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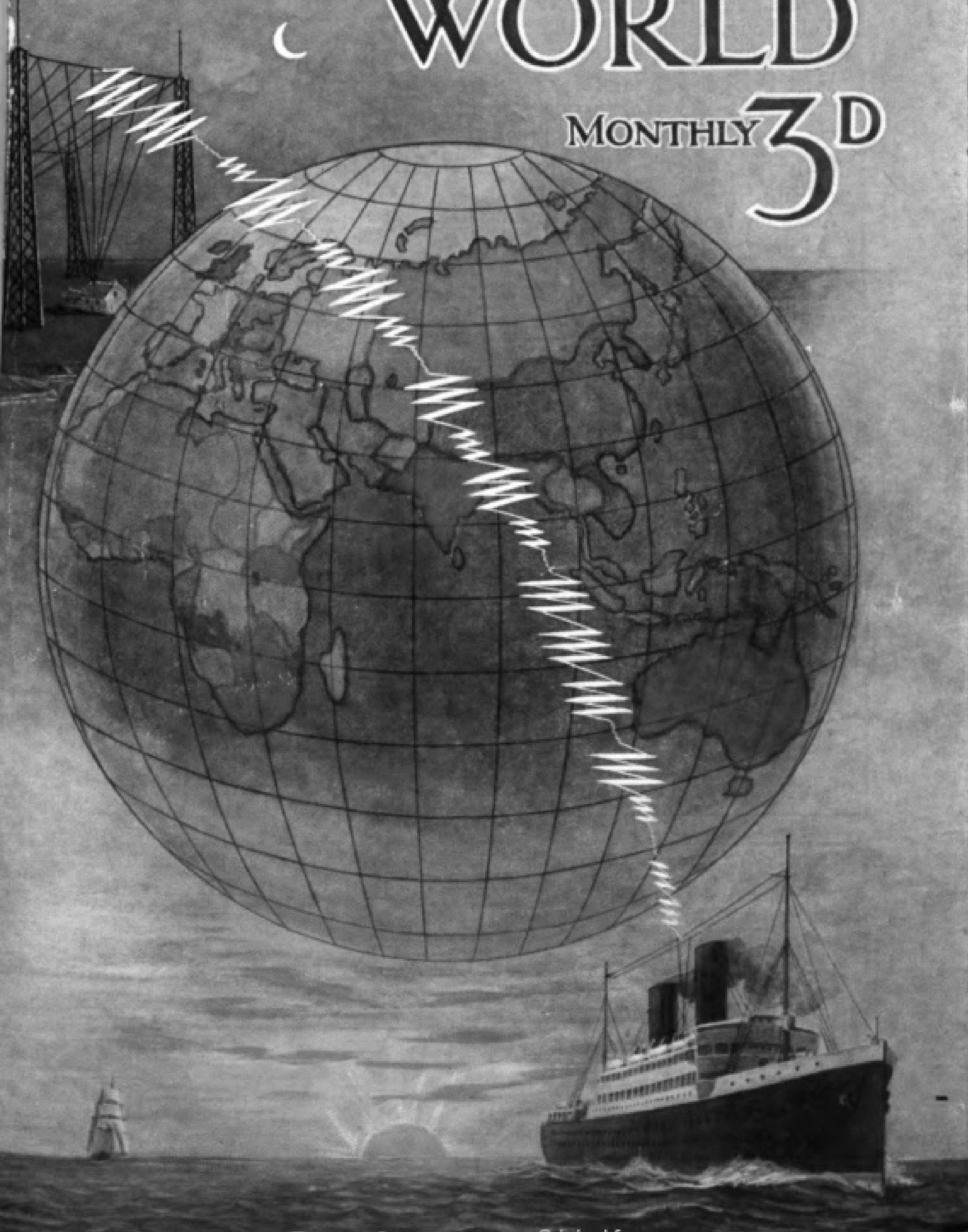
WIRELESS WORLD

MONTHLY 3D



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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.

CONTENTS.

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THE
WIRELESS WORLD
with which is incorporated
The MARCONIGRAPH

Vol. 1.—No. 9. (New Series) December, 1913. Subscription 5/0 per annum post free. Price 3d. Post Free 5d.

The Perils of the Sea.

THE news of the burning of the Spanish steamer *Balmes* which came to hand as we were about to close for press with this number emphasises the object lesson to the world of the beneficent power of wireless telegraphy which the burning of the *Volturno* afforded a striking reminder of last month. Happily, the latest disaster was not attended by the unfortunate consequences which followed the *Volturno* conflagration, for by the means of wireless telegraphy another vessel was able to reach the burning ship before the flames could obtain complete mastery. The story may be briefly told. The Spanish steamer *Balmes*, which hailed from the Gulf Ports and Havana and was sailing for Cadiz, arrived on Sunday, November 16th, at Hamilton, Bermuda, convoyed hither by the Cunard liner *Pannonia*, with the smoke and flames still bursting from her forward decks. The fire broke out three days previously, and when Capt. Capper of the *Pannonia* was about a thousand miles from New York he heard the wireless call for help, and immediately changed his course to find the *Balmes*, which he estimated to be about 200 miles to the south, with 103 passengers on board and 56 officers and crew. During the interval which elapsed between the receipt of the call for help and the arrival of the rescuing vessel, the operator on the Cunarder was sending short messages of encouragement telling the passengers and crew of the hourly progress made by the *Pannonia* and of the arrangements to help everybody.

This incident lends point to the proceedings now taking place in London, where representatives of the different nations are meeting together with a view of taking combined action on behalf of the common interests of humanity. The work of the Conference really falls under two heads. Safety at sea may be achieved either by the avoidance of accidents or by minimising the results of such accidents as do occur. Thus, the first thing necessary is to see to the strength, stability, and seaworthy qualities of vessels, to insist on the observance of all conditions of careful navigation, to take steps to keep sailors informed of the presence of such lurking perils as ice or derelicts, and to take care that full and adequate preparations are taken to warn ships near to land of the dangerous points of the coast. Here, wireless telegraphy figures as prominently as it does in that section of the work of the Committee concerned with the question of the provision of life-saving appliances. This is undoubtedly a matter where the maritime nations of the world should act in unison. If the shipowners of one nation were made to observe rules and regulations which were not applied to their rivals in other countries, it is clear that they would be placed at a serious disadvantage in the fight for the maritime trade of the world. So that if there were no assurance of international co-operation it is not improbable that many Governments would be loath to pass legislation desirable and even necessary in the interests of the public safety. We may hope, therefore, that the Conference will succeed in reaching an agreement as to the measures which should be adopted to minimise the perils of travel by sea.

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SIR W. H. PREECE.

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Personalities in the Wireless World

SIR WILLIAM PREECE

Born February 15th, 1834.
Died November 6th, 1913.

THE passing away of this distinguished electrical engineer must be our excuse for departing from our usual practice of dealing on this page only with living personalities who are contributing to the development of wireless telegraphy. Sir William Preece was an ardent investigator in many branches of electricity, including inductive wireless telegraphy, and although his name is not directly associated with any of the revolutionary discoveries in this science, there is scarcely one that did not owe something to his practical experience and his inquiring mind.

His first experiment in inductive wireless telegraphy dates as far back as 1882, and for some years thereafter he experimented in all parts of the country and published the results in numerous papers.

The inductive method of wireless telegraphy depends for its effectiveness on the fact that an electric current moving backwards and forwards in one wire will cause another electric current to move forwards and backwards in another wire within its field. For practical purposes this system is limited in its value by the fact that in order to increase the distance over which signals are transmitted it is necessary proportionately to increase the length of the parallel wires opposing each other. As the parallel wires had, roughly, to be as long as the distance between them, it will be seen that this method had limits of practical application, even over short distances.

Sir William Preece on one occasion tried to signal by these means between England and Ireland, and on a Sunday night seventeen years ago connected up the main telegraphic lines through the length, north to south, of England and Ireland, thus making two enormous parallel circuits. The results, however, were unsatisfactory, and no definite messages from either Ireland or England were received.

It was about this time that Sir William made the acquaintance of Mr. Marconi, who demonstrated his invention—which was not that of inductive telegraphy, but which depended on electromagnetic waves—before Sir William Preece and other Post Office officials. But, curious as it may appear to-day, there is abundant evidence to show, by the utterances of theoretical and practical electricians of fifteen years ago, that the system at which Mr. Marconi was working was not believed to be of great practical value. Nevertheless, Sir William evinced a deep interest in Mr. Marconi's early experiments in England, and it was due to his influence that Mr. Marconi received considerable encouragement from the British Post Office.

The name of Sir William Preece will always be chiefly associated with the growth and development of the system of inland telegraphs in Great Britain, and he may almost be said to have been contemporary with it. He was electrician to one of the private companies which existed before the system of Post Office Telegraphs was consolidated under Government control, and as he was present at the inauguration of that new system, so also he remained in office till another system of electric intercommunication—that of the telephones—had established its importance.

During his long career as Engineer-in-Chief to the British Post Office he was responsible for many far-reaching improvements for which the public are indebted to him.

Sir William Preece, who was created a K.C.B. in 1899, was a Fellow of the Royal Society and a LL.D., becoming, in 1898, President of the Institution of Civil Engineers. He married in 1864 Agnes, daughter of the late George Pocock., of Southampton. She died in 1874. Sir William's family consists of four sons and three daughters.

B

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The Welsh Wireless Station

PROGRESS OF THE GREAT TRANSATLANTIC STATION AT CARNARVON. THE SITE AND ITS ASSOCIATIONS. DETAILS OF THE BUILDINGS AND PLANT.

THE picturesque old city of Carnarvon will before long be possessed of an interest which will appeal to a wider public than merely historians and antiquarians. For soon the great Transatlantic wireless station which is being built at Cefndu will be completed and a new route of communication will be opened up with our *confrères* across the "herring pond." Then the ancient Kaer Seint yn Arvon of the *Mabinogion* and the birthplace of the first Prince of Wales will be lost in the modern Carnarvon, the possessor of one of the finest wireless stations in the world, and the little river which gives its name to the place will be forgotten in the greater wonder of this outpost of civilisation which has received its name from the city near by.

The construction of the station is now approaching completion. It is situated on the side of the Cefndu Mountain, and merely from a wireless point of view the site is admirable. The ground begins to rise immediately the Ceunant road, which stretches alongside the lower edge of the Company's land, has been passed, until in the extreme east of the site it reaches an altitude of some 800 feet. The station itself is built at a height of 750 feet, and the last row of masts is estimated to stand about fourteen hundred feet above sea level. Such is a description of the locality as it would strike a wireless expert, but from the point of view of the observer of natural beauty much more might be added. Standing upon the mountain side the view is particularly arresting. Looking towards the north the land lies spread out below till it reaches the water's edge. Beyond stretches the glitter of the sea, its loveliness emphasised by the proximity of Anglesea, with its flat tableland stretched out in serene amplitude in the midst of constant movement, like some giant leviathan ever basking on the surface of the waves. Further than this the eye on a fine day can penetrate the blue haze and catch a glimpse of the white shores of Ireland far out in the distance. Looking inland the noble mass of Snowdon makes an imposing spectacle as it stands out among its sister hills, while between lies the narrow valley of the River Senit, which falls into the sea at Carnarvon, where the crenellated outline of the noblest castle in Wales gives a touch of frowning dignity to the scene. It is a splendid spot for those who will be in charge of the station, and though in the winter months it is cold and swept by strong winds, a quick walk down to the valley below will bring them into

Panoramic View of the Station Site.

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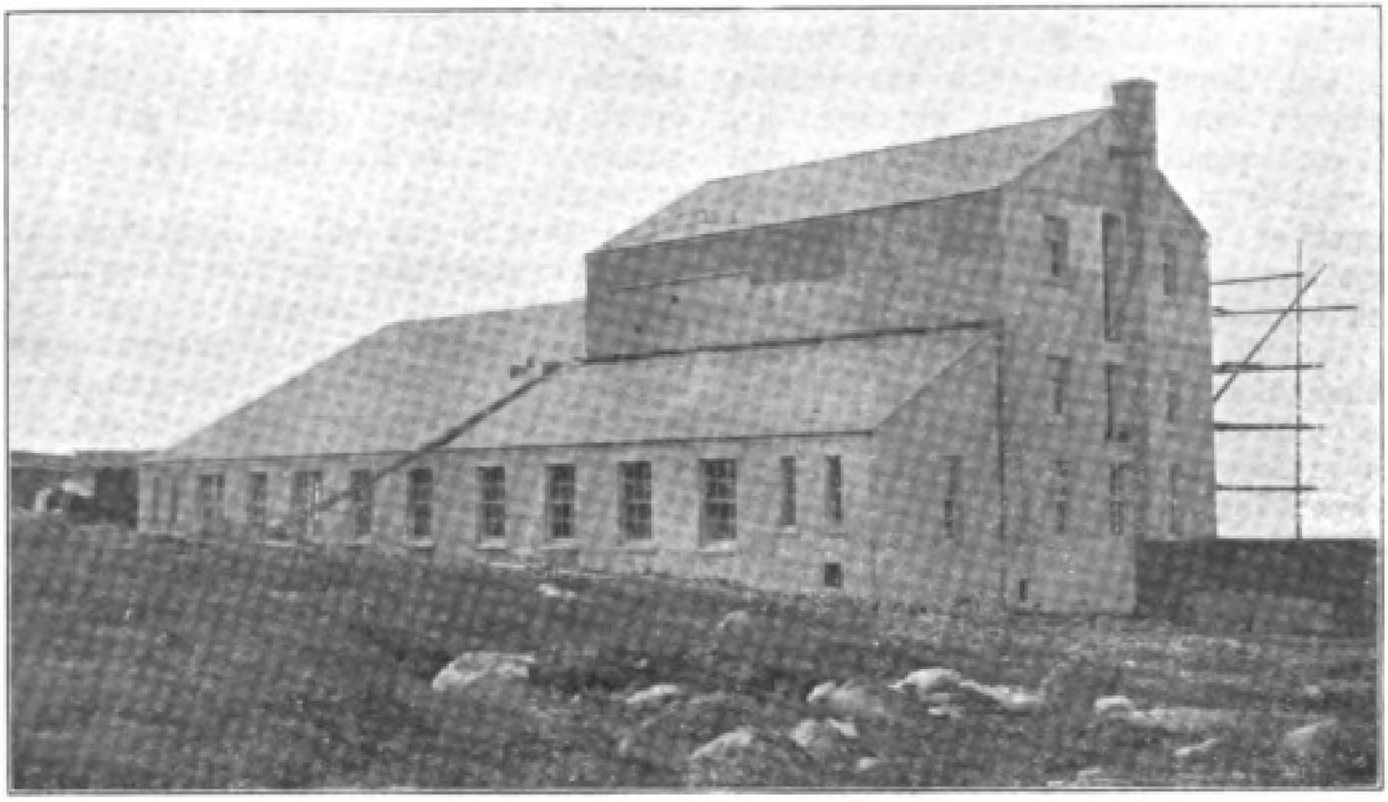
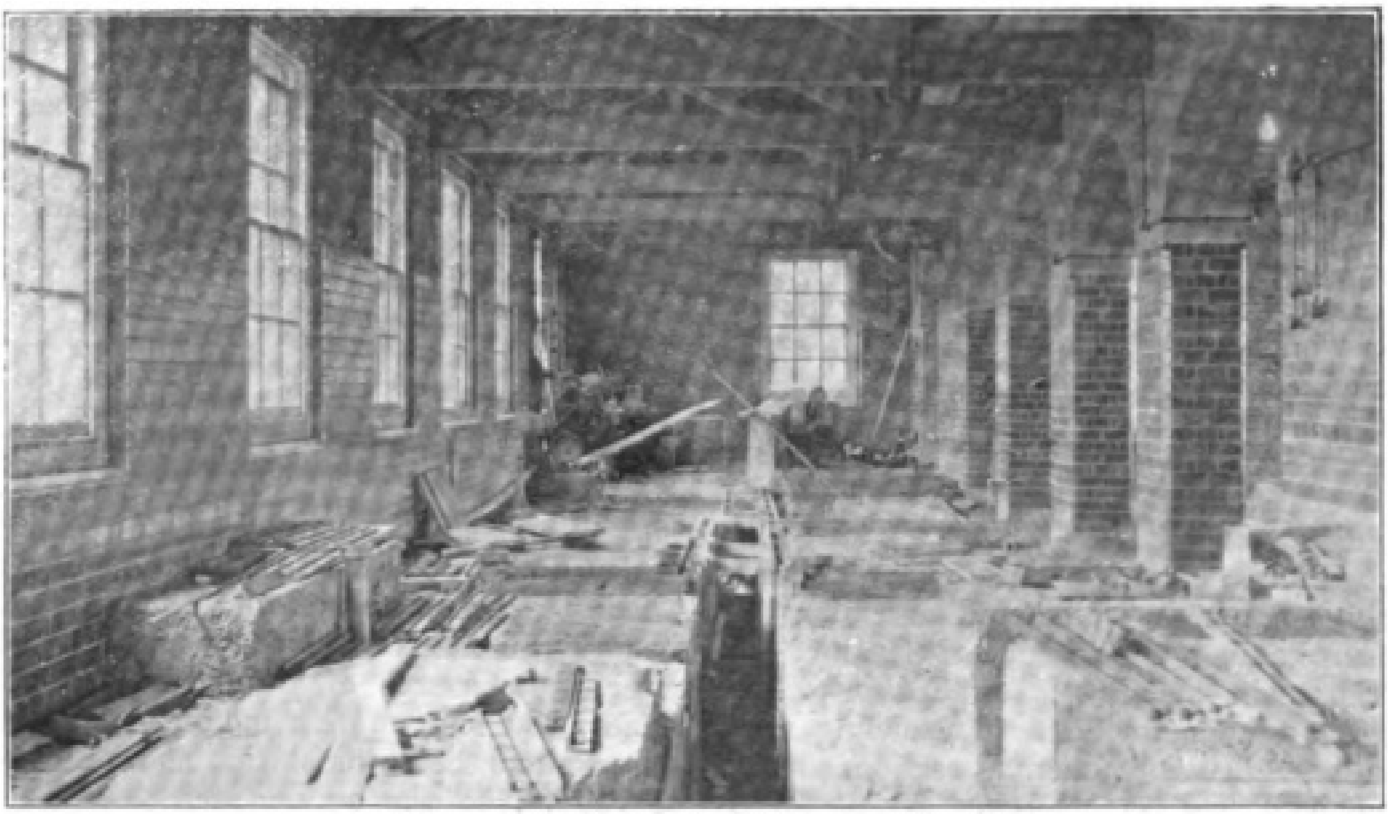


Progress of the Station Building.

another climate, for in all the lower-lying districts and along the coast it is warm and mild.

When completed this station will communicate direct with the second great station now in course of construction at New Jersey, just outside New York, and another direct line of wireless communication with America will then be opened up. At present the only route is *via* Clifden and Glace Bay, but the need of extended facilities has long been felt.

A description of the work which is being carried on at the New Jersey station has already appeared in THE WIRELESS WORLD, and we now propose to supplement this with a short account of the happenings on this side of the ocean, which we think should prove of interest to our readers.



Machinery Hall before installation of the Plant.

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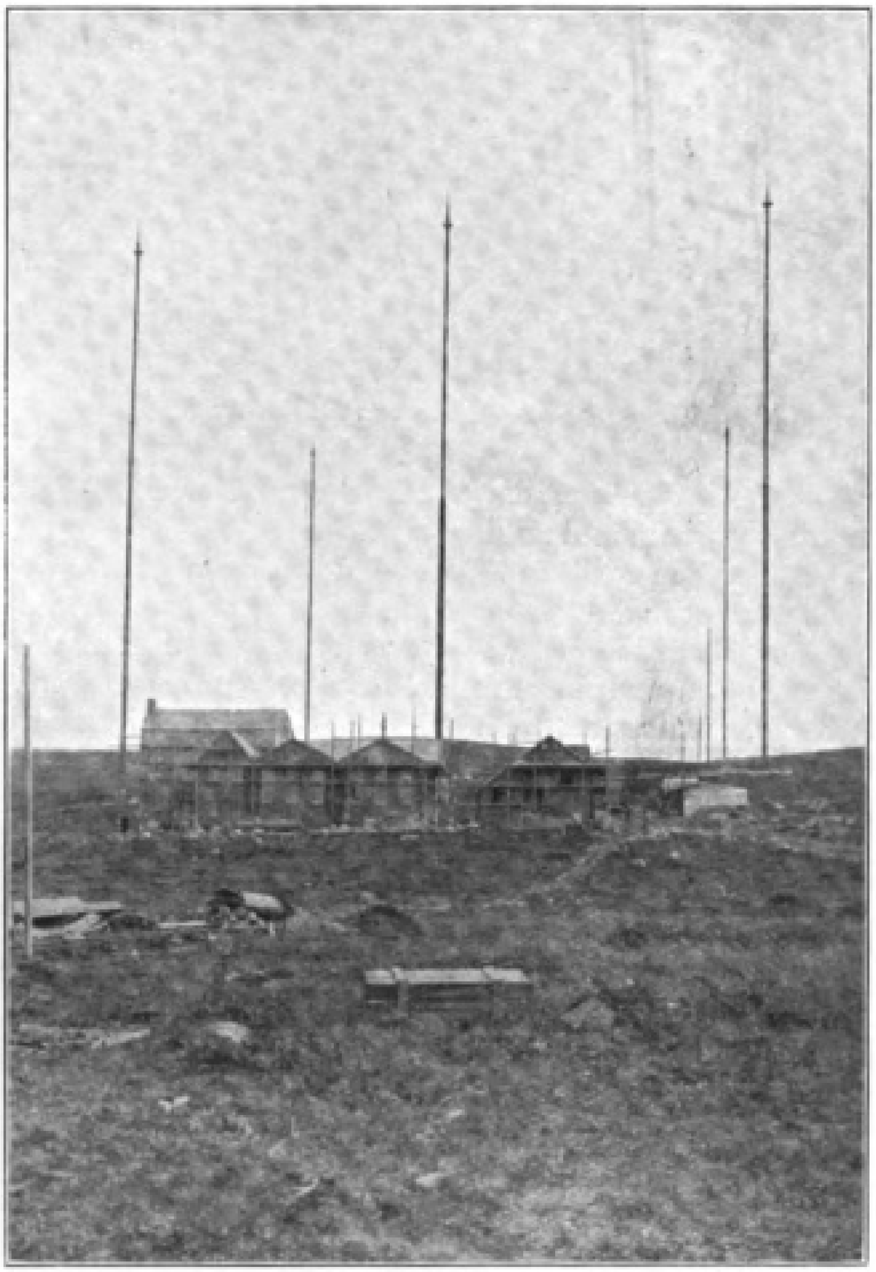
Owing to the extremely boggy nature of the soil, horse haulage up the Cefndu Mountain was considered impracticable, and consequently a light railway was constructed from the Ceunant road to the summit of Cefndu. This line is arranged in three sections, and haulage is effected in each case by means of a steam haulage engine and steel wire rope. Since the opening of this line early last summer between 7,000 and 8,000 tons of materials have been hauled up the mountain.

The transmitting aerial consists of 32 wires of silicon bronze, and is supported on 10 tubular steel masts each 400 feet in height. The foundations and anchors for these masts consist of very heavy concrete blocks, some 6,000 tons of material having been used in their construction. The earth system consists of two very wide circles of plates sunk in the ground, with the main building as centre. Extensions to this system are buried underground immediately beneath the aerial and extending as far as the eastern extremity of the site.



General view of the Station, showing some of the Masts.

The main building is divided into two sections—the permanent transmitting section and the experimental section. The permanent section consists of a large machinery hall which contains two generating sets of 500 h.p., and the main switchboards. On the east side of the hall is an annex in which are situated all the motor generator sets used in conjunction with the transmitting plant.

Adjacent to this hall are the two silence chambers containing the two transmitting discs, and behind these are the transformer room and various offices. This permanent transmitting section also contains spacious store rooms, workshop and shift-engineer's office.

The experimental section adjoins the main machinery hall on the west side, and will contain various machines to be used for special work in connection with Mr. Marconi's latest device for generating continuous waves. The upper floors contain the various details of the transmitting plant.

There will be no prime movers installed on the station; all the power employed is being brought from the North Wales Power Co.'s station, near Llanberis. This station, which is situated at the foot of Snowdon, is fitted with water turbines and receives its source of supply from a lake some 1,500 feet up this mountain. The water enters the power station at a pressure of 750 lb. to the square inch.

Power is delivered on the site to a small

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sub-station situated near the main building, and is transformed down from 30,000 volts to 440 volts, the latter voltage being suitable for running the main motors in the machinery hall.

An efficient fire service will be installed in the building, the mains being fed from a large reservoir which is being constructed higher up the mountain.

The plant at this station will be controlled and operated from the receiving station at Towyn, Merioneth, and land wires are now being installed to connect these two stations.

When completed the stations will work direct with New York, transmission and reception being carried on in duplex.

IMPERIAL TELEGRAPHIC COMMUNICATIONS

A SITTING of the Dominions Royal Commission, which has already sat in Australia and is visiting South Africa in the new year, was held in London, November 11th. Sir E. Vincent (chairman) presided.

Mr. Crabb, C.B., Second Secretary to the Post Office, gave evidence particularly with reference to cable communication with various parts of the Dominions. The Post Office had replied in a memorandum to a series of questions submitted to them as to the question of a State-owned Atlantic cable, and this formed the basis of a number of questions to the witness. The Post Office, it was pointed out, was of opinion that from a commercial point of view the provision of a State cable across the Atlantic was not at present justifiable. Replying to Mr. Tatlow (one of the Commissioners), the witness said the developments by leaps and bounds of wireless telegraphy no doubt contributed to the opinion of the Post Office that the present time was inopportune for establishing a State cable. There was a desire in every way to consult the British Dominions overseas, but the cutting of rates by wireless telegraphy and the possibilities of serious and costly interruptions in cables must be considered in connection with the question of an Imperial cable.

Sir Rider Haggard (another Commissioner) asked the witness whether he thought there was a possibility of wireless telegraphy altogether superseding cable telegraphy. The witness said he was not an expert in wireless telegraphy, and he would not like to reply. He considered that the present position of wireless was an argument against a State-owned cable.

THE FIRST PUBLIC TELEGRAPH OFFICE

WE learn from the *Telegraph and Telephone Age* that a bronze tablet, 16 by 30 inches, designed by Henry Bacon, the eminent New York architect, to mark the site of the first public telegraph office in the United States, has been placed on the wall of the old Post Office Department building, on Seventh Street, N.W., between E and F, in Washington, D.C., and was dedicated recently. Representatives of Congress, the Treasury Department, Post Office Department, and of the District Government took part in the dedication ceremonies.

The inscription on the tablet reads :—

"Samuel F. B. Morse, artist and inventor, opened and operated on this site, under the direction of the Post Office Department, the first public telegraph office in the United States, April 1st, 1844. 'What hath God wrought.'"

Captain de la Garde, of the Military Aviation Centre at Rheims, was killed on November 11th at Villacoublay. He had just flown from Rheims, carrying out wireless telegraphy tests, and was on the point of landing when his monoplane fell headlong.

* * *

Wireless has proved its value in the case of minor difficulties, as well as in great disasters at sea. On the voyage, which ended on October 9th, a fireman aboard the C.P.R. liner *Monmouth* became seriously ill. As the ship carried no surgeon, Capt. Griffiths instructed his wireless operator to get in touch with a ship which did carry a doctor. Soon the Allan liner *Hesperian* responded, whereupon details of the sufferer's symptoms were telegraphed to the doctor, and a prescription received in return. This was repeated daily while the two ships were in touch. Later the *Montezuma* was picked up, and the "absent" treatment continued by the surgeon aboard her. The patient probably owes his life to the medical service thus given.

