. Let us call these two extremely small increases $\delta y$ and $\delta x$, so that we now have to find the value of $\frac{\delta y}{\delta y}$.

[Note that $\delta y$ is *not* $\delta$ multiplied by $y$, but is simply a short and convenient way of writing an infinitesimally small bit of $y$.]

Drawn to a very much increased scale we now have the conditions shown in Fig. 82.

It must be carefully borne in mind that, though both $\delta y$ and $\delta x$ are extremely small in themselves, yet the new values $(y+\delta y)$ and $(x+\delta x)$ still conform to the law $y=x^2$, and also the ratio $\frac{\delta y}{\delta x}$ may be of any value—positive or negative. $A$ is the point $(x, y)$ and $C$ is the point $[(x+\delta x), (y=\delta y)]$.

Now at $A$ we have $y=x^2$

and at C we have $(y+\delta y)=(x+\delta x)^2$

$$=x^2+2x.\delta x+(\delta x)^2$$

Subtract the original equation $y=x^2$

and we have left $\underline{\delta y=2x.\delta x+(\delta x)^2.}$

[Note that at $C$ we do *not* write $(y+\delta y)=x^2+\delta x$.]

The next step is extremely important. $\delta x$ is an infinitesimally small quantity, and so $(\delta x)^2$, being $(\delta x \times \delta x)$ or an infinitesimally small quantity *of* an infinitesi-

mally small quantity *is negligible in value compared with the other quantities in the equation.*

For instance, $\frac{1}{100}$th of £1,000 is £10, but $(\frac{1}{100})^2$ of £1,000 $= \frac{£1{,}000}{100 \times 100}$ $= £\frac{1}{100} = 2$s. only.

$\frac{1}{1000}$th of £1,000 is £1, but $(\frac{1}{1000})^2$ of £1,000 $= \frac{£1{,}000}{1000 \times 1000} = £\frac{1}{1000} = \frac{1}{4}$d. (approximately).

The second powers of $\delta y$ and $\delta x$ can, therefore, be neglected, and instead of $\delta y = 2x.\delta x + (\delta x)^2$ we can write $\delta y = 2x.\delta x$.

From this we get $\frac{\delta y}{\delta x} = 2x$, or the rate of change of $y$ with regard to $x$ is equal to $2x$.

When $\delta y$ and $\delta x$ are reduced to the absolute minimum possible, we write $\frac{dy}{dx} = 2x$, and the ratio $\frac{dy}{dx}$ is called the *Differential Coefficient* of $y$ with regard to $x$.

[Here, again, $dy$ and $dx$ are *not* $(d \times y)$ and $(d \times x)$.]

Knowing, in this way, that the rate of change of $y$ is equal to $2x$, we see immediately that if

$x = 1$, the rate of increase $= 2$,
$x = 5$ „ „ $= 10$,
$x = 0$ „ „ $= 0$,
$x = -10$ „ „ $= -20$,
$x = \pi$ „ „ $= 2\pi$, and so on.

In the foregoing manner we can calculate the relative rates of increase of any quantities connected by known laws.

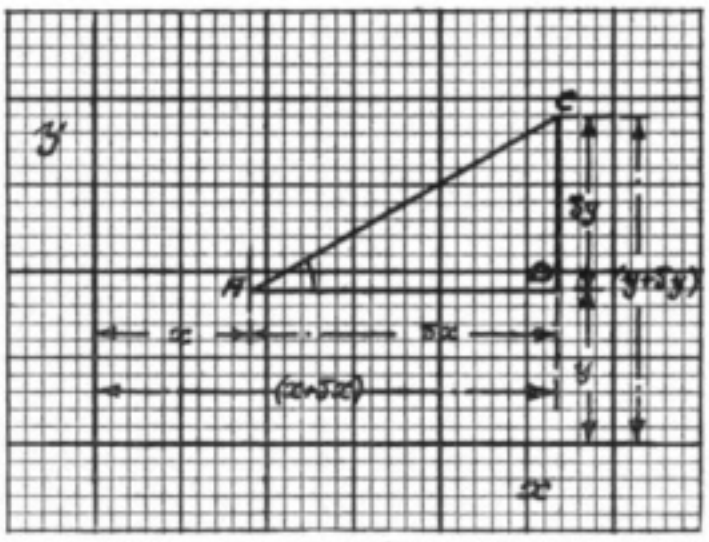


FIG. 82.

*Examples.*

(i.) $y = 6x^5$

$y + \delta y = 6(x + \delta x)^5$

$= 6\{x^5 + 5x^4.\delta x +$ terms containing higher powers of $\delta x$ which can therefore be omitted$\}$.

$= 6x^5 + 30x^4\ \delta x.$

Subtract $y = 6x^5$

and we have left $\delta y = 30x^4\ \delta x.$

Therefore, $\frac{\delta y}{\delta x} = 30x^4 = \frac{dy}{dx}.$

(ii.) A body falling freely from rest, falls so that $s = \frac{1}{2}gt^2$

where $s$ = height fallen through (in feet)

$g$ = acceleration due to gravity (a constant—32·2 ft. per sec. per sec.)

and $t$ = time taken in falling (in seconds).

Find expressions for

(*a*) The velocity, and

(*b*) The acceleration at any time.

$$s=\tfrac{1}{2}gt^2=\tfrac{1}{2}\times 32{\cdot}2\ t^2$$
$$=16{\cdot}1\ t^2$$

Now velocity $=v=\frac{ds}{dt}$

and acceleration $=f=\frac{dv}{dt}$.

(*a*) Starting with $s=16{\cdot}1\ t^2$

we have $s+\delta s=16{\cdot}1\ (t+\delta t)^2$

$=16{\cdot}1\ [t^2+2t.\delta t+(\delta t)^2]$

or $s+\delta s=16{\cdot}1\ t^2+32{\cdot}2\ t\delta t.$

Subtract $s=16{\cdot}1\ t^2$

and we have left $\delta s=32{\cdot}2\ t.\delta t.$

Thus, $\frac{\delta s}{\delta t}=32{\cdot}2\ t$

or $v=\frac{ds}{dt}=32{\cdot}2\ t$ (ft. per sec.).

(*b*) Starting with $v=32{\cdot}2\ t$

we have $v+\delta v=32{\cdot}2\ (t+\delta t)$

$=32{\cdot}2\ t+32{\cdot}2\ \delta t$

Subtracting $v=32{\cdot}2\ t$

we have left $\delta v=32{\cdot}2\ \delta t.$

Therefore, $\frac{\delta v}{\delta t}=32{\cdot}2,$

or $f=\frac{dv}{dt}=32{\cdot}2$ (*ft. per sec. per sec.*)—and is independent of time.

From these results we see that—

the velocity after 10 seconds $=32{\cdot}2\times 10$

$=320$ *ft. per sec.*

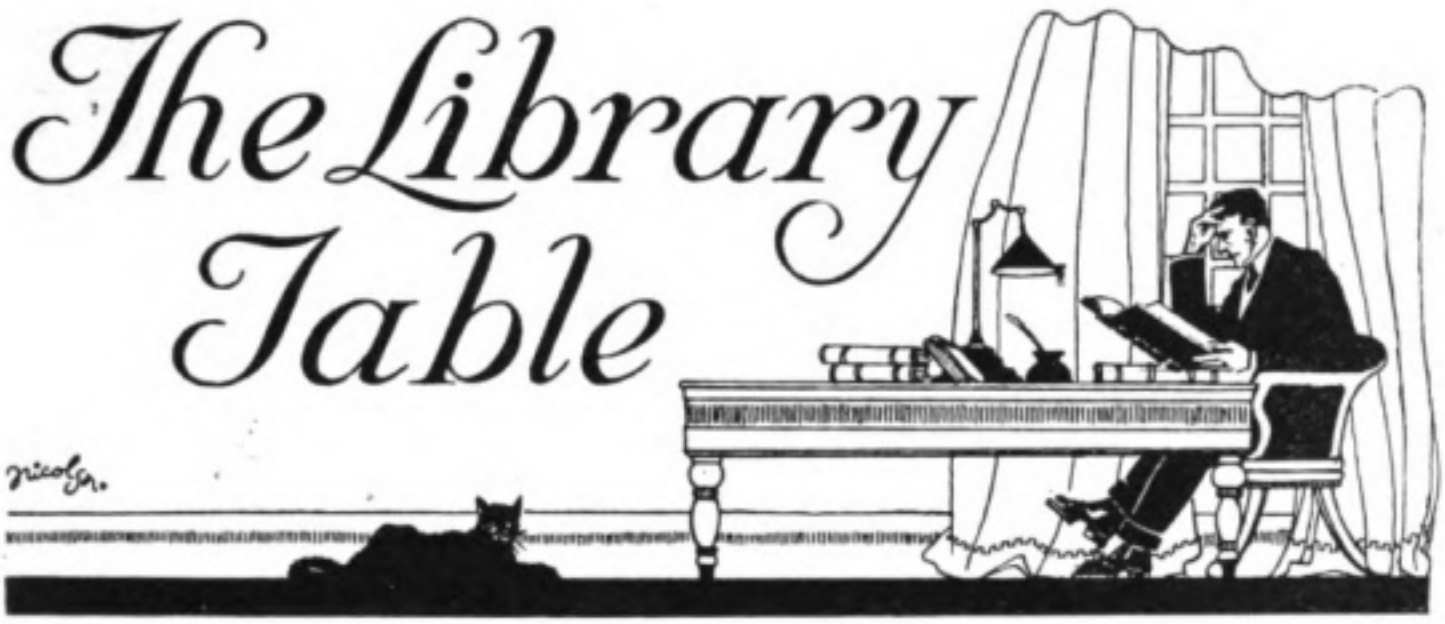
but the acceleration after 10 seconds $=32{\cdot}2$ *ft. per sec. per sec.*

(*To be continued.*)

# The Institute of Radio Engineers

AT the meeting of the Institute of Radio Engineers held on Wednesday, June 7th, in the Engineering Societies Building, New York, a paper on "Arc Oscillations in Coupled Circuits" was read by Professor Hidetsugu Yagi, of the College of Engineering at Sendai, Japan. The efficient transfer of energy from the primary to the secondary and the production of overtones were fully considered. The paper was illustrated by many interesting experimentally determined curves.

# The Library Table



"THE BORDERER." By Harold Bindloss. London: Ward, Lock & Co. 1916. 6s.

To us there always appears a great sameness in the war novels which we have from time to time perused. The book under review forms no exception. The general outline is that Andrew Johnstone, the principal character, is in Canada at the time of the outbreak of war, and receives a summons to return home. His chum Whitney accompanies him, and together they search the southern coast of Scotland for illicit wireless apparatus, and the sources of supply to German submarines. In the course of his narrative Mr. Bindloss refers to Trinity House in connection with the survey of waters around our coast. We believe that he is incorrect here, this forming part of the duties of the Hydrographic Department of the Navy. The book may perhaps find a certain amount of favour, but the interposition of many points irrelevant to the story renders it disconnected. We must say, however, that Mr. Bindloss's composition is pleasing and fluent.

* * * * * *

"A FIRST COURSE IN ENGINEERING SCIENCE." By P. J. Haler and A. H. Stuart. London: University Tutorial Press, Ltd. 2s. 6d.

We learn from the Preface that this little book embodies both the material and the suggested treatment of that material laid down in a recent circular issued by the Board of Education under the title "Memorandum on the Teaching of Engineering in Evening Technical Schools," assigned to the First Year of the Major Course of "Engineering Science." The book also covers the ground required for the examination in Mechanical Engineering, Division 1, Grade 1, of the City and Guilds of London Institute.

The authors have certainly produced a book clearly written in an interesting manner and copiously illustrated. We are glad to see the inclusion of numerous examples and exercises and a useful appendix, giving tables of useful constants, densities of metals, strengths of materials, etc. Answers to the exercises are given in the final pages. Altogether this is an excellent little book, well suited for the purpose for which it is designed.

