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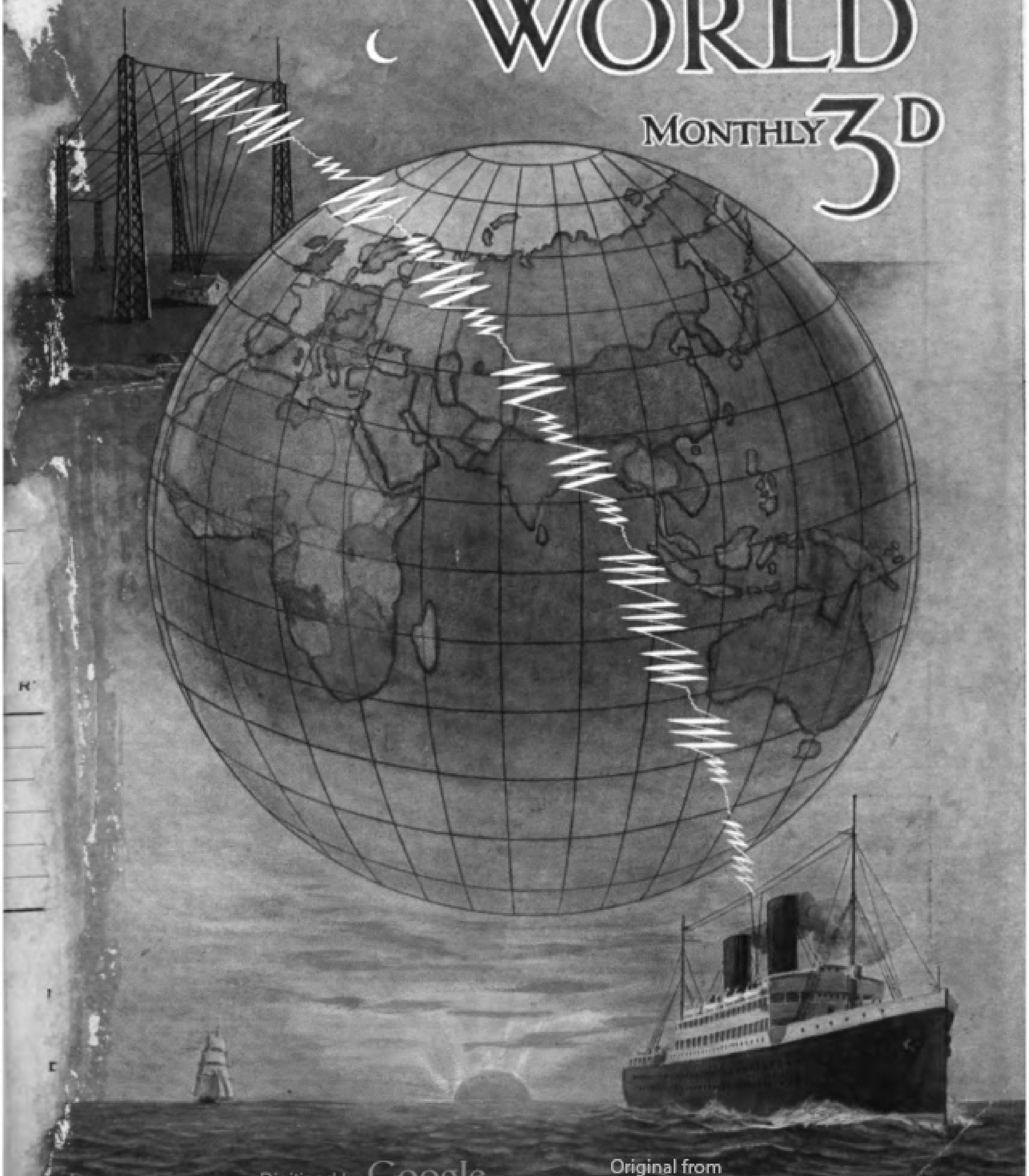
WIRELESS WORLD

MONTHLY 3D



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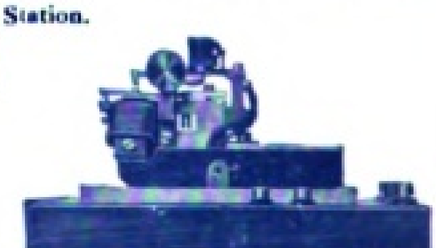

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The Editor will be pleased to receive contributions; and Illustrated Articles will be particularly welcomed. All such as are accepted will be paid for.

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Wireless and Aircraft

ALTHOUGH little has been published recently concerning the application of wireless telegraphy to aircraft it would be a mistake to suppose that nothing is being done in this direction. The main lines upon which this branch of wireless telegraphy will be developed are now clearly understood, and by co-operation with the designers and owners of aeroplanes in the making of the necessary tests we should be within measurable distance of standard wireless equipments which will be to aeroplanes what wireless sets are to ships.

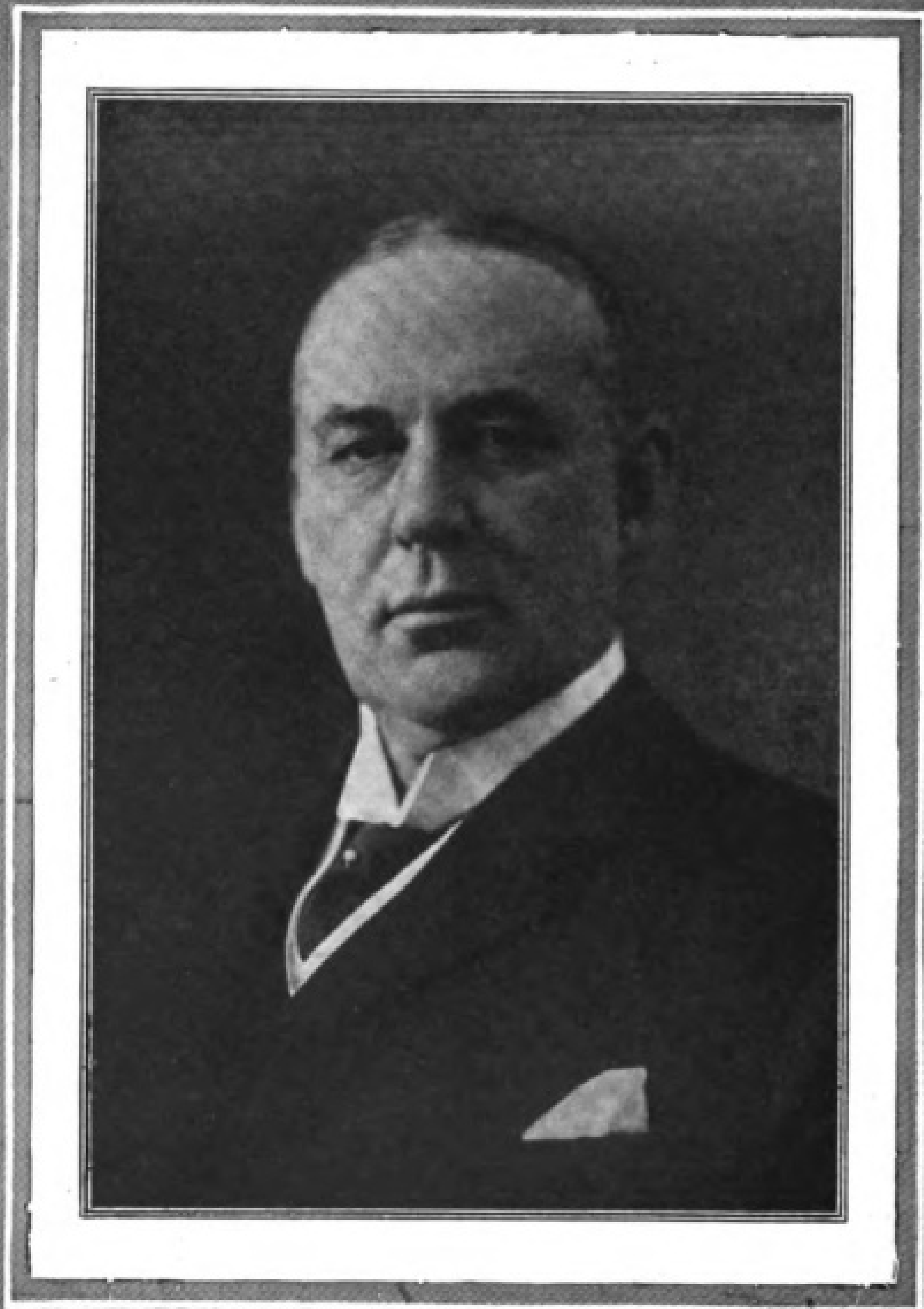
The reticence which has been shown in this matter is quite excusable, as we do not think it helps the public to a clear understanding of wireless progress—by which we mean progress that is calculated to extend the practical application of wireless telegraphy to the requirements and benefits of mankind and mankind's many-sided activities—to herald as advances such achievements as have been gained under the ideal conditions existing in a laboratory and which have not yet emerged successfully from the practical tests made under ordinary, everyday commercial conditions.

It has been an open secret, however, that the question of designing wireless telegraph apparatus for aircraft has engaged the closest attention of the Marconi Company, and it is gratifying to report that such progress has been made that experiments to be carried out at Hendon will demonstrate the degree of success obtained. It is generally believed that this branch of wireless telegraphy has not progressed much beyond the elementary stage; but this is not a correct belief; for one thing the increasing range of the aeroplane has made an improved system essential, and there is good ground for supposing that the new apparatus now being designed will meet the demands of the naval and military authorities.

One of the great drawbacks of the aeroplane wireless apparatus is weight. The present apparatus is equal in weight to that of an average passenger, which, of course, is an important disadvantage. To reduce the weight of the apparatus without sacrificing efficiency is one of the difficult problems to be dealt with, but it is not an insoluble problem. Another problem lies in the wires, which have to be trailed out behind an aeroplane in flight in order to detect messages. There is always the possibility of these wires becoming entangled in the propeller and bringing disaster, especially in the case of machines where the screw is behind the pilot and not in front, as in the tractor type. The solution of this problem would appear to lie in the substitution for the long trailing wires of shorter aerials, probably fixed wires between the planes and the tail.

In receiving messages in the air operators are also at a disadvantage, as the thunder of the engine makes it difficult at times to hear the signals, but with the design of a suitable sound-proof helmet this difficulty should soon be overcome.

That the difficulties will be solved we have no manner of doubt, and once they have been overcome it is manifest that the usefulness of the aeroplane, particularly for military and naval work, will be very greatly extended. In fact, a really reliable wireless installation suitable for such work would increase the value of scouting aircraft out of all knowledge.



MR. GEORGE MORRIS BOSWORTH

Personalities in the Wireless World

GEORGE MORRIS BOSWORTH

Vice-President of the Canadian Pacific Railway, Director of the Marconi Wireless Telegraph Company of Canada

IT is, of course, only natural that a corporation like the Canadian Pacific Railway, with world-wide activities and interests, requires men of the highest possible integrity to guide its affairs; moreover, in the service of such a company the best men are bound to rise up to the highest positions, because there is every opportunity for a capable man to prove his worth. In Mr. George M. Bosworth we have a living example of the way in which, by merit and industry, a man may rise from the ranks to a commanding position.

George Morris Bosworth was born at Ogdensburg, N.Y., in the year 1858, and, like many other great transportation officials, has been connected with railways and shipping from his earliest years, for in 1875 he entered the service of the Ogdensburg and Lake Champlain Railroad, in the comparatively short space of six years obtaining appointment as General Freight Agent to the company. Some men would have been content with a position of that kind, but not so Mr. Bosworth. He wanted fresh experience and a wider field for knowledge, so for a short time he accepted service as Travelling Freight Agent with the National Despatch Line of Chicago. In 1882 he commenced what has proved to be his life work by becoming Assistant General Freight Agent for the Eastern Lines of the Canadian Pacific Railway when the line was very much in its infancy, and in the opinion of many men would never grow up. The railway traffic increased rapidly with the development of Canada, which followed immediately on completion of the line from Atlantic to Pacific, and before many more years had elapsed Mr. Bosworth was appointed General Freight Agent for the Eastern Division. Still the railroad continued to extend its scope, steamship services under its management were commenced, at first on the Pacific from Vancouver to China and Japan, afterwards from European ports to Canada. Ultimately they provided direct communication almost half round the globe, and brought a gigantic increase in traffic, which required an expert to guide and control the immense volume of freight entrusted to the company's care. Mr. Bosworth was the expert who eventually took control of this branch of the company's activities on his appointment as Freight Traffic Manager for the whole system. A yet wider field was given to Mr. Bosworth by his appointment as Fourth Vice-President to his company in the year 1901. His exalted position further proved his great administrative capacity, for the Canadian Pacific by the extension of its activities over so vast a field of enterprise requires a man at the head of affairs who can deal with difficult and varied questions.

Since the year 1910 Mr. Bosworth has held a yet higher appointment with the company. As Vice-President, he is one of Sir Thomas Shaughnessy's right-hand men, and it may safely be said that there is not a single interest or section of the great organisation which does not in some way or other come under his jurisdiction, for he is a veritable corner-stone in the wonderful institution known the world over by the three letters "C.P.R."

Mr. Bosworth's activities do not end with his official duties to the C.P.R.; he is a Director of the Marconi Wireless Telegraph Company of Canada, the Dominion Dry Dock Company, the Crown Trust Company, La Banque Provinciale, as well as Vice-President of the Canada Club, Montreal. One might well wonder how it is possible to keep in touch with such numerous branches of commerce, but that is where the genius of the man asserts itself, for it is most manifest in an extraordinary capacity for assimilating facts and disposing of knotty problems with astonishing rapidity.

New Marconi Stations in Spain

"WIRELESS" never tarries; just as the ether wave charged with a message spreads itself out through space in swift eddies of invisible light and inaudible sound, so the "Marconi Organisation" is making its way into all parts of the world, covering land and sea with a network of communication which is as splendid in its achievement as it is magnificent in conception.

Finisterre, Santander, and Cape Palos must now be marked on the reader's map of the world with a sign which denotes the existence of a wireless station. All three stations are now in working order, and have been subjected to exhaustive tests by a Commission appointed by the Director-General of Spanish Posts and Telegraphs, and the report submitted by this Commission expressed unqualified approval at the splendid results obtained during the examination.

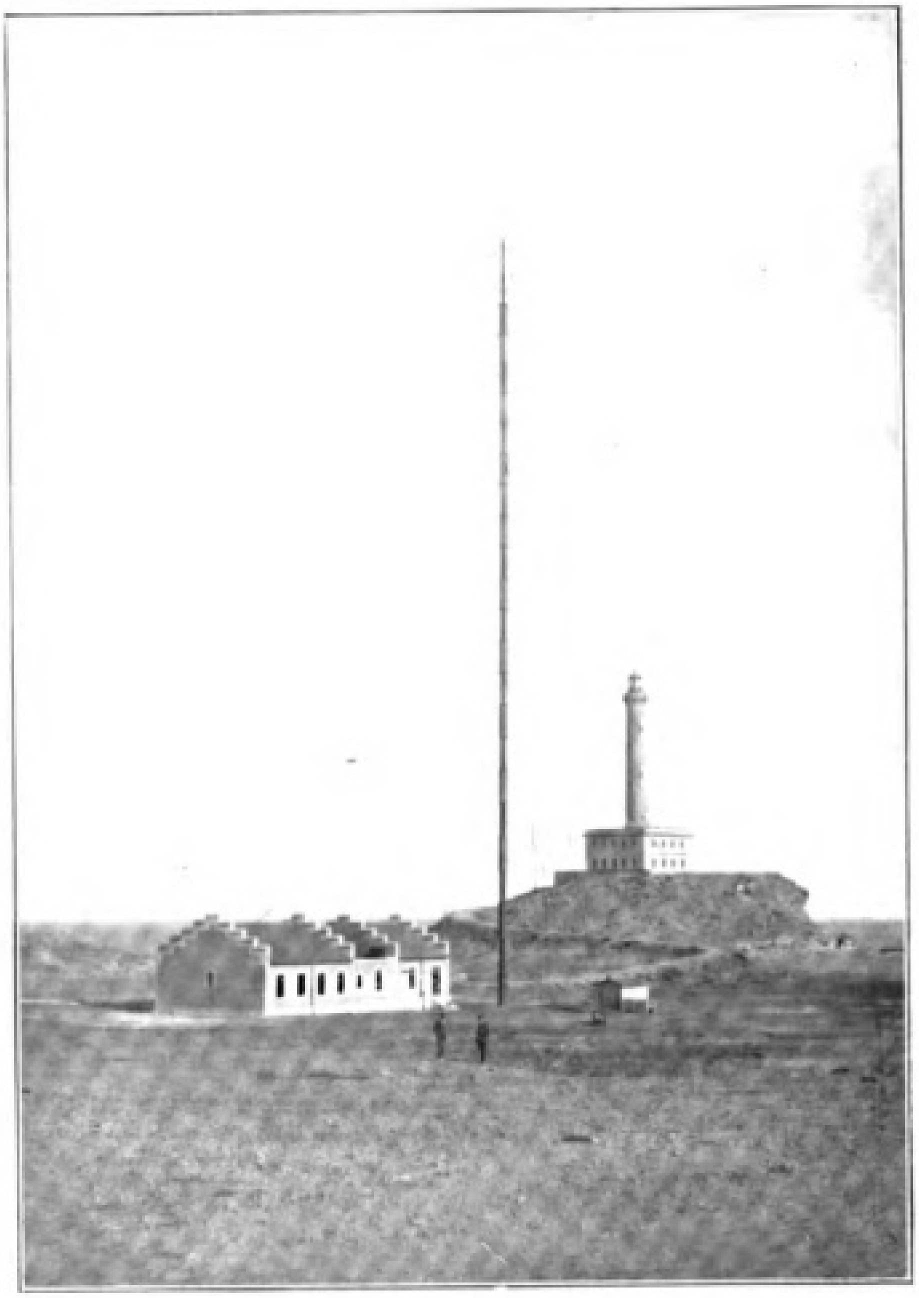
Of the three stations, Finisterre is the most important generally, on account of its strategical position, for it is the most westerly headland of Spain on the coast of Galicia.

Finis Terrae was the name given by the Romans to this prominency of the Ibernian Peninsula, and even to-day it well applies, for the voyager thither cannot but feel himself at the Land's End, so cut off is this corner of the earth from the civilised world. To reach the new station is a journey of 500 miles by rail from Madrid to Corunna, 60 miles by motor from Corunna to Corcubion, a picturesque little seaport situated at the end of Finisterre Bay, with a final 10 miles to be covered as best one may; and it is a very rough best, for the only progress is by narrow mountain paths for at least two of these miles. Yet it is sufficient compensation for the tiresome journey to reach the mountain top where the Station is situated, for what a glorious view lies stretched out beneath!

On the way across Galicia the traveller passes through a country broken into lofty mountains and deep valleys, mountain

The Station at Santander, with the waters of the Bay of Biscay washing its base.

chain succeeding mountain chain in rhythmic beauty till at last Finisterre is reached, and there beneath lies the vast Atlantic, pitting its fury against the rocky vastness of the Cape or stretching out in exquisite calm with its crystal surface reflecting the incomparable blue of a Southern sky. At the foot of the mountain, sheltered from the fierce sou'-westers, lies the little fishing village of Finisterre. Once the inhabitants felt themselves to be forgotten and of no account, but to-day they are awakened up to an active interest in life, for *O Marconho* (the Marconi—for thus do they speak of the new Station) has brought them into the whirlpool of life, and has given to the little village where they have spent all their lives a greater prominence in affairs than ever it boasted of before.



Cape Palos Station, situated on one of the most prominent capes in the East of Spain. To the right is the Lighthouse.

The *Gallegos*, as the inhabitants of Galicia are called, are an astute folk, and keep themselves very much to themselves. The lower orders are not above undertaking the most menial of offices, and for this the Spaniards of other districts, who pride themselves on being more "enlightened," consider the Gallegos an inferior race. In spite of popular prejudice, however, many of the natives of these parts hold the highest positions in the Spanish intellectual world, and as proof of this it may be mentioned that several Ministers forming the late Liberal Cabinet were Gallegos. They are noted for enterprise and a taste for adventure, for their patriotism, and for their thrift.

The Finisterre wireless station has been erected on the summit of a mountain, a step rendered necessary in order to obtain for the station a maximum freedom from "screening" by adjacent mountains and fully justified by the excellent results obtained, although increasing to a great extent the difficulties of construction.

It will be readily appreciated that these difficulties have been of some magnitude when it is mentioned that all the plant and building material, with the exception of such stone as was quarried near the site, had to be landed by lighters at the primitive wharf of Finisterre and carted to the site by oxen over a route which even a great stretch of the imagination could not call a road.

The station is of stone, a construction called for by the Government concession, and rendered particularly necessary in this case by the tempestuous nature of the weather that prevails here.

The offices and plant are housed in a building separate from that used for living quarters, and in this manner operators off duty can take their rest without being unduly disturbed by the "wireless," and the operator on duty is rendered equally immune from disturbance. The two buildings are separated, however, only by a *patio* or yard about 20 feet square, so that all hands are within easy call in case of necessity; access from one building to the other being an easy matter, even in bad weather.

The living quarters contain a dining-room, five bedrooms, kitchen, etc., and are intended to provide accommodation for three wireless operators and one land-line operator.

The operating house consists of the engine room, battery room, "spark" or transmitting room, operating room and land-line office.

The prime source of energy is a 10 h.p. petrol engine direct coupled to a dynamo; the latter being employed to charge a battery of sixty 280 ampère-hour accumulator cells.

The transmitting set is of the standard 5 kw. "battleship" type with disc discharger, a description of which it is unnecessary to give here.

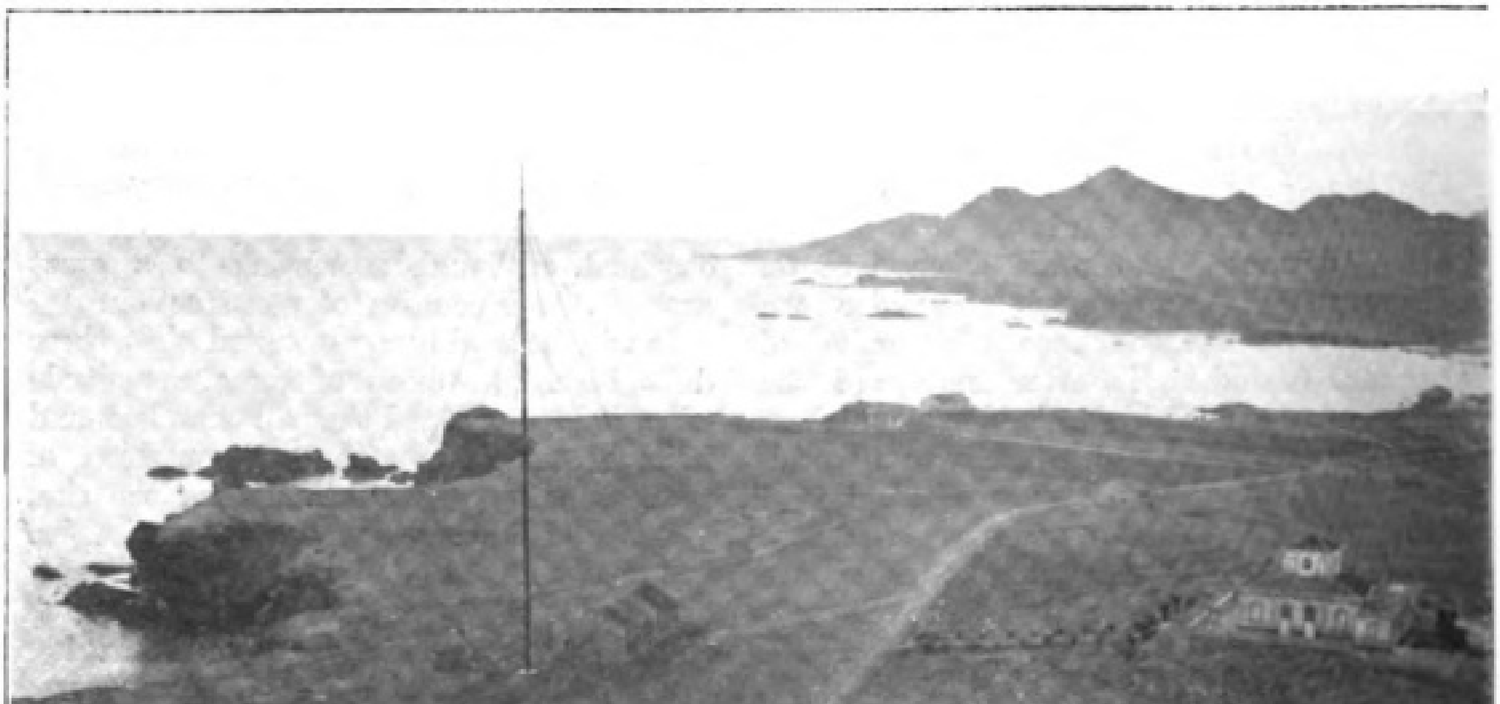
The operating room contains a magnetic detector with its multiple tuner and also the latest type of valve and crystal receivers. The operator, when seated at his desk, has within easy reach of his right hand all the necessary switchgear for controlling the motor-generator.

The land-line office contains the necessary telegraph instruments for working the wire connecting the station with Corunna. The exchange of telegraph forms between the wireless and land-line operators is effected through a small window, without either operator leaving his seat.

The aerial is of the four-wire "umbrella" type and is supported by a 220-feet sectional steel mast, the wire stays of which are amply insulated to prevent loss of energy in them due to induction.

The "earth" consists of eighty galvanised iron sheets 6 feet by 3 feet buried in the ground and connected to the operating house by copper wires.

Finisterre, in spite of its isolated position, is about to become the proud possessor of an electric power supply, and arrangements have already been made for utilising this supply for running the plant of the wireless station. A 6,000-volt transmission line will be run into the station, where the



A panoramic view of Cape Palos, with the Marconi Station in the foreground. It is a which separates the two is pressure will be transformed down to 220 volts. A three-phase induction motor will be installed and coupled by belt to the wireless motor-generator.

Similar in almost every respect to this station is the one which has recently been opened at Santander.

Santander, one of the principal provinces of Castille—cradle of the Spanish race—is generally referred to by Spaniards as *La Montana* (the mountain), on account of the fact that it extends right over the broken counterforts of the Pyrenees, whose sloping northern side projects its cliffs into the turbulent Bay of Biscay.

On one of these cliffs—Cabo Mayor—facing the Magdalena Palace, a new summer residence of the King and Queen, the Marconi station has been erected.

The third station is situated at Cape Palos, about sixteen miles from Carthagena, which boasts one of the finest naval harbours in the world.

Carthagena is also the centre of an intensely active mining and industrial district. Its arsenals, its foundries, its factories, with their smoking chimneys, tell of the reincarnation of this people who, cured to a certain extent of their inordinate fondness for politics, are beginning to direct their energies towards industry, the only true source of prosperity.

But there are no suburban or small industrial centres in Spain. The transition from manufacturing to agricultural districts is swift and surprising, so that the traveller who journeys further afield than Los Blancos, the limit of the industrial zone, is unprepared for the tranquillity which seems to pervade the vast fields that succeed, luxuriant in the rich vegetation of palm and cactus.

Cabo de Palos, to give it its correct name, is one of the most prominent capes on the east coast of Spain. It has no great elevation above the level of the sea, yet one obtains from it a truly magnificent view. On one side we have the Mar Menor or Lesser Sea, a beautiful lake separated from the Mediterranean by a neck of land fifteen miles long and some hundred yards in width, and, for the rest, almost completely surrounding the Cape, the Mediterranean itself—blue and peaceful.

Close by is the tiny village of Palos. Its inhabitants view with lively satisfaction the installation in their midst of this new Marconi station, which will render much beneficial service to the shipping of all nations in the Mediterranean.

magnificent view : on the one hand is the Mar Menor on the other the Mediterranean. The isthmus only about one hundred yards wide.

Safety of Life at Sea

Compulsory Wireless Telegraphy

THE text of the Convention which was agreed upon at the International Conference on Safety of Life at Sea, and which was signed in London on January 20th, was issued in the form of a Blue Book on February 16th. The official text is in French, but the Board of Trade has accompanied that text by a translation for convenience of reference. It is pointed out, however, "that the French text is the only one which possesses any official authority." The Conference agreed that the text should not be published until the middle of the present month, so that the Delegations of the various contracting States might have time to communicate it to their respective Governments, but an outline of the principal results achieved was given in a speech in which Lord Mersey, the Chairman of the Conference, moved the adoption of the Convention. The Convention itself comprises seventy-four articles, with fifty-two supplementary articles embodying the regulations. The attention of the Governments of the contracting States is drawn to the desirability of making every effort to reduce delays for the installation of radiotelegraph apparatus, and the provision and training of operators for the different classes of ships dealt with in the Convention.

Chapter V., which deals with radiotelegraphy, is as follows :—

ARTICLE 31.—All merchant ships belonging to any of the Contracting States, whether they are propelled by machinery or by sails, and whether they carry passengers or not, shall, when engaged on the voyages specified in Article 2, be fitted with a radiotelegraph installation if they have on board fifty or more persons in all.

Advantage may not be taken of the provisions of Articles 2 and 3 of this Convention to exempt a ship from the requirements of this Chapter.

