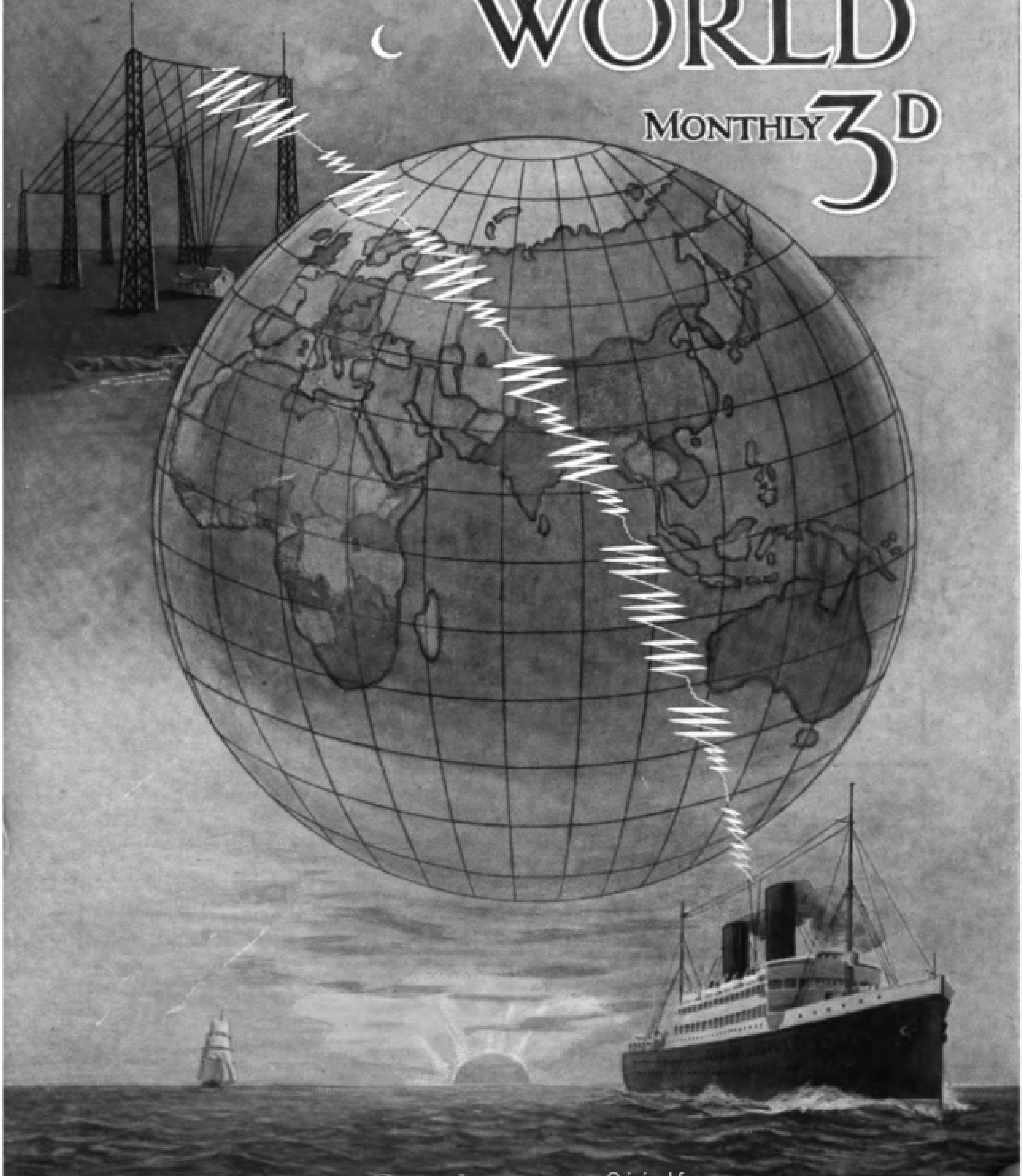
WIRELESS WORLD

MONTHLY 3D



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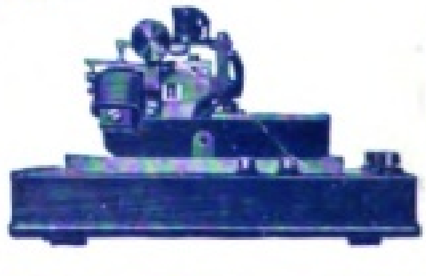

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The Wireless World.