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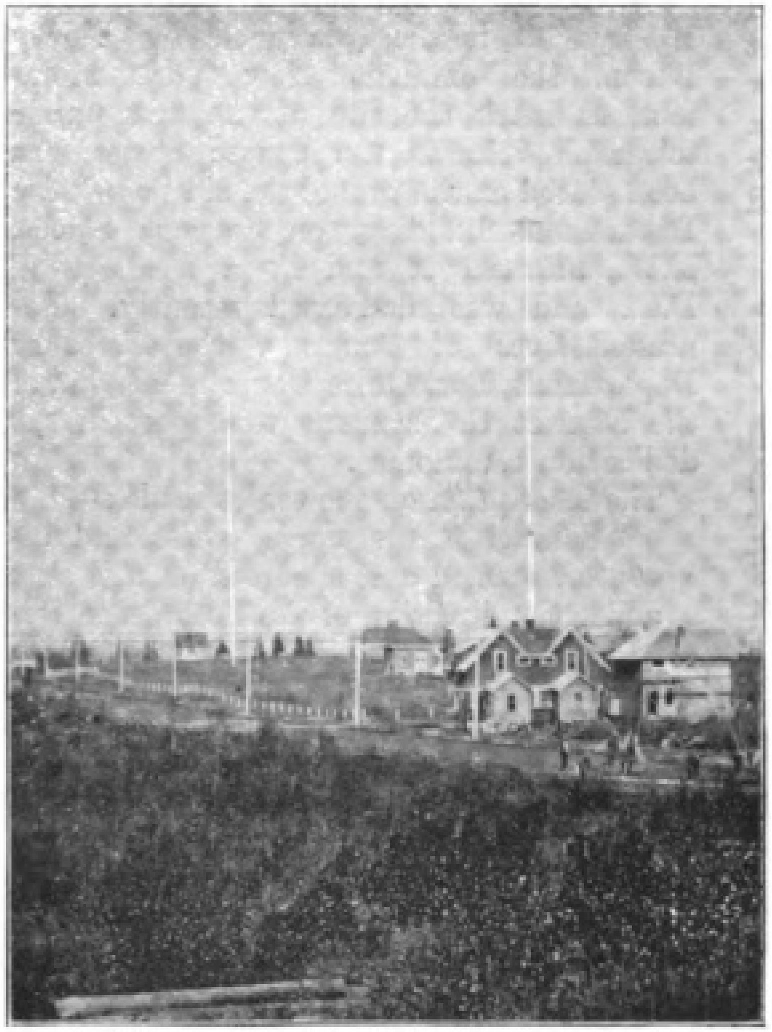
The Great Lakes Wireless Chain

FROM PORT ARTHUR TO THE ATLANTIC. DEVELOPMENTS IN WESTERN CANADA.



Port Arthur Station Buildings and Masts.

VIOLENT storms are reported to have occurred on the Great Lakes of Canada during the past month, and, although at the moment of writing we do not know to what extent wireless telegraphy has mitigated the disastrous consequences of the furious storms, we may be sure that one at least of the stations that stand sentinel on the shores of the Great Lakes—Port Arthur—has played no unimportant part.

Port Arthur, which was formerly known as Prince Arthur's Landing, is situated in the Thunder Bay District, Ontario, on Lake Superior, and although the population is relatively small, the town has become prominent as a shipping centre for lumber and minerals from the surrounding district, and vast quantities of grain from the farther west.

The wireless telegraph station is controlled by the department of the naval service. It was recently remodelled and has been equipped with modern plant by the Canadian Marconi Company. The new masts are of wood each 185 feet high. The transmitting apparatus is in duplicate, and consists of the standard 5½ kw. set as installed at the other Great Lakes stations. Each set can be driven by either a 10 h.p. 3-phase induction motor or an 8 h.p. horizontal slow speed gasoline engine. The station is arranged to transmit wave-lengths from 600 to 1,600 metres, and to receive over a similar range. The work of remodelling the station has just been completed and taken over by the Canadian Government, and the old station building is now being transformed into a residence for the operating staff. The station communicates with Sault Ste. Marie, Ont., a distance of 250 miles. Communication can be effected by means of the 600 metre wave, but better results are obtained on 1,600 metres.

Other stations at Toronto, Kingston and Port Burwell have been erected, and with their completion during the past autumn Canada possesses what is probably the largest single stretch in the world covered by wireless telegraph stations. The entire chain extends from Port Arthur to the Atlantic, so that navigation over the whole St. Lawrence system, a distance of over 2,000 miles, will be under wireless control.

The enterprise of the Government has given rise to an interesting development, which seems to have many possibilities in a country such as Canada.

* * *

It is stated that several applications have

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been received by the Naval Service Department from commercial firms in outlying parts of British Columbia for licences to instal small wireless stations which could communicate with the Government chain, and thus have access to the outside world.

On Queen Charlotte Islands the two stations are being connected with the interior by telephone lines. There is no cable service between the Queen Charlotte Islands and the mainland, and the new telephone connection will now give the residents of the interior of the islands telegraphic communication with the mainland.

* * *

Mr. Ridges, who was recently transferred from the Canadian Marconi Company's technical staff to a position with the Wireless Telegraph Department of the Canadian Government, is expected to return shortly from a voyage to Hudson Bay on the *Beothic*, where he has been looking over the ground in connection with a chain of stations for Hudson Bay which is under consideration by the Government.

Receiving Room, Port Arthur.

* * *

The Canadian Marconi Company have been instructed by the Government to modernise the wireless apparatus on the C.G.S. *Montcalm*, *Lady Grey* and *Druid*, and to instal sets on the *Lurcher* Lightship, near Yarmouth, N.S., and also on the C.G.S. *Simcoe*, all of which vessels are controlled by the Department of Marine and Fisheries.

Exterior of Operating House, Port Arthur.

The *Montcalm* is an icebreaker, and was fitted as far back as 1905 with a coil set. The Government, however, decided to have the vessel fitted with modern apparatus, and a ½ kw. set will be installed, the coil set being retained on board as emergency gear. The *Montcalm* is engaged in the maintenance of the St. Lawrence Channel, and her headquarters are at Quebec.

The *Lady Grey* was also fitted with a coil

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set about two years ago. The headquarters of this icebreaker are at Sorel, some 30 miles below Montreal, and she does duty during the summer maintaining the Channel between Montreal and Quebec, and assists in opening the Channel with other icebreakers in the spring. A ½ kw. set will be fitted, the coil set also remaining on board.

* * *

Mr. C. P. Edwards, Controller of the Dominion Wireless Service, has commenced a tour of the wireless stations on the West Coast of Canada. This new branch of the Government service has this year shown a considerable increase, and further developments are anticipated on the return of Mr. Edwards, whose tour will extend over six weeks.

Mr. C. P. Edwards.

* * *

The *Druid* was fitted about three years ago with a coil set, and will now receive a ½ kw. This vessel acts as a supply ship on the St. Lawrence, and is used for the maintenance of buoys, fog signals, etc., on the river.

The *Lurcher* Lightship is stationed about 20 miles from Yarmouth, N.S., and will be equipped with a 1½ kw. set. It will then be able to communicate with Cape Sable on the one side and St. John, N.B., on the other.

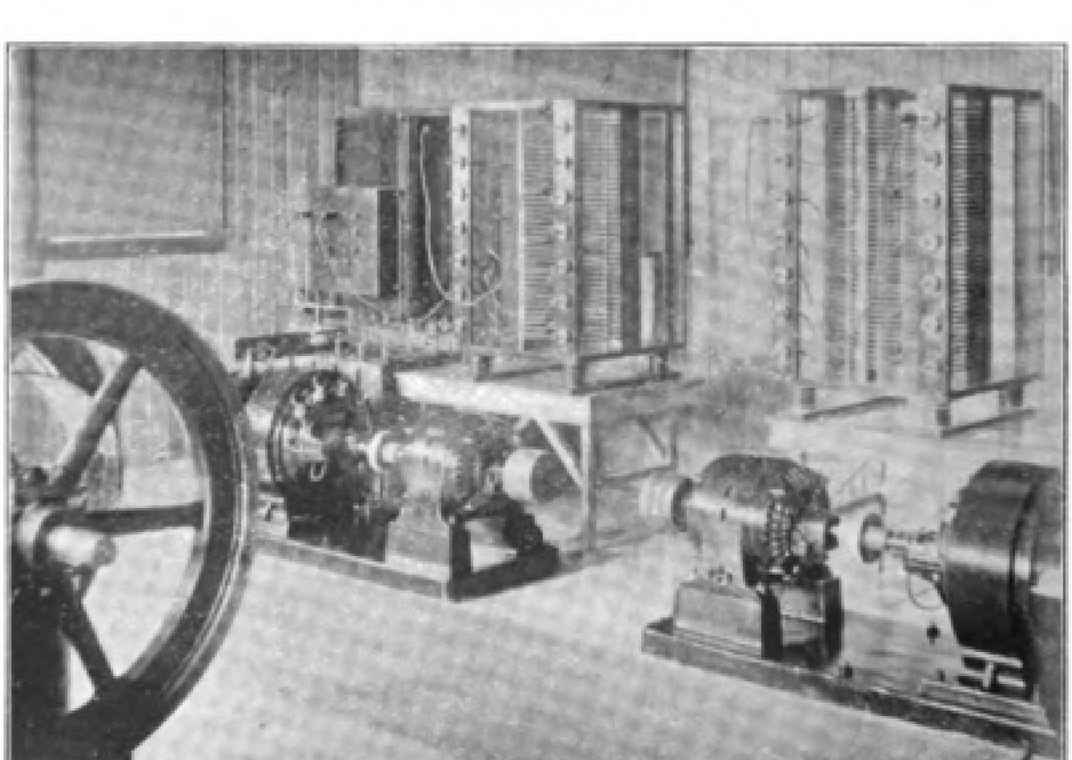
The *Simcoe* is doing duty on the Great Lakes, being used for the maintenance of aids to navigation. She will be fitted with a ½ kw. installation.

* * *

The Marconi station at St. John, N.B., was recently struck by lightning during a severe storm, being put out of commission for a few hours. The lightning played in an uncanny manner around the station, striking it three times without, however, doing any considerable damage. Other buildings in the town were also struck, but did not escape so lightly, and several fires ensued, the lightning in the case of the station being conducted to earth by the aerial wires.

The effect of the lightning on the station was to fuse the aerial wires, and some slight damage was done to the transmitting apparatus inside the station.

An unusual phenomenon was reported on November 7th by a Canadian Pacific Railway train "dispatcher." The work of dispatching is done by a telephone, and while listening at his instrument, the "dispatcher" picked up regular dashes and dots of the Morse code, and as he was an expert telegraphist he could follow the message, which was a wireless communication from some vessel at sea announcing her approaching arrival at San Francisco. Apparently the telephone wires had acted as an aerial. The name of the ship is not known, as only her code number was signalled. Wireless operators and telegraphists here are very much interested in the occurrence.



Transmitting Room, Port Arthur.

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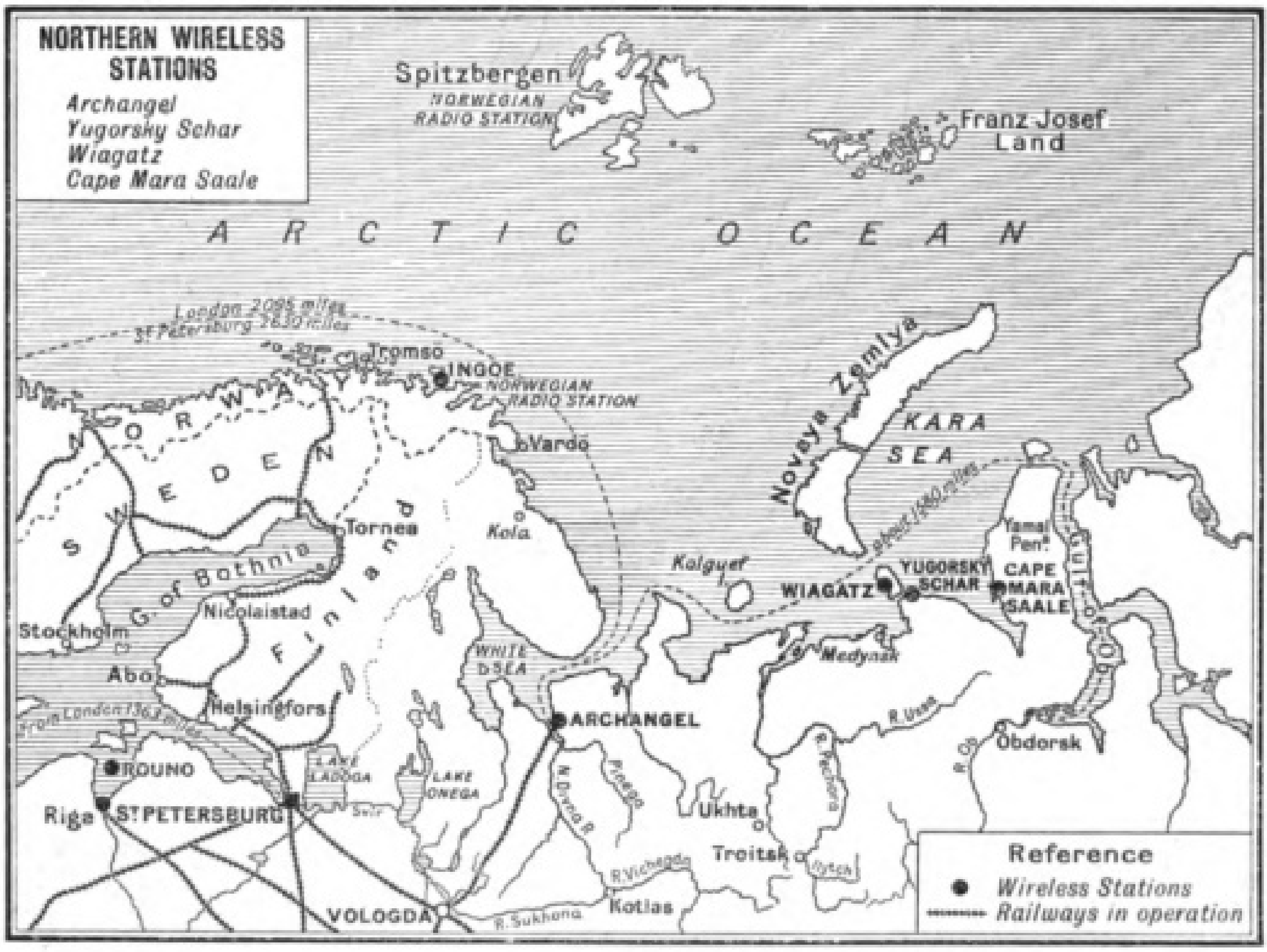
The Development of Wireless in Russia

Opening of the Northern Route



THE development of wireless telegraphy within the Russian Empire has been followed with considerable interest. Those who are acquainted with the Russia of to-day know what splendid opportunities that country offers, and it is almost unnecessary to point to the close association of wireless telegraphy with the development of the limitless resources of the empire. The progress of the Russian Wireless Company during the past year is eloquent testimony to the fact that the Government are fully awake to the possibilities ahead. In 1912 a number of large and important orders were placed with the company, both for the erection of shore stations and the equipment of the Russian Marine. Thirty-six ship stations of the Russian Navy were converted by the Russian Company of Wireless Telegraphs and Telephones, and among the company's other developments in 1912 was the introduction of a special type of light, portable station for the use of the Russian cavalry. Two such stations were worked by the Imperial Hussars during the summer manœuvres of 1912 with the greatest possible success, a special demonstration of their capabilities being afterwards given in the presence of the Emperor. As a direct result of the successful trials of these stations, a Special Commission is now sitting with a

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view of definitely deciding the type of cavalry station most suitable to the needs of the army, and large orders for these stations may eventually be expected.

All matters relating to wireless telegraphy in Russia are subject to an inter-departmental Committee, formed last year. The committee, which is attached to the headquarters staff of the Postal Telegraph Department, is composed of representatives from all public departments and is presided over by an official who is appointed by His Imperial Majesty the Tsar on the recommendation of the Minister of the Interior. This committee exists for the "co-ordination of the work of the various departments relating to the existence and use of the Imperial network of radiotelegraphic and radiotelephonic stations and for the consideration of schemes for the establishment and maintenance of radiotelegraphic and radiotelephonic communication which require preliminary discussion between the departments affected thereby." Incidentally, we may mention, a new law is under consideration to make it compulsory for all passenger-carrying vessels to be equipped with wireless telegraphy, so that in due course a large field should also be opened up in this direction.

The "Dan" on the way to Yugorsky Straits.

Wireless telegraphy in Russia owes its origin to the foresight and enterprise of Mr. S. M. Eisenstein, who, in 1905, laid the foundation of the present great organisation by establishing a workshop and laboratory in Kiev. He erected two stations, one at Kiev and the other at Schmerikka (about 187 miles apart), and the success of these stations encouraged him to transfer his business to St. Petersburg, where he formed a company which undertook the manufacture of apparatus as well as the erection of stations. This company, which is now known as the "Russian Company of Wireless Telegraphs and Telephones," officially commenced operations in October, 1908, and the story of its successful development describes, in a large measure, the commercial development of wireless telegraphy in Russia since that date.

Numerous orders began to come in from the military and naval departments for permanent stations and field stations. Among these may be mentioned an order from the military department for two high-power stations, at Bobruisk and Urschoomka (about 1,650 miles overland), and an order for the erection of stations at Tiflis, Kars, Brest-Litowsk, and Helsingfors, also orders for small apparatus. Soon the company found its premises on the Vassily Ostrov too small to cope with the work on hand, and it was decided to purchase land for the erection of a new building large enough to allow of considerable development. The site for the new works is in one of the most beautiful parts of St. Petersburg—on the Kameno Ostrov, about 2½ miles from the centre of the city, and we hope soon to publish a description of these works.

The development of the wireless telegraph network has been well advanced by the Government. Stations were erected at Nikolajewsk, on the Amur, and at Petropawlowsk, in Kamchatka. These were followed by stations on the Baltic coast, and others in the far east—viz., Ochotsk, Anadyr, and Nayachan, which, in conjunction with Nikolajewsk and Petropawlowsk ensure a radiotelegraphic service between the Sea of Ochotsk, the Bering Sea, and the Bering Strait.

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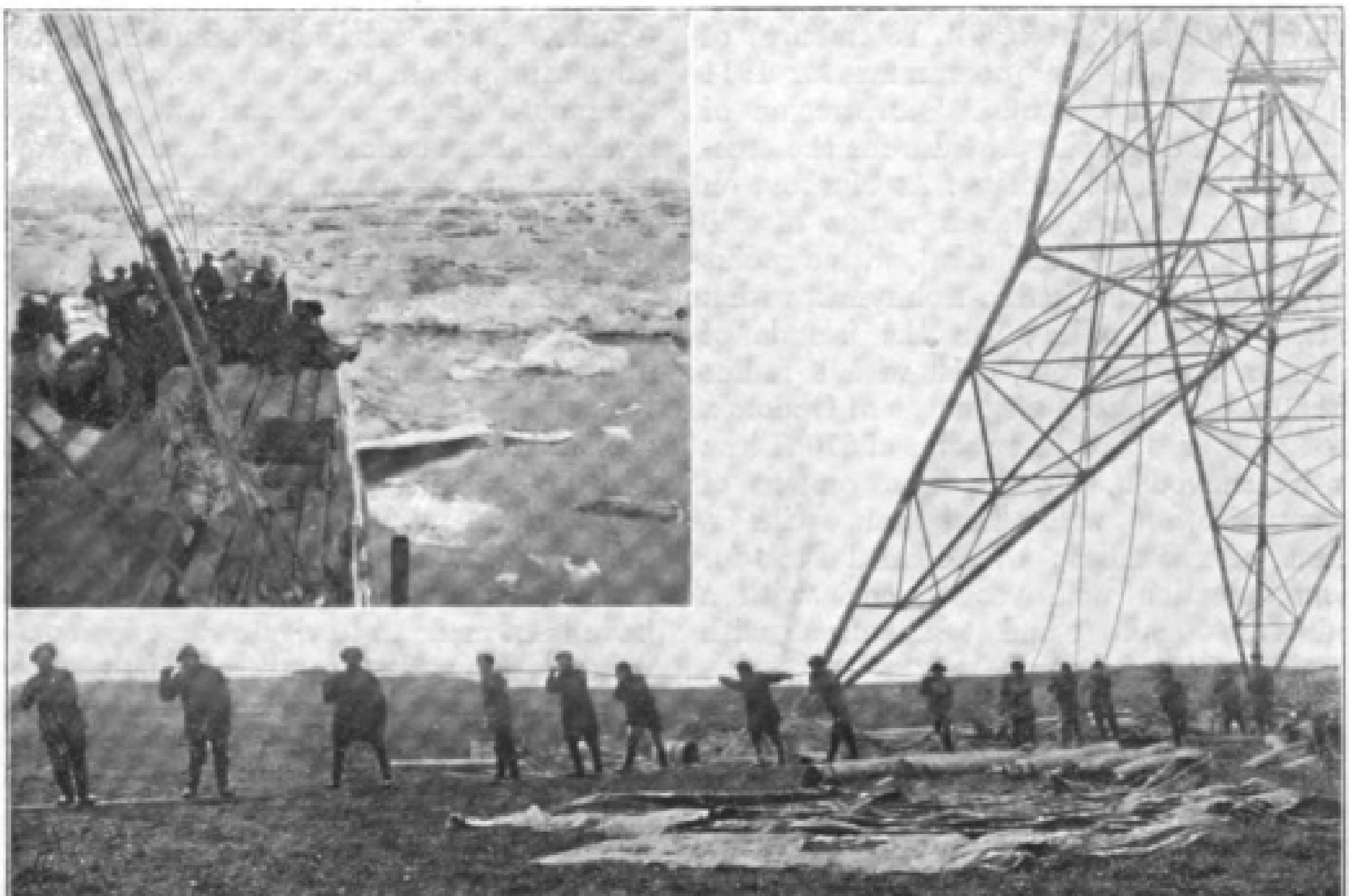
Yugorsky Schar Wireless Station Building.



Erecting Masts at Yugorsky Schar. (Inset: The "Dan" Icebound. Waigatz in the distance.)

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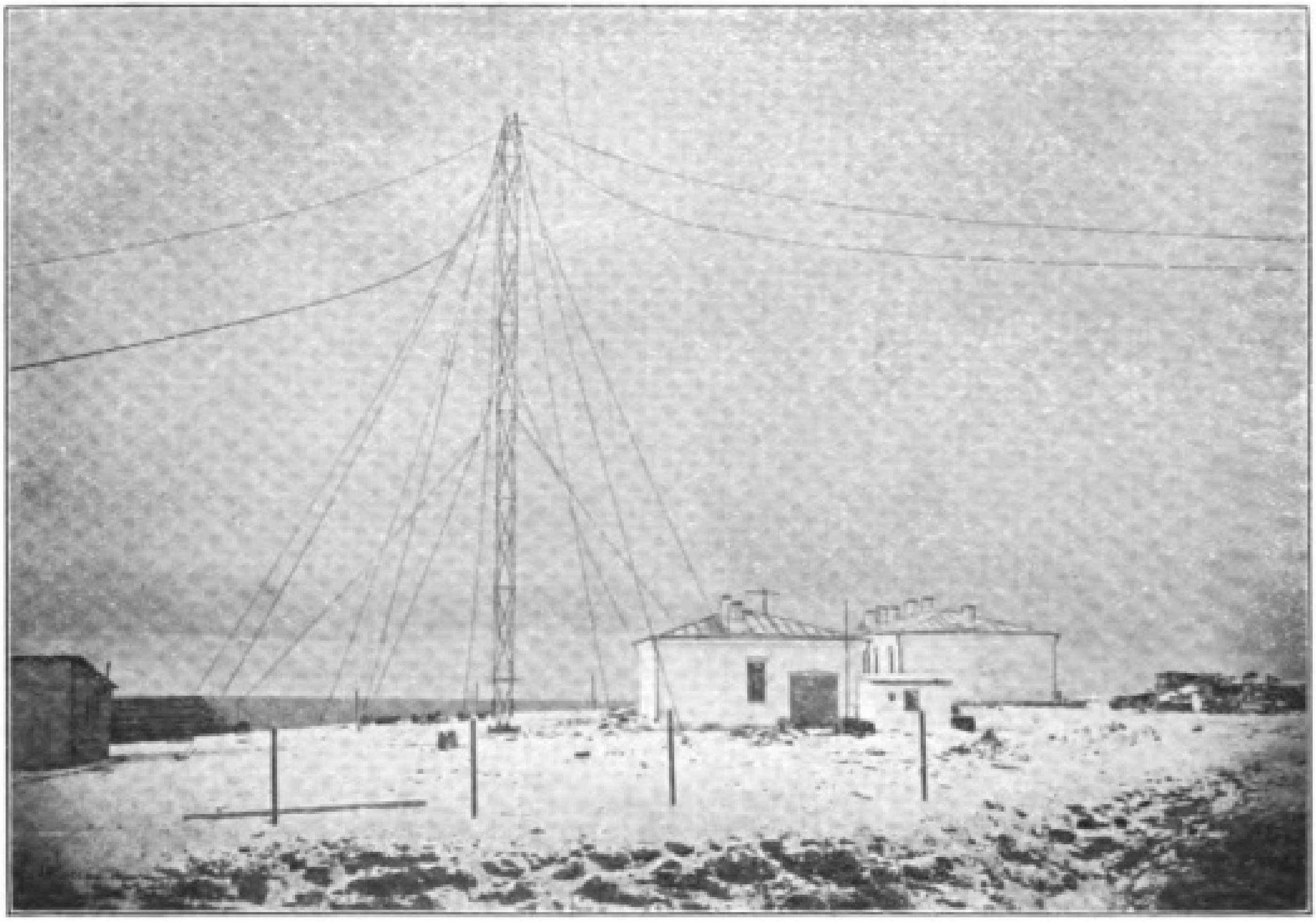

Cape Maare-Saale.

In addition to the above, according to the *Pravitelstvennei Vyestnik* (St. Petersburg) of September 19th, the programme for 1914 of the Russian Central Administration of Posts and Telegraphs provides for the erection of stations as follows: At Markov, on the River Anadyr, with a radius of 200 miles; at Tigila (Kamchatka), with a radius of 1,000 miles; at Sredne-Kolmynsk, with a radius of 535 miles; on the islands of Sakhalin and Solovetz, each with a radius of 200 miles; at the settlement of Obdorsk, on the River Obi, with a radius of 670 miles; at Krasnovodsk, for the improvement of communication with Turkestan, with a radius of 200 miles; at Abo and Poti, for communication with vessels, each with a radius of 400 miles; and at Skobolevsk, with a radius of 400 miles.

No record of radiotelegraph development in Russia would be complete without some reference to the wireless stations erected on the northern coast of the empire by the Russian Company for the Post and Telegraph Department. They are situated respectively at Waigatz, Yugorsky Schar and Cape Maare-Saale in the Kara seas, which are open to navigation during three months of the year only—July, August, and September. These stations communicate with ships sailing from European waters towards the mouth of the Enisei and other Siberian rivers, and are connected with the telegraph network of European Russia through the wireless telegraph station at Archangel. It is interesting to note that the Ministry of Commerce and Industry have invited proposals from Russians desirous of organising regular steamship traffic with the rivers Ob and Enisei. Captain R. V. Webster reopened the northern sea route in the *Nimrod* in 1911, and a successful voyage was made this autumn by Mr. Jonas Lied, in the ss. *Correct* with Dr. Nansen as a passenger.