ARTICLE 32.—Ships of which the number of persons on board is exceptionally and temporarily increased up to or beyond fifty as the result of *force majeure*, or because the master is under the necessity of increasing the number of his crew to fill the places of those who are ill, or is obliged to carry shipwrecked or other persons, are exempted from the above obligation.

Moreover, the Governments of each of the Contracting States, if they consider that the route and the conditions of the voyage are such as to render a radiotelegraph installation unreasonable or unnecessary, may exempt from the above requirement the following ships :—

(1) Ships which in the course of their voyage do not go more than 150 sea miles from the nearest coast.

(2) Ships on which the number of persons on board is exceptionally or temporarily increased up to or beyond fifty by the carriage of cargo hands for a part of the voyage, provided that the said ships are not going from one continent to another, and that, during that part of their voyage, they remain within the limits of latitude 30° N and 30° S.

(3) Sailing vessels of primitive build, such as dhows, junks, etc., if it is practically impossible to instal a radiotelegraph apparatus.

ARTICLE 33.—Ships which, in accordance with Article 31 above, are required to be fitted with a radiotelegraph installation are divided, for the purpose of radiotelegraph service, into three classes, in accordance with the classification established for ship stations in Article XIII. (*b*) of the Regulations annexed to the Radiotelegraph Convention, signed in London on July 5th, 1912, viz. :—

First Class.—Ships having a continuous service.

There shall be placed in the First Class ships which are intended to carry twenty-five or more passengers :—

(1) if they have an average speed in service of fifteen knots or more :

(2) if they have average speed in service of more than thirteen knots, but only subject to the two-fold condition that they have on board two hundred persons or more (passengers and crew), and that, in the course of their voyage, they go a distance of more than five hundred sea miles between any two consecutive ports. Nevertheless these ships may be placed in the Second Class on condition that they have a continuous watch.

Second Class.—Ships having a service of limited duration.

There shall be placed in the Second Class all ships which are intended to carry twenty-five or more passengers, if they are not, for other reasons, placed in the First Class.

Ships placed in the Second Class must, during navigation, maintain a continuous watch for at least seven hours a day, and a watch of ten minutes at the beginning of every other hour.

Third Class.—Ships which have no fixed periods of service.

All ships which are placed neither in the First nor in the Second Class shall be placed in the Third Class.

The owner of a ship placed in the Second or in the Third Class has the right to require that, if the ship complies with all the requirements for a superior class, a statement to the effect that it belongs to that superior class shall be inserted in the Safety Certificate.

ARTICLE 34.—Ships which are required by Article 31 above to be fitted with a radiotelegraph installation shall be required, by the Governments of the countries to which they belong, to maintain a continuous watch during navigation as soon as the said Governments consider that it will be of service for the purpose of safety of life at sea.

Meanwhile, the High Contracting Parties undertake to require, from the date of the ratification of the present Convention, subject to the delays specified below, a continuous watch on the following ships :—

(1) Ships whose average speed in service exceeds 13 knots, which have on board 200 persons or more, and which, in the course of their voyage, go a distance of more than 500 sea miles between two consecutive ports, when these ships are placed in the Second Class.

(2) Ships in the Second Class, for the whole of the time during which they are more than 500 sea miles from the nearest coast.

(3) Other ships specified in Article 31, when they are engaged in the Trans-Atlantic trade, or when they are engaged in other trades if their route takes them more than 1,000 sea miles from the nearest coast.

Ships connected with all kinds of fishing business, including whaling, which are required to be fitted with a radiotelegraph installation, shall not be required to maintain a continuous watch.

The continuous watch may be kept by one or more operators, holding certificates in accordance with Article X. of the Regulations annexed to the International Radiotelegraph Convention, 1912, together, if necessary, with one or more certificated watchers. Nevertheless, if an efficient automatic calling apparatus is invented, the continuous watch may be maintained by this means by agreement between the Governments of the High Contracting Parties.

By " certificated watcher " is meant any person holding a certificate issued under the authority of the Administration concerned. To obtain this certificate, the applicant must prove that he is capable of receiving and understanding the radiotelegraph distress signal and the safety signal described in the Regulations annexed hereto.

The High Contracting Parties undertake to take steps to ensure that the certificated watchers observe the secrecy of correspondence.

ARTICLE 35.—The radiotelegraph installations required by Article 31 above shall be capable of transmitting clearly perceptible signals from ship to ship over a range of at least 100 sea miles by day under normal conditions and circumstances.

Every ship which is required, in conformity with the provisions of Article 31 above, to be fitted with a radiotelegraph installation, shall, whatever be the class in which it is placed, be provided in accordance with Article XI. of the Regulations annexed to the International Radiotelegraph Convention, 1912, with an emergency installation, every part of which is placed in a position of the greatest possible safety, to be determined by the Government of the country to which the ship belongs.

In all cases the emergency installation must be placed, in its entirety, in the upper part of the ship, as high as practically possible.

The emergency installation includes, as provided by Article XI. of the Regulations annexed to the International Radiotelegraph Convention, 1912, an independent source of energy capable of being put into operation rapidly and of working for at least six hours with a minimum range of eighty sea miles for ships in the First Class, and fifty sea miles for ships in the two other Classes.

If the normal installation, which, in accordance with this Article, has a range of at least one hundred sea miles, satisfies all the conditions prescribed above, an emergency installation is not required.

The licence provided for in Article IX. of the Regulations annexed to the International Radiotelegraph Convention, 1912, may not be issued unless the installation complies both with the provisions of that Convention and also with the provisions of this Convention.

ARTICLE 36.—The matters governed by the International Radiotelegraph Convention, 1912, and the Regulations annexed thereto, and in particular the radiotelegraph installations on ships, the transmission of messages, and the certific tes of the operators, remain and will co: inue subject to the provisions :—

(1) of that Convention and the Regulations annexed thereto, of any other instruments which may in the future be substituted therefor.

(2) of this Convention, in regard to all the points in which it supplements the aforementioned documents.

ARTICLE 37.—Every master of a ship who receives a call for assistance from a vessel in distress is bound to proceed to the assistance of the persons in distress.

Every master of a vessel in distress has the right to requisition from among the ships which answer his call for assistance the ship or ships which he considers best able to render him assistance, but he must exercise this right only after consultation, so far as may be possible, with the masters of those ships. Such ships are then bound to comply immediately with the requisition by proceeding with all speed to the assistance of the persons in distress.

The masters of the ships which are required to render assistance are released from this obligation as soon as the master or masters requisitioned have made known that they will comply with the requisition, or as soon as the master of one of the ships which has reached the scene of the casualty has made known to them that their assistance is no longer necessary.

If the master of a ship is unable, or considers it unreasonable or unnecessary, in the special circumstances of the case, to go to the assistance of the vessel in distress, he must immediately inform the master of the vessel in distress accordingly. Moreover, he must enter in his log-book the reasons justifying his action.

The above provisions do not prejudice the International Convention for the unification of certain rules with respect to Assistance and Salvage at Sea, signed at Brussels on the 23rd September, 1910, and, in particular, the obligation to render assistance laid down in Article II. of that Convention.

ARTICLE 38.—The High Contracting Parties undertake to take all steps necessary for giving effect to the provisions of this chapter with the least possible delay. Nevertheless, they may allow :

A delay not exceeding one year, from the date of the ratification of this Convention, for the provision and training of operators and for the installation of the apparatus on ships placed in the First and Second Classes.

A delay not exceeding two years, from the date of the ratification of this Convention, for the provision and training of the operators and watchers on the ships in the Third Class, for the installation of the apparatus on ships in the Third Class, and for the establishment of a continuous watch on ships placed in the Second and Third Classes.

Wireless Telegraphy in the Italian African Colonies

By Lieut. G. MONTEFINALE, of the Royal Italian Navy

[A graphic account of the development of Italian Somaliland and of the part wireless telegraphy has played therein. The whole of the apparatus for the extensive system established there was supplied to the Italian Government by the Rome Agency of Marconi's Wireless Telegraph Company of London. Messrs. Micchiardi and Ricciardelli, of the Italian Navy, under whose supervision the stations were erected, received the privilege of a course of study in the Marconi high-power stations in Europe.]

WIRELESS telegraphy, from the very first, has proved to be of invaluable assistance to travellers, both on land and sea. More especially is this the case with those who have penetrated the wild regions of the African continent, where bold pioneers have succeeded in establishing the authority of practically all the most important European nations.

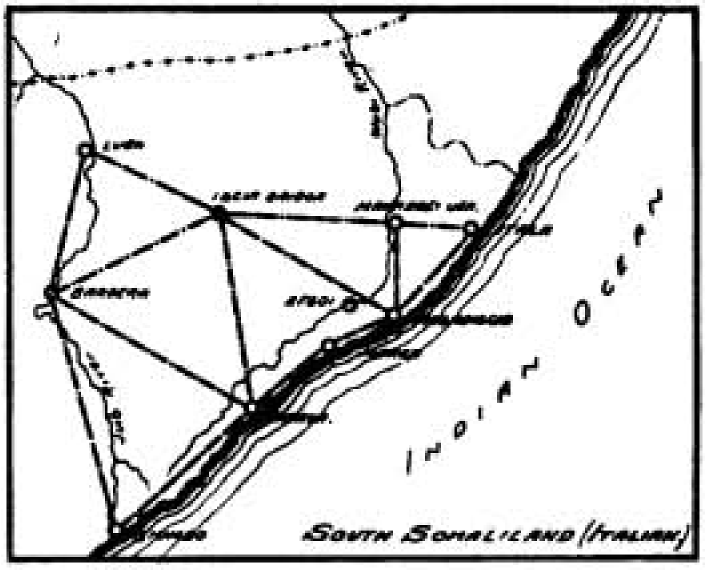
In these lands, where there were no roads, no railways, no telegraphs or any other means of distance communication the introduction of Marconi's wireless telegraphy has marked a new era of civilisation, and has played an important part in the pacification of large tracts of land which were found very difficult to control by the Governments and troops in possession of them.

The colony which affords the best example of such wireless control is perhaps the Italian Somaliland in Eastern Africa.

As is well known, it was in 1889 that Italy took up the protectorate of Northern Somaliland, from the shore of the Aden Gulf down to Warsceik on the Indian Ocean coast, under the name of Benadir. Afterwards the sphere of the protectorate was extended to take in the whole of Southern Somaliland down to Kismayu, which is the extreme northern boundary of the province of Juba in the British East Africa Protectorate.

Benadir was formerly under the control of the Sultan of Zanzibar, from whom Italy obtained the regular possession of it.

To make the occupation of Benadir of lasting effect was a task of great difficulty, and was carried out on these lines. The principal points on the sea coasts were taken possession of by the warships of the Italian Royal Navy. The enterprise was made the more difficult owing to the fanatical



attitude of the natives and the peculiar conditions of the shores, which are visited for several months in the year by the two monsoons of the Indian Ocean.

As may be imagined, these circumstances rendered communication between the points occupied on the coast—Itala, Mogadiscio, Merca, Brava, Giumbo—very uncertain, and militated largely against concerted movements of the troops stationed at one station with those of another, and this was especially the case with regard to the two farthest inland points, Bardera and Lugh. The latter station is some 300 km. from the coast. Furthermore, these great distances separating the various garrisons could only be traversed by means of caravan roads, which are at no time safe for the unpractised traveller, but which were rendered still more insecure by reason of the hostile attitude of the natives who frequented them, so that it is not surprising to learn that up to 1908 the total extent of the Italian rule in these parts was limited to the strip of sea-coast and to certain areas on the left bank of the river Giubba.

Often the Italian Governors and officials were murdered, and always the news of such disasters reached the seat of the Government too late to make relief expeditions or even punitive campaigns at all practicable. Many districts were so isolated from Mogadiscio that for many years bands of Somaliland dervishes or Abyssinian robbers were accustomed to beset and besiege them regularly, without any fear of reprisals.

Furthermore, during those long years of hampered government no regular forward movement of the troops was possible in the fertile region of the river Uebi Scebeli, which runs for a very long tract of the inner Somaliland, owing both to lack of roads and any possibility of long distance communication.

It was in 1908 that the Italian Government, after witnessing the magnificent results obtained by the Marconi system of wireless telegraphy both in Europe and across the Atlantic, decided to erect in the most important centres of Southern Somaliland a complete network of wireless telegraph stations.

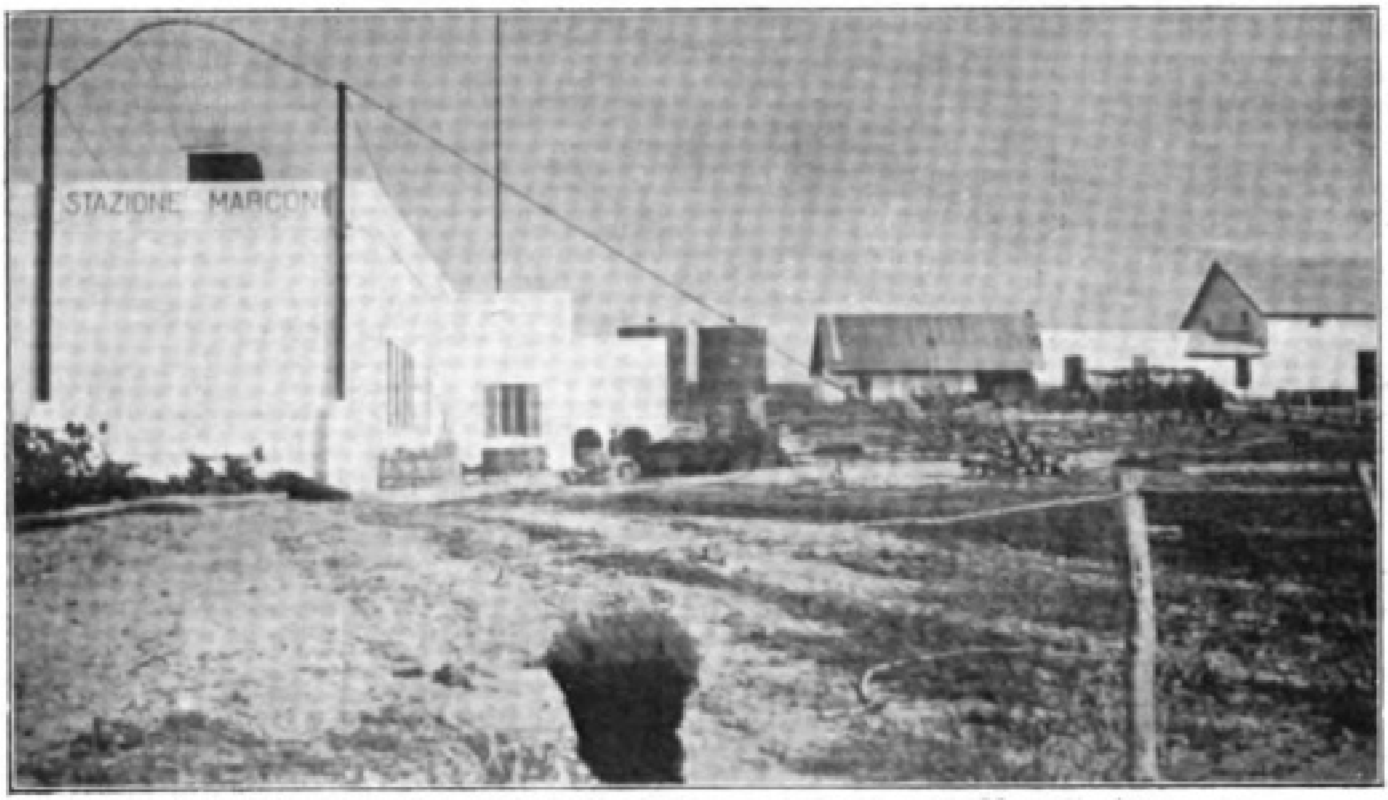
The scheme contemplated three stations of medium range (3 kw.) and four of short range. The sites chosen were: Itala, Mogadiscio, Merca, Brava, Giumbo on the coast and Bardera, Lugh, inland.

The shipment of the material, which was not an easy task, had to be carefully thought out, but finally a vessel of the Italian Royal Navy carried the material and the staff of engineers and mechanics to the scene of their forthcoming triumph.

On arrival, many further difficulties were encountered during the disembarkation of the material for the construction of the buildings, and subsequently the whole of its transportation to the inland stations had to be effected on camel-back, across the intricate paths of the thick Somaliland woods. In spite of what often seemed to be insurmountable difficulties, the stubbornness and energy of the Lieutenant of the Royal Italian Navy, Mr. Micchiardi, who was charged to carry out this gigantic task, achieved the desired result and in less than a year the whole of the Somaliland network had been completed, and connection had been established between the various points of the colony occupied by the Italian flag.

The Station at Brava.

Most important changes followed in the political and economic situation, and they were all of them entirely due to this very powerful means of communication, for by it the control of the Italian Colonial Government was immediately extended all over the area occupied, and very soon those responsible for the Government of the country were rejoiced to discern signs of the complete pacification and submission of the rebellious tribes. Meanwhile the natives themselves, especially the Indian, Arabian and Somalian merchants, of the places where Marconi wireless stations had been installed, soon became accustomed to the innovation, and after their first bewilderment was overcome they did not fail



The High Power (110 kw.) Marconi Station at Mogadiscio.

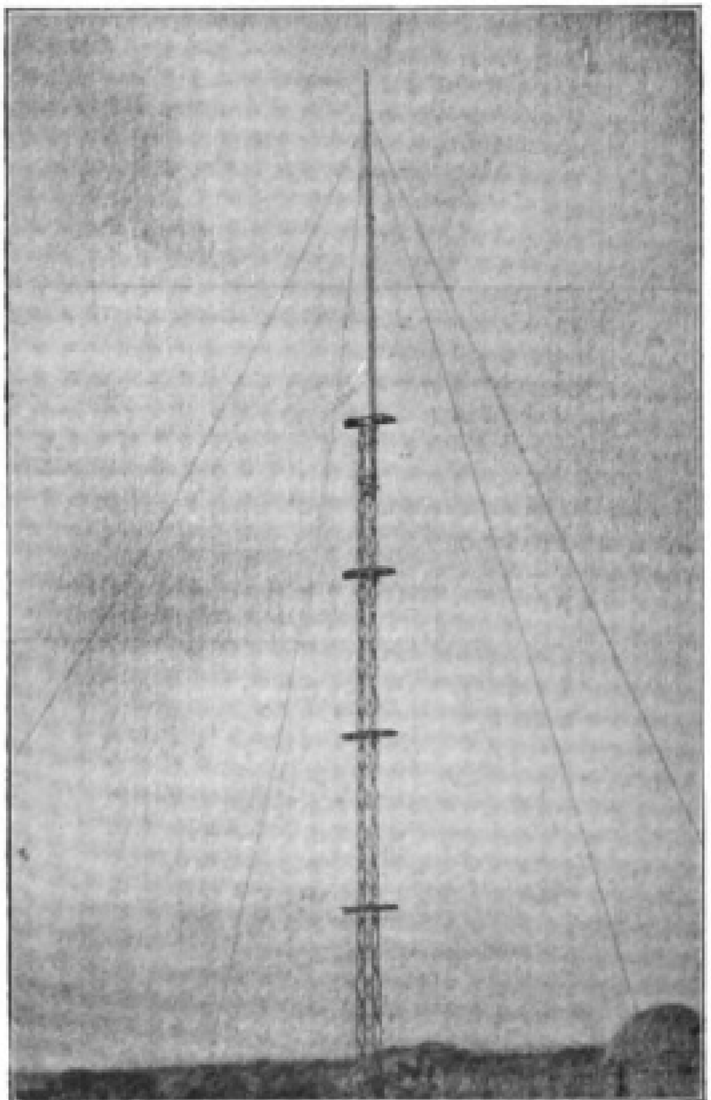
to take advantage of the new telegraph system, recognising the superiority of this means of exploiting their inland trades and even for the swifter settlement of their private affairs.

Its successful installation made it possible for the Italian troops to effect a progress to the interior regions, crossed by the river Uebi Scebeli. This had been attempted before by a handful of intrepid officers of the Italian Navy, but they had been cruelly slaughtered at Lafolé. The new expedition was equipped with field stations, whereby

View of the Indian Ocean from Mogadiscio the Capital City of Italian Somaliland.

communication with the fixed station at Mogadiscio was constantly maintained. After the main object was accomplished, these field stations were definitely installed at certain points on the mysterious river where Italian garrisons had been stationed; and they are still in existence in those places, where, in spite of the old type of the stations and their constant use, they continue to afford a very good service.

This, however, was not enough. The Italian colony of Benadir, although almost completely pacified, was not yet connected in any way with the Mother Country. All telegrams had to be sent by sea to the telegraph offices of Mombasa and Aden. If we consider that the maritime communications at that time were limited only to the north-east monsoon season, during which it is possible to establish the traffic with the land (which is altogether interrupted during the season of the south-west monsoon), it is easy to understand how often very important news would reach the central Government n Rome many weeks, even months, after date.



Mast of the Lugh Station.

It was therefore decided to erect two high power Marconi stations, one at Massawa and the other at Mogadiscio. In this way, telegrams originating from the Italian Somaliland offices could be sent, through the Massawa station and the wire telegraphs of Egypt and the Sudan, to Italy.

This time the Italian Royal Navy, in consequence of the experience acquired in the preceding installation of colonial wireless telegraph stations, were able to install the two new 110 kw. stations within a very short space of time. It should be pointed out, however, that although it is comparatively easy to erect stations of such a power in civilised countries where there are all the necessary means, it is a totally different thing to do so in the African colonies, where the conditions of life are extremely primitive and organisation far from perfect.

The Massawa station was erected in less than a year, the success of the work being due to the energy of Mr. Micchiardi, Lieutenant of the Italian Royal Navy. The signals of this station were received very clearly also in Italy.

The erection of the Mogadiscio station was more difficult, as it is situated on the dunes formed by the effect of the two monsoons on this desolate coast. The landing of the larger material, whereof some of the pieces weighed as much as five tons, was accomplished by astonishingly primitive means, and it is due entirely to the wonderful enthusiasm and ability of the Italian marines that everything was put on shore in good order, for its transfer could only be effected by the difficult negotiation of many very dangerous passages between the coral reefs, which rise through the surf, that continually dashes in white foam against their rough escarpments. The installation of this station was under the direction of Lieutenant Ricciardelli, who had among his more obvious duties to supervise and direct the blasting of a stone quarry, the digging of wells for the water necessary for the works, and the construction of the buildings, machinery and apparatus.

In November, 1911, the labour of the Mogadiscio station construction was brought to an end, and the two Italian colonies of Eritrea on the Red Sea and of the Italian Somaliland on the Indian Ocean were brought into communication over a distance of more than 1,600 km., across large tracts of dry lands, and over the mountainous range of the Abyssinian high plateau, which at times reaches to the height of 2,500 metres.

Notwithstanding the very intense atmospheric discharges of the tropical regions, the service of the two stations is carried on with the greatest regularity. The signals are received with a valve detector, and these are so strong that the human ear of moderate power may detect them.

In general, the two stations have each a 110 kw. generating plant, composed of a 2,000 volts monophase alternator, with 29 periods, designed to supply the electric current necessary to operate the station. Each of the two stations is driven by a Diesel type oil motor of 150 h.p. Such a type of motor has proved to be very practical for use in places like Massawa and Mogadiscio, where coal is charged at a very high price. Five twenty-five kw. transformers transform the 2,000 volts current into a 1,500 volts current, which serves to feed a battery of 74 condenser groups of the Poldhu type, connected in series of groups of three. The rotating disc of the Marconi system is run at a velocity of 3,000 revs. per minute by means of a special electric motor, and the spark gives a distinct musical tone.

The aerial of each of the two stations is formed by thirty parallel horizontal wires, supported and directed according to the connecting line of the two stations, by means of eight large iron towers, each 75 metres in height.

View of the Uebi Scebeli River.

Another View of Merca.

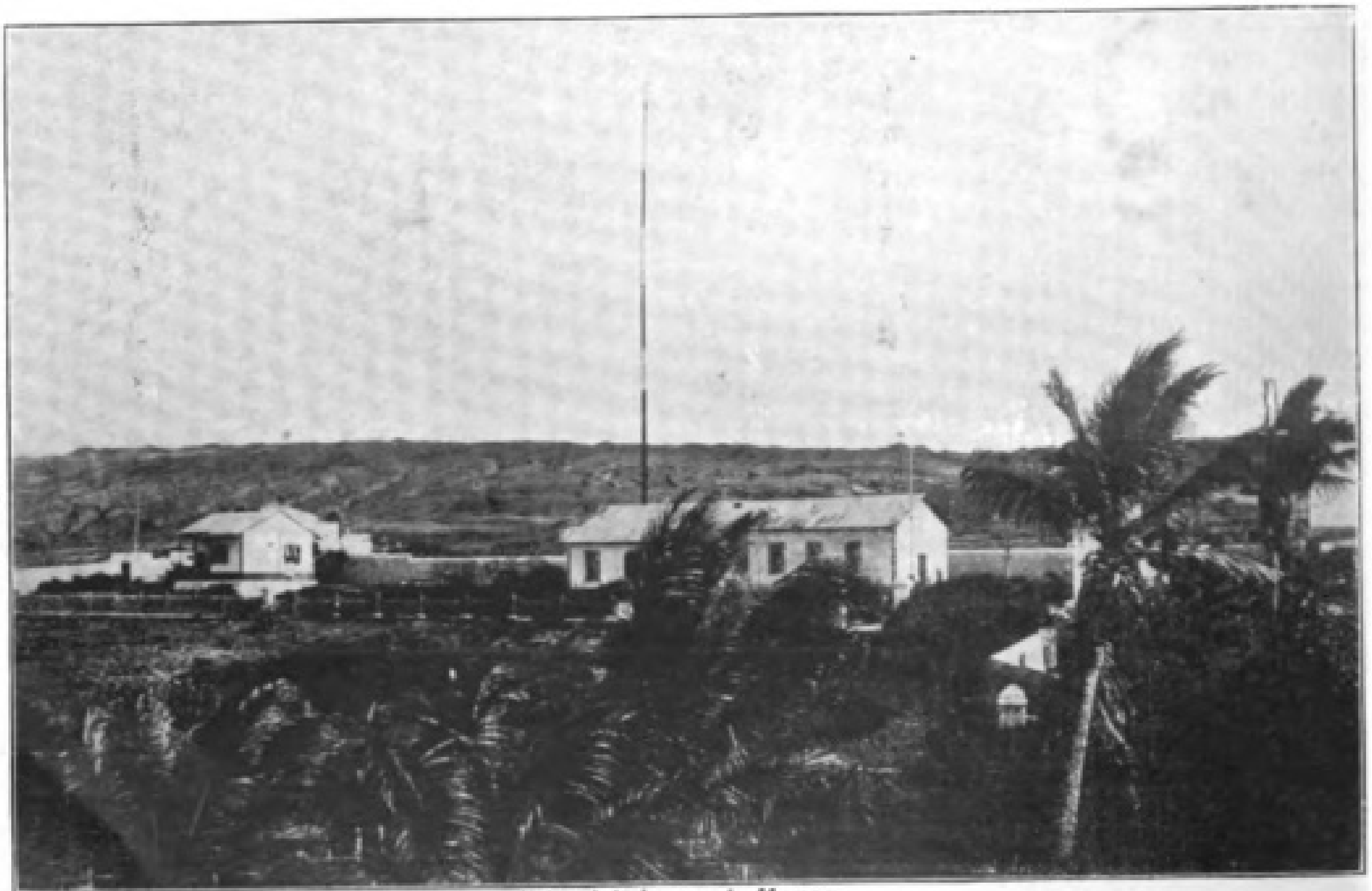
Besides the Italian authorities and the citizens of the colonies, the British Authorities of Jubaland use the high power stations of the Italian colonies in Equatorial Africa for purposes of communication with the office of the "British East Africa Protectorate" in Nairobi, while the merchants of the Benadir coast take advantage of it to send messages to Aden, Bombay, Mombasa, Zanzibar, etc.

Furthermore, the numerous ships of the ss. lines which follow the route of Aden, Mombasa, Zanzibar, Dar-es-Salaam, find in the wireless telegraph stations on the Italian coast of Benadir very convenient points for the transmission of telegrams directed to Europe and other parts of the world.

During 1913, the occupation of the Italian Government was extended to all the territory which was awarded them by the Italian-Ethiopic Convention for the delimitation of the frontiers stipulated in 1908. For that purpo se new garrisons were established in the region of Mahaddei-Uen, in the higher reaches of the Uebi Scebeli River, and at Iscia Baidoa, on the Abyssinian borders.

In these two places permanent stations of $\frac{1}{5}$ kw. and $1\frac{1}{2}$ kw. respectively were constructed. The installation at Iscia Baidoa, erected on the same plan as the others by the Italian Royal Navy, attracted especial attention, because its installation was commenced within only a few days after the occupation of the country, and this in spite of many and great hardships sustained by the staff both on account of the difficulties of transport and also of the rough living conditions, for all the regular routine to which sailors are accustomed was found to be impossible of continuance, and hardly the necessities of every-day existence could be procured, much less any of the comforts of civilisation.