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

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THE WIRELESS WORLD
with which is incorporated
The MARCONIGRAPH

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Paths of Progress

THE announcement that the Postmaster-General has consented to a licence being granted to Marconi's Poldhu station for the purpose of conducting a commercial wireless telegraph service between England and Spain is itself of sufficient importance to mark the past month as an epoch-making one in the annals of wireless telegraphy. But it is not the only noteworthy event; for in the announcement that the next British Antarctic Expedition will be equipped with a wireless telegraph station, and in the record of the part which wireless telegraphy has played in saving life and shipping, the New Year may truly be said to have opened with abundant evidence of progress and of the realisation of mankind's debt to Mr. Marconi.

If the opening of a direct Anglo-Spanish Commercial Wireless Telegraph Service does not fire the public imagination to the same extent as does the more spectacular and dramatic incidents already referred to, it is probably due to the fact that the public are already familiar with Mr. Marconi's remarkable long-distance achievements, of which the working of a regular Transatlantic service is only one example. But there is no gainsaying the importance of this new development, which is calculated to offer many far-reaching benefits. The arrangements are in hand to open this service to the public, and we hope to publish full particulars in our next issue.

If this development illustrates the great advantages which Mr. Marconi's scientific invention has conferred upon the commercial world, the use which is to be made of wireless telegraphy in the next Polar expedition shows what advantages are offered in other fields of human activity. As we point out in an article which appears elsewhere in this issue, wireless has been used by Dr. Mawson in the expedition in which he is at present engaged. In October next Sir Ernest Shackleton will make a start from Buenos Aires with the object of crossing the Antarctic Continent from the Weddell Sea to the Ross Sea, a distance of 1,700 miles, passing the Pole on the way and settling, in particular, two moot geographical points with regard to the extent of the Great Polar plateau and the Victoria chain of mountains. With him he will take a wireless telegraph station having a range of about 500 miles. As far as we at present understand, it is not Sir Ernest's intention to use wireless telegraphy on his ships, but there is no doubt it will be a valuable resource to the sledge party in enabling them to communicate, if necessary, with their base. If there is a breakdown, or if he has to return, he will thus be able to get a party sent out to meet him.

It is unnecessary to make more than a passing mention here of the part which wireless telegraphy has played in the saving of life during the storms of the past month. One striking example stands out, however. It is that of the R.M.S. *Cobequid*, which went ashore on the Trinity Ledges in the Bay of Fundy. If the vessel had been unable to send out its appeals for help far and wide the fate of all on board would have been inevitable, for, even as it was, it was not easy to find the wreck in the midst of the wintry storm in a bay where the rise and fall of the tide is greater, perhaps, than in any other part of the world, amounting to between 60 and 70 feet. But for wireless it is undeniable that the situation would have been a hopeless one.

SENOR A. MARIA DA SILVA

Personalities in the Wireless World

SEÑOR A. MARIA DA SILVA

Administrator-General of Posts and Telegraphs in Portugal.

ENGLISHMEN are, as a whole, liberal-minded, and this characteristic shines out most conspicuously in the diplomatic relationships of England with other nations. England has throughout her national existence been noted for her generous attitude and her willingness to give assistance to all those who may have sought her aid, even though they hold opinions contrary to her own accepted theories. Many a time her disinterested action has, by the caprice of fate, proved of no small advantage to herself, a fact which none who are acquainted with the history of this country can deny; and it is just this same spirit of tolerance which is hers to-day that enables her to occupy her high place in the council of the nations. This has recently been evidenced in the diplomacy which distinguished her relationships with the old and new Portugal. She maintains the same friendly attitude towards the new Republic as she did towards the old Monarchy. She can, without prejudice, observe, and is willing to acknowledge, the many advantages in the new régime established in Portugal; but as she extends the right hand of fellowship she makes this reservation—secure in the knowledge that her disinterested motives will be understood —"you must not expect me to give old friends the go-by; nevertheless, you may rely on me that I shall not interfere with your own personal concerns." And it is in this light that Portugal has accepted her friendship and all works smoothly to the world's weal.