Several more or less successful attempts have been made to navigate these ice-bound waters. Recently, however, as the result of an expedition which Captain Webster undertook in the *Nimrod* to the Kara Sea, a scheme has been provided for the running of ordinary tramp steamers between England and Nova Zembla, on the south-west of which there is a magnificent harbour, and from which goods would be transported to the Ob and Yenisei in vessels specially adapted to resist the ice pressure. It is believed that

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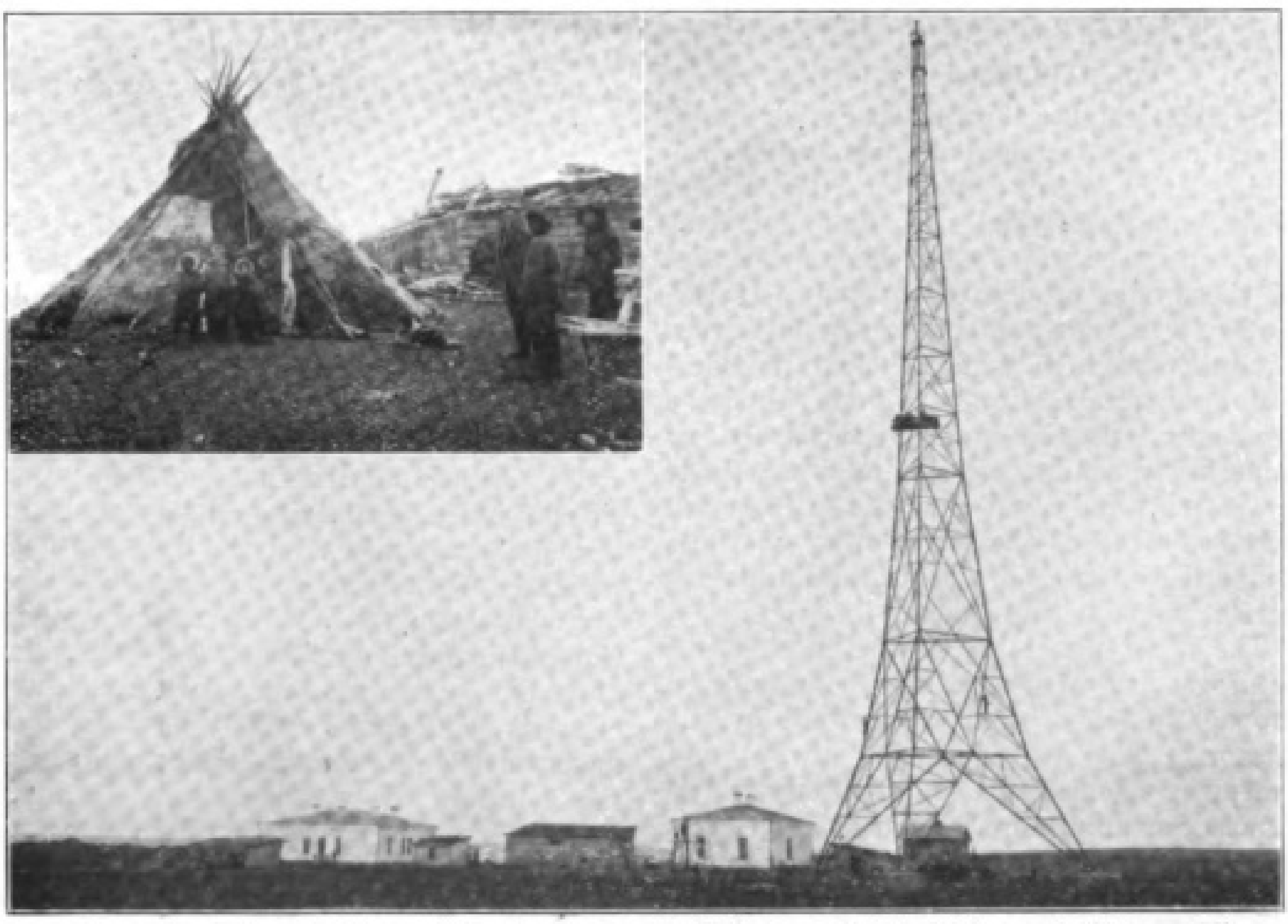
they would be able to make three voyages each way during the season that navigation is possible, and when the Kara Sea becomes blocked it is suggested that the vessels could be employed in sealing. But another point has to be considered. It is doubtful whether it could ever have become part of a practical policy without the aid of wireless telegraphy, for the dangers of the ice-bound coast are many, and the rigours of the climate retard development. Wireless, however, makes no obeisance to the elements and can brave the icy blasts of the Arctic Circle. Now, by the erection of these stations, communication will be set up by the port, and timely warning of the opening of the Kara Seas to navigation during the summer months, with regular reports as to the ice conditions prevalent, will be forthcoming.

The floating ice in the Kara Seas forms the chief peril. The Duc d'Orleans, who in 1907 undertook a cruise in the Kara Sea, has given some vivid descriptions of this dreary waste of black ice. Here is a characteristic passage :

" These ice floes, which are to be found in the centre of the Kara Seas, come from the coast of Siberia, which is low and sandy. They are formed by shingle and shells which have been covered up by snow. This has melted or been congealed by pressure into a thick mass of ice containing the silt. Again the sun and rains wash away the surface ice, and the *debris* becomes compacted into a horrible black soil. As this travels southward it is gradually broken up and diminished in thickness, until at last the whole of the ice is melted away, and the sediment sinks to the bottom to form the ooze of the Kara Sea. Though the phenomenon may be very interesting from the scientific point of view, from the picturesque standpoint it is deplorable. Nothing could be uglier or more depressing than this stretch of sea covered with heaps of dirty snow, and whenever a passing vessel dents into, or overturns, one of these lumps the sediment spreads out over the surface of the water, giving it a muddy chocolate colour. Often the ice-blocks would collect together in front of us, so that at times we could chase before us a whole bank of mud, and look very much as though we were one of those street-brushing machines which as they revolve send the immondices of big towns into the gutters."



Yugorsky Schar Station. (Inset: Samoyede Wigwam at the Village of Khabaroff.)

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Atmospheric Refraction in Wireless Telegraphy.

By W. H. ECCLES, D.Sc.*

IT seems to be agreed among the mathematicians who have worked at the subject, that wireless telegraph signals could not be transmitted a quarter way round the globe by means of diffraction. According to some numerical results of J. W. Nicholson, a station rated at more than a million kilowatts would be required for communication with Buenos Ayres if diffraction alone were utilised. These calculations have all been made on the supposition that the earth is a perfect electrical conductor, and that the medium surrounding it is electrically homogeneous; but these conditions are by no means fulfilled, and it has been suggested that the transmission of signals to great distances is successful either because the earth is not a perfect conductor or because the air is not a perfect dielectric.

SOMMERFELD'S THEORY.

Sommerfeld has shown that the boundary conditions between a homogeneous dielectric and a flat imperfect conductor led to a term in his equations which may be regarded as representing a surface wave which forms part of the whole propagated system. If this surface term were at all important in the case of a spherical earth, it might help us to understand the propagation of signals; but the application of the same methods to the imperfectly conducting sphere, when made by March,† indicated that the effects at a distance were of the same order as those deduced by the theory of diffraction over a perfectly conducting sphere.

The other possibility, that the electrical heterogeneity of the atmosphere assisted propagation, has been put forward by the author.‡ The atmosphere is always and everywhere ionised to some extent, and is almost certainly more ionised at high levels than at low. Some years ago Heaviside pointed out that if strong ionisation sets in suddenly at some high level then this layer would act as a reflecting envelope, and make possible the propagation of waves to the Antipodes. At night signals may travel to remarkable distances whatever their wave-length, and this suggests reflection rather than refraction; in the day signals of great wave-length travel best, which suggests refraction. The hypothesis introduced by the author, which attempts to account for this, is based on the assumption that the sun's rays ionise the atmosphere in such a way that the concentration of ions increases gradually as we ascend in the atmosphere. In this event, a ray started horizontally, say, will pursue a curved path with its concavity towards the earth; and thus, if the ionisation is great enough, an electric ray may follow and overtake the curvature of the earth.

ELECTRIC WAVES THROUGH GAS.

The fundamental theorem is that the velocity of electric waves through a gas is increased by the presence of ions of molecular size in the gas.* The velocity of long electromagnetic waves will thus exceed the velocity of light in an ionised medium. As this seems difficult of belief, the following rough physical explanation is offered: Consider a molecule carrying an electric charge in the electric field Z of the waves; it experiences an alternating mechanical force urging it to and fro. If Z is small, the direction of the motion is that of Z. The motion of the charge constitutes a convective electric current, which may be regarded as a displacement current proportional to the charge and the velocity. Now, the velocity produced by the force is nearly 90 degrees *behind*

* Read before the British Association.
† Annalen der Physik, Vol XXXVII.
‡ "Proc." Roy. Soc., Vol. LXXXVII., June, 1912.

* Eccles, *loc. cit.*, and J. Salpeter, "Phys. Zeitsch," 14, p. 201, March, 1913.

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the force in phase. This may be seen from the analogous fact that the current produced in a choking coil by an alternating voltage is nearly 90 degrees behind the voltage. But the true displacement current in a dielectric free from charged molecules is proportional to $\kappa dZ/dt$, where κ is the permittivity and t is time. From the analogy with the current produced in a condenser by an alternating voltage, we see that this true displacement current is about 90 degrees *in front* of the voltage in phase. Thus the displacement current due to the ions is opposite that due to κ—that is to say, the ions produce in effect a reduction of κ. This involves an increase of the velocity of the waves. The amount of the increase depends on the amplitude of motion of the molecules as well as on the phase.

The mathematical law according to which the ionisation increases as we ascend in sunlit air is quite unknown. Nevertheless, it is of interest to examine the trajectory of rays in an atmosphere obeying an assumed law. The problem of the rays in a medium disposed in concentric spherical shells of continuously varying refractive index is a familiar one in optics. If μ be the refractive index at any point, P, of the path at a distance, r, from the centre of the sphere, and p the perpendicular from the centre O on the tangent to the trajectory at the point P, then the sine law of refraction yields the equation,

$$\mu p = \text{constant}.$$

The constant is $\mu_0 p_0$ when the symbols refer to the starting point A of the ray on the earth's surface. Let θ represent the angle POA, then the above equation becomes

$$d\theta = \frac{\mu_0 p_0 dr}{r\sqrt{\mu^2 r^2 - \mu_0^2 p_0^2}}.$$

When μ depends solely on r, and is one of a limited number of functions of r, θ can be expressed in terms of r by elementary integrals.

As a simple example, suppose $\mu = a/r^{n+1}$ for distances extending to a few hundred miles from the surface of the earth. Let R be the radius of the earth and ζ the zenith angle of a ray starting at any point, A, of the surface. Then integration gives for the polar equation of the ray

$$r^n \sin\zeta = R^n \sin(n\theta + \zeta),$$

and the ray reaches the earth again at the point given by

$$\theta = (\pi - 2\zeta)/n.$$

By following the paths of two consecutive rays in a plane the energy flux-density through the medium at any point of the trajectory can be compared with that at a standard distance from the source. The points of interest to us are on the surface of the earth. Taking two consecutive rays at the angle ζ, the elementary area cut off on the unit sphere by rotating the rays about the vertical is $2\pi \sin\zeta \, d\zeta$, and that cut off on the orthotonic surface at the point (R, θ) is $2\pi R \sin\theta \sin\zeta dz$. Let W_1 be the energy flux density at the unit distance when $\zeta = \frac{\pi}{2}$; then, by Hertz's equations of the field of a radiator, the flux-density at any angle, ζ, is $W_1 \sin^2\zeta$. Hence, if there are no losses by absorption in the medium,

$$W_1 \sin^2\zeta \,.\, 2\pi \sin\zeta(-d\zeta) = W \,.\, 2\pi R \sin\theta \sin\zeta dz,$$

where W is the energy flux-density at any point of the trajectory. Near the earth's surface we have, by geometry,

$$\frac{d\zeta}{dz} = \frac{\tan\zeta}{R}\frac{d\zeta}{d\theta}.$$

Therefore

$$\frac{W}{W_1} = -\frac{\sin^2\zeta}{R^2 \sin\theta \cos\zeta} \cdot \frac{d\zeta}{d\theta} = \frac{n}{2R^2} \cdot \frac{\cos^3 \frac{1}{2}n\theta}{\sin\theta \sin \frac{1}{2}n\theta}.$$

The wave fronts near the receiving station make an angle, ζ, with the horizontal there, and therefore a vertical antenna absorbs energy per unit length at a rate proportional to $W \sin^2\zeta$. [A horizontal antenna would absorb at the rate $W \cos^2\zeta$]. Hence the rate of absorption of energy may be written

$$W = \frac{nW^1}{2R} \frac{\cos^5 \frac{1}{2}n\theta}{\sin\theta \sin \frac{1}{2}n\theta}.$$

where W and W^1 may be supposed measured in watts. Let us take $n = 2{\cdot}6$ [which from other considerations corresponds to a wave-length 5·4 km.] and the standard distance 520 miles, corresponding to $\theta = 7\frac{1}{2}$ degrees; then the value of W at distances corresponding to $7\frac{1}{2}$, 15, 30 degrees are in the ratios

$$1 : 0{\cdot}103 : 0{\cdot}0107.$$

This may be compared with the results of

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the empirical formula given by Austin and Cohen,* which may be written

$$W = W_1\left(\frac{s_1}{s}\right) / exp\left(\frac{2a(s-s_1)}{\sqrt{\lambda}}\right),$$

where s represents the distance measured along the earth's surface from the sender to a moving receiver, and s_1 that to a stationary receiver at the standard distance.

Austin and Cohen give the value of a as 0·0015, the distance being in kilometres. With $\lambda = 5{\cdot}4$ km., the ratios of power absorbed are

$$1 : 0{\cdot}087 : 0{\cdot}0028.$$

These differ very considerably from those calculated above; but, obviously, the law assumed for the variation of μ with r is only very roughly representative of the probable state of affairs in the atmosphere. Moreover, the absorption has been supposed nil.

A more plausible law to connect μ and r is given by

$$\mu^2 = \mu_0^2 \frac{R^2 + 2Rz - az^2}{(R+z)^2},$$

where $z = r - R$, and is therefore height above the earth's surface, and a is a positive constant dependent upon the wave-length. This law makes the index of refraction fall very slowly near the surface of the earth and more rapidly later, till at a certain height μ vanishes, or the air becomes a perfect conductor. The solution is too cumbrous to reproduce here, but the range of a ray reduces to

$$\theta = \frac{\sin \zeta}{\sqrt{1+a+\sin^2 \zeta}}\left(\pi + 2 \sin^{-1} \frac{\sin^2 \zeta}{\sqrt{1+a \cos^2 \zeta}}\right).$$

The characteristic feature of the trajectories under this law is that the ray starting horizontally has the longest range; rays starting at increasing elevations have their vertices at diminishing distances. This crossing of the rays leads to the formation of caustics and of rough foci, which have never been observed in the history of wireless telegraphy. To estimate the energy density at any point it becomes necessary to take into account the reflections from the earth (or sea) of the rays of high elevation and short trajectory, and this is very laborious. These characteristic features of the rays probably appear in all cases where the upper layers are assumed to become very conductive. There is more hope of obtaining calculations which shall fit in with experience by assuming a law of variation of refractive index more in accord with Schuster's views of the electric state of the atmosphere, as found by him necessary to account for the diurnal variations of terrestrial magnetism. The author is, therefore, working out a case in which the refractive index first decreases with increase of height above the earth and then asymptotically approaches a limiting value corresponding to the conductivity of space. It may be remarked, by the way, that if space is, as suggested by Schuster, in some degree conductive, long electric waves should travel faster than light waves from the sun to the earth.

In concluding this account of the simplest method of attacking the problem of refraction of electric waves round the earth, it is convenient to point to a matter of some theoretical importance in connection with the Austin-Cohen empirical formula. This formula being of the form

$$w \propto \frac{1}{s^2} \epsilon^{-As},$$

where w is the power absorbed by a receiver at arcual distance s, and A is a constant (dependent on the wave-length), appears to be interpreted in some quarters as indicating that energy spreads round the earth according to an inverse square law, and is afflicted by absorption of ordinary optical type, as indicated by the exponential. But it is, at least, very unlikely that in the absence of absorption an inverse square law would be followed by waves creeping round the globe, and therefore we suppose that the form in which the formula has fallen is largely accidental, as is so often the case with empirical formulæ. The calculations given above indicate that if a suitable mathematical law of variation of refractive index could be assigned the fall of intensity of signals with distance might be accounted for numerically without any absorption whatsoever. Something rather less extreme than this is, however, to be looked for, since formulæ that have been deduced for the absorption in highly ionised air * prove that some absorption is to be expected in the case of rays traversing the higher levels of the atmosphere.

* "Bull." Bureau of Standards, No. 3, 1911, and J. L. Hogan, *The Electrician*, August 8, 1913.

* Eccles, *loc. cit.*, and O. J. Lodge, "Phil. Mag.," June, 1913.

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Wireless and Weather.

By A. H. TAYLOR.

[This article has been reproduced from the "Electrical World" of New York, and it invites further speculation as to the explanation of the connection between absorption and cloudiness. Professor Taylor suggests that the absorption is atmospheric, and that it is caused by the sun-created conductivity close to the earth's surface (below the normal cloud layers).]

IT is a well-known fact that the night range of a long-distance wireless station is often several times as long as the day range. It is also a matter of common experience that the day range and the night range are both subject to wide variations from day to day or night to night. Reference is not here made to variations attributable to unfavourable conditions at the sender or at the receiver, such as excessive atmospheric electricity, heavy rains with consequent poor insulation, or interference with other stations, but rather to variations that may be traced to general absorption over long stretches of land or sea.

There must be a vast quantity of data on hand bearing on this problem, as every operator must have noticed some connection between transmissivity and weather, but the data are scattered and not readily available. The writer is not aware that any serious attempt has been made to correlate the transmissivity over long distances with the weather conditions prevailing in the region traversed by the waves. There seems to be only one tenable theory as to the source of this absorption, and that is the sunlight theory mentioned by Zenneck, Pierce and others. Ionization of upper layers of the earth's atmosphere by the ultra-violet rays of the sun is supposed to develop a slightly conducting medium which would account for the absorption.

If this is true, it might reasonably be expected that on a night following a day which has been sunny over a long stretch of country between any two stations, the transmissivity would be low, while if cloudy conditions prevail over the same area the transmissivity would be high. On the other hand, it may be urged that the ionization occurs in regions above the clouds, and that no connection between transmissivity and cloudiness should be expected.

There are few stations in this country more favourably situated for the investigation of the problem of absorption over land areas than the radio-electric station of the University of North Dakota, situated, as it is, in Grand Forks, just 1,200 miles from each coast, and within easy reach of the lake district. The aerial is of the inverted L type, 12 ft. wide, 130 ft. long, and 80 ft. above the ground. An audion receiver, used with a loose-coupler and suitable tuning condensers, has been found to be the most sensitive for long distance work. The audions used were operated at a fixed current value somewhat less than the value necessary for maximum efficiency. This heating current was in all cases not far from 0.32 amp. The sensitiveness of an audion receiver was tested frequently by means of a standard test buzzer circuit, adjustable to any desired wave-length and damping. The applied voltage on the telephone circuit was varied so as to keep the sensitiveness at nearly the same value through a series of tests.

It was not possible to obtain United States Weather Bureau maps on the day preceding the test, but through the courtesy of Prof. Simpson, director of the University of North Dakota weather station, it was possible to get the maps on the day following the tests. This had one advantage, namely, that the observer was unprejudiced by any preconceived notions as to the bearing of the weather on results.

On February 24th the author listened between 7 p.m. and 11 p.m. and heard signals from the University of Michigan, at Ann Arbor, when 3.4 kw. was employed, as

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a subsequent letter from Mr. H. S. Sheppard, in charge of that station, indicated. Signals from some ten or twelve other stations along the Atlantic coast were also plainly heard.

It must be noticed that at this distance from the coast, and with a moderately high aerial (80 ft.), coastal stations and ocean vessels are heard only under rather favourable conditions for transmission.

A glance at the weather forecast for Monday morning, February 24th, shows two large cloudy areas moving over the northern part of the United States. This map also shows a clear area some 500 miles wide between the University of Michigan and the University of North Dakota. The test with the University of Michigan station was even more remarkable for the fact that the signals from the University of North Dakota stations were heard faintly at Ann Arbor when calling with 1 kw. This test is the only one so far in which good transmission has been noticed to follow clear weather conditions, and even in this case it is seen that the whole Atlantic coast lay within a cloudy area, which extended to the westward beyond Michigan.

On Sunday, March 2nd, the author was not at the station, but Mr. E. C. Reinecke, an amateur at Fargo, N.D., reported a very good night. Mr. Reinecke thought he heard signals from Colon, Panama, on that evening. A map for Sunday is not sent out by the Weather Bureau, but the map for Saturday, March 1st, shows a general cloudy condition all along the Atlantic coast, and from the Gulf to Winnipeg. The map for Monday shows very cloudy conditions prevailing throughout the Mississippi Valley, and lake district, and the North-west. The indications are, therefore, that Sunday was pretty generally cloudy, and both Saturday and Monday maps show general cloudiness in the area between Fargo and Key West. Whether this condition extended as far as Colon or not I am unable to say. It seems very likely.

On the evening of March 4th we were able to hear signals from the stations from both coasts, and Key West signals were received at the university, and also at Fargo. The weather map for that day shows cloudiness all along the line between Grand Forks and Jacksonville, Fla., and the following day's map shows that this condition moved on down beyond Key West. The map for March 4th shows a cloudy belt to the northwest, toward Seattle and Vancouver, while the whole Atlantic coast is likewise cloudy.

The night of March 13 was one of the best as regards the number of stations from which signals were heard, but the excessive static electricity prevented any but a good operator from recognising many calls. I have no hesitancy in saying, however, that more stations were heard from that night than on almost any other. The weather map for March 13th shows cloudiness everywhere except in the south-west.

The next test was made on March 17th, and practically no signals were heard between 8 p.m. and 11 p.m. The map for March 17th shows all the Eastern part of the country in a clear area. The connection seems to be obvious.

On the next evening the author thinks he identified three calls from the Pacific coast, near Vancouver and Seattle. It may have been a coincidence, but the map for the 18th shows a cloudy area between Grand Forks and Seattle, while the Eastern coast is clear. This seems to explain why signals from no Eastern stations were picked up that night.

The map for the 18th seemed to indicate that the cloudy conditions would proceed eastward. Acting on this hypothesis the author spent the evening of March 19th at the station, expecting to catch signals from many Eastern stations. Much to his surprise not one was heard. Next morning, when the map arrived, it was seen that the cloudy condition had turned and swung down South through the valley of the Mississippi, and that the East had remained clear. This seems to be rather definite evidence that cloudiness and transmissivity are directly connected.

It should have been noted in connection with the test of March 17th, when no signals were heard, that Michigan called us by pre-arrangement at definite intervals, using from 4 kw. to 8 kw., but we were unable to hear anything.

On Monday, April 21st, the University of Michigan called several times, and was heard very distinctly at the University of

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North Dakota, although the static disturbances were very bad. No Eastern stations were heard, but signals from several in the lake district came in very strong. The weather map shows a cloudy area between Winnipeg and Chicago, but a clear region along the Eastern coast. On the following evening the author listened at the receiver between 8 and 9.30 o'clock with no result. The Michigan station did not operate for our benefit that evening, but I should have been able to hear signals from any lake stations if they had operated in that interval, if the cloudy area in that district, as shown by the April 22nd map, has any bearing. The Eastern coast remained clear.

On Wednesday evening signals were heard from the University of Michigan station, several stations in the lake district and several on the northern Atlantic coast. The Wednesday map shows a cloudy area over all of this territory. On Thursday, April 24th, Mr. Reinecke, at Fago, reported hearing signals from a number of stations with great distinctness, an observation which was checked at the University of North Dakota station. The map for this day also shows a cloudy area in the lake region.

It would be possible to multiply greatly these instances of the connection between cloudiness and transmissivity, as I have made many random observances after sunny days of the early winter, when signals from very few stations were held, and more often none at all. So far, of some thirty observations, I have found only two which do not clearly indicate that a general daytime cloudiness over a wide area is sure to be followed by an evening of high transmissivity. It still remains to be shown whether cloudiness at transmission station or at receiving station is more effective, although I am inclined to think that the transmissivity is better when the sunny area, if there is such, affects only the receiving station and its neighbourhood. The transmissivity is even then not so good, of course, as it is when the cloudy area includes both the receiving and the sending stations.

If the connection between cloudiness and transmissivity be conceded, it will be apparent that the general atmospheric absorption does not occur in the regions above the clouds to anything like the same extent that it does in the regions of lower level, which is contrary to previous speculations on this point.

It would also appear that far Northern stations operating in summer when the period of sunshine is of long duration should have a shorter range than in winter. It would be of interest to know if the operators of Alaskan and Northern Canadian stations have any data bearing on this point. With the collection and correlation of more data on radio-transmission and meteorological conditions, doubtless some of the vagaries of wireless experimentation will be accounted for, and might even be put to practical use by the weather bureau.

STRENGTH OF SIGNALS.—In the *Elektrotechnische Zeitschrift* Mr. H. Mosler gives an account of an investigation extending over a year, in which the receiving intensity of a station at a distance of 425 kilometres (255 miles) was measured day and night. He found that during the day the receiving intensity was not influenced by the height of the sun, or in other words was constant during the whole year, but during the night there were characteristic maximum peaks in autumn and spring. The receiving intensity was particularly increased for short intervals in the night during a cold season, and this is probably due to the changes in the ionisation phenomena in the upper atmosphere; effects of moonlight were not observed by Mr. Mosler.

* * *

CORRECTION.—A correspondent writes: "On page 487 of the November WIRELESS WORLD, dealing with the theory of electromagnetic waves, you state: 'If i be the root-mean-square current at any point, the voltage drop per centimetre at that point will have a R.M.S. value of ωLi, where $\omega = 2 \sim$, and will be 90° out of phase with the current.' Is this quite correct, and should it not be $\omega = 2\pi \sim$?

"I should like to say how much I enjoy your splendid paper; it is a pleasure which I look forward to month after month. Thanking you for the instruction received from THE WIRELESS WORLD."

[Our correspondent is quite right in his correction.]

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Safety at Sea

INTERNATIONAL CONFERENCE IN LONDON. WIRELESS TELEGRAPHY. MR. BUXTON PAYS TRIBUTE TO THE INVENTIVE GENIUS WHO HAS RENDERED EFFECTIVE THIS GREAT DISCOVERY.

THE International Conference which is considering the safeguarding of life at sea was opened in London on November 12th by the President of the Board of Trade, the Rt. Hon. Sydney Buxton, M.P. The Conference owes its origin to the anxiety and distress which was occasioned by the startling and sudden destruction of a liner last year, and it is invested with additional importance by the tragic occurrence in mid-Atlantic a few weeks ago. It is the German Emperor who suggested, on the morrow of an unforgettable disaster, that the representatives of the nations should meet, in order to "establish conclusions from the cruel lessons furnished by the catastrophe." His Imperial Majesty's appeal was generally welcomed, and from the first the British Government declared itself ready to undertake preparations.

The London Conference, which is holding its meetings at the Foreign Office, is essentially a conference of practical men representing nearly all the peoples who use the seas. It is engaged upon the consideration of regulations as to the construction of ships, the character of the life-saving apparatus to be carried, and the conditions under which ocean navigation should be conducted. If their deliberations should result in the drawing up of workable regulations which will be enforced by each of the Governments, the foundation will have been laid of a great humanitarian movement, which may rob the sea of many of its terrors.

In the light of recent events public interest will undoubtedly centre in the possibility of further extending the use of wireless telegraphy in the service of mankind. The subject figures prominently in the Conference agenda, and some idea of the value of this invention as a means of saving human life was reflected in Mr. Buxton's tribute "to the inventive genius who has rendered effective this great discovery." As the realisation of humanity's debt to wireless telegraphy increases we are brought nearer to the fulfilment of the prophecy of the leader-writer in the *Daily Telegraph*, who wrote: "Mr. Marconi may never come into the heritage which he has won by his achievement; but the day will arrive when his name will be uttered with those of Jenner, Lister and the other great benefactors of the human race."

The Conference was opened by Mr. Sydney Buxton, who was accompanied by Mr. J. M. Robertson (Parliamentary Secretary to the Board of Trade), and Sir H. Llewellyn Smith. In his address Mr. Buxton outlined the scope of the Conference, and indicated the questions to be discussed, which he divided broadly into five heads:—

(1) Is it possible by constructional arrangements to decrease or to eliminate the liability to founder? I have in mind more especially bulkheads and watertight compartments.