But present results have amply repaid all the labours and trials of installation, for now the wireless telegraph service in the Italian Somaliland proceeds with a regularity which it seems does not exist among the networks of the regular wire telegraphs. Besides, the erection of telegraphic lines in these regions would have been absolutely impossible, especially during the first years of the occupation, for an apparently illimitable plain stretches itself out of sight from the downs of the Benadir to the foot of the Abyssinian mountains of Harrar and of Arussi, and this plain is entirely covered by a thick network of scrub and undergrowth, which is almost impenetrable, only broken here and there by narrow and intricate paths, made by the thousands of wild animals, not excluding the elephant, which make their homes in these wild regions, while the natives of these parts, no matter how friendly disposed they may be to the new order of things, are much too ignorant and superstitious to be of any use in the task of keeping such an extensive system of lines as would be required by the ordinary telegraph in proper repair. But chiefest of all there is the insurmountable problem of making the telegraph poles impervious to the attacks of termites or white ants, which encompass the destruction of anything in the shape of dried wood.



The Station at Merca.

The Production of Vibrations on Strings.

By Professor J. A. FLEMING, M.A., D.Sc., F.R.S.

[Professor Fleming exhibited at a recent meeting of the Physical Society of London an apparatus for the production of vibrations on strings, loaded or unloaded. This is described in the paper which we reprint here from the Proceedings of the Society.]

THE problem of determining the possible vibrations of a loaded string—that is, a flexible string having small masses attached to it at equal distances—is one to which many mathematicians have given attention. It suffices to mention the well-known discussion of the problem by Lagrange,* the full treatment of it by Lord Rayleigh,† and an interesting Paper by Mr. C. Godfrey ‡ published in 1898.

Of late years the matter has acquired an electrical interest from the close analogy existing between the transmission of mechanical vibrations along a loaded string and the propagation of alternating electric currents along a telephone cable having inductance coils inserted in it at equidistant intervals. In seeking for experimental methods of illustrating the properties of such loaded cables it was natural to turn for assistance to the visible oscillations produced on strings loaded or unloaded.

Almost the only method hitherto used for creating sustained vibrations on strings has been the elegant device of F. E. Melde, in which a string attached to the prong of a tuning fork is set into stationary sympathetic vibrations when the length and tension of the string is adjusted so that the vibrations travel along it in a time which has some integer ratio to the periodic time of the fork.

The objections to this method are (1) that we cannot put more than a certain tension on the string without stopping the fork even if the latter is electrically driven, (2) that when long loaded strings are employed we need very large forks to provide a sufficiently low frequency in the impulses, (3) that we cannot alter the frequency of vibration except by changing the fork, (4) that the vibrations of the string take place only in one plane and are not very visible unless viewed from a certain standpoint.

In thinking over these difficulties it occurred to me that the fork could with great advantage be replaced by a small continuous-current electric motor, the speed of which can be easily controlled and measured and made low or high enough to study the vibrations on a string of any length, loaded or not loaded, and with any reasonable applied tension.

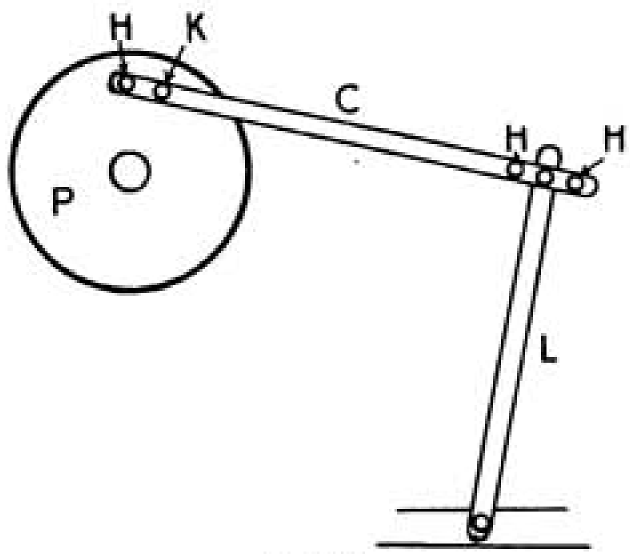


Fig 1.

The best arrangements were found to be as follows :—

On the shaft of a small continuous-current motor, say, $\frac{1}{8}$ H.P. or $\frac{1}{4}$ H.P., is attached a pulley or disc which has a crank pin (K) inserted on its outer face at a distance

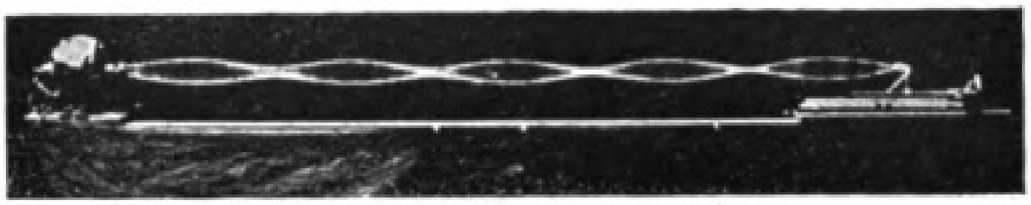
* *Mecanique Analytique*, Vol. I., part 2, sec. VI., § III.
† *Theory of Sound*, Vol. I., Chap. VI., 2nd edition.
‡ "On Discontinuities Connected with the Propagation of Wave Motion along a Periodically Loaded String." *Phil. Mag.*, April, 1898, p. 356.

of about 0·5 in. from the centre (*see* Fig. 1). To this pin is attached a light crank shaft (C) which is connected at the other end to a rocking lever (L). A small hook (H) is attached to the crank shaft, quite close to the crank pin, and another at the far end, close to the junction with the top end of the rocking lever.

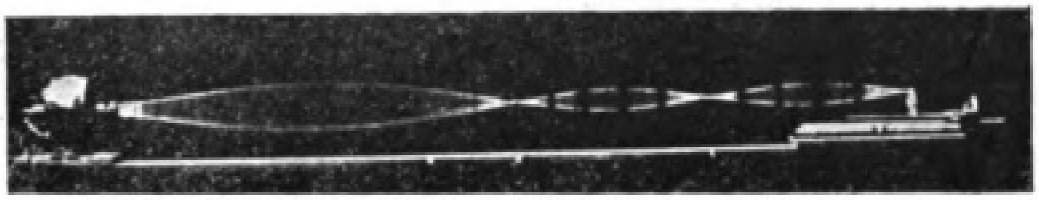
On the other end of the motor shaft is an endless screw gearing with a toothed wheel, the latter carrying a pin on its face which strikes once in every revolution against a small piece of steel clock-spring. This mechanism serves to count the speed of the motor, as we can take the time of 20 or 1,000 revolutions of the wheel by a stop-watch and, knowing the gear ratio, obtain the speed of the motor. The hook on the crank shaft near the crank pin describes, therefore, a circular path in space without rotation, and the hook at the far end of the crank shaft moves to and fro with an approximately simple harmonic motion.

If, then, we fasten a long stretched flexible cord to either hook we have the means of impressing upon the end of the cord simple harmonic motions either (1) in the direction of its length, or (2) transverse to its length, or (3) a circular motion equivalent to the combination of two simple harmonic motions differing 90 deg. in phase, each taking place in a direction at right angles to the direction of the stretched cord.*

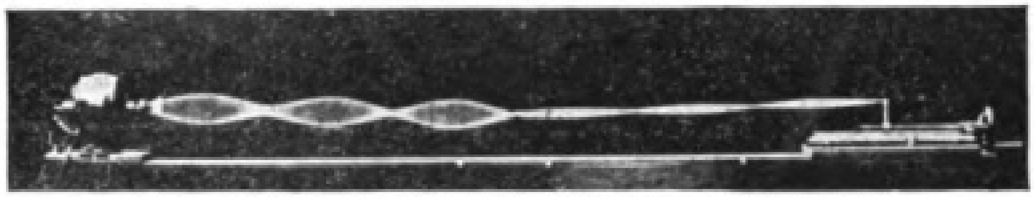
The remote end of the cord is attached to a pin which is screwed into a nut travelling on a long screw similar to the slide rest of a lathe (*see* Fig. 2). We can by this means put any desired tension on the cord, and also measure the tension by a spring balance inserted between the end of the cord and the terminal pin. If, then, we attach one end of the cord to the hook nearest the crank pin of the motor with the string stretched parallel to the axis of the motor and apply a certain tension at the other end of the string, and set the motor in rotation,



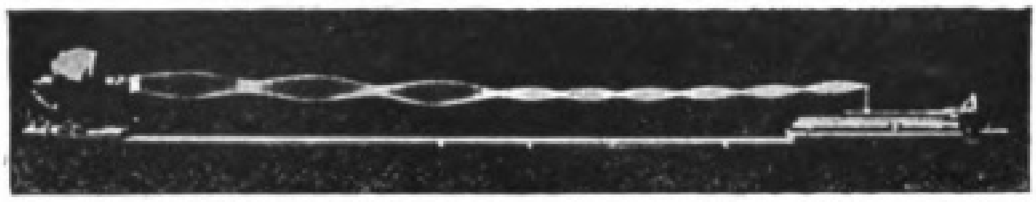
I. Standing Waves on unloaded String.



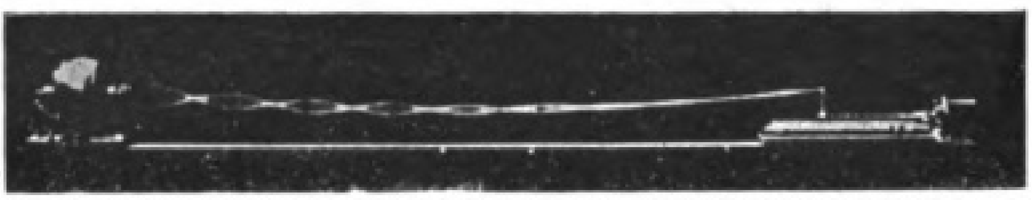
II. Standing Waves on String half-loaded, half-unloaded.



III. Reflection of Wave by load at Centre of String.



IV. Standing Wave on String half-single, half-fourfold.



V. Standing Waves on loaded String; wave length covers about 3 loads.

Fig. 2.

* Since this Paper was printed my attention has been drawn to a footnote in Tyndall's *Lectures on Sound*, Lecture III., p. 96, where he describes a lecture experiment in which a catgut cord had one end whirled round by hand by being attached to a whirling table, the other end of the cord being fixed. The result was to produce stationary vibrations on the cord. The uniformity of rotation must in such case depend on the skill of the operator, and cannot be comparable with that produced by an electric motor. Tyndall does not appear to have used this apparatus for quantitative experiments, nor for experiments on loaded strings as described by me, but he placed beads on his cord for the purpose of showing that such part of the cord was moving in a circle.

we shall have vibrations propagated along the cord so that each part of the cord describes a circular motion. By properly adjusting the tension and the speed of the motor stationary oscillations may be set up on the cord which are the resultant of two simple transverse harmonic motions at right angles and differing 90 deg. in phase. The cord, therefore, when vibrating appears spindle shaped in virtue of the persistence of vision, and if the tension is adjusted we can make the cord vibrate in a single loop or in 1, 2, 3, &c., loops up to a dozen or more segments corresponding to the various harmonics of the fundamental mode of vibration of the cord (*see* Fig. 2).

By the slide-rest arrangement the tension can be accurately adjusted so as to produce any required number of sections and keep them steady. By sending the beam from an arc-lamp lantern along the cord these stationary vibrations can be rendered visible to large audiences. We can easily measure the half wave-length or distance from node to node by a beam compass, and having also the means of measuring the speed of the motor we can calculate the velocity with which a wave motion of any wave-length producible travels along the cord.

Arrangements can also easily be made to apply a tension to the cord by means of a weight attached to the end in the usual manner by passing the end of the cord over a fixed pulley.

The cord can be loaded by fixing on it at equal intervals glass beads or cork or wooden balls, and the possible modes of vibration on this loaded cord studied. By loading half of the cord or a middle portion, we can examine the reflection effects taking place when a vibration passes from one medium to another of different mean density. The following is the simple analytical treatment of the problem.

Let us assume that the mass of each load on the cord is m, in which we must include the mass of the length of cord intervening between two loads. Let d be the distance between the masses. Suppose also that in any shape into which the cord is thrown in its vibrations the angle made by any section of the cord with the straight line joining the extremities of the cord is so small that we may take the sine of this angle as equal to its tangent. Also let T be the tension of the cord, and let y_n be the transverse displacement of the nth mass. Then, following a method used by Prof. Tait,* we have for the equation of motion of that mass

$$m\frac{d^2y}{dt^2} = \mathrm{T}\left(\frac{y_{n+1}-y}{d}\right) - \mathrm{T}\left(\frac{y_n-y_{n-1}}{d}\right). \quad (1)$$

which expresses the fact that the difference of the components of the tensions taken perpendicular to the undisturbed cord on either side of any mass is the moving force on it. If we put $y_n = \mathrm{Y}\cos(pt-qx)$, where $p=2\pi/\tau$ and $q=2\pi/\lambda$, τ and λ being the periodic time and wave-length of the motion respectively, then on substitution in (1) we have

$$-mp^2\cos(pt-qx) = \frac{\mathrm{T}}{d}\{\cos(pt-q(x+d))$$

$$-2\cos(pt-qx)+\cos(pt-q(x-d))\} \quad (2)$$

or

$$p^2 = \frac{4\mathrm{T}}{md}\sin^2\tfrac{1}{2}qd \quad (3)$$

Writing n for $p/2\pi$ and V for $n\lambda$ we have

$$\mathrm{V} = n\lambda = \sqrt{\frac{\mathrm{T}}{m/d}}\cdot\frac{\sin \pi d/\lambda}{\pi d/\lambda} \quad (4)$$

The above is a correct analysis if the vibrations are in one plane, but as regards the case under consideration, viz., when each portion of the string is moving in a circle having its plane perpendicular to the line of the undisturbed cord, we must arrive at the equation of motion in another way.

Since each load then describes a circle of constant radius y, the centrifugal force on a mass m moving with angular velocity p is mp^2y; and if we consider the load at y it is $mp^2y\cos(pt-qx)$. This force, however, is balanced by the sum or difference of the resolved parts of the tensions on either side of it, taken perpendicular to the axis of revolution. Hence we have

$$mp^2y_n = \mathrm{T}\left(\frac{y_n-y_{n-1}}{d}\right) - \mathrm{T}\left(\frac{y_{n+1}-y_n}{d}\right)$$

and by substitution for y_n of $\mathrm{Y}\cos(pt-qx)$ gives us the same equation (2) and hence (4) follows, as above.

If d/λ is very small, that is, if the loads are very close together, then $m/d=\rho$ is the average density per unit of length, and the formula reduces to $\mathrm{V}_0 = \sqrt{\mathrm{T}/\rho}$, which is the known expression for the velocity of propaga-

* *See* article "Wave," *Encyclopædia Britannica*, 9th edition.

tion of a wave along a cord of mass per unit length p and longitudinal tension T. Hence, if we call this latter the wave velocity corresponding to the uniformly distributed or smoothed out masses we have finally

$$V=V_0 \frac{\sin \pi d/\lambda}{\pi d/\lambda}. \qquad (5)$$

Also (5) can be written

$$n=\frac{1}{\pi d}\sqrt{\frac{T}{m/d}} \sin \pi d/\lambda \qquad (6)$$

From which it is seen that no frequency greater than $\sqrt{T} / \sqrt{\pi^2 md}$ can be propagated along the loaded cord. This corresponds to about three loads per wave, or when $d=\lambda/2$.

The values of $(\sin \pi d/\lambda)/(\pi d/\lambda)$ in terms of λ/d or the number of loads per wave are given in the Table I. below :—

TABLE I.

λ/d	$(\text{Sin } \pi d/\lambda)/(\pi d/\lambda)$	λ/d	$(\text{Sin } \pi d/\lambda)/(\pi d/\lambda)$
1	0	6	0·955
2	0·637	7	0·967
3	0·827	8	0·974
4	0·900	9	0·980
5	0·935	10	0·984

It is obvious that this ratio runs rapidly up towards unity and that even when λ/d is as small as 10 the discontinuous loading is equivalent in practical effect to continuous loading, as if the added mass was uniformly distributed along the string.

These deductions from theory can be easily illustrated and confirmed by the use of the vibrating string apparatus above described.

The best cord to use with it is a light inelastic cord called cotton cord, and a useful diameter is about 1*mm.* or 2*mm.* The sample I have used has a weight of 0·00839 gramme per centimetre.

A length of 2 or 4 metres was employed and one end attached to the motor, the other being led over a light aluminium pulley well pivoted and terminated in a scale pan in which weights were placed. Using appropriate tensions and frequencies the cord was thrown into stationary vibrations giving 1, 2, 3, 4, &c., half-wave lengths or loops. The frequency N (per second) and wave-length λ were measured and also the tension T of the cord in grammes weight, reduced to dynes by multiplication by 981. The product $N\lambda$ was then compared with the quotient $\sqrt{T}/\sqrt{\rho}$, where $\rho=0{\cdot}00839$. The following Table II. gives the results :—

TABLE II.—*Transverse Vibrations of an Unloaded String.*

ρ = weight per cm. = 0·00839 gramme. Length = 2 metres

No. of half-waves or loops.	Tension of string = T.		Frequency of oscillations per sec. = N.	Wave-length in cms. = λ.	Velocity of propagation.	
	Grms	Dynes.			$N\lambda$	$\sqrt{T}/\sqrt{\rho}$
1	1,000	981,000	27·9	390	10,900	10,850
2	335	329,000	31·8	200	6,360	6,260
3	150	147,000	32·9	130	4,280	4,200
4	87	85,400	32·9	98	3,220	3,220
5	50	49,100	30·7	79	2,320	2,420
With a cord 4 metres in length vibrations up to the 10th harmonic could be obtained, giving from 10 to 19 loops or half-waves.						
10	55	54,000	31·2	80	2,496	2,540
19	15	14,710	32·2	40	1,288	1,320

It will be seen that the wave velocity given by product $N\lambda$ is approximately equal to the quotient $\sqrt{T}/\sqrt{\rho}$. There is a certain difficulty in measuring the wave-length as the nodes are not very sharply defined, but the agreement is fairly good and proves that the velocity of propagation of the wave varies as the square root of the tension and inversely as the square root of the density of the cord.

A second set of measurements was made employing a constant tension of 110 grammes on the cord and variable speeds of the motor to produce different wave-lengths, and the results are embodied in Table III. :—

TABLE III.—*Transverse Vibrations of an Unloaded String.*

ρ = weight per cm. = 0·00839 gramme. Length = 2 metres.

No. of half-waves or loops.	Tension of string = T.		Frequency of oscillations per sec. = N.	Wave-length in cms. = λ	Velocity of propagation.	
	Grms	Dynes.			$N\lambda$	$\sqrt{T}/\sqrt{\rho}$
1	110	108,000	8·5	390	3,310	3,580
2	110	108,000	17·8	201	3,580	3,580
3	110	108,000	26·1	134	3,500	3,580
4	110	108,000	36·1	98	3,540	3,580
Length of cord 4 metres.						
2	110	108,000	8·7	404	3,520	3,580
4	110	108,000	17·8	201	3,580	3,580
6	110	108,000	26·9	134	3,600	3,580
8	110	108,000	36·7	98	3,600	3,580

These last results similarly prove that within the limits of wave-length employed the velocity of propagation is independent of the frequency and equal to the quotient $\sqrt{T}/\sqrt{\rho}$.

On the cord 4 metres in length there was no difficulty in producing as many as 20 half-waves quite stationary, each having a length of 20 cm.

The next step was to prepare a loaded cord by placing on the same cotton cord glass beads each weighing 0·208 gramme at distances of 20 cm. The mean density or weight per centimetre length of cord was thereby raised to 0·0188 gramme. The same experiments were then repeated with this loaded cord using variable tensions (Table IV.), and constant tension (Table V.) with the results given.

TABLE IV.—*Transverse Vibrations of a Loaded String.* Loads of 0·208 gramme at intervals of 20 cm. Mean weight per cm. $= \rho =$ 0·0188 gramme. Length of cord = 4 metres. Variable tension.

No. of half-waves or loops.	Tension of string = T.		Frequency of oscillations per sec = N.	Wave-length in cms. = λ	Velocity of propagation.	
	Grms	Dynes.			Nλ	$\sqrt{T}/\sqrt{\rho}$
3	810	795,000	25·0	266	6,650	6,510
4	550	540,000	26·8	200	5,360	5,360
5	380	373,000	28·0	158	4,420	4,460
6	265	260,000	29·1	130	3,790	3,720
7	205	201,000	29·1	110	3,210	3,280
8	180	177,000	31·2	97	3,020	3,060

TABLE V.
Same loaded string as in Table IV., but with constant tension.

No. of half-waves or loops.	Tension of string = T.		Frequency of oscillations per sec. = N.	Wave-length in cms. = λ	Velocity of propagation.	
	Grms	Dynes			Nλ	$\sqrt{T}/\sqrt{\rho}$
2	210	206,000	8·1	400	3,240	3,310
3	210	206,000	12·8	266	3,400	3,310
4	210	206,000	16·6	200	3,320	3,310
5	210	206,000	19·9	160	3,200	3,310
6	210	206,000	24·6	132	3,240	3,310
7	210	206,000	28·6	110	3,160	3,310

It will be seen that here also the wave velocity measured by the product $N\lambda$ is approximately equal to the quotient $\sqrt{T}/\sqrt{\rho}$ and that the wave velocity is independent of the frequency.

The loaded cord, however, differs from the unloaded in this respect, that whereas there was no difficulty in producing on the unloaded string as many as 19 or 20 stationary half-waves or loops, each about 20 cm. in length, it was found quite impossible to produce waves as short as this on the loaded string with loads 20 cm. apart. The latter refuses to oscillate sufficiently quickly and will not propagate waves of a higher frequency than corresponds to a wave-length of rather more than double the distance between the loads. On putting on a higher frequency at one end of the cord the vibrations or loops on it are seen to die away quickly, but sustained stationary oscillations on the whole length of the loaded string cannot be set up unless the frequency is less than the critical value.

This method of exciting the oscillations on a string can also be employed to exhibit in a beautiful manner the wave reflection that takes place at the junction between two strings of equal tension but unequal mass per unit of length or at the junction between an unloaded and a loaded string.

If we place glass beads at regular intervals on one-half of a string 4 metres long and attach the extremity of the unloaded half to the motor wheel and apply a tension at the remote end, then standing waves will be produced on both parts when the tension is adjusted (*see* II., Fig. 2). These standing waves have, however, different wave-lengths on the two parts which are inversely as the square roots of the mean cord densities. Thus in one experiment tried the standing waves had a wave-length of 100 cm. on the unloaded half of the string and a wave-length of 66 cm. on the loaded half. These two parts of the string had mean densities of 0·00839 and 0·0188 gramme per centimetre respectively. The ratio of the square roots of these last numbers is as 29 is to 43·3 and $29 \times 100 = 2{,}900$ whilst $43{\cdot}3 \times 66 = 2{,}858$. Hence the wave-lengths are nearly inversely as the square roots of the mean cord densities. The amplitude of the waves on the unloaded half of the cord was, however, much greater than that of the waves on the loaded cord, thus showing the loss of amplitude on reflection. The same thing can be better shown by employing a cord one half of which is single and the other half made of four similar cords in parallel and tied together at intervals. When this is vibrating we have waves on the four-fold part which are half the wave length of those on the single part (*see* IV., Fig. 2).

Again, if the tension was decreased slightly so as to lower the velocity and decrease the length of the waves a point was soon reached at which, whilst standing waves were produced on the unloaded half of the cord, no waves were produced on the loaded half. This happened when the length of the waves on the unloaded half was about 60 cm. and therefore those on the unloaded half should have been about 40 cm., or equal in length to twice the distance between the loads; so that one wave would cover three loads or a little more.

This experiment proves clearly that there is an inferior limit to the possible wavelength and a superior limit to the possible frequency of the vibrations which can be produced on the loaded string exactly as predicted by theory. The same reflection of the waves and loss of amplitude on passing a junction between two uniform cords of different mass per unit of length can be shown by joining two cords of equal length, one a plain cotton cord and the other a piece of whipcord or heavy gilt thread, and attaching one end of the length to the crank of the motor and applying a tension to the other end. By adjusting this tension it is easy to show the loss in amplitude of the wave in passing such a junction, or even the total reflection of the wave (*see* III., Fig. 2). This phenomenon has its electrical analogue in the loss in amplitude or reflection of the electrical waves at the junction between two conductors, say, an unloaded land line and a submarine cable, or loaded line, the two having different capacities and inductances per mile when telephonic currents are transmitted through such a circuit.

Again, we can show by this vibration apparatus the advantage of tapering off the loading in the case of a junction between a loaded and an unloaded line owing to the diminution of the reflection losses. When a wave passes from one medium to another of different refractive index, and if this index changes somewhat suddenly at the junction plane we know that wave reflection takes place. If, however, the index changes gradually the reflection losses are much reduced or else annulled. Hence, if a loaded telephone cable is connected to an unloaded cable partial reflection of the wave takes place at the junction. If, however, the loading is tapered off, these reflection losses are much reduced. This can be visibly illustrated by the vibrating string apparatus very easily. If we load one-half of a string with glass beads but taper off the loading by using towards the middle point beads or knots of gradually decreasing mass, and then attach one end of the unloaded half to the motor crank and apply a tension to the other end of the whole cord, we shall see that the reflection losses at the junction are much reduced.

The partial reflection and consequent loss of amplitude in the transmitted wave can even be shown by placing a single bead or load of appropriate mass in the centre of an otherwise unloaded string. If one end of the string is vibrated and a suitable tension applied we can produce stationary waves of large amplitude on that part of the string between the motor and the load, but the amplitude of the vibrations produced on the far side of the load is much less, thus showing the partial loss of amplitude in the transmitted vibration owing to the reflection losses.

In conclusion, a short method may be given for arriving at an expression for the velocity of propagation of an electric wave along a coil-loaded telephone cable, which was first given by Prof. I. Pupin in his important memoirs on this subject,* but which may be obtained more simply in the following manner:—

Let us assume we have a two-wire cable having capacity C and leakance S due to the dielectric between the wires, both reckoned per unit length of the circuit. Let us suppose that loading coils, each having inductance L_1 and resistance R_1, are inserted at intervals d along the cable. Also let the cable itself have a conductor resistance r and inductance l per unit of length. Let us denote the currents through three successive loading coils by i_{n-1}, i_n and i_{n+1}, and the P.D. between the wires by v_1 at a point half-way between the $(n-1)$th and nth coil, and by v_2 half-way between the nth and $(n+1)$th coil. Furthermore, let the currents and potentials be simple harmonic functions of the time and vary as the real part of ϵ^{jpt}, where $j=\sqrt{-1}$ and $p=2\pi$ times the frequency. Hence $d/dt=jp$ and $d^2/dt^2=-p^2$.

Consider, then, the section of the cable

* *See* I. Pupin, *Transactions of the American Institute of Electrical Engineers*, Vol. XVI., p. 93, 1899, and Vol. XVII., p. 445, 1900. Also *see* J. A. Fleming, *The Propagation of Electric Currents in Telephone and Telegraph Conductors*, 2nd edition, p. 110.

between the $(n-1)$th and nth loading coil. The average gradient of the current in that section of the cable is $(i_{n-1}-i_n)/d$, and if this gradient line is nearly straight the gradients must be equal to $(S+jpC)v_1$.

Also in the same manner for the next section we shall have $(i_n-i_{n+1})/d$ equal to $(S+jpC)v_2$.

Therefore, taking the difference we have

$$\frac{(i_{n-1}-i_n)-(i_n-i_{n+1})}{d}=(S+jpC)(v_1-v_2). \quad (7)$$

But if the impedance of each coil is large compared with that of the line between the coils, we can say that,

$$v_1-v_2=(R_1+jpL_1)i_n \quad (8)$$

If, however, we include the resistance r and inductance l of the cable itself apart from those of the loading coil we must write this last equation in the form

$$v_1-v_2=i_n\left\{\left(r+\frac{R_1}{d}\right)+jp\left(l+\frac{L_1}{d}\right)\right\}d. \quad (9)$$

In actual practice the inductance of the length d of the cable between the loading coils is negligible compared with that of the loading coil, and the resistance of the loading coil is small compared with that of the length of cable between the loading coils. Hence, it is sufficient to write the above equation in the form

$$v_1-v_2=i_n(R+jpL)d, \quad (10)$$

where R and L are the average resistance and inductance of the loaded cable per unit of length of the circuit. Hence, from (7) and (10) we have

$$i_{n-1}-2i_n+i_{n+1}=i_n(S+jpC)\ (R+jpL)d^2 \quad (11)$$

If the current is a simple periodic current then i_n may be taken as proportional to $\cos(pt-qx)$, where $p=2\pi/\tau$, and $q=2\pi/\lambda$ and $x=nd$. The equation (11) then becomes, by substitution,

$$\cos\ (pt-q(x-d))-2\cos\ (pt-qx)+\cos\ (pt-q(x+d))=\cos\ (pt-qx)\left\{RS-p^2LC+jp(CR+LS)\right\}d^2 \quad (12)$$

But since $-p^2=(jp)^2$ equation (12) can be written

$$(jp)^2+2\left(\frac{R}{2L}+\frac{S}{2C}\right)jp = -\left(\frac{4}{LCd^2}\sin^2\tfrac{1}{2}qd+\frac{RS}{LC}\right) \quad (13)$$

Solving this quadratic we have

$$jp=-\left(\frac{R}{2L}+\frac{S}{2C}\right) \pm j\sqrt{\frac{4}{LCd^2}\sin^2\pi d/\lambda-\left(\frac{R}{2L}-\frac{S}{2C}\right)^2} \quad (14)$$

Hence the frequency of the oscillations is given by

$$p/2\pi=f=\frac{1}{\pi d}\sqrt{\frac{1}{LC}\sin^2\pi d/\lambda-\left(\frac{Rd}{4L}-\frac{Sd}{4C}\right)^2} \quad (15)$$

Hence the velocity $W=f\lambda$ with which the wave travels is given by

$$W=\sqrt{\frac{1}{LC}\frac{\sin^2\pi d/\lambda}{(\pi d/\lambda)^2}-\frac{\lambda^2}{4\pi^2}\left(\frac{R}{2L}-\frac{S}{2C}\right)} \quad (16)$$

If then, the primary constants R, L, S and C are so related that $R/L=S/C$, that is, if the cable is sufficiently loaded to be distortionless, we have

$$W=\frac{1}{\sqrt{LC}}\frac{\sin\pi d/\lambda}{\pi d/\lambda} \quad (17)$$

Accordingly the cable will not transmit a wave if the frequency f is increased to a point at which f is greater than $1/\pi d\sqrt{LC}$, that is, if the periodic time T is less than $\pi\sqrt{Ld.Cd}$. If the wave-length is made less than the coil or load interval d, then, as shown by Mr. Godfrey (*loc. cit.*), there are curious discontinuities as the wave-length is progressively decreased. We are presented with a phenomenon analogous to the formation of absorption lines in spectra, in which a medium is transparent or more or less opaque in accordance with the wave-length of the incident light. If, in the formula (15) above, we put $S=0$, it becomes identical with the formula given by Pupin. If we put both R and S equal to zero, and if d/λ is small, then the wave velocity becomes $1/\sqrt{LC}$, and is the same as if the added inductance is uniformly distributed along the cable.