And herein is her attitude justified. Her example has been followed by all the great Powers, and Portugal has been allowed to work out her own salvation unimpeded. Government has been enabled to progress without fear of diplomatic difficulties, and already its strenuous endeavours for the advancement of the country are apparent. More particularly is this the case with wireless telegraphy, which, introduced under the old order of things, has been augmented and its system perfected under the new. The man chiefly responsible for this happy state of affairs is Señor Anton Maria da Silva, the Administrator-General of Posts and Telegraphs, the details of whose brilliant career may interest our readers.

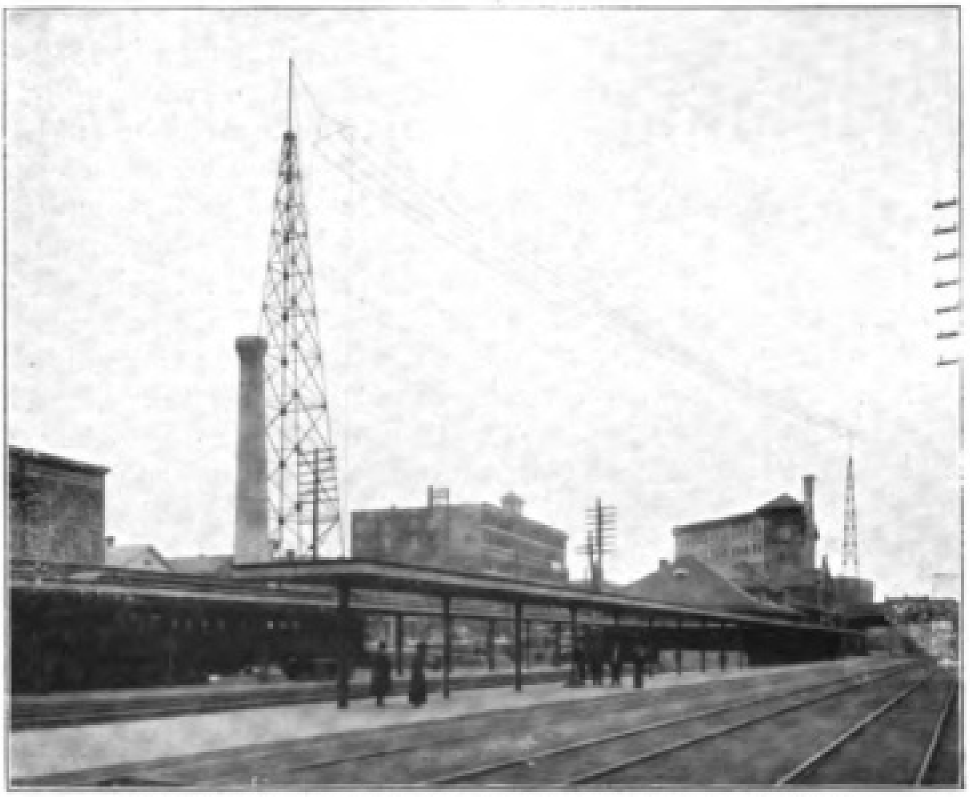
Señor Da Silva was born in Lisbon in 1872, and after the usual preparatory schooling in that city entered the Polytechnic in 1891, thence proceeding to a course of study in the School of Mines, in which he applied himself to such advantage that his name was high up in the list of successful candidates in the final examinations. In June, 1895, when he entered service as a conscript he was nominated an engineer in the Mining Corps, and soon became the chief officer of his battalion, while he was promoted to be subaltern engineer of the second class in 1900 and of the first class later. He also became a member of the Association of Civil Engineers, and in the year 1904–5 he acted as director of that society. He is also a member of the Geographical Society, and at one time was secretary to the Section of Engineering and Land Communications, and also to the Section of Geology and Mines, while last year he was President of the Society for the Promotion of Portuguese Interests. He is a clever writer, and was collaborator in a book entitled "Notes on Portugal" which was issued in connection with the National Exhibition at Rio de Janeiro in 1908. In Parliament he is member for the district of Lilses; finally, in 1910 he was nominated Director-General of Posts and Telegraphs, and when the new Republican régime came into force in 1911 he was created Administrator-General of the same section, which position he still holds.

Señor Da Silva represented his country at the International Radio-Telegraph Conference held in London in 1912, and is a well-known and highly-respected figure in the wireless world.

