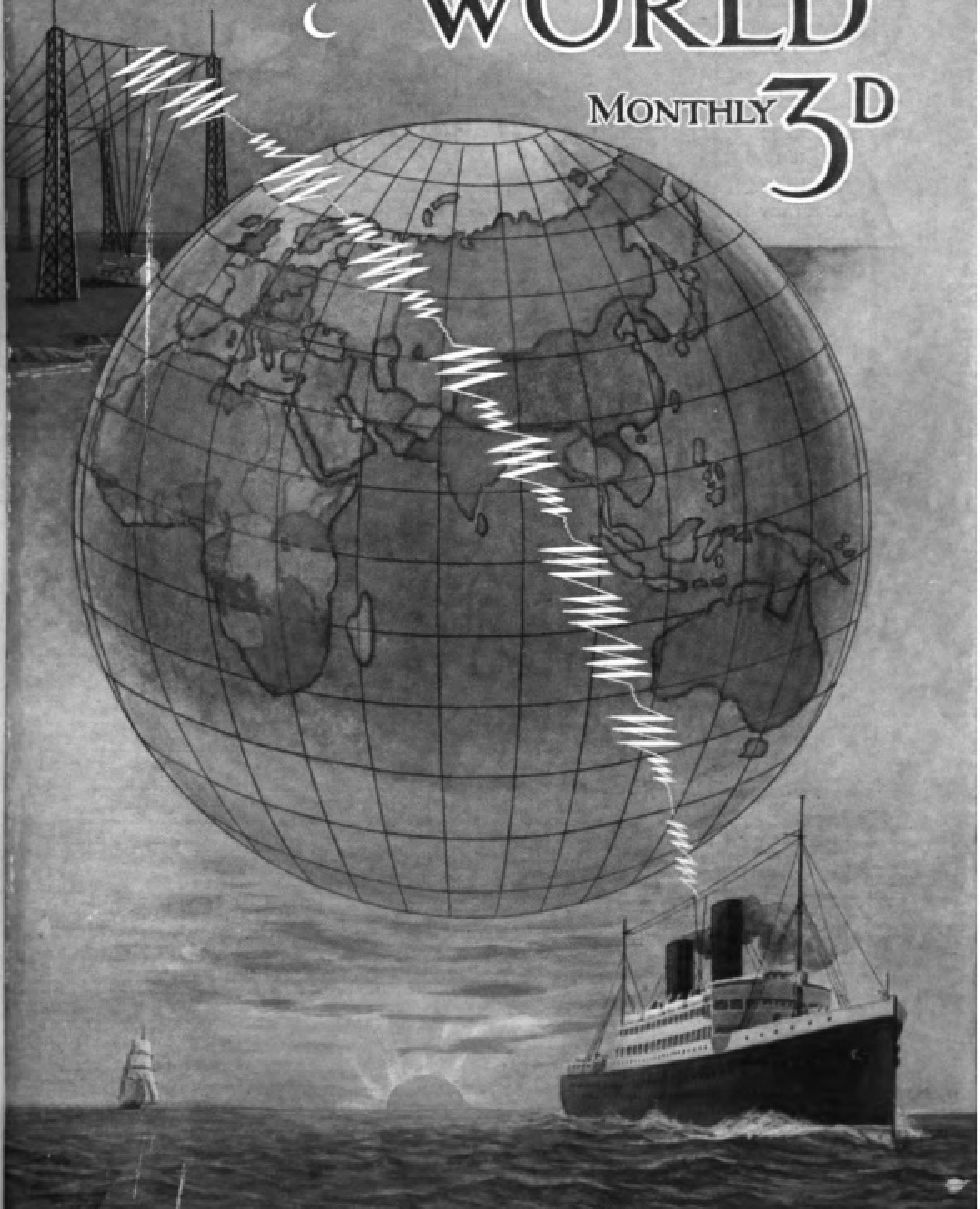
# WIRELESS WORLD

MONTHLY 3D



THE WIRELESS WORLD
with which is incorporated
The MARCONIGRAPH

Vol. 1.—No. 4. (NEW SERIES) July, 1913. Subscription 5/0 per annum post free. Price 3d. Post Free 5d.

# The Wireless Year Book

IT is with unfeigned pleasure that we have to acknowledge the cordial welcome extended to "The Year Book of Wireless Telegraphy and Telephony 1913," which made its appearance in May last. Before offering the book to the public we were assured that the subject it dealt with had reached a sufficiently advanced stage to justify the publication of an annual record. The only doubt that lurked in our minds concerned the practicability of the task we had planned. Any such doubt, however, has been entirely dispelled by the reception accorded to the Year Book, not only by the Press—technical and lay—but also by the public.

We have every reason to be satisfied with the Year Book, for within one month of publication about three-quarters of an edition of ten thousand copies was disposed of. More than that, however, we have received many congratulatory letters from purchasers, which encourage us in the belief that the book will go far to satisfy a demand which undoubtedly exists.

The excerpts from the Press comments, which we give below, indicate the general tone of the reception accorded to the Year Book by the Press. Thus the *Financial Times* says of it:

> "As it is available to the public for the comparatively modest sum of half-a-crown, it justifies itself as a popular reference work in a way which many far higher-priced and not better-edited annuals certainly do not."

In the opinion of a reviewer in the Engineering Supplement of *The Times*, the volume "covers a wide field, and it contains much information of value to those interested in the subject." The *Electrician* considers that for the purpose for which it is published "the Year Book is excellent value," and although our contemporary complains that it is burdened by *embarras de richesse*, we do not think they will find many to share the complaint with them. We have aimed to provide—and the *Scotsman* credits us with having achieved—

> "An interesting and well-ordered conspectus of information of a general and statistical kind, accompanied by many special articles by expert writers."

We do not pretend to have attained perfection, and in spite of the pains taken to ensure accuracy we have since noted one or two errors which we would like to rectify.

One is the omission from the list of periodicals, given on page 545 of the Year Book, of the name of *Electrical Industries*, due entirely to a regrettable oversight, for which we tender our apologies to our contemporary.

In the Glossary of Terms (root means square value), on page 431 the words "The square root of the sum of the squares" should be read "The square root of the mean of the sum of the squares."

Section 20 of useful formulæ on page 411, in the formula for the inductance of a solenoid single layer, the negative sign in the root denominator should be the positive. In the same section in the last column, for "*r* is mean radius," read "*a* is mean radius."


MR. P. BALINSKI.

# The Wireless World.

## With which is incorporated "The Marconigraph."

An Illustrated Magazine for all interested in WIRELESS TELEGRAPHY, published monthly by THE MARCONI PRESS AGENCY, LTD., Marconi House, Strand, London, W.C.

*Registered for transmission by Magazine Post to Canada.*

Telegraphic Address: "Expanse, London." Telephone No.: City 8710 (Ten Lines).
Codes used: Marconi, A.B.C. (4th edition), Western Union.

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| **Subscription Rate** ... ... ... ... ... ... | **5s. per annum, post free.** |
| **Single Copies** ... ... ... ... ... ... ... ... | **3d. each, by post 5d.** |
| **Subscription Rate in the United States** ... ... | **$1.25 per annum, post free.** |
| **Do. in Canada and Newfoundland** ... | **$1 per annum, post free.** |
| **Europe** ... ... ... ... ... ... ... ... | **fr. 6 per annum, post free.** |

All communications relating to Subscriptions, Advertisements, and other business matters, to be addressed to "The Publisher, 'The Wireless World,' Marconi House, Strand, London, W.C."

All Editorial communications to be addressed to "The Editor, 'The Wireless World,' Marconi House, Strand, London, W.C."

**The Editor will be pleased to receive contributions; and Illustrated Articles will be particularly welcomed. All such as are accepted will be paid for.**

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# Personalities in the Wireless World

## MR. PETER BALINSKI

*Vice-President of the Board of Directors of the Russian Company of Wireless Telegraphs and Telephones, St. Petersburg.*

MR. PETER BALINSKI was born at St. Petersburg in 1865. His father, Professor Ivan Balinski, was a notable figure in the ranks of Russian men of science, for besides being a specialist in mental diseases, he was Russia's first eminent physiologist.

Mr. Peter Balinski was educated in one of the public schools of St. Petersburg, and afterwards studied pure mathematics for three years at the St. Petersburg University. Later he became a student of the Emperor Nicolas I. Institute of Civil Engineers, where he took a honours degree as a civil service engineer. Just about this time the Russian Government undertook the construction of the Vilno-Rovno Railway for strategical purposes. The young engineer was immediately employed on this undertaking, and continued to occupy his post until the entire work was completed, when he set up as an architect in his native town. For many years he was attached in this capacity to the St. Petersburg municipality, and several official institutions, hospitals, colleges and many private houses were erected to his designs.

But new ideas and original schemes have always had an attraction for Mr. Balinski, and the rapid development of Russia's larger cities suggested the increasing need for improvement in the means of passenger transit between the various districts of such cities. For seven years Mr. Balinski devoted himself to the study of this problem; and frequent voyages abroad gave him the opportunity of studying the organisation of similar services in the cities of Europe; he gathered abundant statistical data, and elaborated a vast scheme for a Metropolitan Railway system in St. Petersburg.

Three times Mr. Balinski made application to the Government for permission to construct this railway. Each time his scheme received the approval of Russian official circles, and twice it was considered by the Privy Council and discussed by special committees which were appointed by the Government.

Twice also Mr. Balinski succeeded in obtaining the collaboration of foreign capitalists—English and American willing to invest money in the enterprise—but the Government, though giving its general approval to the project, was disinclined to undertake the responsibility of giving a formal guarantee to the undertaking, a condition which the prospective capitalists made a *sine quâ non*, nor would the Minister of Finance grant the right of a free import into Russia of the machinery and metal wares necessary for the construction of the proposed railroad.

In the face of such difficulties it would have been madness to have proceeded farther with such a vast scheme, and Mr. Balinski wisely decided to let the matter drop, at least for a while, and to turn his attention to new lines of industrial activity. He quickly found that the time and trouble he had devoted to this public-spirited project had not been entirely wasted. His negotiations had brought him into touch with a number of important personages and firms in the industrial world. These were quick to appreciate his marvellous capacity for affairs, and many important English and Continental business houses asked him to represent them in Russia. But Mr. Balinski was anxious to associate himself with a scheme that would combine a national benefit with personal interest, and his choice fell on wireless telegraphy. At that time a project was already on foot to establish a wireless company in Russia, and he immediately identified himself with the movement, so that when in 1908 the Russian Company of Wireless Telegraphs and Telephones was inaugurated he was nominated Vice-President, and through its subsequent career he has been one of the most active members on the Board.

# EPISODES OF THE MONTH

THE REPORT OF THE DEPARTMENTAL COMMITTEE OF THE BOARD OF TRADE ON BOATS AND DAVITS. MR. MARCONI'S EVIDENCE BEFORE THE SELECT COMMITTEE. A NOTABLE FEAT IN WIRELESS TELEGRAPHY. A NOVEL INNOVATION. THE SHARE MARKET.

THE Departmental Committee of the Board of Trade on Boats and Davits has now made its report, which was presented to Parliament on June 18th. The main recommendations are concerned with the design and manipulation of ships' life-boats, and the report is instructive where it deals with some of the suggestions for rafts, pontoons, lifeboats and methods of launching them, which were so freely advocated about a year ago. The section dealing with the life-saving equipment of ships is one which particularly interests us, as it refers chiefly to the application of wireless telegraphy to ships' lifeboats. The Committee refer to a "very carefully considered scheme for equipping a certain number of ships' boats with short range installations, put before them by the Marconi International Marine Communication Co., Ltd.," but they "do not feel in all the circumstances that there is any necessity to require any of a ship's lifeboats to be fitted with a wireless telegraph apparatus." The Committee have doubtless chosen this form of exception lest any other view might give rise to a premature demand for the compulsory equipment of such boats. Their reticence is perhaps justified by the fact that no one at the present moment has any experience of the working of wireless telegraphy on lifeboats in the open sea after a shipwreck. Further, there are obviously many points to be considered before such a project can be efficiently carried out, and the idea is evidently one which must be developed by the shipowners and the Marconi Company working together in the closest co-operation. This point will better be appreciated by a perusal of the evidence presented to the Committee by the Marconi Company when this evidence is available.

To return, however, to the Committee's report, it is not clear to us what is meant by the following extract from page 26 of the report: "The only advantage to be obtained from the fitting of a ship's boats with appliances of this kind is that they may assist a relieving vessel in picking up the boats. The ordinary wireless telegraphy installation would be of little value for this purpose." If by the "ordinary wireless telegraphy installation" is meant the standard plant fitted on ships, it is obvious that it could not be installed on a lifeboat, as it is designed for entirely different purposes and conditions. The evidence of the Marconi Company was given as far back as January 16th, and it is perhaps unfortunate that the final form of the apparatus which the company proposed to use for lifeboats could not be executed in time to place before the Committee for their inspection. Since that time, however, considerable progress has been made, and the company will shortly be in a position to demonstrate the practicability of wireless telegraphy as applied to ships' lifeboats.

* * *

We are pleased to note that the summary of Mr. Marconi's evidence before the Select Committee, which we published last month, has aroused considerable interest. Several correspondents have been unable to reconcile a statement made by Mr. Marconi with an announcement which appeared in the Press a few days later, and they have appealed to us for an explanation. In his evidence Mr. Marconi said: "I understand that Mr. Gandil, acting on his" (Dr. Poulsen's) "advice, now proposes to use 150 or 200 kw. for a distance of 2,000 miles, and I agree with him that he will require all this power or more if he be able to construct an arc of such a power, and, when constructed, if he can discover the means of effectively utilising that power."

Further, in paragraph 19 of this report the Advisory Committee state: "We conclude that if the Poulsen system is to be so developed as to be practicable for commercial purposes over distances of 2,000 miles or upwards, the arc will have to be constructed so as to supply the aerial with higher power, or else a more sensitive receiver will have to be used." Reading these pronouncements, our correspondents are at a loss to understand how the contract which the United States navy is said to have made with the Federal Wireless Telegraph Company (Poulsen system) for the supply and erection of a 100-kw. 3,000-mile station will be fulfilled. We would refer them, however, to the examination of the Poulsen "system" which appears on page 228 of this number. Meanwhile we can only add that when a satisfactory 100-kw. arc makes its appearance we shall have to modify our views.

* * *

A noteworthy feat has just been carried out at Cape Race, on the Newfoundland coast. As we announced last month, the wireless telegraph station was put out of action through fire, but at the time of writing we did not anticipate that the interference with the regular operation of the service would be of such short duration as actually happened. Immediately after the fire, work was commenced on the erection of a temporary station, and on permission being obtained from the Department of the Marine and Fisheries of the Canadian Government, the Cape Race Lighthouse engine was belted to the wireless transmitting apparatus, and the temporary installation put in running order. It is gratifying to note that within three days of the date of the fire a continuous twenty-four hour service was again established, and the station was able to effect communication with all vessels on the Canadian route. Cape Race, which is sometimes referred to as "the graveyard of the Atlantic," has become renowned by reason of the services which the station has rendered as an aid to navigation and in cases of shipwreck. It was erected by the Marconi Company, and is controlled by them on behalf of the Canadian Government. It is of great strategic importance, and the new station building to be erected will be of a special fireproof construction. The apparatus will be of a powerful type, so that communication can be maintained with vessels half-way across the Atlantic. Cape Race will very soon have a wireless equipment, therefore, such as it calls for by the importance of its position, commanding as it does the whole of the Grand Banks of Newfoundland, the most dangerous portion of the Atlantic Ocean.

* * *

"A Forum for Electrical Inventions," is the novel innovation proposed by the New York Electrical Society, and one to be welcomed in these days, when the principal function of so many societies seems rather to be the discussion of abstruce technical papers than the rendering of practical assistance to their members. The object of the Forum will be to assist members in keeping abreast with the very latest electrical developments. Manufacturers and inventors having electrical inventions, devices, and appliances of merit will be invited to exhibit them before members at the regular meetings of the society, and to explain them after the usual business of the meetings. It is hoped that in this way the newest apparatus will be brought to the attention of electrical engineers month by month. While it is increasingly difficult to cover a large and prolific field of invention, the Forum, as it aims to do, should certainly enable members to become better posted on current developments, not only in their own branch, but in others outside, in which they naturally have an intelligent interest.

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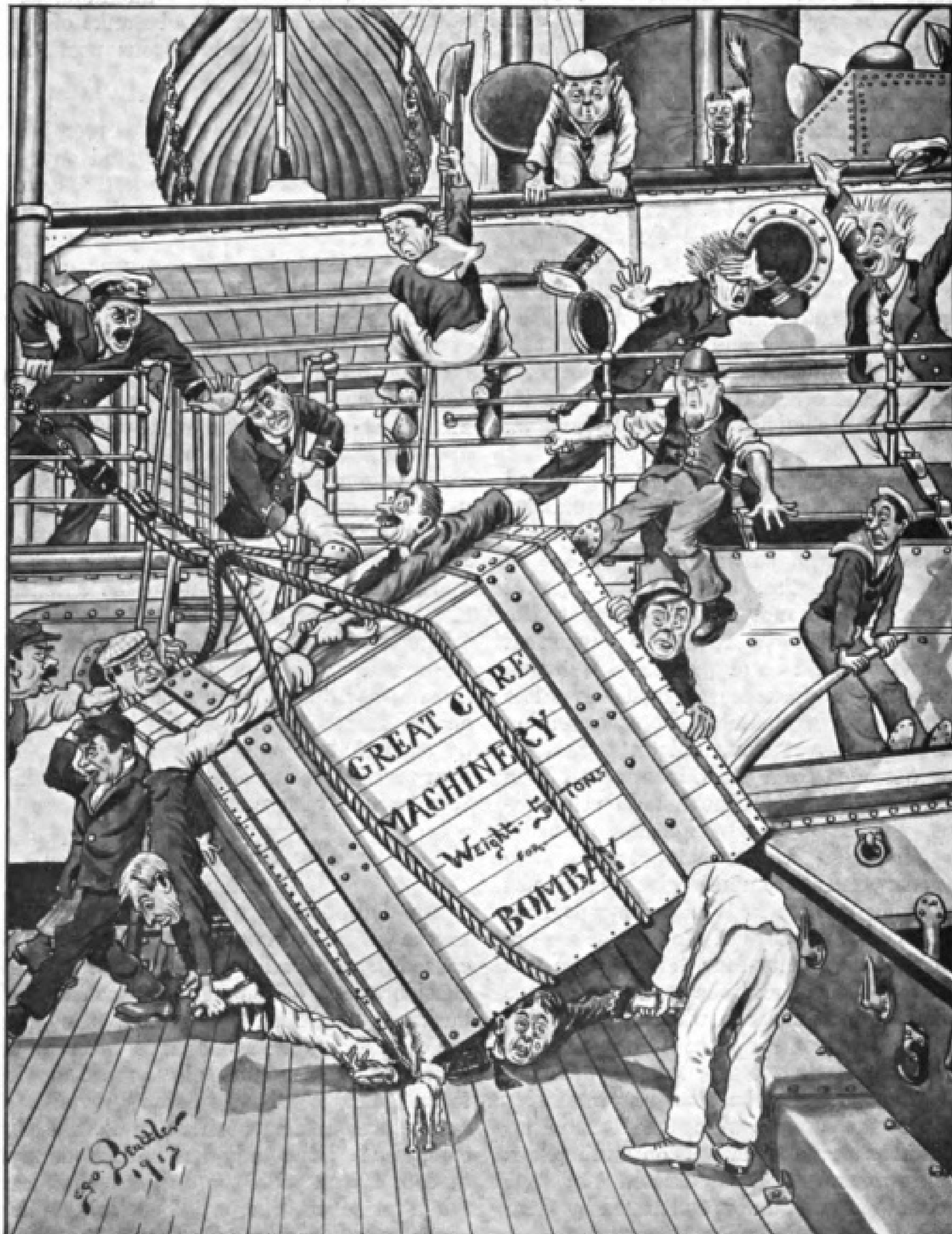
## The Share Market

London, *June 20th*, 1913.

The depression has been very pronounced in the share markets since our last issue, caused by general monetary and political consideration. Although a considerable business has been transacted, the great majority of transactions have been in the nature of realisations of a more or less forced character, the relapse in values in many cases having been severe. The Marconi issues have only suffered moderately in comparison with the declines that have taken place elsewhere. The closing prices as we go to Press are: Ordinary, $3\frac{3}{8}$; Preference, $2\frac{3}{4}$; Canadian, 10s. 6d.; Spanish, $\frac{11}{16}$; American, $\frac{13}{16}$.

# CARTOON OF THE MONTH

## Wireless Terms Illustrated




*IV.—Jamming*

# Across Bolivia with a Portable Set

By RENÉ DEMONT, Ing. Dip.

WHO has not, when looking at a map of the world, had his gaze drawn to that expanse of territory perched like the eyrie of an eagle at the head of the great chain of the Andes? That vast territory to which Bolivar gave his name looks like a mighty Switzerland, cut off from the sea, almost helpless to communicate with the outside world, and seemingly condemned to perpetual poverty. But what a different picture it presents to those who have had the good fortune to visit its fastnesses! It is a land of the giantesque. The least of its lofty mountains has an altitude of over 8,000 feet, but many of these giants of time have suffered from the insatiable energy of man. Often they have been torn open in a fruitless quest for mineral ore. But besides mountains there are the great rolling plains with grass so tall that a mounted man can easily be concealed in its green depths. Further, there are wide tracts of forests of rare trees where the undergrowth forms a network so dense that it is practically impassable.

The people of Bolivia are of very mixed nationalities, and this is due in a large measure to the influx of Spanish blood during the sixteenth century. They can in a general way be divided up into three classes: there are the Bolivians of European ancestry, the Indians proper, and the *mestizos* or *cholos*, which are of mixed European and Indian origin. These last are the most interesting to foreign travellers by reason of the contrast in temperament, appearance and manner of life to the white men, who, though less numerous, control affairs and fill all the positions of authority, whether political or commercial. But it is particularly noticeable that the white man seems to thoroughly understand his primitive *protégé*, and the Indians as a whole receive at the hands of the governing race as much consideration as the ignorant poor of any land receive from those who by inherited or acquired power hold the reins of authority. The laws of Bolivia provide for the Indians in a liberal manner, and under the influence of civilisation these

*The two Pack Saddle Stations employed during the Manœuvres of 1911.*

long-neglected people are surely but slowly advancing in material and intellectual well-being. The members of most of the Indian tribes (and their divisions and sub-divisions are extremely complex) are excellent craftsmen, well skilled in the making of utensils, and still more in their ornamentation; while the Indians of Potosi are particularly expert in miniature work. Among other curious handicrafts they make dolls, which are no larger than mosquitoes, yet if examined under a magnifying glass they will be found to be perfectly made, and dressed correctly in every detail.

The whole land is a country of dreams and of fairies, from La Paz, lying on the side of a lake twenty times as big as the biggest lake in Europe and 5,000 feet above sea level, right to the smiling and sunny confines of Riberalta or Santa Cruz, where the gum trees stand like armies in their thousands; from the high wastes where the Royal Condor sits in solitude to the green plains where the streamlets are the arms of the sea, it is one vast realm of fancy.

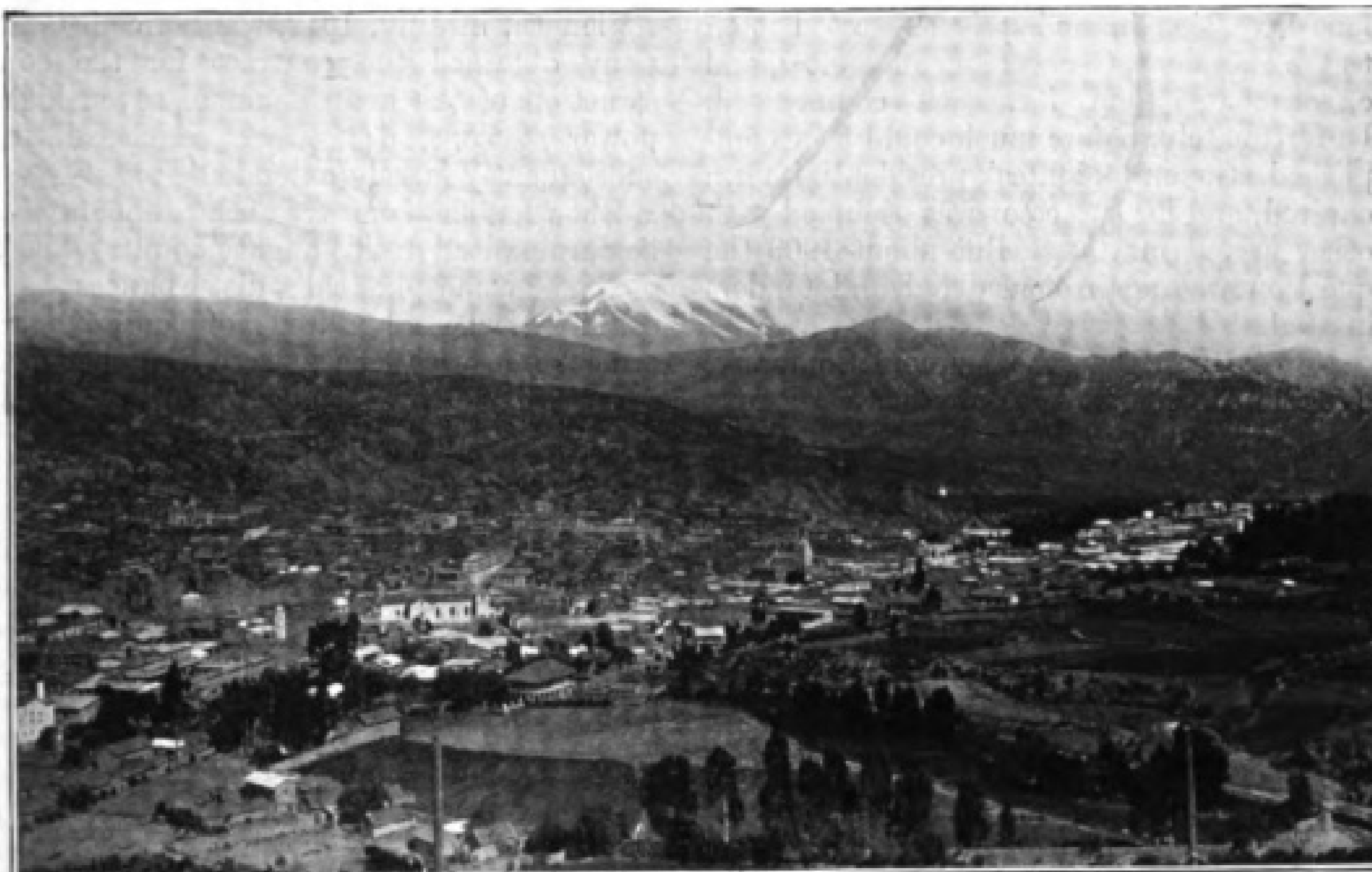
*H.E. General Ismael Montes, President of Bolivia.*

But it is this wealth of vegetation, rich and holding untold riches, that is the real barrier to the development of nearly the whole of Bolivian territory. It cuts the country into two and makes communication between the north and the south well-nigh impossible. Travellers from La Paz to Riberalta must take to the river courses, and a two months' trip downstream means one of four or five months on the return, for our term "river" is ridiculously applied to pouring waters which ought more fitly to be called torrents, and even then their great waves and vast expanse make such a description inadequate and unsuitable. Imagine a river like the Thames leaping from cascades into rapids, from rapids into cascades, and you will have a pretty clear idea of one of these "streams."

But you will not appreciate the sensation of a trip on this torrent made in "boats" fashioned from creepers pressed one against the other to form two huge bundles, which are joined by a little flooring of frail planks and make a primitive sort of raft. Put this little craft on the torrent and see it leap the sixty-mile-an-hour rapids, and you may well pray to be in the good graces of the helmsman. It goes hard with those who miss the rapid or strike a rock; the crocodiles alone can tell *their* story.

Such a hazardous and necessarily slow means of communication makes intercourse between the north and the south extremely rare, while the impossibility of the laying a single telegraph line in these virgin forests is a foregone conclusion to all who know the country. Nevertheless, it is equally clear that the adoption of some means for linking up these two areas of Bolivia was a matter of the utmost urgency for the Government.

As the most satisfactory solution to this



*A general view of La Paz from the site of the Proposed Wireless Telegraph Station.*
***Mount Illimani, 24,000 ft. high, in the background.***

*Celebrating the Anniversary of the Liberation of Bolivia in La Paz.*

problem the utilisation of Marconi's marvellous invention immediately suggested itself to the President, General Ismael Montes, and experiments were forthwith commenced. Unfortunately, before much could be accomplished, General Montes' presidential term expired, and his successor was occupied with other urgent matters. But about 1909 the question was again considered and tenders invited.

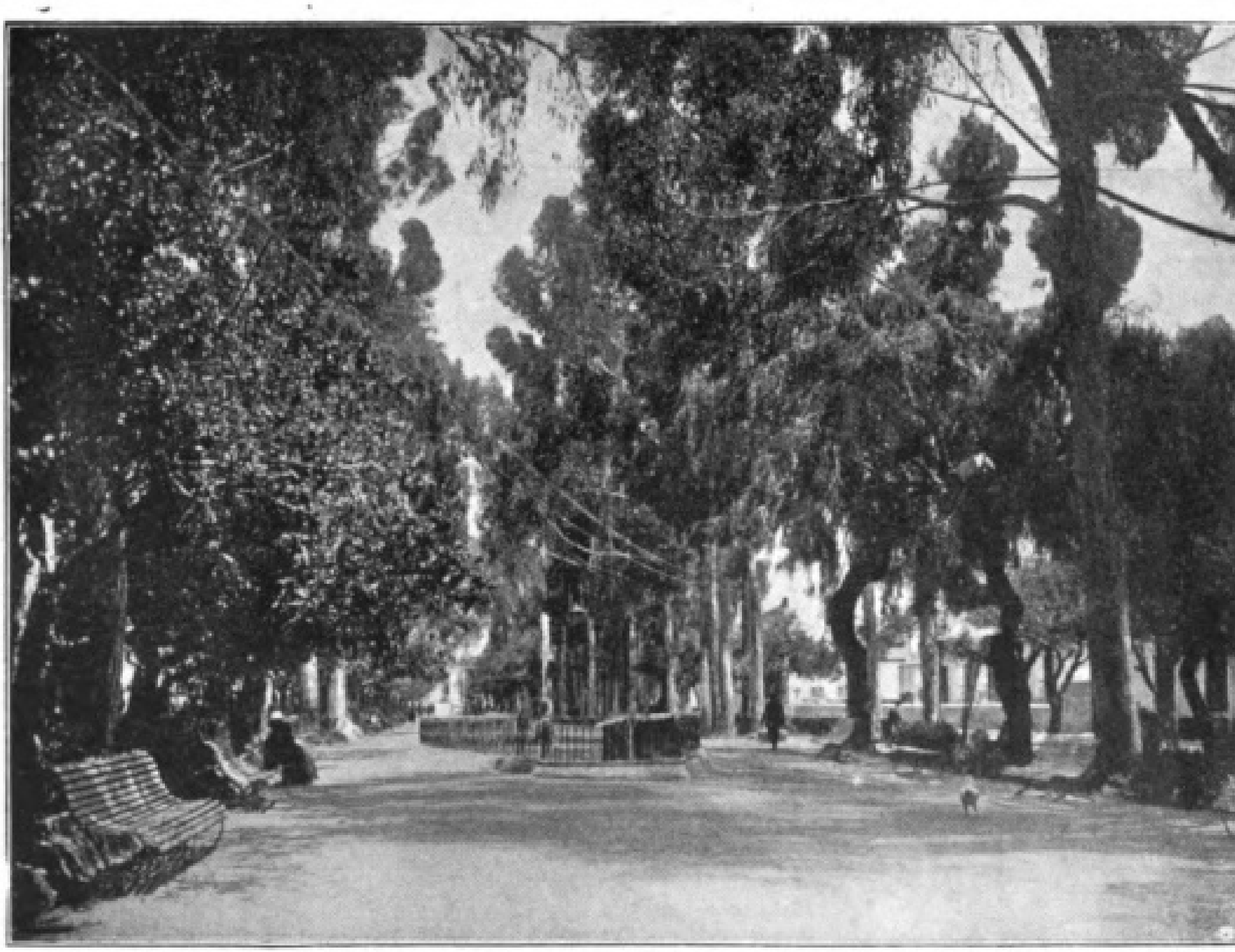
It was then that the Marconi Company, unwilling to plunge into a venture without a full preliminary knowledge of the difficulties to be overcome, decided, before submitting a proposal to the Bolivian Government, to send out two portable installations, whose test performances would furnish information of material value in the construction of a general wireless network.