"THE EDUCATION OF P. J. DAVENANT." By Lord Frederick Hamilton. London: Eveleigh Nash Co. 1916. 6s. net.

There are many more melodramatic institutions, but none more deserving than that which, under the patronage of the Marchioness of Lansdowne, is raising the "Officers' Families Fund." Lord Frederick Hamilton has created a brand-new hero for the purpose of coaxing contributions from the pockets of book buyers, and every purchaser of the volume under review will—thanks to the author's generosity—add his quota to the fund. This hero is a boy in his teens gifted with much of the astuteness of Sherlock Holmes, but possessed of a *naïveté* all his own. His name is P. J. Davenant, and he now makes his third bow before the world.

It is a quaint conceit to open the volume with three chapters, in our opinion the best in the book, and then recommend "those to whom the things of the country make no appeal" to skip them! The author has perhaps found some criticism levelled at young Davenant in his previous appearances on account of his super-boyish acumen and success. Accordingly, in this reincarnation, he opens his "War-time Detection" yarns with a failure; and throughout maintains a considerably sobered tone of colour. The pursuit (and capture) of the German Secret Wireless Spies constitutes a well-thought-out and interesting adventure of the detective variety, and the incidental voyage of H.B.M. Destroyer *Gannet* is described in a way which appears to indicate that the author writes from personal experience.

The literary workmanship of the *Education of P. J. Davenant* displays a marked improvement on that of the previous volumes, and the comico-pathetic sketches of wounded soldiers in hospital, though still suffering a little from the absence of that "restraint" which only practice can give, furnish excellent sentimental reading of the more "obvious" kind. Just one word about "Ted," the gipsy stable-boy. We should like to find, when next we meet him, that his marvellous attainments are a little less pronounced and that his character is outlined with less harsh contrasts of light and shade.

* * * * * *

"ATMOSPHERIC CIRCULATION AND RADIATION." By Frank H. Bigelow, M.A., L.H.D. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. 21s. net.

This volume, the full title of which is *A Meteorological Treatise on the Circulation and Radiation in the Atmospheres of the Earth and of the Sun*, is scarcely of the type of literature which appeals to the "man in the street." On the other hand, it is one of those treatises which, whilst making a strictly limited appeal, is nevertheless of great value to the scientific world.

The author, who was for some years Professor of Meteorology in the United States Weather Bureau and is now attached to the Argentine Meteorological Office, is of course an authority on the subject, and we have no doubt that the volume will be welcomed wherever meteorology is studied.

Although the scientific study of the great problems relating to the weather may be said to date from about the year 1870, an enormous mass of observations has been made, and it is upon the careful study of these observations that this volume has been based. Numerous tables and diagrams are interspersed throughout the book, which is exceedingly well produced.

"QUESTIONS AND SOLUTIONS IN TELEGRAPHY AND TELEPHONY—FINAL EXAMINATIONS." By H. P. Few. London: S. Rentell & Co., Ltd. 1s. 6d. net.

This little book, which is a companion volume to the Author's *Questions and Solutions in Telegraphy and Telephony Grade One Examinations* (already reviewed in our columns), needs no introduction to those who are acquainted with the previous book and its excellencies. The book is designed primarily for students undertaking the City and Guild Examinations in Telegraphy and Telephony, but will be found useful by all who study these subjects whether or not they intend entering for these tests. Here and there we find questions on wireless telegraphy which have appeared in various years' examinations.

* * * * * *

"WHITTAKER'S ARITHMETIC OF ELECTRICAL ENGINEERING FOR TECHNICAL STUDENTS AND ENGINEERS." London: Whittaker & Co. 2s. net.

This useful little book, which has now run into three editions, aims at providing students of electrical engineering with numerous practical explanations and examples, so that they may learn to calculate quickly and accurately. The plan adopted in the book is first to give very briefly the fundamental quantitative relationships and laws and then the numerous worked-out typical examples illustrating the principles of the subject, as a guide to the methods of tackling practical problems. In addition there are some 300 carefully graduated examples for the student to work out himself. The book well deserves the success it has already attained.

* * * * * *

"NOZIONI ELEMENTARI DI RADIOTELEGRAFIA." Ufficio Marconi, Rome. Limp cover, 2 lire; cloth boards, 3 lire, postage extra.

Students and all in Italy who are interested in radiotelegraphy will welcome, under the title of *Nozioni Elementari di Radiotelegrafia*, a translation of the famous *Elementary Principles of Wireless Telegraphy*, by R. D. Bangay. The translation, which has been carefully prepared by the Marquis Luigi Solari, whose connection with wireless telegraphy in Italy is well known, does full justice to the well-known handbook, and is splendidly illustrated with diagrams and drawings of apparatus. It is essentially a book for the beginner and presupposes no previous knowledge of magnetism and electricity, so that it can safely be recommended for use in schools where an advanced course in the science of electricity is not provided. Containing no superfluous matter and filled from cover to cover with interesting facts and explanations, it carries the reader to a point where he is able clearly to understand the underlying principles of wireless apparatus and the manipulation of simple installations. Although it is easily comprehensible by the schoolboy and the young student in technical colleges, it is yet by no means unsuitable for the adult student, and will not irritate by the childish explanations which sometimes appear in elementary text-books. Without a doubt the Italian edition will have an extensive sale wherever that language is spoken.

---

NOTE.—*Any of the above books will be forwarded by return of post upon receipt of remittance covering cost of book and postage, by the Wireless Press, Ltd., Marconi House, Strand, W.C.*

# Personal Notes

It is with great regret that we have to announce the death of Professor Silvanus Phillips Thompson, which occurred at his London residence after an illness of only two days' duration. Professor Thompson was born at York on June 19th, 1851. He attended the Bootham (Friends') School in that city, and the Institute at Pontefract, and graduated at London University in 1869. Devoting himself to physical science, he acted for a time as science master at his old school in York, but gave up that position in order to study in London, where he graduated with high honours as B.Sc. in 1875, proceeding to his doctor's degree in 1878. In the latter year he received the appointment of Professor of Experimental Physics at University College, Bristol, and in 1885 became Professor of Physics in the City and Guilds Technical College, Finsbury, of which he was also Principal. This position he held up to the time of his death. He was an author of no mean repute, and among his well-known works are "Elementary Lessons in Electricity and Magnetism" and "Wireless Telegraphy and Telephony."

* * * * * *

It is our sad duty to record this month the death in action of Lieut. Bernard C. de B. White, who from 1912 until the outbreak of war held the position of Assistant Editor of this magazine. At the commencement of hostilities he obtained a commission as Second Lieutenant in the York and Lancaster Regiment, afterwards transferring to the 1st Tyneside Scottish, 20th Northumberland Fusiliers. It is only recently that he obtained his full lieutenancy. The literary work of Lieut. White will be well known to our readers, for he was the author of numerous signed and unsigned articles and of several poems which appeared in our pages. His death will come as a severe blow to those with whom he worked.

Lieut. White is the second member of the staff of the Wireless Press, Ltd., to be killed in action, the first being Mr. C. F. Warren, whose death occurred in May, 1915.

* * * * * *

A most impressive and pathetic funeral was recently witnessed at Brompton Cemetery, when, in the presence of nearly 2,000 people, the remains were interred, in the family grave, of Mr. Sydney Leonard Leggett, of the Wireless Section, Royal Naval Air Service. The deceased, who was only 21, was killed in a collision at Shoreham whilst motor-cycling. Amongst the many floral tributes was a unique and lovely model of a wireless station, from the family, designed by Mr. Leggett, senior, who is

a florist ; a superb wreath from the officers and men of the wireless section of the R.N.A.S., whilst the young girl who was riding with deceased at the time of the accident, and had a marvellous escape, sent a pretty bunch of flowers.

* * *

We have received a notification that Mr. L. de Moncho has been promoted to the rank of Lance-Corporal on the field, and also that in the Birthday Honours of June 3rd he was awarded the Military Medal for Bravery and devotion to duty under shell fire at Givenchy and Loos. He is now at Vimy Ridge. We congratulate Mr. de Moncho, who before the war was a member of the Accountants Department of the Marconi Company.

LANCE-CORPORAL DE MONCHO

* * * * * *

We have to announce that Wireless Operator Arthur H. Kidd, of H.M.S. *Attentive*, has been invalided out of the service after being four weeks in hospital at Deal.

* * * * * *

Among those mentioned in Sir Douglas Haig's last dispatch for gallant and distinguished service in the field is Sergeant Gilbert Metcalfe, of the Royal Engineers. Sergeant Metcalfe is 28 years of age, and entered the Army in October, 1914. He was attached to the Postal and Telegraph Office at York, and it is in the capacity of telegraphist that he has proved a valued member of his company of Engineers. Since joining the Army he has become proficient as a wireless telegraph operator. We offer him our congratulations.

* * * * * *

We congratulate Second Air Mechanic J. F. Menear, news of whose marriage has just come to hand. Mr. Menear was in the Traffic Department of the Marconi Company, and some time ago enlisted in the Wireless Section of the Royal Flying Corps, being stationed at Farnborough. His marriage took place at St. Mark's Church, Farnborough, on June 7th last. Before he enlisted Mr. Menear was a keen member of the Marconi Athletic Club. We trust that Mr. and Mrs. Menear will have many happy days before them.

* * * * * *

Second Lieut. H. Broadbent, of the Wireless Section 3rd Canadian Division, is well known in wireless circles in the North of England. He took his certificate at the North-Eastern Schools of Wireless Telegraphy, Newcastle-upon-Tyne, and later acted as instructor at the West Hartlepool branch of that institution.

On the outbreak of war Sec. Lieut. Broadbent was Sergeant Instructor of

Signallers and Telegraphists in the 7th Durham Light Infantry (Territorials), and went out with his battalion to France in the spring of 1915. After the second battle of Ypres he was transferred to the Royal Engineers, and it was during his connection with this latter unit that he won the D.C.M. and was given his commission.

The *London Gazette* describes the grant of the medal in the following terms: "2695 Sergt. H. Broadbent, No. 4 Section, 50th Divisional Signal Co., R.E. (T.F.)—for going out alone and mending breaks in the lines under heavy shell fire. Later, when the main cable was broken in several places, he repaired it, and remained all the afternoon on the spot in a dug-out, going out to repair it again whenever necessary."

The General on the parade ground publicly commended Sec. Lieut. Broadbent for his excellent work. On his appointment to commissioned rank he was posted to the 3rd Canadian Division.

* * * * * *

The engagement has just been announced of Miss Wintringham to Captain Williamson, of the Manchester Regiment, now attached to the Royal Flying Corps. This gentleman was in command at the wireless station at Humberstone for some time and is well known in that neighbourhood. He has been out to the Front and was the recipient of the Military Cross.

SECOND LIEUT. H. BROADBENT.

* * *

We learn with pleasure that Wireless Telegraph Operator (first class) A. Andrews, R.N.R., O.N. 13 W.T.S., has been awarded the Distinguished Service Medal. We congratulate him on behalf of our readers and ourselves.

* * *

The funeral recently took place at Oxbridge Cemetery, Stockton, of Mr. Edwin T. Hall, of the Coastguard Service. The deceased had seen extensive service since 1885, when he joined *H.M.S. Exmouth*. His duties subsequently carried him aboard several of His Majesty's vessels, until 1901, when he joined the Coastguard; two years ago he was removed to a wireless station on the North-East Coast. The members of the staff at the wireless station were largely represented in the cortège and a firing party was also in attendance.

# Company Notices

## Marconi International Marine Communication Company, Ltd.

### *Account of General Meeting*

THE 16th Ordinary General Meeting of the Marconi International Marine Communication Company (Ltd.) was held on the 14th June, at the Hotel Cecil, Strand, Mr. Godfrey Charles Isaacs (Managing Director) presiding.