The Admiralty have accepted a tender for an important extension of the naval wireless station which is situated on Horsea Island, in the upper reaches of Portsmouth Harbour. At the present time the aerials are 180 ft. in height, but these are to be replaced with 400-ft. aerials, and the electric installation will be also improved, enabling communication to be established, it is understood, with all parts of the Mediterranean.

Off the Labrador Coast

By W. A. APPLETON

IMAGINE a barren and desolate land stretching away as far as the eye can see into bleak, unbroken solitude. Such is the rocky coastline of Labrador, washed at all times by a tumultuous grey sea, and with scarcely a patch of verdure to relieve its gauntness.

An Ungava Eskimo wearing the wireless 'phones.

Occasionally a fall of snow will cover up these bare ribs of Mother Earth with a glistening mantle, but at other times, especially during early autumn and late spring, it is repellent in its nakedness; while the sound of waves dashing against the rocks and the cries of innumerable sea birds seem to the imagination of the lonely voyager to be hostile voices, warning him off from these inhospitable shores. And yet the hardihood of man has paid no heed to such warnings, for off the Labrador coast fisher folk, not in single spies, but in battalions, carry on a lucrative and increasing business; thither, too, the fur trader makes his way to meet the Eskimo coming south from still more desolate regions and bargain the price of mink and sable and silver fox. But for all this it must not be imagined that the evidences of life and commerce on this coast are frequent. No! The distances to be covered are so great, and the visits of "creation's lords" so short, that they are lost in the waste immensity.

It would be strange if mankind did not do something to ameliorate the conditions of those who are forced by circumstances to journey thither; so that the reader will not be surprised to learn that "Marconi" has already been inaugurated on the coast and has brought the influence of civilisation to a country which is never likely to know the luxurious conditions of life which prevail in more temperate zones.

Nine Marconi stations are already in working order in Labrador. They are: Battle Harbour, Venison Island, American Tickle, Domino, Grady, Indian Harbour, Holton, Cape Harrison, and Mokkovik Harbour, and the list has been placed in order of the situation from Newfoundland northwards. Except in smaller details their equipment is identical. For the sake of efficiency, and because there is no question of "jamming," plain aerials have been used in all the stations, and have always proved most satisfactory. The distances between station and station are comparatively short, but work is not always easy, owing to the rocky land which lies between them, though up to the present communication has never failed. All stations are frequently used by the deep sea fishers, who, when commencing their season's work, always inquire first of all whether the station near their field of operations is in working trim.

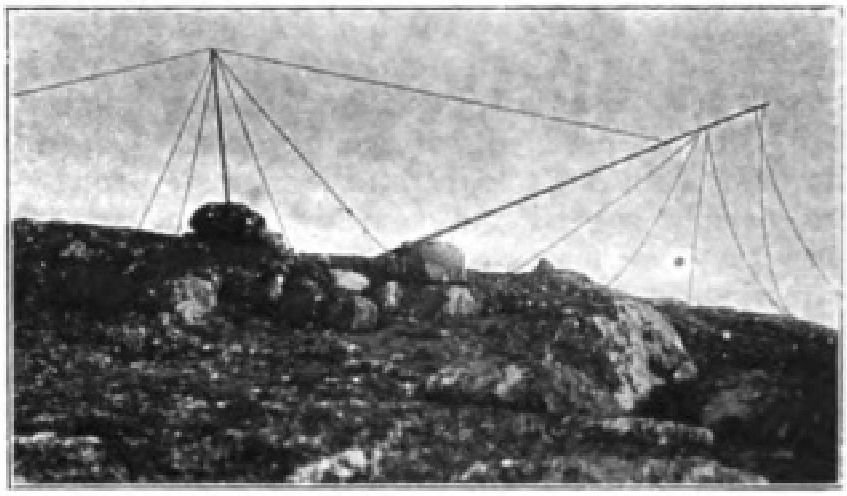
The reason for their inquiry is that the stations are actually closed down during the winter, for then the coast is icebound, and no fishing vessel dare journey northward, but as soon as the weather breaks the operators in charge of these stations are shipped back to their posts, and everything is in readiness for the approach of the fleets. Nor would any fleet be so rash as to set out on its journey without first knowing that the stations are opened for work. More especially for this reason the markets are so well regulated, and competition is so keen that the master of the vessel must have tidings of the market affairs if he is to "place" his catch to advantage. Moreover, he requires information of prevailing meteorological conditions, the state of the ice, and other matters directly applying to navigation. As soon as satisfactory news has been received from the stations in question the fleets get together, and arrangements are made to set sail on a certain day; last year this day was fixed for May 31st.

The vessel carrying the Marconi operators is necessarily the forerunner in the advance northwards, and the experiences are not without interest to the outside world. We will accompany one on the journey from station to station, which is made from year to year. Each time, of course, fresh work has to be done and fresh incidents occur, but in general details one trip is like another, so for the purpose of centralising our tale we will take the journey which was made last year.

On June 3rd the steamship *Kyle* started from St. John's, Newfoundland, with the nine operators on board. The *Kyle* is especially adapted for work of this kind, and with its sister ship, the *Invermore*, is fitted with wireless. It was built in England, and was only launched in the early part of last year. The wireless equipment consists of a Marconi 1½ kw. rotary converter set. Every fortnight she makes a trip round the stations, bringing provisions and mails, and in order that she may be able to plough through the icefields she is constructed on a special design and fitted with ice breakers. On the journey in question she had not travelled far before she found herself in a field of heavy ice, which extended for over 50 miles, and necessitated very slow progress, for it is hard work making headway against the heavy pressure of the icefloes, and great skill is required in navigating the vessel, lest this pressure should produce too great a strain on her sides or fix her so fast that it might be a question of weeks or months before the ice would give way sufficiently to allow her to proceed.

Battle Harbour from the Station Hill.

It is not an unpleasant experience to go through an icefield, especially if the weather—as it was on this occasion—is fine, for then the sight is wonderful—leagues of dazzling white ice sheets which, for all their intrinsic purity, take on prismatic colourings and radiate the light flooding over them from the depths of a clear blue sky. Here and there, where the ice is broken up into patches, it is for all the world as if the ocean had blossomed out into gigantic snowy flowers, floating like water-lilies upon the dark green waves the depth of which is intensified by the wonderful contrast.

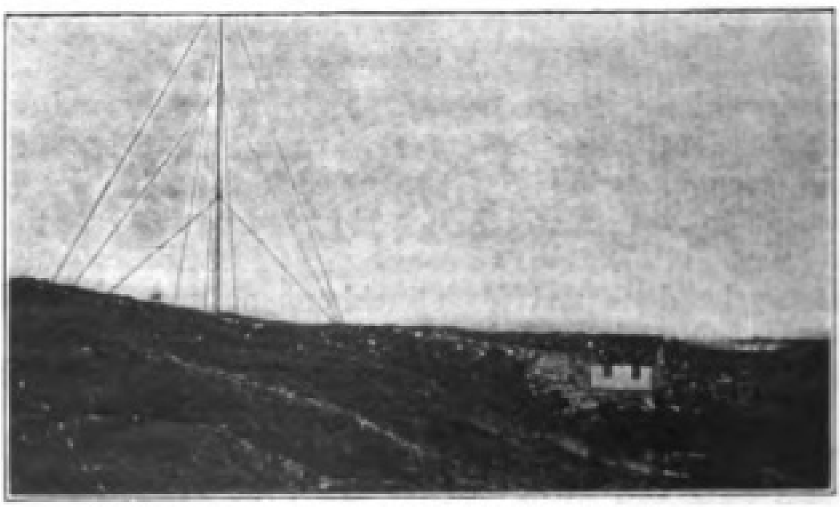


Raising the new mast at Cape Harrison.

At last Belle Isle was reached, and after that journeys were made to Venison Island, American Tickle, and Domino without much delay, but such was not the case in the progress to the next station, for before Holton was reached the *Kyle* found herself in a thick impasse which was proof against all skill and ice-breaking appliances, so that she had to give up this part of her journey and turn back to St. John's, and wait till the next trip to visit the more northerly stations. Even then her work was difficult, for the wintry conditions were stubborn, and it was late in the year before oncoming Spring had made her influence felt; when Mokkovik, the most northerly point, was reached the calendar had already registered July 8th.

The most important work that was done this season was the reconstruction of the Cape Harrison station. Labrador is noted for its terrific gales of wind and "glitter" storms. In the previous winter one such storm had done vast damage to the whole coast, and under its phenomenal onslaught the mast at Cape Harrison had broken down. The Cape is a hill of about 900 feet high, with almost perpendicular sides, and the station is situated on its summit. It is banked with heavy baulks of wood in order to secure it against the wind, but even this cannot always ensure it against damage. It was such damage that had now to be rectified, and four men were landed to complete the work. The process of conveying the men to the station was not difficult; an old skiff was launched, and soon the little party was landed; but it was quite another thing to land the material for the new mast and the provisions. The little boat, laden with heavy cargo, began to make water long before the harbour was reached, and the occupants had to bale for all they were worth to keep her afloat, and it was easy to see that if everything was to be landed safely the work had to be done expeditiously.

It was thought inadvisable to make for the usual landing stage, but to beach the boat on the nearest rock. This was done, and then commenced the laborious task of conveying the goods to the station up the precipitous cliffs; and it speaks well for the energy displayed that, with the exception of a few provisions, everything was satisfactorily transferred. Then the work of erection was commenced, and this occupied the full attention of the party. It was as well that this was so, for Cape Harrison is a lonely situation at the best of times; but this year, owing to the lateness of the season, no fishing schooners had yet arrived, so the little party of wireless enthusiasts were cut off from all the world until the station had been repaired. The work of



The Station at American Tickle.

erecting the new mast was started without delay. Entirely new steel sections were used in its construction, and it was secured as firmly as any two 63-ft. steel masts with horizontal aerials can be secured by human toil, and it will have to be a very strong gale indeed that will reduce it to the conditions of its predecessor. The collapse of the old mast was found to have been due to the entire set of northern stays giving way owing to the opening of the turnbuckle ends, but with the new equipment this is not likely to happen again. Within as short a space of time as possible communication was set up with the Holton and Mokkovik stations.

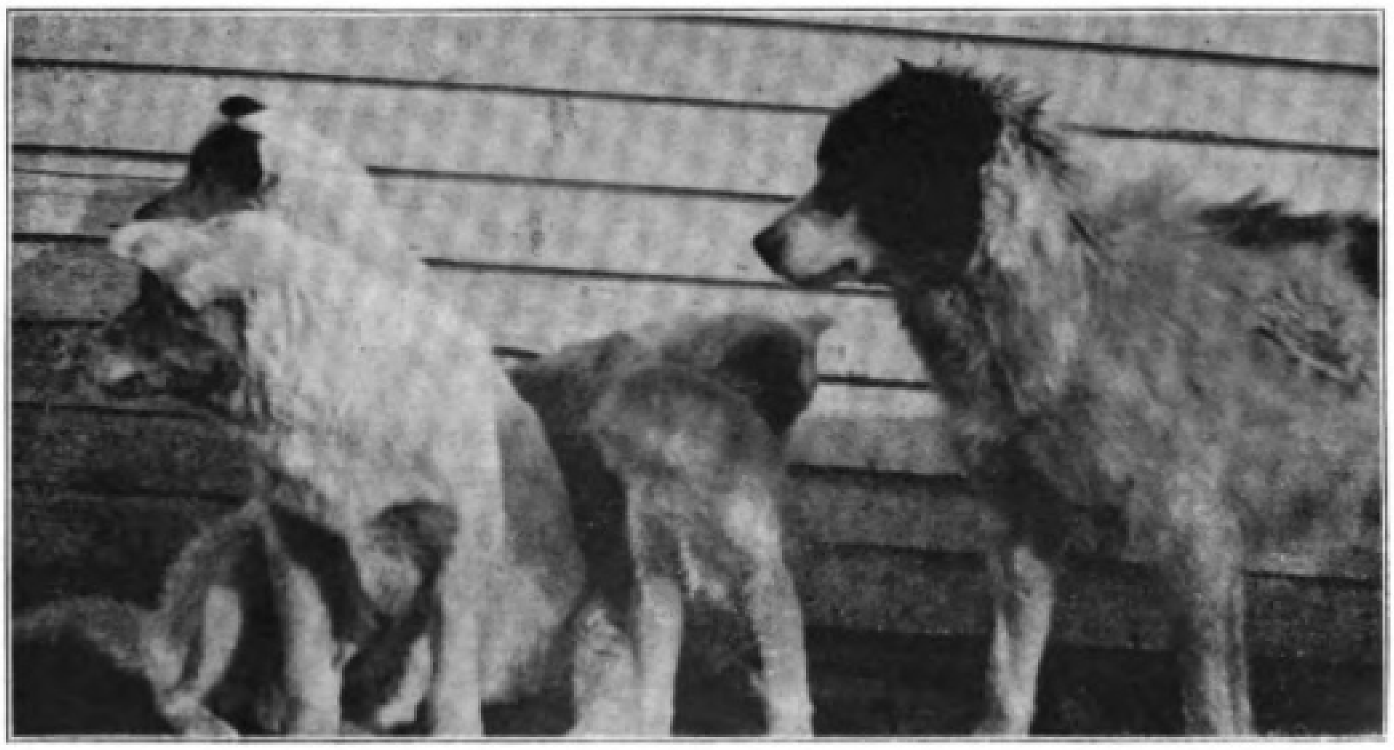
Labrador, in spite of its bleakness, is the scene of much activity between the months of June and August, and the stations are kept busy reporting catches of fish, orders for salt, and many other matters in connection with the fishery. The operator at this time has plenty to interest him. The hauling of traps, then the "making" of the fish, are scenes of daily occurrence, while every now and then a fisherman will drop in to exchange news or send a Marconigram, and is only too willing to pour his tale of adventure into sympathetic ears.

Then, in time off, good sport is to be obtained with the partridges and hares which abound in Cape Harrison, and an hour's shooting will often provide the station with dainty fare for many days.

Occasionally a few Eskimo will come down to meet the fur traders, and already they are becoming accustomed to the institution of wireless, and will sometimes pay the station a visit. Among such visitors last year was a young native of Ungava, who was on his way south to complete his education and to gain some sort of culture from civilisation. He was particularly intelligent, and took much interest in the wireless apparatus. Finally he was persuaded to be "snapped" with the wireless 'phones on his ears, and is probably the first of his race to be so photographed. Clad in his quaint native costume, with this anachronistic headgear, he makes an interesting portrait for THE WIRELESS WORLD.

But summer in Labrador is a fleeting visitor, and in the middle of October orders were received by wireless that the stations were to be dismantled and closed up for the winter and the operators were to be ready for the arrival of the steamer which was to take them back to Newfoundland.

By November work was completed and solitude was left in supreme possession of the Rocky Coast of Labrador.



Labrador Puppies from Seal Islands.

Wireless for Railways

FURTHER EXPERIENCES ON THE LACKAWANNA. ADDITIONAL STATIONS TO BE CONSTRUCTED.

THE successful application of wireless telegraphy to railways as evidenced by the achievement on the Delaware, Lackawanna and Western Railroad, reported in the February number of this magazine, has aroused the keenest interest in Europe, particularly in railway and engineering circles, where, it is not too much to state, the news was received with no little surprise.

Since that article appeared we have received further information concerning the system which may be regarded as demonstrating its efficiency without any doubt.

Wireless telegraph messages were sent and received on January 22nd without interruption by an operator on a special train on the Delaware, Lackawanna & Western Railroad, travelling from 50 to 75 miles an hour, which carried 500 members of the American Society of Civil Engineers from Hoboken to Nicholson, Penn., and back.

Mr. George A. Cullen, Passenger Traffic Manager of the Lackawanna Road, who was on the train, sent to *The New York Times* the first wireless dispatch from a moving train to a newspaper, which read as follows:

New York Times, New York:

> On board Lackawanna Civil Engineers' special, 35 miles east of Scranton, Penn., going sixty-four miles an hour. Greetings in the first wireless message from a moving train to a newspaper. CULLEN.

This message was despatched ahead of the train to Scranton and sent from the wireless station there direct to the American Marconi Co.'s station on the Woolworth Building, from which it was delivered to *The Times* office. It was six minutes from the time the message was handed to the Marconi operator on the train until it was copied by the operator on the Woolworth Building, and no wire transmission was used. The distance covered was about 125 miles.

Shortly after this message was received Mr. Hunter McDonald, President of the American Society of Civil Engineers and Chief Engineer of the Nashville, Chattanooga & St. Louis Railroad, sent another to *The Times*. The train was then twenty-five miles west of Scranton, travelling at the rate of seventy miles an hour. The message read:

The New York Times:

> The members of the American Society of Civil Engineers send you wireless greetings from their special train on the Lackawanna. No S. O. S. call is likely to be heard, as Phoebe Snow is in charge.
>
> HUNTER McDONALD, President.

More than thirty wireless messages were received and sent by the Marconi operator on the train during the day. Greetings were exchanged between passengers and their friends in New York, and news items from Scranton were received on the train.

When the train was thirty-two miles east of Scranton in the afternoon on the return trip, the *Scranton Times* sent bulletins of news to it. They were:

> Battle is expected at Torreon, Mexico, at any hour. Federals are strongly entrenched.
>
> The task of raising the sunken British submarine A7 begins in the White Sand Bay. Huge hawser passed under the vessel.

Mr. William H. Truesdale, President of the Delaware, Lackawanna & Western Railroad Company, sent a wireless message from his office in New York to Mr. McDonald. The message was received when the train was thirty miles east of Scranton. It read:

> Hunter McDonald, President of the American Society of Civil Engineers en route Lackawanna Railroad.
>
> My cordial greetings to yourself and fellow-members of the society, wishing you a very comfortable trip, and that you

will find much to interest you during your visit to our new Clark's Summit-Halstead cut-off line. WILLIAM H. TRUESDALE.

Mr. McDonald replied to Mr. Truesdale by wireless. He said :

William H. Truesdale, President.

Thanks for your wireless message. The members of the society on your special excursion train to the viaduct greatly appreciate your interest and the care you have taken for our comfort. We may Lackawanna, but we lack nothing else.
HUNTER MCDONALD.

A most convincing demonstration of the efficiency of the wireless telegraph was given when the train was twenty-five miles east of Scranton on the return trip. Several of the passengers who had heard about Mr. McDonald's messages to Mr. Truesdale and *The New York Times* went to the wireless operator's cabin and asked to see the original messages. Mr. Sarnoff, Chief Inspector of the Marconi Wireless Telegraph Co., of America, who equipped the train, was in charge. He said that the Lackawanna operator who had sent the messages had left the train at Scranton, taking the original messages with him. He immediately sent a wireless call to Scranton, however, got into communication with the operator, and, while the passengers looked over his shoulder and watched him write them, he received both messages from Scranton. They did not differ in a word or comma from those sent originally, and five minutes after the passengers asked for them they were in their hands.

Wireless stations are now being constructed at Lake Hopatcong, N.J., forty-six miles from New York, on the Lackawanna Road, and Bath, N.Y., 100 miles east of Buffalo. When they are finished the Lackawanna, with the stations at Scranton and Binghamton, will have four stations on its line with overlapping radii, so that at no time between Hoboken and Buffalo will a train equipped with wireless instruments be out of communication with a fixed station.

Both the east and west bound Lackawanna Limited trains, which run between Hoboken and Buffalo, will begin to handle commercial messages as soon as these stations are completed.

Directory of Amateur Wireless Stations.

THE announcement in the December number of the WIRELESS WORLD, that we proposed to publish a Directory of Amateur Wireless Stations, has been received with satisfaction in amateur circles in this country, and has brought a generous response to our invitation to amateurs owning licensed stations to supply us with particulars of these stations for publication in the directory.

We feel, however, that we have not by any means heard from all the amateurs who possess a Post Office Licence, and we believe that many who are not connected with any wireless society have either overlooked our notice, or have not yet taken the trouble to send us the particulars asked for. If there are any such amateurs, we would ask them to favour us with particulars of their stations at an early date, so that we may proceed with the preparation of the directory, which will then be complete in every respect.

We feel confident that in the compilation of this directory we can rely upon the assistance of the members of the amateur wireless societies, and others who are not associated with those organisations, and to whom the existence of a reliable directory will prove of inestimable value.

We shall be glad, therefore, if readers will send us, at an early date, the following particulars for inclusion in the directory :

Name and address.

Call-letters.

Whether the station is for transmitting and receiving, or receiving only.

Transmitting range, in miles.

Transmitting wave-length, in metres.

Receiving range.

Usual hours of working.

General remarks.

Secretaries of wireless associations and clubs will oblige by sending names of their officers, address of headquarters, call-letters and any other useful information.

This directory, when complete, will be distributed free of charge to our readers.

Administrative Notes

Australian Inland Communication.

Residents of Casterton and Strathdownie, in Victoria, Australia, expect to be able shortly to communicate by wireless. The Commonwealth Postmaster - General (Mr. Wynne) has issued instructions for the stations to be erected as expeditiously as possible, as he is anxious to have a practical test as to the efficiency of the system before establishing communication of the same kind between other centres.

* * *

Operators' Certificates in Brazil.

The Brazilian Government have published a notice in the *Diario Official* recognising the certificates given by the Marconi school in Brazil as official. The Director of Posts, Telegraphs and Illumination has been ordered to *visé* the certificates, and the Treasury has been ordered to register them. Under the new wireless regulations which have already been approved of by the Government, and which are shortly to be published, all the operators on ship and shore stations must have a diploma conferred by a recognised school and *viséd* as above. No further licence is required by the operators. At present the Polytechnic and the Marconi school are the only schools officially recognised for granting certificates.

* * *

Regulations for Cargo Vessels carrying Explosive Gas.

The following notice, dated January 9th, has been issued by the Department of Commerce, Washington, U.S.A., to the Government wireless telegraph inspectors : " When inspecting the radio apparatus on tank vessels or cargo vessels carrying gasoline or similar substances which generate an explosive gas or any other explosive which might be ignited by electric sparks caused by the operation of the radio apparatus, you will pay particular attention to the insulation of the antenna, to metallic rigging or equipment of the vessel in which currents may be induced by the action of the radio apparatus, and to the wiring and electrical equipment of the vessel in which currents may be induced by radio apparatus so as to cause sparks to jump between wires or between small gaps. In general this matter should be brought to the attention of masters of vessels, steamship owners, and wireless telegraph companies. If upon inspection sparks of the above character are found, the matter will be reported to the master of the vessel, the steamship company or its agents, and to the company operating the wireless apparatus, and the dangers pointed out."

* * *

Coast Charges.

Commencing January 20th, the coast charge of the Havana (Cuba) Radiotelegraph Station (Call letters HV), was: For messages exchanged with vessels in the Trans-Oceanic service, 4d. per word, with a minimum charge for 10 words ; for messages exchanged with vessels in the American coastwise service, 3d. per word, with a minimum of 10 words. This station is operated and controlled by the Marconi Wireless Telegraph Company of America.

According to the *Telegraph and Telephone Age*, James Dunlop Smith and Elmer E. Burlingame, who were convicted on January 1st of having used the mails to defraud, in connection with the sale of stock of the Radio Wireless Telephone Co., were sentenced, on January 7th, in the Federal District Court, New York, by Judge Hunt. Smith, who had been president of the Radio Wireless Telephone Co., was sentenced to twenty-one months' imprisonment in Atlanta Penitentiary and to pay a fine of $5,000, and Burlingame to two years and six months in the same institution and to pay a fine of $10,500. The Ellsworth Co., which was also a defendant, was fined $10,500.

NOTES OF THE MONTH

WIRELESS FOR INLAND COMMUNICATIONS. SOLVING THE SERVANT PROBLEM IN AUSTRALIA. STEAM TRAWLERS AND WIRELESS. A NEW ELECTRIC WAVE THEORY. THE SHARE MARKET. HONOURING CAPTAIN INCH.

The example of the Postmaster-General in deciding to substitute wireless telegraphy for the existing overhead land lines in exposed parts of the United Kingdom is to be followed by the Government of the Commonwealth of Australia, so as to bring outlying country districts into permanent communication with all the towns and business centres. It is stated that twelve wireless installations will be established immediately in the country districts of Queensland and New South Wales. These are expected to be ready in the course of a couple of months. Experiments will then be carried out to test their reliability, and should these prove successful, as they are expected to do, steps will be taken immediately to link up all the isolated settlements in Australia by means of wireless installations. The Federal Government have also decided to employ wireless telegraphy as an aid to the construction of the transcontinental railroad and to the operation of trains. Parts of the route through which the railway is to run are frequently visited by severe storms, and wire communication suffers much in consequence. In this there are the Marconi Company's successful experiences in America as a guide.

* * *

A novel fact that we announced some months ago has now received confirmation in a Government publication. We pointed out that the demand for domestic servants in Australia was so great that often women immigrants were engaged by wireless telegraphy while on the high seas and before the ship sighted land. This fact has been discovered also by the Dominions Royal Commission, who have just concluded their sittings in London and who issued, at the beginning of last month, a report in which appears the following interesting paragraph: "The demand for female domestics, both in Australia and in New Zealand appears to be imperious and practically unlimited. In some cases, before a ship carrying women migrants sights the land a large number of its passengers have been engaged by wireless telegraphy. In other cases would-be employers go out in tugs to meet it. On the day of its arrival in port, or on one of the following days, according to the varying customs of different places, something recalling the scene of the hiring fair takes place at the receiving homes or the Labour Bureau. Intending employers attend in hundreds, and all the servants with any pretensions to skill and character are engaged at once." To the overworked colonial housewife wireless is, therefore, a boon which she probably never contemplated.

* * *

With the result of Messrs. Hellyer's experience before him, Mr. G. L. Alward had every justification for advocating, as he did when speaking at the prize distribution of the Grimsby Technical School for Fishermen, that "all steam trawlers should be equipped with wireless apparatus." Vessels now venture into the Arctic Circle in mid-winter in search of fish food, a thing undreamt of but a few years ago. Fishermen have to face every conceivable peril of navigation, and anything which can be done to lessen the risks of their calling should be done. Vessels sometimes get fast in the ice in northern latitudes, and if only there were means of communication it is possible that such distressing calamities as that of the loss of the *Monimus* might be avoided. Mr. Alward appealed to the Corporation to include wireless telegraphy as one of the studies at the school, and to trawler owners to equip their ships with the necessary apparatus. It is encouraging to note that Alderman Sir George Doughty, M.P., and other members of the Education Committee who were present at the prize distribution, expressed approval of Mr. Alward's suggestion and promised it their support.

A mild sensation was caused during the past month by the report that "a well-known French engineer" (of whom, by the way, we do not appear to have heard before) had "discovered" that "dangerous explosions are liable to occur at the meeting points of wireless electric waves." This startling theory was backed by the reminder that "the *Volturno* disaster took place just at the junction point of the Eiffel Tower and Glace Bay wireless lines (!) and the recent mining explosion near Cardiff on the Clifden-Paris line (!), while Toulon, where the explosions on board the battleships *Jena* and *Liberté* occurred, is on the Paris-Bizerta line." Some of our friends in the press appear to have taken this report seriously, and one writer has become so scared by the horrible possibilities which lie ahead (according to the latest theory, of course) that he demands "prompt and thorough measures of prevention, even if the rapidity of the development of wireless telegraphy is checked by them." We hope that timid persons will accept our assurance that nothing of the kind predicted can happen. Anybody at all acquainted with wireless knows that the waves do not leave the station like a bolt! They spread out like a vast fan; therefore, if you send a message from England to America the waves are meeting at an indefinite number of points right across the Atlantic.