The tests were followed very closely by the Bolivian Government, the more so since there was a strong body of opinion in favour of a Bolivian chain. They lasted nearly two years before the Government finally decided upon the adoption of a system. At length, in July, 1912, the Marconi Company obtained the contract for the construction of the main chain of seven high-power stations, a network which will be subsequently largely extended.

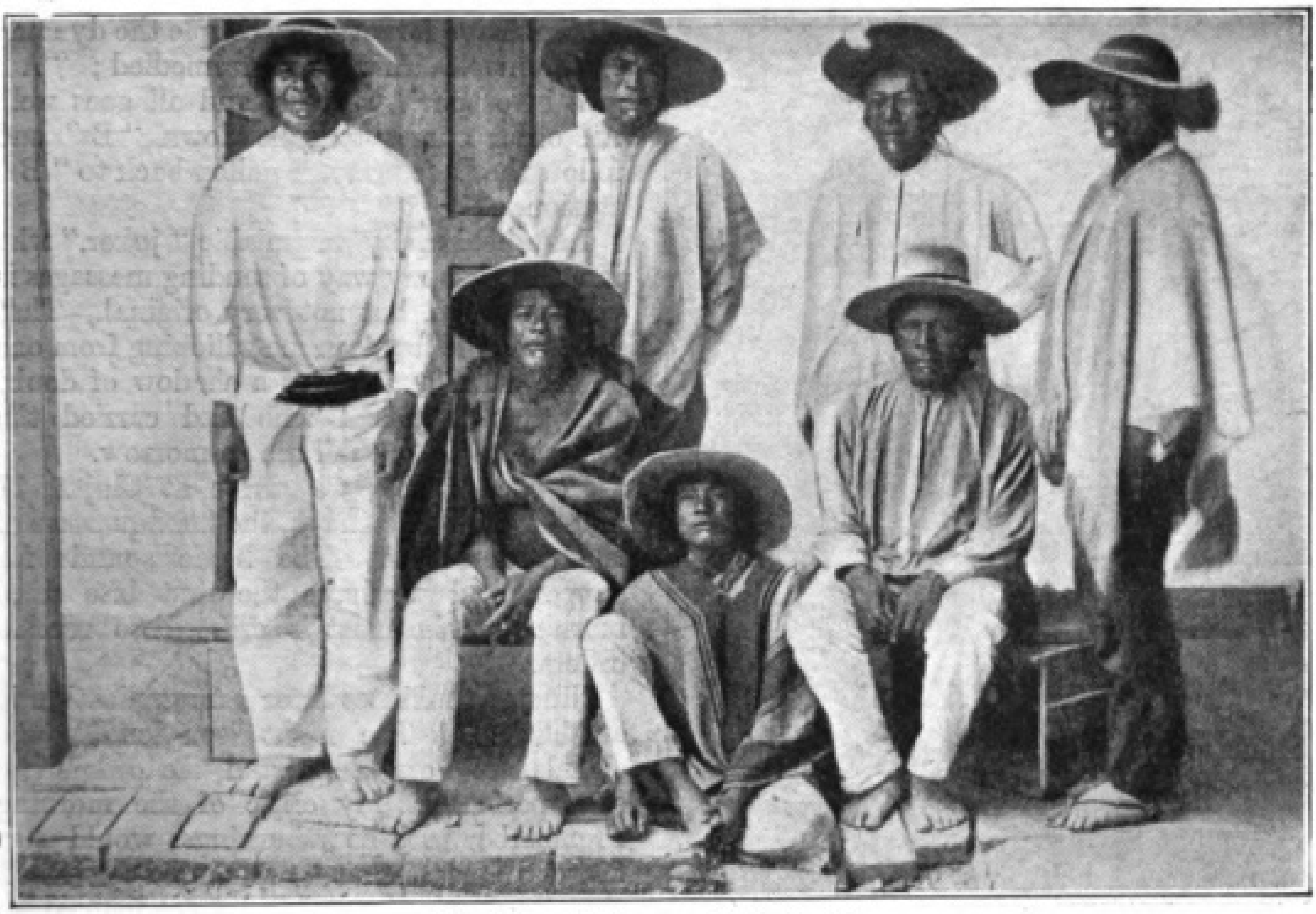
But what shall one say of the difficulties to be surmounted in this mighty country where violent atmospherical disturbances are common, where hundreds of square miles are covered with trees, where right between two stations stands a little mountain which seems to present no impediment, but all the same hinders all attempts at communication owing to its highly metallic nature ?

Yet all these difficulties were well known to the Marconi Company, which had already met and conquered them between Manaos and Porto Velho, so the chain so wisely provided will give every satisfaction to the Bolivian Government.

To recount the many experiences with the two portable stations would occupy an entire volume, so I shall content myself with recalling those during the military



*The Alemeda, the favourite Promenade of La Paz.*



*Tembetas, Indians of Santa Cruz.*

manœuvres of 1911, manœuvres that were important because they brought together almost the whole of the Bolivian army.

Leaving La Paz, we set out. There is trouble ahead of us. For the first time in their lives the mules are saddled with European pack-saddles with all their impeding leathers. They start by rolling on the ground, and then, finding it unwise to kick against the pricks, they accept their lot and away we go.

After three hours' climbing on a ten per cent. gradient from the hollow in which lies La Paz, we reach the summit, 13,000 feet above the city, where the wind blows hurricanes. The thirty miles of the first stage of the journey are covered in seven hours; the little Bolivian soldiers, scarcely five feet high, swing along joyously, each carrying, in addition to his equipment, a tent and food for about ten days' manœuvres, for one must not reckon on a well-ordered commissariat in this great country where villages exist only every fifty miles or so.

We halt at last, a little tired by this first journey. But we are happy and await impatiently the first experiments, just a little apprehensive of what this sandy and stony waste holds for us.

The second day sees us thirty-eight miles along the white road, gloomy and dejected, relieved only by the endless chatter of the soldiers who ask countless questions about a new piece of apparatus they are escorting. They are quiet, intelligent fellows, certainly little in touch with this new development, yet so eager to be instructed that it would show a churlish disposition to be angry with them. Reaching headquarters a little behind time, we find that the second wireless station has arrived by rail. Here we join forces. My little company have stood the journey well. They are dusty, but fresh and ready for the manœuvres the next day.

Wireless station "A" is with the State Major-General; station "B" follows the Blue army. At 5 a.m. we are up for the first experiments over a mile and both stations are erected. Station B accompanies the Blues, but, to my intense dismay, no message comes through. Mounting a horse, I gallop to station "A" in order to find out the reason for its failure to communicate, and to my surprise I discover that the

*A Bridal Couple of the Country District, near Potosi.*

*Guarayo Indians.*

soldiers have forgotten to couple the dynamo to the mast. This is soon remedied; "A" gets into touch with us, and all goes well. An order comes to take down "B" and follow the Blue army. I gallop back to "B" station.

I am held up by an amiable "joker," who remarks that my way of sending messages is very effective, but not very original. That is because he has seen me galloping from one to the other and hasn't a shadow of doubt but that it was I who had carried the telegrams! We shall see to-morrow.

In the evening we arrive at Chijta, 17 miles from Patacamaya, the headquarters of the State-Major. The bugle sounds for supper, and we have the first bite since morning. The mast is erected to receive orders.

Nineteen minutes later communication is established. The night is splendid, the signals are very clear, and the orders are sent perfectly. My critic of the morning I remember with heartburnings; would that he were here so that he might be convinced that the Marconigrams had not travelled by courier this time!

On the following day we travel another 25 miles. At night communication is established. The battle starts and orders are received right to time. Again the mast comes down and we get on the move. Fifteen miles farther on we set up the mast again; all goes well.

"What! fresh orders?" "Yes. You are supposed to have no more ammunition. Retire to cantonments at Sicasica." Another 15 miles back. Down comes the mast again, and away we go. But what a journey! It is midnight. A lashing rain, and world black as the Pit. We have to put up the mast again. It is quite evident we cannot communicate 42 miles in the tempest, and how are we going to set up the station in the dark and in the middle of a town?

We find a street a little farther on and set up the mast by a sort of instinct. When all is ready along comes a courier at a gallop, collides with the stays, and down comes the mast.

At last we are ready again. The spark is clear. Listen a moment. There! We have got into touch, and the wireless messages come, the signals being clearly distinguishable from the muttered rumbling of the storm. The rain is still pouring in torrents.

"Hurry this 140-word wireless message to the General, and we can get a little sleep at last." It is 2 a.m., and in what state do I sleep?—in the room of a real general! Forty minutes later I have the satisfaction of seeing a courier arrive with a telegram which has come by wire; it is a copy of the one which came by wireless. What a success—forty minutes ahead of the wire! On the morrow I make an inspection of the mast, and am amazed that we have been able to receive messages. The two wires, for almost two-thirds of their length, are laid on a roof of zinc. What harmony between the antennæ and the circuit!

And so every day for ten days, erecting and dismantling the station two or three times a day without the slightest mishap, everything going splendidly.

At last comes the hour of reward—the Review. The Marconi Wireless Corps marches past with every eye upon them, the men smart, the motors glittering, the cases polished as if they had just come from the works instead of having travelled three hundred and fifty miles on muleback through dust and mud, this way and that.

The admiration of the officers who were called up to give an account of the services which this apparatus would render in time of war was unbounded. There were congratulations from the President and two fine reports in the general orders from the General-in-Chief, a German officer, and the General-in-Chief of the Blue division, who declared that during the whole of the manœuvres the apparatus worked night and day without interruption.

It was a triumph, for it must be borne in mind that the apparatus was worked for the first time by these soldiers, that the telegraphists borrowed from the cable service were new to it, and that the "A" station was directed by an engineer who had only seen a wireless apparatus for the first time a month before.

A few words in conclusion on the personality of the man who was chiefly instrumental in bringing wireless telegraphy into Bolivia. General Ismael Montes, when only 17 years of age and a student of law at the University of La Paz, enlisted to serve his country in the war with Chile, obtaining his commission after a few months' service. He remained in the army until he was made a Captain, continuing at the same time his studies at the University. As soon as he obtained his degree he retired and commenced to practise as a lawyer, and also acted in the capacity of Professor of Law at the University of La Paz, until the Liberal Government came into power in 1899, when he was appointed Secretary for War. On two

*Two Indians of the Aymará Tribe.*

occasions he went to the Acre territory at the head of troops, and in 1904 he was elected President of the Republic for the period ending in 1908, but owing to the death of the President elect, Congress extended his term of office for another year. On his retirement he was appointed Bolivian Minister to the Court of St. James, Paris, and The Hague, and he has now left Europe for Bolivia, having again been elected President on the 4th of May, and accordingly he will assume the Presidency on the 6th of August this year.

# The "Systems" of Wireless Telegraphy

## II. THE POULSEN SYSTEM.

By HUBERT DOBELL, M.A., A.M.I.E.E.

IN this article we propose to deal with the Poulsen "System," which, like the Goldschmidt "System," claims to produce continuous electric waves.

The Poulsen generator charges up an insulated, elevated "aerial," discharges it to earth, charges it up again in the opposite direction, and again discharges it to earth. And we must consider how this cycle of processes is effected.

### THE ELECTRIC ARC.

If we open a switch or in any other way break a circuit in which an electric current is flowing the actual breaking of the current requires a certain time. During this time the contact, originally a good one, becomes worse and worse, and the surface of the parts touching becomes smaller and smaller. The result is that resistance is introduced, and heat produced; for whenever a current passes through any resistance some of it is wasted in producing heat. Towards the end of the process of "breaking" the temperature becomes very great, so that the ends of the conductors begin to glow and to emit glowing metal vapour. Even when the conductors have been separated by some little distance this vapour may cross the gap and form a conducting, luminous bridge for the current. Such a bridge is called an "arc."

Such an arc can be used for purposes of illumination, but in order to obtain a continuous light carbon rods are substituted for the metal conductors, which would soon fuse and evaporate away. Even with carbon rods special mechanism has to be applied for "feeding" the rods forwards at a rate proportional to their consumption, and also for "striking the arc" (*i.e.*, bringing the two rods into contact and then separating them) when it is required to turn on the light. All this means a great deal of complication and a good deal of unreliability.

It is this arc, with its complicated "feeding" arrangements, which forms the basis of the Poulsen System. The efficiency of the arc method for the generation of continuous electric waves is remarkably low. The efficiency of the modern Marconi disc discharger is of the order of 60 per cent., while the figure given for the arc method by Dr. Poulsen himself is only 14 per cent.

In our article on the Goldschmidt System we arrived at a point somewhat similar to this; and on that occasion we paused to ask the question, "What, then, does this system offer us to compensate for all these defects?"

On behalf of that system we gave the reply: "It offers us CONTINUOUS WAVES," and it is generally supposed that the reply is the same for the Poulsen System.

In that article, however, it was shown that no very mysterious merit lies in the mere fact of continuity; that, in fact, it is a moot point whether the disadvantages do not balance the advantages, even if continuous waves could be obtained as readily, as efficiently, and with as much power to back them as non-continuous waves.

The Poulsen arc, although it actually produces waves which are sufficiently "continuous" to necessitate their being split up into some kind of a note for the purposes of reception, are yet sufficiently discontinuous as to be powerless to produce to the full extent that "cumulative" result on the receiver which is the sole merit of the continuous wave.

This is a statement of fundamental importance; before we deal with it more fully we will consider in greater detail the action of the Poulsen arc as a producer of electric waves.

### INSTABILITY OF THE ARC.

It is a notorious fact that the electric arc lamp is unstable. It is, in point of fact, subject to two kinds of instability. The first and obvious kind is the continual but irregular burning away of the carbon, which tends to keep the actual length of the gap in a state of variation which cannot be avoided even by complicated "feeding" mechanism. Any such variation in length of gap has the effect, naturally, of altering the resistance of the gap and the amount of current flowing through it.

In the case of the Poulsen arc, however, the burning away of the carbon electrode is reduced by the fact that the arc is formed in an atmosphere of hydrogen or some hydrocarbon; but the carbon still has to be kept turning and fed forward, and the gas has to be renewed constantly.

The other, and less obvious, form of instability is due to the fact that the arc does not behave like a simple metal conductor, in which the current increases in proportion to the pressure; the arc produces at its "poles" a back-pressure which opposes the driving force, and the matter is further complicated by the fact that this back-pressure decreases with the increase of current passing. To produce electric waves a condenser and an inductance have to be placed as a shunt to the arc, and some of the current passing goes to charge up the condenser (thus leaving less current to pass through the arc); this diminution of current through the arc causes an increase in the back-pressure; and this extra back-pressure helps to charge the condenser still more. Then, after a time, the condenser can hold no more electricity, so once more the whole current flows through the arc; the increased current then decreases the back-pressure and helps the condenser to discharge through the arc. The whole arrangement, in fact, is in a state of instability; and it was found by Duddell that by a suitable adjustment of the circuit such an arc could be made to give such rapid variations in the current (and consequently such variations in the heating effects produced at the arc) that a "singing note" was produced.

If an aerial of suitable dimensions were connected to one pole of the arc, and an earth connection to the other, it is obvious that the oft-mentioned cycle—charge, discharge, and so on—would be performed.

It is clear that such an arc arrangement, producing a "singing note," would be quite impracticable from a "wireless" point of view, the frequency being far too small, and, like the commercial alternator mentioned in the previous article, it would require an aerial some hundreds of miles long.

Dr. Poulsen, however, by a combination of various devices managed to get an arc circuit which would fluctuate at a very much greater rate—in fact, at a rate suitable for "wireless."

He first placed the arc in a closed chamber filled with hydrogen or some hydrocarbon vapour, constantly renewed; he then replaced one carbon rod by a copper electrode through which a constant stream of water was passed to keep it cool; and finally, he arranged a magnetic field across the arc which was trying all the time to extinguish the arc, and in this way quickened up the process.

### TUNING.

All this sounds rather complicated and not altogether convenient, and it is difficult to imagine that regularity can be obtained.

And yet, if this cannot be done, it is quite clear that the one great advantage claimed for the Poulsen waves—extreme sharpness of tuning—cannot be obtained. The great idea of sharp tuning is that it enables the receiver of one of a pair of stations to be adjusted so that a third station, sending on a slightly different wave-length, is rendered inaudible. But, obviously, if at any moment the frequency of the Poulsen transmitter is liable—as it actually is—to a sudden change, the signals which it is sending out will likewise become inaudible at the receiving station. This means that many words of the message are lost; the receiving operator hurriedly changes his adjustments to suit the new conditions, and while he is searching—to find out whether the new frequency is higher or lower than before—the Poulsen arc returns, perhaps, to its old conditions.

We are now in a position to deal with the statement made earlier in this article that the Poulsen waves are not continuous.

### CONTINUOUS WAVES.

That this is a fact can be very easily proved by listening on an ordinary ("non-continuous wave") detector to a Poulsen station at a short distance. If the waves were truly continuous they would—as explained in our previous article—produce no sound when received on such a detector; while, as a matter of fact, the Poulsen waves can always be heard as a hissing sound. This means that the Poulsen arc, instead of sending out an uninterrupted stream of waves, all of the same strength, actually sends out waves which at frequent and irregular intervals start to die away and then revive again. If they died away altogether before reviving then they could be received at the distant station without further trouble, though only in the form of a hiss instead of the clear musical note of the Marconi waves; but the irregular variations are only strong enough to produce the hiss when the signals are very strong—as at a short distance from the transmitting station. The result is—as we have mentioned—that by the time the signals reach the station at a distance they have to be cut up into a musical note before they can be heard; and as to the objections to this proceeding no one who has read the first article of this series can have any doubts.

On the other hand, this irregular waxing and waning which produces the hiss in the case of very strong signals is quite enough to destroy the power of the Poulsen waves to attain the cumulative effect on the receiver at the distant station.

It would appear that this irregularity is not merely a mechanical defect which one might hope to remedy in time; it has nothing to do with the "feeding" of the carbon electrode, but appears to be an inherent property of the combination used by Poulsen—an electric arc in a strong magnetic field.

We ought not to leave the subject of the real nature of the Poulsen-generated waves without mentioning one other point.

When a physicist speaks of the good "cumulative" effect and the "exalted syntonisation" possible in the case of continuous waves he means by these last two words waves which are not only perfectly uniform in strength (without any decay) but are also of a particular wave-"shape" known as sinusoidal. Any departure from either of these conditions means a decrease in merit so far as the physicist is concerned.

We have already spoken of the irregularly-spaced changes in the strength of the Poulsen waves; it remains for us to mention that the waves are not sinusoidal, "although," as one of the highest authorities puts it, "under certain conditions they may be made to be nearly so."

We are not aware that these "certain conditions" have ever been shown to hold in a Poulsen arc transmitting over any considerable distance.

### LONG DISTANCE WORK.

So far we have not touched on the difficulties which arise when the Poulsen System is applied to long-distance work. These form a topic all to themselves, and before dealing with them we wished to deal with the system as it presents itself under the most favourable conditions.

The most favourable conditions for the Poulsen System are undoubtedly those which obtain when it is called upon to accomplish small distances; the Technical Advisory Committee, appointed by the Postmaster-General, has actually reported that it is "satisfied that it is practicable for short distances."

It is now time to turn our attention to LONG-DISTANCE WORK such as would be entailed by a network of "Imperial" stations.

Everything we have said already about the Poulsen System applies here, and, in addition—as we have foreshadowed—other points arise which have been omitted until now.

In the first place, when we have to deal with a powerful station capable of transmitting two or three thousand miles the question of the cost of the fuel consumed is of paramount importance.

We have already mentioned that the efficiency of the Poulsen generator is only a quarter to a fifth of that of the Marconi generator; the cost of electric generating plant will therefore be much greater apart from increased fuel consumption; but this is not the only cause of increased fuel consumption.

To maintain the Poulsen arc at work satisfactorily it is absolutely essential to keep it in a condition of continuous activity, and the dots and dashes of the Morse Code must be made by throwing the aerial alternately in and out of tune, or by some similar method; the generator of electricity feeding the arc is therefore working at full load *all the time*, while with the Marconi method of signalling the full load is only on for about 60 per cent. of the time. It can be shown that this adds about 30 per cent. to the fuel consumption. On the whole, therefore, the fuel consumption of a Poulsen station will be six to seven times greater than that of a Marconi station.

### The Arc and High Powers.

In the second place—and this is a more vital point still—there is the fact that the arc is even less adapted to the utilisation of high powers than the early Marconi discharger.

It was mentioned in our last article that this early "fixed" discharger could not deal effectively with more than about 70 horse-power, but that the modern Marconi disc-discharger did deal with several hundred horse-power, and that from experimental results there seemed to be no practical limit to the amount of power which could be used effectively by a suitable enlargement of this apparatus.

As regards the Poulsen arc, Mr. Marconi stated in his evidence before the Parliamentary Committee inquiry into the Imperial Wireless Scheme, "Although I have made diligent inquiry, I have failed to learn of an arc (Poulsen) which has ever yet been constructed to effectively utilise more than 40 kilowatts" (about 54 horse-power).

It appears, from the evidence of the Poulsen experts before the Technical Advisory Committee, that they consider about 200 horse-power to be necessary in order to communicate, with their system, over a distance of two thousand miles. Some radical change would, therefore, appear to be called for in their design of apparatus before they can hope for success in commercial long-distance wireless telegraphy.

We have shown in our previous article that continuous waves, when obtained, are not an unmixed blessing, and that the modern Marconi non-continuous waves have most of their advantages and some important ones in addition; in our present article we have shown that the Poulsen System does not produce truly continuous waves, but a species of wave which has the disadvantages of the continuous wave, little of its advantages, and none of the special advantages of the Marconi wave. It also appears that a new invention, comparable in importance with the invention which converted Marconi long-distance work from an experimental result to a commercial service, is necessary before the Poulsen System can hope to attain the results which have already been obtained economically by the Marconi System. Even when the suggested invention has been perfected there will remain the great increased capital cost and cost of fuel due to the remarkably low efficiency of the generator, and to the method of signalling which is inevitable with the Poulsen System.

In these two articles we have dealt with the Goldschmidt and the Poulsen Systems. The Galletti System should, however, be referred to, although the Technical Committee's report states that "they have had no evidence as to the practicability of the Galletti System even over short distances."

We quoted in our previous article a German author who described the Goldschmidt alternator as "producing a medley of alternating currents out of which only one emerges by reason of resonance." Our experience of the Galletti generator is that it produces a medley of crude oscillating currents all interfering with one another, out of which only a few crude waves emerge by reason of good luck.

# Crystals as Rectifiers and Detectors

By A. E. H. TUTTON, M.A., D.Sc., F.R.S.

USES OF CRYSTALLISED SUBSTANCES IN WIRELESS TELEGRAPHY. THE MICROPHONE AS A DETECTOR. WHEN ELECTROMAGNETIC WAVES REACH THE DETECTOR. THE ACTION OF CRYSTALS. THE LINES ON WHICH RESEARCH SHOULD FOLLOW.

WHILE the discoveries of pure science have so frequently led to epoch-making industrial and economic results—the laboratory experiments of Hertz, following up the theory of Clerk-Maxwell, for instance, having led to the wonderful and beneficent new mode of communication by wireless telegraphy—it occasionally happens that new facts of pure science are revealed during the progress of these industrial developments themselves. Such has been the case in regard to the subject of this article, for it has been reserved for wireless telegraphy to reveal a new property of crystals, that which enables them, doubtless by virtue of their perfectly organised structure, to be capable of "rectifying" or converting an alternating current into a direct one, and of acting in consequence as a sensitive detector of electric waves.

Certain crystallised substances, especially carborundum, the crystallised compound of carbon and silicon, are now currently employed, as will be well known to many readers of THE WIRELESS WORLD, in contact with either a plate or spring of metal, or another crystallised substance, as some of the most sensitive and convenient detectors and receivers of the electric waves effective in wireless telegraphy. Such a "crystal detector" replaces the older form of receiver known as a "coherer," of which the original one of Branly or the later one of Marconi may be mentioned, consisting essentially of iron or nickel filings, confined in a glass tube between two metallic plugs. The advent of a train of electromagnetic waves in the vicinity of the coherer causes the filings to cling together in such a manner that their previous high resistance to the passage of an electric current is very materially reduced; tapping the tube again disarranges the filings and restores the high resistance, practically cutting off the current, so that a tapping arrangement or "trembler" forms an essential part of the coherer form of receiver for electric waves.

The microphone of the late Professor Hughes was subsequently found to act as a detector, the best form being a carbon rod lightly pressed by a brass spring against a steel needle, the current transmitted being received by a telephone, which more or less reproduces the sound made at the spark gap of the transmitter. It proved more sensitive than a filings coherer, but is in turn superseded by the new crystal detectors, in which the carbon of the microphone is replaced by a crystal of one of the several minerals or artificially prepared crystalline substances which have been found to be effective for the purpose. The suitability of carborundum was discovered in 1906 by General Dunwoody, of the United States Army.

Carborundum, silicon carbide $SiC$, is manufactured on a considerable scale on account of its great hardness, which is next to that of the diamond, by the fusion together of coke and quartz or sand in the electric furnace; it is capable of replacing the diamond in rock drills and other boring tools or grinding apparatus where extreme hardness is required, and on account of its reasonable cost has been of untold value to civil, mining and other engineers. It crystallises in the ditrigonal-pyramidal class of the trigonal system of symmetry. It generally takes the form of hexagonal tabular crystals, parallel to the trigonal basal plane having the crystallographic indices {111}, with the edges modified by the narrow faces of a whole series of rhombohedra of different degrees of steepness. The crystals, however, are rarely single individuals, but usually masses of parallel or other more irregular growths, or twins on one or all three of the faces of the principal rhombohedron {100}. The angle of this rhombohedron is almost exactly 90°, being 89° 57′, so that the symmetry resembles cubic, that of the diamond. A carborundum crystal exhibits no definite cleavage, but is distinguished clearly from a dark diamond by being doubly refractive, its two indices of refraction being $\omega=2{\cdot}786$ and $\epsilon=2{\cdot}832$ for sodium light, both of which are higher than the single refractive index of the diamond, 2·4175. Its specific gravity is 3·123, less than that of the diamond, which is 3·529.

A carborundum crystal works well as a detector when clamped between two spring contacts, but the more trustworthy method of using it is to solder one end into a metal cap or cup, and to press the other end gently against a steel spring-contact, the amount of pressure being arranged to be delicately adjustable. It is often used, however, by being first wrapped round with a copper wire near one end, and then attached by the wire to the brass holder or clamp, while the free end presses against a steel spring. There appears to be no absolute occasion to obtain a single well-formed crystal, and indeed the pieces of carborundum seen in use have usually been composed of several attached, intergrown, or twinned crystals. But the particular point used as the contact point with the steel spring matters very considerably, and it often happens that if a good point gets broken off there is some difficulty in finding another equally good until several other parts of the crystal have been broken away. What constitutes a favourable contact-point, and whether a specific part or direction of a single individual crystal or merely a particularly shaped point or a definite character of surface be required, is a question urgently needing further investigation.

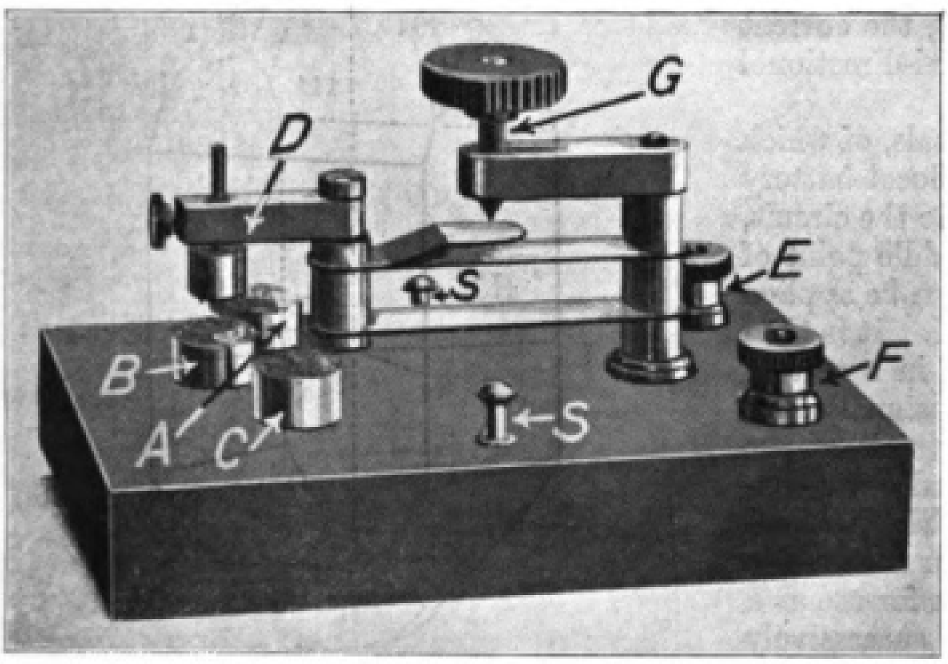


*Fig. 1. Multiple Crystal Holder (by A. C. Cossar & Co.).*

A recent form of multiple crystal holder suitable for experimental work is shown in Fig. 1. Crystals of various kinds are mounted at A, B, and C, in soft alloy in brass cups, which screw into sockets in the ebonite base. A movable arm, D, carries a sliding rod, which terminates either in a metal point or flat spring, or in another cup carrying a fourth crystal in the event of a double-crystal contact being desired to be used. Of the terminals E and F, one is in electrical connection with all three cups, A, B, C, and the other connects through the pillar and metal strips with the arm D. Screws, S, S, are also provided for attaching the base firmly to the rest of the apparatus in use. An ebonite-headed screw, G, serves for the delicate adjustment of the pressure of the contact. When carborundum is used the metal rod sliding in D usually terminates in a flat steel spring which can be adjusted by means of the screw G to press with the desired contact-pressure on the carborundum in A, B, or C.

As to what occurs when the electromagnetic waves reach the detector, certain definite facts have now been ascertained; but they leave the reason for the action almost an open question. The wave partakes of the nature of an alternating current, corresponding to the frequency of the oscillations occurring in the spark-gap of the transmitter; for the portions of the wave in opposite phases are of the nature of currents in opposite directions. It is found in actual practice, however, that the current in one direction gets through the contact of crystal and spring to so much greater an extent than the one in the opposite direction, that the practical effect is to convert the alternating current into a direct one, which passes on and affects the telephone or other receiver in the circuit. Owing to the superimposed effect of self-induction, and to the fact that the resistance of the crystal rectifier is greater for small than for large currents, the net result is as if in the passage through the crystal contact the "tops" or the "bottoms" of the waves (as diagrammatically expressed) are cut off, the current passing on in the form of uni-directional pulses to the telephone.

Sometimes, with certain crystals, of which carborundum is an example, a local battery and a potentiometer are added to the circuit, the lead being taken off the middle point of the battery, so that potential can be applied in either direction to the crystal. It is then found that a certain potential, in a certain direction, produces the loudest signals with any one crystal. Different crystals of the same substance, however, afford very considerable variations of effect with this local battery. In order to choose, for instance, a suitable crystal of carborundum for use as a detector, several crystals are successively submitted to an increasing electromotive force, and a curve plotted showing the current transmitted; this curve exhibits clearly the vast preponderance of current passing in one of the two directions, and also indicates a sudden rise of conductivity for some particular voltage in this direction, corresponding to the sensitive point found on the potentiometer. The actual amount of resistance on the part of the crystal does not appear to matter, so long as the curve afforded is of the right shape.