Wireless for Railways

Successful Results of Trials on the Lackawanna Railroad

WHEN wireless telegraphy became a practical, commercial certainty, the equipment of steamships followed as a matter of course, with the result that the sea has been robbed of much of its terror. Has the time arrived when Mr. Marconi's remarkable invention can be applied with equal success to railways? The unqualified triumph recently achieved in the United States of America points to an answer in the affirmative and indicates that we are on the eve of a development which will revolutionise railway travelling and add much to the safety and convenience of travellers.



Towers and Aerial at Binghamton Railway Station.

The management of the Delaware, Lackawanna and Western, or the Lackawanna railroad, as it is generally called, have been experimenting with wireless telegraphy on its passenger trains, and so successful have the experiments been that the prediction is made by an official of the company that "every Lackawanna train will be equipped with wireless within the next six months."

Since the wireless has been such a success on ships at sea, there seems every reason to believe that it can be advantageously adapted to railways. Certain difficult problems arose in connection with this, but they did not awe the officials of the Lackawanna railroad or of the American Marconi Company, who have scored a signal triumph in the work which they have undertaken.

The value of a wireless installation was strikingly illustrated during a test on the Lackawanna railroad train, which left Hoboken at 10.15 on the morning of November 24th last. The conductor of the train, known as the Lackawanna Limited, which was bound for Buffalo, became ill when thirty miles east of Scranton, Pa. Ordinarily it would have been necessary to stop the train and send a telegram asking for a relief conductor to be ready to take charge, or else wait for another conductor when the Scranton station was reached. On this occasion Mr. David Sarnoff, chief inspector of the Marconi Wireless Telegraph Company of America, was operating the wireless apparatus on the Limited train. The Limited was running at a speed of 50 miles per hour, but a wireless message announcing the conductor's illness and asking for a relief was despatched to Scranton. The train arrived in Scranton about half an hour afterwards and another conductor was on the station platform ready to step aboard.

When the Limited left Hoboken it was filled with passengers, and as it continued the conductor realised that he would require another coach. It was only necessary for him to notify the man at the wireless apparatus of what he wanted, and a few minutes afterwards a message was sent flashing over the mountains to Scranton, asking for another car to be held in readiness and added to the Limited when it arrived. The car was waiting when the train reached Scranton, and no time was lost.

In charge of the wireless test on the train was Mr. L. B. Foley, Superintendent of Telegraphs for the Lackawanna. He decided to get off at Scranton and return to New York on a train due in the former city two hours after his arrival. Mr. Sarnoff, however, remained on the train to continue the tests, and as the train Mr. Foley had arranged to board—the Eastbound Limited—was due in Binghamton an hour before the arrival of the Lackawanna Limited, the Marconi operator decided to leave for New York on an express at midnight.

While in Scranton, however, Mr. Foley was informed that the Eastbound Limited was an hour behind time. A wireless message was therefore sent to Binghamton from Scranton and thence to Mr. Sarnoff on the Lackawanna Limited, informing him that he could make the connection with the East-bound Limited at Binghamton. In consequence he and Mr. Foley returned to New York on the same train.

Mr. Foley believes that when all trains have been equipped with wireless the absolute severing of all communication between trains and stations will be done away with. This will mean that disasters like the Dayton flood and the San Francisco earthquake will not cut off communication between the storm-devastated sections and the outside world. Wrecked or derailed trains will be able to notify stations about accidents as soon as they occur and word can be sent to the nearest point outside the storm centres.

"Communication by wireless telegraphy to and from fixed stations with moving trains is no longer an uncertainty," he said. "Railroads can now go ahead and install the service without any fear of failure. There are many fields for the wireless telegraph in railroad operation, in routine business, and emergencies when lives and property can be saved by its use.