* * *

A graceful act of recognition to heroism was performed at the Mansion House on February 4th, when Captain Inch of the *Volturno* was presented by the Lord Mayor with the *Quiver* Hero's gold medal, a gold watch and chain, a silver casket to contain a certificate of the Freedom of London, and Mrs. Inch with a diamond and sapphire pendant and an afternoon tea service.

The Lord Mayor, in making the presentation, briefly and very aptly referred to the hero's work in the following words:—

> "We ask your acceptance of the accompanying gifts in recognition of your heroism and staunch allegiance to duty during the burning of the S.S. *Volturno* in mid-Atlantic on October 9th and 10th, 1913. For upwards of 24 hours the lives of more than 500 passengers and crew were in the gravest peril. But for your coolness and daring, your unfaltering courage and personal sacrifice, the loss of life must have been appalling. You averted a great maritime disaster. Lord Desart, as President of the Board of Trade inquiry into the burning of the *Volturno*, commended your conduct in the highest terms, and no greater tribute could be paid to any man than the eloquent words he applied to you—'He did his duty.'"

* * *

Mr. Marconi, who was present, endorsed the sentiments expressed by the Lord Mayor, adding that he was very glad to accord his tribute to the heroism of Captain Inch. It was the greatest possible satisfaction to him that wireless telegraphy and those who were working it were not found lacking in what they meant to do, even to the extent of summoning the far-distant oil-tank *Narragansett*. The story of the disaster showed that while they lived in a mechanical age of steamships and wireless telegraphy sailors were still as prone as ever to heroism. One of his greatest happinesses was that his work brought him into close touch with sailors. All who had to do with wireless telegraphy were proud that it made communication possible which formerly was not possible, and that it was able to bring assistance to ships in distress.

Captain Inch, on rising, returned thanks in an admirable little speech, concluding with the remark, which all who have followed the story of the disaster and the work of rescue know to be fully justified, that "thanks were especially due to Mr. Marconi, since had it not been for his wonderful invention they would have all perished in the *Volturno*."

* * *

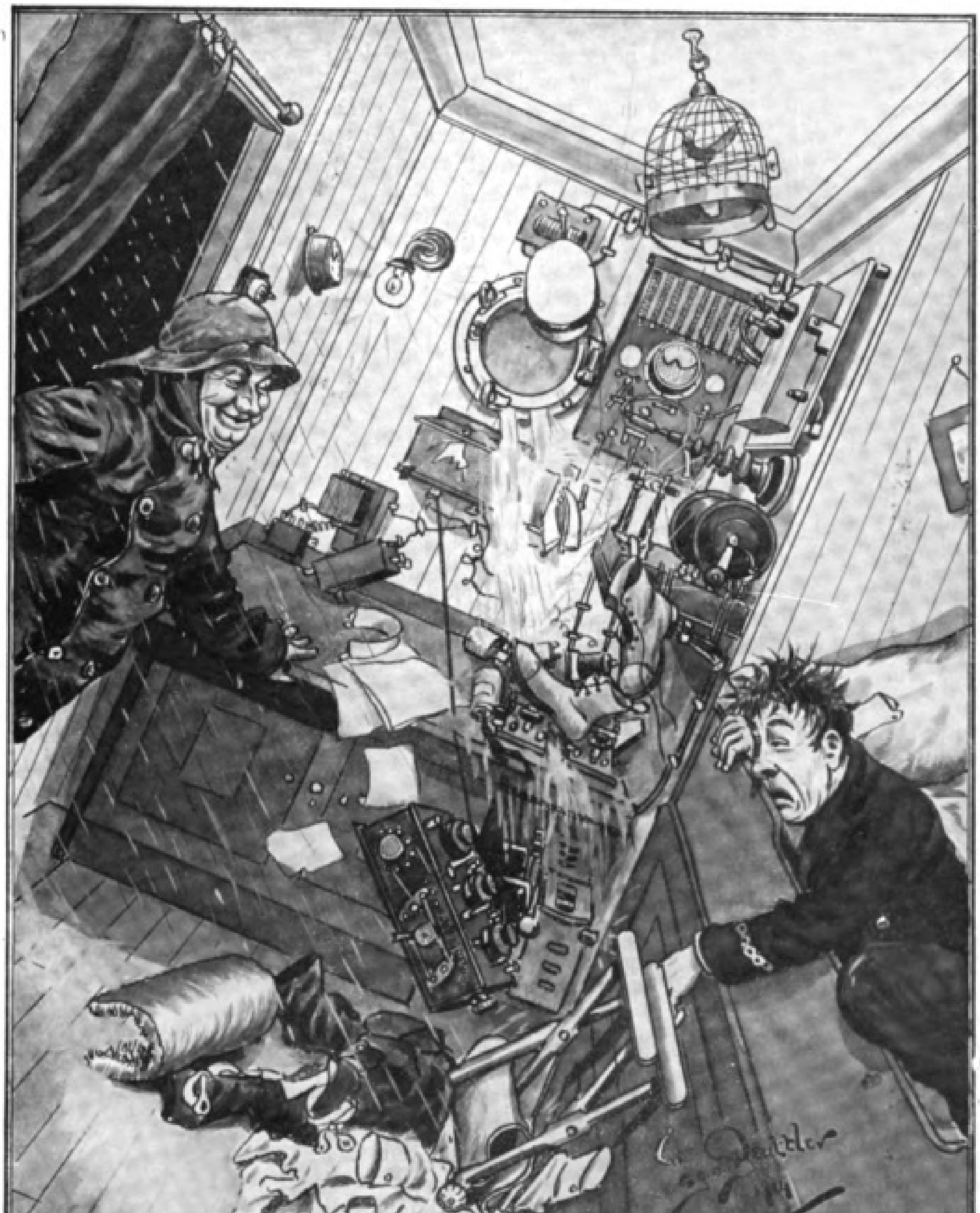
The Share Market.

LONDON, ***February 20th.***

Since our last share market report there has been considerable activity in the various Marconi issues, Marconi Ordinary touching £4 3s. 9d. Prices, however, are now lower in sympathy with the general dullness of stock markets. Marconi Ordinary, £3 13s. 9d.; Marconi Preference, £3 1s. 3d.; Canadian Marconi, 10s. 6d.; Spanish Trust, 12s. 6d.; American Marconi, £1 1s. 3d.; Marconi International Marine, £1 13s. 9d.

CARTOON OF THE MONTH

WIRELESS WORRIES—III.



AN OPERATOR'S FIRST TASTE OF BAD WEATHER.

QUARTERMASTER: "The Capt'n wants to know if yer've got Poldhu yet, sir?"

Maritime Wireless Telegraphy

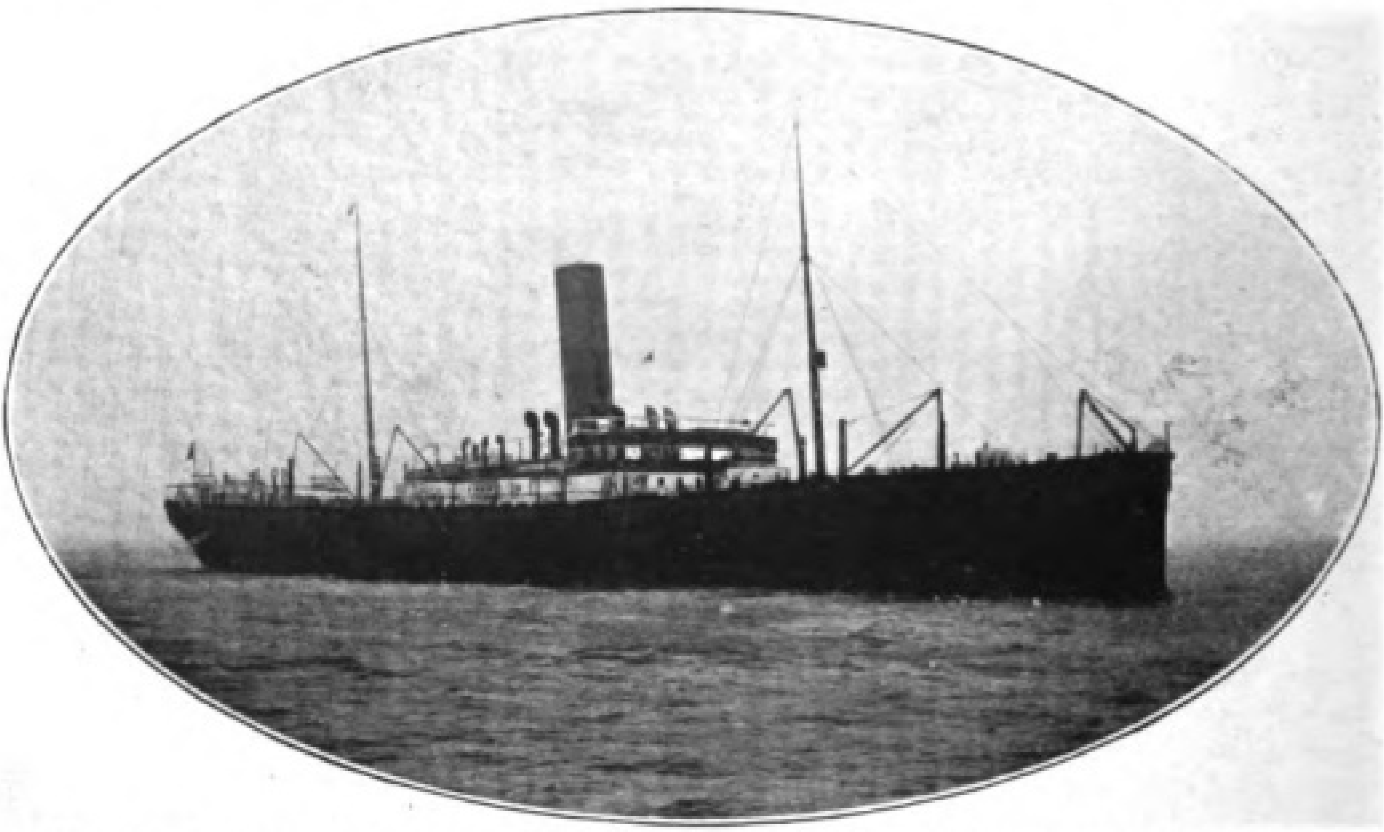
THE most conspicuous of the maritime annals of last month was the stranding of Mr. Vanderbilt's yacht the *Warrior* off the Colombian coast.

The disaster occurred on Tuesday, January 28th, when the *Warrior* struck one of the most perilous parts of this dangerous coast, a part which is popularly known as "The Graveyard of Ships," between Savanilla and Santa Marta. The accident occurred at 6 o'clock in the morning, when the cry "Breakers ahead!" was raised by the look-out, and immediately afterwards the vessel touched bottom. She had struck rocks which, owing to the high sea and the spray-charged atmosphere, were only visible a moment before. Then she slipped off again, a mere plaything in the clutches of gigantic waves. Finally she came to rest with her sides battered hard against the rocky coast formation.

The crew endeavoured to back the vessel off into deep water, but abandoned their attempt when it became apparent that, owing to the nature of the ship's injuries, such a course might sink the *Warrior* even more quickly than in its present perilous situation.

Repeated calls for help were sent out by "wireless," but it was not till noon that the message was picked up by the *Frutera*, one of the United Fruit Company's line, which immediately headed to the work of rescue. Already the position of the *Warrior* had become so perilous that the crew of the yacht were about to launch the lifeboats when they received the *Frutera's* reassuring message. The rescue ship arrived late in the afternoon, and found they were none too early, and immediately sent out messages to her sister-ship the *Almirante* to come and assist in saving the disabled vessel.

The party on the *Warrior* (which included the Duke and Duchess of Manchester and



The Anglo-American Oil Co.'s Tank Steamer "Narragansett," equipped with Marconi apparatus, which was one of the vessels responding to distress call of the ill-fated "Volturno," and which rendered splendid service on that occasion.

Lord Falconer, the son and heir of the Earl of Kintore, besides Mr. and Mrs. Frederick Vanderbilt), had for the last few hours been veritably face to face with death, as they waited, lashed to the rails of the derelict vessel, for an answer to the wireless call for aid.

The *Frutera* lost eight lifeboats trying to reach the shipwrecked party, and would herself have gone ashore had it not been for the arrival of the *Almirante*. A terrible sea was running and the wind blew a gale. The first boat launched was smashed almost before it reached the water, several sailors being stunned as they were hauled against the steel sides of the steamer. The succeeding boats were capsized almost immediately they were launched, and their crews were only saved from drowning by the timely throwing of lifebuoys. In the end all were picked up safely, but in some cases it required much time to resuscitate them. For three hours this hopeless work proceeded; then came the *Almirante* in response to the *Frutera's* call. The sea was now less stormy, and two boats were lowered from the *Almirante*; together they were successful in reaching the *Warrior*, and in taking her passengers off, but the captain and crew refused to leave the vessel in the hope that they might be able to save her when the high seas abated.

As soon as the rescue party were aboard, the *Almirante* returned to Colon, the *Frutera* remaining to stand by the wreck, and she was assisted in her watch by a salvage steamer which put out from Jamaica immediately on receipt of the news.

For the next few days the captain and crew of the *Warrior* remained on their vessel, but their heroism did not jeopardise their safety, while their relatives at home were kept assured that all was well by continuous messages, which were sent from the vessel to New York.

Unfortunately hopes of salvage were destined to be disappointed, for shortly after the passengers had been taken off the vessel shifted into a still more difficult position, and finally it had to be abandoned as a total wreck.

The *Warrior* was one of the finest yachts floating; she was of steel construction, 282 feet long, had twin screws, and was equipped with wireless apparatus by the Marconi Wireless Telegraph Company of America. She was a schooner rigged with a large funnel and graceful clipper bows, on which was a figurehead of a "Warrior" with a gleaming sword over his shoulder, similar to that borne by the old British battleship of the same name.

* * *

The Liverpool Salvage Association's steamer *Ranger* has arrived in the Liverpool docks after successfully salving the Stott liner *Ussa*, which, with a valuable cargo, ran ashore on the Hebrides. Before going to her berth at Holyhead the *Ranger* is to be equipped with Marconi wireless, which has already been installed in the salvage boat *Linnet*, stationed at Southampton.

The Argentine Government radiotelegraphic station at Cape Virgenes was destroyed by fire early in the New Year.

* * *

An outbreak of fire in the power house of the new Post Office wireless station at St. Just (Cornwall), on February 15th, did considerable damage. The fire brigade were summoned from Penzance, but the outbreak had been got under by the local men before their arrival. The roof fell in and the apparatus was put out of operation.

* * *

Ten years ago a boy and girl *affaire* was brought to an end through a proposal being lost in the post, but the error of the mail system has at last been rectified by a marconigram, for Mrs. Frances Thompson while on a recent voyage across the Atlantic received another offer of marriage from her aforetime suitor and marconied her acceptance. The man in the case is a Mr. F. Macintyre, who in the early days lived at Leith, Scotland, where Mrs. Thompson resided as a girl. On reaching manhood he emigrated to America to make his fortune, and this accomplished he sent the proposal which was fated never to reach its destination. The romance seemed at an end, and the girl married. A year ago her husband died, and last Christmas Mrs. Thompson decided to visit some friends in America. Hearing of this, Mr. Macintyre, trusting no longer to the vagaries of the post, wirelessed his important message—and the invisible agent did the rest.

INSTRUCTION IN WIRELESS TELEGRAPHY

(End of First Course.)

Aerials.

[The first article of this series appeared in the May 1913 number of THE WIRELESS WORLD. This article completes the first series, and special attention is therefore directed to the announcement concerning the examination which appears on p. 758 of this issue. Back numbers of THE WIRELESS WORLD in which the earlier articles have appeared will be sent by the Publisher at Marconi House, Strand, London, W.C., on receipt of remittance of 5d. per copy.]

69. The function of the aerial of a wireless telegraph station is twofold.

In the first place, oscillatory currents flowing in the aerial will cause disturbances in the ether surrounding the aerial, which disturbances radiate in all directions in the form of pressure waves.

In the second place, any disturbances in the ether surrounding the aerial, such as those caused by the passing of a pressure wave, will produce oscillatory currents in the aerial.

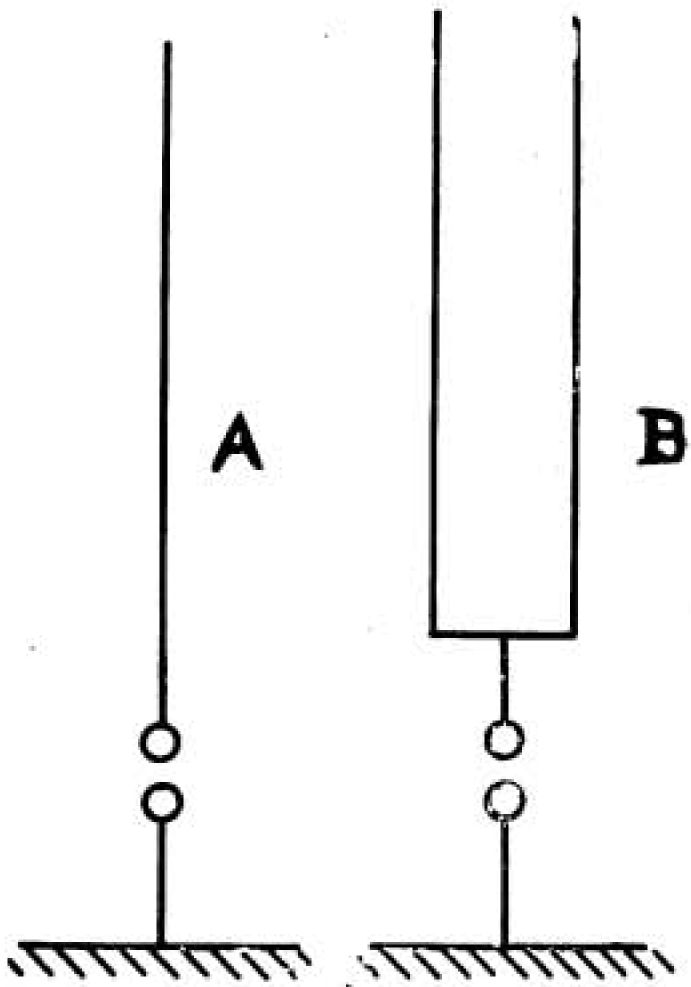


Fig. 1.

Thus, by connecting the aerial either to the transmitting instruments, which are designed to induce oscillatory currents into it, or to the receiving instruments, which are designed to detect oscillatory currents flowing in it, the aerial is used both for transmitting and receiving messages.

70. The first essential of the aerial is to be a good "radiator" and a good "responder."

The second essential is that its electrical dimensions should be suitable for the wave-length it is desired to transmit or receive.

The third essential is that it should be convenient to erect and use.

Efficiency of an Aerial.—Taking the first point, we find that any aerial that is a good "radiator" is also a good "responder."

We also find that its efficiency as a "radiator" increases very rapidly as its average height above the ground is increased; in fact, we find that if we double the height of the aerial we double the range of the station without any increase in the power.

It is important that the number of wires and the size of the wire forming the aerial is sufficient to carry the current which is induced into it by the transmitter without excessive loss due to the resistance of the wire.

The object of these Articles has been to educate the student in the intelligent use of the apparatus for small stations, particularly small portable stations, and as the currents dealt with in such stations are comparatively small, the size and number of the wires in the aerial will not be of great importance.

71. Electrical Dimensions of an Aerial Wire.—The next point to consider is the electrical dimensions of the aerial wire, which must be suitable for the wave-length or wave-lengths it is desired to transmit or receive.

The aerial is most efficient as a "radiator" when neither inductance nor capacity have been connected in series with it, and since the only way to increase the wave-length of the aerial circuit is to connect an inductance in series with it, and the only way to decrease its wave-length is to connect a condenser in series with it, it follows that the most efficient aerial is one whose natural or "fundamental" wave-length is that which it is required to transmit or receive.

It is found that the addition of an inductance or condenser in series with the aerial has a greater effect on its efficiency when used as a transmitter than when used as a receiver, so that where an aerial is used for both purposes it **is usual to design the aerial so that its fundamental wave-length is nearest the wave-length used for transmission.**

The addition of an inductance in series with the aerial reduces its efficiency to a less extent than the addition of a condenser, chiefly on account of the losses in the dielectric of the condenser, so that where it is required to transmit more than one wave-length on the same aerial, **the aerial is usually designed to have a fundamental wave-length equal to or shorter than the shortest wave-length required.**

Another reason for this is that an inductance coil suitable for increasing the wave-length of an aerial from, say, 300 metres to 600 metres is far cheaper to construct than a condenser which would be required to reduce the wave-length of the aerial from 600 metres to 300 metres.

72. Fundamental Wave-length.—Every aerial has its own natural wave-length, called its fundamental wave-length, depending upon its capacity and its inductance. If we increase either its capacity or its inductance we increase its wave-length.

In the aerial wire itself these two qualities are, so to speak, mixed, and distributed along the whole length of the wire, so we cannot alter one quality without varying the other.

If we increase the length of the aerial wire, we increase both its capacity and its inductance, and thereby increase the value of its fundamental wave-length, but **if we add on to the aerial another parallel wire, although we increase the capacity of the aerial, we decrease its inductance,** and therefore its fundamental wave-length remains more or less unaltered.

If, however, the additional wire instead of being kept parallel with the original wire, spreads out radially, as in the case of the "umbrella" aerial, and also if its extremities approach the earth, as is usually the case in the "umbrella" aerial, and is sometimes the case in the "T" aerial, then **the capacity of the aerial is increased more rapidly than the inductance is decreased,**

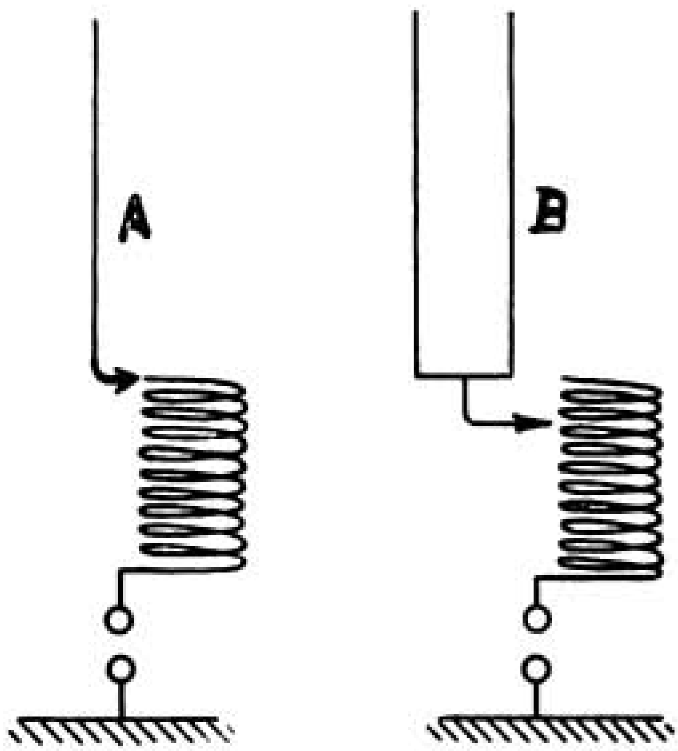


Fig 2.

and therefore the fundamental wave-length is increased.

73. In practice it is found that with single wire aerials or parallel wire aerials, whose wires run either vertically or horizontally with the earth, the wave-length is usually about 4½ times the length of the aerial. With a "T" aerial, the upper portion of which is kept horizontal with the earth, the fundamental wave-length is about 5 times the length of the aerial, but if the ends of the wires are brought down so as to approach the earth, the wave-length will be still further increased.

With an "umbrella" aerial, the wave-length may be as much as 8 times the length of the aerial, according to the number of radial wires forming it and the height of their ends from the earth.

Thus, two or more aerials, both having exactly the same fundamental wave-length, can have different proportions of capacity and inductance.

Two such aerials are shown in Fig. 1, where " A " is a single wire aerial, 100 feet long, and " B " is a two-wire parallel aerial, each wire being 100 feet long.

The fundamental wave-length of both aerials will be about 425 feet, but the aerial " B " will have a greater capacity and a smaller inductance than the aerial " A."

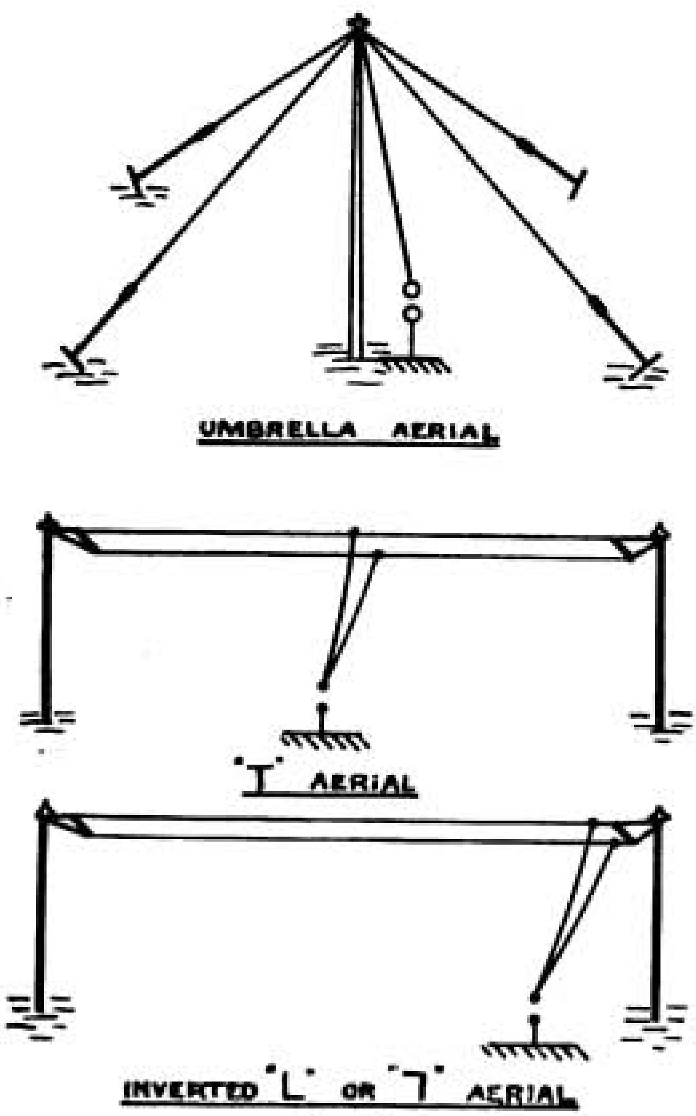


Fig. 3.

Advantage of having a large capacity aerial.—The advantage of having a greater capacity in the aerial is very apparent when we try to increase the wave-length by adding an inductance in series with it.

As already explained, adding an inductance to an aerial reduces its efficiency, so the less inductance we have to add to obtain the required wave-length the better.

74. A larger capacity aerial requires less inductance in series with it to increase its wave-length to a given value than a small capacity aerial, assuming, of course, that the fundamental wave-lengths of the two aerials are the same.

It is quite easy to prove that this is so by the application of arithmetic.

We know that the wave-length is equal to the square root of the product of the capacity and the inductance.

So, if λ = wave-length,
C = capacity,
L = inductance,

then $\lambda = \sqrt{C \times L}$

We will suppose that in both aerials $\lambda = 100$, but in the aerial " B " the capacity is larger, and therefore the inductance is smaller than in the aerial " A." We will suppose that in the aerial " A "

$$C = 100$$
$$L = 100$$

and in the aerial " B "

$$C = 400$$
$$L = 25$$

then, without any extra inductance,

$$\lambda \text{ of aerial " A "} = \sqrt{100 \times 100} = \sqrt{10{,}000} = 100$$

and also

$$\lambda \text{ of aerial " B "} = \sqrt{400 \times 25} = \sqrt{10{,}000} = 100$$

Now let us add on to each aerial an additional inductance of 100. Then we shall have

$$\lambda \text{ of aerial " A "} = \sqrt{100 \times (100 + 100)} = \sqrt{20{,}000} = \text{about } 141$$

but λ of aerial " B " $= \sqrt{400 \times (25 + 100)} = \sqrt{50{,}000} = \text{about } 224.$

It will be seen that with the same additional inductance **we have increased the wave-length of the aerial " B " from 100 to 224, while we have only increased the wave-length of the aerial " A " from 100 to 141.**

Thus, if we wished to increase the wave-length of the aerials shown in Fig. 1. from 425 feet to, say, 600 feet, we should find that perhaps 10 turns of an inductance coil would be required in the case of the aerial " A," while only about 6 turns would be required in the case of the aerial " B," as illustrated in Fig. 2.

75. Form of Aerial.—The most convenient and economical form of aerial depends entirely upon circumstances.

Height of Aerial.—The higher the aerial the farther we can transmit with the same power, but it may be far more convenient and economical to increase the power of a station than to increase the height of the aerial.

For portable stations it is obviously more convenient to keep the masts as low as we can, for it is essential that they can be put up easily and quickly and that they are not too heavy to carry about.