Another interesting point is that if no local battery be used, but the crystal be heated by a flame or hot filament, its sensitiveness rises with the temperature to the same maximum as that obtained by use of the battery. Also, a few exceptionally good crystals, when used alone, afford as strong effects as with either a local battery or extraneous heating. This appears to indicate that the effect of the local battery is merely to warm up the point of contact to the temperature for maximum sensitiveness, and it is of the highest importance to discover what it is which renders these crystals so exceptionally favourable.

Many other crystals have been found effective as rectifiers and detectors besides carborundum. One of the best, the so-called "perikon," consists of a crystal of one of the two double sulphides of iron and copper, chalcopyrite $CuFeS_2$ (a crystal of which is illustrated in Fig. 2) or bornite, $Cu_3FeS_3$, pressing against one of zincite, oxide of zinc, $ZnO$; it acts excellently without any external battery.

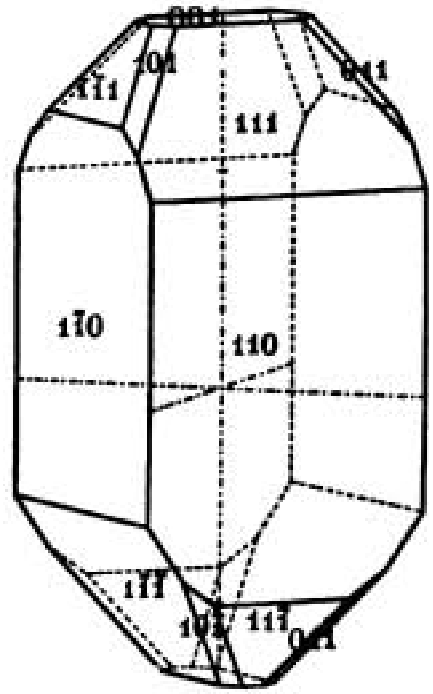



*Fig. 2. Crystal of Chalcopyrite $CuFeS_2$ (tetragonal).*

Another good combination requiring no battery consists of a pointed metallic rod, usually of copper or brass, pressing down upon a crystal plate (hexagonal) of molybdenite, sulphide of molybdenum, $MoS_2$. In this case the current usually flows from the metal to the molybdenite. A similar effect is obtained in the earlier rectifier of Pickard, in which a plate of crystallised silicon (which forms cubic crystals) is used under a copper rod. Iron pyrites (also cubic), $FeS_2$ (a crystal of which is represented in Fig. 3), and two of the forms of titanium dioxide, $TiO_2$, the tetragonal anatase (illustrated in Fig. 4), and the rhombic brookite, have also proved effective as crystal rectifiers and detectors.

So far the most scientific attempt to unravel the mystery surrounding the action

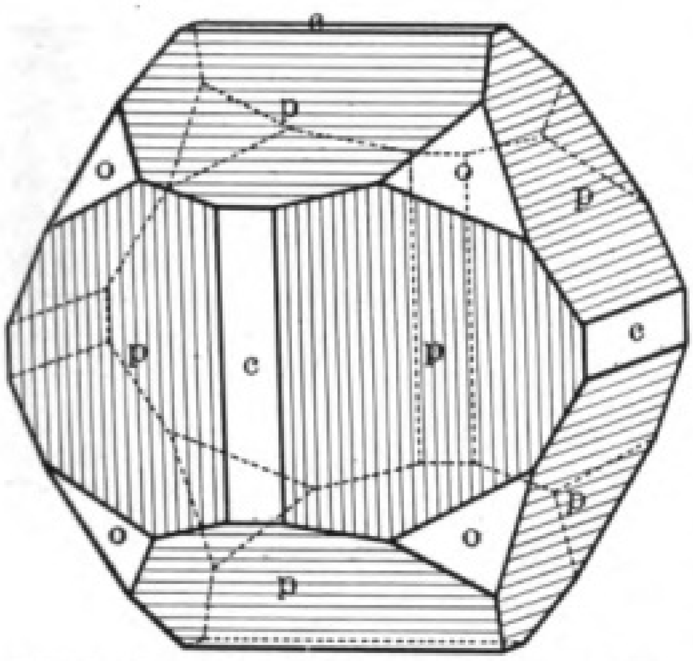


*Fig. 3. Crystal of Iron Pyrites $FeS_2$ (cubic).*

of crystals in this capacity has been that made by G. W. Pierce, who has established the following facts:

(1) All crystal rectifiers show a vastly predominating current transmission in one only of the two directions; the amount of current which passes in this direction is often a hundred times as much as that in the other, and one case was measured in which it was four thousand times as much.

(2) Although all rectifying crystals show, in contact with metals, a large thermo-electric force, which differs in amount at different points on the crystal, the direction of the rectifying effect is often opposite to that observed on heating the contact, so that the rectifying effect is not a thermo-electric one.

A thermo-electric explanation is also negatived by the experiments of Austin, who found that with rectifiers of silicon and steel, carbon and steel, and tellurium and aluminium, the rectified current generally flows in the opposite direction to that produced by heating the contact.

In a communication to the Physical Society so recent as May 30th, Dr. W. H. Eccles emphasised the fact that when an electric current passes across such a light contact as that of a crystal detector, heat is liberated or absorbed in accordance with the laws of Peltier and Thomson, and is also generated in accordance with Joule's law. He then discussed the nature of the curves representing these effects, and showed that the Thomson effect largely predominates. He states, however, that "there may be some coherer action mixed up with the thermo-electric 'rectifying' action." Prof. Fleming at the same meeting also referred to a similar set of curves prepared for him by Mr. P. R. Coursey, but stated that they did not fall in with any very simple theory of such rectifying detectors.

Pierce suggests, as a probable explanation, that the small contact surface of separation between crystal and metal (or other second body) permits the passage of electronic corpuscles more easily in one direction than the other. This would also explain the accompanying independent thermo-electric effect, provided, as is probable, the velocity of the electrons be suitably different at different temperatures.

This view would also appear to be connected with that expressed to the writer by more than one physicist—namely, that the effect is essentially that of "a point and a plate." For obviously it should be easy for electrons to stream from a point to a plate. But this is hard to reconcile with one of the experimental results of Pierce, that the rectifying effect is not only different in

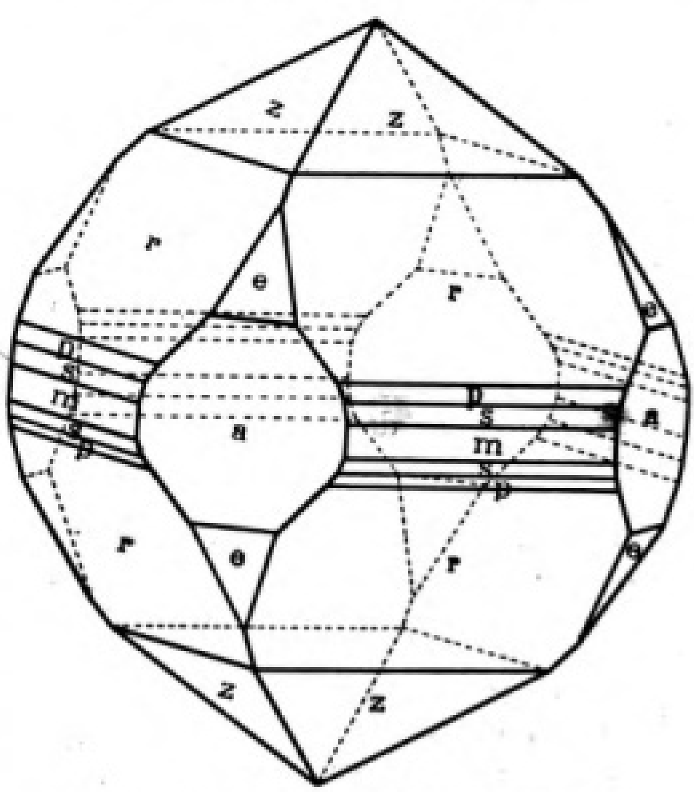


*Fig. 4. Crystal of Anatase (tetragonal).*

amount, but also in *direction*, at different points of the same crystalline substance.

Also, there is very little loss of sensitiveness if the point be blunted, and in some cases good results were obtained with a surface of contact of four square millimetres extent. Another view expressed by experienced observers is that the cause is a slight chemical or electrolytic action, comparable with the idea that a thin film of iron or nickel oxide is produced at each contact when the filings coherer is at work, and then again reduced. Pierce, however, has definitely proved the absence of electrolytic polarisation in the case of crystal rectifiers, by direct experiment during a long period of time, using even very heavy currents and a raised temperature.

It will thus be obvious that this new property of crystals, by virtue of which they act as rectifiers and detectors of electro-magnetic waves, is one of the highest interest to the crystallographer, and one which calls for the most careful investigation. The chief objects of this article are to indicate the main lines which such a research should follow, to offer a few suggestions as to the possibilities, to set forth clearly what a crystal is, and to indicate the main results of previous crystallographic work which in the writer's opinion bear on the phenomenon.

A crystal is the form assumed by a definite chemical substance, when the latter is a solid at the ordinary temperature (or other temperature of formation), and its chemical molecules are able to approach each other so as to aggregate and mutually adjust themselves quietly and undisturbedly, with due deliberation, into the solid assemblage; this may occur either from the state of liquid (fusion) or of solution in a solvent (preferably from a solution only slightly supersaturated), or by direct condensation from the gaseous state without the intermediate formation of liquid. A crystal is a polyhedral body bounded by truly plane faces, mutually arranged in accordance with a definite plan of symmetry, of which there are 32 types (crystal classes), which group themselves into seven systems: the cubic, trigonal, tetragonal, hexagonal, rhombic, monoclinic, and triclinic.

This external symmetry is the expression of internal structural symmetry, that of the arrangement of the regularly deposited chemical molecules, and ultimately of their constituent elementary atoms. These atomic ultimate units are so arranged that, if they be represented by points, the latter form one of the 230 homogeneous arrangements of points which are possible, compatible with such homogeneous structure as is characteristic of crystals. But the molecules themselves (that is, the molecular groups of atoms corresponding to the chemical formula), or symmetrically arranged small

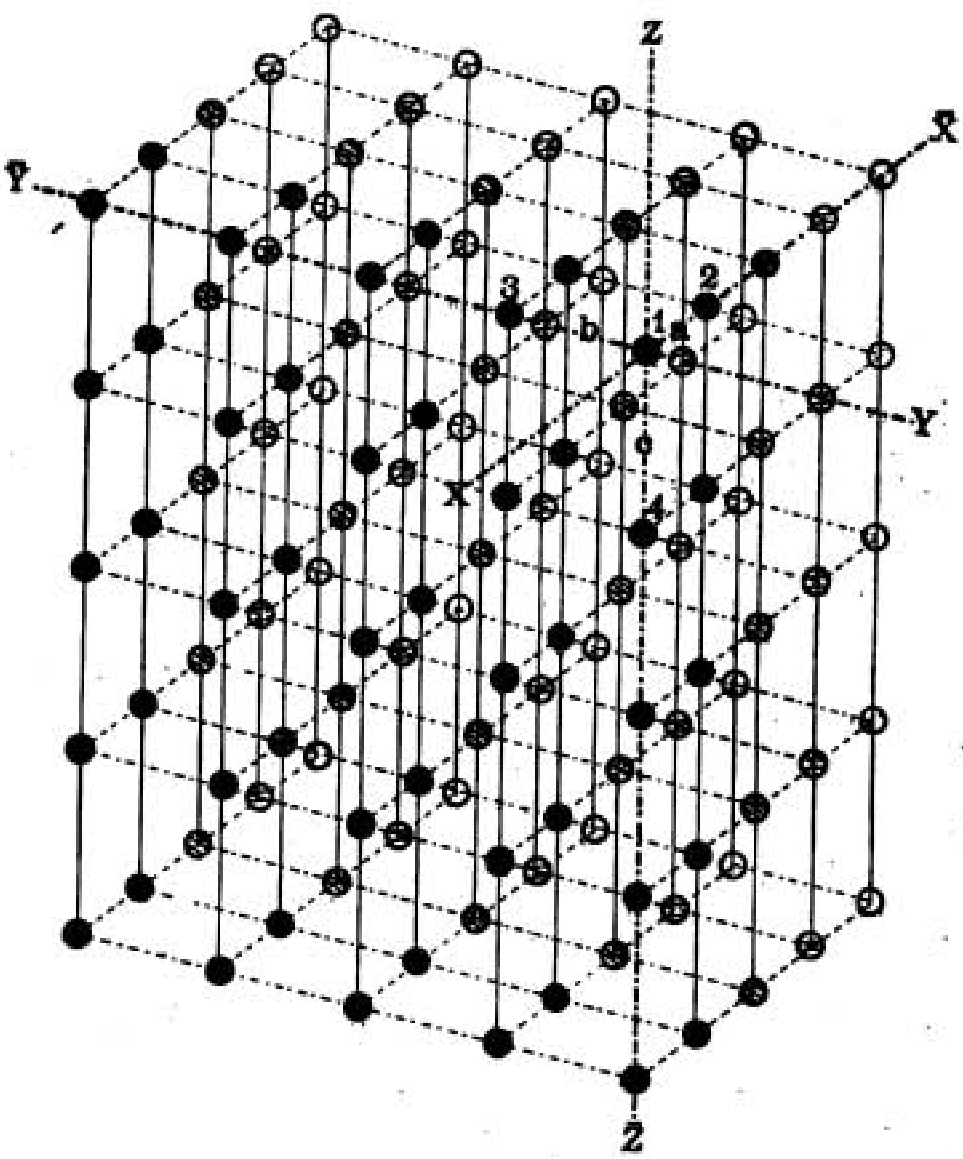


*Fig. 5. Triclinic Space-Lattice.*

groups of molecules, form grosser structural units which it is convenient to distinguish. For if such molecular or polymolecular grosser units be each in turn represented by a point, then the crystal structure is such that the whole assemblage of such points, when joined by imaginary straight lines in the three directions of space, form a space-lattice. The most general (triclinic) form of space-lattice is represented in Fig. 5. Only 14 space-lattices are possible, among which the symmetry of all the seven crystal systems is represented, and no other. This molecular or polymolecular space-lattice (for each unit cell of the space-lattice is the home of the molecule or small group of molecules) is of intrinsic importance, inasmuch as its character determines the crystal-system to which the crystal shall belong, the positions and angles of mutual inclination of the crystal faces, and the occurrence of only such faces as comply with the fundamental crystal-law known as "the law of rational indices." For no faces are possible on the crystal except those which pass through the planes of points of the space-lattice. Any three points of the space-lattice constitute a plane, but it can readily be seen that not many such are possible besides those parallel to the cell-walls of the unit cell of the lattice, and as a matter of fact only the simplest are usually actually developed—namely, such as cut off unit lengths of the three edges (taken as axes) of the cell, or simple multiples of such lengths.

One significant consequence of the above facts is that the all-important space-lattice is also afforded by taking all similar (composed of the same chemical element) and similarly (identically) situated atoms throughout the structure—that is, by selecting any one atom from any particular grosser unit to act as its representative point, and doing exactly the same for every other grosser unit throughout the structure. Hence the planes of the space-lattice are those strewn with similar and similarly situated chemical elementary atoms. It is these planes which have recently been shown by the remarkable work of Laue, Friedrich, and Knipping to be capable of reflecting the excessively minute waves of the X-rays, probably the minutest form of electromagnetic wave motion, very much finer than the waves of light. The positions of these planes of similar and similarly situated atoms have been located thus experimentally in the crystals of zinc-blende, ZnS (a crystal of which is represented in Fig. 6); rock salt, NaCl; quartz, $SiO_2$; galena, PbS; fluorspar, $CaF_2$; magnetite, $Fe_3O_4$; and even in such complicated substances as alum, borax, cane-sugar, and mica, by these German investigators and by others working on their lines in this country. Hence the space-lattice is no myth of the imagination, but an experimentally proved reality, and is without doubt the fundamental groundwork of crystal structure. Although it is thus convenient to isolate the grosser units, the chemical molecules or arranged groups of molecules, on account of their representative points forming the

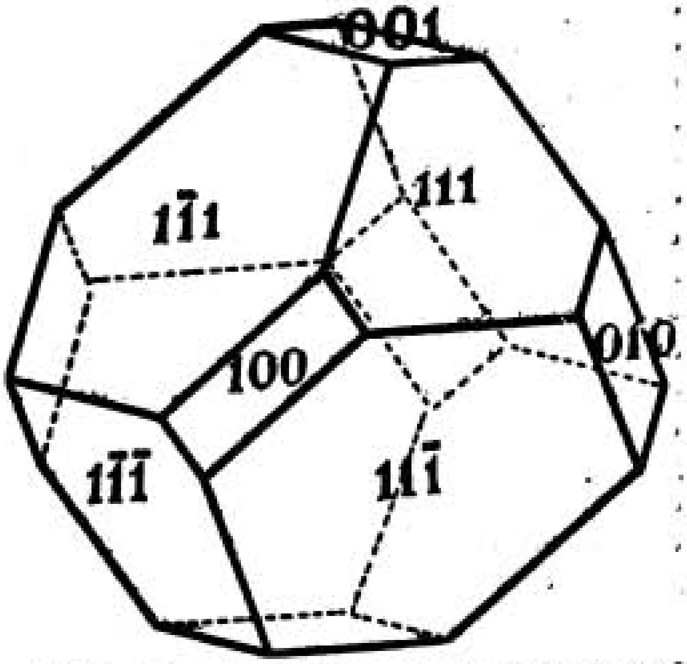



*Fig. 6. Crystal of Zinc-blende ZnS (cubic).*

space-lattice, in the crystal itself the demarcation between adjacent grosser units is eliminated, and the elementary atoms are the actual and ultimate structural units, arranged in accordance with one of the 230 point-systems.

It will thus be seen how very orderly and regular is the structure of a crystal, and it is doubtless due to this wonderful organisation that a crystal can act as a rectifier and detector for electric waves. It is obviously a naturally formed and ever-ready coherer, and for some reason yet to seek the use of a decoherer (the "trembler") is as unnecessary as it would be impossible to apply. Automatically, in some manner or other, the uni-directional current corresponding to part only of the wave is transmitted to the telephone. It is, indeed, a singular fact that the planes of similar and similarly situated atoms in a crystal are capable of reflecting the finest electromagnetic X-ray waves, and also of exercising a selective effect on the almost infinitely grosser electromagnetic waves used in wireless telegraphy.

Now, it is an interesting fact that no striking results have ever been obtained from numerous investigations on the growth of crystals under the influence of a magnetic field, and an explanation of this fact has been offered by Professor Otto Lehmann, whose name is so well known in connection with his fascinating work on "liquid crystals." He has proved that the "molecular orientative force of crystallisation" is a reality, and is that force which impels the chemical molecules to set themselves at close quarters in the regularly organised manner which has been shown above to be characteristic of crystals. For the act of crystallisation is not merely a question of the closest packing of molecules in a purely mechanical and happy-go-lucky manner, but the result of the operation of definite attractive and repulsive forces. When these are sufficient to cause the molecules to take up positions such that their centres of gravity or those of small groups of molecules occupy the points of a space-lattice, and then to set themselves further so that these grosser units (molecular or polymolecular) become strictly parallel to each other with respect to the configuration of the molecule (as regards the internal arrangements of its atoms), a solid crystal is produced. But in the cases of the extraordinary compounds brought to our notice by Lehmann, most of which are of complicated constitution (long chains of atoms) and of somewhat viscous, oily, or soapy character, the second stage is not accomplished, and the grosser units, probably the molecules themselves in these cases, are wobbly about their centres of gravity; the substance, therefore, either forms fluid crystals with rounded edges and mobile form, readily bent or broken, but as readily recovering themselves, or they are drop-like or even unbrokenly liquid in character, and yet exhibit the optical property of double refraction, and afford brilliant colours in polarised light, just like a solid crystal. The study of these bodies has led Lehmann to the conclusion that their molecules behave as if they were freely suspended astatic systems of magnets, which are constantly setting themselves, even while moving about as a liquid, in a crystalline space-lattice. He suggests further that the force in question, productive of crystallisation, is due to the action of the electronic corpuscles composing the elementary atoms rotating within the molecule, causing the molecules to act as magnets, the poles of which mutually attract and repel one another; and that pairs or small groups of four or more molecules thus arrange themselves alongside, in accordance with a definite plan, so as to produce astatic systems, forming a cubic or other less symmetrical assemblage. It has already been shown that crystals are just such assemblages of molecules or groups of molecules, and the whole astatic group in the latter case would correspond to the grosser unit above referred to, the unit of the space-lattice fundamentally governing the crystal structure.

Such an astatic system of molecules would be incapable of attraction by a magnet, as we have seen is the case, and would certainly produce a space-lattice arrangement. For differences in different directions would inevitably be involved in all but the most simple and perfectly symmetrical cases, with regard both to internal friction and the power of thermal expansion, as well as regards optical properties and doubtless also electrical conductivity and dielectric capacity. For the electrical properties of crystals are just as much functions of their symmetry as are the optical, thermal, and elastic properties. Lehmann points out that either electric currents or mechanically moved quantities of electricity, such as moving negatively electrified electronic corpuscles, can give rise to just such magnetic effects, and he suggests that these corpuscles are the true cause.

It will be obvious at once that if there be any truth in these speculations and experiments of Lehmann, the conclusion of Pierce, that transference of electronic corpuscles across the junction-point of crystal and metal plate is the reason for the action of crystals as rectifiers, takes on a new importance and comes to us in quite a new light and with greatly enhanced interest. For it is most natural to suppose that the electromagnetic waves, on reaching the relatively minute point of contact of the crystal with the metallic plate, will cause some of the moving corpuscles to become detached from the system and to pass in one direction preponderatingly, owing to the directionally different nature of the crystal structure, or to the greater facility for streaming from the point, and with a velocity dependent on the temperature. Such an explanation clearly correlates the observed facts: (a) that a crystal acts as a more efficient coherer than a filings tube, being more perfectly and permanently arranged in orderly assemblage; (b) that a point-and-plate contact is the most efficient on the whole; and (c) that certain parts of a crystal act better than others. It is the writer's belief that the secret of finding a suitable point in the case of carborundum is the finding of a truly single individual crystal suitably orientated for maximum effect in the right direction, and with a clean solid angle, in which several interfacial edges meet, presenting its apex to the metallic plate. In a conglomerate crystal, a mass of intergrowths, twins, or parallel growths, it may not be easy always to discover such a spot—a supposition which agrees exactly with the observed facts.

In conclusion, it may not be without interest to enumerate the lines of future research which are necessary, in the writer's opinion, in order finally to settle this question of such high interest to the crystallographer. A series of exhaustive experiments should be made in the first place with the very best procurable single individual crystals, of the various pure substances found so efficacious as rectifiers. They should be used in a complete series of well ascertained, crystallographically definite directions and orientations, in order to ascertain quantitatively the effect of direction within the crystal and of position of the point presented to the plate; that is, a large number of points all round the crystal should be presented in turn, both ends of every important direction line within the crystal being thus investigated. Experiments should also be made with artificially pointed crystals of different degrees of bluntness, and with naturally pointed crystals (pyramids or bipyramids) of as many degrees of steepness as the pyramidal forms developed on the crystal permit. And lastly, crystals such as tourmaline should be tried, which belong to classes of symmetry of lower than the full systematic symmetry, particularly those which are differently terminated by virtue of the absence of an equatorial or other plane of symmetry possible in the system, and which are distinguished in consequence by the presence of what is known as a polar axis. For it is just such crystals as these which exhibit the interesting phenomena of "pyro-electricity" and "piezo-electricity"—that is, the development of opposite electric polarity at the two terminations of the polar axis on warming the crystal or permitting it to cool, or by compressing it along the axis and again releasing the pressure.

The experiments now adumbrated would take full cognisance of the already well-known electrical properties which are purely functions of the symmetry, such as electric conductivity, thermo-electric character, and dielectric capacity. In many cases it may be very difficult to obtain perfect single crystals, and the experiments may show that it is quite unnecessary to expend time in doing so. But only by such a systematic series of investigations can we get to the bottom of this most interesting property of crystals. Moreover, in the course of such an investigation it is quite possible, and even probable, that very much more sensitive crystal rectifiers and detectors may be discovered than the best at present in use, a result which of itself would be of considerable value in the further development of long-distance communication without wires.

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The Bureau of Navigation has issued a statement showing that during the first four months of the operation of the Act to regulate radio communication, which took effect on December 13th, 1912, the Department of Commerce, through the Bureau of Navigation, has issued 3,407 licences to wireless operators and stations in the United States. The first grade commercial operators' licences number 1,279 and the second grade 186, while 1,185 amateurs have been licensed. So far 46 American ship stations and 18 coast stations have been licensed, and this branch of the work will now proceed more rapidly.

# Crystal Detectors and Electrothermal Action.

IN a paper to the Physical Society, Dr. W. H. Eccles deals from a new theoretical standpoint with "Electrothermal phenomena at the contact of two conductors," and develops a theory of the action of crystal detectors.

In his introductory paragraphs he says:—

"When an electric current is caused to pass across the interface between a pair of conducting masses, heat is in general liberated or absorbed in accordance with the law of Peltier. When the masses are in contact over a very small area, as, for example, when a cylinder of graphite is laid across a copper wire, there may be, in addition, appreciable generation of heat in accordance with the law of Joule. If the substances constituting the contact are bad conductors of electricity and of heat, and if they stand far apart in the thermoelectric series, the phenomena arising when a current is forced across the joint become very striking, for in such circumstances relatively large amounts of heat may be developed, the heat is conserved, and therefore the thermoelectric effects enhanced.

"It is evident that the thermoelectric forces called up by the local heating may assist or may oppose the E.M.F. applied to produce the current and that the phenomena of a symmetric conduction at once arises. But besides the Joule and Peltier effects, the Thomson effect may contribute to the phenomena. In the case of bad conductors of heat the temperature gradients very near the contact will be very steep, and thus the Thomson effect will be localised in the immediate neighbourhood of the contact.

"Further than this it is obvious that, on account of the temperature changes, the portions of the substances near the contact will suffer a change in the magnitude of their electrical resistivity. It has been shown* that this effect alone leads to remarkable and important results, and is sufficient to account for all the principal features of the single-point coherer used in wireless telegraphy.

"The thermoelectric forces and the changes of electrical resistance that arise from differences of temperature are much greater in combinations of such substances as iron pyrites than in combinations of ordinary metals. A pyrites-lead couple yields an E.M.F. some 200 per cent. greater than a bismuth-lead junction, between the same extremes of (ordinary) temperatures; while the temperature coefficient of resistance of pyrites is probably four times as great numerically as that of copper. But the thermal conductivity of pyrites is so very much smaller than that of lead that all these thermoelectric phenomena are greatly accentuated in the former case. Contacts between non-metallic conductors are of special interest, for the reason that the bulk of the wireless telegraphy of the world is carried on by aid of detectors that consist of nothing else than a contact involving at least one non-metallic conductor.

"The thermoelectric constants of such substances as pyrites, zincite, carborundum, etc., are not easy to measure accurately, and their coefficients of increase of resistance with temperature are exceedingly difficult to determine. The author has made numerous determinations, and has found that all the materials examined follow with fair precision the ordinary thermoelectric law that their thermoelectric powers are linear functions of the temperature, and also that their temperature-resistance coefficients are all large and negative."

* "Proc." Physical Society of London, Vol. XXII. p. 869.

The writer goes on to consider a circuit including a loose contact, such as that formed by a piece of pyrites pressing against a piece of metal; the other junction making a very good contact, so that its temperature remains unchanged.

"Let an E.M.F. be applied to the circuit in any manner so as to produce a current in the direction opposite to the E.M.F. that would be produced by heating the contact. The heat liberated near the contact is, per absolute unit of electricity flowing through the contact, equal to the thermoelectric force $e$ plus the heat absorbed at the cold junction.

"This heat tends to be concentrated in a small volume of the substance near the contact, but is dispersed continually by thermal conductivity and radiation. We will assume that the rate of loss of heat by these agencies is, as a whole, proportional to the excess of temperature of the junction over its surroundings. The rise of temperature causes an alteration of the electrical resistance of the joint; let the true resistance at any temperature above the temperature of the surroundings be expressed by $\rho\,(1+\gamma\theta)$ where $\gamma$ is a temperature coefficient dependent on both the substances at the contact."

His mathematical investigation leads to the obtaining of an equation for the current $y$ sent across a typical detector-junction, in terms of the P.D. between the extreme ends of the conductors which vary in temperature. If this P.D. be represented by $x$, the equation obtained, omitting negligible terms, is

$$ax^2y^2+cxy^2+bxy-x+\rho y=o.$$

The constants $a$, $c$, $b$ in this equation are mainly dependent on the Thomson effect, the change of resistance with temperature, and the Peltier effect respectively. If the part of the circuit which undergoes no appreciable temperature-change possesses the constant resistance $r$, and the applied E.M.F. be denoted by $e$, then $x = e - ry$, and the steady current *characteristic curve* as usually drawn from observations of applied E.M.F., and consequent current is identically that obtained by applying to the curve drawn from the above equation a homogeneous shear of amount $r$ parallel to the axis of $x$.

The author proceeds to deal with particular cases of this equation, assigning various values to the constants $a$, $c$, and $b$, and showing the derived curves.

The paper itself should be consulted by all who are interested in the subject; it is too long for a full abstract to be given here. Among other interesting conclusions arrived at, it is indicated that when the constant $a$ is positive, the current produced by a definite voltage is greater when the voltage is negative than when it is positive; while when $a$ is negative or zero the positive voltage produces the greater current. Now, various writers (if we remember rightly, Professor Pierce in particular) discredit the theory that crystal-rectification is due to thermoelectric action, on the ground that when some such contacts are warmed by direct communication of heat the thermoelectric force is in the opposite direction to the current produced by the rectifying action. Dr. Eccles considers that this argument is a fallacy; for the observation of the direction of the thermoelectric force produced by direct heating shows only the sign of the Peltier effect and not the sign of the Thomson effect in the circuit, and thus ignores the sign of the important constant $a$.

There is, we think, another argument against the thermoelectric explanation of crystal-action—the fact, obtained experimentally, that the maximum current produced thermoelectrically may be thousands of times less than the rectified current produced from an alternating current which gives rise to the same increase of temperature at the contact.

We do not know whether the experiment referred to was carried out in such a way that the two cases could truly be compared, but we should doubt it, since the current produced by rectification would depend on what point of the curve was being worked on.

We have submitted the above point to Dr. Eccles, and he takes the same view, pointing out that his mathematical treatment shows that if the E.M.F. $e$ is adjusted to a sharp bend in the curve, the rectified current might be enormous compared with the thermoelectric current. Thus things which show no thermoelectric E.M.F. may be good rectifiers, and he quotes as an example a pair of pieces of galena, which form a very good rectifier at a certain E.M.F. (about $\frac{1}{4}$ volt), but which show no thermoelectric action.

# THE MARCONI INTERNATIONAL

THE Report of the Directors of the above Company and the Statement of Accounts for the year ending December 31st, 1912, was presented at the Thirteenth Ordinary General Meeting of the Company, held on Monday, June 23rd, 1913.

It will be observed from the Accounts that the business of the Company has continued to show very satisfactory progress during the year under review, the net profit for the year amounting to £24,435 17s. 11d. after deducting £10,780 13s. 1d. for depreciation and allowing for debenture interest, as compared with £15,027 15s. 7d. in the preceding year.

The revenue from ships' telegrams, traffic, subsidies, etc., amounts to £100,325 3s. 10d., showing again a substantial increase over the amount of £64,165 16s. 8d. for the year 1911 and £40,535 15s. 8d. for the year 1910.