2) In the event of collision, fire, (or other accident, what apparatus and machinery are required to minimise the disaster and to save the lives of those involved? This head covers the provision of boats and their accessories, and of other life-saving appliances, of fire extinguishing appliances, and other apparatus into the details of which I need not enter.

(3) And equally important—What are the best arrangements to ensure the organised use of these life-saving appliances, so that they can be most effectively, coolly, and expeditiously handled on board the ship herself, and on board a rescuing ship as well?

(4) How can aid and assistance from another ship, or from the shore, be most quickly and effectively invoked and

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obtained? Under this head I especially have in mind wireless telegraphy—a question of vital importance. I should in this connection like, on your behalf as well as my own, to pay a tribute to the inventive genius who has rendered effective this great discovery.

Finally, what measures, apart from the vessel itself, can be taken to diminish or avert the likelihood of accident? Under this heading come the observation of ice in the North Atlantic; the patrol of the ice regions in those waters; the observation and reporting of derelicts; storms and fog-signals and warnings, etc.

The King sent a message of greeting to the delegates, telling them that he takes a special interest in the subject of their discussions, and pointing out that, as a sailor, he has had personal experience of many of the matters which will come before them. The delegates were afterwards welcomed on behalf of the Government by Sir Edward Grey. Lord Mersey, the principal British representative, has been unanimously chosen as president of the Conference.

Before they dispersed, the delegates were entertained to luncheon at the Foreign Office, Sir Edward Grey presiding. In reply to the Chairman's welcome, M. Guernier, the chief French delegate, said: In the name of the delegates of the Governments which are supporting the Conference, I beg you to accept our thanks for the courtesy and affable cordiality with which you have received us. When the Government of his Britannic Majesty invited the maritime Powers to attend a conference for the purpose of finding a means of at least diminishing the disasters of the sea, its words found an echo which was all the greater because they appealed to the most noble of the sentiments which do honour to humanity. For centuries the cries of distress uttered by those in peril on the seas have been lost on deaf or indifferent horizons. But now a mysterious voice, the child of science and of daring, defies infinite space, and reminds navigators of the great lesson of solidarity. Sometimes, alas! they arrive too late. Therefore it is necessary that at all costs shipwrecked people should be provided with means for awaiting the opportune hour in order that the work of rescue should embrace everybody. That is the problem which the Conference will apply itself to solve in as complete a manner as possible.

The Right Hon. Sydney Buxton (on right) and Sir H. Llewellyn Smith on their way to the opening of the Conference. Sir H. L. Smith presided over the International Radiotelegraphic Conference in London last June.

The delegates were entertained to dinner by the Government on November 18th, and a large and distinguished company was

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Commander F. G. Loring (Great Britain), Inspector of Radio-Telegraphy to the Post Office.

invited to meet them, among the guests being Mr. Marconi.

The Lord Chancellor, who was the chief speaker, referred to the scientific aspect of the conference. Looking back over a period of little more than half a century, he was particularly impressed by the contributions which had been made by all nations to pure science. It was made clear that the country which failed to produce men great in abstract science must fall back in the race of progress. Those were the men whom the world would best bear in mind and honour—the men of science whose discoveries could be applied to practical affairs, to such work as the conference had met to do.

Hon. F. T. Chamberlain (United States of America), Commissioner of Navigation.

The Hon. J. W. Alexander (United States), who replied to the toast, said his country felt deeply indebted to Mr. Marconi for the discovery of wireless telegraphy, and was one of the first to seize upon it.

The following is a list of the delegates :—

AUSTRALIA.—Captain R. Muirhead Collins, C.M.G.

Count Rev Di Villarey (Italy).

AUSTRIA-HUNGARY.—Baron George de Franckenstein ; Austria—Dr. Paul Schreckenthal, M. Pierre Fragiacomo, M. Wilhelm Palm ; Hungary—M. Ladislas Dunay, M. Andor Steinacker, M. Etienne Machay,

BELGIUM.—M. E. A. Pierrard, M. Ch. le Jeune, M. L. Franck ; Assistant Delegate, M. J. de Ruelle ; secretaries, Commander A. Bultinck, M. J. Hostie, M. E. Bogaert ; assistant secretary, M. R. Capelle.

H. J. Nierstrass (Holland), Director of the Radio-telegraph Service.

CANADA.—Mr. Alexander Johnston ; consulting experts, Mr. Frank McDonnell, Mr. Charles F. M. Duguid, Major H. Maitland Kersey, D.S.O.

DENMARK.—M. A. H. M. Rasmussen, M. Emil Krogh, M. Host, M. Topsöe Jensen; secretary, M. Axel Helper.

FRANCE.—M. Guernier, M. Tréfeu, M. le Contre Amiral Journet, M. Boris, M. Frouin ; consulting experts, M. Grolous, M. Berthe de Berthe, M. Géraud, M. le Capitaine Brenot ; secretary, M. Keller.

GERMANY.—His Excellency Dr. Von Koerner, Dr. Seeliger Herr Schutt, Dr. Reiss, Professor Pagel, Herr Schrader, Rear-Admiral Behm ; Assistant Delegates—Captain Schmaltz, Herr Walter, Herr Polis, Herr E. Gribel ; Secretary, Herr Voelkner ; attached to the Delegation, Herr von Bulow.

GREAT BRITAIN.—Lord Mersey, Mr. E. G. Moggridge, Sir Archibald Denny, Sir Norman Hill, Sir John Biles, Captain Acton Blake, Captain A. H. F. Young, Mr. C. Hipwood, Mr. W. D. Archer; consulting experts, Captain Loring, R.N., Commander J. T. W. Charles, C.B., R.N.R., Commander M. W. Campbell Hepworth, C.B., R.N.R., Mr. J. Havelock Wilson ; secretaries, Mr. J. A. Webster, Mr. G. H. Locock ; assistant

A. Frouin (France), Director of Telegraphs.

secretaries, Mr. F. P. Robinson, Mr. T. Lodge, Mr. W. Carter, Mr. H. Leak; attached to the secretaries, Mr. G. H. E. Parr.

HOLLAND.—M. J. V. Wierdsma, M. H. S. G. Maas, M. A. D. Muller, M. J. Wilmink; M. J. W. C. Coops (secretary); consulting experts, Professor Vossnack, M. H. J. Nierstrass, M. P. H. Gallé.

ITALY.—Grande Ufficiale Commendatore Carlo Bruno, Commendatore Vittorio Ripa di Meana, Cavaliere Ufficiale Gustavo Tosti, Commendatore Giovanni Battista Veroggio, Cavaliere Filippo Bonfiglietti, Count Carlo Rey di Villarey, Nobile Guglielmo di Palma Castiglione, Commendatore Michele Fileti, Signor Domenico Barricelli; secretary, Cavaliere Pier Luigi Fiore.

NEW ZEALAND.—The Hon. Thomas Mackenzie.

NORWAY.—M. H. Pedersen, Dr. Johannes Bruhn, M. Jens Evang.

RUSSIA.—M. Roman Mikhailovitch Loviaguin.

SPAIN.—Captain Rafael Bausá; secretary, Captain Don Eliseo Sanchiz.

SWEDEN.—Vice-Admiral Olsen, G.C.V.O., M. W. R. B. Lundgren, M. E. Loefgren, M. N. G. Nilsson.

U.S.A.—The Hon. J. W. Alexander, the Hon. T. E. Burton, the Hon. E. T. Chamberlain, Commander E. P. Bertolf, Rear-Admiral Washington L. Capps, Captain George F. Cooper, Mr. Homer L. Ferguson, Mr. A. G. Smith, Mr. Andrew Furuseth, Captain W. H. G. Bullard, and Mr. George Uhler; consulting expert, Mr. McBride; secretary, Mr. Walter R. Alexander.

An Electrostatic Oscillograph

AT the meeting of the Physical Society held recently, a paper on "An Electrostatic Oscillograph," by Messrs. H. Ho and S. Koto, was read by the latter.

The paper describes an electrostatic oscillograph suitable for recording very high voltages. Two vertical bronze strips pass symmetrically between two parallel metallic plates called "field plates." They are connected at their lower ends by a silk fibre which passes under an ivory pulley. An extremely small mirror is fixed in the strips. This arrangement constitutes the vibrator which, mounted on an ebonite frame, is immersed in an oil bath. To the upper extremities of the strips are connected the terminals of a direct-current voltage of about 300. The alternating voltage to be recorded is connected to the "field plates," in parallel with which there are two oil condensers in series. The electrical mid-point of the direct current battery is connected to a point between the condensers.

The turning moment on the strips is proportional to the product of the momentary values of the alternating current voltage and the direct-current voltage, so that if the latter is constant the deflection of the mirror accurately follows the variation of the former.

Oil plays an important part, not only acting as a damper agent and insulator, but increasing the sensitiveness on account of its high dielectric constant.

In cases where the voltage is low, but the source of energy is so limited that a sufficient current cannot be taken to actuate the ordinary oscillograph, the electrostatic vibrator may be used by applying the voltage in question to the strips, while the terminals of a high-tension battery, or influence machine, are connected to the "field plates." The instrument may also be used for recording very small currents by replacing the oil condensers by two exactly equal resistances, which are traversed by the current.

In the discussion which followed the reading of the paper, Mr. A. Campbell thought it was a considerable advantage to be able to do without high resistances. Dr. G. W. C. Kaye had suggested to him that the instrument might be of great use in work with X-rays and in other cases where the charge was being taken from an induction coil.

Mr. R. S. Whipple emphasised the commercial advantage of the instrument. High resistances were very expensive. Einthoven was the first to propose an electrostatic oscillograph, and a Belgian inventor had constructed an instrument similar in principle.

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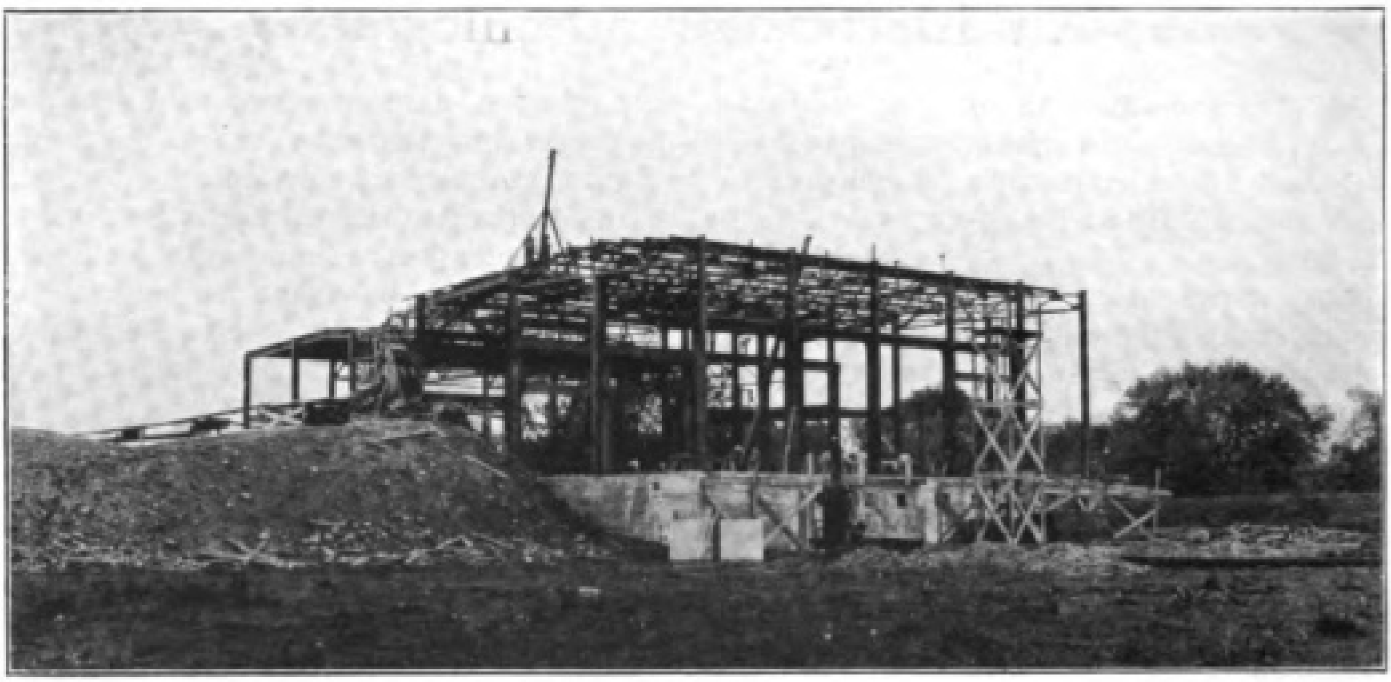
Trans-Pacific Wireless Telegraphy.

Marconi Stations in California Nearing Completion.

THE Marconi high-power stations in California are rapidly nearing completion. These stations will be made up of the transmitting plant at Bolinas Point, eighteen miles north-west of San Francisco, and the receiving station, near the town of Marshalls, about eighteen miles further north on Tomales Bay. Despite the difficulties attending the transportation of building material, the progress on the California sites has been satisfactory. Most of the material for erection purposes—steelwork and machinery, as well as all mast sections and the wire rope—is being made in the East. It is sent from New York by boat to the Isthmus of Panama, across the isthmus by rail and thence by water again to San Francisco.



Bolinas Power House in Course of Construction.

The site at Bolinas is not advantageously located for bringing in heavy loads of material. The rough roads leading to it are at least four miles distant from the highway regularly used for traffic. There is no railway available, and it is necessary to send the material by water from San Francisco, unload it at the wharf at Bolinas Bay, and haul it to the site. Across the mouth of the bay is a shallow sand bar which makes it impossible for a boat of any size to get to or from the wharf except at high tide, and the coast is so dangerous to shipping that owners of vessels are reluctant to have their craft navigated in and out of the bay. As a matter of fact, only one small schooner enters the bay, and she makes the trip only when there is enough material to warrant it. The construction work has strained to the utmost the schooner capacity of 100 tons and overloaded the wharf. A larger derrick has been installed to unload the heavier pieces and the area of the wharf has been extended to give greater space for materials. The fear of winter storms and consequent impassable roads has stimulated the men in

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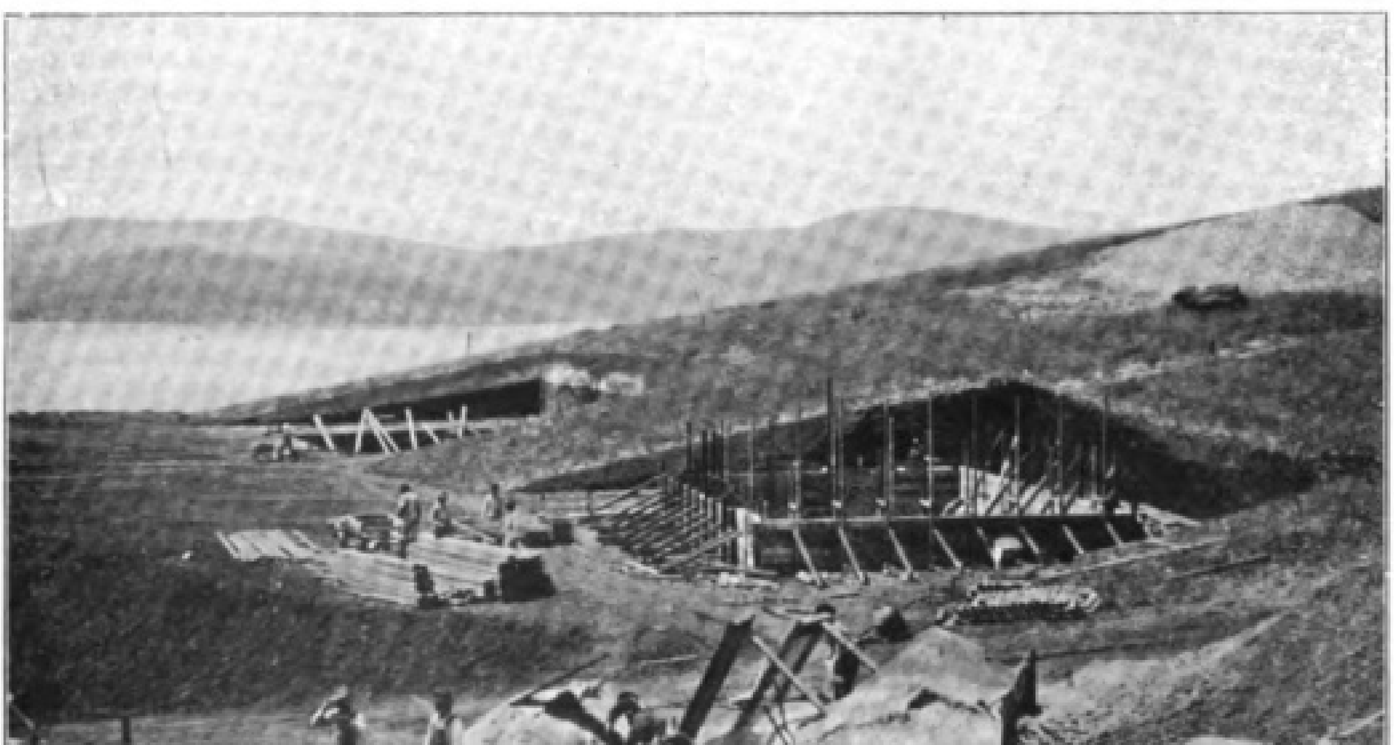
Residences for Chief and Assistant Engineers at Bolinas.

charge of the work to make every effort to transport the machinery and heavy materials as quickly as possible.

The buildings are located on an incline at a height of about 160 feet and within 500 feet from the shore.

The stay anchorages have been put in place and the masts are being erected. The power-house foundations are complete and the piers and foundations for the motor generators, disc dischargers, and other machinery are being erected. Rapid progress is being made in the construction of the headquarters and the residences for the chief and assistant engineers. These buildings are constructed of steel and concrete, with tile roofs to make them fireproof.

To reach the site of the receiving station



At the Site of the Receiving Station, Marshalls.

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it is necessary to ferry from San Francisco to Sausalito, board a train on the North-Western Pacific Railroad, and travel about an hour and a half or two hours on a narrow-gauge railway to the little town of Marshalls on the eastern shore of Tomales Bay. For several months workmen have been busy in this section, with the result that considerable progress has been made in the construction of the buildings which now form a feature of the hillside.

Tomales Bay, celebrated for its clams and oysters, is about twelve miles long and a mile wide. It is navigable for good-sized boats and is extremely popular with fishermen. On the eastern shore, just south of the Marconi property, is located a fishing colony. Along both shores the hills rise abruptly and stretch away on the eastern side in a rolling tableland. The tongue of land between the bay and the ocean is about three miles wide. Covered with heavy woods, this promontory is a favourite summer resort for campers and hunters. It affords good duck shooting and deer are also to be found in the woods. The residential quarters and section for the housing of the lighting and heating plant are about three hundred yards south of the line of the aerial; the operating building at the end of the aerial line is nearly a fifth of a mile from the other structures. These are arranged in a semi-circle above the country road, looking out over the bay from an elevation of one hundred feet. The operating building is on the top of a hill on an elevation of about one hundred and thirty feet.

The construction of the buildings has advanced rapidly. Satisfactory progress has been made on the mast erection. One mast has been completed and stayed, while all the others have at least four sections up. The top plate of the mast foundation can now be accurately levelled up and the last grouting concrete poured.

With regard to the station at Honolulu, work is going along satisfactorily, 141 persons being employed at Kahuku and 108 at Koko Head.

The November meeting of the Institute of Radio Engineers was held at Columbia University, New York, on the 5th ult., when a paper entitled "The Audion—Detector and Amplifier" was read by Dr. L. de Forest.

Directory of Amateur Wireless Stations.

IT is estimated that there are about one thousand licensed amateur experimenters in wireless telegraphy in Great Britain, and this number is steadily increasing. It is only natural, therefore, that there should be a demand for facilities to enable these experimenters to get in touch with their neighbours, which at present they are unable to do in the absence of a suitable directory.

We have decided, therefore, in the interests of the *bonâ fide* amateur, and at the suggestion of some of our readers, to undertake the preparation of a complete directory of amateur wireless stations, which we hope to publish as a special supplement to an early number of THE WIRELESS WORLD.

We believe that the publication of a directory such as we have in view will bring to light a large number of experimenters whose existence is unknown to their neighbours. It will encourage the establishment of wireless associations, and will help to strengthen existing associations by increasing the status of the amateur.

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.

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CARTOON OF THE MONTH

A Bedstead Receiver!

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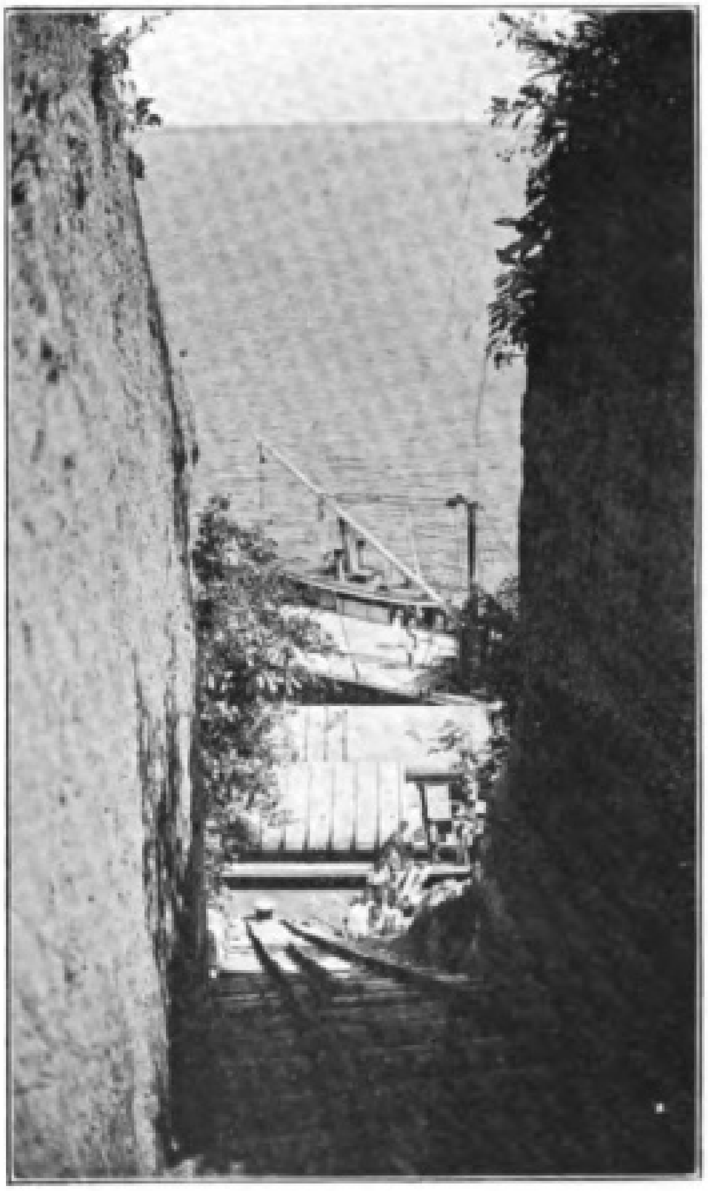
In a South American Forest.

THE BRAZILIAN-BOLIVIAN BOUNDARY COMMISSION. WIRELESS SIGNALS DETERMINE DIFFERENCE OF LONGITUDE. EXPERIENCES OF THE COMMISSION. DANGER TO OVERHEAD TRANSMISSION LINES.

IT is now nearly three years ago that the wireless telegraph stations were erected at Manaos and Porto Velho, and since then Brazil and Bolivia have witnessed great developments, due in a large measure to the civilising agency of wireless telegraphy, for it is only by this means that the far-away districts of Central America can be brought into touch with the world at large. How far they are away may be judged by the fact that the boundary line between Brazil and Bolivia yet remains unsettled, and there are large tracts of country still untraversed and unsurveyed. Nevertheless, this state of things is not likely to continue much longer. For three years Commander Edwards and a party of explorers and surveyors have been settling this difficult question of boundaries, and at the same time exploring the country.

After a period of strenuous work Commander Edwards returned to England for a short time this year, and during his brief stay found time to deliver an important and interesting lecture on his work before the Royal Geographical Society. Now he is once again in Bolivia at the head of the Bolivian Boundary Commission, and is reported to be awaiting the arrival of the Brazilian Commissioner, General Pando, before starting on a campaign of wider exploration.



Porto Velho. Landing material for the Construction of the Wireless Station.

One feature of the work of the Commission must be mentioned here, inasmuch as it illustrates an important use of wireless telegraphy. It was perhaps little dreamt at the time when the now famous stations at Mañaos and Porto Velho were erected by the Marconi Company for the Madeira-Mamoré Railway that, in addition to their ordinary work, they would communicate to an intrepid party of explorers, sent into a South American forest to carry out so delicate an operation as the determining of the boundary between two contiguous countries, signals that would enable the explorers to discover the difference of longitude between two given points, thus rendering them independent of chronometers. This is exactly what has been done, however.

Since its arrival the Commission has been determining the difference of longitude between Manaos and Porto Velho by means

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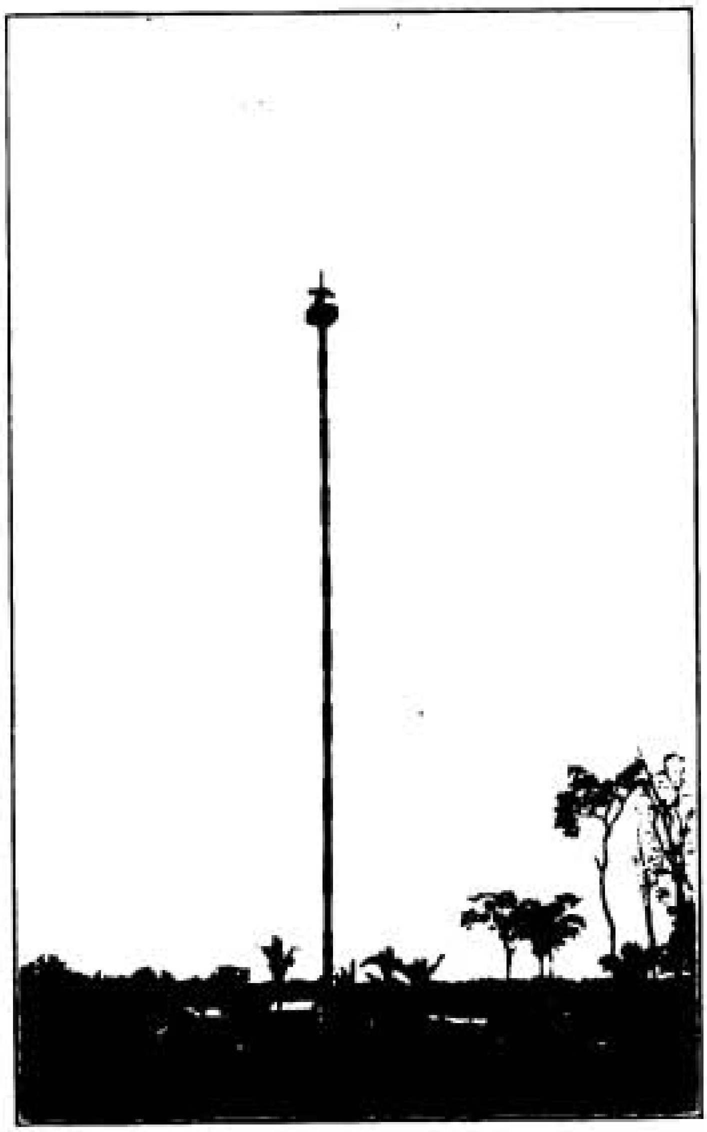
of exchange of wireless signals. The result will make the Commission independent of chronometers during the journey from Manaos to Porto Velho, and this will mean a great saving of time and anxiety, for chronometrical work is tedious and difficult, and observations have to be taken frequently, so that deficiencies, which constantly occur, may be rectified, and a workable approximation obtained.