For stations that are going to be carried by hand or on horseback 30 feet is a very convenient height of mast, for it can be pulled

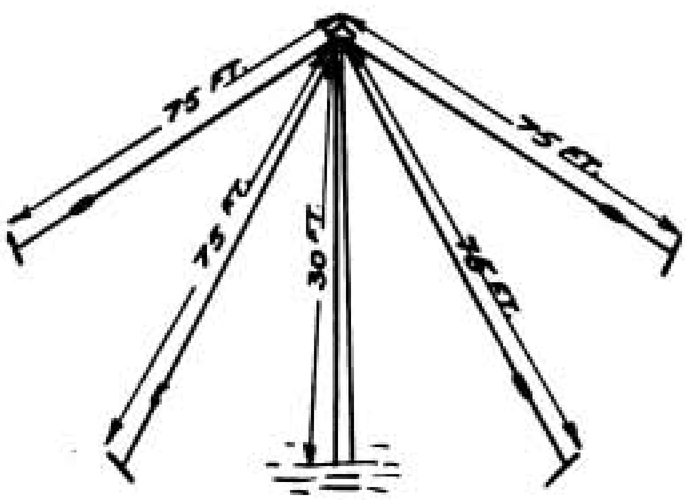


Fig. 4.

up by hand without the assistance of a derrick, and it can be divided up into short sections of 5 feet each, which are easy to handle and pack.

76. Shape of Aerial.—The next thing to consider is the most convenient shape of aerial.

Aerials can be classified under three headings — namely, " Umbrella " aerials, " T " aerials and " Inverted L " aerials. Fig. 3 illustrates an example of each of these forms.

For very small portable stations using short wave-lengths, the " umbrella " aerial is very convenient, as it only requires one mast, and the aerial instead of putting a strain on the mast acts as a set of stays to support it.

Whatever the form of aerial used, one important point to remember is that the farther apart the wires of the aerial are separated the greater the increase in the capacity of the aerial. Moreover, **there is very little advantage in putting two parallel wires less than five feet apart.**

In the case of an " umbrella " aerial, the

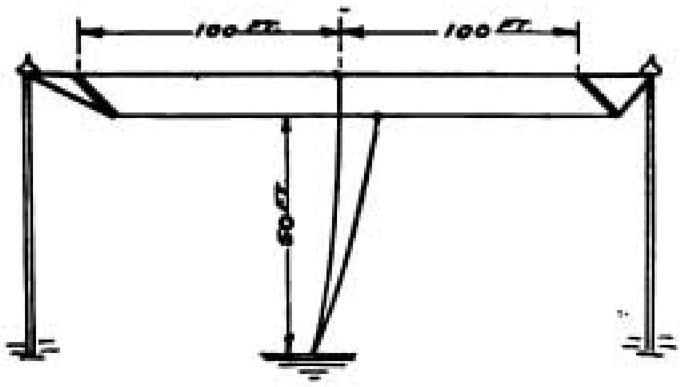


Fig. 5.

wires are usually distributed equally all round the mast, and are therefore amply spaced, but in the " T " or " ⌈ " aerials, where more than one wire is used, they should be separated by spreaders at each end, which should be at least 5 feet long, and more if possible.

77. The Length of an Aerial.—The length of an aerial is not necessarily the total length of wire, but is the length of wire from the point where it is connected to the instruments or earth, to any one of its extremities.

Thus in the " umbrella " aerial shown in Fig. 4 the length of the aerial is 105 feet, made up of 30 feet of " down-lead " and 75 feet of radial wires.

The length of the " T " aerial shown in Fig. 5 is 150 feet, made up by 50 feet of

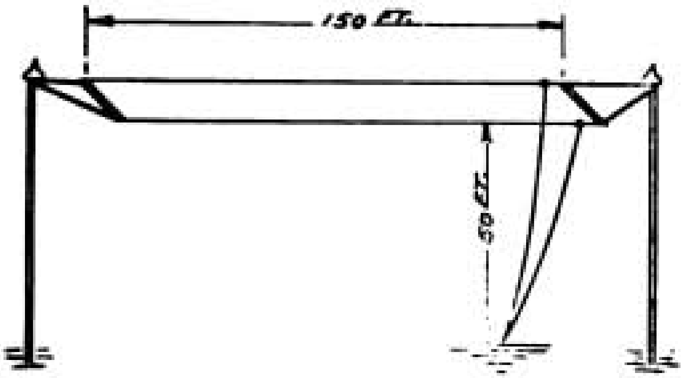


Fig. 6

" down-lead " and 100 feet of horizontal wire in a 200 feet span.

And the length of the " ⌉ " aerial shown in Fig. 6 is 200 feet, made up by 50 feet of " down-lead " and 150 feet of horizontal wire.

Instruction in Wireless Telegraphy.

THE MARCONI EXAMINATION.

CONDITIONS AND PRIZES.

Important Announcement.

IN this number of the WIRELESS WORLD we bring to close the series of instructional articles which began in May last, and, as then intimated, examinations will shortly be held at suitable centres under the direction of Marconi's Wireless Telegraph Company.

The scheme of instruction and examination was submitted to the Heads of the Territorial Forces, the Boy Scouts' Association, the Church Lads' Brigade, and other organisations, and amongst the letters of approval which have been received are the following from Lieut.-General Sir Robert S. S. Baden-Powell, K.C.B., K.C.V.O., and Major-General Edward C. Bethune, C.V.O., C.B., Director General, Territorial Forces.

Sir Robert Baden-Powell wrote :—

"Wireless has become a favourite hobby with boys of the right sort, and it is a valuable hobby for them, because it has a big future before it.

"The Marconi Company have seen their opportunity, and have come forward with characteristic energy to help and encourage the boys in taking it up.

"I hope that the Boy Scouts, at any rate, will make full use of the opportunity thus given them, and will, by their good work and progress in efficiency, repay such kindly interest.

(Signed) "ROBERT BADEN-POWELL,
Chief Scout."

Major-General Bethune, writing to Captain H. Riall Sankey, a director of the Marconi Company, stated in the course of his letter :—

"I have considered the scheme of instruction proposed by Marconi's Wireless Telegraph Company, Limited, as far as the tuition of lads and Territorials is concerned, it meets with my approval.

(Signed) "EDWARD C. BETHUNE (Major-General),
"Director General, Territorial Forces."

We restate here the particulars of the conditions of the examination, together with the prizes to be won.

1. *Territorials and Cadet Battalions.*—1st prize, value 10 guineas; 2nd prize, value 5 guineas; 3rd prize, value 2 guineas; and 5 prizes of 1 guinea each.

The following conditions must be observed:—

(*a*) No one may compete who is professionally engaged in wireless telegraphy, or telegraphy, or is a member of the Territorial Engineers.

(*b*) No one may compete who has not passed his recruits' course.

A complete set of field station wireless telegraph apparatus will be given to that unit to which the first prize winner belongs.

2. *Boys' Brigade, Church Lads' Brigade, and Cadet Corps.*—1st prize, value 3 guineas; 2nd prize, value 2 guineas; 3rd prize, value 1 guinea; and 10 prizes of 10s. 6d. each.

The following conditions must be observed:—

(*a*) Each competitor must be under 18 years of age on the date of the examination.

(*b*) Must have completed at least three months' service.

A complete set of field station wireless telegraph apparatus will be given to the unit containing the first prize winner.

3. *Boy Scouts' Association.*—1st prize, value 3 guineas; 2nd prize, value 2 guineas; 3rd prize, value 1 guinea; and 10 prizes of 10s. 6d. each.

The following conditions must be observed:—

(*a*) Each competitor must be a second-class scout and must be in possession of his signalling badge.

(*b*) Each scout must be under 18 years of age on the date of the examination.

A complete set of field station wireless telegraph apparatus will be awarded to the troop to which the first prize winner belongs, and another set to the troop obtaining the highest percentage number of certificates of proficiency, irrespective of prizes.

With this number we are issuing an Application Form to sit for the examination, which should be filled in and sent to: The Editor, WIRELESS WORLD, Marconi House, London, W.C., to reach him by March 31st. Additional forms may be obtained by sending a stamped addressed envelope to the Editor.

Arrangements are being made for holding the examinations in different centres, and under proper supervision, and candidates under the various categories will be advised of the address of their centres in due course.

The series of instructional articles is being reprinted in book form, and we hope that copies will be ready before the date of the examination.

In the April and subsequent issues of the WIRELESS WORLD, instructional articles will be continued with a view of enlarging the scope of the examinations, which it is proposed shall be held annually. Full particulars of next year's examination and the conditions and prizes relating thereto will be published in the April number.

A Pawn in the Game

(Serial Story)

By BERNARD C. WHITE

CHAPTER XIII.—(*contd.*)

WAR!

SOON a further message came through, this time from a cargo vessel making hurriedly for Yarmouth Roads. The planes were advancing at a rapid rate, and some score or more had been counted. Charles judged it was time to send out his single emissary against the advancing host. He touched the lever that set the powerful dynamo rotating at full speed. The airship rose steadily out of its hangar—that little bubble on which so much depended!

Swiftly it sped out to meet the enemy's planes like some kestrel defending its home against a swarm of bats. Charles looked through the sighter. The vessel dwindled further and further into the distance, until it was a mere speck.

The rising sun caught its flanks, and showed it up against the blue background. Then it disappeared into the mist. But the electric apparatus was working in the dim light of the shuttered operating room, the little spark shining an electric blue, marking its course on the screen. Yet another message that the planes had been sighted swiftly approaching the shore. Now Charles could see them in the sighter, for with the rays of the sun the fog was swiftly disappearing. On they came, two and three together. It was time to make the airship rise so as to be above them. Up it sped, climbing its spiral ladder heavenwards. Charles panted for breath in his excitement. Now it was poised over the first of the German aeroplanes. With nervous fingers he touched the fateful lever and swiftly it descended, even more like a kestrel in its downward flight, and pounced upon the enemy. The button was to regulate the death-flame. A flash! The mote in the sighter disappeared, only the blue glow travelled unconcernedly down the mirror. Another touch of the keys, and the light turned swiftly round, then reascended the glass; but the airship had to work swiftly now, for not one, but several of the enemy were within reach. A message was sent down that the dynamos should work at their utmost power. It was needed, and now the full benefit of the weary practice of the last few weeks in operating the keys was reaped, for, as a typist types on a machine, so Charles was pressing the keys on his table. Another monoplane was located, another flash sent, and once again the sighter was clear of the mote that troubled it. But another was there, and another. The monoplanes were dangerously close, but the airship had not far to travel. This time it met its enemy face on. The direction of the flash was altered, and the blow sent. It served its purpose. Swiftly it turned to the right as the airship rose into the air once more the conqueror, but only to stand poised over another, which likewise fell beneath its power. By this time the rear-guard of planes had come up, and it was evident that consternation prevailed in the ranks. The airmen seemed scarcely to know what to do. There was no concerted movement with the body. They spread out in skirmishing order, but such tactics little affected the swift onslaught of the defending giant. In a moment Charles made up his mind. He would attack the enemy to the left, for they were most likely to make good their escape if they should chance to get out of reach of the vessel and descend into the wild moors of Yorkshire. It was soon evident that the puny strength of the monoplanes was nothing as compared with the flight of the airship. She caught up one, then another, and each in its turn was sent to destruction. The sighter and the mirror veered round on their pivots as the chase proceeded, and Charles heaved a sigh of relief when he saw the last of the black specks clear from the lens. Then he changed the course of the vessel. Swiftly it came round forming a semicircle in an endeavour to catch up with the fleet that made their course to the right, but they had speeded along too fast, and many minutes elapsed before he caught sight of them. At last one appeared in the sighter, only to disappear a moment later, when the airship was sent swiftly in its chase. Its fate apparently created a panic in the remaining group. With one accord they rose in the air. The airship rose with them. Then they veered round, and presently were making out to sea again, the airship following. It caught up one, a laggard, and was almost within striking distance of a second, when by a clever movement the aviator caused his plane to make a spiral, and the flash which the airship emitted had no effect. After his continued success the disappointment of this failure upset Charles's balance. He hesitated for a moment and touched the wrong key. Immediately the airship fell, and ruin was within a hair's-breath when Summers quickly recollected himself, and brought it once again into a vertical position by directing it in a circular course. But the wasted moment had had its effect. It gave the enemy an opportunity to escape, and they were not slow to avail themselves of it. Already the planes had grown so faint in the sighter that they were difficult to locate, and soon they were lost to view. Charles briefly consulted with the commanding officer, and it was agreed that it would be useless to continue the chase further. Therefore he brought the airship back to its hangar, blackened with the heat of the fray and travel-stained with its journey, but none the less ready to act on the defensive again should the necessity recur.

But now it was not the condition of the airship which was to cause any anxiety to the defence authorities. It was the inventor. For on him the final excitement had produced disastrous effects. Already strung up by weeks of anxiety and want of rest, his nerves had reached their breaking point, and the knowledge that so much depended on him had had its due effect. Even while he was manipulating the keys his fingers twitched as though they were uncontrollable, and when his work was done he rose unsteadily from his chair, and complained of a splitting headache. Suddenly he turned giddy, and with a convulsive movement put his hand to his head. Then he clutched at the officer's arm as if to stay himself. With assistance he managed to crawl down the spiral staircase, all the while his knees shaking under him. At first it seemed that these were merely passing effects, due to the recent excitement; but in reality they were ominous signs, presaging trouble to come. The final blow was not long delayed. Laboriously Charles dragged himself to the hangar, and in a dazed condition inspected the vessel to see that all was right. As he bent over the machinery his pale face flushed and his eyes seemed to stare. Then, satisfied that all was as it should be, he drew himself up with a gasp, only to fall with a dull thud on the asphalte beside the machine. Willing hands lifted him up, and he was carried into his room, his right arm hanging helplessly down. It was some time before he recovered consciousness, and then when he attempted to speak he could only utter inarticulate sounds. A doctor was sent for, and at a glance pronounced it to be a paralytic stroke.

CHAPTER XIV.

But it was not a severe attack. A twitching of the eyelids and the working of the muscles in the face showed that nerve power was still active, and that in all probability the patient would ultimately recover. But, as in all such cases, convalescence would naturally be slow, and in the meantime the defences at Caister would be in disorder. The commanding officer, as soon as he received the doctor's report, informed the War Office, and they in turn sent a messenger to personally supervise affairs. It was Sir Harry Dever's idea to go himself as soon as he had the opportunity. In the meantime he sent the news to Braithwaite at Sotheby Vicarage, telling him to inform the relations, but to keep the matter silent to all outsiders. Late that same afternoon he hastened down himself to Caister, and it was well he did, for, arriving there in the afternoon, he found as perplexing a situation as it was possible for a man to cope with. Fortunately all the apparatus was intact and ready for use, but there was no one at the station who had picked up sufficient knowledge to manipulate the instrument. Therefore, as far as the actual good the invention could now be as a means of defence, it might just as well not have been organised. It was the officer in charge who suggested a way out of the difficulty. Did Sir Harry know of anyone who could manipulate the machine? If so, it would be well to fetch him, for it looked very much as though the enemy's 'planes would make a fresh attempt to land at night fall. Could he telephone for anybody? No, Sir Harry knew of nobody. Then a bright idea occurred to him. What about Braithwaite? He sent another message to the Vicarage, which was in code, and read: "Can you work wireless airship for Summers?" Fortunately it found Braithwaite in, and he immediately replied in the negative, cursing his luck that he was not able to seize this opportunity to distinguish himself. In the evening he went round to Thrale Hall to communicate the news of Summers's illness to Gwen. The man-servant opened the door, and in response to his enquiries told him that Miss Thrale was at home, but was dressing for dinner.

In a minute Gwen came down. Braithwaite turned to greet her, and as he looked at her frank, enquiring gaze, he spoke quickly and evenly, telling her all he knew. He began to comment on Summers's procedure sarcastically. Surely he could have foreseen what was likely to happen if he overworked himself. Why in the name of fortune didn't he have an understudy? There were heaps of men at the works who could have given him a hand.

Then she turned on him.

"I don't think I want to listen to your opinions, Mr. Braithwaite. It's enough to me that Charles is ill, and if you say it is through overwork, that's all the more honour to him. He couldn't foresee that this should happen to him just at the moment when he was wanted most; and as for an understudy, I was his understudy. I know as much about that machine as he does, unless he's altered it very much since I have seen him."

"Oh, yes, Miss Thrale, I know you collaborated with him in the affair, but I thought it was more by your interest than by practical help! Do you understand the working of the machine?"

"Yes, I do."

"Well, then, couldn't you manipulate it?"

"Yes, I could, if, as I said just now, it isn't very much altered."

"Then—you——"

"Yes, I could. I know what you are going to say. Why, of course—at least I can go down to his station and see. Let me go at once. You don't mind?"

Swift as a thought she turned to the bell. The butler appeared. "Tell Foster to get out the Royce car, I shall want to go on a long journey immediately. There is not a moment to lose. He must have it round to the door in five minutes."

She turned to Braithwaite. "Now I will go and see father."

She was not long on her errand, but by the time she came back the car was heard making its way to the door. She came down with a fur cloak and other furs over her arm. Braithwaite helped her to adjust them. Then she entered the car, and told Braithwaite to give his orders. He directed the chauffeur to Caister, adding that it was a matter of great urgency, and they would have to go like the wind, but he would see that they were not interfered with. Then began a journey which neither of them was to forget for the rest of their lives.

CHAPTER XV.

CHECKMATE.

Caister at last. Gwen was only too thankful when the car slowed up in the muddy road that brought them to the gates of the station. Braithwaite stepped out and rang the bell. Sir Harry Dever was there to meet her, and in a few courteous words thanked her for coming, then led her into the officers' study The usual owner of the room was introduced to her, and he reported on Summers's condition. Everything was satisfactory: the patient had to be kept quiet, but the doctor saw no reason why he should not completely recover, as his general condition was good, and the attack had been brought on only by extraordinary excitement, and was not constitutional. She was asked if she would care to see him, but bravely she said "No." How she longed to go to him and give him the comfort of her presence when he was needing it! The knowledge of his proximity made her senses tingle and her heart beat fast, but she was afraid that her visit might unnerve her for the work she had in hand. It would be better to go with her duty fulfilled than empty handed, or with only her love; so instead she asked to be taken to the operator's room in order that she might look over the apparatus, and see whether she could undertake the task of manipulating it. The commanding officer guided her up the narrow staircase to the little room perched like a crow's nest in the high tower. She went up to the operating table. Yes, it was just the same, at least in its main plan; but it was all so much bigger. Before she had played with a toy; now she had to operate a machine of war. She put several questions to the commanding officer, seeking explanations of this or that new part of the apparatus which she could not immediately recognise. He informed her to the best of his ability; but, finding her unsatisfied with his explanations, he sent for the foreman engineer, who had been Summers's chief assistant, and the officer told Gwen to put her questions to him, and this she did, much to the little man's amazement, for, as he remarked afterwards, "He'd never 'a thought in this 'ere world to clap eyes on a lidy who was an engineer, and a purty little bit o' goods too." He found her questions very much to the point, and this filled him with a profound respect. It encouraged him to give adequate explanations, and he was still more surprised to find how quickly the "lidy" in question tumbled to things. The only difficulties were the camera obscura and the sighter. Nothing like them had been constructed at Sotheby, and they were too much of a task for Gwen to understand in a minute or two, but she promised herself to have a shot at it, and see if she could manage to work it; if not, she promised herself she would use the searchlight. Charles had had a searchlight in his own den, and she knew she could work that all right. She saw by the fixtures that there was such an apparatus attached to the tower, and that gave her some confidence. As soon as she had mastered the chief points in the new instrument she asked if she could have the airship out, and immediately the dynamos were set working, and the drone of the engines reverberated in the midnight air. Then, with half a prayer crowding up into her heart, half a dedication of her work to her beloved—she was sure he was her beloved now—she discarded her cloak and sat down at the keys. A moment's hesitancy, then her fingers pulled the lever which sent the airship sliding down the hangars; a second, and it was mounting into the air. She saw it from the look-out and held her breath. It was so enormous—it almost frightened her. Dare she attempt to direct this gigantic fire-fly, this awful craft of war? But she had no time to think. She must try to remember everything that Charles had taught her, and she was a little out of practice. The key to make the machine curve spirally? She looked round bewildered. Ah, there it was. She touched it, and the answering movement of the airship gave her encouragement. Now she must send it out across the sea. Again she was not at fault. 1, 2, 3—those black levers with the white dots, they were the ones, and sure enough the vessel sped on its way, obedient to her will.

A call at the telephone. The little fat man hastened to the receiver. The enemy was upon them, hastening along at a terrific pace with a favouring wind. He shouted the message across to Gwen, and almost the airship tumbled into the abyss of the dark waters, for she was not expecting this. She had almost forgotten that she was taking part in the stern reality of warfare. Now she was brought up sharp with a quick reminder. Again the half-choked prayer made itself heard, but it was no time for praying, only for acting. Nevertheless it gave strength and brought with it a sense of calm—nay, more than that, a cold, icy unreality. She almost felt she could laugh. It was so amusing, this funny little game of war. Then a sigh escaped her—"I can't see it any longer, and I can't make out this light." She sank back in the chair as though she were tired of the game, and would like to give it up. Fortunately the little man was there, and he grasped the situation. "Keep it up, miss," he said; "keep in touch with the hairship and I'll get the light on. This 'ere searchlight is good enough to go for a few miles, and I'll work the Johnnie if only you'll only figger the hairship."

It was just the note of encouragement Gwen wanted. She nodded her head, and the fire-fly was sent far out to sea. A moment later and the searchlight fell full on it. She was not a bit surprised when the aeroplanes hove in sight, but she couldn't quite recollect how to get at them. It didn't matter, though; she would remember in a minute. Again the little man came to her rescue.

"There's a plane coming, miss. Get the hairship face on. I'll keep the light full on it. You follow the direction it takes and you'll catch up with it. That there's the knob for the fire-ray, I know. Now. are you ready?" Yes, Gwen was ready: she remembered all about it now. What a chase for a minute or two, but it was a crowded minute of life! A plane dipped and rose and swerved to right and left to get out of the ray of light, but the little fat man was one too many for the aviator. It never escaped, and with every motion it took the airship followed suit. "Work the keys as fast as you can, miss. Get above, then drop in front of it, and you'll do it. A little more, a little higher. Now. The button, quick, miss!" Gwen obeyed. There was a flash of light, the aeroplane flared, then seemed to shrivel, just as a moth shrivels when caught in the flame of a lamp. Like a moth, too, it fell out of the beam of light, and disappeared into the darkness, the nethermost hell. The little man gave a chuckle, but Gwen was not even surprised at her success. It all seemed so natural, just as it ought to be. But the little man's chuckle had stopped half-way. "Look, they're absolutely swarming up now thick as flies," and, sure enough, the aeroplanes were coming in a phalanx upon the airship. "Now, miss, there are three coming abreast. See, they're a-spreading out. We must cop each one. The airship'll work faster now. Don't lose 'em for God's sake!" Gwen wanted no encouragement now. She was thoroughly worked up. All her learning had come back to her, and in a few moments the three vessels, one after another, had sunk beneath the searching death ray. Yet, quick though she had been, two planes had escaped her, flying wide to the south. She attempted to overtake them, but was pulled up by her companion. "Never mind 'em, miss; they will be pulled up all right down there. There's more on 'em coming up from the west. Keep the hairship to 'em." Gwen obeyed, and the airship made an advance to meet them. Oh, it was exciting work! One (a pause), two, and six more of the enemy's soldiery were sent to their account. That decided it. The fleet of planes was disorganised. The great searchlight had picked out the centre body of the force, and the destruction which followed was apparent to all the oncoming planes. Already unnerved by the fate of the first contingent, they were terror-stricken at this unknown foe whom they could not cope with, and who could overreach them and bring death, while they were helpless to resist or escape. Their machine guns were ineffectual to reach her. The instability of their machines made it impossible to take accurate aim, and the swift evolutions of this great war vessel were outside their calculations. They spread themselves out, but to no avail; first one, then another of the fleet was singled out, chased, and picked off. Then it seemed that they were too scattered to effect a landing. Wireless messages were passed between the various units of the fleet, and it was finally decided to give up the attack as hopeless. First one, then another of the planes swerved round and hurried back out of the danger zone, to tell reinforcements that the plan of campaign was a failure, and further advance only meant destruction.

About twenty out of the thirty planes of the main fleet remained. Eight had been irretrievably lost. Two, so it was computed, had escaped by steering northward, and their fate was uncertain. It was a disheartened Council that met on board one of the German steamers in the North Sea, and it was a still more disheartening message that was wirelessed to the main army council in Berlin announcing the ill fate of the expedition and the futility of any further attempt to land on the East Coast. But if the distress of the Germans was great, greater by far was the exultation that filled the little Marconi room. Once again the enemy had been repelled—"and this time by a lidy," as the little fat man said when he nearly wrenched Gwen's arm out of its socket, "An' you call yourself a bloomin' amateur! We'd be mighty glad of a few more bloomin' amateurs like yourself at Caister, that we would." He took no credit for his own part in the affair—he was too generous hearted. Gwen smiled and thanked him; but it was a very wan smile, and a very limp hand that he shook. She was exhausted with mental fatigue, and was trembling all over. But there was a quiet light in her eyes; past blunders had been wiped out in the present success.

CHAPTER XVI.

At first Gwen hardly realised the important part she had played in the episode just completed. Everything was too big and her mind could only grasp little things. She was worried about the two planes that had escaped her, and suggested to her companion that they should search for them. He agreed, and the light was sent all over the neighbourhood, without any success. Then he suggested the search should be given up, "for you see, miss," he argued, "if those Johnnies do land they won't be much good by theirselves Some of our men will be sure to snap 'em up." Gwen submitted to his benevolent decision, and brought the airship back to the hangar. Then, when all was completed, she rose from the operating chair, so tired out she could hardly stand, her poor little head a whirl of aches and pains. But she was not allowed to go away in peace. News of the defeat was already abroad. There were steps on the stairs, and the commanding officer appeared, followed by Sir Harry Dever. Following the accepted tradition of the British Army they behaved with becoming composure in the face of success, but there was a triumphant ring in their quiet "Thank you, without your help we were powerless to prevent the landing of this force." Then Sir Harry Dever added, "Now, I should think they will not make a third attempt after they have twice failed, but it is best to be prepared, and if you do not mind remaining we could arrange to put you up here. We will try and make you as comfortable as possible and give you every assistance. Could you do this for us?" Gwen nodded. She was too done up to say anything, and now that immediate anxiety was passed, her only wish was to see Summers. The little fat man was the first to think of it, and he suggested that the "lidy" should be taken down to see "her young man." Brought to a sense of their want of thought, the two officers were sincerely apologetic. Would Miss Thrale like to see Mr. Summers now? He was awake and conscious, but had to be kept very quiet. The doctor had been asked if the patient could see any friends; he had given his consent, but any visits were to be of the shortest possible duration, and Mr. Summers was not to be allowed to speak. Thereupon they led the way down the iron staircase. The sight of the invalid gave Gwen a shock. She could not realise that this was Charles, the long, gaunt active man she had always known who had seemed impervious to fatigue and illness. She leaned forward forgetful of the nurse, and knelt by the bedside, picking up the hand which lay on the bedclothes, and kissing it. But she only knelt a moment, then, standing up, she stooped over him and gave him one long kiss on the forehead, such as she had never given him before. She forced herself to smile, then returned as quickly as she came in, not daring to look back as she went out of the room.

. . . .

For several weeks Gwen remained at Caister in case of emergencies, but no enemy appeared, and as the commander of the station put it, "It looked as though the Germans had had a sufficient drubbing to teach them manners." Some time after his opinion was confirmed by the report that the strange vessels and submarines that had been located far out in the North Sea had disappeared, and it was believed they had managed to get through the line of the British fleet off the Baltic, for no trace of them could be found. The airships, too, had disappeared into oblivion, though a good many could be seen reconnoitring off the German coast, though they never got within reach of the British guns. As to the two stray airships, they had been accounted for. One landed at Kirby Moorside, and the other not far from Galashiels. They were both easily overcome, and the passengers realising the uselessness of resistance, surrendered to unkindly fate. All this time Charles had been making rapid progress towards recovery. A masseur had been called in, and now he had full control of his limbs, though he was weak and shaken. Charles's exploits and her own had been blazoned abroad in the papers, and the romance attached to them stirred up the sentimentality of the English public, as it always is stirred by romance. Charles Summers's name was on the lips of the man in the street, and that meant fame. But it was not fame of an ephemeral description, for his work was of a lasting quality and likely to outstand the breeze of popular favour. It stood for a revolution in military aviation, and the fact that it had been authorised by the Government gave it sufficient prestige to awaken the interests of the chief scientists of the kingdom. One and all acknowledged the genius of the inventor, and many were the schemes suggested for his reward.

. . . .

Caister had become a dream. Charles had been back to Sotheby Vicarage, and he, his father and sister, and Gwen, were now at Bournemouth tasting to the full the benefit of the soft spring air, and delighting in the transformation of the land from winter to summer.

One day as the two were sitting together watching the sea curling tremulously blue beneath the cliff, Gwen broke the silence with a sigh, then turning towards her lover, she put her hands in his.

"Charles," she said, "I have something to tell you," and she told him the story of Braithwaite's infatuation for her. She paused as she ended, but Charles said nothing, only looked down at her and smiled, the same old smile that she had learnt to love and wait for. That gave her encouragement, and she added: "I can see it all now, dearest. I can see what a silly little fool I was, but then I was so much younger. Life had never taught me any of its real lessons. I can see how wayward and foolish and perverse I was. I thought I knew everything, and I knew nothing at all. Those foreigners wanted your invention, and they got it through me, and Braithwaite wanted his own success and hoped to get it through me. I was the pawn in the game, and the stakes were love and honour. Thank God they got neither." Charles looked at her and smiled, then he lifted the little hand and kissed it.