Some further indication of the substantial development of the Company's business is shown by the number of telegraph stations owned and worked by the Company on board ships on the high seas, the number of which increased from 250 at the end of 1910 to 350 on December 31st, 1911, and on December 31st, 1912, the actual number of stations in work had increased to 580. To the present date progress continues on much the same scale, the number of ships actually equipped by this Company being 686, and con-

## Dr. BALANCE SHEET,

| | | £ s. d. | £ s. d. |
|---|---|---|---|
| To CAPITAL— | | | |
| *Authorised.* | | | |
| 350,000 Shares of £1 each ... ... ... ... ... ... | | 350,000 0 0 | |
| *Issued.* | | | |
| 204,056 Shares, fully paid ... ... ... ... ... ... | | | 204,056 0 0 |
| " 6,250 5½ PER CENT. 1ST MORTGAGE DEBENTURES OF £20 EACH ... | | | 125,000 0 0 |
| " CREDITORS ... ... ... ... ... ... ... ... | | | 72,566 7 7 |
| " RESERVE FOR REPAYMENT OF DEBENTURES ... ... ... ... | | | 1,750 0 0 |
| " PROFIT AND LOSS ACCOUNT— | | | |
| Balance as per last account, December 31st, 1911 ... ... ... | | 18,646 1 3 | |
| *Deduct*— | | | |
| 7 per cent. Dividend for 1911 ... ... | £14,283 18 5 | | |
| Reserve for Repayment of Debentures ... | 1,750 0 0 | | |
| | | 16,033 18 5 | |
| | | 2,612 2 10 | |
| *Add*— | | | |
| Balance of account for the year ending December 31st, 1912 ... | | 24,435 17 11 | |
| | | | 27,048 0 9 |
| To Contingent Liability on shares in Associated Company, £200. | | | |
| | | | £430,420 8 4 |

## Dr. PROFIT AND LOSS ACCOUNT for

| | £ s. d. |
|---|---|
| To SALARIES AND DIRECTORS' FEES ... ... ... ... ... ... ... ... ... | 9,418 9 8 |
| " TRAVELLING EXPENSES, OFFICE RENTS, LAW CHARGES AND SUNDRY EXPENSES ... | 6,310 0 5 |
| " EXPENSES OF SHIPS' STATIONS, including depreciation of Plant and Apparatus ... | 53,551 15 7 |
| " DEBENTURE INTEREST ... ... ... ... ... ... ... ... ... ... | 6,609 0 3 |
| " BALANCE CARRIED TO BALANCE SHEET ... ... ... ... ... ... ... | 24,435 17 11 |
| | £100,325 3 10 |

### Report of the Auditors to the Shareholders.

We have audited the above Balance Sheet. The Plant, Apparatus, Furniture and Stores have been we have required, and in our opinion such Balance Sheet is properly drawn up so as to exhibit a true explanations given to us and as shown by the Books of the Company.

LONDON, *June 12th*, 1913.

# MARINE COMMUNICATION Co. LTD.

siderable additional orders are in hand. There are now some 1,700 ships of different nations, exclusive of ships of war, fitted with Marconi wireless stations.

With every prospect of the Company's business continuing to show further substantial development, for which additional capital will be required, it is the intention of the Directors in the early future to place a further portion of the unissued capital, and this in the first instance will be offered to the Shareholders.

The Directors recommend the payment of a dividend for the year 1912 at the rate of 10 per cent., which will absorb the sum of £20,405 12s., and to allocate the sum of £3,500 to the repayment of Debenture Account, leaving the sum of £3,142 8s. 9d. to be carried forward.

On July 31st, 1912, Mr. Edgar St. Paul de Sincay retired from the Board, and Mr. Maurice Travailleur was elected in his place.

The retiring Directors are Major Samuel Flood Page 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.

## December 31st, 1912. Cr.

| | £ | s. | d. |
|---|---|---|---|
| By Plant, Apparatus, Furniture and Stores ... | 144,847 | 0 | 4 |
| „ Consideration for Licence and Rights and Shares in Associated Companies | 228,936 | 11 | 7 |
| Note.—The Licence and Rights are subject to the provisions of four Agreements between this Company and four Associated Companies, under which this Company received Shares in Associated Companies for this Company's rights in Canada, Argentina, Uruguay, and all European countries and their Dependencies except Great Britain and Ireland and Italy. | | | |
| „ Debtor Balances ... | 40,222 | 12 | 3 |
| „ Debenture Discount ... | 14,843 | 15 | 0 |
| „ Cash at Bankers and in Hand ... | 1,570 | 9 | 2 |
| | £430,420 | 8 | 4 |

## the Year ending December 31st, 1912. Cr.

| | £ | s. | d. |
|---|---|---|---|
| By Ships' Telegrams, News Service, Traffic and Ships' Subsidies, Rentals and Sundry Receipts ... | 100,322 | 17 | 10 |
| „ Transfer Fees ... | 2 | 6 | 0 |
| | £100,325 | 3 | 10 |

GODFREY C. ISAACS, *Director.*
HENRY S. SAUNDERS, *Director.*

certified by representatives of the Company. We have obtained all the information and explanations and correct view of the state of the Company's affairs according to the best of our information and the

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

# The American Marconi Company

## Annual Meeting and Payment of First Dividend

THE annual meeting of the Marconi Wireless Telegraph Company of America was held on June 16th, at the New Jersey offices of the company, 15, Exchange Place, Jersey City. The following is the official report of the proceedings:

The meeting, being a very important function, was largely attended, no less than a million shares being represented in person and by proxy. The meeting was duly called to order, and on motion duly made and seconded the President, the Hon. John W. Griggs, took the Chair, and Mr. John Bottomley was nominated secretary of the meeting.

Whilst the voting was in progress, the Chairman addressed the meeting substantially as follows:

"Gentlemen,—In reviewing the operations of the company during the past year, we are gratified to find a degree of growth and advancement that should be very satisfactory to the shareholders, as it is to the officers of the company. It is a striking truth that heretofore the world at large has reaped the greatest benefits from the marvellous work of Mr. Marconi, while those who have furnished the funds to carry on and finance the developments of the wireless system of communication in America have as yet had no returns in dividends earned and paid. The navies of the world Powers, as well as the merchant ships, now sail the perilous seas with an assurance of safety and protection immeasurably greater than before, because the Marconi wireless has brought within their call every sister ship of every nationality within a radius of two hundred miles to answer calls for help in time of distress. The debt of humanity to Mr. Marconi for life and property saved is already enormous. The comfort that comes to hundreds of thousands of passengers who cross the Atlantic on the great liners because the wireless is aboard to give them news of friends at home is a distinct addition to the general sum of human happiness. To accomplish these beneficent results the public has contributed nothing; the genius that has devised has been that of Marconi; the capital that has enabled him to carry out his wonderful work has been that of private stockholders. It is to be regretted that our own Government, which has so freely made use of the fruits of Mr. Marconi's inventive genius, has not yet in any way made the slightest recognition of the value and importance of his work. The magnetic telegraph was a wonder-working invention; the extension of its principles to the ocean cable made another great step in the advance of world-wide communication: but when Marconi marshalled the wild waves of ethereal energy, reduced them to orderly control, and made them carry with the speed of light the words of men through the vast wastes of space, he accomplished a miracle, surprising, stupendous—almost awe-inspiring. It is gratifying, however, to know that the great public has had faith in the success of the invention, and has furnished ample funds to carry on and establish the great designs of the inventor. After years of experimental work the time has come when we see the practical results in a commercial way, and we have satisfactory reasons to expect that substantial profits are to accrue to those who have supported the enterprise with their money.

GROWTH OF BUSINESS.

"The growth of your company's business in the last year will be best appreciated from a comparative statement. The net traffic receipts for the years 1905, 1906, 1907, 1908, 1909, 1910, 1911 and 1912 were as follows:—

| | |
|---|---|
| 1905 ... ... ... ... | $18,358.29 |
| 1906 ... ... ... ... | 37,195.52 |
| 1907 ... ... ... ... | 53,558.01 |
| 1908 ... ... ... ... | 50,191.32 |
| 1909 ... ... ... ... | 60,999.57 |
| 1910 ... ... ... ... | 63,868.93 |
| 1911 ... ... ... ... | 67,941.93 |
| 1912 ... ... ... ... | 109,943.10 |

"The large increase in receipts for the year 1912 is mostly due to the acquisition of the fleet of boats heretofore equipped by the United Wireless Telegraph Company, which boats came under the supervision and control of your company in the month of July last. A comparison of the number of messages and words sent in the years 1910, 1911 and 1912 is interesting: In 1910, 31,051 messages consisting of 407,173 words were sent. In 1911, 41,000 messages consisting of 550,000 words were sent. In 1912, 227,944 messages consisting of 3,863,098 words were sent. There are now equipped by the Marconi Wireless Telegraph Company of America more than 450 ships of the American mercantile marine, and with the addition of the shore stations there are now equipped by the company over 500 stations on the Atlantic and Pacific coasts. We are justified in saying that practically all commercial vessels flying the American flag are equipped with the Marconi apparatus as supplied, operated and controlled by this company. Contracts which have heretofore been placed at a basis that does not satisfactorily recompense the company for the work and labour entailed in operating the stations thereunder are being re-formed, and the steamship companies, seeing that it is impossible for the company to continue to do business profitably at the low rates hitherto prevailing, have, with signal fairness in almost every instance, agreed to an amelioration of the contracts, and it is expected that shortly the general run of such contracts will be on a basis that is much more remunerative.

TRANSATLANTIC COMMUNICATION.

"Gratifying as these figures are, they are only a small thing compared with the results that must follow when direct communication is established between the United States and Great Britain. In the report of the directors to the stockholders is set forth the progress that has been made towards this end. We are assured by our engineers and contractors that the co-operating stations in New Jersey and Wales will be completed by next November. Allowing for all necessary delays in adjusting and trying out the stations, active commercial business across the Atlantic should be going on by the first of next year; thus the two most important nations of the world will be closely bound together by invisible, intangible, immaterial bands, and a new, additional and less expensive service will be furnished not only for the business world, but also for the Press, the Governments and for private and social purposes, realising an increase of income and profit to the shareholders which we have every reason to believe will be substantial and gratifying. The plans of your directors do not stop however, with the Anglo-American stations. Already well under way is the construction of co-operating stations at San Francisco and in the Sandwich Islands. From Honolulu we look beyond to service connection with the Philippine Islands, thence to Japan and China—an American Imperial chain. As stated in the report of your directors, a contract has been entered into with the Norwegian Government for the erection of co-operating high-power stations in Norway and the vicinity of New York for the purpose of conducting a commercial wireless business between Northern Europe and America. This contract is for a definite period of 25 years, and its terms are favourable to the wireless companies participating therein. The contract awaits the ratification of the Norwegian Parliament, which we are advised will in due time be obtained. It is also in contemplation to establish communication between various countries in South America and the United States by similar long-distance high-power stations.

VALUE OF THE SYSTEM.

"The ability of the Marconi apparatus to transmit and receive messages over vast distances has been fully demonstrated through the experiments of Mr. Marconi. A Committee of the Parliament of Great Britain has made a thorough examination of the various wireless systems that are claiming the attention of the world, and the following extract from their report will be, I am sure, of the highest interest to Marconi shareholders. They say:

"'We report, therefore, that according to our investigation the Marconi System is at present the only system of which it can be said with any certainty that it is capable of fulfilling the requirements of the Imperial Chain.

"'The directive aerial used in the Marconi System has the advantage of not requiring very great height and of giving preference in the desired direction.'

"In view of future operations on the Philippine Islands we have had one of our engineers out there for some time, who has equipped a 5 k.w. set at Zamboanga, and under date of April 24th we have received the following advice of the work which that station is doing:—

"'I beg to advise that the 5 k.w. set is now in operation. The Bureau of Posts is using it a number of hours each day in handling its regular business between this station and Jolo Malabang Balvo and Puerito Princessa. As regards the strength and tone of signals, the Bureau is very much pleased with the set. On Sunday afternoon we were testing with Olgnpo, which station is 150 or 200 miles north of Manila, and our signals were perfectly received. The army transport "Merritt," which arrived in port yesterday, reports that she heard our signals in Manila Bay and all the time on the trip to Zamboanga.'

"The recent great development in the size and speed of sea-going vessels has enormously increased the responsibilities of the officers commanding and navigating them, and it has been necessary, in order to minimise dangers of collisions or groundings, to reduce the speed of these vessels in foggy weather, with a consequent loss of much valuable time and money, and even when precaution has been taken accidents are not infrequent. The Marconi Companies have accordingly been led to give considerable attention to the development of an instrument which is now aptly known as 'The Wireless Compass.' The wireless compass is a combination of some of Mr. Marconi's recent inventions, and the Bellini-Tosi patents, the sole use of which for the United States has been secured by your company. The Marconi wireless compass is quite independent of weather conditions, and by its use the position of a ship with regard to any coast station can be determined, and the direction of an approaching or overtaking ship can be found. The apparatus is of very simple construction, which is another strong point in its favour. Your company anticipates that the manifest advantages to shipowners of this instrument will cause it to be widely adopted, and its sale should add considerably to the revenue of your company.

PROFIT AND LOSS ACCOUNT.

"The confidence of the people in the Marconi system was shown in the large and full subscriptions to new stock in May of last year, whereby your company has been supplied with ample funds for the establishment of the extensive international stations that had been referred to. These funds have been temporarily invested by your directors in securities of the most approved character, and are earning a fair rate of interest. The general profit and loss account for the year ended January 31st, 1913, a copy of which has been sent to each stockholder, shows a surplus of profit at the end of the year of $224,483.65. Your Board of Directors, in view of the very large cash fund on hand, have deemed it fair and prudent to distribute to the stockholders a dividend of 2 per cent. upon their capital stock out of this balance of profit and loss shown by the statement of operations for the past year. In the absence of any unforeseen disturbance or setback in the course of present prosperity, the Board will be able to continue the payment of dividends for each six months of current business hereafter, the amount of which cannot at the present time be precisely estimated. I take this occasion to congratulate you upon the safe and sound condition of your company's affairs, and to express the most earnest hope for the realisation of those reasonable expectations of profitable business that have been so generally entertained on the part of the stockholders of this company."

The polls having been closed, it was found that the following had been elected to serve as directors for a term of five years, or until their successors shall be elected:—Hon. John W. Griggs, James M. Townsend and Marcus Goodbody. The telling also reported a large vote in favour of the amendments to the by-laws, whereby the fiscal year is made to end December 31st instead of January 31st, as heretofore; also permitting the directors to elect additional Vice-Presidents, assistant treasurers and assistant secretaries.

# STATEMENT of ACCOUNTS of the AMERICAN MARCONI CO.

**For the Year ending January 31, 1913.**

## CAPITAL - - - - - $10,000,000

DIRECTORS.

HON. JOHN W. GRIGGS, President.
COMMENDATORE G. MARCONI, LL.D., D.Sc., First Vice-President.
JOHN BOTTOMLEY, Second Vice-President, General Manager, Secretary and Treasurer.
GEORGES DESOUSA, Assistant Treasurer.
JAMES M. TOWNSEND.
JAMES W. PYKE.
EDWARD L. YOUNG.
GODFREY C. ISAACS.
MAJOR S. FLOOD-PAGE.
JAMES R. SHEFFIELD.
JOHN L. GRIGGS.
KENNETH K. MCLAREN.

ACCOUNTANTS.

DELOITTE, PLENDER, GRIFFITHS AND COMPANY.

COUNSEL.

HON. JOHN W. GRIGGS. SHEFFIELD BENTLEY AND BETTS.

TRANSFER AGENTS.

MARCONI WIRELESS TELEGRAPH COMPANY OF AMERICA.

REGISTRARS.

EQUITABLE TRUST COMPANY.

OFFICES OF THE COMPANY.

WOOLWORTH BUILDING, No. 233 BROADWAY, NEW YORK. 15 EXCHANGE PLACE, JERSEY CITY.

## GENERAL PROFIT AND LOSS ACCOUNT AND BALANCE SHEET

**For the Year ended January 31, 1913.**

GENERAL PROFIT AND LOSS ACCOUNT.

| | | | |
|---|---|---|---|
| Administration Expenses, including Salaries of Directors, Executive Officers and Consulting Engineer, Rents, Taxes, and General Office Expenses, Reserves for Outstanding Liabilities, etc. .. .. | $79,650.73 | Profit from Operation of Land and Ship Stations, Sale of Apparatus, etc. .. | $170,694.79 |
| Legal, Patent and Stock Transfer Expenses | 10,357.42 | Interest on Temporary Investment of Surplus Funds .. .. .. .. .. | 161,548.29 |
| Depreciation on Buildings, Equipment, etc. | 30,989.36 | | |
| Profit carried to Balance-sheet .. .. | 211,245.57 | | |
| | $332,243.08 | | $332,243.08 |

BALANCE SHEET, JANUARY 31ST, 1913.

| ASSETS. | | | LIABILITIES. | | |
|---|---|---|---|---|---|
| Cash in Banks, on Hand and at Call: | | | Capital Stock— | | |
| Cash in Banks and on hand | $308,491.11 | | Authorised: 2,000,000 Shares, par value $5.00 each .. .. .. | $10,000,000.00 | |
| Bankers' Certificates of Deposit .. .. .. | 775,000.00 | | Less: Subscribed for but not yet issued 119,486 Shares, par value $5.00 each .. .. .. | 597,430.00 | |
| Bankers' Collateral Loans | 2,320,000.00 | $3,403,491.11 | | $9,402,570.00 | |
| Investments and Loans (at cost): | | | Less: Stock held in Treasury .. .. .. | 500.00 | $9,402,070.00 |
| Railway Bonds and Notes | $2,108,502.56 | | Sundry Creditors and Credit Balances .. .. .. | | 195,857.47 |
| Bankers' Time Collateral Loans .. .. .. | 250,000.00 | | Reserves for Outstanding Liabilities, Rentals Prepaid, etc. .. .. .. | | 44,032.33 |
| Foreign Government Bonds | 97,875.00 | | Profit and Loss Account— | | |
| Municipal Loans .. .. | 75,000.00 | | Balance, January 31st, 1912 (adjusted) .. .. | $13,238.08 | |
| Bankers' Time Certificates of Deposit .. .. | 100,000.00 | | Profit for year ended January 31st, 1913, per Profit and Loss Account .. | 211,245.57 | 224,483.65 |
| Shares of other Companies | 1,470.00 | $2,632,847.56 | | | |
| Interest Accrued .. .. | | 22,717.82 | | | |
| Sundry Debtors and Debit Balances, after providing Reserve for Doubtful Accounts .. .. | | 309,684.56 | | | |
| Patents, Patent Rights and Goodwill .. .. | | 2,691,215.29 | | | |
| Real Estate and Buildings, Machinery, Plant, Apparatus at Works, Land and Ship Stations, after providing Reserve for Depreciation of Equipment .. .. .. | | 806,487.11 | | | |
| | | $9,866,443.45 | | | $9,866,443.45 |

We have audited the accounts of the Marconi Wireless Telegraph Company of America in New York and San Francisco for the year ended January 31st, 1913. We have duly verified the Balances in Banks and on hand, and the securities representing the Investments, as set forth in the Balance Sheet, have been produced for our inspection.

No provision has at present been made for writing off any portion of the book value of Patents and Patent Rights.

Subject to the correctness of the appointment of Cost Values of Assets acquired during the year, we certify that the above Balance Sheet, in our opinion, fully and fairly sets forth the position of the Company as disclosed by the books as at January 31st, 1913.

New York, *June 5th*, 1913. DELOITTE, PLENDER, GRIFFITHS AND CO.

# The Russian Marconi Company
## Annual Meeting and Dividend

### *USE OF MARCONI SYSTEM IN ARMY AND NAVY*

THE general meeting of the (Marconi) Russian Company of Wireless Telegraphs and Telephones was held on 31st May (Russian style) in St. Petersburg. The following is the official report of the proceedings:

Mr. M. G. Salberg read the report of the directors, which stated: A year ago, in view of the orders which the company then had in hand, and the rapidly increasing growth of the business, the Board informed you in its report that there were good reasons to expect a satisfactory result for the year 1912. The present balance sheet fully justifies the expectations expressed by the directors at the general meeting in May, 1912, and it is a matter of considerable satisfaction to your Board to be able to place before you accounts which show so marked an improvement as compared with those of the preceding year. Looking at the figures you will find, on the credit side, that there is a gross profit of 250,189.64 roubles on completed contracts as compared with 62,850.17 roubles for the preceding year, which, after deducting a sum of 109,390.46 roubles to cover the company's general expenses and percentages, leaves a net divisible profit of 139,801.58 roubles as compared with a loss of 39,058,78 roubles for 1911. The only other point in connection with the balance sheet which calls for special notice is in respect of the company's freehold property. This property is shown in the balance sheet at cost price, but the directors desire to call attention to the fact that the land has increased considerably in value and that land in the immediate vicinity, less favourably situated, is commanding more than double the price which the company paid for their freehold property at the time of its purchase only four years ago.

GENERAL EXPANSION.

During the year 1912, owing to the rapidity with which the business extended, it was found necessary to enlarge the premises and increase the machinery and staff. The estimates for 1913 are therefore submitted to you at an increased figure. The development of the company's business in 1912 is particularly marked by the wide-spread adoption of our stations by the Russian Admiralty. In previous years it has been a matter of regret to the Board that comparatively few orders were received from the Admiralty, whose stations formerly were almost exclusively equipped with apparatus of our competitors; in 1912, however, the position was entirely changed, and a number of large and important orders were received both for the erection of shore stations and for the equipment of vessels of the Russian marine. Of special significance is the fact that among the orders completed in 1912 for the Admiralty was the conversion of thirty-six ship stations of the Russian Navy from our chief competitors' system to our own. Among the company's other developments in 1912 was the introduction of a special type of light, portable station for the use of the Russian cavalry. Two such stations were worked by the Imperial Hussars during the summer manœuvres of 1912 with the greatest possible success, a special demonstration of their capabilities being afterwards given in the presence of the Emperor. As a direct result of the successful trials of these stations, a special Commission is now sitting with a view of definitely deciding the type of cavalry station most suitable to the needs of the army, and large orders for these stations may eventually be expected.

ARMY AND NAVY CONTRACTS.

Up to the present time the Russian Commercial Fleet has taken little or no advantage of the many facilities offered by wireless telegraphy; in 1912, however, a beginning was made by the equipment by this company of six vessels belonging to the Russian Volunteer Fleet. A new law is now under consideration by the Government to make it compulsory for all passenger-carrying vessels to be equipped with wireless telegraphy, so that in due course a large field should also be opened up in this direction. In the present year (1913) a large and important contract has been entered into with the Russian War Office for the erection of a powerful station at Nikolaeff and for the reconstruction of the station at Ourjumka; in addition to the above, a further contract has been entered into with the Admiralty for the conversion of fifty-one ship stations from our principal competitors' system to our own. Altogether the company has new contracts in hand for 1913 amounting to over 900,000 roubles, whilst further large and important orders may confidently be expected as soon as the Budget for 1913 has been confirmed. It will be seen from the above that the company's business is rapidly increasing and the field for wireless telegraphy is spreading with ever-growing rapidity owing to the development of the military and naval strength of the country and of the vast tracts of land where no form of telegraphic communication exists. The company's business having outgrown its resources, the directors have had to seriously consider some means of coping with this situation. In view of the conditions obtaining in Russia large sums have to be kept available in order to make a deposit with the Government as guarantee, with every order received. With a comparatively small capital this has proved a serious drain on the company's resources, as it has not left sufficient funds available to carry out the actual work of construction even under the most favourable conditions, necessitating therefore the borrowing of money and consequently reducing the profit owing to the high rates of interest which have had to be paid.

In addition to this it is considered desirable to purchase the land which is at present rented for trials and demonstrations in the neighbourhood of the company's works. No time should be lost in doing this, as otherwise the company may find itself in an unfavourable position, for it would be very inconvenient to carry out tests on ground anywhere but in the immediate vicinity of the works. In view of these circumstances, therefore, and in order to place the company's affairs on a more profitable basis in the future, the directors beg to recommend the increase of the company's capital by a new issue of shares to the nominal value of 1,200,000 roubles. As the result of the ever-increasing business of the company, it is impossible to avoid indebtedness, and the Board of Directors ask you to authorise them to pledge the company's credit with Government and private institutions, if necessary, up to 1,000,000 roubles. In addition to the accounts and balance sheet the directors also submit for your approval the estimate of expenditure for 1913, amounting to 229,500 roubles. The directors submit for your approval and passing the following resolutions: (1) To confirm the report of the Board of Directors for the period from 1st January to the 31st December, 1912, and the balance sheet as at 1st January, 1913, and the distribution of the profits. (2) To approve estimate of expenditure for the year 1913, amounting to 229,500 roubles, exclusive of any interest which may have to be paid. (3) To authorise the Board to take sums on credit in Government and private institutions, issuing cheques and bonds on behalf of the company up to the sum of 1,000,000 roubles. (4) To authorise the increase of the capital by the issue of a new series of shares to a nominal value of 1,200,000 roubles. Besides passing the above resolutions, the general meeting, as per sections 25 and 28 of the company's charter, has to elect—(*a*) two directors who retire by rotation, and one to fill the vacancy on the Board; (*b*) five members of the revisionary committee.

PROPOSALS AGREED TO.

It was unanimously decided: (1) To confirm the report for the period from 1st January to 31st December, 1912, and the balance sheet as at 1st January, 1913. The profit as per report, of 139,801.58 roubles, to be distributed as follows: Placed to reserve (5 per cent.), 6,990.08 roubles; to depreciation of real estate (workshop, laboratory, etc.), 7 per cent. of original cost price (219,988.72 roubles), 15,399.21 roubles; income-tax (5¼ per cent. of 117,412.29 roubles), 6,457.68 roubles; revisionary committee's remuneration, 1,000 roubles; dividend of 6 per cent. on 1,800,000 roubles, 108,000 roubles; carried forward, 1,954.61 roubles. The dividend to be payable on and after the 1st October, 1913. (The members of the Board and of the revisionary committee refrained from voting.) The meeting approved the estimate of expenses for the year 1913, amounting to 229,500 roubles, and authorised the directors to take sums on credit from Government and private institutions and from private persons, when needed, up to a sum of 1,000,000 roubles. The meeting further decided to increase the capital of the company by 1,200,000 roubles by the issue of 12,000 additional shares of a nominal value of 100 roubles each, and authorised the Board of Directors to: (*a*) decide the method of issue—of all or part—of the shares, also the terms and price of issue of the new shares, on condition that the price should not be lower than 100 roubles; (*b*) to enter into agreements with banks and other institutions and persons for the purpose of guaranteeing the new issue of shares, on conditions approved by the Board of Directors; and (*c*) to negotiate with the Government for permission to realise all the above decisions and to make in the statutes of the company all the alterations necessary to carry out the above decisions.

## BALANCE SHEET, WORKING ACCOUNT AND PROFIT AND LOSS ACCOUNT for Year 1912.

BALANCE SHEET TO JANUARY 1ST, 1913.

| CR. | | | DR. | |
|---|---|---|---|---|
| By Patents and Patent Rights | | 980,000 00 | To Share Capital | 1,800,000 00 |
| Freehold Land and Buildings | | 336,567 73 | Reserve Capital | 606 21 |
| Workshops, laboratories, machinery, plant, etc. | | 219,988 72 | Bills Payable | 463,726 74 |
| STOCK— | | | Creditors | 627,727 33 |
| Apparatus, Finished and Unfinished Parts and Raw Material | | 368,763 03 | Fine Capital | 25 50 |
| ORDERS— | | | PROFIT AND LOSS ACCOUNT— | |
| War Office and Marine | | 342,733 29 | Profit for 1912 | 139,801 58 |
| Cash in Hand | | 14,345 01 | | |
| Deposits as Guarantees | | 163,169 90 | | |
| Debtors | | 349,069 15 | | |
| Establishment Charges | | 49,694 09 | | |
| Expenses carried forward to 1913 | | 35,000 00 | | |
| PROFIT AND LOSS ACCOUNT— | | | | |
| Loss 1910 | 133,497 66 | | | |
| „ 1911 | 39,058 78 | | | |
| | | 172,556 44 | | |
| Total Roubles | | 3,031,887 36 | Total Roubles | 3,031,887 36 |

WORKING ACCOUNT FOR THE YEAR 1912.

| | | | |
|---|---|---|---|
| Receipts | 875,464 95 | Expenditure | 735,663 37 |
| | | Profit | 139,801 58 |
| | 875,464 95 | | 875,464 95 |

PROFIT AND LOSS ACCOUNT, 1912.

| | | | | |
|---|---|---|---|---|
| Profit from Completed Orders | 250,189 64 | | General Expenses | 112,653 70 |
| Sundry Receipts | 2,265 64 | | Profit | 139,801 58 |
| | | 252,455 28 | | |
| | | 252,455 28 | | 252,455 28 |

# Wireless Telegraphy on Railways

## New Stations in Canada

THE completion of the negotiations for erecting wireless stations at Le Pas and Port Nelson, two principal stations on the Hudson Bay Railway, marks another important step in the opening up


*Le Pas—Port Nelson Route.*

of this important trading route. For many years the question of its development has been before the Canadian public, but such schemes need careful and elaborate consideration before the work can be definitely started, as, once the hand is on the plough, there is no turning back.

The contract for the work has just been awarded to the Marconi Company of Canada by the Department of Railway and Canals of the Dominion Government. Two stations will be erected, one at each of the terminals of the proposed Hudson Bay Railway, viz.: Port Nelson on Hudson Bay, the northern terminal of the railway, and Le Pas in Manitoba, the connecting point of the new line with the Government railway system. The Canadian Government has thus shown that it fully realises the great utility to be derived from wireless telegraphy.

This is the first occasion that the assistance of wireless telegraphy has been resorted to in connection with railway construction on the North American Continent. It is, however, employed with great success in Brazil, where the Marconi Company some years ago erected two stations on behalf of the Madeira Mamore Railway Company, one at Manaos, where the local offices of the railway are situated, and the other at Porto Velho, at the head of the railway some 1,000 miles away, the only access to which point being by means of boats on the Madeira river. The results of the application of wireless on that line have proved its value in railway construction.

The object of the Hudson Bay Railway, which will be about 440 miles long, is to give the grain growers of the north-west means of cheap communication between the interior and Europe *via* Hudson Bay and the Atlantic, and the Canadian Government is doing its utmost to have the line completed before 1914.

The wireless stations will play an important part in the construction, as they are primarily intended to serve as intermediaries for the ordering and forwarding of material

*A Typical River Steamer in use in the Far North.*

and labour from the base to the scene of operations, etc. The town of Port Nelson is cut off from communication with the capital during nine months in the year, but once the stations are erected the work of the officials at Ottawa and elsewhere will be greatly facilitated, as they will be able to remain in close touch with the progress of the work on the line.

The stations will be of 10 kw., the power for which will be obtained from 20 h.p. engines, and each station will have a range of 500 miles.

*Loading Logs on Police Team on East Side Churchill River, Hudson Bay.*

Le Pas is on the Saskatchewan river, and is distant, as the crow flies, some 410 miles from Port Nelson. This is one of the principal ports on the south-west coast of Hudson Bay. It stands at the mouth of the Nelson river, which, with its tributaries, drains the whole of southern Manitoba. The main river rises in Lake Winnipeg, but the tributaries form a network which link up a great many of the smaller lakes, and so effect a junction with the Churchill river. At present all this country is undeveloped, for its climatic conditions are unfavourable to agriculture, as it lies within the influence of the Arctic zone. But Le Pas is on the borderland between the uncultivated and the cultivated districts of this part of Canada. The Saskatchewan river runs through some of the most fertile parts of Saskatchewan. Round Alberta, for instance, there are vast corn lands and good pasturage. Now it would be quite easy to ship cargoes of wheat on the river and convey it by this means to Le Pas, thence, when the railway is completed, to Port Nelson, and from there shipments are easy to the markets of the world.

The settlement of Le Pas was formerly one of the Hudson Bay Company's posts in the north-west, but enjoys considerable historical importance as being perhaps the last civilised place from which word was received from the great explorer Franklin, of Arctic fame, when on his last trip to the north. An interesting feature of Le Pas is the little Anglican church where Franklin held Divine service.

Port Nelson, the site of the corresponding station and the northern terminal of the railway, is destined to become a summer port of importance. The wireless station at Port Nelson will also comprise a special installation to communicate with vessels trading with that port.