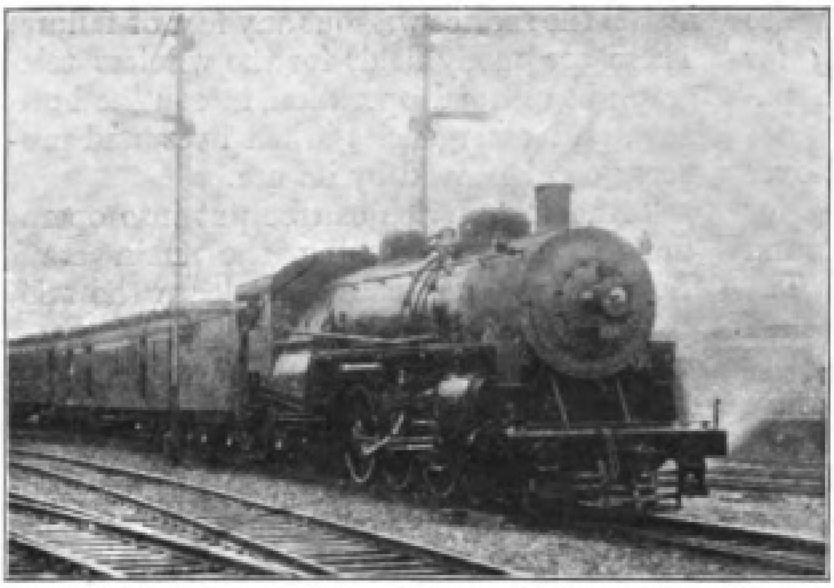
"And the service can be put into opera tion without increasing the train staff Regular trainmen can easily learn the tele graph alphabet or telegraph operators on trains can perform the duties of trainmen. Later it may be found necessary and profitable to place a telegraph operator on limited trains running long distances without stopping to handle commercial telegrams for the public.

"In my opinion the wireless will revolutionise railroading. The time is coming, and it is not far distant, when the wireless telegraph on trains will make the safety and convenience of railroad travelling 100 per cent. greater than they are to-day, and as a preventive of accidents I think the wireless will prove of the greatest value.

"In the Hudson tubes and subway, for example, the train dispatcher sits in his room, and by the flashing of lights knows where every train is. If two trains get

Scranton Railway Station. Showing the Aerial for Wireless Telegraphy.

B



The Lackawanna "Limited No. 3"

those at Scranton and Binghamton. You see, on account of the tunnels and low bridges over the tracks we cannot have a high aerial on the train, but high aerials are necessary if messages are to be sent any great distance, so we built them high at the stations and work them with a low aerial on the train. This makes the transmitting of messages between the train and the stations more difficult, but I believe this difficulty can be overcome.

"We have sent and received messages so easily that we are convinced that the only thing required to perfect the service is a perfect adjustment of the instruments. We shall make an experimental trip every other day until this adjustment is satisfactory. Then the wireless service on the Lackawanna Limited will become a regular thing."

dangerously close together he can send a signal that will almost instantly stop one or both of them. I believe that the same thing can be done on railroads with the wireless. The dispatcher can sit in front of a board on which the location of each train will be shown by wireless telegraph. If he sees trains getting too close together for safety, he can send a wireless message that will stop one of them anywhere—out in the country miles from a telegraph station.

"But, of course, all this is in the future. At present we are only experimenting. As far as they have gone, however, the experiments justify the predictions.

"Our doubt when we contemplated installing the wireless was about using the rails for grounding the electric current. There is a ground wire at every wireless station, but you can't have one from a moving train. So we tried sending our ground current to the rails. The scheme worked well and the first difficulty was overcome.

"And another problem was settled at the same time, that of supplying the electric current for the messages. We simply used the dynamos already in the train for lighting purposes. We had feared that they would not furnish sufficient current for the wireless, or if they did, that using it would weaken the lights. But we used all the electricity we needed and the lights were not perceptibly dimmed. I think it is certain that we can use the rails for ground wires and the ordinary lighting dynamos for our current. This was demonstrated.

"Our next problem is to get our instruments on the train absolutely in tune with

Setting signals by wireless is the next step, according to Mr. Foley. He said that if an operator wishes to set a signal for a moving train not in communication with him he can cause the semaphore blade of the signal post to rise or fall at his will by sounding the correct dots and dashes on his key.

"Signals can be set by wireless," he said, "as easily and as surely as they are now set by electricity conducted in wires.

"This means that if any mistakes are made in the orders issued to engineers and conductors at stations or in the case of any emergency in which a train must be stopped to avert an accident, the station operator can signal the train as certainly as if he had direct wire communication with someone on board.