"Gwen," he said, "you did more for me than I could have done for myself, and, my beloved, I didn't deserve it. If you were wrong I was doubly wrong, for my love was selfish and self-centred. I was patronising and magnanimous. I treated you as a child when it was your due to be treated as a woman. I, too, did not see it then, but I too have learnt a lot. Once I thought that all my work was being done for you, now I can confess that it was for my own pleasure, and you hardly came into it at all. But I want you to forgive me for my unworthiness, forgive and forget. You can afford to be generous, Gwen, for all that I am or am likely to be is your doing; you have given it me, every bit. Let's cry quits and begin afresh. Teach me to love you as a man and not a scientist."

Gwen looked up at him, and her eyes were full of tears. She took his face between her hands and gave him a long sweet kiss, such a sympathetic kiss as only those who have failed and tried again and won know how to give. Then there was silence when heaven touches very close to earth. At last Charles drew Gwen nearer towards him.

"Come closer, Gwen," he said, "come closer, for the pawn in the game won me my queen." [THE END.]

Atlantic Coast Chain

New Station at Miami.

WHILE appeals are being made for the subscription of large sums to celebrate the century of peace between England and America, which has just been completed, the work of cementing the friendship of the two nations is being silently carried on by other powers besides ambassadors and International Committees. Industrial development, which makes no announcement from the housetops, has been one of the most potent factors in the cause of peace, for one of the chief lessons that commerce has to teach is the fact that the nations must stand shoulder to shoulder if mutual prosperity is to be advanced at all. But commerce needs a voice and ears if her operations are to be effective, and only adequate means of communication can supply this necessity. In the last century such possibilities have been developed enormously, and now with the establishment of wireless telegraphy it seems that commerce is well provided with resources. But such is the use made of this service that it is continually necessary to build always larger and more powerful stations. That at Miami is the latest addition to the service, and when it is opened, as is expected it will be very shortly, it will be one of the most important commercial wireless telegraph stations in the United States. Miami is in Florida, and is situated at the mouth of the river which gives it its name, and has steamship connection with Havana, Nassau and San Juan. The station will thus break up a long stretch between Jacksonville and Key West, thereby greatly facilitating the handling of messages, besides controlling much of the business which now passes through the Government station at Key West. By establishing communication with the Nassau station it should be able to supplement the ship and shore business.

Miami. The pavilion in which the Wireless set will be erected.

Active work on the new station was commenced by the Marconi Wireless Telegraph Company of America at the beginning of this year, and the accompanying illustrations are reproductions of photographs taken before building operations commenced. The wireless set is being installed in the pavilion which is being adapted for the purpose, and the towers will be erected near the end of the bridge shown in the second illustration. A 5 kw. set is being installed.

General view of the Miami Site, the towers to be built near the bridge.

Contract News

Marconi's Wireless Telegraph Company of America have received orders from the North Pacific Steamship Company to install a wireless apparatus on board their steamer *Cetriana*. The call letters will be M O B.

* * *

In last month's issue of the WIRELESS WORLD, six steamers, the *Thessaloniki*, *Frederik VIII.*, *Bolama*, *Loanda*, *Funchal*, and *Sitges* were notified as having been fitted with wireless by the Debeg Co.; they should have been inserted under the list of ships fitted by the Société Anonyme Internationale de Télégraphie sans Fil, of Brussels.

The S.A.I.T. have this month equipped the following Vessels :—

Name of Vessel.	Owners.	Type of Installation.	Call Letters.
Commonwealth	Chr. Nielsen	Coil sets	—
Karrakatta	"	"	—
Kelm	"	"	—
Francoli	Tintore	½ kw.	EFF
Guine	E.N.N.	½ kw. and emergency set	CSG
Noordwijk	Erhardt and Dekkers	" " "	PHG

Orders have been received by the Marconi International Marine Communication Company to equip the following Vessels :—

Name of Vessel.	Owners.	Type of Installation.	Call Letters.
Great City	Great City Steamship Co., Ltd.	1½ kw. and emergency set	MKW
Mexico	La Cia Mexicana di Navegaçao S.A.	" " "	XBB
Tokomaru	Shaw, Savill and Albion Co., Ltd.	1½ kw.	MNP
Minnie de Larrinaga	Larrinaga and Co.	"	MLA
Indus	J. Nourse, Ltd.	½ kw. and emergency set	MCB
Mutlah	"	" " "	MDA

The following Vessels have been equipped with Marconi Apparatus since the last issue of this Magazine :—

Name of Vessel.	Owners.	Type of Installation	Call Letters.
Massilia	The Anchor Line	1½ kw. and emergency set	MHQ
Olympia	" "	" " "	MHI
Nonsuch	Messrs. G. Yuill & Co.	" " "	MYH
San Jeronimo	The Eagle Oil Transport Co.	" " "	MJP
San Lorenzo	" " "	" " "	MND
San Ricardo	" " "	" " "	MBR
Carnarvonshire	The Royal Mail Steam Packet Co.	" " "	MZR
Palma	The Peninsular and Orient Line	" " "	MKD
Broadstone	The Blue Star Line	" " "	MIS
Missouri	The Atlantic Transport Line	" " "	MLD
Colorado	The Wilson Line	" " "	MMS
Baron Napier	H. Hogarth & Son	" " "	MJS
Orduna	The Peninsular Steam Navigation Co.	" " "	MGP
Architect	T. and J. Harrison	" " "	GYO
Highland Laird	Nelson Line	" " "	MEP
Eupion	The Pierce Oil Corporation	½ kw. and emergency set	MKT
Roebuck	The Great Western Railway Co.	" " "	—
Pardo	The Royal Mail Steam Packet Co.	" " " (refitted)	GLL

Practical Hints for Amateurs

My Wireless Station

By M. F. GANTLY *

PERHAPS the following notes on my wireless receiving station may be of interest to some enthusiasts. It is rather discouraging to the wireless aspirant to hear so many comments regarding the height of the aerial. Well, of course, the higher the better, but with a height of 34 ft. I have gained results which exceeded my most sanguine expectations.

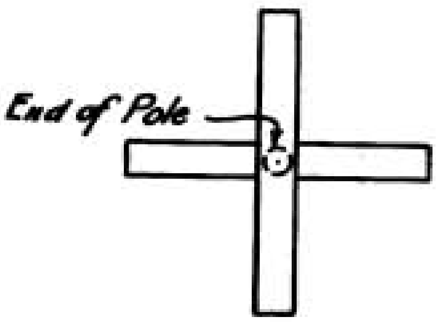


Fig. 1

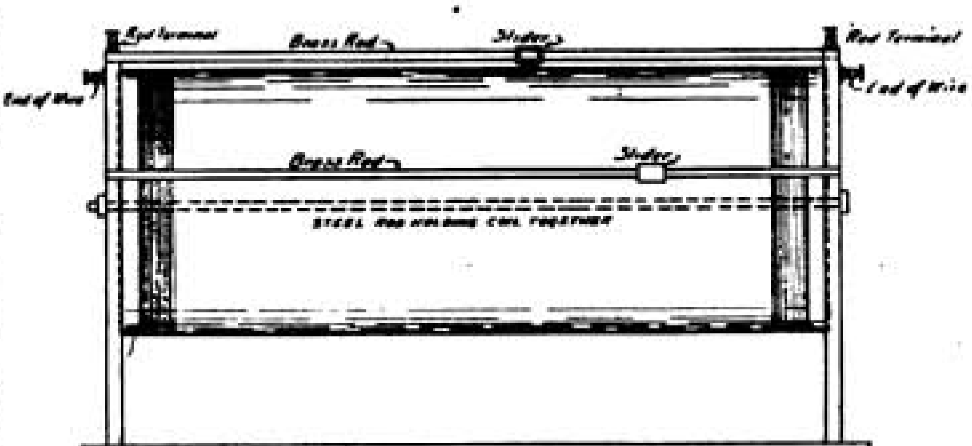
I obtained two scaffolding poles, 38 and 34 ft. high. The holes in which they are buried are 4 ft. deep. On the end of the poles are fixed two crossboards, about 4 ft. long (Fig. 1). These tend to keep the poles steady in the ground. The poles were given a good coat of tar. They stand 34 and 30 ft. above the ground, and are 70 ft. apart. A few wire stays are sufficient to keep them in position. The aerial is a two-wire one, the wires spaced 6 ft. apart. The lead-in is taken from the highest end, which is the farthest from the instruments. It was originally taken from the nearest and lowest end, but the latter arrangement is far better.

The earth consists of a plate of lead, 2 ft. by 1 ft., and a plate of corrugated iron, 4 ft. by 4 ft. These are buried at a depth of 5 ft., separated by coke, and are surrounded by coke also. The earth wire is a thick copper one. It is soldered on to each plate and the joint covered with pitch to prevent the action of the earth from taking effect on the solder.

The receiving instruments are a two-slider tuning coil, detector, fixed condenser, variable condenser, and phones. With the exception of the latter they are home-made.

The tuning coil is made as follows:—A cylindrical cardboard roller, 14 in. long by 5½ in. diameter, and well coated with shellac varnish. When dry, I wound about 300 turns No. 22 enamelled copper wire on it, taking care that each turn was spaced from the next. I then cut two end-pieces and made a circular groove in each to hold the ends of the coil, which were also coated with shellac. The coil was fitted together with a steel rod passing through the end-pieces and coil and clamped with a nut. It was then given two coats of shellac, and when dry the insulation was scraped off where contact was desired. Two brass rods, fitted with terminals, were fitted to the end-pieces for the sliding contacts. The sliders used were of the ball contact type.

The detector is simple in construction and is of the crystal type. It is made from old scrap brass and bicycle nuts—rather



View of Tuning Coil

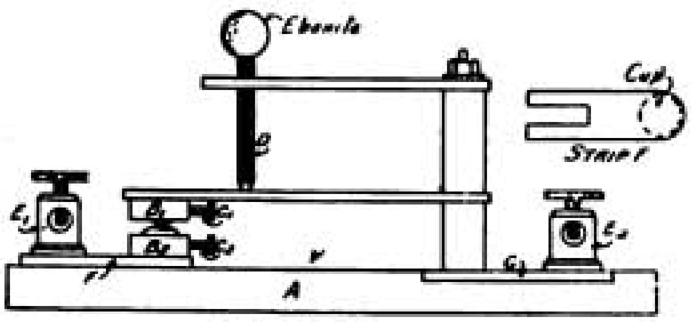
Fig 2

* See our comment on page 771.

E

crude materials, no doubt, but efficient. Its construction is shown in Fig. 3.

A is a hardwood base which has been steeped in paraffin wax; B1, B2, are the



DETECTOR
Fig 3.

two cups for holding the crystals, and are made of bicycle valve nuts. They are fitted with screws, C1, C2, which hold the crystals in position. This makes it easy to adjust the crystals and fit new ones when

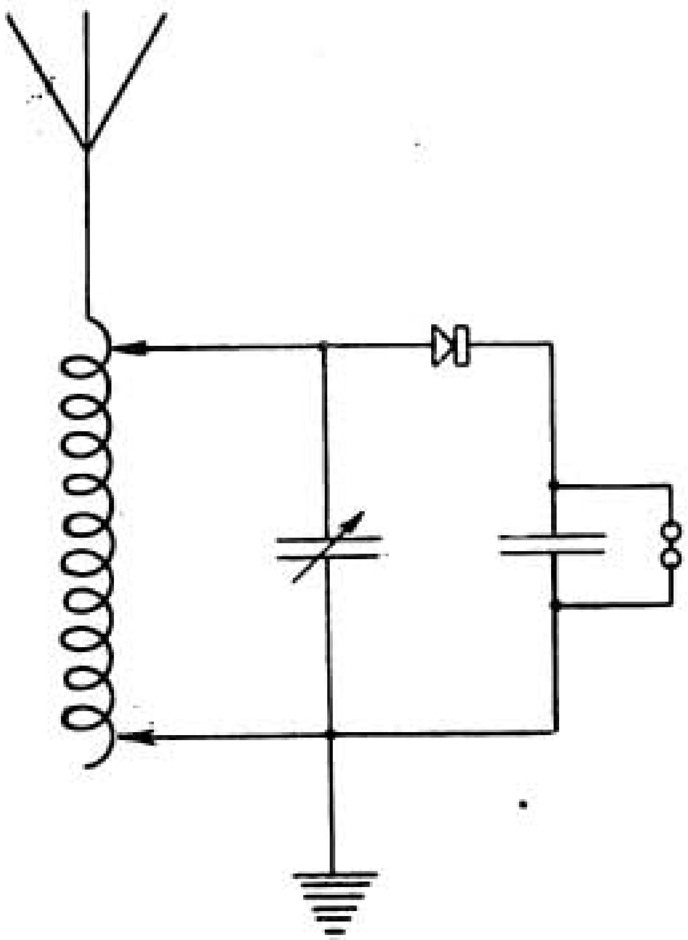


Fig 4

the old crystals become insensitive. It is just as efficient as using Woods metal and much more simple. I find that zincite and copper pyrites are the best crystals to use. The screw, D, allows of the contact of the crystals being varied. It is fitted with an ebonite head. The part, F, is cut as shown in Fig. 3. This allows it to slide under the terminal E1. The terminal E2 and the stand are connected by the brass strip, G.

The fixed condenser consists of four sheets of tinfoil, 5 in. by 4 in., and five sheets of paraffined paper 4½ in. by 4½ in. The tinfoil is cut with a tab at the end of each sheet. The sheets of tinfoil are placed alternately with the paraffined paper, in such a way

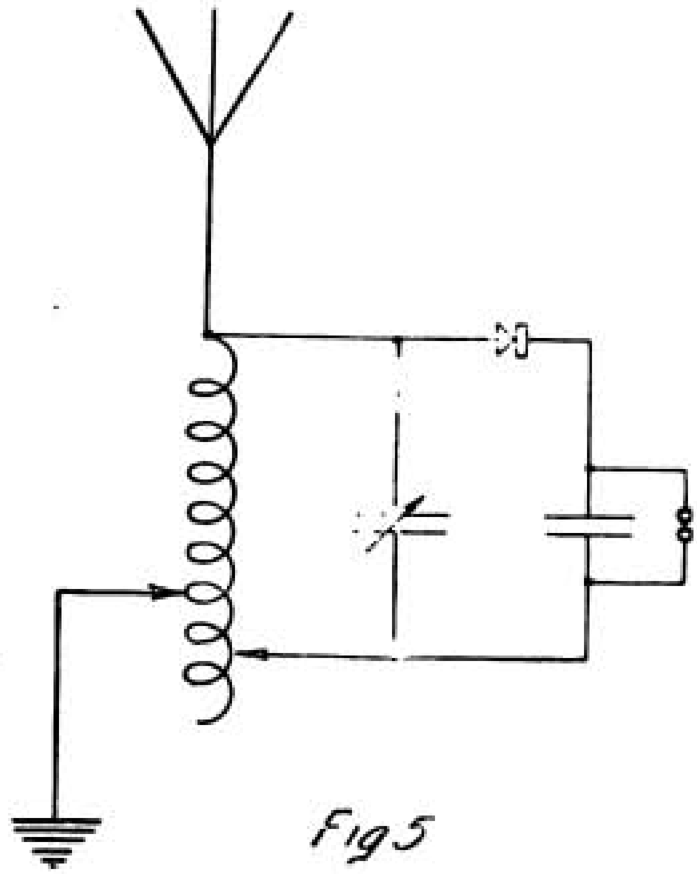


Fig 5

that the tab of the second sheet is on the opposite side to the first, and so on. A terminal is then passed through the tabs at each end and through a cigar box (or anything else suitable), and the condenser is complete.

The variable condenser is made of ten glass plates (old photo plates, with film thoroughly cleaned off, are admirable for the purpose), 8½ in. by 6½ in., five sheets of tinfoil, 6½ in. by 4½ in., and five strips of copper foil, 4 in. by 1 in. One of the strips of copperfoil is stuck with shellac on each of five of the glass plates, leaving about an inch projecting beyond the edge. Over these are stuck the tinfoil sheets in the centres of the plates, thus leaving an inch margin all round. The tin and copper foils must make perfect contact. The glass margin is now given a coat of shellac, and one of the plain glass plates is stuck over each, thus forming a tinfoil "sandwich."

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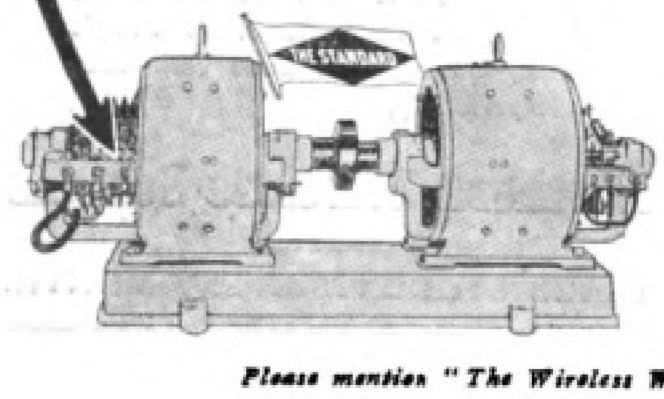

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Eight pieces of cardboard are now prepared and immersed in shellac. These strips hold the "sandwiches" together and form four spaces to admit of the movable zinc plates. A stand is made to hold the glass plates. The copperfoil tabs are clamped by a terminal to a piece of ebonite fitted into the stand for the purpose. Four zinc plates are clamped together on a brass rod, with a washer separating each plate to allow them to slip easily between the glass plates. The variable condenser is made in accordance with the description which Mr. F. G. Perkins published some time ago.

I have found that the variable condenser is useful with long wave lengths, as it greatly increases the strength of the signals.

The connections were originally as shown in Fig. 4, but I found that with the arrangement shown in Fig. 5 I was able to get ships very loudly. I can hear Liverpool, Crookhaven, and many of the ships without using a variable condenser at all, but connected as Fig. 6.

By connecting the aerial and earth direct to phones through the detector, without

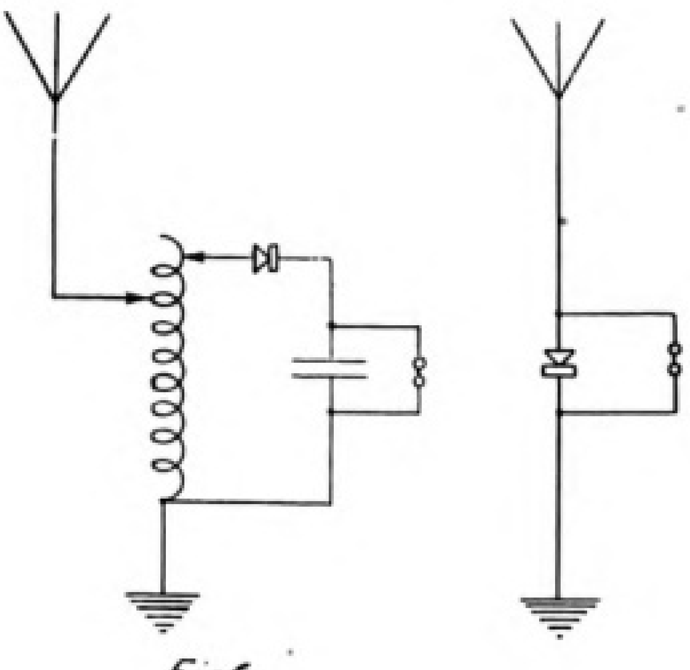

Fig 6

using anything else, I can get Clifden very loud and can also get Poldhu.

This is a simpler method of reading Clifden than by using a loose coupler. It seems to be an understood thing with many wireless enthusiasts that you need a big aerial, loose coupler, and other rather expensive apparatus to get Clifden. Well, I get the station working, either day or night, with the detector as described. Two of my

Mr. Gantly's Wireless Set.

friends who are also interested in wireless get Clifden in the same way.

With this simple set it is possible to read Poldhu with a fine, steady note, sending out press. It is possible to hear the operator in the Eiffel Tower, Paris, tapping out his time signals in a deep base note and to read the high-pitched piping note of Norddeich or the clear even one of Clifden sending "LCO's" over the Atlantic to Glace Bay. The signals sent by a liner ploughing her way through the deep are clearly heard, as is Cleethorpes sending out weather reports in a quick, rather peculiar note.

It is interesting to listen to the large ships in mid-ocean exchanging signals with each other when miles apart, just as though they were berthed alongside.

In fact, it is only when listening to this, and pondering over it, that one realises the marvels of wireless telegraphy, the priceless boon for which the world owes its gratitude to the brilliant genius of its great inventor, Mr. Marconi.

AMATEUR NOTES.

MR. GANTLY, whose article dealing with his station we publish on page 769 of this number, asks us if anyone else "gets Clifden" with the circuit described by him. We admit we were surprised to learn that he succeeded in receiving Clifden with such a very incorrect circuit, but were relieved to see from the address on his notepaper that he lives in Co. Tipperary, and is not, therefore, very far from the great station. He asks also for an explanation of the fact that with his receiver he finds signals very faint for a time, and then a slight "click" comes and signals get all right. This looks to us like a coherer-effect (or the effect of some other kind of imperfect contact), and probably lies in the crystal-contact itself. Possibly an atmospheric comes along and breaks down a thin film of oxide, after which all goes well.

* * *

In a recent number of THE WIRELESS WORLD we published some correspondence between Mr. Hope-Jones and the Secretary of the General Post Office, regarding the proposal of the Postmaster-General to levy a tax or royalty on those who desire to use wireless receiving sets for listening to the International Service of Time Signals which now cover half the surface of the globe, and are easily picked up in England, from the Eiffel Tower, Paris, and Norddeich, Wilhelmshaven. The Secretary to the Post Office now announces the abandonment of this intention in a letter to Mr. Hope-Jones, dated February 5th, of which the following is a copy:

"With further reference to your letter of December 16th last and previous correspondence on the subject of the issue of licences for the reception of Time Signals by Wireless Telegraphy, I am directed by the Postmaster-General to express his regret that it has not been possible to send you a definite reply at an earlier date, and to inform you that, in view of the representations made by you and others, he has decided not to require payment of an annual royalty for licences issued in respect of apparatus intended for this purpose. The fee of £1 1s., which is charged to cover the Office expenses connected with the issue of the licence and the inspection of the installation, will, however, still be payable by applicants for such licences. "(Signed) E. CRABB.

"On behalf of the Secretary, P.O."

* * *

We were only able to refer briefly in our last issue to the inaugural meeting of the Wireless Society of London on January 21st, which, from every point of view, was an unqualified success. Never have we seen the large lecture theatre of the Institution so crowded by a gathering which followed the proceedings with the closest interest and manifested by its applause its sense of appreciation of the successful demonstration of the ways by which signals coming from Eiffel Tower and elsewhere could be made visible and audible.

* * *

An aerial was erected on the roof, and arrangements were made to receive a message from the Eiffel Tower. This was received on a syphon recorder, and the movements of the pen marking the strip were clearly shown on the screen by the use of a Lietz Universal Projector. For working the syphon recorder three of the relays designed by Mr. S. G. Brown were used. One of the "A" type instruments was connected to the oscillation transformer. This fed a telephone "G" type relay, to which a telephone was connected, and lastly this was coupled to a "W" type relay. This relay is so adjusted in use that the contact is broken by the very small quick movements of its rocker. The movements are too quick for the syphon recorder to follow, but the duration of each group, however, is recorded. Among the other detectors may be mentioned the sensitive manometric flame, which is influenced by feeble sounds from the receiving telephone, or the gas issuing from a very fine jet may be passed through a piece of wire gauze and lighted. This flame is more rapid in action and therefore more dead-beat. The most sensitive spot for the telephone is at the mouth of the orifice from which the jet issues. These instruments may be tuned to discriminate between sounds of different acoustic pitch. Besides the Brown relays, the Heurtley relay may be used. In this a moving coil moves a very fine straight wire of considerable resistance, which is slightly heated by passing a current through it, in and out of a blast of cold air proceeding out of a narrow slot. The alterations in resistance due to the temperature changes are sufficient to work a telegraphic instrument. In the Orling relay a suspended coil has a finger which just touches on one side of a minute jet of acidulated water. When the coil moves the jet is moved to a much greater extent, and is arranged to bridge or leave open the space between two contacts in a local circuit

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Mr. Swinton compared the sensitiveness of electrical detectors with that natural detector of electromagnetic waves—the human eye. The light from a 12 candle-power lamp on a perfectly dark and very clear night can be seen at a distance of about five miles, the amount of energy radiated as visible light in all directions being about one watt. Assuming that the aperture of the eye of the observer under such conditions is one-fifth of a square inch, then the proportion of the one watt radiated that reaches the retina is the proportion that the area of a circle one-fifth of an inch bears to the superficial area of a sphere the radius of which is five miles. This gives the amount of power that reaches the retina as about one-sixth of one-billionth of the one watt radiated; so it would appear that the sensitiveness of artificial and natural detectors of electromagnetic waves are of the same order. For instantaneous effects both these artificial and natural detectors of electromagnetic waves are vastly more sensitive than any photographic process, though, owing to the cumulative nature of photographic action, things can be photographed by means of prolonged exposures that the human eye or our most delicate electrical instruments would not in any way be able to detect. This is, of course, taken advantage of in many cases, as, for instance, in astronomy.

* * *

Lord Rayleigh, some years ago, found that the human eye and ear were of the same order of sensitiveness; and how very sensitive the human ear is to the most minute sounds is shown by the fact that Mr. Swinton has been able to hear the Eiffel Tower with his very small aerial and a single relay upon a hot-wire telephone. This instrument, which was invented by the late Sir William Preece many years ago, consists simply of a short length of very fine wire attached to a diaphragm. The current is passed through the wire and, owing to its expansion and contraction, causes the diaphragm to vibrate. In his case, he has taken the inside out of an ordinary Bell receiver, put in a mica diaphragm, and stretched between this and a little device for altering the tension a tungsten wire only fifteen microns in diameter; in fact, a piece of lamp filament. It is obvious that with electric currents of the magnitude with which we are dealing changes in the temperature of the wire caused by the signals must be a very small fraction of a degree, and consequently the elongation and contraction of the wire must be almost inappreciable, yet the diaphragm vibrates sufficiently for the signals to be clearly detected by the ear.

* * *

With regard to the future of wireless telegraphy, using the latter word in its Post Office sense, which includes telephony, Mr. Swinton supposed that no one thought otherwise than that wireless was in its infancy, to use a stock expression that it used to be the fashion to apply to electricity. Wireless telephones, he supposed, were sure to come before long. The chief difficulty at present was to get a telephone transmitter or microphone that would carry sufficient current without burning up, or, at any rate, becoming overheated. Multiple transmitters, water cooling, and even transmitters on the Chichester-bell principle, in which the current is caused to vary with speech by applying the articulate vibrations to a water jet, had all been employed, but with none of them could more than a few kilowatts be dealt with. Another difficulty was that changing over from sending to receiving or *vice versa* required the operation of switches, which rendered ordinary conversation somewhat troublesome. These were, however, difficulties that ought to be got over in time. While wire telegraphy and telephony were particularly fitted to send messages to particular places and to reach particular individuals, wireless seemed by its nature to be suited for the universal distribution of intelligence, weather reports, time signals, or speeches. Indeed, with a little imagination, one could picture to oneself in the not very distant future wireless receiving stations specially set up in connection with halls resembling picture palaces, where people would be able to go and hear *viva voce* all the prominent speakers of the day, although these might be speaking hundreds of miles away. Again, why, with improved apparatus requiring less attention and adjustment than what we at present use, should not a wirelessly operated column printing telegraph in every house tell the latest news to all the nation, as also to the newspapers, should any of these continue to survive this much more rapid method of disseminating intelligence?

* * *

One thing seemed pretty certain, that if we were ever to have transatlantic telephony, it would be wireless, as on this system all the difficulties due to capacity and self-induction of the cables were avoided, and it is these that rendered long-distance submarine telephony impossible at the present time.

* * *

The following is a translation of the copy of the message which was received from Commandant Ferrié; it was transmitted in French:

"Commandant Ferrié sends to the worthy President and to his esteemed fellow-members of the Wireless Society of London his heartiest greetings and the assurance of his cordial goodwill. Long live England! and long live the *Entente Cordiale*!"

* * *

The following reply was sent:

"The President, Committee and Members of the Wireless Society of London thank Commandant Ferrié very sincerely for his expression of goodwill to the Society, and reciprocate it most heartily.

"Long live France and the *Entente Cordiale*!"

* * *

At the January meeting of the Dublin Wireless Club, Mr. P. K. Turner delivered an interesting address on the use of detectors in wireless telegraphy. He divided detectors into the following three classes, viz.: coherers, magnetic and crystal. Mr. Turner explained the theory of the magnetic detector, paying special attention to the phenomenon of hysteresis. The valve and electrolytic detectors were treated at some length, and excellent analogies were given, which made the principles more easy to understand. Woolaston's ingenious invention for drawing platinum wire out to a minute portion of an inch was also touched upon. All through the lecture Mr. Turner took great trouble in his explanations, making them obvious to the beginner, and illustrating by diagrams of connections each section dealt with.