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

The Chairman said: Gentlemen,—Mr. Marconi, having matters of the highest importance to attend to in Italy, wishes me to express again his regret at not being able to preside to-day. With your approval I adopt the usual course of taking the report as read, and I will proceed to deal with the figures in the accounts.

BALANCE-SHEET CHANGES EXPLAINED.

Turning first to the balance-sheet, you will observe that the Debentures show a small reduction of £320, accounted for by purchases to that amount having been made during the year. The creditor balances at the end of 1915 are some £11,000 less than they were at the same time in the preceding year. The item of £10,000 standing to special reserve for war contingencies we are proposing to transfer to general reserve account, having debited all the losses incurred during the year from the submarine warfare to the profit and loss account. As we have informed you in the report, we are also transferring to reserve account the £17,639 14s. 3d. which previously appeared as share premium account, and this sum, together with the £10,000, will amount to £27,639 14s. 3d. carried to the reserve account. Having regard to the item of £219,381 11s. 7d. which stands upon the other side to the credit of licence and rights and shares in associated companies, we think it right to build up year by year a substantial reserve to set off this item. The only other figure calling for any comment on the debit side is that of £8,095 8s. 6d. for excess profits duty. This was the amount payable for 1914, and I feel sure that the whole of our shareholders will be at one with me when I say that it has afforded us the greatest satisfaction in the present circumstances to be able to contribute this amount and to know that the sum payable for the past year will be a more substantial one still.

Turning to the credit side, the item of plant, apparatus, furniture, and stores, which represents for the most part telegraph stations on board ships, shows a net increase of nearly £3,000, notwithstanding the fact that a number of installations were lost during the year, and a substantial sum has been written off in keeping with our custom for depreciation. The increase is, of course, explained by the amount represented by new installations fitted during the year exceeding the sum represented by loss and depreciation. Our available cash resources at bankers and on loan show an increase of some £11,000, which is very satisfactory considering the large expenditure made during the year upon capital account.

GROSS AND NET RECEIPTS INCREASED.

Turning to the profit and loss account, our gross receipts amount to £208,899 14s. 2d., being £33,000 higher than for 1914, and the net profits for the year amount to £63,630, an increase of nearly £8,000 over those of the preceding year. I think we can congratulate ourselves upon this result, especially when we bear in mind, firstly, that our business is necessarily being conducted in very difficult and abnormal circumstances, and, secondly, that the whole of our losses incurred through the submarine warfare have been debited to the profit and loss account.

It will be interesting here to note the regular growth of our gross receipts during recent years: In 1911 they amounted to £64,166; in 1912 to £100,325; in 1913 to £146,325; in 1914 to £175,105; and in 1915 to £208,927.

THE YEAR'S DIVIDEND 12½ PER CENT.

Turning again for a moment to the balance-sheet, the available balance to the credit of profit and loss account at the end of 1914 was £64,855 14s. 11d. Out of this sum we paid dividends of 10 per cent., amounting to £30,608 8s., we placed to reserve for repayment of Debentures £3,500, to special reserve £10,000, for additional Directors' fees £1,000, and excess profits duty £8,095 8s. 6d., which left a balance to be carried forward of £11,971 18s. 5d. This sum, added to the profit and loss account for the year under review, gives us an available balance of £75,602 1s. 1d. We have declared an interim dividend of 5 per cent., which was paid on February 1, absorbing a sum of £15,304 4s., and, subject

to your confirmation, we propose paying a final dividend of 7½ per cent., making 12½ per cent. for the year, which will require a further £22,956 6s., and, after placing a further £3,500 to reserve for repayment of Debentures, we carry forward, subject to excess profits duty, a sum of £33,841 11s. 1d.

### Effects of Abnormal Conditions: Necessity of Wireless Telegraphy at Sea.

Having regard to the fact which I have already mentioned, that our business is being conducted at the present time under very abnormal conditions, that our telegraphic receipts are very much below what they would be in ordinary circumstances, that the losses incurred and debited to profit and loss account are considerable and would not arise in times of peace, that in consequence of the continual and substantial growth of our business generally our profits show a substantial increase, we have considered ourselves fully justified in paying a higher dividend, and we feel sure that this can at least be maintained. Except in such abnormal times as these, we are not subject in our business to any material variation in our figures in consequence of fortuitous circumstances, activity, or slackness of trade. We provide what is an absolute need, to the great importance of which each year has given more marked demonstration, and I would tell you without question that this last year has given greater proof than in any previous time of the extreme utility, if not the absolute necessity, of a wireless telegraph installation on board every merchant ship; and I think I can go yet a step farther and say that not only is it essential that every ship should be equipped with wireless telegraphy, but overwhelming evidence has been afforded of the importance of a world-wide organization such as this Company has built up. I do not hesitate to say that such an organization never could have been developed efficiently except under one management. The Navy, the Army, and the whole nation can be thankful that such an organization exists and that it is in the hands of a British Company.

### The Company's Telegraph Stations.

As we have informed you in our report, the number of telegraph stations owned and worked by the Company as public telegraph stations on the high seas—which has reference, of course, to merchant ships only—had increased at the end of December, 1915, to 1,008. At the present time it is between 1,100 and 1,200, and this number is increasing day by day as fast as it is possible to turn out and fit the installations. If progress is not greater at this moment, it is only in consequence of the existing circumstances and the exigency of other demands.

### Present Position of the Company.

This, gentlemen, is the position of your Company to-day. We have a sound industrial business, which, in my opinion, can only progress, and which I think after the war will develop more quickly than hitherto. I would remind you, however, that this position has not been obtained without a very great struggle. Those of you who have followed the history of this Company since its inception some 16 years ago will remember the innumerable difficulties which have been encountered, how slow was the country to appreciate the value of the work which the Company had taken in hand, and how dangerously near one was to the whole business falling into foreign hands. It required some courage on the part of the shareholders to face an expenditure of upwards of £200,000 over a period of years before one penny of profit was earned. One cannot help thinking what a different state of things might have existed had this company shown less enterprise. It gives one hope that the lessons of this war will lead to national assistance, should it again fall to the lot of a British Company, situated as this Company was, to develop a new science and a new industry destined to become of such paramount importance to the nation.

I do not suppose that the work of any man has ever been responsible for the saving of so much life, and I am very sorry indeed that Mr. Marconi is not here to-day to tell you of his new work. His recent developments will dispose of one more peril of the seas. He authorizes me to inform you that in the very near future he will introduce a new, independent, and very simple apparatus, to be worked from the bridge of a ship, and by one of the ship's officers, which should put an end to all danger of collision in darkness or fog. He has described this new work to me, and I have little doubt that every seagoing vessel will be equipped with this further great invention of Mr. Marconi, and, turning to the practical business side of the question, this should prove of no small value to your company.

### Bravery of the Telegraph Operators.

Gentlemen, I cannot close without reminding you that we have in our employ in these perilous times some 2,000 young men almost continuously upon the seas, and I think it speaks volumes for the great inherent qualities of our young men from the moment they are given serious occupation and responsibility that in no single instance has one of them been found wanting in the moment of peril. It is true that we are at some pains in selecting men for this service, and inquire thoroughly into their records, both at school and subsequently, of their parentage and of their home life, and it is significant that all these young men, born of respectable parents, no matter how humble may be their station, have borne themselves admirably in all circumstances.

It will interest you, perhaps, to hear two or three instances. In July last year the Lords Commissioners of the Admiralty presented a gold watch to Mr. J. F. Rea, operator in charge of the wireless installation on board the s.s. *Anglo-Californian*, for his devotion to duty in remaining at his post in the wireless cabin during the time the *Anglo-Californian* was heavily engaged and shelled by a German submarine. The junior operator, Mr. W. G. Williams, was highly commended for his splendid conduct in going down into the stokehold and assisting the engineers in keeping up steam when the

stokers had refused to go below. Both Rea and Williams stuck to their posts, although heavily bombarded for hours. In another case the captain of a ship, which for reasons I will not name, desired to report to us how well pleased he was with the splendid work of the operators, Messrs. Weselby and Ingle, and that he desired that his appreciation be put on record. These operators were on board a ship which was captured and boarded by officers from the cruiser *Emden*. The enemy carried off the accumulators, telephones, and coil back contacts; they cut down the aerial and threw the wire overboard. When the ship was released the operators, with great intelligence and ability, reconstructed their apparatus and were soon in communication with a coast station, which secured the safety of the ship. Another instance is the case of the s.s. *Armenian*, where the senior operator, Mr. J. S. Swift, rendered great service. While the ship was being chased and shelled he remained at his post sending calls for help until the wireless cabin and the aerial were destroyed by shell fire. He subsequently showed the greatest calmness and presence of mind upon leaving the ship and in the boat during the night. The captain wrote: "I can highly recommend him as a man of good character, sobriety, and of being most attentive to his duties at all times." There is another case which I must mention—it is that of our wireless operator, Mr. Proughton, who was on the s.s. *Zent*, which was torpedoed on April 5 of this year. The protest lodged by the captain contains a very fine story of the heroism and self-sacrifice of Mr. Proughton. "But for his gallantry and devotion to duty," it is stated, "not a single life would have been saved. He remained to the last in his wireless cabin, and was never seen again," but he succeeded in bringing help to the others. There are many more such instances, but it is impossible to recite them all. I am sure you will all agree with me in being proud of such men. They vie with the Navy and the Army in proving that there has been no decline in the spirit of our race.

It will interest you to know, further, that 82 of our operators were employed on mercantile ships which have been sunk by the enemy. Three were drowned, two have been seriously injured, and seven have been slightly injured; and of the operators whom we have transferred to the Admiralty service, I am sorry to say that seven have already lost their lives.

### Services of the Manager and Staff Warmly Commended.

Before formally moving the usual resolution, there is one word more I feel I must say, and that is how very highly the Directors appreciate the great ability shown by Mr. Bradfield, our Manager, during all these troublous and difficult times, and the untiring attention given by the Heads of the Ship Department, Mr. Cross and Mr. Lewis, and all the Staff working under them. Shareholders will well understand that all the men essential for the conduct of a business of such immense importance in these times have been retained, and that the work which they do is of no less importance than that of any man who is rendering other service to the country. It was a duty, however, to release every man that could possibly be spared, and this naturally has thrown much longer hours and greater responsibility upon all the members of the staff who have remained behind. I have nothing further to add, gentlemen, and I now beg to move: "That the report of the Directors submitted, together with the annexed statement of the Company's accounts at December 31, 1915, duly audited, be received, approved, and adopted." I call upon Captain Sankey to second the resolution.

Captain Henry Riall Sankey, C.B., R.E.: Gentlemen, I have much pleasure in seconding the motion.

The Chairman: Before formally putting the resolution, I shall be very pleased to answer any questions that any shareholder may desire to ask. After a pause, and no shareholder rising to address the meeting, he continued: If there are no questions I will now formally put the resolution, and will ask those in favour of it to signify the same in the usual way. Against. Carried unanimously. It is now my pleasure to move: "That Senatore Guglielmo Marconi and Alfonso Marconi, Esq., the retiring Directors, be re-elected Directors of the Company." I need not say anything to you, I am sure, in support of that proposal.

Mr. Henry S. Saunders seconded the motion, which was carried unanimously.

Captain Sankey: Mr. Chairman and Gentlemen,—Obviously, from the comparatively small attendance at this meeting, the shareholders have great confidence in the Directors. The Directors also have great confidence in the shareholders, because every year they have to ask for their fees, and therefore I have much pleasure in proposing the following resolution: "That the remuneration of the Directors for the year 1916 shall be the sum of £2,000, subject to such further sum, if any, as may be determined at the next general meeting of the Company." This sum is divided among the Directors by the Accountant, who uses a mysterious formula, but the result is quite satisfactory to the Directors.

Mr. Alfonso Marconi seconded the motion, which was carried unanimously.