Commander Edwards' first expedition on frontier work was commenced in 1911, and was the result of a report from Colonel Fawcett, who headed an exploratory party through this region in 1907. The journey was one of 2,000 miles up the River Purus, and its tributary the Acre, which brought the party to the Bolivia-Brazil boundary line in time to commence survey work at the beginning of the dry season. The main streams of these two rivers are fairly well known, and are open to small steam navigation for four or five months during the wet season of the year—December to April—during which time food supplies are rushed up to the depôts situated on the river bank, and a large quantity of india-rubber is brought down.

One of the towns visited by the expedition was Empreza, the capital of the Prefecture of the Acre. It possesses about 1,200 inhabitants, and Commander Edwards was hospitably entertained by the Prefect, who enthusiastically pointed out his schemes of improvement, and was particularly proud of the installation of the wireless station, which had just been erected. The region of Acre is known as "Inferno Verde," or Green Hell, and hints at the lawlessness of the inhabitants. At Capatara the party first experienced the *friajem* or cold snap, known in Bolivia as the *Suracon*. This is a sudden change in the weather, usually heralded by a fierce storm of ice-cold rain and wind, during which the temperature falls rapidly from its normal of about 90° F. in the shade to round about 47° F. These *friajems* last from four to seven days, and are of frequent occurrence during the dry season from May to September, causing great inconvenience, and even hardship, to the sun-loving worker in these parts, who, during the continuance of the low temperature, rarely leaves his hut or hammock. In the forest all is still, not an animal moves from its nest or lair, the birds sit dumbly huddled together amongst the topmost branches of the trees, the silence of the swamps is unbroken by the usual music of the frogs, the leaves of many trees and shrubs close together, and many crumple up and die. All Nature appears in a state of suspended animation, but bursts forth into exuberance again as soon as the sun shines and the sky clears.



Manaos Station. View of the mast.

From Capatara a thirteen-mile journey through dense forests was made to Rapirran, where the Central Frontier station was established, and this practically completed the work for that year.

In May, 1912, work was commenced at Cobija, and the Commission traversed and mapped the frontier line of the River Acre from Cobija to Tacna. The water in the river was unusually low, and the work of dragging their laden canoes over the sandbanks and snags was arduous in the extreme. The bed of the River Acre above Sacada is

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literally strewed with snags, stumps of trees, etc., and in several places the river breaks into *cachuelas* or rapids, which, however, are easily passed by lightly laden canoes. At Tacna, where the three countries of Bolivia, Brazil and Peru touch, permanent boundary marks were erected, and the Commission returned to Cobija. After erecting the permanent marks at Cobija, the party passed into the forest to the source of the Arroyo Bahia.

The exploration of the Arroyo Bahia and Floresta was soon finished, and the Commission returned to Cobija, and thence to Manaos, voyaging 1,500 miles down river in their own little motor boat, 30 feet in length.

The annual rise of the rivers commences about the middle of October, and they are at their highest in January. The Acre rises thirty feet, the Iquiry, Rapirran, Ina and Xipamanu about twenty feet.

Usually the last big *ripoquette* takes place towards the end of May, and is given the name of *mata-feijoe*, or the *beankiller*, as it sweeps away the young bean plants which at that time are well above ground. In March and April, as the waters fall, the natives clear away all vegetation from the sandy banks and playas of the rivers, and plant beans thereon, and great hardship and loss result to them should the *mata-feijeo* be of unusual strength. This bean sowing is practically the only general agricultural process in operation, though in the vicinity of the townships of Empreza, Xapury and Cobija, and at some of the large depôts on the Acre, settlers are cultivating sugar-cane, coffee, mandioca (from which they make flour and a spirituous liquor something like gin), macaxera, maize, yams, pineapples, oranges, mangabas, and papaia or mamao. Yet the soil is wonderfully fertile, and with very little toil returns a harvest out of all proportion. The Government of Bolivia is pursuing the wise policy of making small grants of land near Cobija to time-expired soldiers, and thus is building up a type of colonist, attached to the land, with local interests and aims. Brazil will, no doubt, follow suit, and the day may not be far distant when these remote regions will supply their own population with the immediate necessities of life, instead of being, as at present, dependent on supplies brought up at enormous freight charges by river steamers from Manaos and Para.

Porto Velho. General view of one of the Wireless Telegraph Stations which communicated with the Boundary Commission.

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The banks of the River Acre are dotted with rubber deposits, usually consisting of a store, rubber shed, and a few barracas or huts, erected in a clearing, and from these depôts long straight *varadors* or mule roads are cut through the forest, as far back as the limits of the seringal extend. Away from the Acre depôts, but on the *varadors*, are the *centros*, or distributing and collecting centres, which are always in touch, by means of mule transport, with the depôts; and away from the *centros* in the depths of the forest are the isolated "barracas" of the actual rubber collector.

It is sacrilege to lay violent hands on the rubber tree, and in the seringals, or rubber estates, questions of poaching are settled out of hand with the rifle, usually without time being allowed for personal explanations.

This illustrates the danger to overhead transmission lines by falling trees in the Amazon district.

The Government of Ecuador have drawn up a Bill to be laid before the present Congress for the installation of wireless telegraphy, at an expenditure of £30,000.

"Wireless is the great life-saver at sea, and it also has smaller uses. A friend of mine just returned from South Africa says that his ship's doctor played chess most of the way with the doctor in the *Kenilworth Castle*, the latter being many miles in the rear."—Mr. Gossip in the *Daily Sketch*.

PHILLIPS MEMORIAL.

After many months of delay a site has at last been found at Godalming for the memorial to Jack Phillips, the chief wireless telegraphist of the *Titanic*, who was a native of the town. When a site had been almost secured nearly a year ago difficulties arose, with the result that the Memorial Committee, which includes the Mayor, Alderman E. Bridger (chairman), Mrs. G. F. Watts, Lady Chance, the Hon. Mrs. Arthur Davey, and Mrs. W. E. Horne, had to look elsewhere. The site now chosen is glebe land near Godalming Parish Church, and the assent of the Ecclesiastical Commissioners, the Bishop of Winchester, and the vicar, the Rev. G. C. Fanshawe, has been obtained. The land, three acres in extent, is to be bought by the corporation for £300, and the Memorial Committee will contribute £50 towards the cost in return for the piece of land they will require. The remainder will be utilised by the Corporation as a recreation ground, and a shed will be erected to provide facilities for bathing in the River Wey, which flows past the land. The design of the memorial, which is by Miss Gertrude Jekyll and Mr. Thackeray Turner, is for a rectangular cloister of some 120 feet square. The memorial will cost between £600 and £700.

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NOTES OF THE MONTH

STATE RESEARCH IN RADIOTELEGRAPHY. THE POST OFFICE YEAR. "LLOYD'S." WIRELESS TELEGRAPHY AND NATIONAL AMITY. THE ART OF SPECIALISING.

THE Postmaster-General has appointed a committee to consider how far and by what methods the State should make provision for research work in the science of wireless telegraphy, and whether any organisation which may be established should include problems connected with ordinary telegraphy and telephony. The committee's office is at 6, Catherine Street, Strand, London, W.C. The names of the members of the committee are as follows: The Right Hon. C. E. H. Hobhouse, M.P. (chairman), the Right Hon. Lord Parker of Waddington, Sir Joseph Larmor, M.P., F.R.S., Sir Henry Norman, M.P., Dr. R. T. Glazebrook, F.R.S., Mr. W. Duddell, M.I.E.E., F.R.S., Mr. R. Wilkins, C.B., Rear-Admiral E. F. B. Charlton, R.N., Sir Alexander King, K.C.B., Mr. W. Slingo, Commander F. Loring, R.N., Major the Hon. H. C. Guest, M.P., and Commander J. K. Im Thurn, R.N. Of the members of the new committee Lord Parker of Waddington, Mr. W. Duddell, F.R.S., and Dr. R. T. Glazebrook, F.R.S., were also members of the technical committee appointed last January on the recommendation of the Select Committee on the Marconi Contract, Lord Parker being the chairman. The reference to that committee was "to report on the merits of the existing systems of long-distance wireless telegraphy, and in particular as to their capacity for continuous communication over the distances required by the Imperial chain," and they reported in due course.

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The annual report of the Postmaster-General is one of the most interesting documents issued by any Government Department. It reflects the work of a department which touches the public more closely than is generally imagined, and if the Post Office receives an ample share of criticism, it is because it is so great a public convenience. The report for the year ended March 31st, 1913, shows how enormous is the volume of business transacted by the department which is controlled by the Postmaster-General. More than five and a half million postal packets and six million parcels passed through it last year, and it is estimated that the value of goods exported and imported by parcel post during the same period amounted to more than ten and a half million pounds sterling. The pages of the report throw a flood of useful light upon the banking, telegraphic and other business conducted through the Post Office, revealing an organisation of which the country has just cause to be proud. We turn with interest to that section of the report dealing with wireless telegraphy, and in the few printed sentences we find evidence of the maintenance of the steady increase in business. The number of radio-telegrams dealt with at the Post Office Coast Stations during the year was 51,109 (43,650 inwards and 7,459 outwards), as compared with 44,507 last year—an increase of about 15 per cent. These figures show that the public are beginning to realise and take advantage of the opportunities that exist for communicating with ships at sea, and if the existence of these facilities for sending radio-telegrams were better known, the returns would show a considerable increase. As it is, progress is assured by the rapidly increasing number of ships having wireless installations. Readers of the Postmaster-General's report will not fail to note the growth in the number of wireless telegraph licences granted during the year. In all, 729 new licences, covering 869 stations, were granted in the United Kingdom under the Wireless Telegraphy Act for the purpose of experiments, while 45 licences for experimental stations were cancelled or expired. On March 31st last there were in existence 942 licences for the purpose of experiments, as compared with 258 on March 31st, 1912. The number of licences in operation for wireless telegraphy on board ships registered in the United Kingdom was 105, covering 646 ships, as compared with 72 licences covering 450 ships on March 31st, 1912.

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"Lloyd's" annual report supplements some of the information published in the report referred to above. It covers practically the same period as the Postmaster-General's report, which it resembles in this respect: that whilst it evidences the considerable growth in the application of wireless telegraphy, it shows likewise what an enormous field there is for commercial development. At the close of the Society's year ended June 30th, 1913, 10,466 merchant vessels, registering over twenty-two and a half million tons gross, held classes assigned by the Committee of Lloyd's Register. Of these 1,932 vessels were recorded in the Society's Register as fitted with wireless telegraphic installations as compared with 1,392 at a corresponding date last year, and 806 fitted with submarine signalling apparatus, as compared with 630 last year. The increase in the number of vessels equipped with wireless telegraphic apparatus during the past year is a feature which stands out prominently in the report, and although the number of vessels now equipped with wireless is small in proportion to the number of vessels registered, we are convinced that at the present rate of installing the figures will be more in line within a very few years. The report tends to show that the vast majority of new ships have been equipped, and that it is among the older vessels that wireless is not making such rapid progress as might be desired. Last year 651 new vessels were built, 593 being steamers and 58 sailing vessels. During the same period 540 vessels were fitted with wireless telegraphic installations, so that on the whole there is little cause for complaint in respect of modern vessels.

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It is gratifying to note that wireless telegraphy played a not unimportant part in the inauguration of what there is every reason to believe will be an era of close friendship between France and Spain. On the conclusion of a visit by the French President to Spain which will be a memorable event in the annals of the two countries, courtesies by wireless were exchanged between M. Poincaré and his royal host. M. Poincaré sent a wireless dispatch from the *Diderot* to King Alfonso, who was on board the battleship *España*, expressing his gratitude to King Alfonso, Queen Victoria, and the Spanish nation, for the sincere and friendly welcome he had received and the cordial sentiments shown for France, and conveying the warmest wishes of France for the King and Queen and for Spain. King Alfonso replied in a wireless telegram thanking the President sincerely in the name of Spain, the Queen and himself, and expressing the warmest wishes for the greatness and prosperity of France and the happiness of M. and Madame Poincaré.

* * *

In the course of his inaugural address to the Manchester section of the Institution of Electrical Engineers, Professor E. W. Marchant discussed the place of the electrical engineer in the industrial world and the reward he should receive. He maintained that electrical engineering had developed in so many directions that it was impossible for one man to keep in touch with all the branches of activity in which electrical engineers are employed. It is quite true, as stated by Professor Marchant, that the electrical engineer of to-day is a "highly specialised person," and it is interesting to consider how far the specialist from the training college can fulfil the requirements of wireless telegraphy. The development of this branch of industry has resulted in the demand for a definite type of engineer possessing qualifications that are common to other branches of engineering. The nature of the work on which the wireless telegraph engineer is engaged is such that knowledge of mechanical and civil engineering is no less a requirement than that of electrical engineering. In practical work he is concerned with the installation of various types of plant, in addition to the wireless gear. He has to erect large masts with the corresponding systems of aerial wires and earth wires, and he must be so versatile that he should be able to organise a telegraph business which has to work as regularly as if it were on an ordinary land line. It is thus evident that the average student of a technical college who has specialised in any one particular branch of engineering will find himself at some disadvantage if he enters the profession of wireless telegraphy, and it is perhaps just as well to make it quite clear that the type of man required is not so much an electrical as a general engineer.

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Administrative Notes

A New Post Office Station.

A LETTER has been received by the Devizes Town Council from the Commissioners of Woods and Forests stating that the Postmaster-General is about to erect a small power station on the Marlborough Downs at a point about five miles from Devizes, where the corporation waterworks are situated. It has been known for some time that a wireless station was contemplated at this point, but this is the first official information. It is conveyed in the course of a letter asking for a supply of water to the station.

* * *

Wireless Licences to Military Officers in India.

ACCORDING to the *Englishman* of Calcutta, the Government of India have decided that the granting of licences to military officers in respect of wireless telegraph apparatus used for experimental purposes shall be regulated by the following general principles: (1) When an officer conducts experiments in wireless telegraphy in his official capacity at the expense of Government no licence is required, but only executive permission, which may be given so far as the Telegraph Department is concerned by the Director-General, Posts and Telegraphs.

(2) When an officer carries on experiments as a private individual at his own expense he must obtain a licence. If the approval of the military authorities is required to what he proposes to do he should obtain such approval before the Director-General, Posts and Telegraphs, is approached. The licence will then be submitted by the Director-General, Posts and Telegraphs, for the sanction of the Government of India.

(3) With reference to the above, attention is drawn to the necessity for applying for licences to own and use wireless telegraphy apparatus or installations, experimental or otherwise. Applications for such licences will be submitted through the Chief of the General Staff and will contain particulars regarding the apparatus showing (*a*) system it is proposed to employ, (*b*) maximum range of signalling with applicants' own receiving apparatus, (*c*) power (current and voltage), (*d*) source of power.

* * *

Time Signals.

THE Japanese Government has notified that the shore station of Choshi transmits time signals every night, except Sundays. The following list of shore stations are officially announced to send out time signals:

Station.	Time of Transmission.	Wave-length.
		metres.
GERMANY:		
Norddeich	Mid-day and Midnight by Greenwich time.	1,650
Tsingtan (Signalberg, China)	Mid-day and 8 p.m. by time of meridian 120° East of Greenwich.	1,250
UNITED STATES OF AMERICA:		
Arlington, Va. ..	Mid-day and 10 p.m. by time 75° West of Greenwich.	2,500
Boston, NAD .. Charleston, S. Carolina .. Key West, Flo. .. New Orleans .. Newport, Rhode Is. New York, NAH .. Norfolk, Va... ..	Mid-day by time 75° West of Greenwich.	1,000
Eureka, Cal. .. Mare Island .. North Head .. San Diego, Cal. .. Tatoosh	Mid-day by time 120° West of Greenwich.	1,000
JAPAN:		
Choshi	9 to 9.4 p.m. by time 135° East of Greenwich.	600
MEXICO:		
Campeche .. .. Guaymas .. .. Mazatlan de Sinaloa Payo Obispo.. .. Veracruz deVeracruz	Mid-day by meridian of Tacubaya.	—

* * *

Dutch Vessel Fitted.

THE Administration of the Netherlands has informed the Berne Bureau that the steamship *Van Lansberge*, belonging to the shipping company "Koninklijke-Paketvaart Maatschappij" of Amster-

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dam, has left Amsterdam on September 10th for Batavia, and that it is fitted with a wireless station. The provisional call-letters for this station are "P M G" and the tax for messages sent by this station is 40 centimes a word, with a minimum of 4 francs per telegram.

* * *

Australian Coast Stations.

THE following additional stations in Australia have been opened for the transmission of public correspondence: Geraldton (W.A.); Rates, 6d. per word (no minimum); call signal, VIN; hours of attendance, 8 a.m. to midnight. Rockhampton (Q.): Rates, 6d. per word (no minimum); call signal, VIR; hours of attendance, 8 a.m. to midnight. Cooktown (Q.): Rates, 6d. per word (no minimum); call signal, VIC; hours of attendance, 8 a.m. to midnight.

* * *

Spanish Stations.

IN accordance with a Royal Order of July 12th last, and in reply to the Royal Order of the Minister of the Interior of December 7th, 1912, the Minister of War has made known that there is no objection on his part to the establishment of a radio-telegraphic station on Cape Finisterre, provided it be subject to the dispositions of the laws in force relating to coastal and frontier military zones.

The installation of a station on Cape Mayor, in the province of Santander, was approved, subject, in case of need, to the possible requirements of building a battery projected by the War Department for the defence of that part of the coast. The said station, with a permanent service, was opened to the public at current rates in July last. The Minister of War has also given his consent to the station in Malaga at the site known as Almellones.

* * *

Weather Reports.

THE Department of Posts and Telegraphs, Pretoria, announces that the radiotelegraph stations at Cape Town and Durban will signal at 1 o'clock in the afternoon of each day weather reports containing information relative to the meteorological conditions affecting the coastal belt of the South African Union.

* * *

Indian Telegraphs.

THE annual report of the Indian Telegraph Department for 1912–13 states that new wireless telegraph stations were opened during the year at Karachi and Butcher Island, Bombay, with a working range of 600 miles, for the exchange of ships at sea, and the temporary station at Bombay was closed. In addition to the erection by the department of the four large Marconi stations at Karachi, Nagpur, Lahore and Bombay, an important event of interest in India has been the large increase which has taken place in the number of ships fitted for wireless telegraphy. Most of the passenger steamers plying regularly in Indian waters are now fitted with wireless apparatus. The increased demands made by ships on the coast stations have been met by opening a new station at Karachi, and by arranging that Calcutta, Diamond Island, Mergui and Victoria Point should operate by night as well as by day.

The opening of the stations named in the list given below is advised in the last supplement to the official list of wireless telegraph stations:—

Name.	Call Signal.	Normal Range in Nautical Miles.	Wave-length in metres (the normal wave-length is printed in italics).	Remarks.
Nassau, Bahamas (British West Indies)	VPN	400	*600*, 1,800	Open for general public business.
Archangel (Russia) ...	RQA	250	300, 420, *600*	Open for public business. The coast charge is 0·60 fr. per word, but for communication with Russian coast and ship stations it is 0·13 fr.
Sierra Leone... ...	VPU	250	300, *600*	Open for general public correspondence.
Guadalajara (Spain)	ECZ	54	900	Owned by the Ministry of War.

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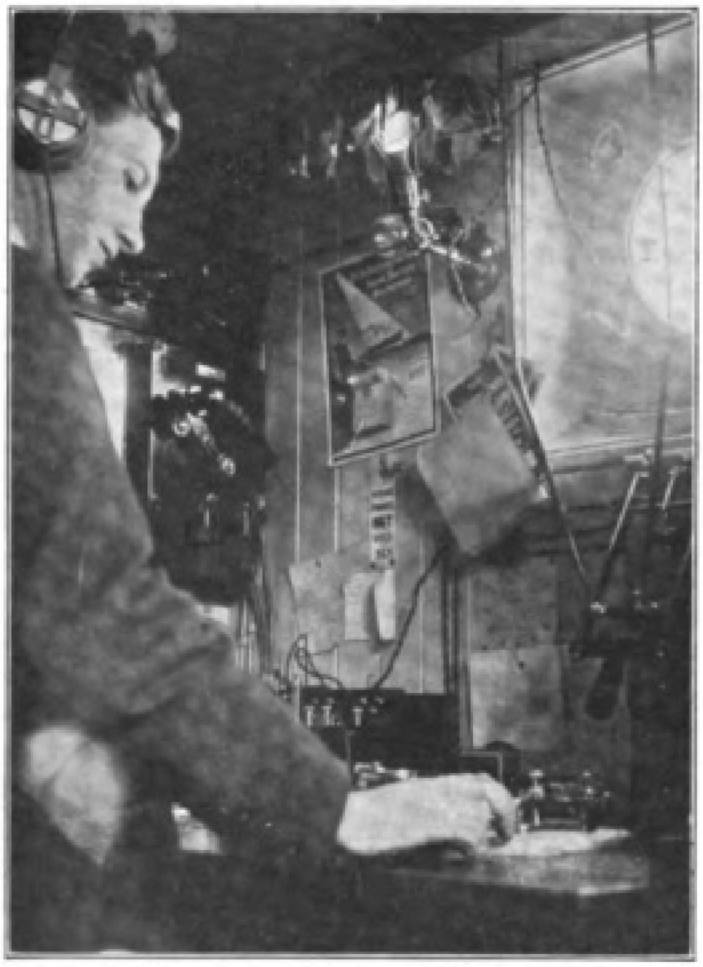
Maritime Wireless Telegraphy

IN a recent issue we described some highly successful experiments with wireless telegraph apparatus on board steam trawlers, which resulted in the Marconi Company receiving instructions to equip several of these vessels. One of the first vessels thus equipped is the *Cabban*, on which is installed a $\frac{1}{2}$ k.w. set. The trawler's masts are each 65 feet in height, with 70 feet between them. The range over which these small stations communicate is governed by the height of the masts, and in the case of the *Cabban*, the guaranteed range was 100 miles. The vessel left Hull on November 7th, and so successful was the working of her "wireless" that communication was maintained over a distance of 150 miles.



Mr. J. Lees, operator on the "Czar," one of the vessels which answered the wireless call for help from the Volturno and saved 102 passengers.

* * *

A mysterious incident has just been reported on the arrival of five men at Plymouth, who were picked up by the P. & O. Liner *China*, and who stated that they are the crew of a new steam tug, the *Nana*, which had set out towards its destination, which is Rio Galangoes, in Patagonia. Soon after the *Nana* had started from Brightlingsea, and was making its way down the Channel, bad weather was encountered so that the little vessel shipped heavy seas, and by daylight had developed a list to port. In order to right the vessel it was decided to cut away part of the bulwark and lower the lifeboat and tow it astern. All the men were ordered into the lifeboat, and the only man left on the steam tug was the captain. Then, as the vessel righted itself, the strain broke the rope and the lifeboat drifted away, so that the *Nana*, with Captain Kite alone on board was soon out of sight in the surrounding darkness. Fortunately for the men on the lifeboat they were picked up by the *China*, and when the commander of the rescuing vessel heard the men's story he sent out a wireless message asking that a tug should be dispatched from Falmouth to search for the little steam tug and its single passenger. The work of rescue was, however, accomplished by the German steamer, *E. Russ*, who brought back Captain Kite and his vessel to Falmouth, but it is satisfactory to note that the work of rescue did not rest solely upon a chance meeting with a passing vessel, but that efforts could be, and were, made to reach her, a thing only possible through the sustained efforts of wireless telegraphy.

* * *

The *Mount Temple* of the C.P.R. Line from London to Montreal stuck fast in the mud in the St. Lawrence River opposite her point of destination on October 24th. The vessel was refloated two days later only after she had been lightened of a considerable portion of her cargo. On the vessel going aground the Commander at once dispatched wireless calls for assistance to the C.P.R. Marine Superintendent, and within a very short time numerous tugs were on the scene.

The wireless installation on board the *Mount Temple* rendered valuable service, as

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by the intermediary of the Montreal station, continuous twenty-four hour communication was maintained with the ship, and the C.P.R. office was kept advised of the progress made in the efforts to release the vessel.

* * *

The equipment of the yacht *Leda*, which is owned by Mr. G. L. Carels, the well-known engineer and manufacturer, of Ghent, who is Honorary President of the Royal Yacht Club, is notable for many reasons, not the least important of which is that the *Leda* is the first Belgian yacht to have a wireless installation. The set is installed in a cabin on the bridge measuring only 3 ft. 8 in. Notwithstanding the small space occupied, the *Leda* station is quite complete, with singing spark, and capable of receiving waves of different lengths. A standard ½ kw. set is employed, the power being obtained from the ship's accumulator battery, which, in turn, is charged by the ship's dynamo. The receiving apparatus comprise the Marconi multiple tuner and magnetic detector. The dimensions of the aerial are, of course, limited, the distance between the masts being about 20 metres, and the height about 22 metres above the waterline. The range of the station is 200 kilometres. The aerial has attracted considerable attention, because the Belgian public are not accustomed to the sight of the familiar wires suspended between the masts of this class of vessel. The installation of the *Leda* is a reminder that yacht owners are becoming more alive to the advantages of Mr. Marconi's invention, and in the United States and Great Britain a great many yachts have now their stations. This is not to be wondered at when we remember that yachting is a recreation indulged in by many whose occupations and interests do not permit them to remain for any length of time unacquainted with the world's happenings. Thanks to wireless telegraphy, busy men can now leave the toils and cares of life in the city, and follow their favourite pastime without losing touch with what is going on in their absence.

The Yacht "Leda" showing Aerials.

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Wireless Heroes

AN impressive ceremony took place in the school at Marconi House, London, on November 12th, when the *Volturno* operators, Mr. Walter Seddon and Mr. C. J. Pennington, and the *Templemore* operator, Mr. R. Emanuel, were presented by Mr. Marconi, on behalf of his company, with gold watches in commemoration of the splendid work they performed under circumstances that are still too fresh in the public memory to need mentioning here.

The presentations were made in the presence of a large gathering of the students attending the Marconi day classes, to whom the proceedings were of especial significance, as many of them were on the eve of entry into the profession which was honoured by the records of heroism and devotion to duty about to be commemorated that day.

The opening remarks of Mr. Godfrey C. Isaacs formed a keynote of the proceedings. He observed that nobody employed in the Marconi Company had ever failed to respond manfully and bravely to the call of duty. On several occasions already men employed, as many of them were, in a duty of the greatest responsibility—upon which often depended the safety of the lives of many fellow men and women—had, whenever called upon, proved themselves quite thoughtless of their own personal safety; they had done their work nobly and magnificently, and had been responsible for the saving of a large number of lives. Mr. Seddon, Mr. Pennington, and Mr. Emanuel had performed their duty as other officers of the company had done on previous occasions. That of itself should constitute a great satisfaction to every man upon whom such an opportunity devolved, for it was that sense—that inward feeling—of having done one's duty which constituted the real satisfaction and the real happiness in the lives of men. A man who had encountered such an opportunity and had risen to the occasion would go through life ennobled by the thought of his achievement.

Mr. Isaacs added:

"It has been and it will continue to be our custom to present each of those gentlemen who do their duty in the way that these men have done with a little souvenir of the occasion. Nothing that we can do can possibly show the real appreciation that one has for the work which has been performed in this direction, but one does feel that one wants to have the opportunity of presenting something from the company to be kept throughout all time as an indication of the way in which the recipient has carried out the duties in his lifetime. Therefore we took this opportunity of asking these gentlemen to be present to-day in order that Mr. Marconi may present each of them with a little souvenir for himself and for the company."

Mr. Marconi then said:

"There is not much which I can add to what has been said so ably and so eloquently by our Managing Director, Mr. Godfrey Isaacs. I wish, however, to congratulate these three operators most sincerely on behalf of the Marconi Company on the splendid manner in which they carried out their work in most trying circumstances. I am sure that the company—not only the company, but all their countrymen—are proud of the fact that in time of peril and danger on the sea the wireless operators of this company have never once been found wanting in courage, in discipline, and in devotion to their most important and responsible duties. The story of the *Volturno* and of the *Templemore* is too well known for me to refer to, but it is a story that will live. I think the memory of these wireless operators who have done their duty will also live, and will be one of the things to which seamen and sailors and all those connected with this new science of wireless will look back upon with satisfaction and with pride. I cannot add any more, but I am glad to have had this opportunity of showing this mark of appreciation to these three employees, to these three fellow-workers of ours, as Mr. Isaacs has put it, who have done their duty so well and so bravely."