Another effect of the Hudson Bay railway will be the opening up of one of the best fishing trades in the world. All the lakes of the district are full of fish, and if, as is the case on Lake Winnipeg, fishing is made to pay when the haul has to be carried a distance of 140 miles or more to rail, then the carriage of this commodity by the new route, which will reduce the distance to about 40 miles, will greatly enhance the prospects of the fishing industry, for it will bring this important item of food supply within easier reach of such big towns as Aberdeen, Prince Albert, and Battleford. Then there is a good deal of whale fishing to be had in Hudson Bay. During the summer months the Hudson Bay Company bring in many whales to their depots at Port Nelson and Port Churchill. These measure about 10 to 15 feet in length, and weigh as much as 2,000 pounds. The fish is cut up and kept to feed the dogs in the winter, while the blubber is boiled down at the factories and the hides are sent to England. Of course, one of the most important industries of North Manitoba is fur-trading and the capture of fur-bearing animals. These include the fox, beaver, otter, mink, ermine, and wolverine. At present the work is carried on by natives, Indians or Eskimos, and the method of trading between the fur companies and the natives is unique and interesting. It is carried on by means of a standard value called in most parts of the country "A Skin." There are different skins, such as "Working Skin," "Fur Skin," "Blubber Skin," "Sunday Skin," and so on. When a trapper goes to sell his goods at a store, the man in charge examines his furs, tells him he has so many "skins" worth and hands him thirty or forty small pieces of wood in lieu of cash. These he retains until he wants goods, when he returns them one by one, until he has had goods to the value of the skins he deposited. These men seldom use steel traps, but resort to the old-fashioned method of deadfalls. The Eskimos round the eastern coast of Hudson Bay are a good-natured hardy people, not particularly tall, broad-chested, with great fat greasy faces, black piercing eyes, straight black hair, and beautiful teeth. They can carry burdens of immense weight, and are fond of wrestling and other sports.

One of the most beautiful of northern phenomena, the *aurora borealis*, is particularly vivid in this district. At such times streamers of light will flash across the sky as though an invisible hand were shaking out a veil of a rainbow light over the blue immensity of the heavens. First delicate fringes of starry white appear and die, then gold, azure, amber tints, and rose follow with swift intensity, and make a panorama of fleeting loveliness. Among the natives these brilliant lights are considered to be heralds of colder weather.

It is rumoured that these stations may form the commencement of a wireless chain to extend through Northern Ontario and Quebec, and the Hudson Bay Straits, eventually linking up with the Newfoundland Government's stations on the Labrador Coast. This would be the first step towards the opening up of those territories, the development of which has hitherto been handicapped by their extreme isolation.

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The Marconi Wireless Telegraph Station at the Pabst Brewery, Milwaukee, is being removed to the Broadway Building, Broadway, Constance Street. The removal has been necessitated by the large increase in business.

Mr. C. E. Hansen, of Los Angeles, when returning home from Europe on the *Mauretania*, sent a wireless message to Los Angeles ordering a motor-car for his wife. The message ran: "Have Hupp Yates runabout prepared for delivery to wife. Notify her of gift.—Hansen." The lady was in Europe when the message was sent, and the salesman immediately transmitted to her a message announcing that a motor-car awaited her arrival as a gift from her husband. The order was received by wireless and the advice was despatched in the same form. The knowledge that the transaction was carried out in such a unique way should considerably enhance the value of the gift.

# Administrative Notes

**Wireless at Dar-es-Salaam**

THE Board of Trade have received through the Foreign Office a copy of a despatch from His Majesty's Ambassador at Berlin stating: A wireless telegraph coastal station has been opened at Dar-es-Salaam (German East Africa) for public communication with ships at sea. The call letters are K.A.C., the normal wave-length 600 metres, and the charge for messages is 30 pf. per word without minimum charge. The range of the station is stated provisionally to be about 1,100 kilos.

* * *

**A Brazilian Scheme**

WE have on a previous occasion announced the issue of a decree providing for a Government organisation of wireless telegraphy throughout Brazil. The *Diario Official* now publishes further particulars regarding the scheme, which will embrace an international service of wireless telegraphy both terrestrial and trans-oceanic, a river service, a frontier service, and an inter-state service. Stations will be of both the fixed and portable types. The international stations will include one at Belem, having a range of 4,000 miles, one at Cape Santa Martha, having a similar range, and another at Rio de Janeiro, having a range of 2,000 miles. The contract for these stations has already been granted to the Marconi Company.

* * *

**Australia and Weather Reports**

A STATUTORY rule (No. 18 1913) has been issued by the Commonwealth of Australia relating to ocean forecasts of weather reports. It amends Statutory Rules No. 128 1911 by inserting after the regulation under the heading "Charges" the following regulation :—"Ocean forecasts sent by the Commonwealth Meteorologist will be transmitted from radio-telegraph stations owned, operated, and maintained by or on behalf of the Postmaster-General to vessels at sea, and weather reports received at such radio-telegraph stations from vessels at sea, and addressed to the Commonwealth Meteorologist, will be transmitted, on payment of the following charges :—For each communication not exceeding 20 words, 2s. ; for each additional word, 1d. ; plus the ordinary land line charges." This regulation is subject to amendment, but whatever charges are ultimately made, they will be paid by the Meteorological Bureau and not by the ship's station.

* * *

**Revised Regulations**

Two ordinances have recently been published, one affecting St. Lucia and the other Sierra Leone. The former provides that a person shall not establish any wireless telegraph station, or instal or work any apparatus for wireless telegraphy in any place or on board any ship registered in the Colony, except under and in accordance with a licence granted in that behalf by the Governor. Further, a person shall not work any apparatus for wireless telegraphy installed on any merchant ship, whether British or foreign, while that ship is in the territorial waters of the Colony, otherwise than in accordance with prescribed regulations. The Sierra Leone ordinance, which amends the "Wireless Telegraph Ordinance, 1903," provides that a person shall not work any apparatus for wireless telegraphy installed on a merchant ship, whether British or foreign, whilst that ship is in the territorial waters of the Colony, otherwise than in accordance with certain prescribed regulations. The regulations are not applicable, however, to the use of wireless telegraphy for the purpose of making or answering signals of distress.

* * *

**Regulations in the Western Pacific**

THE use of wireless telegraphy in certain islands in the Western Pacific was governed by the Wireless Telegraphy Regulation of 1907, which is now repealed by "The Wireless Telegraphy Regulation, 1912 (No. 9)." Under the new regulation it is provided that it shall not be lawful for any person to establish, instal, or use any apparatus for the purpose of electrical communication by means of wireless telegraphy in any of the Protectorates, islands, or places within the jurisdiction of the High Commissioner as specified in the regulation without a licence to do so first obtained as may be prescribed. The regulation is not to apply to the islands of the Pacific Ocean known as the New Hebrides (including the Banks Islands and the Forres Islands), but is applicable to the following places :—British Solomon Islands Protectorate, Gilbert and Ellice Islands, Union (Tokelau) Islands, Phœnix Islands, Fanning Island, Washington Island, Christmas Island, Pitcairn Island, and all other islands in the Western Pacific not being within the jurisdiction of the Commonwealth of Australia or any of the States thereof, or of the Dominion of New Zealand, or of any civilised Power. Certain rules issued by the High Commissioner under the above regulation have also been made for regulating the use of wireless telegraph apparatus on merchant ships in the Western Pacific.

* * *

**Training Operators in Canada**

THE general shortage of telegraph operators throughout the country has been felt in the wireless telegraph service, and in the annual report of the Canadian Department of the Naval Service. Mr. C. P. Edwards, the superintendent of the Government Radio-telegraphs, states that it was found difficult at times to maintain a 24-hour watch at all the stations; in fact, so acute has this shortage become on the Pacific coast that the Department has been compelled to inaugurate a learners' division for the training of operators. The procedure adopted in this connection is as follows: An inexperienced man is attached to a station without salary until such time as he is capable of passing our "Learners' Examination," which calls for a general elementary knowledge of the apparatus and organisation, and an operating speed of 15 words a minute in the international Morse code. A learner who has successfully passed this examination is then admitted to the "Junior Operator" division at a salary of $45 per month, and is regularly attached to a station to assist in its operation. He remains in this division until he has successfully passed the "Third Operators' Examination," which calls for a thorough knowledge of the adjustment of apparatus, organisation, etc.; and an operating speed of 20 words per minute; he then receives a permanent appointment.

* * *

**United States Regulations**

THE regulation of wireless telegraphy in the United States is being taken up by the Government with unremitting zeal. To give effect to the law which received the approval of Congress in August last, drastic regulations were made by the Department of Commerce and Labour. They have already been summarised in our columns, as have the regulations to control the amateur in the United States. Now the Navy Department has established the office of Superintendent of the Radio Service under the Bureau of Navigation. This official will be charged with matters "pertaining to the operation of radio apparatus ashore and afloat, except the technical operations hereafter assigned to the control of the Bureau of Steam Engineering." His functions are set out as under:

(1) The preparation of regulations and issue of detailed instructions for the operation of stations in accordance with military efficiency, international agreements in force, and the laws affecting the operation of naval radio stations.

(2) Control of the commercial work handled by naval radio stations, including issue of accounting and operating forms, auditing commercial accounts, traffic agreements and accounting with commercial and other Government departments involved.

(3) He shall keep the Bureau of Steam Engineering advised of all matters within his cognisance requiring work of a technical nature.

(4) He shall correspond directly within the naval service in accordance with the procedure laid down by the regulations in the case of bureaus and other offices under the Navy Department in regard to all matters in which he is authorised to take action. He shall correspond directly with private and commercial concerns upon matters of reciprocal interest relating to the commercial operation of naval radio stations in questions of interference, traffic arrangements, proposed changes of rates, and accounting.

(5) He shall submit to the Bureau of Navigation, with his recommendation, a statement of all matters that require departmental action.

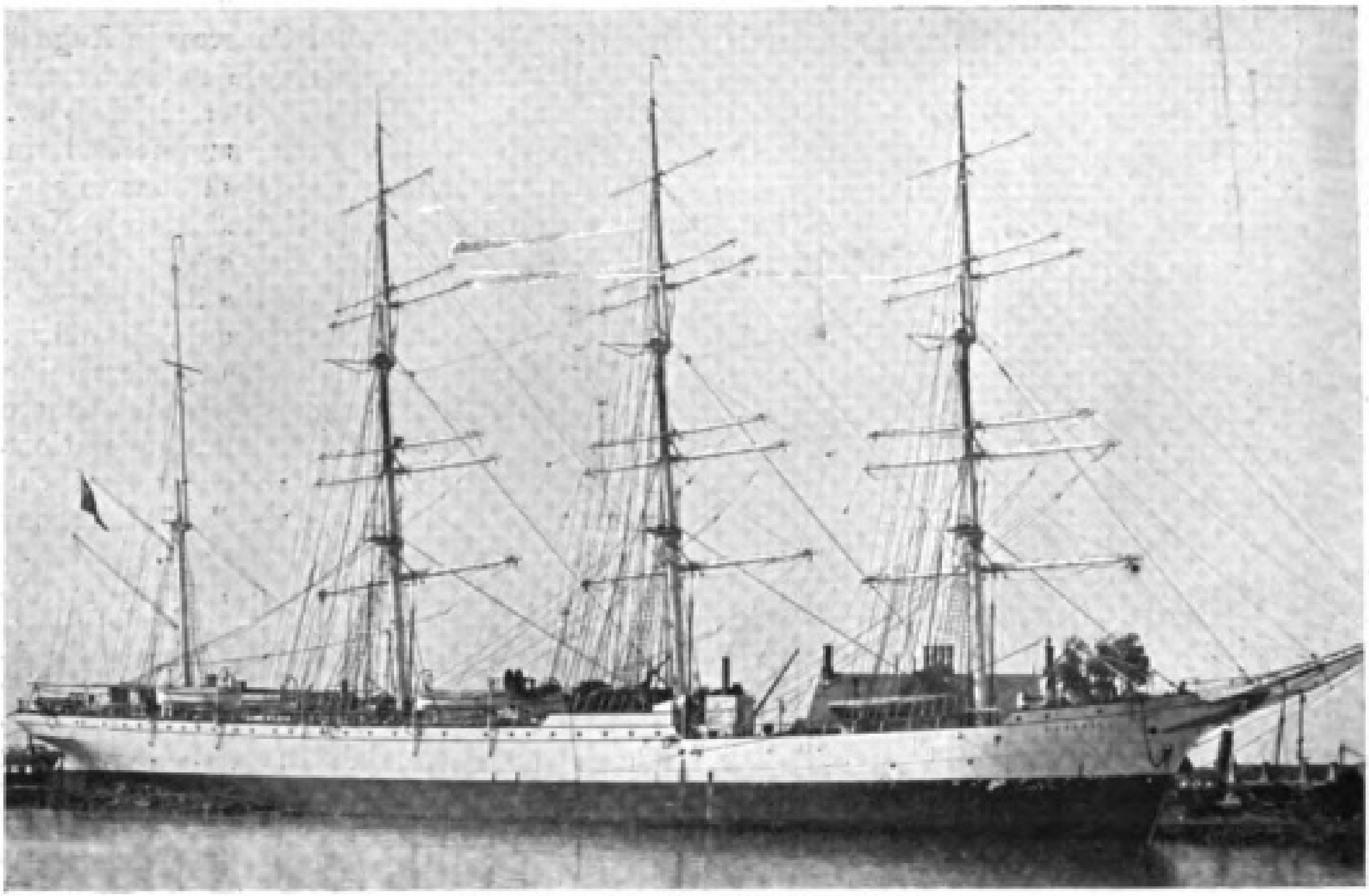
(6) He shall submit such reports in regard to the naval radio establishment as may be called for by the Secretary of the Navy.

(7) His office shall be established at the radio station, Arlington, Va., of which the telegraph, radio and post office address will be Radio, Virginia. All communications for the Superintendent of Radio Service and all departmental radiograms shall be sent to that address. The necessary expense of his office will be borne by the appropriation "Equipment of vessels."

# Maritime Wireless Telegraphy

THE last month has been notable for two mishaps which might have been attended with serious consequences but for the assistance rendered by wireless telegraphy.

Early in the month the s.s. *Haverford* ran ashore at Rocky Bay at the entrance to Cork Harbour. On the previous day she had started from Liverpool for Philadelphia with over 1,200 passengers on board. The news of the disaster was first received by wireless at the Admiralty Offices, Queenstown, and immediately several tenders and tug-boats were dispatched to the assistance of the *Haverford*. The dense fog made it difficult to locate the disabled vessel, but after a time this lifted and the tenders soon took off the passengers. Two Government tugs and three of the Clyde Shipping Company's tugs assisted in the work of rescue, and as soon as it became known that the *Haverford* was in danger the coastguards stationed on shore received instructions to be ready in case of an emergency, but, fortunately, their assistance was not required. Throughout the proceedings the discipline on board the *Haverford* was admirable. The shock of the impact naturally caused some alarm, but the ship's officers did everything possible to allay anxiety, and the information which was circulated to the effect that aid had been summoned by wireless and was coming largely helped to relieve anxiety.



*The Training Ship "L'Avenir."*

The other mishap was a collision between two British liners in a dense fog on Sunday, May 25th, sixty miles off Finisterre. The vessels were the s.s. *Tainui*, homeward bound from New Zealand, and the *Inca*. The *Inca* was seriously damaged and sent out a wireless call for help. The *Garth Castle*, journeying from Africa to Plymouth, happened to be in the vicinity and immediately answered the call. On her arrival, after consulting with the disabled vessel, it was decided that for the sake of safety all the passengers should be transferred to the *Garth Castle*.

In the meantime the steamer *Galicia* arrived on the scene and escorted the *Tainui* to Corunna. Here the *Tainui* was docked, and it was found that her bows had been completely stove in. The *Inca* was able to sail under her own steam to Vigo, where she also was found to be considerably damaged. Her bows were stove in and her fore-peak was full of water, though the collision bulkhead was tight.

* * *

With the arrival of the training ship *L'Avenir* at Havre we have been able to ascertain some few facts and figures relating to the working of the wireless telegraph station on board this sailing ship. That the installation has been of value to the training ship there can be no doubt, and all concerned are highly satisfied with the results obtained and the services rendered.

From time to time during both the outward and homeward voyages information has appeared in the Press concerning the whereabouts of the *L'Avenir*. Such information would have been unobtainable without the mysterious aid of Marconi's invention, and needless to state it has brought much comfort to the anxious parents and relatives of those on board. Time was when the application of "wireless" to sailing vessels was considered a matter of enormous difficulty, but the installation on the Belgian training ship has successfully dispelled any doubts of success in this connection.

Let the figures speak for themselves: News was received from the long-distance Marconi station at Poldhu (Cornwall) up to a distance of 3,700 km., and the time signals from the Eiffel Tower (Paris) up to a distance of 4,260 km. Communication with other stations over distances of four, five, and six hundred miles was of frequent occurrence, while with certain stations much greater distances were covered with ease; for example, with the steamer *Oropesa* 2,022 km., the coast stations at Pernambuco 1,956 km., Olinda 2,220 km., Fernando da Noronha 2,555 km., etc.

It is also very interesting to note that the *L'Avenir* was able to maintain communication with the Australian Government naval coast station at Melbourne throughout seven entire days, *i.e.*, until the vessel was off Flinders Island (Bass Strait)—homeward bound — and that, when the *L'Avenir* was in lat. 55.58 S., long. 75.32.30 W., communication was effected over the Andes with the steamer *Mendoza*, lying at Puerto Gallegos. The wireless station on this interesting vessel is of the Marconi 1½ kw. type.

* * *

To the exceptionally long ranges covered from time to time by the Marconi Standard wireless telegraph ship stations must be added that of the *Kelvinbank*. While 1,500 miles distant from Pernambuco this vessel got into communication and remained in touch with the shore station for two days.

* * *

The Canadian Government ice-breaking steamers *Minto* and *Earl Grey* are making regular trips between Charlottestown, Prince Edward Island, and Pictou, U.S.A. These two boats are in constant communication with Cape Bear, Grindstone and Pictou, the last being the controlling station. Daily Press messages are passed between the isolated Magdalen station and Pictou. Before the Marconi stations were erected at Grindstone the natives used to place the mails in barrels and set them adrift to be picked up by passing seal steamers, as it was too dangerous for small craft to attempt venturing out into the ice fields, with the result that the inhabitants of these lonely lands were entirely cut off from communication. As it is, the ice breakers have as much as they can do to keep open a small passage clear of ice for a steamer service. On one occasion last winter the *Earl Grey* was carried ashore by pressure of the ice floes.

* * *

Bound for Cuba, one hundred and sixteen Spanish emigrants, amongst whom were a number of women and children, were rescued by wireless when the Atlantic & Eastern Steamship Company's steamer *Luganò*, bound from Liverpool to Havana, struck the Ajax reef about 40 miles from Key West. The *Lugano* struck in a heavy sea that rendered the lowering of boats a dangerous operation. When her wireless calls were received by the Key West station the tug *Nome* went out, and after two hours' smart work succeeded in transferring all passengers without loss.

# THE IMPERIAL WIRELESS SCHEME

## REPORT FROM PARLIAMENTARY COMMITTEE

THE report of the Select Committee on Marconi's Wireless Telegraph Company, Ltd., Agreement was issued on Friday, June 13th.

The Committee, which was appointed on October 23rd last, and met for the first time on October 29th, originally consisted of Mr. Amery, Mr. Booth, Lord Robert Cecil, Mr. George Faber, Mr. Falconer, Mr. Gordon Harvey, Mr. Macmaster, Mr. Mooney, Mr. James Parker, Mr. Neil Primrose, Mr. William Redmond, Sir Herbert Roberts, Mr. Harold Smith, Sir Albert Spicer, and Mr. Henry Terrell. Sir Albert Spicer was appointed chairman, and on the resignation of Mr. Harold Smith and Mr. Terrell in April last, Sir Frederick Banbury and Mr. Butcher became members. Mr. Gordon Harvey subsequently resigned and was succeeded by Sir Walter Essex, but Mr. Harvey rejoined the Committee on Mr. Primrose's resignation.

The following are the terms of reference :

> To investigate the circumstances connected with the negotiation and completion of the agreement between Marconi's Wireless Telegraph Company, Ltd., Commendatore Guglielmo Marconi, and the Postmaster-General, with regard to the establishment of a chain of Imperial Wireless stations, and to report thereupon, and whether the agreement is desirable and should be approved.

The report is divided into three parts. Part I. is concerned with the rumours against Ministers, which the Committee begin by declaring " became current before the date of the acceptance of the tender." Part II. reviews the circumstances in which Sir Rufus Isaacs, Mr. Lloyd George and Lord Murray of Elibank became interested in the American Marconi Company ; and Part III. consists of a single brief paragraph as follows :

> On the whole matters relating to the conduct of Ministers which have come before the Committee, the Committee find that all the Ministers concerned have acted throughout in the sincere belief that there was nothing in their action which would in any way conflict with their duty as Ministers of the Crown.

In Part I. the Committee find that " there is no foundation for any of the charges made against these Ministers " (*i.e.*, Sir Rufus Isaacs, Mr. Lloyd George, and Mr. Herbert Samuel) either as regards the negotiation of the contract or dealings in shares of the English company. The publication of the charges in the *Outlook*, the *Eye-Witness*, the *New Witness*, the *National Review*, and the *New Age*, and references to them in the *Spectator*, are next noted, and it is declared that no evidence was submitted to justify them. The Committee also state that they cannot adopt the view that the Postmaster-General unduly pressed for the approval of the Agreement before the rising of the House on August 7th, 1912.

They state that the construction of the Imperial Chain of Wireless Telegraphy was declared by the Imperial Defence Committee to be a matter of extreme urgency ; and this was also the view of the Admiralty and the War Office. Statements to that effect were made to the Committee by representatives of both Departments in public, and their evidence was further explained and emphasised at meetings with them held in private.

Having regard to the urgency of the matter and to the fact that he regarded the Agreement as a satisfactory one, the Committee consider that the Postmaster-General was bound to do everything in his power to secure the approval of the Agreement at the earliest possible date.

This section is brought to a close by a series of conclusions which are summarised in the following paragraph :

> Your Committee further find and report that the charges made against Sir Rufus

Isaacs, Mr. Lloyd George, and Mr. Herbert Samuel are absolutely untrue, and that the persons who are responsible for their publication had no reason to believe them to be true.

There follows this expression of opinion:

> The Committee cannot too strongly condemn the publication in such a way of unfounded charges against the honour and integrity of public men. The combined and persistent action of the journals named has given widespread currency to a slander of a particularly vile character on the Ministers against whom it was immediately directed, and on the whole public life of the nation.

Part II. of the report is devoted to the dealings of Sir Rufus Isaacs, Mr. Lloyd George and Lord Murray in the shares of the American Marconi Company, and the opinions expressed are applied to the original purchase of shares by Sir Rufus Isaacs from his brother, Mr. Harry Isaacs; the purchase of shares from Sir Rufus Isaacs by Mr. Lloyd George and Lord Murray, the subsequent independent purchase of shares by Mr. Lloyd George and Lord Murray, and the separate purchase by Lord Murray. Of these four transactions it is reported:

> The Committee find that in these transactions there is no ground for any charge of corruption or unfaithfulness to public duty, or for any reflection on the honour of any of the Ministers concerned.

The report states that in purchasing the American shares Sir Rufus Isaacs acted "in perfect good faith and with a sincere conviction that his personal interests conflicted in no wise with his public duty," and that Mr. Lloyd George and Lord Murray acted "on the faith of the assurance given to them by Sir Rufus Isaacs that the American company was in no way concerned with the English company." The Attorney-General, the Chancellor of the Exchequer, Mr. Harry Isaacs, Mr. Godfrey Isaacs, and a number of witnesses concerned in the issue of the shares of the American company, in the opinion of the Committee, "gave their evidence fully and frankly." Lord Murray's separate purchase of shares is described as being "on behalf of a political fund at his disposal."

The following are the conclusions arrived at in regard to the transactions in the American shares:

> (1) They find that before any purchase was entered into by the Attorney-General he made special inquiry, and was satisfied that the American company had no interest in the agreement between the Postmaster-General and the English company, and that there was no ground on which a purchase of its shares by a British Minister would be open to objection. He informed the Chancellor of the Exchequer and Lord Murray of the result of his inquiries when offering shares to them.
>
> (2) That the Ministers concerned, when entering into the purchases, were all *bona fide* convinced that the American company had no interest in the agreement, and that there was no ground on which the purchase of shares in the American company would be open to objection.
>
> (3) That the American company is a company formed and registered in New York; that its organisation and operations are confined to the United States of America; that it has no interest, direct or indirect, in the proposed agreement with the British Government, and no interest, direct or indirect, in any profits which might be derived therefrom.
>
> (4) That neither the English company nor its managing director, Mr. Godfrey Isaacs, was a party to any of the transactions in question, or in any way directly or indirectly interested in them.
>
> (5) That in connection with the transaction between the Attorney-General and Mr. Harry Isaacs, neither the Attorney-General nor the Chancellor of the Exchequer, nor Lord Murray, received any favour, advantage, or consideration of any kind, either from the English company or from Mr. Godfrey Isaacs. The shares were acquired by the Attorney-General from his brother, Mr. Harry Isaacs, who had no connection with or interest in the English company. They were bought by the Attorney-General on April 17th, 1912, at £2 per share, which the Attorney-General had ascertained from Mr. Harry Isaacs to be the market price at the time. Other sales at or about that price (some being slightly below and some slightly above) took place on the same day, and although the price of the shares rose rapidly on the

18th and 19th, this was owing to an exceptional rush on the part of the public to buy.

(6) That neither the Attorney-General nor the Chancellor of the Exchequer, nor Lord Murray, nor Mr. Harry Isaacs was a party to or in any way concerned in any arrangement or understanding with any other person or syndicate with regard to the purchase or sale of shares.

The debate on the report of the Committee was begun in the House of Commons on Wednesday, June 18th, and lasted two days. In the end, the following motion was carried by a unanimous House:

"That this House, after hearing the statements of the Attorney-General and the Chancellor of the Exchequer in reference to their purchase of shares in the Marconi Company of America, accepts their expressions of regret that such purchases were made, and that they were not mentioned in the debate of October 11th last; acquits them of acting otherwise than in good faith, and reprobates the charges of corruption brought against Ministers, which have been proved to be wholly false."

## Marconi Station in Norway

THE Committee of the Norwegian Storthing unanimously recommends the Storthing, provided that certain modifications are obtainable, to sanction the contract made by the previous Government, subject to the Storthing's sanction, with the Marconi Company, to erect a large wireless telegraphy station near Stavangar, at a cost of 2,000,000 kroner, in connection with the wireless station erected by the Marconi Company near Boston, says Reuter. The modifications asked for have been agreed to by the Marconi Company.

## Libel Action

AFTER a trial which lasted ten days Mr. Cecil Chesterton, journalist, was convicted at the Central Criminal Court, on June 7th, of publishing a defamatory libel on Mr. Godfrey Isaacs, managing director of Marconi's Wireless Telegraph Company, and was sentenced by Mr. Justice Phillimore to a fine of £100, and also to pay the costs of the prosecution.

The Judge, in passing sentence, said he entirely agreed with the verdict of the jury. It seemed to him that a good deal of the libellous articles were due to what theologians would call "invincible ignorance," and that the defendant, and possibly those behind him, were partly actuated by prejudice and partly blind to business matters. It was well that on an occasion such as that it should be publicly stated, to the terror of evildoers, what the law upon the subject was, and what the maximum of punishment that could be inflicted was, because one of the objects of all criminal proceedings was the prevention or deterring of similar matters in future. Upon each one of the five counts upon which he (Chesterton) had been convicted he might have been sent to prison for a year, and he might, in addition, be fined, as well as having to pay the costs of the prosecution. That was the maximum, and it was not the punishment he (the Judge) proposed to award. Continuing, his Lordship said, when he remembered the cruelty of some of the charges, when he remembered the sending of placards along the front of Mr. Isaacs' place of business in the Strand, it was extremely difficult to refrain from sending defendant to prison. But upon the whole he hoped that what he had said, and the opinion of the defendant's countrymen, as expressed by the jury, would be sufficient with the punishment he inflicted.

## Contract News

The Italian Government have ordered three more 3-kw. sets for battleships.

* * *

The Marconi Wireless Telegraph Company have received orders from the Johnston Line to fit four of their steamers, including the *Templemore*, the *Vendamore*, and the *Quernmore*, with 1½-kw. sets.

* * *

The Isle of Man Steam Packet Company have also given orders for fitting four of their vessels with 1½-kw. sets. They are the *Ben-my-Chree*, the *Viking*, the *Empress Queen*, and the *King Orry*.

The Lantern Tower and Time Ball which has been erected on the New Seamen's Institute in New York City was dedicated on April 15th as a memorial to those who lost their lives when the *Titanic* sank on her maiden voyage.

# Instruction in Wireless Telegraphy

## IV. ELECTRIC WAVES AND OSCILLATING CIRCUITS

IN the last article we showed how, in order to convey signals from one point to another by means of wireless telegraphy, it was necessary to have an apparatus for producing electric waves at one end, and an apparatus for detecting the presence of such waves at the other end.

24. **Electric Waves.**—These electric waves are produced in the æther by the inter-action of electro-magnetic lines of force and electrostatic lines of force. **Electro-magnetic lines of force** were referred to in paragraph 4, and they are produced around a wire when that wire carries an electric current. **The electro-static lines of force** are produced by any body which is charged with electricity.

Consider a vertical length of wire insulated from the earth, and suppose we have means of charging and discharging it in rapid succession, first charging it positively and then negatively; whilst being charged a current of electricity will flow in the wire, and during this time electro-magnetic lines of force will be produced. The current is strong at first, then diminishes until it becomes zero at the moment the wire is fully charged; the strength of the electro-magnetic lines of force will vary in proportion. The electrostatic lines of force are zero at the beginning of the charge, increase as the charge augments, and reach a maximum at the moment of full charge—that is, when the electromagnetic lines of force are zero. On discharge the reverse action takes place. The effect of each charge and discharge produces a pulse in the æther, and if we have a succession of positive charge—discharge—negative charge—discharge, the four pulses—having regard to their direction—form a complete electric wave which starts travelling into space with the velocity of light—namely, 300,000,000 metres per second. The wire which is thus charged and discharged is known in wireless telegraphy as the aerial, and is given various shapes, as we shall see later.

A more complete explanation of this phenomenon is beyond the scope of these notes, but some further insight into the matter will be gained by considering pressure-waves in air. In Fig. 1 a long india-rubber

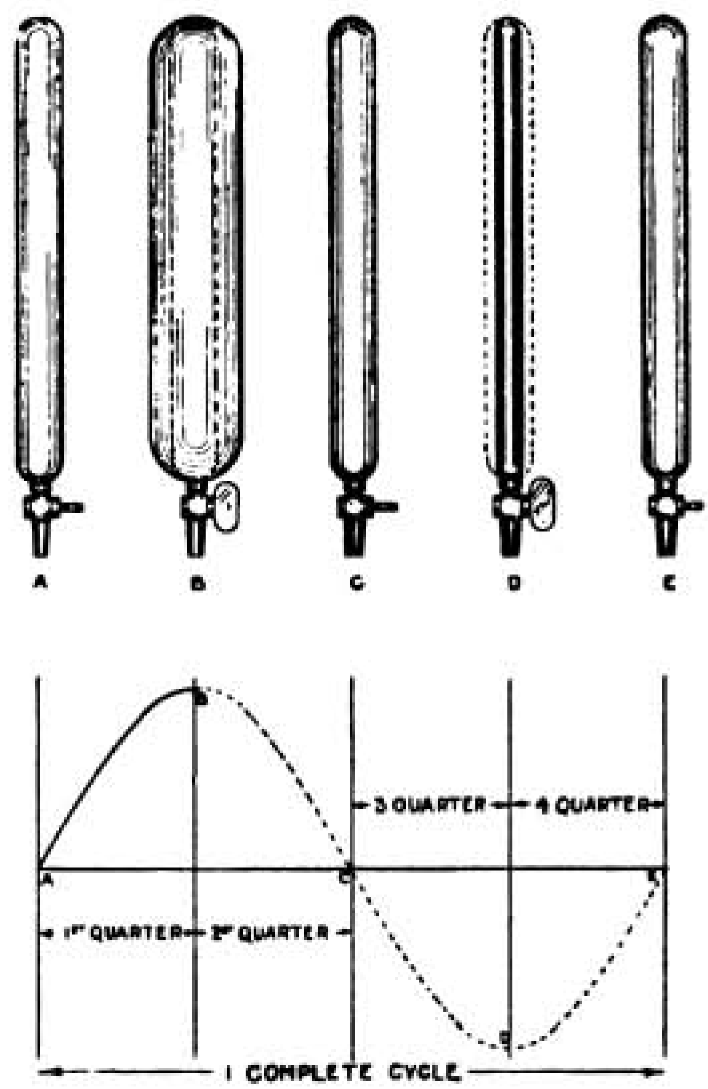



*Fig. 1.*

tube is indicated; it is blown out with air, and by means of a pipe connected to an air-compressor the pressure of the air can be varied. At the point A the air pressure in the tube is normal, and this corresponds to the discharged condition or earth potential of the wire. The pressure is now increased, and the tube increases in diameter, thus impressing a pressure pulse on the atmosphere. The maximum pressure is reached at the point B, and the increase of pressure can be indicated by the dotted curve from A to B on the lower part of the figure. Discharge is illustrated by the curve from B to C, at which point the air pressure in the tube returns to the normal; another pulse is thus produced on the atmosphere. Then the air pressure is still further reduced from C to D, illustrating charge in the opposite direction—*i.e.*, negative charge, and finally from D to E the tube returns to the normal conductor, illustrating the electrical discharge of the wire. Thus altogether four pulses have been impressed on the atmosphere, constituting together a complete wave. This wave travels outwards into the atmosphere—or is radiated—at the velocity of sound—namely, 1,040 feet per second. It is clear from the above that in order **to produce electric waves we must first produce an oscillating current in a circuit.**

25. **Wave-Lengths.**—As will be seen by the following, the wave-length depends on the frequency of these oscillations.