The Chairman: I now have pleasure in moving: "That a final dividend of 7½ per cent., equal to 1s. 6d. per share, less income-tax, upon the capital now issued and paid up, be and the same is hereby declared for the year ended December 31, 1915; that the said dividend be payable on July 7, 1916, to the shareholders registered on the books of the Company at June 13, 1916."

Captain Sankey seconded the resolution, which was carried unanimously.

On the motion of Mr. David Morgan, seconded by Mr. Charles Lucas, Messrs. Cooper Brothers & Co. were re-elected Auditors for the ensuing year, and the proceedings then terminated.

**Dr.** **BALANCE SHEET,**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | £ | s. | d. | £ | s. d. |
| To CAPITAL— | | | | | | | | | | | | | | | |
| *Authorised*— | | | | | | | | | | | | | | | |
| 1,250,000 Ordinary Shares of £1 each | ... | ... | ... | ... | ... | ... | ... | ... | ... | £1,250,000 | 0 | 0 | | | |
| 250,000 7 per cent. Cumulative Participating Preference Shares of £1 each | ... | ... | ... | ... | ... | ... | ... | ... | ... | 250,000 | 0 | 0 | | | |
| | | | | | | | | | | £1,500,000 | 0 | 0 | | | |
| *Issued*— | | | | | | | | | | | | | | | |
| 1,222,688 Ordinary Shares of £1 each, fully paid | ... | ... | ... | ... | ... | ... | ... | ... | ... | | | | 1,222,688 | 0 | 0 |
| 250,000 7 per cent. Cumulative Participating Preference Shares of £1 each, fully paid | ... | ... | ... | ... | ... | ... | ... | ... | ... | | | | 250,000 | 0 | 0 |
| | | | | | | | | | | | | | | | 1,472,688 0 0 |
| ,, BILLS PAYABLE | ... | ... | ... | ... | ... | ... | ... | ... | ... | | | | | | 11,716 10 6 |
| ,, SUNDRY CREDITORS | ... | ... | ... | ... | ... | ... | ... | ... | ... | | | | | | 154,648 12 3 |
| ,, RESERVE FOR EXPENSES UNPAID AND PAYMENTS IN ADVANCE AND OTHER CREDIT BALANCES | ... | ... | ... | ... | ... | ... | ... | ... | ... | | | | | | 34,663 16 6 |
| ,, GENERAL RESERVE ACCOUNT | ... | ... | ... | ... | ... | ... | ... | ... | ... | | | | | | 667,530 0 6 |
| ,, PROFIT AND LOSS ACCOUNT— | | | | | | | | | | | | | | | |
| Balance as per Appropriation Account, 31st December, 1914 | ... | | | | | | | | | | | | 69,497 | 8 | 6 |
| Profit for the year as per Account | ... | ... | ... | ... | ... | ... | ... | ... | ... | | | | 377,817 | 12 | 1 |
| | | | | | | | | | | | | | | | 447,315 0 7 |
| To Contingent Liability on Shares in Associated Companies £50,862 10s. 0d. and Liability under an Agreement | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | £3,088,562 0 4 |

## Report of the Auditors

We have audited the above Balance Sheet with the books in London and accounts from Rome. The entered in the Balance Sheet at £23,986 1s. 3d. and shares of the nominal value of £1,354,518 14s. 5d. out that these shares are held on behalf of this Company. This item also includes shares for which certificates opinion such Balance Sheet is properly drawn up so as to exhibit a true and correct view of the state of the the books of the Company.

LONDON, 19th June, 1916.

**Dr.** **PROFIT AND LOSS ACCOUNT for**

| | | | | | | | | | | | £ | s. | d. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| To RENTS, RATES, TAXES, TRAVELLING, PUBLICITY, GENERAL EXPENSES AND WAR SUBSCRIPTIONS | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 20,047 | 7 | 1 |
| ,, SALARIES OF STAFF, CONTRIBUTION TO STAFF SUPERANNUATION FUND AND DIRECTORS' REMUNERATION | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 72,834 | 17 | 1 |
| ,, LAW CHARGES, PROFESSIONAL FEES AND PATENT EXPENSES | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 14,936 | 19 | 8 |
| ,, LOSS ON EXCHANGE AND DEPRECIATION ON INVESTMENTS | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 53,363 | 8 | 2 |
| ,, DEPRECIATION OF PLANT, MACHINERY, BUILDINGS AND FURNITURE | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 19,175 | 14 | 1 |
| ,, FOREIGN AGENCIES EXPENSES | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 4,037 | 12 | 11 |
| ,, STATION EXPENSES | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 19,451 | 18 | 7 |
| ,, BALANCE BEING PROFIT FOR THE YEAR CARRIED TO BALANCE SHEET | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 377,817 | 12 | 1 |
| | | | | | | | | | | | £581,665 | 9 | 8 |

**Dr.** **APPROPRIATION**

| | | | | | | | | | | | £ | s. | d. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| To DIVIDEND OF 7 PER CENT. ON PREFERENCE SHARES FOR THE YEAR ENDING 31ST DECEMBER, 1915, paid 1st February, 1916 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 17,500 | 0 | 0 |
| ,, INTERIM DIVIDEND OF 5 PER CENT. ON ORDINARY SHARES FOR THE YEAR ENDING 31ST DECEMBER, 1915, paid 1st February, 1916 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 61,134 | 8 | 0 |
| ,, PROPOSED FINAL DIVIDEND FOR THE YEAR ENDING 31ST DECEMBER, 1915, ON THE ORDINARY SHARES AT THE RATE OF 5 PER CENT. PER ANNUM | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 61,134 | 8 | 0 |
| ,, BALANCE CARRIED TO NEXT ACCOUNT | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 307,546 | 4 | 7 |
| | | | | | | | | | | | £447,315 | 0 | 7 |

**31st December, 1915.** **Cr.**

| | £ | s. d. | £ | s. d. |
|---|---|---|---|---|
| By Cash at Bankers and in Hand ... ... ... ... ... | | | 76,829 | 19 0 |
| ,, Investments and Temporary Loans Against Securities ... | | | 443,848 | 14 3 |
| ,, Sundry Debtors, Debit Balances and Expenditure on Foreign Developments ... ... ... ... ... ... | | | 749,074 | 2 1 |
| ,, Stock at Cost or Under as certified by Officers of the Company ... ... ... ... ... ... ... ... | | | 159,647 | 6 5 |
| ,, Freehold Works at Dalston ... ... ... ... ... | 38,419 | 6 1 | | |
| *Deduct* Mortgage ... ... ... ... ... ... | 12,611 | 12 4 | | |
| | | | 25,807 | 13 9 |
| ,, Freehold Property at Chelmsford and Plant, Machinery and Buildings at Chelmsford and Genoa Works ... ... ... ... ... ... ... | | | 99,829 | 19 1 |
| ,, Long Distance Stations in England and Ireland (including Stores) and Movable Plant at other Places ... ... ... ... ... ... ... | | | 120,109 | 7 6 |
| ,, Expenditure on Leasehold Premises, Office Furniture and Fittings, London, Chelmsford and Foreign Agencies ... ... ... ... ... ... ... | | | 29,757 | 3 9 |
| ,, Shares in Associated Companies and Patents ... ... ... ... ... ... | | | 1,383,657 | 14 6 |
| | | | £3,088,562 | 0 4 |

Shares held in Associated Companies are of a par value of £2,484,369 14s. 10d.

HENRY S. SAUNDERS, *Director.*
S. GEOGHEGAN, *Director.*

**to the Shareholders.**

item, Shares in Associated Companies and Patents, includes shares held abroad without nominal value of a total nominal value of £2,484,369 14s. 10d. Except as to a small part we have seen letters stating have not been issued. We have obtained all the information and explanations we have required. In our Company's affairs according to the best of our information and the explanations given to us and as shown by

COOPER BROTHERS & CO., *Chartered Accountants,* } *Auditors.*

**the Year ending 31st December, 1915.** **Cr.**

| | £ | s. d. |
|---|---|---|
| By Balance of Contracts, Sales and Trading Account ... ... ... ... | 581,125 | 8 2 |
| ,, Transfer, Share Warrant and other Fees ... ... ... ... ... ... | 540 | 1 6 |
| | £581,665 | 9 8 |

**ACCOUNT.** **Cr.**

| | £ | s. d. |
|---|---|---|
| By Profit and Loss Account— | | |
| Balance Brought Forward as per Appropriation Account for 1914 ... | 69,497 | 8 6 |
| Profit for the Year as per Account ... ... ... ... ... ... | 377,817 | 12 1 |
| | £447,315 | 0 7 |

# Marconi Wireless Telegraph Company, Ltd.

## *Report of Directors and Statement of Accounts*

THE Directors herewith submit the Balance Sheet and Profit and Loss Account for the year ending December 31st, 1915.

The Profit and Loss Account for the year shows a gross profit of £581,125 8s. 2d., and a net profit carried to Balance Sheet of £377,817 12s. 1d., an increase of net profit over the preceding year of £145,101 3s. 2d. The net profit, added to the sum of £69,497 8s. 6d. brought forward from the previous year, increases the balance now to the credit of Profit and Loss Account to the sum of £447,315 0s. 7d.

The Directors regret to have again to inform the Shareholders that they are still without an agreement as to the basis of remuneration and compensation from the Government for the use of the Company's high-power stations since the beginning of the war, and for the other services rendered in connection therewith. It has therefore been once more impossible to include any sum in respect of these matters in the accounts. There have been, however, a large number of contracts entered into by the Company with Government Departments in respect of all of which payments have been regularly received.

There are four heads under which considerable sums are payable by the Government to the Company, viz. :—

1. The Post Office, for remuneration and compensation in respect of the use of the Company's high-power stations since the beginning of the war, the staffing and management of those stations, and other services in connection therewith.

(It is hoped that a substantial payment on account may be received shortly.)

2. The Admiralty, for the use of the Company's patents since the expiration, on the 31st March, 1914, of the Admiralty agreement of 1903, no new agreement having yet been concluded.

(There have been difficulties in arriving at a settlement of this matter and delay has been unavoidable. We have, however, received an assurance that every despatch will be given to deal with the matter as quickly as possible.)

3. The War Office, in respect of the use of the Company's patents, without agreement, during the whole time Wireless Telegraphy has been used by the War Office.

(This matter is about to be referred to the Treasury for settlement under the Patents and Designs Act, 1907.)

4. The Post Office, for compensation in respect of their withdrawal from the contract for the Imperial chain of stations, with regard to which no agreement has been arrived at, and the Company has therefore been obliged to leave the amount of compensation to which it is entitled to be settled by a Court of Law.

Shares in Associated Companies and Patents, following our usual custom, are taken at their cost price, viz., £1,383,657 14s. 6d., which shows an increase of £23,531 19s. 2d. The Company's holdings in Associated Companies, except for some additions, have undergone no change during the past year. The par value of the shares held in Associated Companies, as shown in the margin, now stands at £2,484,369 14s. 10d., exclusive of shares which have no capital denomination.

After crediting £100,000 allocated from Profit and Loss Account of the preceding year, the General Reserve Account now stands at £967,530 0s. 6d.

The Marconi International Marine Communication Company has continued to show substantial development of its business and a further increase in profits. Dividends for the past year amounting to 12½ per cent. have been declared and the sum of £33,841 11s. 1d. has been carried forward.

The Russian Company, Société Russe de Télégraphes et Téléphones sans Fil, has continued to do a large business. A dividend at the rate of 15 per cent. for the year 1915 has been declared.

The French Company, La Compagnie Française Maritime et Coloniale de Télégraphie sans Fil, has declared a dividend for the year 1915 at the rate of 10 per cent. on the Ordinary Shares and 31.25 francs on the Founders' Shares.

The Amalgamated Wireless (Australasia) Limited has paid a dividend of 6 per cent. in respect of the year ending 30th June, 1915.