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Contract News

Vessels fitted with Marconi Apparatus since the last issue of the *Wireless World*.

Name.	Owners.	Installation.	Call Letters.
Columbia	Hellyers Steam Fishing Co.	3 kw. and emergency	MFH
Cardiganshire	R.M.S.P. Co.	1½ kw. and emergency	MAU
Alaunia —	Cunard Steam Ship Co.	"	GAI
Glenetive	Caledonia Steamship Co.	"	MEZ
Baron Jedburgh	H. Hogarth & Sons	"	MGD
Highland Brigade	Nelson Line	"	MCZ
Highland Harris	"	"	MDO
Banca	P. & O. Line	"	MFS
Star of India	J. P. Corry & Co.	"	GYZ
Star of Australia	" "	"	MAH
Engineer	T. & J. Harrison	"	MFO
Statesman	" "	"	MHP
Kumara	Shaw Savill & Albion Line	"	MFG
Mexico	Compania Mexicana de Navigacion	"	XBB (provisional)
Amber, C. S.	Eastern Telegraph Co.	"	GFI
Hatumet	H. B. & A. Gourlay	½ kw. and emergency	MGR
Swazi	Bucknall Steamship Line	"	MAV
Karema	" " "	"	MAF
Caliban	Hellyers Steam Fishing Co.	"	MGS
Bardolph	" " "	"	MGE

Orders have been received to equip the following Vessels with Marconi installations.

Name of Vessel.	Owners.	Type of Installation.	Call Letters.	Remarks.
Montcalm	Belonging to the Canadian Government	½ kw. and emergency	—	
Lady Grey	" " "	"	—	To refit with modern apparatus.
Druid	" " "	"	—	
Simcoe	" " "	"	—	
Lurcher	" " "	"	—	Lightship.
Trinidadian ..	The Trinidadian Co., Ltd. ..	"	GLH	Trading between West Indies and N.Y.
Rossetti	Messrs. Lamport & Holt, Ltd.	1½ kw. and emergency	MEY	
Raeburn	" " "	"	MES	Trading between South America and the River Plate.
Raphael	" " "	"	MET	
Rembrandt	" " "	"	MEU	
Romney	" " "	"	MEV	
Desabla	Andrew Weir & Co.	"	GYV	The *Desabla* and the *Barnesorn* are engaged in general foreign trade, while the other vessels are chiefly engaged in transit work between India and Africa.
Barneson	" "	"	GYW	
Surat	" "	"	GEL	
Kathiawar	" "	"	GEM	
Gujarat	" "	"	GBO	
Massilia	The Anchor Line	"	MHH	Three more of this famous line of passenger vessels engaged in the Bombay service to be fitted with Marconi installations.
Olympia	" "	"	MHI	
Scindia	" "	"	MHJ	
Kelvinia	The Glasgow Steamship Co., Ltd.	"	MGQ	General cargo.
El Cordobes ..	The British and Argentine Steam Navigation Co., Ltd.	"	MHO	Engaged in South American trade.

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Our Bookshelf

WIRELESS TELEGRAPHY AND TELEPHONY. By Charles R. Gibson, F.R.S.E. London: Seeley, Service & Co. 5s. net.

On the whole "wireless" has been very fortunate in the men it has found to write about it. It is true that at times a good deal of unsound stuff has appeared dealing with the subject, but lately, at any rate, we have had occasion to notice a number of small books on the subject at which some of the older sciences must look with envious eyes; rather as the present generation, looking back to its childhood, grumbles that it never had the advantages and luxuries, the toys and the good time generally, which it sees offered to the generation growing up around it.

The latest example which we have come across is the thoroughly well-produced book whose title is given above. Here, helped by a large number of excellent illustrations, is a very plain and straightforward "popular account of the past and present of wireless telegraphy and telephony," which assumes, as the author states, "no previous knowledge of the subject on the part of the reader." It does not profess to go very deeply into the subject, but it gives just those clear introductory outlines which, we feel sure, will leave many a reader with the determination to explore further; while those readers who have no time for such fascinating explorations will be content to know that, after reading this book through intelligently, they really have a sound and reasonable idea of what wireless telegraphy and wireless telephony are.

We have only one quarrel with Mr. Gibson. He quotes the late Professor Ayrton's early prophecy: "The day will come, when we are all forgotten, when copper wires, gutta-percha covers, and iron bands are only to be found in museums, that a person who wishes to speak to a friend, but does not know where he is, will call with an electrical voice which will be heard only by him who has a similarly tuned electric ear. He will cry 'Where are you?' and the answer will sound in his ear, 'I am in the depth of a mine, on the summit of the Andes, or on the broad ocean.' Or perhaps no voice will reply, and he will know that his friend is dead. . . ." Our quarrel with Mr. Gibson is that he refers to this as a "humorous prophecy." To anyone who is thoroughly imbued with the spirit of the "wireless" this adjective jars, rather as it would if applied to a part of Ecclesiastes.

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"LIGHTSHIPS AND LIGHTHOUSES," by Frederick A. Talbot. (London: William Heinemann, 6s. net.)

The author's gift of language and his skill in investing what would, in other hands, be heavy material, with the charm of romance and vivid narrative, is as abundantly evident in Mr. Frederick A. Talbot's new book on "Lightships and Lighthouses" as it was in his previous volumes. There is not a dull page in the book, for we find the story of the safeguarding of the world's coast line brimful of incident and adventure.

Humour plays an occasional part in the tale of sea life, and some of Mr. Talbot's descriptions of storm and danger are vivid writing, and when it is remembered that such storms as he describes are no uncommon experience to the dwellers on these outposts of civilisation, it adds a fearful realism to the tales he has to tell. Another point he brings out clearly is the desolation which the lighthouse keeper is forced to endure. Often we come across such passages as this in his book: "Belle Isle is a lonely station in the fullest sense of the word, for six months the guardians of the light are isolated from the world at large. . . . As the wireless installation is closed down when navigation ceases, the keepers and their families settle down to the weary vigil, knowing nothing of the rest of the world, and all but forgotten by civilisation, for the storms and stress of winter often rupture the submarine cable, which cannot be repaired until the ice disappears." What communication with the outside world means to these watchers, a reference, made by the writer, to the wireless installation on Sable Island, off Nova Scotia, will explain: "The life of these lonely workers now is

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lightened very appreciably, as the island is fitted with a wireless station, wherewith the men are able to talk through space with the mainland, and with passing vessels."

Mr. Talbot commences his chapter on the Guardian Lights of Canada's Coast with a description of the beacon at Cape Race, where, as is well known, an important wireless telegraph station has been built. Never were there two institutions more needed, for this coast is a very Charybdis to passing vessels, or, as Mr. Talbot puts it, "more millions sterling of cargo and ship have been shattered and lost here than on any other corresponding stretch of coast in the world." Just as the lighthouse carried the completest apparatus of its kind, so the Marconi station is a model of up-to-date equipment.

Another interesting chapter in Mr. Talbot's book is that on "The Lamp-posts of the Great Lakes." The enormous cost of safeguarding vessels navigating these waters is little understood, but the fact that £470,000 had been spent on safeguarding Lake Michigan alone up to the year 1883 will give some idea of the immense cost. Even now the latest development in lighthouse engineering is being constructed on Carribean Island, Lake Superior. But the Canadian Government have recognised a cheaper means of safeguarding the shores, and already a chain of Marconi stations is rendering invaluable service to "ships that pass."

Towards the end of his book the writer, without hampering his subject with technical phraseology, gives some excellent descriptions of the apparatus now in use, both in lighthouses and lightships, and one of the paragraphs that interested us most was that on the most wonderful invention of modern lighthouse engineering, the "Dalen" valve, which depends upon the action of the sunlight alone, and automatically lights and extinguishes the light at dusk and dawn respectively. Altogether "Lighthouses and Lightships" affords excellent reading, and can be warmly recommended to any who want to know something of modern invention and progress outside the limits of their own particular fireside and community, but who have not the time to wade through heavy nautical reports, or gather information from the many sources which Mr. Talbot has "tapped" so adroitly.

"ELECTRIC CIRCUIT THEORY AND CALCULATIONS," by W. Perren Maycock, M.I.E.E. (Whittaker & Co., 3s. 6d.)

Luckily for the general public, there are—scattered about the world—many of whom it may be said, "Give him a spanner, an oil-can, and a broken-down bicycle, and he'll coax it to do typewriting for him." These are the men who, after a few minutes, private conversation with a complicated piece of machinery, which may be a total stranger to them, will know, as it were, by instinct, its complete history, its habits, failings, fads and pet tastes, and will be able to tend it, mend it, and even improve it far better than a man who may have been brought up beside it but yet lacks the engineering instinct. But put some of these instinctive engineers in front of a piece of paper containing a few lines of arithmetical calculations relating to that very machine, and it will drive them to a state of acute despair. To such as these, Mr. Perren Maycock's book will prove a real boon so far as electrical work is concerned. We can imagine them seizing on this volume, devouring it eagerly, and then crying out for a companion volume dealing with the mechanical side of their work. The author has managed to put himself into the frame of mind which finds nothing too elementary to explain; and his admirable patience and clearness of exposition should result in a very hearty welcome for his book.

* * *

"TELEPHONE ERECTION AND MAINTENANCE." A handbook for the contractor and wireman. By Herbert G. White. (London: S. Rentell & Co., Ltd., 36 Maiden Lane, Strand, W.C.) Pp. 125 (illustrated). 1s. 6d. net (1s. 9d. post free).

The main object of this book is to explain the principles underlying domestic telephones of the type that the electrical contractor and wireman have to handle, and this object has been kept in view right through the work. No attempt is made to deal with public telephone service; this subject has been ably dealt with by other writers, and is beyond the requirements of the contractor. On the whole, this book should prove interesting and of value to those for whom it was written.

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A Pawn in the Game

(Serial Story)

By BERNARD C. WHITE

CHARACTERS IN THE STORY.

CHARLES SUMMERS.—*Inventor and engineer. Son of the Vicar of Sotheby, and affianced to Gwen Thrale, daughter of the squire. His most recent invention is an airship worked by wireless, which is likely to revolutionise aerial warfare. Negotiations are proceeding with the War Office for its purchase from the inventor.*

GWEN THRALE.—*Charles Summers's fiancée, a bright, intelligent and original girl, the idolised daughter of the squire, and secretly a member of a Fabian Society. She coaxes Summers to teach her "wireless," and soon becomes a proficient operator and a bit of an engineer.*

DOSS AND SUK.—*Pedlars, for ever on the prowl, and the universally recognised purveyors of village gossip. They are discovered and "tapped" by——*

M. DUPONT AND HERR BEULNER.—*Foreigners, making a prolonged visit to England. Ostensibly they belong to the leisured and wealthy class; but in reality they are secret agents for a foreign Government sent over to England for the purpose of securing military or naval secrets. Their attention is directed to Summers's work, and they determine to get possession of the airship's plans.*

SIR HENRY DEVER.—*Under-secretary at the War Office and in charge of the department of aerial defence. An energetic man with a keen insight of affairs.*

LIEUTENANT BRAITHWAITE.—*A clever young official, and confidential secretary to Sir Henry Dever. He is sent to Chittingham ostensibly as companion to Charles, but in reality to act as a detective in case anyone should endeavour to tamper with the valuable papers which Charles has in his possession.*

CHAPTER IX.

A STRATEGIC MOVE (*contd.*)

SO now his catastrophe did not touch him. It only left him empty, empty of purpose and idea, as he sat back in the chair and did nothing, thought of nothing—merely lit a cigarette and watched the smoke curling up in fantastic shapes and patterns. Sir Henry, on the other hand, had now become doubly alert. He leaned forward against his desk drumming with a pen handle on the blotting pad, or scratching the white surface of the paper into ridges of miniature mountains with his pen point. All this time Braithwaite was standing practically motionless, only his eyes were alive, and they were bright and eager. It was clear he was taking in the details of the situation with as much interest as his superior. After a time Sir Henry got up, thrust his hands into his trousers pockets, and began pacing the room. Then he became aware of Braithwaite's presence, and curtly dismissed him, adding at the same time, "You had better remain in your office, as I may want you again shortly."

As soon as the door clicked behind the young man Sir Henry turned to Charles. "I suppose you realise, Mr. Summers, that the situation is one of extreme delicacy? I think I shall have to be frank with you, and put the matter as plainly as I can. You are no doubt aware that matters with Germany are in a very unsettled state. It is in all the papers, and every man in the street is talking about it. But perhaps you are not aware that the situation is much more serious than the man in the street even dreams of. In fact, we are perilously near war. It may break out any moment, and I may add—in strict confidence, you understand—that the only reason why we are hesitating to break out into open hostilities

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is that the defences of England are in a chaotic state, and we are quite unprepared to resist any invasion, or even to take the defensive against such a formidable enemy as Germany. That is why the Cabinet is temporising, but we cannot do that much longer, so the only thing to be done is to increase our efficiency in the little time left to us. Of course you know that my department is in charge of the aerial defences, and has to organise everything connected with it. I need hardly say that my hands are more than full; for years things have been hampered for want of money, and now we have to make up arrears as fast as ever we can, so that you can understand that the loss of your invention is a very serious blow to us. I had been counting on it as the only possible means of getting anything like an aerial defence force equivalent to the enemy's. It is hopeless for us to attempt to build 'planes to equal those that Germany possesses. If we were to work for years we could not come up to their aerial strength, and the only hope was that your machine, being of an entirely different type from any that they possess, would make up in quality and prestige for our numerical deficiency; but now it seems that they have got hold of the plans, and it looks very much as though we are checkmated. I think I have got the whole facts of the case in my head, at least as far as I can see, but there are one or two questions I want to ask you. First tell me if you can the whole history of your invention, and how you worked it out. You have mentioned some foreigners. What have they to do with it? Tell me the whole story and try and call to mind *anybody* with whom you have either discussed the thing, or even shown the model."

Charles immediately related the whole history of the building of the airship, not forgetting the episode of the mishap, and as well as he could he described Dupont and Beulner and his acquaintanceship with them, but an instinctive sensibility made him omit Gwen from his account. When he mentioned her at all he spoke of her as "a friend," and took care not to divulge his relationship, but Sir Henry was an astute man, a man of the world, and moreover one born to be a detective. During Summers's recital he said nothing, but afterwards he put a few pertinent questions.

"But have you no copy of your plans?"

"No," said Summers, "I haven't. All I have is a few rough notes—at least, I call them rough, though they are pretty extensive. With careful supervision they could no doubt be worked up. You see I couldn't very well have the specification typed out, as I didn't want to let any outsider in the know, and I did not think it necessary to copy the whole thing out myself."

"Then how about the calculations? Have you all those worked out as well as the notes you speak of?"

"No," said Summers, "I haven't. I thought those were the most likely things to be stolen, or at least, if they were stolen they would be more useful than anything else to the thief, so I destroyed them as soon as I had finished with them. I didn't much like the idea of the old pedlar woman prowling round, and that put me on the *qui vive*, so I am afraid I shall have to work all those out again."

"But I suppose you have most of them fairly definitely in your head? It wouldn't take you very long to make them out again?"

"No," said Summers; "in that way it would be all right. I shouldn't forget anything of that kind."

"Didn't the consulting engineer whom you visited in Queen Victoria Street make many alterations in the paper?"

"No, not many, but those he did do were rather important. It was with regard to the equilibrium of the machine that he did the most, and I don't know whether I can remember them off-hand. I think I should have to consult him again."

After this there was another long silence, which Sir Henry was the first to break.

"Now, Mr. Summers, are you prepared to do all you can to help us? I think I can see a way out of the difficulty, but the extraordinary situation demands an extraordinary procedure; but, first of all, I want you to promise to do absolutely everything I tell you, and what is more important than anything else to ask no questions. But before I say anything more, I want your definite promise."

Of course Charles made the promise, and he was not one to go back on his word, but he little knew at the time how much his word of honour was to cost him.

"Then," said Sir Henry, "I can go ahead,

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and the first thing is—I do not want you to mention the loss of these papers to anyone—anyone at all—and"—with a pause—"not even to your best girl."

He gave a queer glance of scrutiny to Charles and leaned back in his chair to watch the effect. Taken off his guard, the young fellow flushed quickly and made as though he were going to speak, but instantly recovered himself, and thought the better of his intention, so said nothing.

"Also, Mr. Summers," said Sir Henry, quickly changing the subject, as soon as he had found out all he wanted to know, "if you have mentioned any anxiety about these papers, the best thing you can do is to dispel them as soon as you get home. You have got to tell a lie for once and make it clear to everyone that the papers have arrived safely, and that everything is satisfactory. Then, if there is anybody watching the turn of events they will be nonplussed, and we can go ahead. Another thing is, I want you to invite young Braithwaite to your house as a friend. Do you think it will be necessary to mention exactly who he is, or what his purpose is at home?"

Charles thought that it was not. He could introduce him at Sotheby as an old college chum, whom he had met by chance.

"And I want him to stay with you indefinitely. It's as well that you should have somebody besides yourself to keep an eye on the neighbourhood, and he will do very well as an amateur detective. He has been under me for a number of years, and I can put every confidence in him. As a matter of fact, I think you will find it some relief to have somebody like him to talk to. But what is most important of all, he can keep an eye on such busy-bodies as those pedlars, and see what happens behind your back."

Charles acquiesced, and Braithwaite was ordered to prepare to accompany Charles back to Sotheby that evening, and a telegram was sent off to the Vicarage to announce the forthcoming arrival of his newly found "friend." Gwen was at the station to meet them. She was eager to know the news, and Charles suffered a severe pang of self-reproach when he gave her the lie direct and told her that the papers had been found, and that everything was working smoothly. It went hard against the grain to have to do this, but he felt some solace in quoting Lovelace to himself as a conscience salve:

I could not love thee, dear, so much
Loved I not honour more.

Braithwaite was formally introduced to Miss Thrale, and made himself an agreeable companion. He had taken advantage of the train journey to give Charles some idea who and what he was, and already he had assumed the position of a chum. He came of an old Irish military stock. All his family had been soldiers. His father had been killed while he was still a lad in the Matabele war, and he had been brought up by his mother in a far-away corner of County Meath, where the old family house was situated. Parental influence had obtained a commission for him in the Army, and by diligent application to routine work and study he had gained promotion to a position in the War Office, where there was every prospect of his obtaining rapid advancement. He was a special protégé of Sir Henry, and with such a man to back him up there was no knowing what position he might some day occupy. He was by no means a book-worm or an office drudge. He had an aptitude for all kinds of sport, but more especially for horsemanship and billiards. This made him an acceptable member in the clubs, and a good family connection gave him his *entrée* into society. His manner was that of a man accustomed to move in good social circles. He was never embarrassed, always knew how to adapt himself to his surroundings, so that before the evening was out he was already quite at home at the vicarage. A game of bridge and a jolly chat quickly made him one of the family, and the succeeding days only served to strengthen this position. Of course, he was taken to Thrale Hall, and a game of billiards with old Mr. Thrale won that gentleman over completely, so that he was given a hearty welcome whenever he cared to avail himself of it. This was very often, for like any other young man in his position, he found life at Sotheby somewhat flat, especially when Charles was away at work, and perhaps it was not so much Charles's absence that made him seek entertainment at Thrale Hall as the fact of Gwen's presence there. Gwen and he found much in common to interest them, and as the latter aptly described it, they soon became

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"chummy." Often they would go for long rides over the Downs, and there is nothing like a brisk canter and the exhilarating influence of the strong air to make ardent enthusiasts yet more ardent and more enthusiastic, or to cause their companionship to assume the quality of friendship. This increasing *camaraderie* never troubled Charles. He was always glad to see Gwen enjoying herself, and he was much too sure of her affection to suffer any qualms of jealousy. Besides, jealousy was a thing foreign to his nature, so that he could well afford to look on with a rather parental and patronising air.

But to go back to Whitehall and the War Office. On the evening Charles left with Braithwaite for Sotheby Sir Henry Denver was very busy. His telephone was much in request. He had to excuse himself from a social event at which he was due to appear, and instead ring up several officers whose names were often on the public lips. When Sir Henry rang up his calls never passed unheeded, and as a result late that night a little party of high officials met together in his rooms at the War Office to discuss a matter of some urgency. When they were all assembled Sir Henry gave them a concise history of Summers's invention, and the details of the negotiations with the subsequent loss of the plans. Already he had pierced the obscurity and mystery which weighed like a nightmare on Summers's brain. He could account for the presence of the foreigners at Sotheby, and made a shrewd guess at the reason for the pedlar woman's presence within the precincts of the Sotheby Vicarage garden. He also guessed that it was no good trying to recover the lost papers. There was only one thing to be done—that was to get this new airship constructed in the shortest possible time, and before any foreign government could put the plan they had acquired into effect; and further, to run no risk of any future loss of specifications. So he laid his plans before this little committee.

"I have seen Mr. Summers, gentlemen," he said, "and I am thoroughly convinced that he is of too impracticable a nature to be allowed to work without careful supervision. His purpose is entirely honest—so honest, indeed, that he is likely as not to give away secrets without knowing that he has done so. Besides, he is perfectly without suspicion, and I think cannot be left to look after his own affairs by himself. He will, I gather, have to work out a great deal of these lost specifications again, and this may mean some experimental work with his airship. Now, his occupation is fairly well known in Sotheby and the neighbourhood, and there is no doubt—or, at least, it is quite possible—that he may be watched. We must avoid this and prevent any chance of his or our plans being frustrated once again. Another thing is—he must work without interference of any sort, and however well he may be inclined to do this, he cannot in his present circumstances be without interruptions. He has not told me directly, but I was able to gather from his conversation that he has a *fiancée*, or some particular friend in whom he is interested, and such outside influence must detract his attention to some degree, but we have not time to allow him this liberty, and I propose, gentlemen, that the best course to pursue will be to have him arrested. I suggest that he be detained in provisional imprisonment at a naval base, or at one of the Government wireless stations, where he will be given every facility for experimenting and completing his invention; or what would be a still better course, he should be enabled to build an airship after his own type on a full scale, and be given control of a wireless station so that the invention may be put into proper practice with as little delay as may be. There is no knowing how useful this invention is likely to prove, and it is my conviction from what I have been able to gather that it is of considerable moment and likely to revolutionise aerial warfare. You understand the gravity of the international situation at the present moment, and if you will give me your support to my scheme, I propose to communicate with Scotland Yard immediately so that my plan may be carried into effect."

One of the listeners objected that the plan was rather drastic, but Sir Henry replied that the situation compelled prompt measures. Another suggested that Summers should be apprised beforehand of what was likely to happen, but to this Sir Henry would not agree.

"No. I'm convinced that the young

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fellow is engaged, and I do not think him the sort of man to keep such knowledge to himself. I do not say that he would unwittingly blurt out about it, but he would show his dilemma by his looks and acts. The girl—for, as I say, there is a girl in the case—would soon guess something was up, and this is what I want to avoid. If *nobody* knows what is likely to happen there is no chance of the wrong person getting hold of the information, and I think for the sake of security all personal feelings must be sacrificed to the good of the community."

It was felt that Sir Henry was right in his contentions, and it was finally agreed that he should carry out his suggestions. Late that night, therefore, when his colleagues had departed Sir Henry had an interview with one of the heads at Scotland Yard, and the result was a warrant was issued on the person of Charles Summers, engineer, of Sotheby Vicarage, near Chittingham.

CHAPTER X.

"THE COURSE OF TRUE LOVE NEVER DID RUN SMOOTH."

There was no doubt about it. Braithwaite was infatuated with Gwen Thrale, and it was equally certain that for her part the young heiress of Thrale Hall was playing into his hands. Excuses can be made for either side. Gwen was certainly attractive, much too attractive to be the single star of the Sotheby firmament, for it gave her opportunities of making triumphs whenever the chance came her way. Therefore, when so desirable a victim as the clever young aide-de-camp came within reach of her fascination, she was too human, too much a daughter of Eve, to let the golden opportunity slip by. As for Braithwaite, what else could be expected of him than that he should succumb to her charms? Here was an energetic good-looking and smart young man foisted suddenly and by the caprice of fate into a perfect social wilderness as compared with the life he had been accustomed to lead: so the two became more and more "chummy," for Braithwaite had plenty of time on his hands to while away. His duties only occupied him for an hour or so in the mornings, and they seemed to consist chiefly in answering much lengthy correspondence which came to him from the War Office. What this correspondence contained not even Summers himself knew, and the aide-de-camp volunteered no information either by his words or actions, and he had been too well schooled in the game of diplomacy for even the most astute observer to read his face. As a matter of fact all the letters referred to Summers, and his own plan of action in the affair. As soon as matters were definitely settled he was informed of Summers' impending arrest, and he was warned against affording the victim any clue of what was likely to happen. Needless to say he obeyed instructions well. Summers was entirely oblivious of his impending fate. This was not so difficult as it would seem, for Braithwaite, as soon as business was settled, devoted himself entirely to his new sport: that was the ingratiating himself into the affections of a pretty and charming *ingénue.*

This increasing friendship did not remain unnoticed by the countryside, and exercised the united wits of all the village clubs and "charitable" institutions; even it became the subject of discussion at the weekly Dorcas parties, so that eventually, seasoned with gossip, it came to the ears of Miss Summers. It soon took on the proportions of a village scandal, until at last Miss Summers felt it her bounden duty to speak to her brother on the subject. His reception of the news was not very gratifying to her sense of duty and sisterly solicitude, for Charles appeared to take no notice of his sister's report. That might have been expected of him had the subject been one of casual importance, but when it was one which so nearly interested him his nonchalance was a little disconcerting. As a matter of fact his manner belied the true state of his feelings, for he had already noticed the growing intimacy, and his charitable disposition was a little disquieted. Now he felt it was time to raise a protest, but as he was wont to remark, he hated "having rows," so let the matter slide as long as it was possible. At length he was bound to acknowledge even to his loyal soul that things had become "too thick," for he soon found out that whenever he tried to arrange meetings with his *fiancée*, they were usually frustrated by some previously arranged plan; either she was going for a picnic, or Braithwaite was taking her to a dance, or such and such plan had been made without any reference to Charles's wishes or ideas.

(*To be continued.*)

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INSTRUCTION IN WIRELESS TELEGRAPHY

Wireless Telegraph Receivers (II.)

(Eighth Article.)

[The first article of this series appeared in the May number of THE WIRELESS WORLD, in which number there also appeared particulars of the examinations to be held when the course is completed, and full details of the prizes offered by the Marconi Company to successful candidates. A further announcement appeared on page 461 of the October number.]

UP to the present we have considered the action of the crystal to be purely one of rectifying the oscillatory currents induced across it into uni-directional currents.

58. The crystal can therefore be considered as a conductor offering a certain resistance to current passing through it in one direction, and offering an infinitely larger resistance to current trying to pass through it in the other direction.

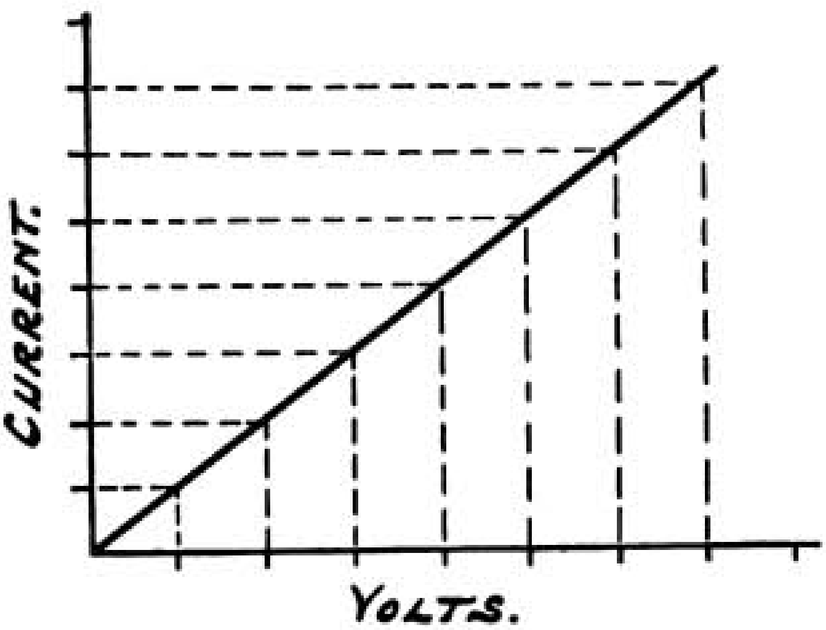

Fig. 1.