* * *

A General Meeting of the Club was held on February 5th. Mr. G. E. P. Marshall was unanimously elected to the office of President, vacated by Dr. Spencer Sheill, who, through the increasing demands made on his time by professional duties, found that he could not attend the meetings of the Club as he felt the President should. Resulting from the report of the sub-committee appointed to go into the matter of obtaining more central premises, the offer of the use of rooms and apparatus for one evening per week at a nominal rental, made by Mr. P. K. Turner (proprietor of the Dublin School of Wireless) was accepted; and to fit in with Mr. Turner's kind offer, the night of the Weekly Meeting of the Club was changed from Thursday to Wednesday. It was decided that the members should meet at the new premises, 11, Lower Sackville Street, on the first and third Wednesdays in the month, and on other Wednesdays at the Club Headquarters, St. Pancras, Harold's Cross Road, Terenure. Mr. H. J. Duncan was elected Treasurer. Intending members are invited to send in their names to the Honorary Secretary, Mr. F. Dixon, 21, Ashdale Road, Terenure, Dublin.

* * *

A meeting of the Northampton and District Wireless Club was held in the new club room, at the "Garibaldi," Ash Street, on January 28th. The President, Mr. F. H. Wright, was in the chair. A communication was read from Le Commandant Ferrié. Mr. E. H. Coleman having been appointed to an important position with a Birmingham engineering firm, resigned his position as Secretary, and a vote of thanks was accorded him for the work he had done. Mr. A. E. Farmer was elected Secretary in his place. The erection of the Club station was then discussed, the matter being left in the hands of the Committee. Mr. T. Hancock then displayed his portable receiving set, giving particulars of experiments he had carried out with kite aerials and various earths. The Secretary's address is 7, Aberdeen Terrace, St. James's, Northampton.

* * *

A well-attended meeting of the Birmingham Wireless Association was held at the Club-room, John Bright Street, on Wednesday, February 4th, which was addressed by Mr. H. von Kramer. The chair was occupied by Mr. W. F. B. Bartram. Mr. von Kramer's subject of address was

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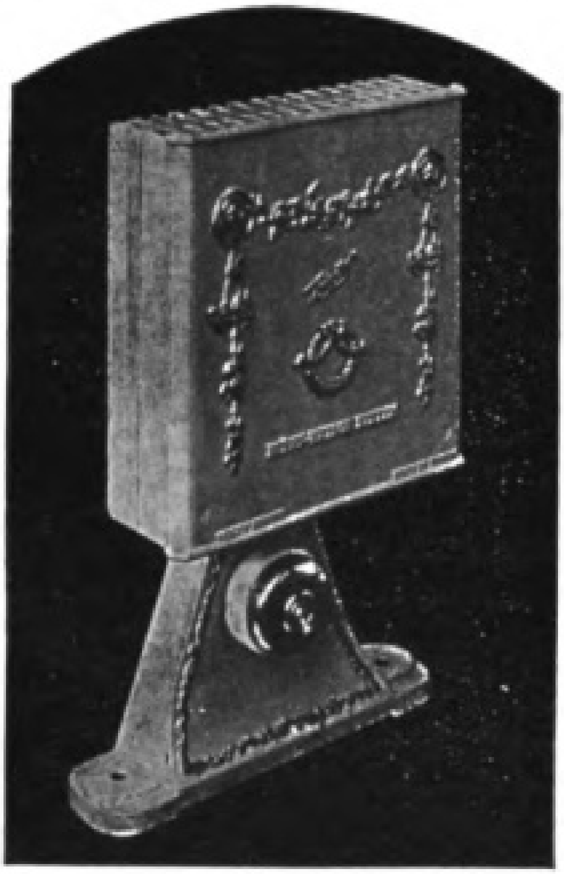

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the "Railophone and the K.K. Detector." He laid great stress on the fundamental laws of electricity, particularly with regard to induction, and then described some of his experiments with inductive circuits, the result of which has been the introduction of the Railophone system, for the automatic prevention of collisions on railways, by bringing any train to a standstill which endeavours to pass a home signal at danger.

* * *

At the annual meeting of the Liverpool Amateur Wireless Association it was reported that satisfactory progress had been made during the past year. Mr. J. T. Mathews, Chairman, Mr. J. R. Forshaw, Vice-Chairman, Mr. S. Frith, Hon. Secretary and Treasurer, and Mr. Wilde, Assistant Secretary. A committee comprising the following gentlemen was elected: Messrs. J. A. Henderson, N. D. B. Hyde, G. Irvine, J. Bolton, W. H. Constable Kew, and J. Coulton. The question of renting a permanent club-room was discussed, and Mr. F. Shaw called attention to the complaints of interference received from the Seaforth Station. It was agreed that the members of the Club should use their best efforts to suppress this nuisance.

* * *

A meeting of the Liverpool and District Amateur Wireless Association was held on February 10th, with Mr. J. T. Matthews in the chair. Several new members were elected, and it was announced that Mr. F. Shaw had consented to become president for the current year.

* * *

A report was presented regarding the negotiations for the new club-room, and a motion was carried that the tenancy of the proposed room should be entered into. It was also arranged for a detail list of members' stations to be compiled and printed in conjunction with the club rules. One member reported results of experiments with an inside aerial: total length 15 feet long, 30 feet lead to instruments, and is said to have heard Marseilles, Orient and other French stations, as well as English coast stations. Another member gave a report on his observations on atmospherics. There were also elementary and advanced Morse code practice.

The Barnsley Amateur Wireless Association held a successful general meeting on January 21st. The special wireless message which was sent from the Eiffel Tower, Paris, to the Wireless Society of London during their meeting held on the same evening was received simultaneously at the headquarters of the Barnsley Wireless Association.

* * *

The Cheshire Radiographic and Scientific Society has lately adopted a new title and is now known as the Radio-Scientific Society. A smoking concert inaugurating the society under its new title was held on January 21st at Manchester, with the further objective of bringing all the members together for a discussion on the future policy of the society and for the arrangement of a comprehensive programme for future meetings. Under the able chairmanship of Mr. J. R. Halliwell all these matters were satisfactorily dealt with. The meeting concluded with an admirable entertainment of varied character. Particular mention should be made of a remarkable selection of phonograph "music" given by one member of the society, who reproduced "in linkèd sweetness" signals from the wireless stations at Paris, Seaforth, and Liverpool, which were recorded on an instrument of his own invention. Later, the same member reproduced musical records by means of his improved sound-box.

* * *

Meetings of the society are held each Wednesday evening at the "City" School of Wireless Telegraphy, 43, Thomas Street, Manchester, and all desirous of joining are invited to come to the meetings or communicate with the Honorary Secretary, R. J. Thompson, Southbank, Broad Road, Sale, near Manchester. The subscription is 5s. per annum. The society has now more than 60 members and is still steadily growing. A portion of each meeting is devoted to "Code" practice, and a course of short lectures on "Electricity as Applied to Wireless Telegraphy," by Mr. J. R. Halliwell, is proving of great assistance to members. In addition to the above, a special subject is given at each meeting, followed by a general discussion. A lantern is now at the service of lecturers who wish to illustrate their papers by means of slides.

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. Such questions must be accompanied by the name and address of the writer, otherwise they will remain unanswered.

J. M. N. (Manchester).—We fear that your experiment is merely a step in the backward direction, leading to inductive "wireless" as used in pre-Marconi days.

E. B. (Louvain).—(1) We cannot give any opinion as to the novelty of an invention; we think the arrangement you propose would work, the drawback being that the inertia of the diaphragm might be rather great. (2) Tissot's value is the nearest.

S. G. (Kingstown) is a young beginner, and writes to ask us several questions. He very politely adds that if they are too much trouble to us to answer, we are not to bother about them. It is not the trouble which we cannot spare, but the space. We think that a careful study of our Amateur articles, our instructional articles, and our Questions and Answers columns will give him most of the information he requires. In a few words we may give the following hints: No. 22 is a good wire for a direct coupled inductance for short waves, but if he intends to receive the big stations this wire would take up too much room, and he should use No. 26 or 28. Enamelled wire is convenient. For the crystal, carborundum with battery and potentiometer, or zincite-bornite without. As high and long an aerial as possible. For small light aerials No. 18 copper or silicon-bronze is good.

J. P. H. (Fleetwood).—Your aerial seems all right as it stands. On the right of your sketch you show a straight vertical line marked "44 ft. from ground"; we do not know whether this represents another building, or merely a height. If it is the wall of a building, it is possible that you are being rather badly shielded by this. You do not say what stations you have been trying to receive; if you are looking for ships, we should say that your secondary circuit was tuned to far too long a wave; for even on the shorter stops you have all the self-capacity of the unused portion adding itself on to the capacity of your condenser across the secondary. By the way, you do not mention what that capacity is; that alone may be too big for ship-waves. Do not forget that for any waves, using a high-resistance detector you want *large* inductance and *small* capacity in your secondary circuit. If you are trying for waves of 2,000 metres or so, we think your apparatus is well-adapted to them (though even here we are handicapped by lack of data) and can only suggest that the circuits are not properly tuned. For long waves you might try, as a preliminary, connecting your detector direct to the top of the tuning inductance of the aerial-circuit, thus cutting out the coupled circuit.

A. C. (New Brighton) has a one-slide tuning-coil, which he puts in series with a two-tappings coil; he puts the aerial on to one end of this combination, and then leads the other end to earth through his silicon-platinum detector, across which he shunts a pair of phones, 100 ohms each, and connected in parallel. He is altogether wrong: he has got a high-resistance crystal in series with his oscillating aerial circuit; not only that, but the crystal is situated at the point of lowest potential instead of highest; and he is using telephones which are not in the least suited to "wireless" unless used in conjunction with a telephone transformer. He should buy all the back numbers of THE WIRELESS WORLD and read all the Questions and Answers dealing with telephones and telephone transformers; all our instructional articles, and, above all, our reply to W. E. D. in the February, 1914, number.

E. J. F. (Woolwich).—(1) Yes. (2) Best to mount carborundum in brass cup with Wood's metal or soft solder, point pressing against steel spring. But it is not necessary to have any cup at all, the crystal being held between two springs. (3) The wires will probably affect your receiving to some small extent but we do not think your proposed change would be of any benefit. (4) Yes, for receiving.

N. E. J. M. (Watford) proposes to erect a receiving station, and asks us what the normal day-and-night range would be, and if it would be capable of receiving from Barcelona, Cadiz, Lisbon, Aranjuez, Vigo, Stavanger, Coltano, Bergen, Dantzig, Copenhagen, and Gothenburg. In reply to such a comprehensive query as this we really can only reply "Wait and See." We have said over and over again that there is no such thing as an intrinsic "normal range"; too much depends on the nature of the surroundings, skill of erection of aerials and earths, the design of the apparatus, the crystals used, and, above all, the technical skill of the experimenter in adjusting his instruments properly.

A. D. (Glasgow) is puzzled by the fact that when resistance is put into the field of a motor the latter speeds up. He also wants to know how the power—and, therefore, the range—of a station using a rotary-converter to produce the condenser-charging current is increased; he has tried to increase the a.c. voltage and amperage by speeding up the converter, but finds that this has no effect. If he reads Hawkhead's "Handbook" he will find most of his difficulties vanish. The effective a.c. voltage of a converter is a definite fraction—0·745—of the d.c. voltage which drives the machine; and, therefore, speeding up the latter has no effect on the a.c. voltage, except in so far as it may pull down the driving voltage. A. D. is using a higher voltage to drive the machine than the normal; he is in fact using 250 volts instead of from 70 to 110 volts; and he asks if this accounts for the power being over 1½ kw. Probably he means that by multiplying the a.c. volts and amperes together he gets a value of more than 1½ kw. The "Handkook" explains that this does not necessarily mean that he is getting more than 1½ kw. of actual power. He also asks a question as to his aerials; if the angle which his down-lead makes with the horizontal part is not too sharp for receiving work (as he says) it is not too sharp for transmitting either. But we do not feel quite satisfied that he is justified in saying that it is not too sharp for receiving. He should certainly try a comparison of the two cases for himself, measuring the strength of received signals in either case.

F. L. (Oxfordshire Boy Scouts).—At the end of your last letter you ask "Does the fact that our gear is in an iron building make any difference?" This might easily be enough to cause all your troubles; if your aerials, either for sending or receiving, are near the iron walls of a building, you will lose a very large proportion of the energy. Make your preliminary tests, at any rate, right in the open; and make sure that you have good earths at either end; if you cannot bury metal plates, then use wire-netting or run a number of wires out along the surface of the ground.

M. G. R. (Woolford).—With regard to the planning of your aerial, we are inclined to think that the best plan would be for you to erect three separate "twin-wire" or "hoop" aerials radiating from a mast attached to chimney F to the three corners, A, D, and C, leading in from all three through the window, E. The wires would not reach right to the three corners, but would have such lengths of small rope attached to their end-spreaders as to keep these latter at a good height from the ground. These ropes would be made fast in the three corners, and in order to make them pass at a convenient height above the bowling-green, etc., you might put in a short mast at each place; the guys for these masts would be so short that they need not reach the green.

H. D. G. (Bristol).—Your letter is far too long and complicated to be dealt with in detail. To sum up our advice in a few words: by changing your aerial from Fig. 1 to Fig. 3, you increase its average height from 31 ft. to 41 ft., and would, therefore, get much better signals, although, since you are changing from 5 wires to 2, you will require more inductance to tune up to the same waves. Your connections are all right except for the fact that in both figures you show the battery and potentiometer (which very likely are poorly insulated, and in any case have a considerable capacity to earth) connected to the high-potential end of a circuit—in Fig. 1 to the top of the long tuning-inductance, and in Fig. 2 to the top end of the jigger-secondary. If you read our columns carefully, you will see that the crystal should go *direct* to the high-potential end of the circuit, and things which are earthed, partially earthed, or have a big capacity to earth, should be connected to the low-potential end; that is, in Fig. 1, to the earthed end of the tuning-inductance, and in Fig. 2 to the bottom end of the secondary, which should be coupled to the earthed primary *only at the bottom end.*

G. E. H. (Aberdeen).—With your two-wire 70-yard aerial, your tuning-coil of No. 20 wire, 4 in. diameter, and 10 in. long, is probably quite insufficient for the waves you wish to receive, and you had better increase it to about 4,000 microhenries. You will find a formula in the *Year Book of Wireless Telegraphy and Telephony* for calculating this inductance, or perhaps you already know one. The ultimate end of the pipe which runs down the house, and which is forming your earth, is wrapped in mystery; it is quite possible that it forms a very ineffective earth, but, on the other hand, if it continues of metal and runs well underground, and has no joints with any insulating material in them, then it might be quite good, especially if it delivers water and thus keeps the ground around it wet.

E. T. F. (Pretoria).—The probable effect of running your aerial for all its length 5 feet above a corrugated iron roof will be to give you an aerial whose effective height is about 5 ft. On the other hand, some strange results have been recorded where the near neighbourhood of earthed conductors has worked miracles in the way of improving signals. Frankly, we do not feel very much confidence in these results, but it is not safe to lay down the law in wireless. We do not think that the dynamo within the iron building would trouble you.

N. de P. ("Marci").—(1) In the *Year Book of Wireless Telegraphy and Telephony* on page 331 it states that "The condensers are protected against excessive increase of voltage from surging, by suitable spark gaps placed at various positions on the bus-bars." Is this a misprint or is it an addition to the ordinary Marconi set? (2) Can you tell me an effective means of reducing the self-induction in the telephones when the converter is running? (3) Whilst operating recently I had occasion to pull out wall plug from receiving to send, and got a very severe shock from the plug.

Answer.—(1) Neither a misprint nor an addition. In certain sets—notably the smaller ones—the maximum voltage which can be produced by local surging is well below the breakdown voltage of the condenser, provided the set is worked properly. Hence there is no "excessive increase," and, therefore, there are no spark-gaps on the bus-bars; the only safeguard provided being the safety-gap across the discharger, which protects the set in case too long a spark is used. In the larger sets the bus-bar gaps are provided if, owing to the length of bus-bars, the large capacity of the condenser, and other reasons, excessive local surges are liable to occur. (2) Keep your commutator in good order so as to avoid sparking; earth the lead covering of the A.C. wiring; open your A.C. switch. (3) We can only suggest that it was some kind of retribution.

A. H. has obtained carborundum from several different sources, but has been unable to find a crystal which would approach zincite-pyrites or zincite-bornite for sensitiveness and general efficiency on a *small* aerial. Even silicon, he says, is very much better. He does nor transmit, and suggests that, perhaps, this would account for the discrepancy between his experience and our recommendations, as he can quite understand that these extremely sensitive crystals might not stand so well if subjected to comparatively heavy voltages. We were getting nervous, and started wondering whether we should jump at this excuse, while surreptitiously getting rid of our stock of carborundum, when we were relieved to notice his post-scriptum: "I get Cleethorpes, Norddeich and Poldhu, etc., sometimes very loudly with zincite, but with carborundum sometimes can hardly get Eiffel. . . ." His aerial is 300 ft. long and 40 ft. high; and if he can sometimes "hardly get F. L." with carborundum, something must be seriously wrong; something which cannot be attributed to the inferior sensitiveness of carborundum as a receiver. A. H. should read (1) Our comment on Mr Pope's letter; (2) Our answer to W. V. H.; (3) Our answer to "Zeta," and (4) Our answer to W. E. D., all in the February number. If possible, he should get hold of a micro-ammeter (or adapt a milli-voltmeter so as to use it as a micro-ammeter) and set to work to plot the curves of a few of his carborundum specimens; the results should help him to make sure that he is applying the potential in the right direction and to the right amount.

R. B. (London).—(1) What would be a suitable design for a transformer to take 50 watts from 205 volts A.C. mains 50 ciphers? (2) My aerial is T-shaped. Could receiving results be improved by altering design of my aerial?

Answer.—(1) Buy one ready-made; it will be cheaper. Specify your requirements as to voltage, frequency, and power. (2) You certainly should not work with the arms of your T unequal, though, as a matter of fact, your aerial is so short compared with the long waves you are probably receiving that the inequality will not matter so much as it would in the case of an aerial designed for those waves. But it must be bad for your short-wave transmission. For the latter, it would be best for you to transfer your down-lead to the centre of the horizontal part, if converting the whole into an inverted L aerial by a down-lead from the far end (the house seems to get in the way of a down-lead from the near end) produces a natural wave-length too great for your transmitting licence. This latter plan would appear to be the best of all for long-wave reception, but it would give you a natural wave of over 200 metres. As a compromise, we should be inclined to transfer the down-lead to the centre of the horizontal part.

R. B. (Queenstown).—The station at Poldhu was originally erected for Trans-Atlantic work, but this class of work is now being performed through the Clifton Station, and Poldhu will work a continuous commercial service with Spain.

With regard to your second inquiry we would refer you to our April, 1913, number for details of the *Pembroke* to *H.M.S. New Zealand* feat. We might suggest the advisability of keeping a file of the back numbers of THE WIRELESS WORLD.

F

Patent Record.

1914.

1,169. January 15th. Wm. H. Shephard and A. E. McKechnie. Wireless telegraph or telephone system.

1,556. January 20th. John Hays Hammond, Junr. Control of moving bodies by radiant energy.

2,206. January 27th. Fernand Holweck. Cathodic detectors.

2,214. January 27th. Robert Goldschmidt. Spark gap devices for wireless telegraphy.

2,413. January 29th. Wm. H. Shephard and A. E. McKechnie. Recording apparatus for use with line or wireless telegraph systems.

2,679. February 2nd. John Hays Hammond, Junr. Methods of controlling distant apparatus by Hertzian waves.

2,738. February 2nd. Roberto C. Galletti. Transmission of wireless signals.

2,739. February 2nd. R. C. Galletti and Richardo Manzetti. Electric dischargers.

2,740. February 2nd. Roberto C. Galletti. Method of producing electric impulsive discharges.

2,935. February 4th. Auguste L. Chaudet. Crystal detectors for wireless telegraphy.

3,080. February 5th. A. T. M. Johnson, F. H. Varley and Annie C. N. Try. Wireless telegraphy.

3,171. February 6th. Egbert von Lepel. Method of periodically modifying high-frequency electric currents.

3,191. February 6th. George O. Squier. Radio-telegraphic and radio-telephonic receiving system.

3,192. February 6th. Emile Girardeau. Radio-telegraphic station.

3,232. February 7th. W. P. Thompson (for Rudolf Goldschmidt, Germany). Frequency transformers.

Obituary.

It is with regret that we record the death of Mr. Ernest Thomson, wireless operator on the ss. *Michigan*. Mr. Thomson joined the Marconi Company in the June of last year, and on January 1st was appointed to the *Michigan*. On January 6th, however, he was taken to the hospital at Antwerp, suffering from typhoid fever, to which he succumbed two days later. It is sad that death should have cut short what promised to be a very successful career, for Mr. Thomson was full of initiative and energy, and took an active interest in his work. He was in his twentieth year.

Marconi House Notes

Debating Society.

The Debating Society has held two meetings during the month. The subject of the first debate, "Is the granting of adult suffrage desirable in the best interests of the community?" gave an opportunity for Mr. Sampson to open eloquently the case for the affirmative position. Mr. Bangay replied from the opposite point of view, and when, after a long debate, Mr. Rattray, the chairman, took the voting, the general opinion was shown to be in favour of wider franchise.

The second meeting debated "Is the future of the country bound up in Trade Unionism?" The debate was opened by Mr. Rice, the secretary, to whom replied Mr. Morse. Mr. Stevenson made an interesting suggestion for the accommodation of Trade Unions to the needs of the future. Captain Sankey, in the chair, did much to encourage the timid and stimulate the discussion when it showed signs of getting thin. The voting was with practical unanimity in favour of the prospects of Trade Unionism.

Football Section.

The return match with Oratory Brigade will be played on March 7th, at South Ealing, and if the Marconi team play well enough to reverse their former defeat, they may once more take top place in the competition.

Tennis Section.

Last month the Lawn-Tennis Section held a general meeting for the purpose of electing officers for the coming season. The result of the voting was that Miss Haynes and Messrs. Pontifex and Cummins were re-elected. The Committee by their own labours, and with the assistance of two energetic volunteers, brought in by the appeal made in this column last month, have already made an excellent start on the re-turfing of the courts. Doubtless the weather has prevented many of the members of this large section of the club from lending a hand, but we would remind these that the task is not yet completed, so that the opportunity of co-operation is still theirs to take.

The Musical Society.

All the efforts of the Musical Society were at the time of writing directed to preparations for the concert, which took place on February 21st. It was found necessary to enlarge the stage in order to accommodate the massed bands, which numbered some 40 players. The chief feature was the contest between the Works (Chelmsford) and Office (London) Bands for a handsome cup presented by the Directors of the Marconi Company.

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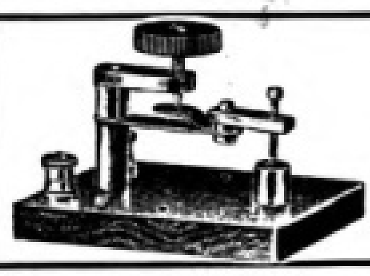

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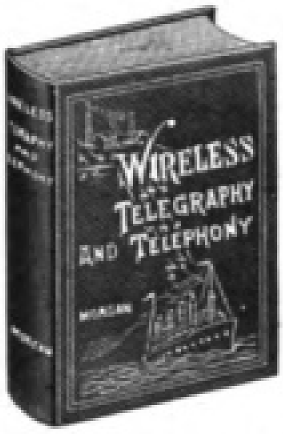

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The January issue contains the following articles:—

Re-Organisation of the Wireless Coast Communication Scheme: Full Description of Land's End (St. Just) and Fishguard Stations by E. S. PERRIN, A.M.I.C.E., B.Sc., and F. W. DAVEY.
Secondary Cell Maintenance by J. G. LUCAS.
New Cables: The Anglo-German Telegraph and the Anglo-Irish Loaded Telephone Cables.
Improvements on the Baudot Telegraph System by A. C. BOOTH.
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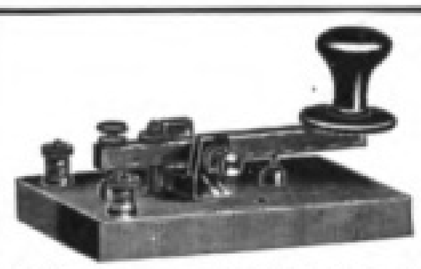

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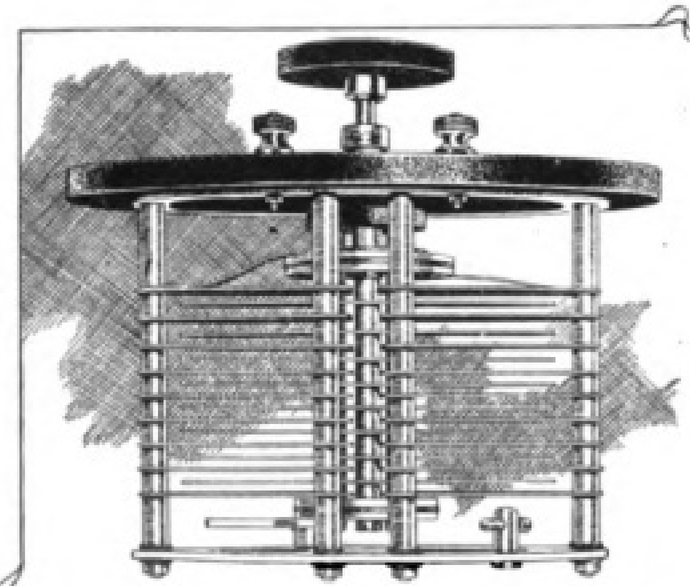

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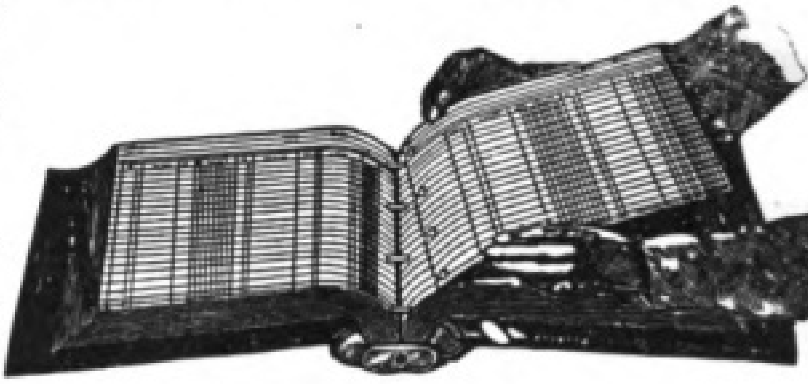

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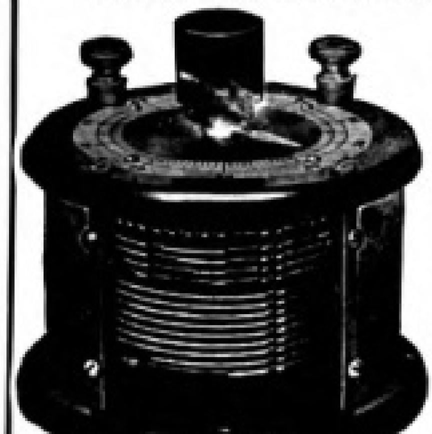

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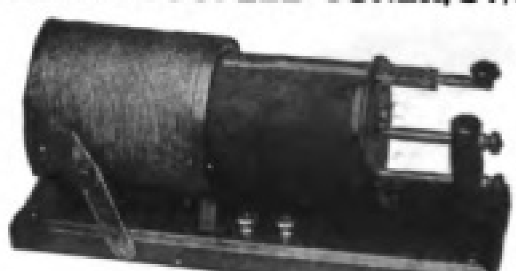

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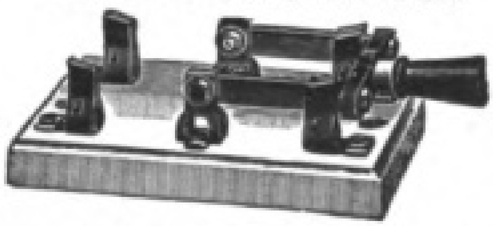

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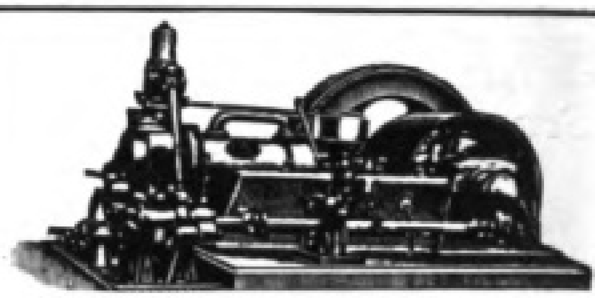

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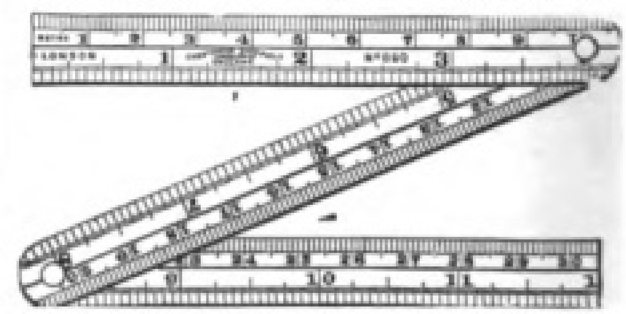

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