The Wireless Press Limited has paid a dividend of 25 per cent. in respect of the year ending September 30th, 1915.

The Marconi Wireless Telegraph Company of America has again earned increased profits for the past year, but its principal revenue is expected to be derived from the Transatlantic Service, which, in consequence of this Company's stations being in Government service, has been obliged to remain idle. It is apprehended that the compensation to be received in respect of this Company's Carnarvon stations will also embrace the loss incurred by the enforced idleness of the American stations.

Owing to the unfavourable rates of exchange large sums of money have had to be placed on deposit with foreign banks, principally in allied countries, until such time as the exchanges become normal. Had these moneys been remitted on the 31st December last there would have been a loss in exchange of £25,757 2s. 5d. Temporary investments at the end of the year showed a depreciation of £27,606 5s. 9d. It has, therefore, been deemed right to debit to Profit and Loss Account both these sums, which amount to £53,363 8s. 2d. There have since been substantial improvements, and it is contemplated that if held until hostilities cease the loss will be completely recovered. In the event of eventual realisation without loss, the amount so written off will appear as profit in another year.

In view of the state of war and having regard to the large sums of money abroad, and to the uncertainty as to when any of the moneys due to the Company from the Government will be received, your Directors deem it prudent to husband their resources, and recommend the declaration of a final dividend upon the Ordinary Shares at the rate of 5 per cent., which, together with the 5 per cent. interim dividend paid on the 1st February, 1916, will make 10 per cent. for the year. They will, however, further recommend that a substantial bonus shall be declared and paid out of the moneys due from the Government as soon as they are received.

The Directors retiring at this meeting are Captain H. Riall Sankey and Mr. Alfonso Marconi, who, being eligible, offer themselves for re-election.

The Auditors, Messrs. Cooper Brothers & Co., also retire and offer themselves for re-appointment.

By Order of the Board,
HENRY W. ALLEN,
*Secretary.*

Marconi House, Strand, London, W.C.,
19th June, 1916.

# Marconi Wireless Telegraph Company, Ltd.

## *Account of General Meeting*

THE Nineteenth Ordinary General Meeting of Marconi's Wireless Telegraph Company (Limited) was held on the 30th June, at the Hotel Cecil, Strand, Mr. Godfrey C. Isaacs (the managing director), presiding.

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

The Chairman said: Ladies and Gentlemen,—I have this morning received a telegram from Senatore Marconi, in which he says: "Please express my great regret that duties here prevent my attending general meeting." Mr. Marconi is in Rome. I am sure you will all regret that he is not here, but I am equally sure that there is nobody, in the circumstances, who would have it otherwise.

### Explanation of the Accounts.

I propose, with your approval, to adopt the usual course of taking the report and accounts as read, and will proceed at once to deal with the figures of the balance-sheet and profit and loss account. Turning first to the balance-sheet, there is no change since last year in the capital. The bills payable and sundry creditors show reductions this year of some £8,000 and £16,000 respectively. The general reserve account now stands at £967,530 os. 6d., which is £100,000 more than the figure at which this item stood in the accounts of last year. On the credit side, cash at bankers and in hand shows an increase of some £20,000 in round figures; investments and temporary loans exceed the previous year's figures by £173,500; sundry debtors, debit balances, and expenditure on foreign developments have increased by the sum of £23,000; the stock taken at cost is slightly reduced; there are also reductions in the figures representing freehold works at Dalston, freehold property at Chelmsford, machinery and buildings at Chelmsford and Genoa Works, long-distance stations, and leasehold premises. These have in most cases been added to by some additional expenditure, but the amounts written off in every case exceed the sum expended. The shares in associated companies and patents show an increase of between £22,000 and £23,000 in consequence of our having acquired some additional interests. Otherwise, there is no change; all the shares held at the end of 1914 were held in 1915. They appear in the balance-sheet, according to our habit, at cost, but have a par value of £2,484,369 14s. 10d., which excludes some shares representing a substantial value, but the shares having no capital denomination do not figure in this total. Turning to the profit and loss account, the balance of contracts, sales, and trading account shows an increase of some £210,000 over that of the preceding year, and the net profit of £377,817 12s. 1d. is an improvement over that of the preceding year of some £145,000.

### The Question of Depreciation.

I have no doubt you will all consider these figures, in the circumstances, as highly satisfactory, particularly when one bears in mind that there are many substantial items not yet settled with the Government, which are therefore not included in the figures of last year, and in addition we have written off the sum of £53,000 in respect of depreciation of exchanges and investments. But this item, it must be borne in mind, does not at the present moment represent a loss, inasmuch as no actual loss has been incurred in exchange, as it has not been necessary to bring home from abroad the moneys which are lying at banks upon interest, nor has it been necessary for us to sell the investments which, had they been realised on December 31st, 1915, would have resulted in a loss. There is every reason to suppose that before it will be necessary for us to bring home our moneys from abroad exchanges will have become normal or thereabouts, and before we require to realise our securities, which are with one exception gilt-edged securities, it is possible that we shall realise not only the cost price, but a substantial profit. The one exception to which I have just referred showed a loss on December 31st of some £13,000. This investment was certainly not what is termed a gilt-edged security, but it is one of an absolutely sound nature, and was made for the purpose of assisting our business. The price at December 31st last was a nominal one, but it was the only guide which we had. If we had to deal with the figures to-day instead of at December 31st last, not only would that £13,000 loss have disappeared, but there would be a profit upon the shares, and as time goes on we are confident that that profit will increase. We have therefore every hope that the item of £53,000 will appear as a profit in a future account. There is only one thing that I perhaps might add, and that is, that had we not treated this sum as a loss at December 31st, 1915, our profit and loss account for this year would have been the record in the history of the company. I think there is nothing more which I need say relating to the account, but if there are any other explanations regarding the figures which may be required, or which I may have omitted, if my attention is drawn to them I shall be very glad to give further particulars.

### Last Year's Working and the War: "Considerable Business with the Admiralty."

Our business during the year under review has certainly not been normal. There is considerable work in certain parts of the world which we should have been doing, but which it has been impossible to do in consequence of the war; on the other hand, we have had some compensation by having many additional orders at home and from Allied countries.

In particular we have done considerable business with the Admiralty, and nothing could have been more agreeable than the relations between the company and that Department, and I am glad to say that this feeling is reciprocated by the high officials with whom we have had to deal at the Admiralty. They have told me how deeply they are indebted to us and to our staff and to all the employees of the company for their consistently admirable and prompt work on their behalf; their wishes, they say, have always been met immediately and cheerfully, and no trouble has seemed too great to supply them with exactly what they wanted at the shortest possible notice; that they have been grateful for the prompt response to their sometimes very urgent requests for skilled operators at a moment's notice, and which responses must have been of great service to the Empire. I am sure you will be pleased to learn, too, that I have been told that no company has served the Admiralty better. It has been a source of great gratification to me, as I am sure it will be you, to know how

much those with whom we have had to do at the Admiralty have appreciated our work. We, the company, and you, Ladies and Gentlemen, as shareholders, are not alone in owing a deep debt of gratitude to Mr. Bradfield and to others of his staff who have been mainly responsible for the carrying out of that work.

### THE ASSOCIATED COMPANIES: THE NEW TRANSATLANTIC SERVICE.

Our associated companies have not been able, in consequence of the war, to make the progress which they otherwise would have done. This applies particularly to our Spanish and Argentine companies, to the Relay Automatic Telephone Company and to a considerable degree also to the American Company. The new direct Transatlantic service with New York, which was ready to open when war broke out, and to which we both have attached the very first importance, has continued in enforced idleness, the stations on this side having remained in the service of the Government. For this we hope we shall receive due compensation. As soon as the war comes to an end we are confident that this new Transatlantic service should be productive of very considerable revenue to our American Company, besides to our own, which added to the profits which they are now making should soon place them in a position to pay substantial dividends. Independently, however, of this, we have in view, in conjunction with our American Company, a new and very considerable programme, which I am afraid it would be inexpedient for me to divulge at the present moment. I have for some time intended taking the first opportunity of visiting New York in respect of these matters, and had booked my passage for the steamer leaving this coming week. Unfortunately, however, there are so many matters of importance which demand my presence here that I am bound to defer for a little my visit. Others, however, will go in my stead; I shall follow at the earliest opportunity and so soon as I can dispose of pressing matters, to one of which at least I think you will attach some importance, and that is the distribution of a bonus, to which I will refer a little later.

Our Belgian Company, whose business Captain Sankey and I, as directors of that company, have assisted to direct, has been unable again to make up any balance-sheet, and I am consequently unable to give you any information with regard to the results, and we have therefore also received no dividends.

Our programme in respect of the Canadian Company has also been obliged to remain in abeyance meantime.

The French Company has continued to do a satisfactory business, and has paid dividends equivalent to those of the preceding year.

The Marconi International Marine Communication Company, notwithstanding its considerable losses, has shown an increased profit, and is making excellent headway, and I am glad to be able to say that in the case of this company it has been able to pay an increased dividend. Mr. Turnbull, who has been largely responsible for the management of this company's affairs, is entitled to special credit.

Our Russian Company has continued to be extremely busy, and has declared a dividend for the past year at the rate of 15 per cent., with which we have every reason to be well satisfied. We can congratulate ourselves upon the choice of the member of our staff, Major Simpson, who has acted as managing director of that company ever since our inception of it, and nothing I can say can speak more eloquently of his direction than is indicated by the results achieved and the dividends paid.

The Spanish and General Trust has suffered very naturally in consequence of the war, but I hope ere long part of the programme of that company will be realised, and I may be able to add its name to those from which we are receiving revenue in the shape of dividends.

The Wireless Press, which all of you must have observed has been very prominent in all the daily papers, has developed an excellent business under the very able management of Mr. H. W. Allen, our secretary, who is mainly responsible for its successful development.

We have continued to do an important business with the Italian Government through our Italian Agency, under the energetic and able management of the Marquis Solari, who represents the company in Italy. His unswerving loyalty to the company and the able manner in which he conducts its affairs are deeply appreciated by the directors.

### THE DIVIDEND: A CONSERVATIVE POLICY.

I now come to matters in respect of which I am sure you will expect to hear something from me. We have had an excellent year, and having £447,315 0s. 7d. to the credit of profit and loss account, we are distributing only a small proportion of this amount, carrying forward £307,546 4s. 7d., and you will, no doubt, want to know why we are adopting this course.

I do not think I can do better than remind you of what I said upon this subject last year. I then told you, after having described to you the nature of the competition with which the company had had to contend in the past and the many difficulties with which they have been confronted from time to time, that I had given you that information in order that you should better understand the reasons for the conservative policy which the board had determined to follow, and I added that we contemplated that when this war is over, in consequence of the great utility which wireless telegraphy has proved itself to be, there will be a very considerable business to be done with a great many foreign countries, and that in consequence of the financial position which may then obtain, it was, in our view, essential that we should be in the strongest possible position to undertake business in all parts of the world without the necessity of requiring immediate payment therefor. That position has not changed to-day, except perhaps to be more accentuated. In harbouring our resources, therefore, we are satisfied that we are unquestionably acting in the best interests of the company. Had we known our position with regard to the several matters in respect of which we have to receive payments from the Government we should have been able to be more generous in the distribution which we are recommending. Until we know a little more of that position it is better for us to act conservatively.

### "CONSIDERABLE SUMS" DUE BY THE GOVERNMENT.

There are, as we have told you in our report, four heads under which considerable sums are payable by the Government to the company, in respect of which also you will no doubt look to me to give you some more information than is furnished you in the report. The first of these is the remuneration and compensation which is due to us from the Post Office, acting on behalf of itself and other Government Departments, in respect of the use of the company's high-power stations since the beginning of the war, the staffing and management of these stations, and other services in connection therewith.