Its value as a **sensitive detector,** however, depends upon another property. Even in the direction of conductivity, it does not act in the same way as an ordinary conductor.

With an ordinary conductor the current passing through it increases directly as the voltage applied across it increases. Thus if we draw a "curve" illustrating the increase in the current which would flow through an ordinary conductor as the voltage across it is increased, this curve would take the form of a straight line, as shown in Fig. 1.

If, however, a curve be drawn illustrating the increase in the current passing through a crystal as the voltage across it is increased, it will take the form shown in Fig. 2. In this case it will be noticed that when the voltage is increased beyond the point "A," the current passing through it rises very much more rapidly than before in proportion to the increase in voltage across it.

This is due to the fact that the **effective resistance of the crystal does not remain constant,** but starts to decrease when the voltage across it is increased above a certain value.

By referring to this curve it will be seen that between the point "O" and "A" a certain increase in the voltage across the crystal produces a very small increase in the current passing through it, and thus through the telephones, whereas beyond the point "A" the same increase in the voltage across the crystal produces a large increase in the current passing through it.

To produce a sound in the telephones it is necessary that the current passing through them be increased, and the strength or loudness of that sound will depend upon the amount by which the current is increased.

It is obvious, therefore, that the voltage produced across the secondary coil of the jigger by the oscillatory currents will cause a greater increase in the current passing through the crystal and telephones if it be applied after the point "A" is reached. It is for this reason that a potentiometer is necessary in order to bring the initial voltage across the crystal up to the point "A."

59. Efficiency of Receivers.—In paragraph 57 of the article which appeared in the

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November issue of THE WIRELESS WORLD we mentioned the fact that the efficiency of the receiver depended on keeping the capacity of the secondary circuit as small as possible. The reason for this is that a given amount of energy will produce a greater increase in voltage across a small condenser than across a large condenser.

The energy stored up in a condenser depends upon the product of the amount of electricity with which it is charged, and the pressure at which it is charged.

Let us suppose that we have a certain amount of energy represented by, say, a cubic foot of water at a pressure of 1 lb. per square inch.

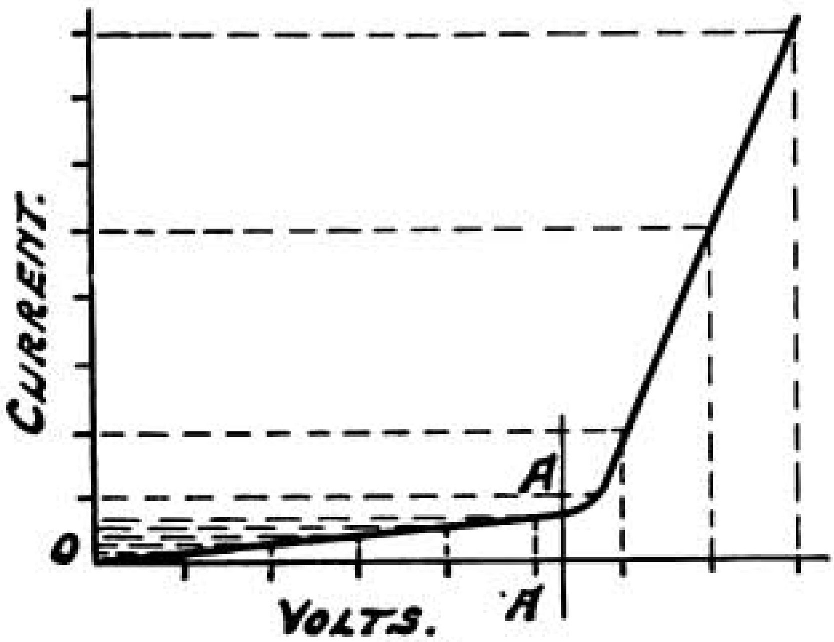

Fig. 2.

It is obvious that half a cubic foot of water at 2 lbs. per square inch will represent exactly the same amount of energy.

In paragraph 17 of the article in the May issue of THE WIRELESS WORLD, in describing the quality of "capacity," we likened a condenser to a football bladder.

So taking this analogy again, if we wish to store this energy in a football bladder we can do it either by forcing a smaller quantity of water, namely, half a cubic foot, into a football bladder of such a size that the walls of the bladder exert a pressure of 2 lbs. to the square inch on the water, or we can force the larger quantity of water, namely, one cubic foot, into a larger football bladder, so that the pressure on the water is only 1 lb. per square inch.

If we force more than half a cubic foot of water into the small bladder the pressure on the water will increase rapidly, as the amount of water forced into it is increased owing to the stretching of the bladder, so that the energy it holds will be increased in two ways: firstly, owing to the greater volume of water which it holds, and secondly, owing to the greater pressure which the bladder is exerting on the water.

It follows, therefore, that for a bladder of a given size, a given amount of energy will only charge it up to a certain pressure. It also follows that the smaller the size of the bladder the greater the pressure to which a given amount of energy will charge it. Thus it is easy to imagine a bladder so small and made of such thick rubber that it would exert a pressure of 100 lbs. per square inch on $\frac{1}{100}$th part of a cubic foot of water, yet it would still hold the same amount of energy as before, provided, of course, that the bladder were strong enough to withstand the pressure without bursting.

So it is with an electrical condenser. The smaller the capacity of the condenser, the higher the pressure or voltage to which it will be charged by a given amount of energy.

Now in our receiver the power in the circuit is a fixed quantity, depending upon the strength of the oscillations produced in the aerial, which are, in turn, induced into the secondary coil.

It is, therefore, obvious that the only way to increase the voltage across the condenser is to reduce the value of that condenser to a minimum.

In so reducing it we reduce also the wave-length of that circuit, and as it is necessary to keep this in tune with the wave-length which is being received, we must counterbalance the effect of reducing the capacity by increasing the inductance of the circuit. The extent to which we can do this, as already explained, is limited by the fact that every coil of wire has self-capacity, and as we increase the coil to get a greater inductance, so, at the same time, we increase its capacity. The rate at which we increase this self-capacity, however, can be controlled by the design of the coil—that is to say, by its diameter, its length, and the size of the wire with which it is wound.

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A question which will probably arise in the minds of those studying this explanation will be that, in describing the receiver, we said that the crystal was placed across the inductance, whereas in explaining the reason for keeping this inductance high, in proportion to the capacity, we take the point of view that we wished to increase the voltage across the capacity. This is only because it is easier to understand how the voltage must necessarily increase across the condenser if the value of that condenser is decreased, and, since in an oscillating circuit the condenser is connected across the inductance, it follows that the voltage across the inductance is likewise increased.

60. The Use of High Resistance Telephones.—So far we have not touched upon the construction of the telephone receivers.

The function of the telephone receivers, usually called "telephones" for short, is to convert the electrical currents into an audible sound.

It is, of course, of as much importance for this part of the apparatus to be efficient as any other, and in addition to its being made efficient it must be made suitable for the circuit to which it is applied.

A telephone-receiver consists essentially of an electro-magnet and a diaphragm.

The diaphragm is a circular piece of very thin sheet iron, supported all round its edge by the outer case or shell of the ear piece, as close to the face of the magnets as possible without actually coming in contact with it.

Fig. 3 shows diagrammatically a section of a telephone ear-piece where "A" is the iron core of the electro-magnet, B the coils of the electro-magnet, C the case or shell, and D the diaphragm.

Unlike an ordinary electro-magnet, the iron core of the telephone receiver is permanently magnetised.

It is evident then that the diaphragm "D" will normally be strained slightly towards the magnet, as shown by the full line D in Fig. 3.

As already mentioned, it is supported by the shell of the ear-piece all round its edge, but being thin and springy it will bulge in the middle towards the magnet.

61. The action of the telephone receiver is as follows: If a current is sent through the coils in such a direction that the lines of force set up by it assist those of the permanent magnet, the strength of the magnet will be increased and the diaphragm will be attracted still closer to the magnet, thus taking the position shown by the dotted line D_1.

If, on the other hand, a current is sent through the coil in the opposite direction, thus setting up lines of force opposing those of the permanent magnet, the strength of the magnet will be decreased and the diaphragm will be allowed to spring further away from the pole and take up the position shown by the dotted line D_2, owing to the fact that it has already been displaced out of its normal position due to the normal pull of the permanent magnet.

Owing to the form of the diaphragm it acts in just the same way as the head of a drum, and will produce a big sound with a comparatively small displacement of its centre.

Just as the noise produced by a drum will depend upon how hard it is hit by the drum

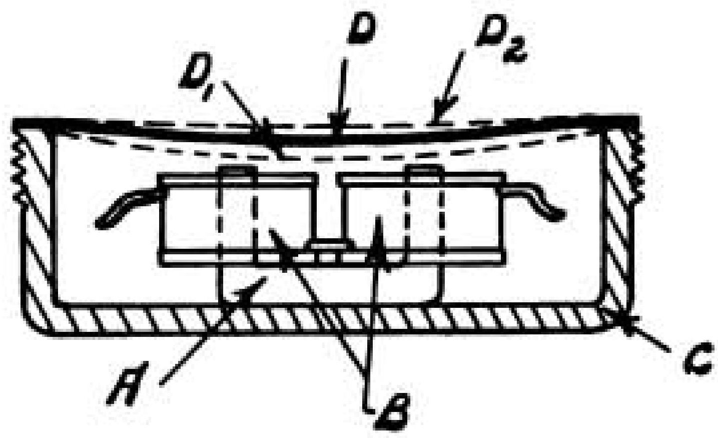

Fig. 3.

stick, so will the noise produced by the diaphragm depend upon the amount of increase or decrease in the magnetisation of the magnet.

It is obvious that the increase or decrease in the magnetism of the magnet will depend upon the magnetisation force or "**magneto-motive force**" which is applied to it.

62. The magneto-motive force depends upon two things: (1) the number of turns of wire which are encircling the magnet, and (2) the amount of current passing through them. The greater the number of turns and also the larger the current the greater will be the resulting magneto-motive force

We may say then that magneto motive force = amperes × by turns.

For a given size of magnet we have only a definite space into which to get our turns of

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wire, so that the only way of increasing the number of turns we can get on is to decrease the size of the wire. The thinner the wire the greater the number of turns which we will be able to get into the space at our disposal.

Unfortunately, however, as we reduce the size of the wire so do we increase the resistance per turn of that wire, and therefore decrease the amount of current which would pass through it for a given voltage. Therefore, unless the current at our disposal is already limited by some external resistances we shall not gain anything by increasing the number of turns if at the same time we increase the resistance of the coil.

If, however, the telephone is in a circuit in which there is already a high resistance, then the increase in the resistance of the coil will not have so great an effect on the total resistance of the circuit and therefore on the current which is passing through that circuit.

For an example, let us suppose that a coil wound with 10 turns of a certain size wire will have a resistance of 1 ohm, and let us suppose that the external resistance of the circuit is 99 ohms. The total resistance of the circuit is then 100 ohms. If our voltage across this circuit is 1 volt, then it follows that our current through this resistance will be $\frac{1}{100}$th part of an ampere, and our magnetomotive force will consequently equal

$$\frac{1}{100} \times 10 \text{ turns} = \frac{1}{10}.$$

Now let us wind the same coil with wire one-tenth the former size. It follows that we shall get 10 times the number of turns—that is to say, we shall get 100 turns of wire on to the coil, but our resistance per turn will be increased ten times.

The resistance per turn in the first coil was $\frac{1}{10}$th of an ohm, so that our resistance per turn will now be 1 ohm; therefore the resistance of the coil will be 100 ohms. Adding this to our external resistance we get a total resistance in the circuit of 199 ohms. Now for the same voltage, *i.e.*, 1 volt applied across this circuit, we shall get $\frac{1}{199}$th of an ampere, and our magnetomotive force will be:

$$100 \times \frac{1}{199} = \text{approx.} \tfrac{1}{2}.$$

It is obvious, therefore, that we have increased our magneto-motive force nearly five times by winding the coils with a finer-sized wire.

On examining the diagrams of connections of our wireless telegraph receiver, it will be seen that any current passing through the telephones will have to pass through the crystal.

The resistance of our crystal at its most sensitive point is somewhere in the neighbourhood of 10,000 ohms. It will, therefore, be obviously inefficient to wind the telephone receiver coils with such a sized wire that their resistance is only, say, 200 ohms if a finer wire is available.

In practice special telephones are made suitable for circuits with such external resistances. These telephones are wound with the very finest wire which it is possible to manufacture, in order to get the greatest possible number of turns on to the limited space of the bobbins.

Such telephones have a resistance of approximately 3,500 ohms per ear-piece, and two ear-pieces can be used, connected in series, thus making a total resistance of a pair of telephones about 7,000 ohms.

The point which must be clearly understood is that the object of using high resistance telephones is not because they have a high resistance, but because they are wound with a very much larger number of turns than the low resistance telephones, and therefore, owing to the high external resistance of the circuit the magneto-motive force is increased to a greater extent than it is decreased by the reduction of current passing through the circuit owing to the increase of resistance of that circuit.

At the annual meeting of the Gateshead and District Scouts' Association the Hon. Secretary, Mr. R. B. Hindmarsh, reported that a wireless telegraphy section had been formed—the first of its kind in the North—possessing two complete stations which were licensed by the Postmaster-General.

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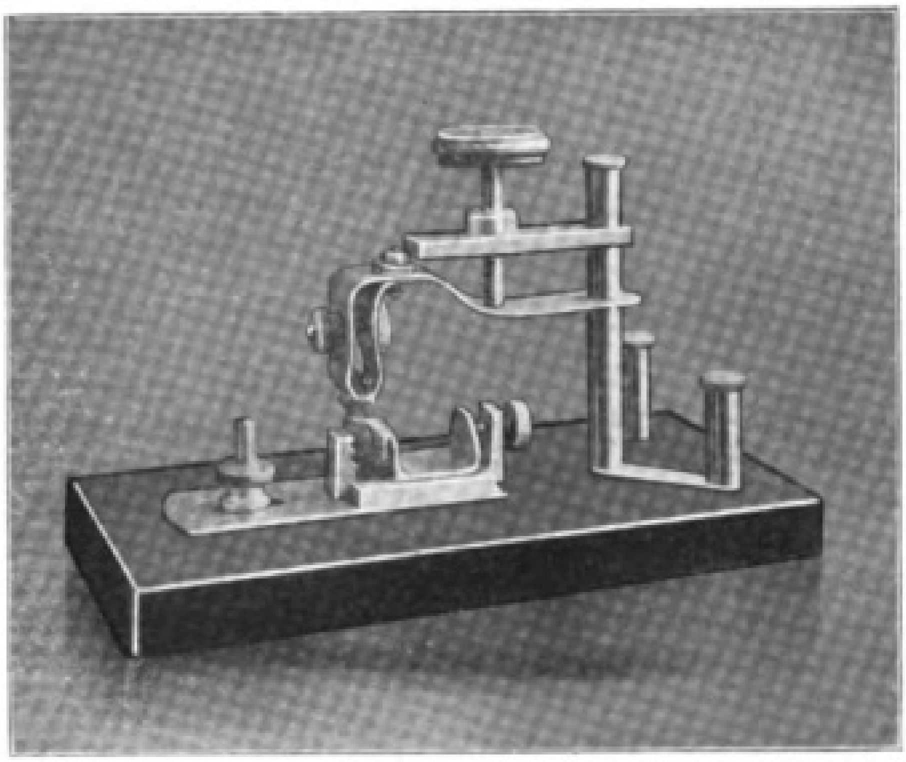
Practical Hints for Amateurs

A Crystal Detector Without Cups

By H. G. EADES



THE crystal detector usually found in an amateur installation is one which has the crystals sealed into brass cups with a metal of low melting point, such as Wood's metal.

The detector here described is home-made, does away entirely with cups, and may be said to have the following advantages :

(*a*) Avoids the troublesome operation of sealing-in.

(*b*) Different combinations of crystals can be used without providing new cups, and, what is more important,

(*c*) Allows *any* part of *either* crystal to be used at will.

The particular advantage of (*c*) will be appreciated by the amateur who knows the difficulty of finding the most sensitive portion of a crystal. Once sealed into a cup, the spot opposing the opposite crystal must always remain the same, whereas in the present arrangement to bring a new portion into play is the matter of a few seconds.

As will be seen from the illustration, the lower crystal is held in a small holder somewhat resembling a horizontal vice. This holder was made by the writer from an old binding screw clamp, the end of which forms one jaw of the vice ; the opposing jaw being made from a thick piece of brass soldered to a plate, which, with two guiding pieces, form the tunnel in which the arm of the holder moves. The end of this plate is turned up, and provides a stop for the tightening screw.

Teeth are filed into the faces of the jaws.

The base plate on which the holder is fixed is slotted, and will move in any direction, the binding screw to the left making fast when adjustment is complete.

The upper crystal is held in a sort of clip. This clip is a continuation of the spring brass arm attached to the supporting standard. Teeth are filed in the ends, and a binding screw holds the crystal quite securely.

The pressure adjustment is made by turning the milled vulcanite screw at the top. The base is of vulcanite.

It will be clear to the reader that the crystals can be rotated with the finger and thumb, by simply loosening either the jaws of the " vice " or the binding screw of the clip. In practice the detector works excellently. The writer has had no difficulty in getting adjustment with all kinds of crystals in the shortest possible time, and the fact that Oran is heard with an aerial only 70 feet long by 50 feet high is surely sufficient evidence of its sensitive nature.

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DESIGN OF A STATION

By J. Barton

THE station described in this article has been constructed by myself. It is designed on the loose-coupled tuning system, and the following specification, if read in conjunction with the illustrations, will enable other amateurs to construct a similar apparatus with equal success.

Fig. 1.—The Station and its Owner.

Fig. 1 shows a general view of the station (transmitting gear is not shown with the exception of Morse key and mercury break).

Fig. 2 shows the general arrangement and connections of the instruments. In this, A is the leading-in wire from the aerial; B is the wire leading to earth; C is the switch for shorting aerial to earth; D is the switch for connecting the aerial to instruments; E is the aerial and earth change-over switch from sending to receiving; F is the Morse sending key; G is the magnetic key, which causes the current supplying the coil to pass between mercury cups on Morse key being depressed, thus preventing the heavy current burning the contacts; H is the sending helix, composed of 10 turns of $\frac{1}{4}$-inch copper tubing on a 12-inch diameter frame; I is the spark coil for sending, giving 5-inch spark; J is the motor mercury break for spark coil; K is the starting switch and resistance for motor of mercury break; L is the spark-gap, provided with zinc electrodes—this part of apparatus is placed in centre of sending helix and is muffled, see Fig. 3; M is the high-tension condenser, consisting of 13 sheets of copper foil, 6 inches by 4 inches, interleaved with $\frac{1}{8}$-inch glass plates sealed in paraffin wax; N and O are a two-volt lamp to show when aerial is radiating properly, and switch for shorting same; P is the primary coil of loose-coupled tuner, wound with 50 turns, No. 18 s.w.g. enamelled copper wire on a wooden drum 7½ inches diameter; Q is the secondary coil of loose-coupled tuner, wound with 90 turns, No. 22 s.w.g. enamelled copper wire on a wooden drum 8½ inches diameter. This coil is provided with an overhead slide so that it can be slid away from the primary, and even tipped up, as shown in Fig. 1, an extreme loose coupling; R is the extra inductance, wound with 60 turns, No. 18 s.w.g. enamelled copper wire on a wooden drum 10 inches diameter; S is the change-over switch which enables variable condenser to be put in series or parallel with

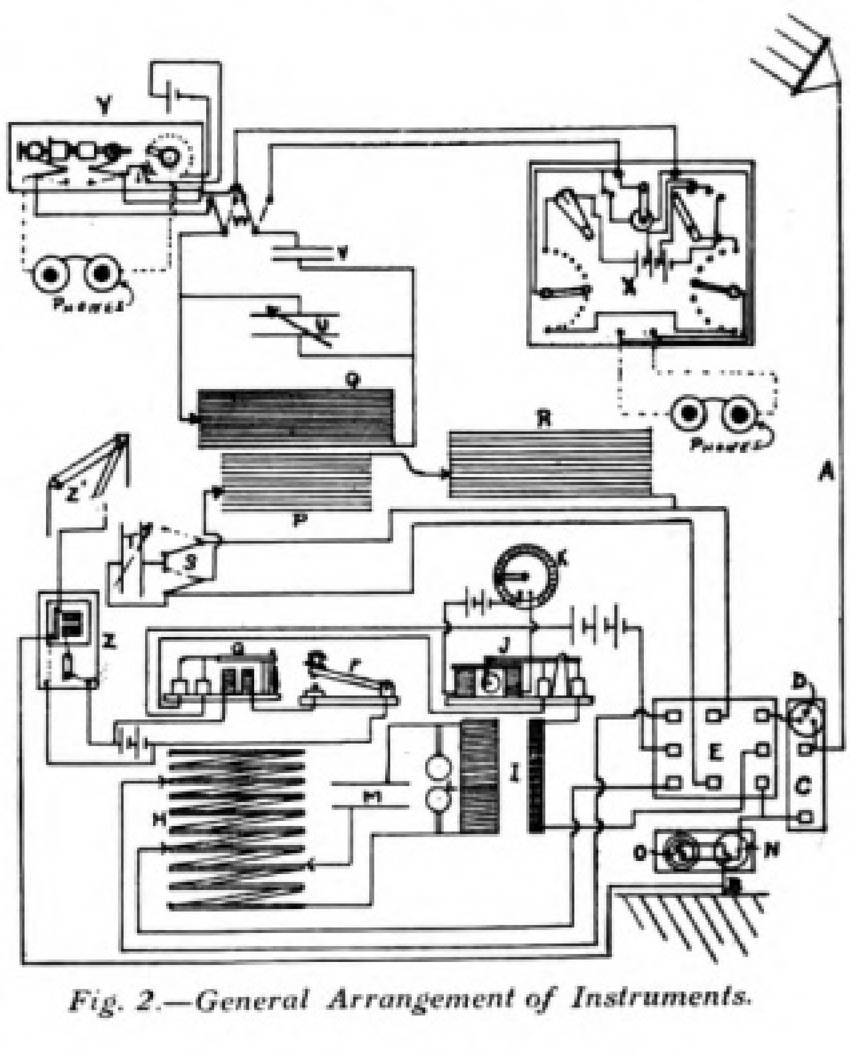

Fig. 2.—General Arrangement of Instruments.

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the primary and extra inductance. For receiving wave-lengths up to 600 metres it is put in series, and from 600 to 4,000 it is placed in parallel; T is the variable condenser for the primary circuit, consisting of 23 moving waves 7 inches diameter working in paraffin oil; U is the variable condenser for the secondary circuit, consisting of 7 moving vanes, 7 inches diameter, working in paraffin oil; V is the blocking condenser, consisting of 7 sheets of copper foil interleaved with waxed paper made in semi-variable, and sealed in paraffin wax; W is the change-over switch which enables either electrolytic or crystal detector to be used; X is the electrolytic detector, with double potentiometer, shunt and battery switches; Y is the crystal detector and potentiometer, which is made from design given in the WIRELESS WORLD, page 208, June issue, with the addition of a switch for cutting out

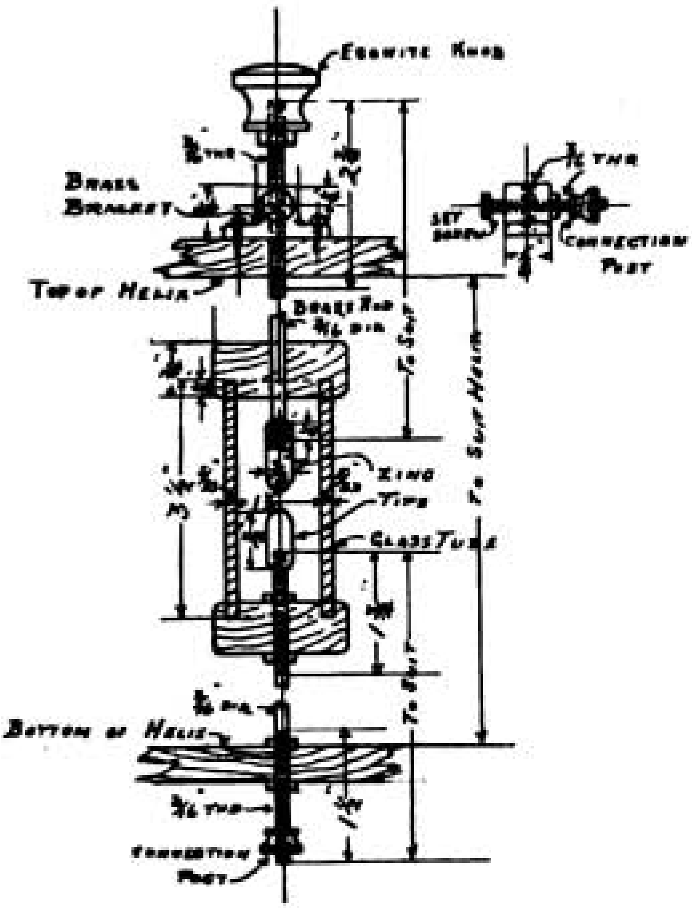

Fig. 3.—Spark Gap Muffler.

the battery when not in use to prevent its running down, and switches for open circuiting detector when transmitting—crystals used are zincite and bornite; Z is the buzzer and buzzer key; Z^1 is the buzzer aerial, which is made as model of outside aerial for appearance only—it can be seen in Fig. 1 ust below motor starting switch.

Occasionally the noise of the spark at the spark-gap is very annoying. Those who have a sending helix wound on a hollow wooden frame may overcome this annoyance by making a spark-gap muffler and placing it in the helix. The construction of same can be easily followed from Fig. 3, the

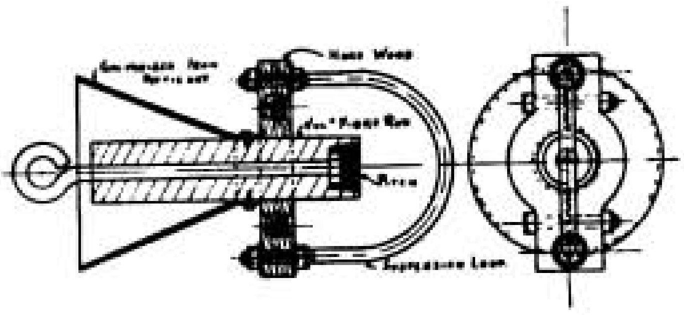

Fig. 4.—Aerial Insulator.

glass tube being 1¼ inches inside diameter, $\frac{5}{32}$ inches thick, and 3½ inches long.

A simple, yet reliable, aerial insulator for an amateur to construct is shown in Fig. 4. It consists of a vulcanised fibre rod with a small diameter hole bored through it, and a cup-like recess at one end. A metal rod runs through this hole, and a nut is placed on one end and rests in the cup; the cup is then filled in with pitch. The whole tube is clamped between two pieces of oak about 1 inch thick, to which the suspension loop is fastened. A galvanised iron petticoat may be attached to further lessen the possibility of leakage. I use three of these insulators at each end of my aerial, and they give perfect results. The aerial used in conjunction with this set of apparatus consists of two 12 s.w.g. aluminium bare wires, 85 feet long, suspended 6 feet apart, at a height of 45 feet above the ground.

The programme of lectures for the winter session of the Montreal Electrical Society includes a lecture by Mr. A. E. Reoch, of the Marconi Wireless Telegraph Company of Canada.