In Fig. 2 the interval between the lines A and B represents the distance that a wave will travel in one second; that is to say, 300,000,000 metres. If during one second ten complete oscillations have occurred, and each oscillation produces one complete wave, the interval AB will be occupied by 10 waves. Hence the length of each wave will be one-tenth of the distance represented by AB; this is to say, the wave-length will be 30,000,000 metres. If the interval A B were occupied with one million waves, then the frequency would be one million per second, and the wave-length 300 metres.

We see, therefore, that we can vary the wave-length by varying the frequency of the oscillations in the circuit, and that **the greater the frequency of the oscillations the shorter the wave-length.**

The wave-lengths at present usually employed for the purpose of wireless telegraphy vary in length from 100 metres to 8,000 metres. Generally speaking, the larger the power of the station the longer the wave-length employed.

The wireless apparatus on ships and at the shore stations with which the ships communicate is designed to transmit wave-lengths of 300 metres and of 600 metres. Long-distance stations use wave-lengths varying from 1,000 to 8,000 metres.

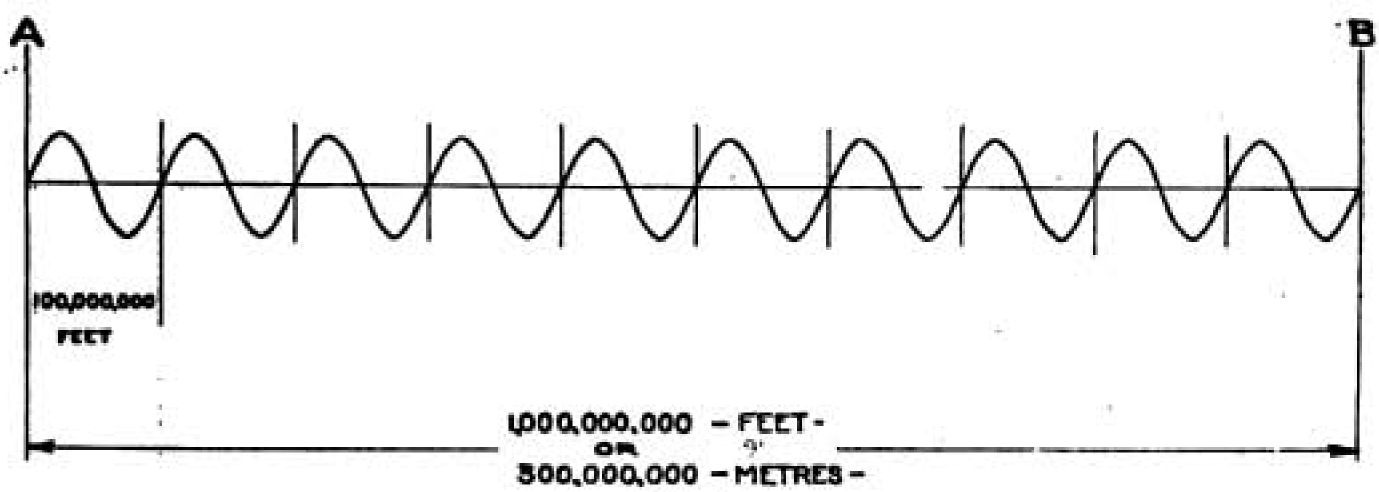



*Fig. 2.*

The apparatus to be dealt with in these articles is limited to wave-lengths between 100 and 600 metres, and by the application of the principle involved in Fig. 2 we find that the frequency of the oscillations must lie between 3,000,000 and 500,000 per second, and the generator of these oscillations must be designed accordingly.

26. **Production of High-Frequency Oscillations.**—There are several ways of producing high-frequency oscillations. In these articles we will confine ourselves to the method known as the **"spark" method.**

If a condenser is charged and then suddenly discharged by connecting its two opposite plates through a "spark-gap," not only does the current flow from the positively charged plate to the negatively

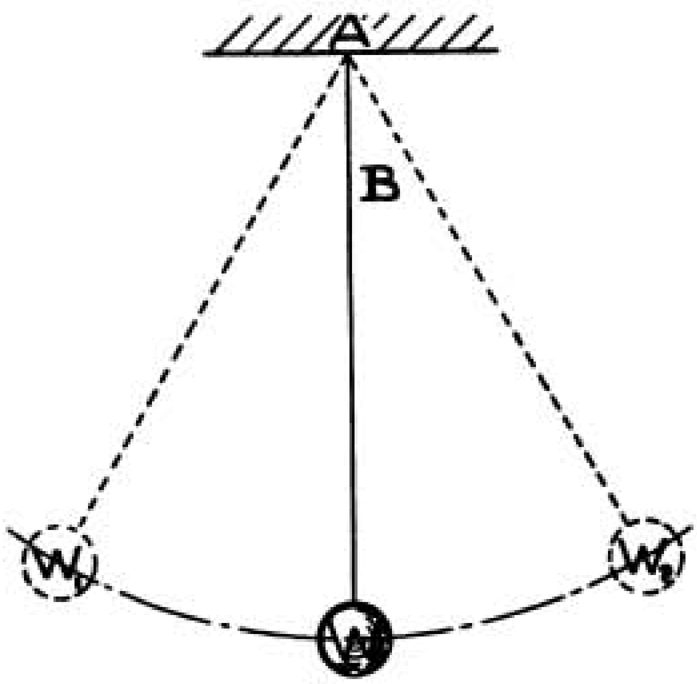



*Fig. 3.*

charged plate until the plates are at the same potential, but the current, so to speak, overruns itself, causing that side of the condenser which before was negatively charged to become positively charged, and *vice versa*, not, however, to the same extent, because a certain amount of the energy is frittered away by resistance. The action is then reversed and again reversed and so on, each time with less energy, until the whole of the energy originally in the condenser is absorbed. An oscillating current is therefore produced of gradually diminishing strength.

The action can be illustrated by making the experiment with the pendulum illustrated in Fig. 3, where the weight, W, is shown suspended from a fixed point, A, by a piece of string, B.

If this weight be displaced to the position shown by the dotted lines to the mark $W_1$ and then released, it will not immediately take up the position W, but will swing backwards and forwards between the positions $W_1$ and $W_2$, and it only comes to rest at the position W after some considerable time.

In this case the number of swings which take place in a second—that is, the frequency—can only be varied by varying the length of the string. A similar experiment can be made with a vibrator, shown in Fig. 4, in which there is a flat steel spring, B, fixed firmly at the point A, and carrying a weight, W, at its other or free end.

If the weight be displaced and released it will swing or "oscillate" between the positions $W_1$ and $W_2$.

In this case the number of swings per second will depend upon the length of the spring, B, and also upon the weight, W, and we can therefore vary the frequency either by varying the length of the spring or the weight, or by varying both. It will be found that the longer the spring the less the number of swings per second, and also the greater the weight the less number of swings per second. The distance between the position $W_1$ and the position $W_2$ is called the maximum amplitude of the swing, and generally the distance between successive positions, such as $W_3$, $W_4$ in Fig. 4, is called the amplitude.

Owing to friction of the air the amplitude will start at a maximum and gradually diminish until the spring comes to rest in its normal position, and the rate at which the swing decreases is called the **Decrement.** The frequency will, however, remain constant quite independently of the amplitude; that is to say, in Fig. 4, the time taken for the weight to travel from the position $W_1$ to $W_2$ and back again will be exactly the same as the time it takes to travel from the position $W_3$ and $W_4$ and back again.

To summarise, two matters have to be considered in connection with such a vibrator, viz.:

1. The frequency—depending upon the elasticity of the spring, which can be varied by altering its length or its thickness, and upon the weight.

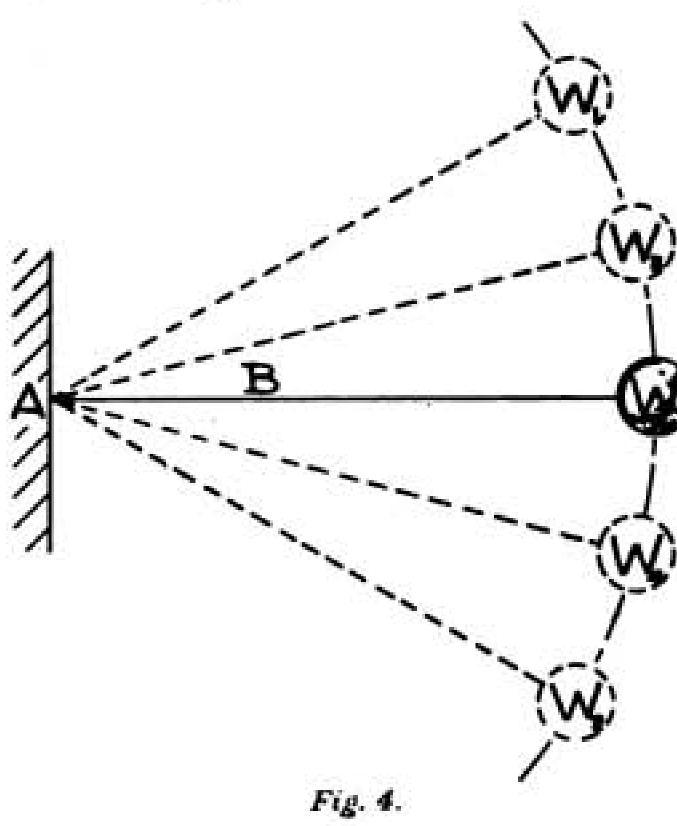



*Fig. 4.*

2. The decrement—depending only upon the resistance to motion.

27. **Oscillating Circuits.** — In the first article we stated that an electrical circuit had three properties — viz., inductance, capacity, and resistance; and if we compare the oscillating circuit, described in paragraph 26, with the vibrator, we may say that the inductance corresponds to the spring, the capacity to the weight, and the resistance to the resistance to motion.

If we make a simple electrical circuit, as shown in Fig. 5, consisting of a condenser, A, connected to an inductance, B, and a resistance, C, such a circuit can be made to vibrate or "oscillate" electrically. Moreover, it will oscillate with a definite frequency, which will depend upon the value of the condenser, A, and of the inductance, B. Also the oscillations will gradually die out, and the rate at which they do so depends upon the value of the resistance, C.

It will be found that as we increase either the value of the capacity or of the inductance of the circuit so do we decrease the frequency of the circuit, but not proportionately. It can be shown by a mathematical proof (if the resistance is small enough) that the frequency is

$$\frac{1}{6{\cdot}28\sqrt{\text{inductance} \times \text{capacity}}}.$$

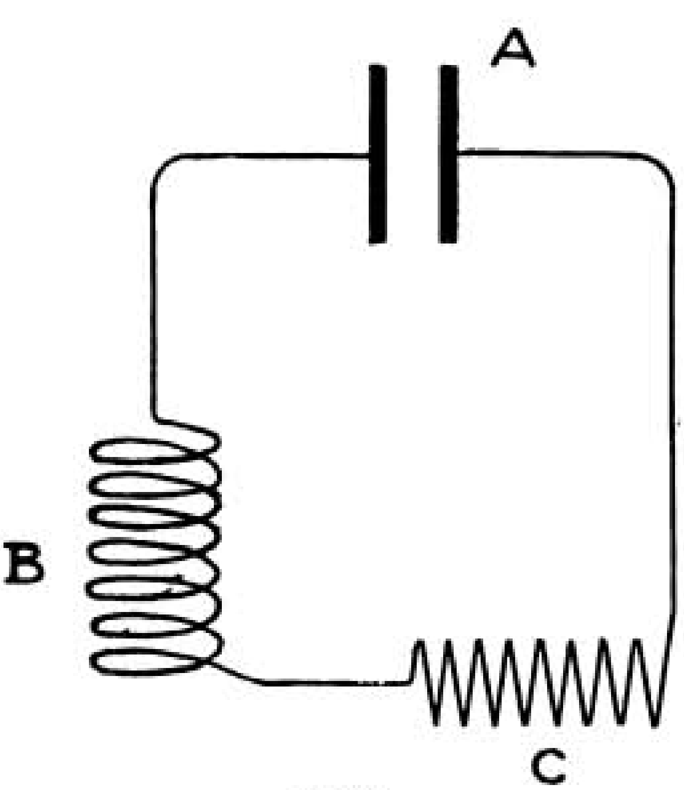



*Fig. 5.*

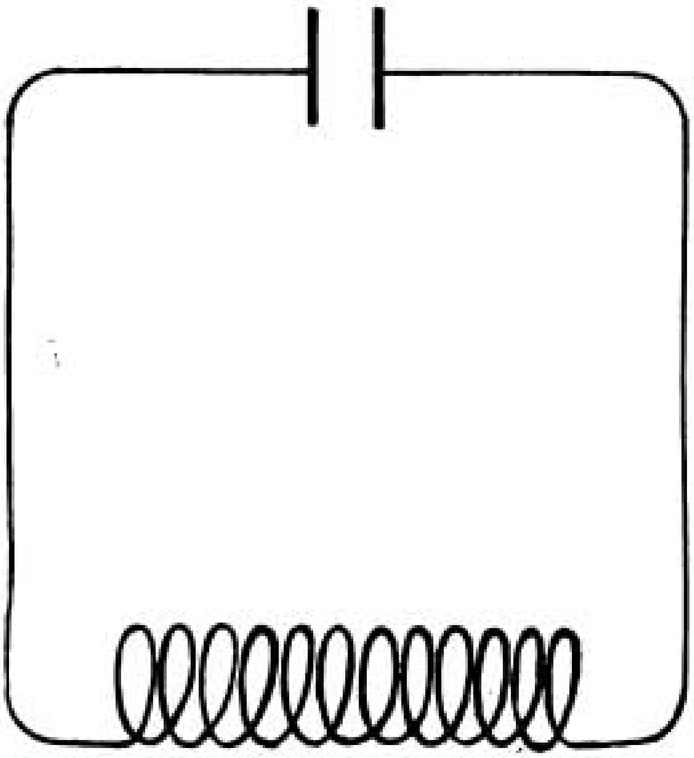


*Fig. 6.*

If, however, the resistance is greater than a certain amount there will be no oscillations. In the circuits we are considering the resistance is small, and then the resistance has no effect on the frequency, but only on the decrement.

Resistance is an undesirable property, as it absorbs power. In every oscillating circuit, therefore, the resistance should be reduced to a minimum quantity, which is effected by increasing the size of the conductor and reducing its length as much as possible; there must be, however, always a certain amount of resistance.

A simple oscillating circuit is therefore usually shown diagrammatically as having only inductance and capacity, as shown in Fig. 6, it being understood that the resistance is kept as small as possible.

Fig. 5 represents an aerial wire connected to a spark-gap, which in turn is connected to earth; the aerial acts as one side of the condenser, and the earth acts as the other; the wires forming the aerial also supply the inductance. We thus have the combination we require to produce an oscillating circuit, in conjunction with an aerial which will convert the successive charges and discharges into electric waves, as we have already explained.

Such a circuit is called an **open oscillating circuit,** and it has also the property that

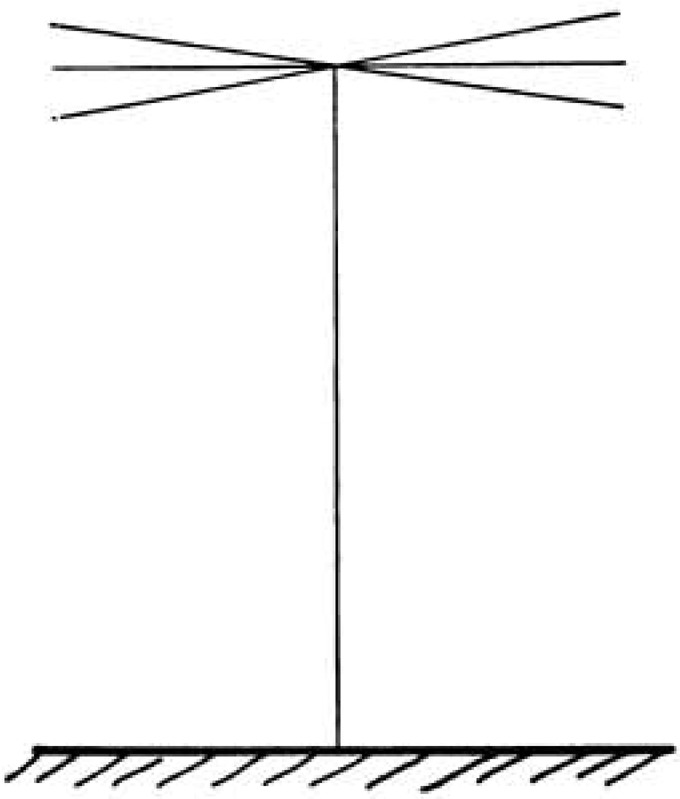


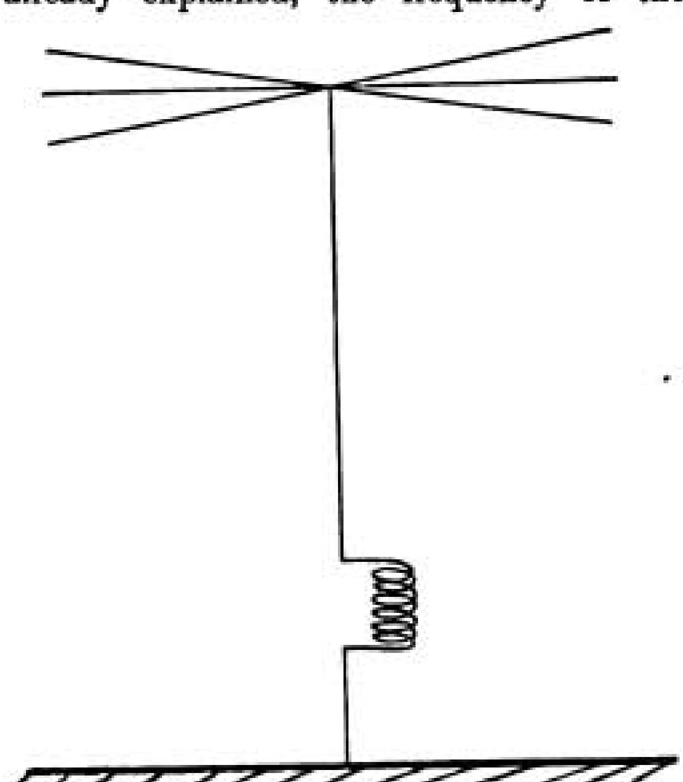
*Fig. 7.*

electric waves passing across it will induce oscillatory currents in it, and thus it can be used for receiving wireless messages.

**Closed oscillating circuits** can also be formed, such as those shown in Figs. 6 and 7, and they have this important property that they do not radiate electric waves to any appreciable extent.

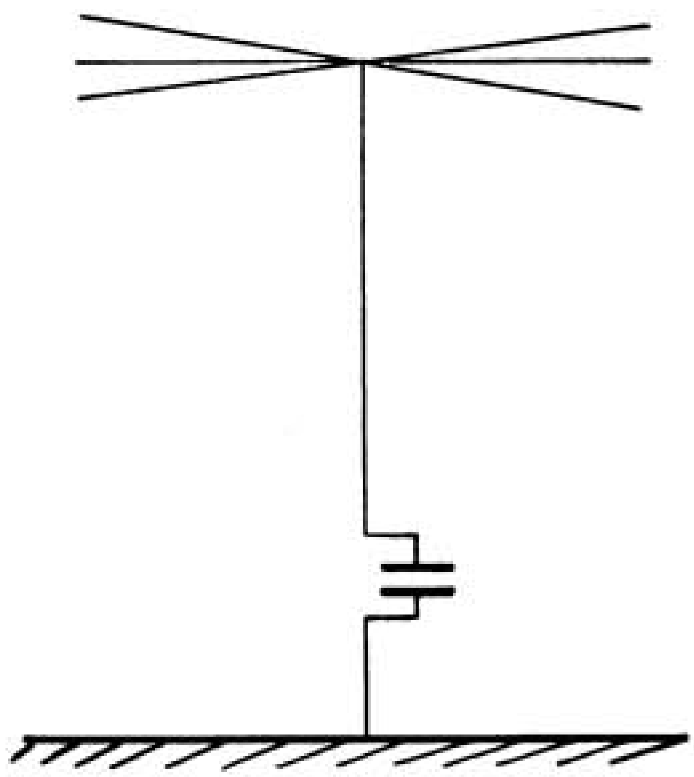
28. **Variation of Wave-Length.** — As already explained, the frequency of the aerial oscillating circuits must be adjusted so that the wave-length of the emitted electric waves is that desired, and this can be done by altering either the capacity or the inductance, or both.

The capacity of an aerial can be increased by increasing the number of the wires forming it, and the inductance of the aerial can be increased by lengthening the wires. Thus the larger the aerial the less the frequency, and therefore the longer the length of the electric waves.



TO INCREASE λ

*Fig. 8*



TO DECREASE λ

*Fig. 9*

It would be a tedious and, in fact, impracticable operation to alter the aerial every time it was required to alter the wave-length, and therefore another method is adopted, based on the addition to the aerial circuit of an inductance or of a condenser.

If we connect an inductance in series with another inductance the total inductance is increased. Therefore, if we insert an inductance, λ, as shown in Fig. 8, in series with the aerial, **we have increased the total inductance of the circuit, and thereby increased the wave-length**, and this method is adopted when it is desired to increase the wave-length to a value greater than the natural wave-length of the aerial.

This added inductance tends to make the open oscillating circuit of the aerial into a closed oscillating circuit; the more inductance we add the nearer do we approach a closed oscillating circuit. As already stated, a closed oscillating circuit does not radiate to any appreciable extent; we therefore reduce the radiating properties of the aerial by adding inductance. There is, therefore, a limit to the amount of inductance that can be so inserted into the aerial circuit.

In practice it is found that the natural wave-length of an aerial can be about doubled without seriously interfering with the radiation; thus we have a simple means of controlling the wave-length.

**The frequency of the oscillating circuit can be increased by reducing the capacity,** as already pointed out, and we thus have a means of reducing the wave-length. If we place a condenser in series with another condenser, the total capacity instead of being increased, as might at first be imagined, is reduced. Therefore, if we insert a condenser, as shown in Fig. 9, in series with the aerial, the total capacity is reduced and the wave-length is also reduced.

The amount by which we decrease the capacity depends upon the capacity of the condenser which is inserted in series, and it it important to remember that the greater the capacity which is inserted in series with another capacity, the less is the reduction of the original capacity; that is to say, by inserting a small capacity in series with the aerial we reduce the wave-length of that aerial far more than by inserting a large capacity in series with it, because the combined capacity is always less than the smaller of the two.

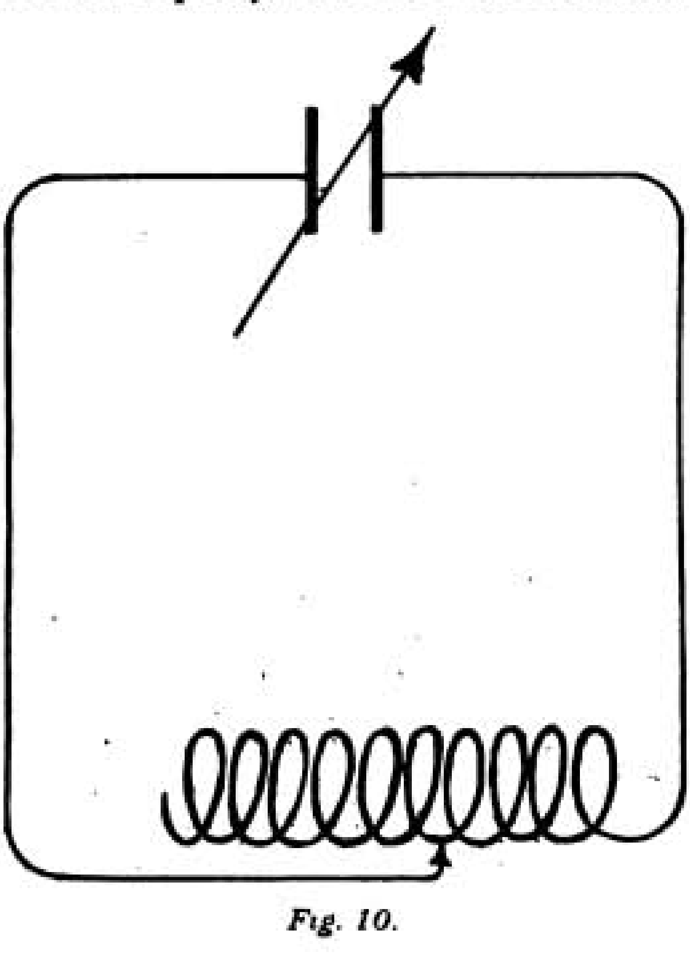


*Fig. 10.*

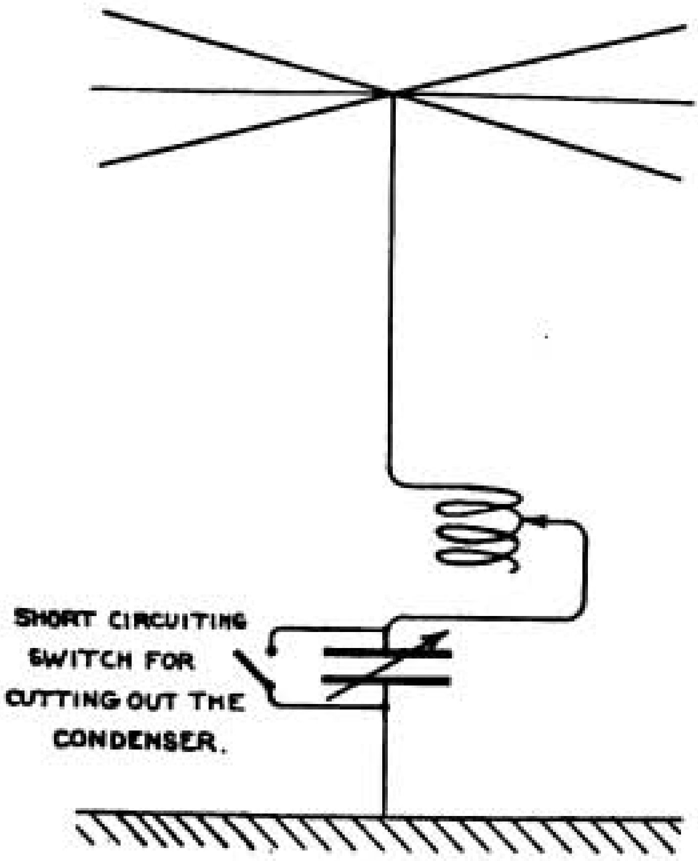



*Fig. 11.*

Similarly, as in the case of inductance, the insertion of a capacity in series with the aerial reduces the radiation of the aerial, and as a practical matter it is found that the natural wave-length of the aerial can be halved by this means. It will be seen, therefore, that the length of the electric waves emitted by the aerial can be varied from one-half to double the natural wave-length of the aerial by adding a condenser or an inductance to the circuit.

Fig. 10 shows an aerial with an adjustable condenser and an adjustable inductance connected to it. The frequency can be changed, and such an aerial is capable of emitting waves of different lengths within the practical limits mentioned above.

Fig. 11 shows a closed oscillating circuit in which both the condenser and the inductance can be varied, and is therefore an oscillating circuit with an adjustable frequency. The use of such a circuit in conjunction with an aerial oscillating circuit will be described in the next article.

# A Pawn in the Game

*(Serial Story)*

By BERNARD C. WHITE

CHARACTERS IN THE STORY.

CHARLES SUMMERS.—*Inventor and engineer. Son of the Vicar of Sotheby, and affianced to Gwen Thrale, daughter of the squire.*

GWEN THRALE.—*Charles Summers' fiancée, a bright intelligent and original girl, the idolised daughter of the squire, and secretly a member of a Fabian Society.*

M. DUPONT AND HERR BEULNER.—*Foreigners, making a prolonged visit to England. Ostensibly belonging to the leisured and wealthy class with no particular aim in life.*

DOSS AND SUK.—*Pedlars, for ever on the prowl, and the universally recognised purveyors of village gossip.*

*Charles Summers, the only son of the Vicar of Sotheby, is an engineer and inventor. His peculiarities arouse comment among the villagers, and his workshop is the subject of so much curious speculation that Doss and Suk, two itinerant pedlars, make it their business to discover its secrets. They are, however, strictly warned off the premises. The only person "in the know" is Gwen Thrale, Summers' fiancée, a high-spirited girl, who often looks in to "help" him in his work. Gwen is no unsophisticated Miss; she has been a probationer at the Slade School, and is secretly a member of the Fabian Society, and in this connection has become acquainted with two foreigners, M. Dupont and Herr Beulner, who are discovered to be visiting the neighbourhood. These two men are apparently members of the leisured class and can afford to tour about the country in a grey motor. On one occasion the motor comes to grief just as they are passing Miss Thrale and her fiancée, who immediately go to their assistance. In this way they get an introduction to the inventor, and then by means of the Fabian Society they achieve closer acquaintance, and finally obtain Charles' invitation, through his fiancée, to visit him in his workshop. In the meantime they have chanced upon Doss and Suk, and through them have discovered a good deal about the inner workings of Summers' wireless airship. But for some reason or other they are determined to know even more, and lay their plans accordingly.*

CHAPTER IV. (*continued*).

A FEW moments passed, and then Charles hurried in and leaned over her shoulder.

"Now turn round that switch till it comes over to that knob. Now you are in tune. Now press that brass dot—don't forget to watch how the thing's going from the telescope.

"There, hasn't her prow dropped? Yes, but she's going straight, and she'll be into the stable in a minute if you don't look out. Look, there's that button to touch—quick! Oh, that's better, she just rising above the roof. I made sure the poor little toy was gone for good then."

"But, Charles, she's going in a straight line. She'll be out of sight in a minute. Can't you make it go into a circle?"

"Yes; touch those three ebony keys marked 1, 2, 3; they'll bring her round. Don't touch them too sharply. It makes her jerk, and that doesn't do the machinery any good."

"Now what am I to do to make her do a figure of eight?"

"Why, press that lever, and then touch those three keys again. There, now, isn't that all right? I can't see; you must see how she's going."

"Yes; she's all right, but she's heeling so. What is to steady her?"