The remuneration to which we think we are entitled is certainly a very considerable sum. The

services which we have rendered I cannot go into in detail, but I do not suppose there is a single member of the public who has not some appreciation of their magnitude. There is one thing, however, which I think I may be permitted to tell you, and which will not only interest you, but also give you some idea of the extent and usefulness of our work. To the end of December, 1915, we had handled foreign messages in transmission, reception, and delivery which represented in the aggregate a total of, in round figures, over 20 million words.

As regards compensation, you are aware that we had just completed the construction of our Carnarvon and Towyn stations, and also in America the American Company had just erected its New Brunswick and Belmar stations, all of which represented a very considerable outlay, for the purpose of opening a direct telegraph service between Europe and America. Traffics during the period of the war have shown very considerable increase, and there is no doubt whatsoever that the business we should have done would have been on a very large scale indeed, and the profit which we have every reason to expect we should have realised each year since the outbreak of war would have, in our estimation, run well into five figures. We are of opinion that we should receive a substantial sum to compensate us for this loss, and we have every hope that the Government will appreciate the value which our stations and our services have been to the nation, and remunerate and compensate us fairly if not generously. I have every hope that this matter will be settled in the very early future. On Monday morning last I was glad to have had the assurance of the Postmaster-General that these questions were receiving his earnest consideration, and every endeavour would be made to deal with them at once.

### Claims under the Patents and Designs Act.

Under item (2) of the report is our right under the Patents and Designs Act, 1907, to receive payment from the Admiralty in respect of the use of our patents since the expiration of the agreement on March 31, 1914. We have supplied the Admiralty with a very considerable number of installations since the outbreak of war under contract, and the royalty in each of these cases has been defined and paid, but there have been infinitely more installations which were already fitted and others which have been constructed by the Admiralty themselves in respect of each of which a substantial sum is payable to us. In cases where we supply the Admiralty with installations we, of course, make a manufacturing profit in addition to the royalty payment; it is therefore fair to assume that, where we have not had the opportunity of making the manufacturing profit, the royalty to which we should be entitled should not be less than in cases where it is accompanied by a manufacturing profit. The agreement which was made with the Admiralty in 1903 came to an end on March 31, 1914, and there is no single installation in the use of the Admiralty since that date which is not using patents which are our property and in respect of which, therefore, we are not entitled to receive payment, except in such cases as I have already mentioned, where payment has already been made. We have every reason to believe that a fair and equitable settlement of these matters will be made at the earliest possible moment. That such a settlement has not yet taken place we in no way complain, for there have been certain matters of some complexity which required to be dealt with, and which will be dealt with, I hope, very soon, before we could arrive at an agreement as to the payments to be made to us.

Under Number (3) of the report there is a similar claim upon the War Office. We have never had any agreement with the War Office in respect of the use of the Company's patents, and up to the time of the war there had been some use of our patents, but not on a large scale. An offer was made to us in 1912 which was less per installation than what we have since been receiving from the Admiralty, and which we did not feel justified in accepting. Since the war the use of the Company's patents has been very considerable indeed. There has been an immense number of installations supplied to the War Office from outside sources and a very large number also manufactured in the factories of the War Office, all of which come under our patents. In our interpretation of the Patents and Designs Act of 1907 there should have been a genuine endeavour to agree with us the payments which were to be made to us in respect of the use of these patents. Having regard, however, to the immense increase in the work of the War Office during the war, we must, perhaps, not complain that there has been no endeavour to arrive at such an agreement, and that it is left to the Treasury under Article 29 of the Patents and Designs Act of 1907 to decide what is the royalty to which we are entitled. As we have informed you in our report, this is a matter which is now being referred to the Treasury, and we hope that ere long it will be disposed of.

### The Post Office and the Contract for the Imperial Chain of Stations.

The fourth item to which we have made reference—namely, payment from the Post Office for compensation in respect of their withdrawal from the contract for the Imperial chain of stations—is by far the most important matter of all, and I had hoped that it would have been possible to have arrived at satisfactory terms which would have avoided the necessity of my saying more than a few words to you upon this subject. Unfortunately, however, we have not been able yet to arrive at terms which we consider we should have been justified in accepting on your behalf, and it therefore is my duty to-day to tell you what Mr. Marconi would have told you last year had it not been that we were then in negotiation for a new agreement, and contemplated that these negotiations would have been fruitful.

You will remember that in the Directors' report issued in 1914 we informed you that we had been permitted to make but slow progress with the six high-power stations for which we had contracted with his Majesty's Postmaster-General, and that the Company's interests were being seriously prejudiced thereby. At the general meeting last year our Chairman informed you that at the end of 1914 the Company received letters from the Postmaster-General informing them that, owing to the altered circumstances resulting from the war, the Government had decided not to proceed with the Imperial wireless chain; that the governing factors in determining the Imperial scheme would be better met by means other than the construction of stations of the character and in the situations contemplated by the contract for the Imperial chain; and that the amounts disbursed by the Company in respect of the contract would be refunded. He further told you that subsequently, in February, 1915, negotiations were entered into with his Majesty's Government for the erection of certain stations on conditions differing from those in the original scheme, that negotiations were proceeding upon a basis which, if agreed to, would represent to the Company a reasonable equivalent of the terms of the 1913 contract, but, he added, nothing, however, has yet been definitely decided. This statement, ladies and gentlemen, before it was made to you received official approval.

CORRESPONDENCE WITH THE POSTMASTER-GENERAL.

After receiving, on December 31st, 1914, from the Postmaster-General, the intimation of the intention to withdraw from the Imperial contract for the reasons given, to which I have already referred, some correspondence took place with respect to the compensation which the Company should receive, which resulted in our being informed by the Secretary of the General Post Office that inasmuch as the Company took up the position of claiming compensation, the Postmaster-General, on behalf of the Government, unconditionally withdrew his letters and was prepared to co-operate in carrying out the terms of the contract of 1913 with all possible promptitude. In a subsequent communication of January 21st, 1915, we were informed that the Postmaster-General was willing to proceed with the construction of all the six original stations. I would remind you that we had been informed just before this that the Government had decided not to proceed with the construction of the stations of the Imperial chain owing to the altered circumstances resulting from the war, and that the governing factors in determining the scheme could be better met by means other than the construction of stations of the character and in the situations contemplated by the contract for the Imperial chain of 1913. Upon these and other considerations it was quite evident that not only was there no urgency for the construction of these stations, but that they were not, in fact, required.

Ladies and Gentlemen,—We declined the Postmaster-General's offer to reinstate the contract, notwithstanding all the importance which you and we have always attached to it. I am sorry that it would not be right for me at this moment to make public all the reasons for the course which we took. They will, no doubt, be given on another occasion elsewhere. Were I able to tell you all that you must one day know, I am satisfied that you would unanimously agree that we were not only justified, but wise in the decision we took.

NEW NEGOTIATIONS.

In February, 1915, as you will remember Mr. Marconi told you last year, new negotiations were entered into with his Majesty's Government. On this occasion, however, these negotiations were not with the Post Office, but with the Admiralty, and in consequence of its being represented to us that four of the original stations were urgently needed, and although the conditions offered to us were in my view less favourable than those of the 1913 contract —the number of stations being reduced from six to four, and the duration of the contract shortened—I felt myself constrained, in view of its national importance, to undertake to recommend my colleagues to accept the basis proposed for the new agreement. The draft of this agreement was to be submitted to us promptly and the stations were to be proceeded with immediately. I have told you that, in my opinion, the new agreement proposed was far less favourable to the Company than was the contract of 1913, but owing to the urgent need for the immediate construction of the stations, I did not feel justified in being the cause of any delay in their being erected and I believe that you would have approved the course I was then adopting, to the detriment of the Company, but in the national interest.

Ladies and Gentlemen,—When we met you last year, and when the Chairman made the statement he did on the question of the Imperial contract on July 26th last, we were daily expecting to receive the draft agreement. No draft agreement has ever been received. The Company has never yet been officially informed why this draft agreement has never been submitted to us. After several inquiries without result and many more months of patient waiting, we realized that there was no alternative but to proceed with our claim for compensation. We therefore took the necessary steps to this end, and I am prevented from discussing subsequent matters. To sum up what I have already said, however, whereas your Directors in early 1915, believing the stations to be urgently needed, were of opinion that they were warranted in making a heavy sacrifice, to-day, in all the circumstances, some of which I have described to you, they are convinced that in your interests they are not called upon and cannot conscientiously agree to make that sacrifice.

This, Ladies and Gentlemen, is all that I feel I can publicly say to-day upon this subject. Whether we are able to arrive hereafter at an agreement or not, there is every reason to hope that the whole matter may be dealt with and disposed of before the end of the year. But we are not in any sense depending upon a settlement of this matter to carry out our promise to you of a substantial bonus. We look to any one of the items under one, two, or three of the report for this purpose. As I have told you, we are of opinion that we are entitled to a very large sum under each of these heads, and whichever one of them is settled first should enable us to carry out our promise. It will, of course, be understood that both classes of shares will receive whatever bonus it may be decided to pay.

LOYAL SUPPORT OF THE OFFICERS AND STAFF.

Before moving the resolution I must tell you how sensible are the Directors to the loyal support which they have received from all the officers of the Company and to every member of the staff, without exception, in the Company's employ. The work which they have done has been of the first importance, not only to the Company, but to the country. Very many of our staff are in Government service, many are with his Majesty's forces in the field, and we owe a deep debt of gratitude to them and to those who have rendered equal service at home.

MR. MARCONI'S RESEARCH WORK IN ITALY: "FAR-REACHING RESULTS."

There is but one other matter to which I want to make reference before I sit down, and I think you will agree with me that it is certainly not the least important. You will remember that on April 3rd last we informed you by circular that Mr. Marconi had been engaged in research work in Italy, where he had been able to carry out some important improvements and tests. The results obtained were far-reaching, and directly concerned the future practice of the entire science of wireless telegraphy and wireless telephony over both long and short distances, no matter whether conducted by means of ordinary sparks, quenched sparks, or continuous waves, and that by this means results hitherto impossible would be obtained. This information was sent to you with the express authority of Mr. Marconi. Since then he has been able to pay a visit to this country and has described to me the nature of this new work. I announced at the general meeting of the Marconi International Marine Communication Company, which was held a couple of weeks back, that in the very near future Mr. Marconi would introduce a new, independent, and very simple installation, to be worked from the bridge of a ship, which would put an end to all danger of collision at sea in darkness or in fog. This represents but a part of Mr. Marconi's latest work. It is my belief that his new inventions will prove as epoch-making in the progress of the art of wireless telegraphy as was in 1900 the now world-famous patent known as the four sevens.

Ladies and Gentlemen, I now formally move: "That the report of the Directors submitted, together with the annexed statement of the Company's accounts, at December 31st, 1915, duly

audited, be received, approved, and adopted." I call upon Captain Sankey to second the resolution.

Captain H. Riall Sankey, C.B., R.E.: Ladies and Gentlemen, the shareholders of this company generally expect to get some important information at the annual meeting, and I think they will not have been disappointed this year. You have also had some sort of indication of the difficulty the directors, and more particularly the managing director, have had in working the affairs of the company; and I should like to express, as I have now the opportunity of doing so, my great admiration of the way in which Mr. Isaacs has conducted the negotiations referred to. Really the way in which he does things is almost miraculous, but I think his great strength is his absolute honesty of purpose and the straightforward way in which he deals with matters. I feel sure that the shareholders can absolutely rely on the way in which he will conduct the business of the company. I believe that the 20,000,000 words to which Mr. Isaacs referred have been since the beginning of the war; it does not say so in the report, and it may be worth while to note the point. I would also like to say one word about the works, as I am one of the directors more particularly concerned with them. I should like to assure the shareholders that they have in those works one of the best-equipped works in this country for the business they have to do. I should also like to say that Mr. Mitchell, the works manager, is a most capable man for the work. I do not know anyone who could do the work better than he. I beg to second the resolution.