His Majesty King Albert of Belgium recently visited the stand of the Antwerp Telephone and Electrical Works at the Ghent Exhibition, and was greatly interested in the Marconi Wireless Telegraph Apparatus exhibited. His Majesty graciously accepted two knapsack stations for his sons, Leopold, Duke of Brabant, and Charles Theodore, Comte de Flandre.

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Wireless Time Signals

SO many watch and clock manufacturers, besides amateurs, now listen to the wireless time signals given from the Eiffel Tower, in Paris, that a possible decision of the Postmaster-General to impose a tax on so doing will cause widespread interest and possibly some resentment.

In a letter to Mr. F. Hope-Jones on the subject, Mr. E. W. Farnall, on behalf of the Postmaster-General, wrote on October 20th as follows :

"With reference to your letter of July 17th last and subsequent interviews on the subject of licences for the reception of time signals by wireless telegraphy, I am directed by the Postmaster-General to inform you that, although the conditions upon which such licences can be issued have not yet been definitely decided, it is probable that an annual royalty may be charged, in addition to the fee of £1 1s. already asked for in respect of the expenses involved in the issue of the licence. Licences cannot be issued until a decision is arrived at, but meanwhile applicants are being authorised to proceed with the installation of their apparatus, provided that they will make a deposit of £3 3s. (or £2 2s. if the fee of £1 1s. has already been paid), and will undertake to conform to the conditions of the licence when it is issued, or to dismantle their apparatus without delay should they find themselves unable to accept the conditions. The deposit will be refunded should they decide not to proceed with their application."

Mr. Hope-Jones replied that the watch and clock makers of other countries are freely permitted to listen to the international time signals, and any attempt to restrict their reception in this country would be detrimental to the science of accurate time measurement, and would put the British watch and clock makers at a disadvantage to their foreign competitors. He also pointed out that the international wireless time signals interfere in no way with the Post Office system of telegraphic time signals for the synchronisation of clocks.

Major E. H. Hills, F.R.S., in a letter which appeared in the *Times* on November 12th, appealed to the Postmaster-General "to hesitate before he attempts such a retrograde step." He adds :

"I need not here enter into the history of the establishment of this time service beyond saying that it is the outcome of an international conference held at Paris, that it has been welcomed by scientists, including the Astronomer Royal, and that it is in no sense competitive with the time service of the Royal Observatory, Greenwich.

"These signals will be of great value both to clock and watch makers and to astronomers and owners of observatories, while it is hoped by many that their use will be found so simple that an apparatus for receiving them will become part of the equipment of every village and of many country houses.

"Besides these utilitarian applications there is at present an inducement for boys of a scientific turn of mind, sixth form boys on the science side in schools and young electricians in technical colleges and universities, to construct apparatus for themselves and listen for these strong signals. Even some detachments of Boy Scouts have, I am told, little field apparatus. To impose an annual tax upon all receivers would, to a large extent, strangle the use of these signals as far as this country is concerned. I am not entitled to speak on the legal aspect, but it is at least doubtful whether an apparatus for receiving only is a 'wireless station' or 'installation' within the meaning of the Act of 1904.

"However this may be, it is a sound principle of legislation not to make laws or regulations which cannot be enforced. The receiving apparatus for strong signals is of so simple a nature that evasion of the tax would present little difficulty. Thus, in any case, it would probably be ultimately collected from only a small proportion of the users."

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AMATEUR NOTES.

"Words" over "Wireless."

OUR contemporary the *English Mechanic* has recently been holding in its correspondence columns some heated controversies on the subject of Wireless Telegraphy. We particularly like the severe tone of "Radio-Telegraphist," who writes: "In reply to 'W.N.' (letter 352), I regret to see he chooses to uphold a very obvious error. An inductance of 80 millihenries is about eight times too much for Clifden, and, so far as wireless waves are concerned, it is a practical impossibility. . . . The aerial inductance of a Marconi Multiple-Tuner designed to take Poldhu is only *four* millihenries." He ends with the caustic remark, "But perhaps 'W.N.' is a new reader." After this, we cannot help hoping that "W.N." will "get some of his own back."

In the first place, since the wave-length of Clifden is more than twice that of Poldhu, the aerial inductance required would be about four times that required for Poldhu; so that, even on "Radio-Telegraphist's" own showing, 80 millihenries could hardly be "eight times too much." If this were all, however, "Radio-Telegraphist" would appear to be nearer the mark than "W.N."

* * *

We have not seen the discussion from its beginning, but we gather that "W.N." was referring, not to aerial inductance, but to jigger-secondary inductance. The latter can in no way be compared with the former; for the aerial inductance is combined with the capacity of the aerial, while the jigger-secondary is combined with whatever variable capacity may be placed across it. Since the relation of this capacity to the inductance varies—for best results—with the nature of the crystal which is in use, it is impossible to say what is the best value for the inductance of the jigger-secondary. One thing, however, is certain: using high resistance crystals such as silicon or carborundum, an inductance of from 80 to 100 millihenries gives, for the reception of Clifden waves, a very suitable value for the capacity across it, and forms an excellent jigger-secondary.

Another interesting controversy, already far advanced it would seem, deals apparently with the working of certain wireless schools in the neighbourhood of London. We gather from the letter of "C.Q." that certain amateurs have been worried by interference caused by the learners at these schools transmitting too diligently. Indeed, "C.Q." goes so far as to state, with every appearance of responsibility, that "there is no doubt that the transmitting of these schools is a serious nuisance, and not to amateurs alone, and the matter can hardly remain where it is." It would appear that these schools are having the audacity to use the magnetic detector, instead of some of the innumerable crystal receivers, about which we receive every month so many questions as to the eccentricities of their behaviour. We rather gather that the frame of mind of those correspondents who are protesting against the conduct of these schools is this: "If I, by careful adjustment, can receive signals on my chalcopyrite-molybdenite crystal—quite five times out of ten—without missing more than a few words now and then when my crystal goes out of adjustment, why should there be any need for anyone else to use the magnetic detector, which is undoubtedly less sensitive, and therefore requires stronger signals which interfere with my experimenting?"

* * *

No readers of THE WIRELESS WORLD can think for a moment that we do not appreciate the importance of the Amateur; nevertheless, we cannot come across such an attitude as this without making an earnest comment. The learners, whose practice in the duties of commercial wireless appears to be interfering with the experiments of these correspondents, are taking up wireless seriously as a profession; in a short time, perhaps, they will be in charge of the wireless plant of some big liner, and on their efficiency and nerve and self-forgetfulness may depend the lives of hundreds. Have not they, then, a thousand times the prior claim on the ether? Is it "good form"—to say the least of it—for an amateur who is often merely amusing himself in his spare time to try to "put his spoke in their wheel"? Or—looking at it in a lighter spirit—is it not rather like the old Major who has missed his putt and, pointing furiously to the far

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horizon, exclaims furiously, "How the —— can one be expected to putt with those —— ships sailing up and down?"

* * *

We have no doubt that those who are responsible for the schools in question are quite capable of defending themselves; we have no intention of taking up cudgels on their behalf, but we feel prompted to give our opinion on the controversy, as it strikes us. Leaving aside for the moment all questions of ethics and dealing only with hard facts, it seems to us that "C.Q." has not a leg to stand on. One thing is certain: if these schools are transmitting with "40 to 50 watts antenna energy," they have obtained a licence from the Postmaster-General to use that amount of energy; that is to say, they have convinced the Postmaster-General and his experts that the use of such power is justifiable. In spite, therefore, of "C.Q.'s" remark that "the matter can hardly remain where it is," there seems every possibility of it remaining where it is unless "C.Q." can convince the Postmaster-General that his decision was wrong. And as a first step towards doing this, "C.Q." must be in a position to show that he realises the difference between what is necessary for experimental "reception," and what is necessary for commercial wireless, where the missing of a single word may render a message valueless, and might—in the extreme cases which have to be allowed for by those who devote their lives to the cold science—render a call for aid entirely fruitless. If "C.Q." points to a receiver which has saved a tithe of the number of lives which the magnetic detector has saved—in spite of the fact that it does not claim to be so sensitive as the other receivers of the Marconi Company, or as the "freak" crystal receivers which offer such attractions for experimental work—he would at least be doing something to justify the patronising tone which he employs towards the most superbly reliable instrument in use in "Wireless."

* * *

An interesting fact, concerning which "C.Q." is in all probability ignorant, is that in cases of shipwreck it is often necessary to use what is called the "Emergency Set," which sends out the call for help in powerful, highly-damped waves, well calculated to arrest the attention of every ship within a large radius; and for the reception of such waves the magnetic detector is particularly well adapted, apart from the fact that it would be in perfect working order after a shock, which would put every crystal-receiver ever conceived out of adjustment, and might shatter even the highly-perfected Marconi valve-receivers.

It is being proposed to form a wireless club in the Potteries, to be called the Stoke-on-Trent Wireless Club. All those interested and desiring to join the above club should forward their names and addresses to Mr. F. Pamment, 349, Florence Terrace, The Meir, Longton, Staffs.

* * *

A Wireless Association has been formed at Bristol, and the secretaries are Mr. K. W. Cox, of 16, Edgecumbe Road, Redland, and Mr. N. M. Driver, of 13, Claremont Road, Bishopston, Bristol. At a meeting held on November 15th, over which the Rev. W. P. Digby presided, it was announced that some interesting papers would be read during the ensuing session.

* * *

A meeting was held recently in Leeds, at 22, Blenheim Terrace, Woodhouse Lane, by a number of telegraphists, electricians, etc., who are interested in wireless telegraphy, whereat it was decided to form a club called "The Leeds and District Wireless Club." Office bearers were elected as follows:—J. R. Cyril Hillman, C.E., President; J. W. O. Donohoe, Treasurer; A. M. Bage, Hon. Secretary, 4, Warwick Place, Leeds.

* * *

The Derby Wireless Club and Derby Society of Model Engineers are holding a joint exhibition on wireless apparatus, working models, etc., in the Mechanics' Institute, Derby, on Wednesday, December 3rd, which will be open from 4 to 10 p.m., and the respective organisations will welcome the presence of amateurs from other towns.

Other Club Notes are unavoidably held over.

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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.

L. D. L. (Macclesfield).—My aerial has a natural wave-length of about 400 metres and I wish to shorten it to transmit on a 300 metre wave. Can this be done by inserting a variable condenser instead of a variable inductance in the open or aerial circuit.

Answer.—Yes; it is necessary to reduce the capacity of the aerial by putting another condenser in series with it; it need not necessarily be a variable one—a variable condenser which will stand the voltages of transmission would be a difficult thing to make. You could build up a fixed condenser of glass and zinc plates, making it once and for all of the right value to tune the aerial and jigger-secondary to the right wave. The introduction of this condenser means that your aerial will normally be insulated from earth, so that for protection from lightning you should have a short-circuiting plug which you can put in at any time. If you are devoting yourself to the 300 metre wave communication, it would pay you to reduce your aerial till it gave the right wave; but we suppose you wish to keep it at its full length for long-distance reception.

E. A. E. (Lymm).—My twin-wire aerial gives a natural wave-length of about 300 metres. As I am only allowed a 200 metre wave for transmitting how I am to use 200 metres without altering my aerial? I also want to receive on 200 metres without dimming signals in any way. Will you also give dimensions for a transmitting jigger to use with a ½ inch spark coil with the above aerial (poles 150 feet apart, average height of horizontal portion 40 feet, lead-in of 40 feet from one end.)

Answer.—If you are going to use your aerial entirely for the 200 metre communication, it will pay you to shorten the aerial length—by introducing a suitable length of rope at the lower mast—until it gives you the 200 metres when put in series with your transmitting jigger-primary. If you want to use it also for long-wave reception, and therefore wish to keep it at its maximum length, you will have to reduce its capacity by putting a condenser in series with it, both for transmission and reception. If you have a wave-metre, this is not a very difficult job, but it is better to avoid it if possible as it interferes to some extent with the efficiency. As for your transmitting jigger, the particulars of this depend on the particulars of your coil. You want to make your transmitting condenser of as large capacity as possible without reducing your spark too much, say, not below 1 mm. Therefore the size of your condenser cannot be fixed until you know the capabilities of your coil—the fact that it is a ½ inch spark coil does not specify its qualities sufficiently. Until the capacity of your condenser is fixed, you cannot say what the inductance of your jigger-primary should be in order to give you the 200 metre wave. Find out what inductance you want and then design your primary accordingly; and proportion your secondary to fit this. A usual ratio for the number of turns in secondary to number in primary is 7 to 1. A 4 inch diameter former would probably suit you for the secondary.

W. B. (Cheltenham) asks for the design of an aerial. He is able to have a 40 foot pole with a short lead-in as he is hemmed in by houses.

Answer.—Could you not make use of a chimney or two belonging to your neighbours' houses? If so, try and get some form of T aerial; but the cross of the T need not be exactly in a straight line. Run up two wires from your receiving-room to a light spreader (say 5 feet long) at the top of your mast, and from the spreader carry them, still parallel to each other, to another spreader fastened to a chimney, if possible. This gives you the upright of the T and one-half of the cross; the other half is provided by two more wires from the same spreader, in electrical connection with the first half, taken to another spreader fastened to another chimney, somewhere opposite to the first. Or you can simplify matters by using a single-wire T instead of the "twin" described above. Take care to keep each half of the cross of the T equal in length. In the case of the "twin," the wires should not be joined at the far ends. Insulate the aerial at every point of suspension. Make sure you have a good earth and never leave your aerial un-earthed. If you cannot use the chimneys you must bring the ends of the cross to light lines fastened to pegs in the ground, but do not bring the ends of the cross too near the ground. You might also try a simple vertical aerial of the "sausage" shape, say 5 equal wires disposed round three child's wooden hoops.

It is necessary to obtain the Postmaster-General's licence for a receiving station.

J.A. (Aberdeen) proposes to instal a receiving station and asks for information regarding tuning coils and 'phones. He can get an aerial at an average height of 50 feet, length 80 to 100 feet, two wires 24 inches apart, the earth wire being connected to water pipe.

Answer.—You could get quite good results with a two-slide coil, no variable condenser, only a fixed condenser (or better a condenser which can be varied in two or three steps) and the aerial earth and telephones which you mention. You would get better results, greater selectivity for instance, with three sliders, variable condensers and a more complicated circuit generally.

F. H. T. (Eastleigh).—(1) I want to use an ordinary telephone receiver about 500 ohms resistance. Can I connect a 500 ohm resistance coil across the terminals of the 'phone; if so, would this answer the same as rewinding the coil in the receiver to 1,000 ohms? (2) Should the connecting wires between instruments and earth plate be insulated? (3) I have a tuning coil primary 5¾ inches diameter by 10½ inches long, and secondary 4¾ inches diameter by 9 inches long, wound with No. 22 S W G: D C C wire; secondary sliding inside of primary. Using an aerial 40 feet long by 40 feet high, what stations ought I to "pick up"?

Answer.—No. See reply to H. C. B. (No. 3) in this issue. (2) Not important; it is as well to insulate them till they are clear of the receiving table. (3) So far as the inductance of your primary coil is concerned you ought to be able to tune to all stations up to 3,000 metres wave. You can make the secondary tune to anything by putting a suitable small variable condenser across it.

W. J. B. (Tipton).—Sorry, but we feel inclined to refer you to our Irresponsible Expert's reply to N. Parker (Lowestoft) in the November number. Seriously, yours is not a suitable question for these pages.

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F. G. L. (Newbury) has been coming up against the phenomenon that his wireless transmission gets received —unintentionally—on neighbouring telephone-circuits, and he is puzzled to explain this because he believes "it requires a rectifying detector to make alternating currents work a telephone, and there is certainly nothing of the kind in the ordinary telephone." As it stands, this statement is not at all correct; alternating currents will work a telephone admirably; in fact, they are just what a telephone likes; it is only when they become so rapid as to be really "high-frequency" or oscillating currents that they fail to affect the telephone, partly because the impedance of the coils is too great to allow them to pass, partly because the diaphragm cannot keep up with them, and partly because the ear cannot hear so high a note. F. G. L.'s waves, which he sends out to his other station, are certainly high-frequency; but if he is using "plain aerial" (see Instructional Articles, or Year-Book Glossary) he is charging up his aerial to a certain high voltage every time his coil-trembler breaks contact—which is just a suitable number of times per second to suit a telephone—and his aerial is inducing a corresponding effect on the telephone wires below it. It is not radiation, but induction, which the telephone circuits are picking up in this case. But this is not the only way in which wireless signals can affect an ordinary telephone-circuit. Practically every telephone instrument comprises a receiver and a microphone-transmitter. The carbon granules of the latter are quite capable of acting as coherers, and would thus be affected by the true high-frequency currents picked up by the telephone wires from the energy radiated from a wireless aerial, letting the current from the telephone-batteries through the receiver just as the vibrations caused by the voice let it through.

H. C. B. (Norwich).—(1) Does the crystal detector act as a valve to the oscillating electricity? (2) Why is it that a battery has to be used with some detectors? Is it because the crystals have no rectifying effect unless a small current is passing through them? (3) Why must the 'phones have such a high resistance? (4) What is the effect of damping the oscillations in the transmitting circuit? Does this affect the range of the station? Why does it not matter having the oscillations in the receiving circuits highly damped?

Answer.—Far too many questions at once. We can only reply to the first four in this number.

(1) It is rather that the crystal acts as a valve allowing one-half of the wave to pass and charge up the condenser, but refuses to allow the following half—which is, of course, in the contrary direction—to pass and neutralise the effect of the first half.

(2) This "rectifying" effect of the crystal is due to the fact that its current-voltage curve is not a straight line (as it would be if it obeyed Ohm's Law) but a curve with a sharp bend in it. To obtain the most sensitive effects we must work the crystal at this bend, and, as in the case of many crystals—most carborundum crystals, for example—the bend comes some little way away from the point of zero voltage, we must apply a carefully regulated constant voltage so that the signals may have a "start," as it were, as far as the bend of the curve.

(3) The actual resistance of the 'phones affords no advantage, but rather a disadvantage. It is merely the custom to speak of 'phones being "high-resistance" when we mean that their coils have a large number of turns (which means great sensitivity for small currents) because a large number of turns in a small space implies fine wire and high resistance. This point does not seem to be at all well understood; we have known people deliberately wind their telephones with resistance-wire so as to obtain the high resistance.

(4) It means less waves in each wave-train and therefore less cumulative effect in the receiving circuits: which leads to flat tuning and loss of selectivity. See article on "Syntony" in the Year-Book for 1913.

E. R. Fr. W. (Leeds).—The effect of the method of construction of the Quenched Gap is to restore the non-conducting character of the gap the first time the closed circuit comes to rest, and thus leave the radiating circuit to oscillate in its own period. How would it be possible to take photographs in both circuits to determine whether this is so?

Answer.—Rather too intricate a matter to deal with fully in these columns. The best method is to use a very special form of vacuum tube in which alternating or oscillating currents produce a glow, the actual length of which is proportional to the current passing. This tube would be placed across the condenser of the oscillating circuit, and the glow viewed or photographed after reflection in a rapidly rotating mirror.

There are various complications, such as the necessity for timing the mirror revolutions to suit the discharge-frequency; the whole process is tolerably simple for very long waves with their consequent low frequency, but becomes very difficult with short waves.

W. I. (Watford).—I notice in your October number, in your reply to R. J. H. B., you say, "the free ends should not be joined together as you show them." This is my difficulty. Some books say that the ends should be open, and some clearly indicate them joined. Will you kindly tell me whether my antenna is correctly made? It seems to work well, but possibly might work better.

Answer.—You give the length of your aerial in your sketch, but do not mention the width; from the drawing it would appear almost square. If this, by any chance, is the case, the whole arrangement as you have it resembles an elevated capacity (like a Lodge aerial) more than an ordinary aerial, and probably the fact that the down-lead comes off quite unsymmetrically from one corner would have no serious effect; similarly with the fact that the ends are joined. But if this square effect is only a mistake in the sketch, and your aerial is an ordinary one, very long in comparison with its breadth, then you should certainly leave the far ends free and take care that the length from each free end to the receiving apparatus is exactly the same; preferably all the wires should remain insulated from each other until they join to enter the receiving-room.

BAFFLED.—In my private installation I have a transmitting jigger of the following dimensions: Primary: 4 turns, ¼ inch copper pipe, 6½ inches diameter, turns 2 inches apart. Secondary: 7 turns, 5½ inches in diameter, No. 16 gauge copper wire, turns ½ inch apart. I find that on charging a ·075 mfd. condenser with a 10-inch spark coil, and discharging through primary, I get no effect whatever in the secondary circuit. The primary circuit has been carefully tuned to 300 metres, and also the secondary, but when the two are coupled together I get no effect in the wavemeter, a Marconi portable. Can you tell me my error or offer any advice for its improvement?

Answer.—It is almost impossible for us to deduce what is happening unless you send us a diagram of connections. Your description of your method of procedure might be read in so many ways. You "charge up a ·075 mfd. condenser with a 10-inch spark coil" and "discharge it through primary." It is to be presumed that this means the ordinary discharge through a spark-gap, but no spark-gap is mentioned. If the gap has been omitted you naturally would not get any effect in the secondary. But we can hardly think that this is the solution. At the same time, we should like to know something about the nature and length of the gap. But what is even more puzzling is the combination you give of a ·075 mfd. condenser and a 4-turn primary, 6½ inches diameter, to give a 300 metre wave. With such a condenser the inductance necessary to give 300 metres would be about one-third of a microhenry, and we should say your primary—apart from leads to spark-gap, etc.—would be about 1¼ microhenry. So we do not see how your primary circuit can be accurately tuned up to 300 metres.

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Catalogue of Books on Wireless Telegraphy

ASHLEY.—*Wireless Telegraphy and Telephony (including Wireless on Aeroplane and Airship).* By Chas. G. Ashley, E.E. Treating in a simple, concise manner on the earlier forms of wireless, electrical waves, development of radio-telegraphy, radio-telegraphic apparatus, and describing the systems of radio-telegraphy. Contains 144 pp. 4s. 6d. net.

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HAWKHEAD.—*Handbook of Technical Instruction for Wireless Telegraphists.* By J. C. Hawkhead. 294 pp., 249 illustrations and diagrams. 3s. 6d. [This is the latest book published on the subject of wireless telegraphy. It is a sound and trustworthy guide through a course of instruction on wireless telegraphy, which should enable the diligent reader to qualify for the Postmaster-General's certificate.]

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The above and other electrical books, English and foreign, can be obtained at the published prices from the Marconi Press Agency, Marconi House, Strand, London, W.C., on receipt of remittance to cover cost of postage. On orders amounting in value to £1 and over the books will be sent carriage paid in the United Kingdom.

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Patent Record.

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

No. 20,521. September 11th. Arthur B. Williams and Wm. A. Solomon. Rotary interrupters or contact breakers, and similar devices for, in connection with wireless telegraphy and like installations for analogous purposes.

No. 20,798. September 15th. Marius Paul Otto. Process and apparatus for establishing synchronisation by means of electric waves.

No. 20,806. September 15th. Frederick Miller. Apparatus for the production and radiation of electrical oscillations.

No. 20,937. September 16th. William H. Wilson. Production of high tension discharges.

No. 21,212. September 19th. Marius Paul Otto. Apparatus for manœuvring at a distance marine or aerial torpedoes or other engines.

No. 21,672. September 25th. Marconi's Wireless Telegraph Co., Ltd., and Richard N. Vyvyan. Improvements in the connections of electrical condensers.

No. 21,732. September 26th. John R. Pickford. Microphones, transmitters, detectors, and the like.

No. 22,220. October 2nd. Arthur B. Williams and Wm. A. Solomon. Electro-magnetic relay for use in connection with wireless telegraphic installations and for other purposes.

No. 22,437. October 6th. Frederick J. Chambers. Radiotelephony.

No. 22,537. October 6th. John G. Balsillie. Wireless Telegraph transmitters.

No. 23,113. October 13th. Henri Abraham. Receivers adapted for wireless telegraphy.

No. 23,340. October 15th. Marconi's Wireless Telegraph Co., Ltd., and C. P. Ryan. Means for operating gas valves from a distance.

No. 23,557. October 17th. Marconi's Wireless Telegraph Co., Ltd. and C. S. Franklin. High-frequency alternators.

No. 23,728. October 20th. Signal Gesellschaft, M.B.H. Radiating system for signalling by electric waves from aeroplanes.

No. 24,148. October 24th. Marconi's Wireless Telegraph Co., Ltd., and A. Gray. Masts.

No. 25,085. November 3rd. Thomas D. Smith. Telescopic radio-telegraphic masts.

No. 25,434. November 7th. Frank P. W. Allen. Wave detector for wireless telegraphy and telephony.

No. 25,612. November 8th. Ivor Scott Winby and Reginald Garrett. Wireless telegraphy.

Personal Items.

Sir William Crookes, O.M., has been elected President of the Royal Society.

Capt. P. B. Coulston and Lieut. W. Bottomley, Western Wireless Signal Company, Royal Engineers (T.F.) have resigned their commissions.

Mr. W. Llewellyn Preece, who recently underwent a serious operation, is, we are glad to state, making satisfactory progress.

Capt. A. M. Deacon, R.M.L.I., has been appointed to the *Impregnable* as Instructor of Wireless Telegraphy and for command of Royal Marine Detachment.

Mr. Herbert B. Tilley, A.M.I.E.E., of Marconi's Wireless Telegraph Co., Ltd., Chelmsford, was married recently at the Wesleyan Chapel there to Miss Winifred Norris, daughter of Mr. and Mrs. J. A. Norris, Mount Pleasant, Chelmsford. Mr. Tilley was for a number of years connected with Messrs. Bruce Peebles & Co., Ltd., of Edinburgh. Among the many presents received were a clock from "old friends" at Bruce Peebles, table silver from the employees of Messrs. Christy & Norris, Chelmsford, and also presents from the staff of the Marconi Company. A unique notification of the wedding was the hoisting of a Union Jack to the top of one of the high Marconi poles (500 feet) immediately after the ceremony.

Obituary.

Sir Robert Hunter died on November 6th at Haslemere in his 69th year. For over thirty years he was solicitor to the Post Office, and in his official position he came in contact with the negotiations in connection with the Imperial Wireless Scheme.

We regret to record the death of P. L. Brownfield, an operator in the service of the Marconi International Marine Communication Co., Ltd. Mr. Brownfield at the time of his death was operator in charge of the s.s. *Letitia*, and he became ill with typhoid fever on a recent voyage, and on arrival of the vessel at Montreal he was taken to the General Hospital in that city where he died some days later. During his illness on board the s.s. *Letitia* Mr. Brownfield was well looked after by Captain McNeill and other officers of the vessel. Mr. Brownfield was in his twenty-fourth year. He joined the Marconi company as a learner in March, 1910, and he served on several other vessels before taking up his duties on the *Letitia*. Prior to joining the company's service he was employed as a telegraphist in the Central Telegraph Office, London. He received his training at the British School of Telegraphy. Mr. Brownfield was a popular officer, and his early death is deeply regretted by his many friends and acquaintances among the operating staff. He was buried at Montreal on October 17th. Every ship in port was advised by Captain Gillis, and practically every ship was represented at the funeral by its Marconi operator. It was gratifying that the Marconi operators responded so readily to the call, and at least twelve men in uniform were present with Mr. J. H. Lauer, general manager of the Canadian Marconi Company office staff. The casket was covered by the Union Jack and two beautiful wreaths, one of which was sent by the staff of the Canadian Marconi Company.

Horace Toon, who was employed in the Transfer Department of Marconi's Wireless Telegraph Company, died on October 23rd. Although deceased has not been long associated with the company, his engaging personality endeared him to all with whom he came in contact, and by whom his early death is deeply regretted.

An electrician employed at the Arlington government station, U.S.A., O. L. Clark, died recently as the result of injuries received when he fell against the sparkgap disc, making 1,250 revolutions a minute. Clark was alone in the room. The power had just been closed down, but there was enough current from the disc to inflict fatal injuries. The operator was a man of several years' experience.

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