"Well, make the circles wider. See—play on the other notes on the higher keyboard, and now push in that little nickel point that regulates the engines. Now, do you want to send an electric flash?"

"Yes; so long as it doesn't hurt the machine."

"Well, when I say Go, release that lever, and then jerk it back. There you are, that's all right. How did it go?"

"Why, it sent out a terrific flame. But, I say, I don't think it would be very long before I could pick this up. You'll let me have a practice or two, won't you, Charles, dear? It would be so lovely if I could do it all by myself. Do show me how to, and give me a lesson or two. Can't I come next Saturday? I'll be very quiet and won't disturb you a little bit. Really I'll learn quite quickly."

With her head looking up at him, and those grey eyes adding emphasis to her petition, what could Charles do but say "Yes."

. . . . .

But the trial trip of the miniature Summers' airship had been witnessed by other interested spectators besides the little group on the Vicarage lawn. Doss and Suk were trudging through the heather on their way across the downs to Chittingham when they first sighted the phenomenon. Breathlessly they watched its evolutions as it rode like an unquiet spirit over the dark masses of the pine trees. Then they caught sight of the fire balloon rising from the depths of the valley and slowly sailing towards them, while the unearthly hunter gave chase. Presently came the flash which made their old eyes nearly start out of their heads, as the fact was literally burned into their dull intelligence that they had witnessed something beyond the ordinary, something wonderful, something terrible. In a fuddled way they realised that some unknown force had been let loose that evening, some enemy was stalking through the night air, but what the exact interpretation of the phenomenon might be it was beyond them to discover. None the less their old bones were shaken by the apparition, and Suk's long-drawn exclamation, half groan, half sigh, expressed the feelings of them both.

But it was Saturday night, a time when there was always good trade to be done in the highways of Chittingham, for then the week's work was over and the lads would be out walking with sweethearts and the wage-money would still be heavy in their pockets. Such propitious seasons are not to be neglected, even by pedlars, so with a "Thee be losing time, Suk," Doss reluctantly turned on his heel and made his way down the hill. Then Suk made haste to shuffle after him, but even more reluctantly, for every now and then he loitered to see if anything more was to be seen. But the airship was the only thing now visible, and as it continued its solitary flight it might have been some exultant aerial conqueror that had slain his rivals, and now, in splendid isolation, was revisiting the scene of his conquests in all the insolence of his triumph.

But as the darkness drew on and the way became steeper the two old people were obliged to give all their attention to choosing their path, and presently the pine trees entirely shut out the sky. After a time they emerged on the high road, but had only gone a short distance along its dusky margin when a large grey car slid silently by, the two great goggle lamps flooding the whitened hedges with light. In the glow Doss and Suk were silhouetted sharply against the hedge, their eyes blinking as they supported each other, for they were made giddy by the brilliant rays. Scarcely had the motor passed when it stopped, as though waiting for them to catch it up. They shuffled along, prepared to whine a pitiful tale on the offchance of a few coppers, but their intentions were cut short. The car was indeed waiting for them, and one of the occupants was half leaning over the side. He was the younger of the two, and as they came up he held out a silver coin, which Doss took with unbecoming alacrity. Then he spoke.

"Can you tell us where we are? Surely we ought to be quite close to Sotheby?"

"Thee be roight, sur. It be scarce ten minits' walk even for the laikes of a poor old body like me, and with that great car ye'll reach it slithy as blue lightning."

"Good; but we shall have to put up for the night. Where's the best inn?"

"The Granby Hotel does for the gran' gentry, though it's 'Chittingham Arms' as takes in the most of us honest country folk, who be too pur fer feather beds."

"Well, then, we'll try and find the Granby. It's down this way, I suppose?"

Suk nodded.

"But there's one thing more we want to know. Whose is that airship which was just now making big circles in the sky above the pine trees over there?"

"I dunno; but it's laikely be some of

Maister Summers' capers. He be the Vicar's son, and they say as how he's a cracked 'un, but I don't believe no cracked 'un could set that turble thing sailing through the air like some great Devil's Bird, and when the lightning flashes thro' the creetur's eyes it be that unearthy it do make me old bones creep. Us folk don't want no more parson's sons, or cracked 'uns, if they be all laike Maister Summers."

"What does this Master Summers do? Where does he live?"

"Oh, he lives at the Vicarage with's feyther, but 'e ha' a quare little shanty all on's own in the garden where he do sit time an' times rubbing 'is 'ands through his long 'air—an' 'e's as shock as me ole beesom—or else 'e's messing about with tools as ye never seen the like of."

The airship had not yet finished its trial trip, for Gwen was "practising," and, at this moment, she switched on the final flash from the heat antennæ. The result was a brilliant lighting up of the sky, which the increasing darkness intensified, and the effect was not lost on the talkers in the lane.

"But there's another white flash. I wonder what's happened now!"

"Some more Devil's tricks, you be bound. A turble sight too much 'appens when those white lightings coom. The ugly craitur chases any manner o' thing that flies near it. It's scarce twenty minits agone since it caught a balloon and burned it to nothing before you could draw a breath out o' your body. It's noo doot it caught another just then, for it's only when it's near to catching 'em that a glar light appears."

"So that's what the machine does, then. It chases anything that comes near it. But how can that be done, I should like to know?"

"Ah, well, how's honest folk to find it out? Lord's mercy! we do na want all the parish a doin' o' Satan's work an' sending up sooch like flying things to destroy harmless folks' peace o' mind. One's enough—And I heer's as how he tinkers about with lots on other queer tack. I've heerd, too, as how he knows all about that wireless which them larned folk an' the noospapers talk about, though I've never struck on any that knows aught to tell a body. I'd be swoorne there beant nothing in it, and them sciencelarnd men talk aboot it to make themsel's look fine, or else it's a rale gran' secret that they dursn't tell on."

"Then Mr. Summers has got a long flagstaff set up in the garden?"

"Na, there beant no flagstaff, but thar be a long pole sticking up from the roof of the shed with wires stretched across to another pole, as though 'e be thinking of making telegraph lines, but 'e ain't got no forrader. There they be slack as when 'e first put them up. It must be nigh some year ago. But 'e's got something wonnerfu strange yere in that room of 'is, and 'e makes wonnerfu strange noises when 'e taps on 'is table. I'm sure, 'e beant so cracked as they ses 'e be. I'd lay my old pipe 'e's a limb of Ole Nic'."

Other questions asked by the inquisitive stranger failed to elicit further information, so putting his hand in his pocket—a movement Suk watched curiously from the corner of her eye—he ended the interview by saying: "Well, all you've told us about Mr. Summers has been very interesting; but I think these experiments are dangerous to the public, and the authorities should be told. But though you have told us a great deal—and here's something for your pains—it wouldn't be quite sufficient to make a case of, so if you keep quiet and can find out anything more about these experiments we'll pay you well for your help."

"Na, na; ye'll be bringing on us to the coorts, I can see.'

"No, my good woman, we should do nothing of the kind. There'd be no need to say how we got our information, so you needn't worry about that. I don't know your name now, and I need never know your name, so your part in the affair would never be known. But some more news might be useful, so if you can get us any we'll pay you well for it. Five shillings each time you can tell us something fresh."

"But where shall we find ye, sir?"

"Oh, there'll be no difficulty about that. You'll often see us driving about in these parts; we shall be down nearly every weekend to Chittingham, and we'll make a point of coming round this way sometimes, so if you keep a look-out you will be able to come across us easily enough."

"Veery good, sur; an' thank ye; an' if old Suk can't get noos, whey then nobody in Chittingham can get it for ye. I'll find ye out when I larn anything more sartin' about Master Summers. Thank you kindly, sur. Gu'ni."

With that the two old vagrants started towards the village, while the grey car and its occupants continued its way, and was soon swallowed up in a cloud of dust. For a long time Suk continued to rub the two half-crowns which had been given her between the horny palms of her hands. Such a sum to her was a small fortune.

"Them folk be real anxious fur noos," she remarked as she tossed them on the ground to see if they rang true. "An' demme if old Suk cannot geet 'em sum moore," she added as an afterthought as she picked them up and put them in her wallet. She still owed the Vicarage people, and Charles Summers in particular, a grudge for her rough treatment on the occasion of her last visit. With that disproportionate view, which so often comes of solitary reflection, she had magnified a little roughness into a great insult, and the conversation with the occupants of the grey motor-car had added fuel to the flame. It made the old indignation smart intolerably now that she felt she had the opportunity to pay off those old scores. It would not be her fault anyhow if a few more half-crowns did not come her way.

## CHAPTER V.

### LIMING THE TWIG.

The lecture room in Kensington was ready for the evening's entertainment. The rows of chairs, like a gaunt and imposing array of ribs, were not yet clothed with humanity, and the speaker's platform looked dreary and discomfited with only a red baize tablecloth and the glass and water-bottle to adorn its vacancy. But while there was yet a good half-hour before the lecture opened, enthusiasts began to arrive, mostly young women in skimpy gowns, with lean collarless necks stretched out in æsthetic and revolutionary vehemence. After a time there entered a typical Bohemian in slouch hat and his Inverness cape escorting two companions, the one short and dark of the towselled hair, the other clean, neat, spruce, well liking. The Bohemian motioned his friends to make their way along the gang-way while he talked to an attendant, and as they sauntered along, choosing what seemed to them a likely position, they were easily recognisable as the occupants of the grey motor. Evidently they were expecting great things, for Dupont was nervous, and showed it by tugging his moustache, while the pink and white complexion of Beulner was more flushed than ordinarily. With extreme care they settled themselves in their seats, and then started a conversation. This must have been of some interest, for they leaned closer and closer towards one another till at last their heads almost touched. Dupont was certainly engrossed in his topic, for his hands began to demonstrate his theme. They closed together, they were parted, occasionally his right hand would rest on Beulner's shoulder. Then the plump, short fingers would open and close, sometimes they would seem to be struggling with a difficulty, then they would be smoothed out, as if it had been overcome. Occasionally both hands would be clenched, or he would grip them together as he bent forward. All this time his excitement grew till at last he gave a chuckle and exclaimed loudly, "*Et nous attrapons l'oiseau!*" while he rubbed his palms together as if in foretaste of a triumph. Beulner seemed hard to convince, but after a time he apparently gained fresh insight into the older man's argument, for he, too, became excited. But his friend's exclamation, however, caused him to realise his surroundings, for as he glanced round to see the Bohemian standing beside him, a shadow of annoyance or confusion passed over his face. It was so momentary, however, that neither of his companions observed it, and the small talk, interpolated by the intruder, enabled him to forget his self-consciousness.

"Well, my friends, and so you catch your hare, then cook him. That's very nice, but I should like to know what it was all about; for though I am a Fabian, I don't believe in social anarchy, and you look as though you intend to overthrow thrones and potentates."

Dupont immediately set himself to dispel such an illusion.

"Oh there, you artists, your susceptibilities are so *fines*; and, indeed, all you English imagine such horrible things. Why only yesterday a funny old josser, you call him, at Hampton Court, was telling me all about the spooks there. He was ver-ry much in earnest, for his eyes *faisaient des grands Oes*, and though he tried to laugh when he told me the tale, I saw the terror, for the ghost of poor Katrine was upon him like an evil eye. So then you. You think me anarchist; me the most respectable man of society, me who have more to lose by Socialism than the most poor have to gain. *Oh comme vous etes drôles!* Come and sit down and I will tell you all about a little idea we have, the most charming in the world. You say we shall meet Miss Thrale. Well, we owe her a little acknowledgment for much kindness. Only the other day herself and her fiancé did help us when we were in much trouble. Do you know I told you all about how our motor-car tumbled into a ditch, and she and, I forget his name, helped us. Therefore, why not let us give a leetle dinner in her honour after the lecture. You can preside, you can be host. We will pay, and it will give us the opportunity to give her proper thanks when we ask her health over a glass of wine. Beulner agrees very much with this proposal. Don't you think it's a good idea, and if only we can get Miss Thrale to accept we shall be most happy. Do you persuade her, or, if she will not come alone, you will know some lady perhaps who can come with her. See, *mon ami*."

*Mon ami* considered the question, and thought the idea not bad. Miss Thrale was a favourite and good company, besides there would be a chance of asking another friend ("Amie") or two, and of making a little impromptu festival, such as the soul of the artist loves. He, therefore, commended the idea, but emphasised the necessity of finding one or two ladies to accompany Miss Thrale. In the meantime the empty chairs of the auditorium had gradually filled, and the "early" enthusiasts were augmented by the "interested," and these were being quickly supplemented with the "curious" and the "general" audience. In fact, it only wanted five minutes to the scheduled time, when the *élite*, the *cognoscenti*, of the company were due to take their seats on the platform. The eyes of the three men began to wander over the audience, the Bohemian to find out the other two who were to make up the dinner party, Beulner and Dupont to discover *la belle samaritaine*, as the latter had elegantly described her. Just as the hands were pointing to eight o'clock she appeared with a companion, and began to look hastily round for a vacant seat. Dupont was prepared for this, and hastened forward to meet her with that exquisite bow of a Frenchman, which is a combination of homage, flattery and audacity. He told her that he had forestalled her coming, and had been bold enough to reserve a seat near his party. Would she occupy them. There were two if she cared, and he would be most happy. She would be able to see and hear the lecturer to the best advantage. Gwen, who had guessed how things would be, but had hoped that fortune might have ruled otherwise, could not very well do anything else but accept. They were taken to the seats reserved for them, and embarrassing preliminaries were cut short by the opening of the debate. Then any misgivings she might have had were overcome in the interest of the subject under discussion. The arguments of the speakers were brilliant and enthusiastic, for the Fabians know how to organise debates. Fervour is not wanting at their meetings, and the whole atmosphere was soon electrified as only whole-hearted zeal can quicken politics and economics into life. Gwen felt it. It stirred her blood. It kindled the spirit of adventure which was easily awakened in her. Her sparkling eyes and flushed face showed her excitement, and before the lecture was at an end a whole whirlwind of excitement possessed her. All this was not lost upon Dupont. With an insight, which is not uncommon in Frenchmen, he gauged her disposition, and knew exactly how best to make his proposition.

"Oh, Miss Thrale, this evening has been magnificent. I feel that I want to be a Socialist, a martyr, a hero, a propagandist; and I can be none of these. All that is left for me is to put on my overcoat and to chase an omnibus. But I don't want to do these things. There is no fun. It has nothing of *la joie de vivre*. But I know what we can do. Permit us to make a little dinner in honour of the *affaire* of your recent kindness. My friend here knows all the ropes. Will you be my guest for just one little hour, and will your kind companion accompany us, while my friend has another lady whom he wishes to come, too, so that we can all finish up in a proper way so pleasant an evening?"

Of course Gwen had excuses to make. She must get home, and if she were any later the 'buses to Bayswater were few and far between.

"Oh, but Miss Thrale, dere is a taxi, which will take you to the door in a *clin d'œil*. Then the 'buses at Bayswater could go hang, and your friends will still be surprised to see you so soon. We will not be very long. We will be as short as you like, but permit us to pay you this compliment which we suggest and we shall both be infinitely happy for the honour."

What was there to say? Gwen's companion was agreeable to the enterprise, the "*amie*" of the artist had been brought up and introduced, and was already drawing on her gloves in preparation for a speedy departure. Without making a scene Gwen could not very well get out of it, besides in her heart of hearts, although entirely against the dictates of reason, she quite agreed with Dupont that it would be a good ending to the evening. She allowed herself to be persuaded, and so fate brought another adventure to the adventurous.

The question of where to dine introduced a vivacious discussion amongst the party. Finally the Coventry was decided upon. Then how to get there. There was only one possible solution to this question. A taxi cab. But there were too many for one taxi cab. Two taxi cabs would make the party three in each—most unsatisfactory. The thing was to be done in style if done at all, so a third was chartered, and the little party paired off into the several vehicles. In spite of Gwen's instinct to avoid Dupont for a partner, and certainly without any marked effort on his part to secure the result, she ultimately found herself seated by him in the taxi, which was skimming along the wide streets of the metropolis. She was dissatisfied with the situation, or, rather, she felt disinclined to throw herself into an adventure which would, under ordinary circumstances, have been very much to her liking, but she was, above everything, a creature of circumstances and quickly influenced by her surroundings, so that before she was well aware of it she was already reconciling herself to the inevitable, and that was but a short step to becoming interested and vivacious once more. Besides, Dupont was irresistible. He was a man of culture, of infinite worldly wisdom, a keen observer of human nature, and, above all, knew how to make himself fascinating. He knew exactly how to trade on his foreign origin and accent. He knew, too, how to draw his companion, and combined with this he knew how to listen without saying a word, merely expressing his sympathy by little gestures, a raising of the eyebrows, a motion of the hand, even the attitude he assumed would emphasise his interestedness, and there are few people who are proof against a good listener. At present, however, he was reconnoitring; groping, as he would say, *à tatons*; carefully avoiding any line of conversation that would be likely to divulge the ultimate issue of the conversation, yet, like a skilful general, he was directing the flying columns of his speech. He wanted to avoid the main action for the present, as there was a chance of the conversation being broken off at an untimely moment, when it would be difficult to renew the attack without his purpose being observed. He therefore kept his subject well within bounds, and contented himself with by-play, but at the same time he lost no opportunity of opening up avenues of approach, so that when the exact moment arrived he might bring the whole battery of his eloquence to assault the secret citadel and break down the barriers of Gwen's reserve. Like a Wellington in this conversationary encounter he kept his watch in his hand, timing the moment for commencing preliminaries. Gwen by this time was talking fluently. Together they discussed the merits and demerits of Sotheby and the beauty of the surrounding neighbourhood. Dupont graphically described the Granby Hotel, he imitated the buxom housekeeper who would drawl when she spoke of the "gentry" and whose one purpose in life seemed to be the destruction of flies in their myriads and the consequent strategic disposition of fly papers in the most unexpected places throughout the Granby Hotel. Gwen laughed heartily at his vivacious descriptions, and Dupont noting that Hyde Park Corner was reached and that they would not be long spinning down Regent Street, enlarged on the subject by giving his hearer a description of herself as he had received it from the mouth of Mrs. Bundross.

(*To be continued.*)

# Our Bookshelf

"LA TÉLÉGRAPHIE SANS FIL," par Leon Van Aerschodt, attaché a la bibliotheque de l'Observatoire royal de Belgique. (Brussels: Veuve Ferd. Larcier, editeur. 0.50 fr.)

This small volume comprises only 27 pages, but by judicious selection the author has given an interesting account of the development of wireless telegraphy. His work differs from others dealing with the subject, inasmuch as it is not a practical treatise, nor does it describe systems or apparatus. Mr. Aerschodt has given a review of a remarkable discovery in a style which is at once interesting and instructive.

* * *

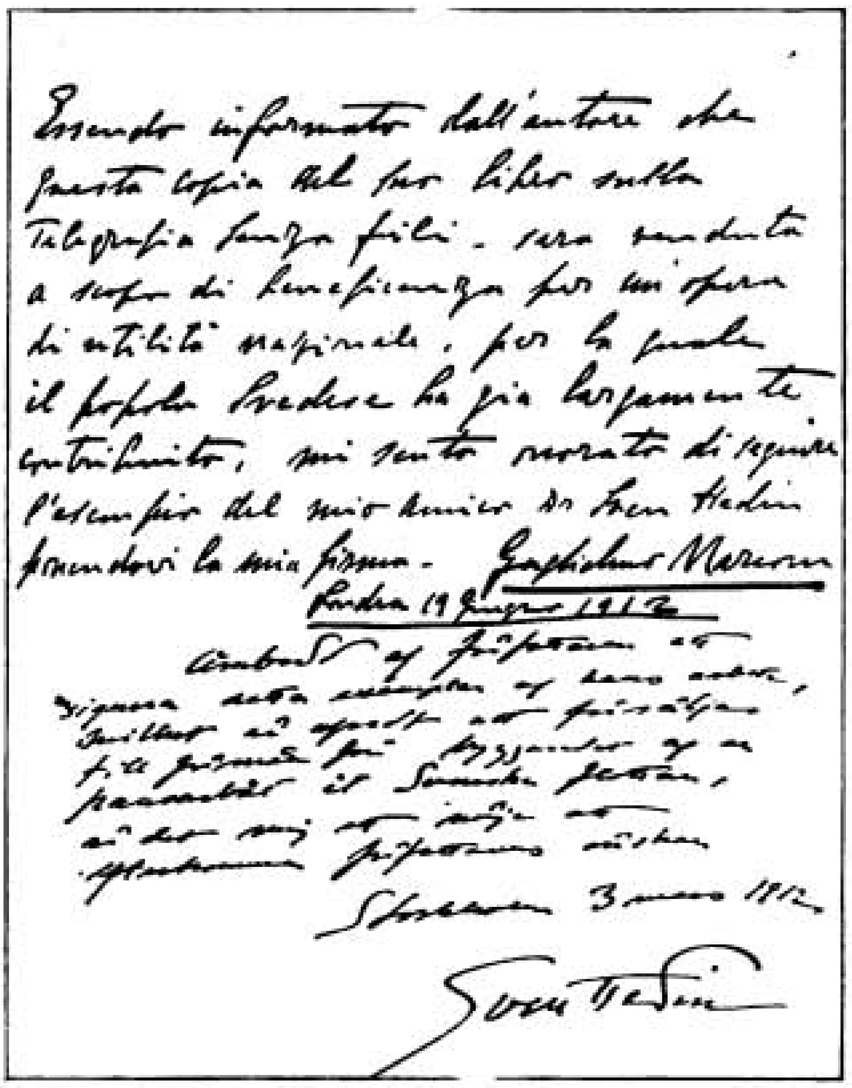
"THE SEA MONARCH," by Percy .F Westerman. (London: Adam & Charles Black. 3s. 6d.)

Mr. Westerman has set himself a task which is beyond his power. His aim has been to write a story of thrilling adventure for boys, introducing all the latest novelties of sea craft and armament, to say nothing of anticipating the future, and inventing a good deal of complicated machinery, which, if it confuses the mind of the reader, has at least the merit of bringing about more than one dramatic situation in the course of the story. The hero, Gerald Tregarthen, is a young naval officer on board a mysterious Super-Dreadnought, the *Olive Branch*, which is owned and commanded by a certain Captain Brookes. Captain Brookes maintains that he has a special mission—to eliminate warfare. By means of a "potential electric fluid" he is able instantly to destroy a fleet, and his idea is to exterminate the ships of all nations who persist in attempting to settle their differences by the arbitrament of the sword. In his efforts in this direction Captain Brookes brings his ship through several vivid, exciting scenes. He is proclaimed outlaw by the Great Powers, but evades capture in a most masterly way. Finally the *Olive Branch* arrives in the nick of time to save the British fleet from disaster at the hands of a powerful European alliance and turn defeat into a glorious and final victory. Throughout the tale wireless telegraphy and telephony play a conspicuous part. But the whole story is unconvincing. Even the school-boy will recognise that the author has allowed himself to overlap the bounds of possibility, and has made too large a demand on the credulity of his readers. It is a pity, for Mr. Westerman has a pleasant style and writes briskly, while there is no gainsaying that he has plenty of imaginative power and his knowledge of naval affairs is considerable. If he were to write another book and exercise more control of his pen, we feel sure that the effort would repay him, for the number of good writers for boys is lamentably few. As regards production, the book is wonderful value. There are 227 pages of clear readable type. There are 12 admirably drawn illustrations by E. S. Hodgson, and the whole is bound in a strong, sensible cover. But a word should be said for the cover paper, which displays a brilliantly executed scene of a naval battle.

* * *

Books to build a battleship. It sounds as extravagant as "new lamps for old." But let us be done with dark sayings and set the facts of the case as concisely as may be. Early last year the Swedish Government decided that it was impossible to carry out a plan of warship construction which had previously been arranged, and was to include the completing of a warship belonging to the "F" type. This would have given the Swedish navy a vessel larger than any she at present possesses, and the necessary curtailment of armament expense roused the whole of Sweden to an unwonted pitch of patriotic fervour. Meetings were held all over the country, and it was decided practically unanimously that whatever happened Sweden was not to be disappointed of her warship. A national subscription was started to raise the sum necessary for its construction, and this was no light task, for the estimate put down the cost at about 12,000,000 krone. But Sweden was not to be put off in her ambition. A hundred expedients were devised for raising the necessary money, and the enthusiastic response to the call on the nation's private purse resulted in a subscription list which totalled more than 16,000,000 krone, or 4,000,000 krone above the amount actually required for the specific purpose of the fund. Such a sum works out at about 3s. 6d. per head of the population, a remarkable testimony to the patriotism of the Swedish people. Among the schemes devised for raising funds was a book auction. It took place in the chief hall of the Grand Hotel in Stockholm, and was itself an event of much importance in the annals of literature. All the books were provided by notable authors, who themselves wrote inscriptions, or added autographs to the volumes, so that it was a unique collection which was put up for auction in March last year before an assembly which included all the best-known members of Swedish society.

The book which brought the highest price was one on "Wireless Telegraphy," by Mr. Thor Thörnblad, and 1,300 krone, or about £72, was the sum paid by the purchaser, Countess Wilhelmine von Hallwyl, who has graciously permitted us to reproduce a facsimile of the flyleaf which bears the inscriptions of Mr. Marconi and Dr. Sven Hedin, besides that of the author. The work is still in publication at the price of £1, and contains some 900 printed pages.


Essendo informato dall'autore che questa copia del suo libro sulla Telegrafia senza fili. sarà venduta a scopo di beneficenza per un'opera di utilità nazionale, per la quale il popolo Svedese ha già largamente contribuito, mi sento onorato di seguire l'esempio del mio amico Dr Sven Hedin ponendovi la mia firma. Guglielmo Marconi
Londra 19 Giugno 1912

Sven Hedin

Dr. Sven Hedin first contributed his inscription. It is in Swedish, of which the following is a somewhat free translation:

"Asked by the author to sign this copy of his book, which is intended to be sold for the benefit of a fund to build a warship for the Swedish navy, it is a great pleasure to me to comply with the author's request.

"Stockholm, the 3rd of March, 1912.

"SVEN HEDIN."

Mr. Marconi, following the lead of the brilliant explorer, also added a brief message before signing his name. It is in Italian and reads:

"I have been informed by the author of this work as to the purpose for which this copy of his book on Wireless Telegraphy will be sold—that is to say, in order to augment the funds, contributed so generously by the public of Sweden, for carrying out a work of national importance. I have therefore the honour to follow the example of my friend Dr. Sven Hedin, and to append my signature.

"GUGLIELMO MARCONI."

# Contract News

**The following vessels have been equipped with Marconi Apparatus during the past month.**

| Owners. | Name of Vessel. | Installation. | Remarks. |
|---|---|---|---|
| Messrs. Elders & Fyffe | *Bayano* | 1½ kw. and emergency set | Vessels taking limited number of passengers, with considerable fruit trade, between England and West Indies. |
| „ „ | *Patia* | „ | |
| „ „ | *Patuca* | „ | |
| | *Grand Duchess Maria Nicolaevna* | „ | — |
| The Canadian Pacific Railway | *Empress of Asia* | „ | Passenger between Vancouver and Japan in connection with the C.P.R. |
| Greenshields, Cowie & Co. | *Knight Companion* | „ | — |
| James Chadwick & Sons | *Drumcliffe* | „ | Cargo vessel between Liverpool and Buenos Ayres. |
| Trinidad Shipping and Trading Co. | *Matura* | „ | Travelling between New York and Trinidad with fruit cargo. |
| The Orient Line | *Ophir* | „ | — |
| The Leyland S.S. Co. | *Cambrian* | „ | These vessels carry a limited number of passengers, but their transport between Liverpool and Boston is very considerable. |
| „ „ | *Philadelphia* | „ | |
| The Gulf Transport Co. | *Indore* | „ | — |
| The Norfolk and N. American S.S. Co. | *North Point* | „ | Being part of an order to equip this line of vessels, which is engaged entirely in North Atlantic service. |
| „ „ „ | *South Point* | „ | |
| „ „ „ | *West Point* | „ | |
| Furness, Withy & Co. | *Kanawha* | „ | Engaged in general trade, no fixed destination |
| The White Star Line | *Ceramic* | „ | Passenger between Liverpool and Australia (refitted). |
| The P. & O. S.N. Co. | *Nellore* | „ | Travelling in Eastern Waters. |
| The British India S.N. Co. | *Manora* | „ | Passenger vessel between Calcutta, Rangoon and the Straits. |
| The London & S.W. Railway Co. | *Cæsarea* | „ | Passenger vessels engaged in Channel Island service. |
| „ „ „ | *Sarnia* | „ | |
| C. J. Barrie & Son | *Den of Ruthven* | ½ kw. and emergency set | — |
| „ „ | *Den of Crombie* | „ | — |
| The Hall Line | *City of Bombay* | „ | Part of large contract to fit this line of passenger vessels. They are engaged in service between Liverpool, Bombay, and Karachi. |
| „ „ | *City of Norwich* | „ | |
| „ „ | *City of Edinburgh* | „ | |
| Bucknall S.S. Co. | *Kasenga* | „ | Cargo vessels with world-wide service. |
| „ „ | *Karroo* | „ | |
| The Tyne and Tees Shipping Co. | *New Londoner* | „ | Cargo vessel carrying limited number of passengers between London and Newcastle. |

**La Société Anonyme de Télégraphie sans Fil have equipped the following vessels.**

| Owners. | Name of Vessel. | Installation. | Call Letters. | Port of Registry. |
|---|---|---|---|---|
| Naam | *Oosterdijk* | 1½ | PGX | Rotterdam |
| Norske Amerika Linien | *Kristianiafjord* | ½ | LCK | Christiania |
| Amsterdam Tug and Salvage Co. | *Atlas* | 1½ | PIB | Amsterdam |
| R.L.O. | *Vollrath Tham* | 1½ | SFV | Pitea |

**The following vessels have been equipped by the Debeg Co.**

| Owners. | Name of Vessel. | Call Letters. | Remarks. |
|---|---|---|---|
| Rickmers | *Andree Rickmers* | DND | — |
| D.A.P.G. | *Tecumseh* | DTC | Accounting through the Debeg Co. |
| „ | *Prometheus* | DOP | — |
| The Hansa Line | *Imkenturm* | DIM | — |
| „ „ | *Solfels* | DOU | — |
| „ „ | *Kybfels* | DKY | — |
| „ „ | *Reichenfels* | DXR | — |
| The Hapag | *Bosnia* | DBZ | Cargo vessel |
| „ „ | *Armenia* | DXM | Cargo vessel |
| The Kosmos Line | *Sakkarah* | DYD | — |

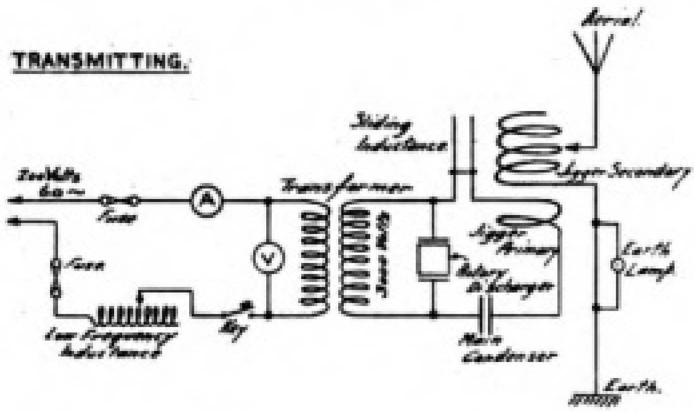
# HINTS FOR AMATEURS

## An Experimental Station.

By H. W. Pope.

IT is now a little more than two years since I commenced to experiment in wireless telegraphy.