The Chairman: Before putting the resolution formally to the meeting I shall be glad to reply to any questions which any shareholders may wish to put to me.

### The Discussion.

Mr. S. P. Derbyshire: Mr. Chairman, the Marconi Company was established to work one of the most amazing inventions that the brain of man ever devised in the history of the world, and in consequence of its uncanniness it brought upon itself from its inception the most scathing criticism. Had the great Marconi lived in olden days he would have been burnt at the stake as a wizard. The people of this generation did not act quite in that manner towards him, but instead of acclaiming him as one of the greatest benefactors the world has ever known, they did not scruple to use him and his associates as a whip with which to attempt to flog prominent political personages. You may say —Why bring that matter before us to-day? Why bring up something we are all too well acquainted with and wish to forget? Because, ladies and gentlemen, I can detect to-day in the public Press many indications that the spirit which so harassed our directors several years ago is not yet dead. We have heard to-day from our chairman a most lucid report of the many difficulties which we as a company have had to contend with, and we are told that at some future time we may be paid a bonus of 5d. per share, or 5s. per share, or £5 per share—we know not what—and what does the Press say about it? In that great organ the *Daily Mail*—it is a great organ—you find it everywhere—I read: "The situation again places Marconi shares in a fine position for speculative manipulation." Whose fault is that? Surely, not ours. We have heard how the directors have laboured for many months past to settle the matter with the Government, and no impartial person can say that it is our fault that our shares to-day are in a position for manipulation. Perhaps we ought not to complain of the remarks of the City Editor of the *Daily Mail*, but rather accept them as a tribute to his insight and broad grasp of the position. But I do feel that we have a right to complain of the way the Government has treated us. The last thing any shareholder in this company would like to do is anything that would inconvenience the Government of this great Empire at this time. Speaking personally, for my small interest in the company, I would make them a present of it willingly if I thought it was in the national interest, but I do feel that our interest ought to be carefully attended to by the Government, and I beg of them to give some little attention to us and enable us to continue the great work which we are doing in the interests of the Empire. This is to-day the opportunity—the only annual opportunity—the shareholders have of meeting together, criticising the balance-sheet, and expressing any views they may have with respect to the conduct of this company's business, and my first note must be that I feel sure I express the feeling of the shareholders when I say that our predominant feeling is one of deep gratitude to the directors for the balance-sheet they have been able to lay before us and for their report. Turning to the details of the balance-sheet, I have one or two criticisms to offer. I should very much like to be told what the parent company itself earned, and how much we get by way of dividends from the shares we hold in the associated companies of the par value of nearly two and a half millions sterling. The chairman later on will probably give us a full answer to that question, so far as he feels he is at liberty to do so, but I do not wish to press him to give us any information which might inconvenience him in the conduct of the company's business. Again, I observe that the balance-sheet is a very good one, but I notice that there is one slatternly little item in it which I very much object to. Here, with assets of £3,000,000, we appear to have a mortgage down Dalston way of £12,600. Do, Mr. Chairman, before you go to New York, go to Dalston and pay off that mortgage, even if you are not entitled to pay it off at a month's notice. Give the mortgagee a share or two or a bonus and pay him off, and let us see that we have no mortgage in our balance-sheet. In conclusion, I have three requests to make. First, will the Press please leave us alone? They had a good innings a year or two ago; give us a miss in baulk now. Secondly, will the Government please pay us our little bill? Thirdly, will the directors please continue to pursue their successful policy of building up one of the finest businesses in the world?

Mr. John Waring: Mr. Chairman, I think it was in 1914 that I told Mr. Marconi, our splendid managing director, and our directors, that I had every confidence in their bringing this company to the position in which we find it to-day. Now I desire to thank Mr. Marconi, our managing director, and our directors for the splendid report which they have placed before us to-day, and I thank them all. I am pleased to say that I still hold the same number of shares to-day—namely, 300, which I held then, and I thank you all for the patience you have displayed in connection with our affairs. I am sure that we have every confidence in you, and that you will do great things for us.

Mr. F. M. David: May I ask, Mr. Chairman, two short questions? Referring to the 20,000,000 words, does that include all means of transit, such as the high-power stations in the employ of the Government, and so on; in other words, all means of transit? With reference to Mr. Marconi's new patents, or the one referred to in the circular, are they two different patents or discoveries or one—in connection with avoiding collisions at sea?

Mr. Lanham: Mr. Chairman, the last item on

the balance-sheet reads something like this: "Shares in associated companies and patents, £1,300,000 odd," and in a line later you give the information that these are of a par value of so and so. I am not much of an expert in financial matters, but to me, Sir, that conveys very little. What we should like to know, I think, is the cost to us and the present valuation, which may be entirely different. Then, sir, there is one small point I should like to ask a question about with respect to Mr. Marconi's new inventions. We have read the circular and heard from the chairman to-day that Mr. Marconi has made these discoveries, but so far as I have been able to understand, there is little indication as to what the connection is between those patents and this company. Mr. Marconi has been clever enough to make this invention, but does it follow that this company is to get the benefit of it, and if so to what extent? Up to the present it seems to me that that point has been rather evaded, and, for anything which has so far been said, this company might have nothing whatever to do with it. It appears to me that that is a little point on which you might kindly give us some information.

Mr. Barnes: Mr. Chairman, I should like to ask whether, with regard to these Post Office questions, they have paid for the salaries and out-of-pooket expenses, or whether the company has borne all that outlay and has charged it up; and the same with the disbursements in connection with the wireless business. I understand that these outlays must have been very considerable in both cases, and I understand that they have been charged in the company's accounts, but that nothing has been received from the Post Office or the other Government offices mentioned. Then, as regards the compensation, I think we shall all be very glad indeed if that matter can be settled without going to litigation. We shall all be very thankful indeed if the company can keep out of the Law Courts, and I think we all rather feel that we would prefer to give the Government something rather than take anything from them at the present time, if only from a patriotic point of view. With regard to your investments, I should like to ask whether there is any amount in them representing War Loans.

### The Chairman's Reply.

The Chairman: With regard to the first question put to me, relating to dividends on shares, I do not think it would be advisable to state at a public meeting what is the amount of the dividends which we receive on shares, or to give any information which would enable one by dissecting our figures to arrive at information which it is not desirable he should have, but if any shareholder thinks it is worth his while, and he cares to come and see me at the office, I shall be very pleased to give him the information. As regards the mortgage, I quite appreciate the feeling of the shareholder who spoke upon that subject, but it so happens that this is a mortgage which was arranged many years ago, and under it we pay, as you have probably remarked from the accounts, £1,000 every year, and it is gradually in process of extinction. I do not like the look of that small item, considering the large sums of money which we have available, but on the other hand, as business men, having arranged this matter many years ago, when money was very cheap, I do not think it is quite advisable to give them the benefit of that arrangement to-day. In reply to another shareholder, those 20,000,000 words embrace all the words we have actually handled for the Government since the commencement of the war until the end of 1915 through the stations which we are managing on their behalf. It does not, of course, touch our own Transatlantic service. A question was asked as to whether Mr. Marconi's new invention embraces one or two patents. I am afraid I cannot tell you. I am not at all sure that the one patent, which is, and, presumably, will be the master patent, may not cover the use of those patents for many purposes besides those which I have in my mind, and which I have already announced; but I do not think it necessarily means that there should be more than one patent. In any case, this work has been carried out in Italy, and protection has been applied for in Italy first. I have not yet seen the provisional specification, and I hope it will be quite a long time before anything is made public with regard to the details of that work. The longer it remains where it is, the better for us and the worse for Germany.

### The Value of the Shares in the Associated Companies and Patents.

With regard to the question relating to the last item in the balance-sheet, "Shares in associated companies and patents," a shareholder said that that gave him very little information, but I am afraid he has not observed what we have said every year in our report, and which I feel sure we have not omitted to say this year. On page 6 you will see we say, "Shares in associated companies and patents, following our usual custom, are taken at their cost price." Therefore, although the balance-sheet does not say so, the report tells you that that figure represents the cost of all the shares you hold, and, in addition, the cost of all the patents you hold. To give you a valuation of those shares, particularly in times such as these, would be, I am afraid, a responsibility which is greater than I would care to take upon myself, inasmuch as we have a good many shares which are not quoted—a good many shares, in fact, which have never been heard of. They represent interests in different businesses, and I do not think it would be possible for us to arrive at a valuation with such accuracy as would be necessary if we had to make a statement as to what the value of those shares is. But I think shareholders know in a general way what the shares we hold mainly consist of. They know that we have a large number of shares—I think, speaking from memory, it is very nearly 200,000—in the Marconi International Marine Communication Company. Well, they have a market for those shares, and they can form their own opinion as to what they are worth. I believe they are worth at the present moment about £2 per share. We have, speaking again from memory, about £200,000 nominal value of shares in our Russian company. Well, those shares pay a dividend of 15 per cent. Everything that could be written off has been written off. We have a magnificent freehold property, and we consider the value of those shares to be not less than that of the International Company's shares. Then we have a large number of shares in the Canadian Company, and those are quoted; also in the Spanish Company, and those are quoted; as well as in the American Company, and those are quoted, so that in a general way the shareholders can arrive pretty well at what is the value, which is, of course, a changing value, of the shares we hold. I do not think it would be possible for us to attempt to give a valuation of them. It will perhaps satisfy the shareholder who asked the question if I tell him that the realisable value of those shares to-day would far exceed the cost price.

### The Ownership of Mr. Marconi's Patents.

The other question, I think, was as to Mr. Marconi's patents or his inventions, and to whom they belong. Well, ladies and gentlemen, I thought

that all the shareholders knew that the agreement which was entered into by this company with Mr. Marconi at the inception of the company provided for the company having all improvements that Mr. Marconi may ever make in relation to wireless telegraphy or telephony other than in Italy; and as regards Italy the arrangements which then obtained between Mr. Marconi and the company, which required the omission of Italy, have changed. We have made other arrangements with him, and we are therefore interested also in the patents in Italy.

### A Settlement with the Government Desired Without Litigation.

In reply to the question as to whether we have been reimbursed the salaries and our disbursements in respect of the out-of-pocket payments which we make in the running of the stations for the Government, recently, or comparatively recently, we have been paid the greater part of our out-of-pocket expenses, and we are paid from time to time cheques on account of those expenses. As regards the disbursements on the wireless stations which we partly erected under the Imperial contract, we have been paid a substantial part of our outlay, but the matter has not yet been finally settled. I am very much in sympathy with the shareholder who hoped that we might arrive at a settlement with the Government without having recourse to the Law Courts in respect to this action. I had hoped to have made it very clear in my opening speech that I have done nothing else but endeavour to make such a settlement, and I am still disposed to endeavour to make such a settlement; but what I said, and what I think you will approve, is that whilst we are very desirous of making this settlement, and we are even willing to make something of a sacrifice to obtain that settlement, we are not disposed to-day to make the sacrifice which we were disposed to make twelve months ago, when we thought the matter was of urgent national importance. The last question had relation to our investments. We have, ladies and gentlemen, a very large sum indeed invested in War Loan.

The resolution was then put to the meeting and carried unanimously.

The Chairman: I now have to move, "That a final dividend of 5 per cent., less income-tax, upon the Ordinary shares now issued and paid up be and the same is hereby declared for the year ended December 31st, 1915; that the said dividend be payable on August 1st, 1916, to the shareholders registered on the books of the Company on June 29th, 1916, and to holders of share warrants to bearer."

Mr. Alfonso Marconi seconded the motion, which was unanimously agreed to.

Mr. Henry S. Saunders: The next resolution is, "That the retiring Directors, Captain H. Riall Sankey and Mr. Alfonso Marconi, be re-elected, Directors of the Company." As you are all aware, the great bulk of the work must fall on our capable and valuable Managing Director, Mr. Isaacs, also on Mr. Marconi, our illustrious Chairman and inventor, but I think that every Director is doing his best in this Company for your interests, and I am sure that the two gentlemen whom I ask you to reappoint render most valuable services. I have, therefore, much pleasure in proposing that resolution.