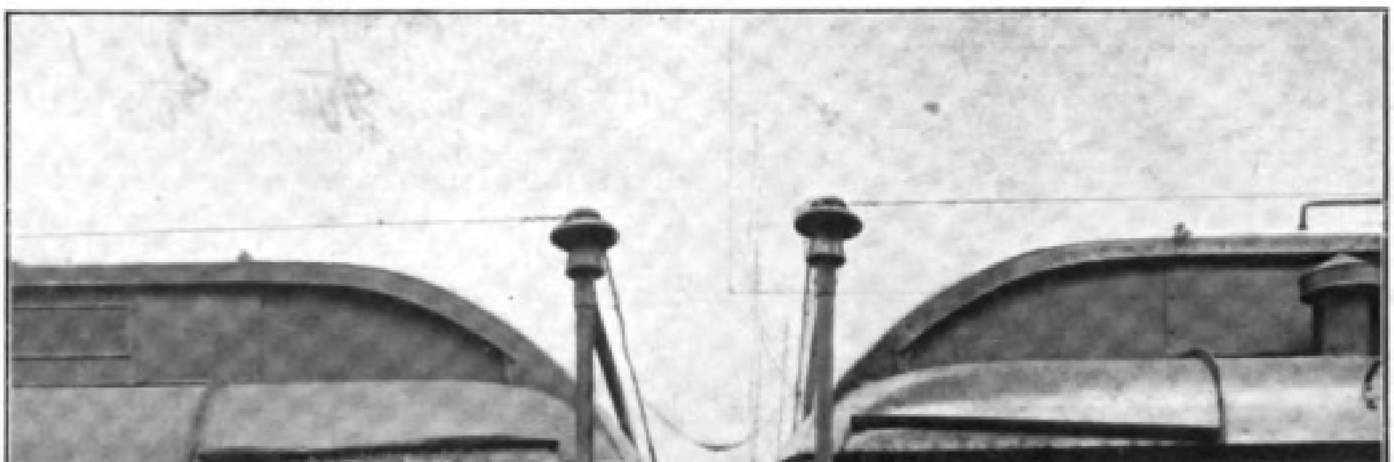
"Another valuable use to which the wireless-controlled signals can be put is the handling of freight trains on long runs. At present a through freight must make many stops between its starting-point and destination, so that orders and instructions concerning right of way can be delivered to the conductors, but these frequent stops are a source of expense and delay which will be abolished by the wireless telegraph.

"Keeping freight trains in motion for long distances without stops will result in great economy of operation. Railroad operating officials know how expensive it is to start and stop heavy freight trains, the additional cost of fuel with the attendant pulling out of drawheads and the wear and tear of equipment being no inconsiderable items in themselves. With direct communication with a train and the ability to set and release signals by wireless, dispatchers can keep in touch with conductors and make the stops needless. The wireless permits the dispatcher to board every train and deliver his instructions as surely as if he handed them to the conductor in a sealed envelope.

"That the wireless service for ordinary operating purposes is no longer an experiment is proved by the fact that the Lackawanna has already depended upon it when wire communication was cut off. The railroad has used the wireless for handling train orders, and find it as accurate and reliable as the telegraph or telephone. Recently, when a severe sleet storm put all telephone and telegraph lines out of commission in the Mountain Division of the Lackawanna railroad, all train orders were handled by wireless between Scranton and Binghamton, where the railroad's two fixed stations are. The signals were strong and distinct, and the messages were received and sent by the operators without difficulty. The wireless was the only means of communication between Scranton and Binghamton for two hours during which fifty-four orders were transmitted."

Commercial telegrams have already been sent from the Lackawanna Limited and a set of regular toll rates is now being prepared.

The wireless apparatus on the Limited has been installed in the forward part of the train. The aerial consists of a quadrangular closed loop on each car, supported at each corner by insulators on iron pipe attached



The Aerial on Passenger Coaches. This consists of a closed loop on each car supported at each corner by insulators on iron pipe attached to the corners of the car. The aerial is raised 18 inches above the roof of the car.

A Wireless Operator on the Train.

to the corners of the car. They are raised eighteen inches above the roof of the car, this being the maximum space allowable on account of bridges and tunnels. Four cars are thus equipped, the connection between cars being by means of a plug and socket. The aerial on each car is sixty-five feet long and is composed of a twisted cable of seven No. 18 silicon bronze wires. The car aerials are brought together at a point about the centre of the train and lead into the station, which is located in a small box-like compartment at one corner of the passenger cars.

The power for operating the train equipment is obtained from the generator storage battery and lighting outfit, and about 2 kw. of energy is used for the wireless service.

The radius of train operation at the present time is approximately fifty miles, but this range will be extended after the equipment has been tuned up.

The ground connection on the train is obtained through the steel trucks and wheels of the cars and rails.