The first thing I made was a single slide tuning coil, and I wound it on a 4 inch cardboard tube 24 inches long, with 18 gauge

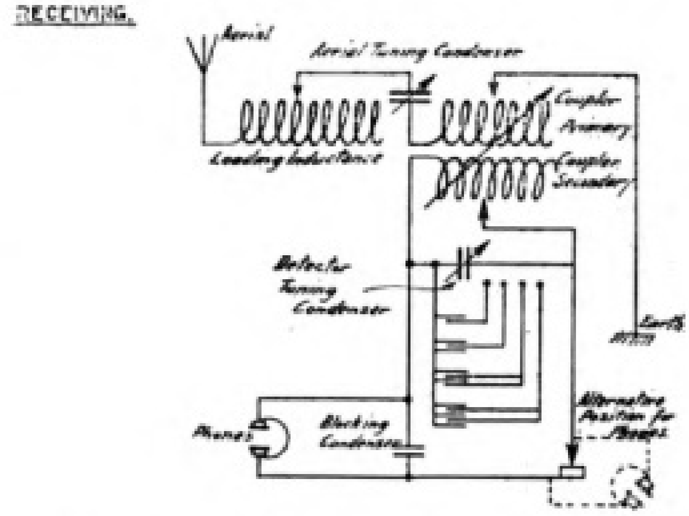



dcc. wire; I still use this coil as loading inductance for my loose coupler.

Quickly followed an inverted aerial about 120 feet long, on a 28 feet mast, at the end of the garden, the home end being fastened to the eaves of the house.

Other apparatus consisted of electrolytic detector with potentiometer and a small variable condenser. I also made a change-over switch with two screws, which stuck through a piece of wood and dipped into two sets of mercury cups for sending and receiving; and lastly I came across a pair of indifferent 'phones for 1s. 6d., but they were good enough for the half mile I wished to get signals over.

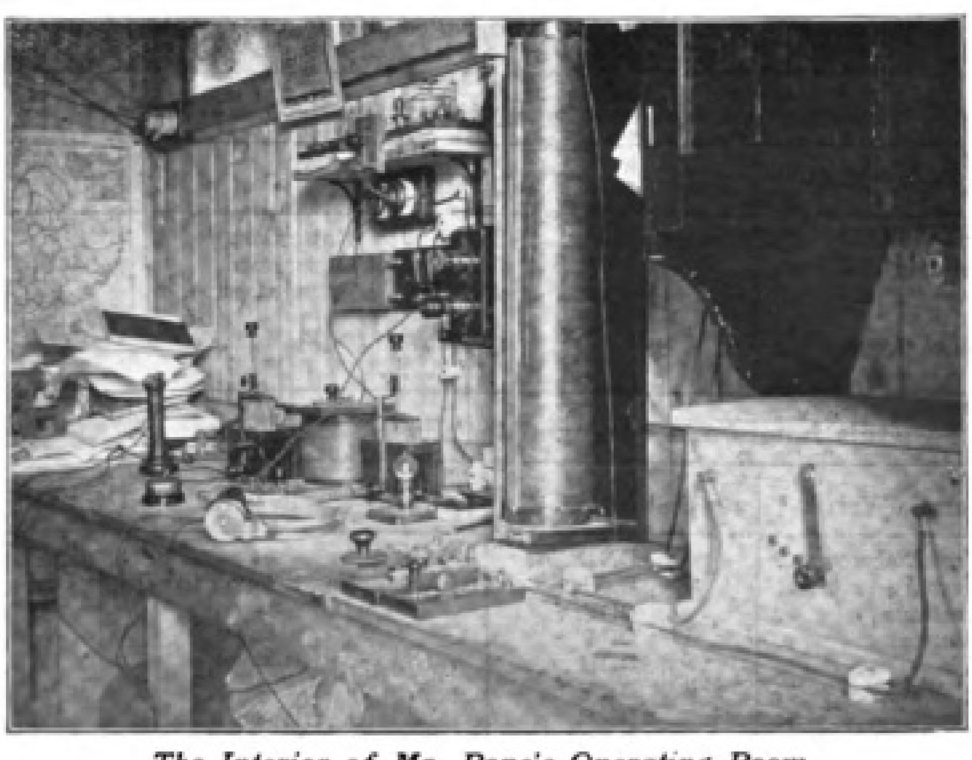
Later came the inevitable motor-coil, direct coupled helix, small home-made tap-




ping key, and my solitary accumulator, but the spark gap was a thing of beauty in my eyes, $\frac{3}{4}$ inch spun brass balls, highly polished and nicely lacquered; but it was soon discarded in favour of zinc electrodes, which I found did not arc so quickly.

About ten months of experimenting with this small set, and sundry conversations with people more advanced than myself, brought home to me that my aerial was not high enough to do wonders with, so with the collaboration of a local builder I erected the present one. It is 65 feet high to the top of a mast on the roof, with a 45 footer at the end of the garden; the lead in is taken from the far end and brought back to the house, where it enters the out-building which serves for both cabin and workshop.

The total length of aerial is 230 feet down to the earth connection, and I find this form of aerial very efficient both for sending and receiving. It consists of two wires only, and there is, of



*The Interior of Mr. Pope's Operating Room.*

course, not so much capacity as if I had four; but then it is long, and there is a more symmetrical distribution of power.

My new apparatus consists of the old single slide tuner done up, and now being used as loading inductance, a loose coupler with primary outside, wound with 20 gauge dcc. wire, and tapped off into four sections on a 5 inch cardboard tube 5 inches long, secondary which is hinged to loosen coupling, is wound with 22 gauge dcc. also tapped into four sections on a 4 inch cardboard tube 4 inches long. Aerial tuning condenser made with tinfoil on one side, and sliding zinc on the other, insulated with old ¼-plate negative glass, and the whole clamped in a wood case with cardboard strip separators where the zincs slide in; a pointer is attached to the zincs, and travels along a scale which is quite arbitrary, but forms a useful guide for future adjustments.

The detector tuning condenser is similar to the aerial tuning condenser, except that at the back there are four paper-insulated fixed condensers capable of being put in parallel with variable condenser by means of a small four-way switch.

I now use a zincite-bornite combination detector which is proved to be about equal in sensitiveness to the best of silicon detectors, but much more hardy, and if open circuited on both sides *close-up* seldom goes out of adjustment.

My sending gear consists of ¼ kw. transformer of my own design and construction, giving only 3,000 volts across secondary, but I find this low voltage quite satisfactory, even with a large amount of low-frequency inductance in. I am using a non-synchronous rotary discharger of the treadmill type, with flat blades, driven by a small 6 volt motor working on d.c. from accumulators. I also have a Marconi type sliding jigger and primary sliding inductance as used on the 1½ kw. set, also glass plate main condenser.

At present I can only use one wave, viz., 450 metres, but when I have made another similar condenser to put in series or parallel I shall be able to produce 300 and 600 metre waves, which will give me more flexibility in cases where the station I am working to is jammed.

My best-known results at present are as follows:—sending 22 miles to W. Malling in Kent, and am at present experimenting to St. Albans (30 miles). Receiving—I get Soller, Marseilles and all French and English coast stations.

In conclusion, I have to thank the *Marconigraph* for much useful information and interesting reading matter, and wish it every success in the future under its new title.

## AMATEUR NOTES.

THE Postmaster-General has allotted the code letters XBS as a special wireless code signal for Boy Scout Troops.

* * *

It has been proposed to form an Amateur Wireless Club in Newcastle-on-Tyne, the objects being to secure a club-room, hold meetings for wireless experimenters' benefit, and generally bring together all interested. Intending members should send their names to Mr. Chas. M. Denny, of 24 Eversley Place, Heaton, Newcastle-on-Tyne, who proposes to arrange a meeting of those interested.

* * *

We have great pleasure in publishing on page 274 an article from Mr. Pope, who is evidently an ardent and enthusiastic amateur. We congratulate him on the sensible design of his apparatus and circuits, and even more on the extreme legibility of his MS. and the clearness of his diagrams. *O si sic omnes!* His literary form is perhaps somewhat breezy for a technical article, reminding one, indeed, a little of the epistolary style of the well-known "Visits of Elizabeth"; but it is eminently readable. We are a little uncertain as to his transmitter; the origin of that alternating current at 200 volts seems wrapped in mystery. And for everybody's sake we should recommend him to put in an air-core protecting "choke" between his oscillating circuits and his low-frequency transformer windings.

* * *

An interesting gathering took place at Bournemouth on June 10th in connection with the 1st Parkstone Troop of Scouts, the occasion being the inauguration of an electrical Morse signalling apparatus, the gift to the troop of the District Secretary, Mr. Alan Fletcher. Sending and receiving stations had been installed in the large hall and the smaller hall, which is the Scouts' "guardship." The Mayor, who is Assistant Sea Scout Commissioner for East Dorset, sent through the first official message, "Are you prepared?" and afterwards formally took over the apparatus on behalf of the troop, and expressed their thanks to the donor. The 1st Poole Troop, under the direction of Mr. W. E. Tydeman, attended.

* * *

The Birmingham Wireless Association, which has a membership of over 80, has met with cordial support from local amateurs. A club room has been obtained at Geoffrey Buildings, John Bright Street (entrance Severn Street), the aerial has been erected, and the room itself is being fitted up in a suitable manner. The aerial is divided into two similar parts, which may be used as one or independently, and this arrangement should be very useful for testing instruments such as 'phones, coils, electrolytic detectors, etc.

Although at the time of writing the silence room is just nearing completion, no instruments have yet been installed, but several meetings have been held. Mr. J. J. Shaw, one of the society's keenest committeemen and the well-known seismologist, has addressed a meeting on "Home-Made Apparatus," and gave his audience a great number of useful and practical hints in the construction of the same.

A meeting which evoked much discussion was one at which the vice-president, Mr. W. F. Baxter Bartram, spoke on "The erection of a good receiving station for £3." Another most interesting evening was spent when a member, Mr. R. Robinson, of the "Royal Engineers Wireless Section," gave the association hints on learning the Morse code, practice at low and high speeds of reading, and explained the routine of "ship and shore" messages. Forms of application for membership may be obtained from the secretary, Mr. J. B. Tucker, Brentwood, Solihull.

* * *

At a recent meeting of the Derby Wireless Club accounts were given by Mr. S. G. Taylor and Mr. A. T. Lee of experiments carried out this and last summer with various kites and small balloons, to which "aerial" wires were attached. When about 100 yards of wire were taken up the received signals were considerably louder than on an ordinary aerial. The natural "wavelength" of the wire appeared to be considerably less than that of the ordinary horizontal aerial, presumably owing to absence of capacity. The chief difficulty consisted in obtaining a satisfactory "earth." In the experiments last summer at the seaside, an excellent "earth" was easily obtained by trailing a few feet of wire on the damp sand. Inland, however, different arrangements had to be made. A single wire laid along the ground, or in a brook, was not found to be very efficient.

* * *

Mr. Taylor also described some experiments in which Induction Coil Secondary Sections were used as receiving oscillation transformers. The flat discs were tapped off for 600, 1,800, 2,100 and 4,000 m.WL., and gave very satisfactory results. He also exhibited some small wooden discs with a groove at the edge, in which was wound several layers of wire. Used as a loose coupler, Cleethorpes could be heard with the discs 6 inches apart, and, in series, Clifden. A "double-acting cartwheel jigger" might be obtained by placing a primary disc between two others. The "cart-wheel jigger" effected a saving not only in space but also in wire, as considerably less was needed than in the usual single-layer tuning coil. Signals from all the large stations were as good on the discs as on the ordinary type.

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A young Kentuckian recently sued a telegraph company for the loss of his sweetheart, $1,999 being the value placed upon his wounded feelings. He telegraphed to his intended to meet him in Louisville for the wedding ceremony, but the message she received called her to Nashville. She went to Nashville and waited, and he went to Louisville and waited. Her disappointment was followed by anger, and she would not listen to any explanation. She thereupon broke off the engagement, and the disconsolate young man calculates that it will take about $1,999 in money to re-establish his former condition of mind.—*Telegraph & Telephone Age.*

# QUESTIONS AND ANSWERS

*Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study. To enable a reply to appear in the current number such questions should reach the Editor by the 12th of the month. Correspondents are reminded that all letters must be accompanied by the full name and address of the writer, otherwise their questions will not be answered.*

G. C.—*Design of Receiving Station.*—I propose to erect a receiving station, but before making the various parts I should like your opinion upon my scheme. Am I right in supposing that, as I have so much adjustment capacity in the circuit—assuming, in the first place, that the connections, etc., are sound—a *variable* condenser is unnecessary? So far, I have a two-phase "jigger" in mind, the dimensions of which are as follows: *Primary*—Coil 12 inches long, 5 inches diameter, 8 S.W.G.; one layer each. *Secondary*—Coils 5 inches long, 6 inches diameter, 30 S.W.G. (adjustable). Is this all right? Is the idea of a two-phase "jigger" feasible at all? I notice that Marconi had one in conjunction with an ordinary coherer, but I have not heard of one with a crystal detector.

*Answer.*—A variable condenser is nearly always advisable, because it can be varied continuously instead of in "steps," as is the case with a variable inductance. If the latter is made with a slider making contact on the bared wire of the turns themselves, contact is apt to be unreliable; while if contact is made on tappings, one either has to have a multiplicity of tappings or else big "steps" in adjustment. A two-phase jigger is feasible; we have employed it with some success for crystals, but not with the connections shown by you, which are not quite right. The Marconi coherer-jigger had its secondary in two parts, as you show; but the two parts were joined at the centre by a fixed condenser. The whole was so designed that a half-wave was formed in it, giving a loop of potential at each end, and a node at the middle point. The coherer was connected across the ends, and therefore got the benefit of the maximum potential difference; while connection to choking-coils, relay, local battery, etc., was made on either side of the central condenser, at the node of potential. This plan should be adopted in your case; your crystal should not be put at the centre as you show; it would be advisable to put a very small variable capacity across the ends of the secondary, so as to form a closed oscillatory circuit, and to connect your crystal across that. Your battery and potentiometer—if you are using, as we advise, a crystal such as carborundum, which requires a battery—could then go to the two mid-points of the secondary, with telephones in series. Your jigger primary should not be as long as you mention, which would occupy the whole length of the secondary; it should be quite short—two narrow coils, one on either side of the central point of the secondary, would be best; this leaves the ends of the secondary properly free for the potential loops. Of course, the inductance which you lose by thus reducing your primary must be made up by external tuning inductance.

N. H.—*A Tuning Inductance.*—I wish to make a loose-coupled tuning inductance, using a load coil of 350 feet of No. 20 wire. Kindly give me particulars of a suitable jigger, giving quantity and gauge of wire and number of tappings, on primary and secondary; also sizes of variable condensers. I wish to tune to 4,000 metres. My aerial is 150 feet long, and I am using crystal detectors. In giving size of variable condensers, kindly give me area and number of vanes. Note that I want the primary and secondary tapped off; I do not want to use sliders.

*Answer.*—If—as we should judge from the tone of your letter—you are taking up "wireless" experimental work in a serious spirit, the best thing we can do for you is not to give the answers you ask for, but to show you how you should set about finding out for yourself. If you were setting to work seriously to learn a new language, you would not begin by getting some deep book written in that language, and then write and ask what each word meant; even a dictionary would not help you much in such a proceeding, because a dictionary takes for granted that you are in a position to apply the various rules of declension and conjugation and so on. Apply this in the case of wireless telegraphy.

In the first place, it is necessary to know the relations between velocity, wave-length, frequency of electric waves, and their connection with the values of capacity and inductance. When you have got this all clear, and realise what resonance and "tuning" really mean, you will be able to see the use of a certain little formula which crops up everywhere in "wireless"—namely:

$\lambda$ = wave-length in metres = $1885\sqrt{\text{Cmfds} \times \text{L mhys}}$

which gives the wave-length in metres in terms of the capacity in microfarads, and the inductance in microhenries. In the second place, you must make or buy—preferably make—a wave-meter. If you buy one, it will, of course, be calibrated; if you make one, you should endeavour to calibrate it yourself by some method which will be instructive and sufficiently accurate for your purposes. For instance, the wave-length given by a straight vertical wire is very nearly accurately four times the actual length of the wire; so by comparing your wave-meter readings with the lengths of the wire you can get several points on your calibration curve. You cannot proceed in this manner indefinitely, because you cannot get an indefinite length of vertical wire; but there are several ways of going on. For instance, if you make your condenser four times as large—(how can you make it four times as large? By putting a fixed condenser, three times as large as the maximum value of your original condenser, in parallel with the latter. How can you tell when you have made the fixed condenser three times as large? By the knowledge you have just obtained of the beginning of your calibration curve: think it out)—you know from that useful little formula just quoted that your wave-length will now be twice as long as the longest possible on the first condenser. Or you can multiply the inductance coil of your wave-meter by four, or nine, or sixteen, and similarly increase its range; and you can arrange plug or other switches to change from one range to another. If you once get started in the right way, it will soon be clear to you that it is a matter of common-sense.

When once you have got your wave-meter, and have found by familiarity that there are different ways of employing it usefully, you will begin to see that you could answer all your questions yourself; not truly accurately, but sufficiently accurately for your purpose, while at the same time you would be making real progress along the right lines. If you want to get strictly quantitative results, you will require as a standard of reference either a capacity or an inductance of known value. This you can buy, ready standardised, or you can make one from first principles; or you can make use of data (such as are given in the recently-published "Year Book of Wireless Telegraphy and Telephony"): for instance, that the capacity of a square metre of flat plate, placed at a distance of 1 centimetre from a similar parallel plate, with air between, is ·00088 of a microfarad.

Turning to your specific questions; you can, by the use of your wave-meter, find the "natural" wave-length of your aerial; you can then add in series to it a succession of coils of equal inductance (made equal and confirmed by the use of that same wave-meter), and plot a curve showing the tendency of your particular aerial to increase in wave-length with added inductance. By such a curve you can see at once how much inductance is necessary to obtain a given wave-length. As it is not convenient to add inductance in very small steps, nor to make use of a slider (which is not a particularly reliable contact for such delicate things as weak signals), it is advisable to have a continuously-variable condenser in series with your aerial; as a general rule this can be kept "short-circuited" for a rough adjustment, and used for a final adjustment to bridge across two steps of added inductance. What is the effect of such a condenser in series with the aerial, and how can it be used for such a purpose? Think it out, from first principles.

As for the sizes of variable condensers, etc., one thing is definite—namely, that they must be so proportioned to the inductances that the formula $\lambda = 1885\sqrt{CL}$ holds good. In your crystal circuit itself, to get the *best* results you would have to change the proportions of C and L so as to suit the particular kind of crystal. With a high-resistance crystal, such as some kinds of carborundum, the higher potential you get at the crystal the better, so that C should be made very small; its maximum value—for it should be adjustable—might be measured in ten-thousandths of a microfarad. With low-resistance crystals, current rather than potential should be sought for, and the capacity should be larger, and the inductance less.

W. H. G.—*Telephone Receivers.*—I should be grateful if you would give me a little information regarding telephone receivers suitable for wireless telegraph work. Is it necessary to have a receiver of any special design mechanically? How is the required resistance determined? Can you advise me of any evening classes running during the summer months where I could obtain instruction in wireless telegraphy?

*Answer.*—For reply to the bulk of your question, see replies in this and former numbers. In the matter of special mechanical design, with regard to the telephone itself, the diaphragm should be thin; poor results are obtained with certain commercial telephones owing to the thickness of their diaphragms. Then, of course, the headgear should be so designed as to press the receivers firmly and closely to the ears. With regard to evening classes, we would advise you to study the article on "The Wireless Operator" which appeared in the May number of THE WIRELESS WORLD. Full particulars appear there of the classes at Marconi House. If you are not eligible for those classes you might communicate with a telegraph training school, a good selection of which appears in the advertisement pages of THE WIRELESS WORLD.

G. H. D.—*Ranges.*—How far should I be able to receive with the following apparatus? An inverted L aerial, 100 feet long, lead of 50 feet from the top end, which is 75 feet high; the lower end being 35 feet high. (2) Double-slide inductance (12 inches long), a gold-silicon detector, a double phone headgear (2,000 ohms), and a blocking condenser of about ·002 mf. How far should it be possible to send with the same aerial, a 4-volt accumulator, ½-inch spark-coil, Leyden jar condenser about ·004 mf., and a helix?

*Answer.*—See reply to G. L. in May number. In any case your information is far too vague; "a double-slide inductance, 12 inches long," might be of any value. Moreover, what do you mean by "how far should I be able to receive"? You might receive one station well at a distance of 300 miles, and fail entirely to get signals from another station at half a mile. Your aerial sounds quite a good one, your telephones seem of a suitable type, and if you are not "shut in" badly by buildings or hills, and if you are a skilful experimenter (this is perhaps the most important point of all), you should be able to receive quite a number of English coast stations, and large stations in Spain, France and Germany if they come within your range of wave-length, whatever that may be.

M. P.—*Receiving Station.*—I wish to put up a receiving set to receive from the coast stations, if possible. I can use two poles, one 30 feet high, the other 15 feet; they are 80 feet apart. (1) What size S.W.G. copper wire shall I use for aerials, and how many lengths are these connected in series? (2) What shall I make the length of tuning coil with one slider, what is diameter of this coil, and size of wire? (3) What are lengths and diameters and size of wire for primary and secondary of jigger? (4) What is capacity of variable condenser (capacity in microfarads)?

*Answer.*—You might either use a "twin-wire" aerial—two wires side by side, but separated by four or five feet—or a sausage-shaped multiple aerial made up of, say, six wires spaced equi-distantly round light wooden hoops some three feet across. The size of wire is not of much importance for your purposes; 7/22 stranded is a usual size, but you could do with something lighter. We do not understand what you mean by "how many lengths are connected in series?" If you wind your tuning-inductance on a 3½-inch diameter cardboard tube, using No. 28 S.S.C. wire and winding to a length of one foot, you should have a range of tuning which would about reach to the Poldhu wave. We do not recommend "sliders"; it would be wiser for you to take tappings off at intervals instead. Your jigger-secondary might be wound with the same wire, and on a former, say, 6-inch diameter. If this is wound to a length of about 8 inches, and the capacity across it is made to vary from a very small value to a maximum value of ·0002 microfarad, the range of the circuit thus formed should be about what you want. Such a condenser could easily be made from one piece of brass tubing sliding over another piece of smaller diameter, the two being separated by an insulator such as layers of paraffined paper. If you happen to be using low-resistance crystals, you will get better results with a larger condenser and a smaller jigger-secondary. Your jigger-primary should have a variable coupling to the lower end of the secondary, and the crystal should be connected to the upper end of the latter, so that the battery and potentiometer come so as to connect to the lower end—*i.e.*, the end which is coupled to the earthed primary. The primary might be a coil about 1½ inch long of No. 22 wire.

J. B. H. inquires telephone transformer connections and other queries.—You have not quite got hold of the idea of the use of a transformer; the fine-wire winding should be put in the circuit exactly in the place where the telephone itself would normally go if it were suitable for use without a transformer, and the telephone should be connected directly across the thick-wire winding. You have this latter part right in your sketch, but your crystal is shown in quite a wrong place with respect to the rest of the circuit. With regard to your transmitter, the fact that you say your condenser consists of six sheets of tinfoil, 4 inches by 5 inches, and do not mention what they are separated by or how far they are apart, suggests to us that your ideas want putting on a sound basis. Altogether, we should recommend you to read the series of instructional articles coming out now in this paper before setting to work experimentally. It is absolutely essential that the principles of electricity in general and of "wireless" in particular should be grasped thoroughly to start with.

## Patent Record

The following patents have been applied for since we closed for press with the June number of this magazine:

No. 11,833. May 21st. H. L. Short, A. E. Short and H. O. Short. Wireless telegraphy.

No. 11,945. May 22nd. Laurence B. Turner. Contact make and break device adapted for use in wireless telegraphy and other purposes.

Nos. 12,074, 12,075, 12,076 and 12,157. May 23rd. Wm. Theodore Ditcham and Grindell Matthews' Wireless Telephone Syndicate, Ltd. Oscillation sparkgaps, microphones for use in wireless telegraphy, apparatus for use in wireless telephony, switching arrangement for use in wireless telegraphy and telephony.

No. 12,942. June 4th. Wm. Albert Freeman. Wireless transmitting and recording apparatus.

No. 13,503 and 13,504. June 5th. Thomas Harvey. Apparatus for detecting and magnifying minute electrical oscillations, receivers for wireless telegraphy.

No. 13,065. June 5th. W. T. Ditcham and Grindell Matthews' Wireless Telephone Syndicate, Ltd. Call or alarm apparatus for use in wireless signalling.

No. 13,310. June 9th. J. Hays Hammond, Junr. System and apparatus for radio control.

No. 13,458. June 10th. Robert Pickersgill Howgrave-Graham. Electrical device for the selective detection of periodic electrical impulses.

Nos. 13,636 and 13,637. June 12th. Marconi's Wireless Telegraph Company and C. S. Franklin. Receivers for use in wireless telegraphy and telephony, means for increasing the frequency of alternating currents.

No. 13,755. June 13th. Wm. Hamilton Wilson. Production of high tension discharges.

No. 13,793. June 14th. James Alex. Gardner and Alexander Ferguson. Apparatus for causing electrical impulses for transmission to a distance.

## Athletics

On Saturday, June 14th, the Marconi Athletic Club held their first annual sports. The club ground at Acton was looking its best, and the weather was all that could be desired, while the light garments of the competitors and the summer dresses of the fairer section of the company helped to make a particularly picturesque scene.

As regards the feats done that day, the club has every reason to be proud of the results, for some of the events were won in excellent time. The Silver Cup, given by Mr. W. W. Bradfield for the quarter mile championship, aroused the keenest rivalry, and resulted in some very good heats, while the final was fought out in brilliant

*A Group near the Winning Post.*

style, F. W. Noakes eventually winning from F. J. Menear by about three yards. The other races were:

The Hundred Yards Handicap: Winner, W. C. Jewell. (The first prize for this race was a silver cigarette case, presented by W. Mackie, Esq.)

Throwing the Cricket Ball: Winner, F. W. Noakes, who gave an excellent display, making a distance of 96 yards.

High Jump: Winner, D. French, at a height of 4 feet 9 inches.

Half Mile Handicap: Winner, E. G. Buttfield from scratch.

*Competitors in the Potato Race.*

Victoria Cross: Winners, A. R. Williams as rescuer, and Pannel as the wounded comrade.

One Mile Flat Handicap: Winner, E. G. Buttfield, with 10 yards start.

Potato Race: Winner, E. J. Wagstaff.

Sack Race: Winner, W. Holloway.

Thread-Needle Race: Winner, W. C. Jewell.

Three-Legged Race: Winners, E. G. Casserley and W. T. Kipling.

Veterans' Race: Winner, Geo. Pells.

One Mile Walk: H. G. Pearce. The prize, a silver cigarette case, was presented by Mr. S. Strickland.

There were besides two departmental races, which aroused the keenest interest: the first was a relay race, which was won by the accounts department, the second was the tug-of-war, in which a brave struggle was finally decided in favour of the school. At the close of the meeting the prizes were presented by Mrs. Bradfield, who was accorded a hearty vote of thanks for her kindness. Then followed a concert, given by members of the Marconi staff, from the platform of the pavilion; by this time it was growing dark, so that the fairy lights which outlined the pavilion produced a very dainty effect. The programme was varied and excellently rendered, and made a fitting conclusion to the afternoon's enjoyment. The sports committee, and especially the indefatigable secretary, Mr. H. G. Pearce, are much to be congratulated on the success of their enterprise.

## A Musical Society

It has been decided to form a musical society in connection with the Marconi Athletic Club. An orchestra of twenty members has already been formed, and the first rehearsal was held on Tuesday, June 24th. The conductor, Mr. H. F. White, will be glad to hear from intending members. It is also proposed to rehearse songs, quartettes, glees, etc., if a sufficient number of singers are forthcoming.

## Movements of Engineers

E. C. Montague, from foreign service leave to Poldhu.

E. Bellini, from Italy to London, and afterwards to Holland for demonstrations.

F. S. D. Marden, from Poldhu to Head Office.

L. S. Payne, from Liverpool to Newcastle: ship-fitting, and afterwards to the Canadian Company for land station erection.

G. S. Kemp, on sick leave from Letterfrack.

D. H. Payne, from London to Clifden.

C. H. Taylor, from London to New York.

O. Trost, from Cefn Dhu to London, and afterwards to Towyn.

H. J. Round, from London to Towyn.

C. James, from Liverpool to Hull (trawler tests).

T. E. Hobbs, from London to Hull (trawler tests).

B. S. Benning, from London to Hull (trawler tests).

J. M. Poyntz, from Broomfield to Poldhu.

E. L. A. Mathias, from Broomfield to Poldhu.

J. H. Shannon, from Cefn Dhu to Canada for the erection of land stations.

A. H. Morse, from Broomfield to Head Office.

## Movements of Operators

J. R. Driscoll, London School to *Scotian*.
P. Denison, London School to *Trent*.
G. J. G. Nicholls, London School to *Dominion*.
L. H. Cox, London School to *Adriatic*.
N. Sedding, London School to *Devonian*.
A. R. Brown, London School to *Campania*.
M. E. O'Carroll, London School to *Letitia*.
M. W. Meredith, London School to *Columbia*.
D. Arbuckle, London School to *Parisian*.
A. W. N. Evans, London School to *Hesperian*.
H. C. Wills, *Galway Castle* to *Ruahine*.
E. A. Planterose, *Avon* to *Trent*.
G. C. Fenton, *Scandinavian* to *Bayano*.
W. H. Ponsford, *Caledonia* (Anchor Line), to *Scandinavian*.
A. C. Lund, *Virginian* to *Malta*.
T. Stubbs, *Devonian* to *Minnehaha*.
W. Crabb, *Galileo* to *Guelph*.
R. H. Packer, *Minnehaha* to s.y. *Iolanda*.
C. P. Litchfield, *Minnehaha* to *Den of Ruthven*.
C. H. Banner, *Saxon* to *Asturias*.
G. McCormack, *Victoria* to *Virginian*.
J. H. Rockey, *Hesperian* to *Devonian*.
J. O'Connor, Liverpool School to *Canada*.
P. J. Renshaw, *Adriatic* to *Ultonia*.
J. G. Buttle, *Columbia* to *Mesaba*.
B. Basson, *Dominion* to *Iroquois*.
Wilfred Taylor, *Dominion* to *Cluny Castle*.
G. H. Thomas, London School to *Asturias*.
E. Murphy, *City of Marseilles* to *Montcalm*.
A. Cookson, *Gloucester Castle* to *Mongolia*.
S. A. Leith, *Pancras* to *Atahualpa*.
J. R. Bamford, *Himalaya* to *Darro*.
T. Robb, *Gothic* to *Menominee*.
W. S. Croughton, London School to *Mesaba*.
O. G. Mauro, London School to *Ascania*.
C. J. A. Gill, *Corinthian* to *Knight Companion*.
A. H. d'Avigdor, London School to *Ultonia*.
J. W. F. Carleton, *Tainui* to *Ballarat*.
D. M. Sproat, *Wayfarer* to *City of Marseilles*.
A. J. Thompson, *Campania* to *Adriatic*.
J. Camfield, *Haverford* to *Ulster*.
S. H. Devereux, *City of Bristol* to *Royal George*.
H. S. Smith, *Hawke Bay* to *Galileo*.
G. W. O'Brien, London School to *Minnehaha*.
C. T. Parker, *Norseman* to *Dover Castle*.
J. H. Moores, Liverpool School to *Darro*.
T. M. Blackshaw, *Haverford* to *Atahualpa*.
H. A. Bowman, *Campania* to *Welshman*.
B. F. Emery, *Novara* to *Angora*.
H. A. Flick, *Angora* to *Novara*.
R. Sweetnam, *Highland Piper* to *Egypt*.
L. C. Duggan, London School to *Carmarthenshire*.
W. E. Tyler, *Laconia* to *Victorian* (Leyland Line).
A. W. L. Owen, *Hypatia* to *Laconia*.
R. V. Patrick, *Kinfauns Castle* to *Saxon*.
F. V. Kinder, *Virginian* to *Flamenco*.
W. C. Ryan, *Orontes* to *Montreal*.
C. J. Brett, *Goth* to *Waimana*.
B. S. Elliott, London School to *Empress of Asia*.
J. G. Bull, *Waimana* to *Manhattan*.
M. W. Woollam, London School to *Minnewaska*.
G. K. Flagg, *Danube* to *Avon*.
H. J. Stanley, *Iroquois* to *Nore*.
F. A. Thomson, *Highland Scot* to *Highland Piper*.
H. A. Whitmore, *Malwa* to *Themistocles*.