Mr. Samuel Geoghegan seconded the motion, which was carried unanimously.

Mr. Alderman J. C. Ford (of Cork): I have much pleasure in proposing, "That Messrs. Cooper Brothers & Co. be re-elected Auditors for the ensuing year, and that their remuneration for auditing the accounts to December 31st, 1915, be 600 guineas."

The motion was seconded by Mr. Bagster and unanimously agreed to.

The Chairman: Ladies and Gentlemen,—I think this concludes the business of the meeting.

### The Chairman, Directors, and Staff Cordially Thanked.

Mr. Alderman J. C. Ford: Before you do conclude the meeting I think it would be very ungrateful indeed on our part if we did not move a vote of thanks to Mr. Isaacs for the able manner in which he has conducted this meeting. It is a source of satisfaction to us, Mr. Chairman, that in the absence of our great inventor, Senatore Marconi, you are here to-day to take his place worthily and well. Many things have been said here to-day, but we can all thank you for the encouraging way in which you have portrayed the position of the Company at the present moment. A number of questions were put to you, Mr. Chairman, in connection with Mr. Marconi's recent inventions, but as far as I could see your mouth was closed owing to the Defence of the Realm Act; but I think any man watching the papers carefully could see the answer for himself. During the past week you have seen in the papers that the premium on shipping war risks has decreased by two-thirds per cent.; that is, that the premium of £3 per cent. of last week has been reduced to £1. That speaks volumes. We do not know what the reason is, but the fact is there. You were good enough to mention that the Admiralty had expressed their thanks to the staff. Well, I think we should be ungrateful on our part if we did not ask you, Mr. Chairman, to convey to the staff our grateful thanks for the manner in which they have worked the concern. Any shareholder who has from time to time gone into the office of the Company has experienced nothing but courtesy from every member of the staff, from the head down to the humblest member, so it is only right and fair that a vote of thanks should be accorded to them. Mr. Chairman, you have placed everything before us in an exhaustive manner, and I am sure that every shareholder present here and those who read the proceedings of this meeting to-morrow will be pleased. The only thing we have to hope is that after all the vicissitudes we have gone through the Government will now make up a little leeway by at least "forking out" the money which is due to us as quickly as possible.

The vote was unanimously accorded.

The Chairman: Ladies and Gentlemen,—On behalf of the Directors, as well as on behalf of the staff, I thank the last speaker for his kind remarks. I am sure we all very much appreciate them.

The proceedings then terminated.


***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.***

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.*

SPR. M. F. G. (Flanders).—Your friend is right. Poldhu transmits the Press bulletins automatically by means of Wheatstone tape.

---

A. E. B. (York).—*The Elementary Principles of Wireless Telegraphy*, by R. D. Bangay, *Handbook of Technical Instruction for Wireless Telegraphists*, by J. C. Hawkhead and H. M. Dowsett, are both books which your son should study. To enter the engineering side of the profession he would have to have practical engineering training at a recognised technical college. Write to the Chief Engineer, Marconi's Wireless Telegraph Co., Ltd., for a list of approved colleges.

---

R. F. (Manchester).—For answers to your questions see the article on "How to Become a Wireless Operator" in our issue for August last.

---

H. C. (Wallasey).—We do not think the authorities would object. The best thing to do would be to write to the G.P.O. for permission, saying what apparatus you propose to use. We think it would be granted. (2) Yes, if it were a sensitive one.

---

V. E. S. (Barry Dock).—You cannot join any section until you are nineteen.

---

V. E. S. (Victoria, Australia).—(1) Selenium can be obtained from any of the big dealers in scientific apparatus if you order it. (2) Yes, we should think so. (3) Yes. Vol. 1 and back numbers can be ordered through Messrs. Gordon & Gotch from the Wireless Press, Ltd. We are glad you appreciate the "Questions and Answers" Columns.

---

"SPARK" (Moate, Co. Westmeath), who says that the mathematical Instructional Articles are the very plainest and easiest to understand that he has ever read, asks whether it is our intention to publish them in book form.

*Answer.*—Yes; these articles will be published in book form as soon as the series is completed.

---

J. L. W. (Stockport) asks whether Leclanché cells would run themselves down if connected in parallel instead of series. This question shows that our correspondent is not clear in his mind as to what is meant by connecting cells in series and parallel. Whether cells run themselves down or not depends on other things besides the way they are connected. We would refer J. L. W. to Chapter IV. of the *Handbook of Technical Instruction for Wireless Telegraphists*, where the subject is very clearly treated.

---

A. H. K. (Exeter).—There is no book *How to Join the Wireless Service*, but you will find in our issue of August last an article which will probably give you all the information you require.

---

WINGS (Birmingham).—Your assumption regarding the uniform of wireless operators in the Navy is correct.

---

D. M. (Cardiff).—If the iron core were not laminated it would heat up considerably, but a properly laminated iron core would certainly not melt. The answer to the question is quite

sufficient, the object being merely to find whether the student realises the main effect of introducing an iron core.

F. A. D. (Hornsey) writes: "In your June "issue I see one of your correspondents has had "permission to have a tapping key and buzzer, "also a pair of head receivers. May I ask "what is the use of the receivers, as you can "hear the buzzer quite distinctly without "them?"

*Answer.*—It is quite true that the buzzer can easily be heard without the receivers, but students who learn from a loud buzzer often experience difficulty in reading signals when they first put on the telephones. For this reason it is usual to learn from the beginning from signals in the telephone head piece, as signals heard in this way very closely resemble those which the operator has to read in an actual wireless installation. By far the best book for a beginner is the *Elementary Principles of Wireless Telegraphy*, by R. D. Bangay.

F. H. (Peckham).—We would advise you to obtain THE WIRELESS WORLD for August last, in which you will find an article dealing fully with the life of a wireless operator, and giving much valuable information on the subject.

E. J. E. H. (Berks.).—The arrangement of opposed rectifying circuits for the elimination of atmospherics is not new, and several varieties of it have been tested from time to time. Theoretically the idea is a pleasing one, but in practice loss in strength of signals and difficulties of adjustment have given great trouble. One of the best of these arrangements, which was patented by the Marconi Company some years ago, consisted in coupling inductively two receiving circuits to the aerial, one being adjusted to the signals required, and the other being placed slightly "off tune." The signals required were supposed to confine themselves to one circuit only, and the atmospherics were presumed to affect both circuits equally. The signals from the two detectors were then opposed to one another with the idea of causing the atmospherics to "balance out." The trouble is that a balance which is right for some atmospherics is wrong for others, and in all cases there is great difficulty in obtaining a good balance. We are sorry we have not space to go fully into the interesting subject raised in your second query, but a series of practical tests carried out in the United States some while ago showed that the series method was the better, and in tuning an aerial with a condenser shunted across the inductance the efficiency diminished as the size of the parallel condenser was increased. The best way is to have the condenser of fairly big capacity in series with the aerial, as is done in the Marconi tuners.

W. H. R. (B.E.F., France).—To deal with your query fully and to do justice to it would need many pages of this magazine. There is no difference in the underlying principles of the two systems, although the Marconi apparatus is by far the more robust, fool-proof, and the easier to handle. The system to which you refer has in its transmitter a motor generator of 500 cycles, tubular condensers, flat spiral direct coupled jigger and quenched spark gap. The spark frequency of a thousand gives a high piercing note, which, whilst it carries through atmospherics very well, is very tiring to the ear when it has to be read for a long period, as you have probably found. On the receiving side there is an inductively coupled tuner with no intermediate circuit, and no tuning condenser in the detector circuit. Crystal detectors are used with high-resistance telephones. It is not possible to "break in" as with the Marconi apparatus; the change from sending to receiving is effected by means of a switch, and not automatically. These are a few of the main points. If this information is not sufficient we will try to give more if you will put definite queries to us as to what you require to know.

H. M. (Toulon).—All the latest improvements in the Marconi Company's valves, amplifying valves, crystal receivers, direction finders and the like are being used for war purposes, and we therefore much regret that we are unable to give you any information about them at the present time.

H. L. (Mombasa).—The arrangement of circuits suggested by you would not, we think, prove satisfactory. Such relays are unsuitable for wireless work unless the received signals are exceptionally strong. When it is desired to obtain very loud signals it is customary to use some form of amplifier, such as a Marconi amplifying valve or an S. G. Brown telephone relay. In reply to your second question, it is not true that dry wood is a better conductor of high frequency currents than copper. Dry wood is an exceedingly poor conductor of such currents—almost an insulator. Neither is it true that most X's are heard on a 600-metre wave. Sometimes atmospherics are strongest on one wave and sometimes on another. Don't forget that in tuning for long waves on a small aerial a large amount of inductance must be placed in series with the aerial, and this acts to some extent as a choke, reducing the strength of atmospherics. Perhaps this is what has misled you. We are sorry that space will not allow us to give you patterns of variometer for transmitting. See answer to C. M. for some information on this point.

J. W. (Brocklesby).—We cannot pass any opinion as to which is the best wireless school for obvious reasons, but if you will turn to our advertising pages you will find a number of announcements concerning these colleges.

Ch. S. (Las Palmas).—The aerial shown in your diagram is quite a good one for receiving, although we should prefer a "T" aerial with

extensions *both* ends, and a lead taken down from immediately above the cabin. The wave length of the aerial in your diagram can be calculated in the same way as that of the usual "L" type.

F. A. (Royal Engineers).—There are no books devoted exclusively to directive wireless telegraphy, and the practical details are dealt with only in the pamphlets issued by the Marconi Company for use with the apparatus. These are not supplied to the general public, but we think that you should be able to obtain one through official channels, which will probably suggest themselves to you. We are not aware of any book dealing with the erection of semi-permanent masts, but the Instructional Articles in THE WIRELESS WORLD for May and June, 1914, contain a great deal of valuable information on this subject.

C. M. (Angoulême, Charente).—The so-called "variometer" to which you refer appears to us to be simply a receiving transformer with tappings on the primary and secondary windings brought out to studs, and the coupling varied not by sliding two windings closer together or farther away from one another, but by rotating one inside the other. The name "variometer" is usually applied to a coil, the inductance of which is continuously variable by moving one part in relation to another; thus, if we have two spiral coils connected in series and placed close to and parallel with one another, the inductance will be very different from when the coils are at right angles. By hinging these two coils together, like the covers of a book, the inductance can be varied within wide limits by altering the angle between the two coils. This type of "variometer" is very widely used.

B. V. W. (Cardiff).—There is no book published on the correct procedure to adopt to gain proficiency in Morse signalling as used by wireless operators, nor is there any need for one. If you are able to obtain one of the practice sets referred to and a set of Marconi gramophone records you should be able to obtain proficiency quite easily. While listening to the Morse signals on the gramophone you will learn exactly how they should be sent, and listening to signals in this way will teach you far more than any book could do. In reply to your second question, the Marconi Company has no medical representative in Cardiff, and we are afraid that it would be necessary for the candidate to come to London to be tested by the company's doctor. This, in any case, would have to be done at his own expense, whether he proved suitable or not. In reply to your third question, why not put your other questions directly to us? In reply to your fourth query, the age limit of the Marconi Company is twenty-five years, and for this reason you could not obtain employment with them, although it is just possible that one or two of the shipping companies who employ their own operators might be able to employ you if you were suitably qualified; as, however, the great majority of ships carry operators provided by the Marconi Company your chances are not very great.

I. E. T. (Karachi).—We are afraid that considerations of space, and the fact that your query does not deal with wireless telegraphy, will not allow us to answer your question here, in view of the large number of "wireless" queries we have on hand. It is an interesting subject, however, and we believe something is being done in the way you suggest. Expense is the great trouble.