The equipment on the train consists of a standard 1 kw. Marconi set of modern design, especially adapted to this service. The motor-generator is automatically controlled, the operator simply throwing on and off a switch, as necessary. A special feature of the installation is the limited amount of space required for it.

The distance between Scranton and Binghamton is about sixty-five miles, and in the experiments it was found possible to maintain communication from the train running at fifty-five miles an hour, part of the time direct from the train to the fixed station away from which the train was speeding, and when the train had proceeded to a point too far away for its short aerial to force signals through to this first station direct, the signals were delivered to the station by being picked up at the second station and relayed back. At no time during the tests was the train out of communication with both stations.

One of the most striking features in connection with train wireless was illustrated during one of the test trips, when news of the day was received while the train was travelling between Scranton and Binghamton at the rate of 60 miles per hour. Passengers were shown the latest despatches from the United States and abroad, 250 words having been sent to the train by the *Scranton Times*.

Railway men, both in the United States and elsewhere, have shown great interest in the tests. On December 17th Messrs. Logan and McDonald, of the telegraph department of the Pennsylvania railroad, made a two days' inspection of the Lackawanna wireless system. They spent the first day watching the wireless work between Scranton and Binghamton. On the second day they were at Scranton when Mr. Sarnoff, of the Marconi Company, on the Limited, fifty miles east of Scranton, sent a wireless message to Mr. Logan, introducing himself. From that time until the train, which was westbound, arrived in Scranton communication between the Limited and the Pennsylvania men at Scranton was kept up. Then Messrs. Logan and McDonald boarded the train at Scranton, the former taking the key in the wireless room. He sent messages to both Scranton and Binghamton.

Mr. Graf sent out the following call recently, while the Lackawanna Limited was forty miles from Buffalo and speeding toward that city: "Any radio station in Buffalo, adjust me." He repeated the call for twenty minutes, and finally received a response: "Who are you?" This was followed by "What position are you in?" Mr. Graf replied, "Operator on board No. 3 Lackawanna Limited speeding toward you."

The Buffalo operator, evidently believing that he was communicating with a vessel on the Great Lakes, asked, "What longitude and latitude are you in?" Once more Mr. Graf flashed back an answer, and this time it was understood. The Buffalo operator, Mr. Jackson, of the Marconi Wireless Telegraph Company of America, sent his congratulations on the success of the train wireless and met the Limited when it arrived in Buffalo.

The possibilities of wireless applied to railroads multiply almost constantly. Soon after the installation had been made on the Lackawanna Limited three tramps were discovered by conductor Simrell riding on the tank of the locomotive, unobserved by the engine driver and the fireman. The Limited was between Scranton and Binghamton at the time and the conductor did not want to stop the train to put the men off. Therefore he reported his discovery to Mr. Foley and Mr. Graf.

The wireless apparatus was put in operation and a message sent to Binghamton informing Mr. M. F. Collins, a special division agent of the railroad in that city, of the fact that the Limited was carrying three men who were without tickets. When the train pulled into the outskirts of Binghamton and slowed up, Mr. Collins and his assistants took the three into custody. The tramps were greatly surprised when they were told of the means employed to capture them, and apparently took pride in the fact that they were among the first of their class to take a place in the history of train wireless.

The first Lackawanna train order was sent on October 23rd from Scranton to Binghamton. It marked the first time in the history of the world that a train order was sent by wireless.

Wireless Operator at Scranton Railway Station.

The Two Voices

Two Sonnets on Radio-telegraphy.

Dedicated by kind permission to Commendatore Marconi

I

The Primitive Voice.

SILENCE, that mock'd at Life; untouch'd, intense,
Numbing the stagnant waters of the void,
Until divine compassionate wings deployed
The glory of their quickening influence,
And a wind rose above the waste Immense
In awful music, as it were God's breath
Creating souls beneath the ribs of Death,
And glowing worlds in its omnipotence.

Followed another voice. A primal sea
Interpreted unspanned Eternity
Into the flux of Time: and after these
Arose the voices of the plains, the trees,
Till, last, through all Creation's Song there ran
The modulate, well-tuned voice of *Man*.

II

The Ultimate Voice

MOST POTENT by its reason'd Unity,
Man's voice was yet too utter weak to take
The Ear of the Invisible, and make
Far-reaching echoes through the lofty sky.
But the decree was urgent: "Strive and try,
For Life hath hid from you her treasure deep;
That learning how to win, ye learn to keep,
So that ye may be perfect by and by."

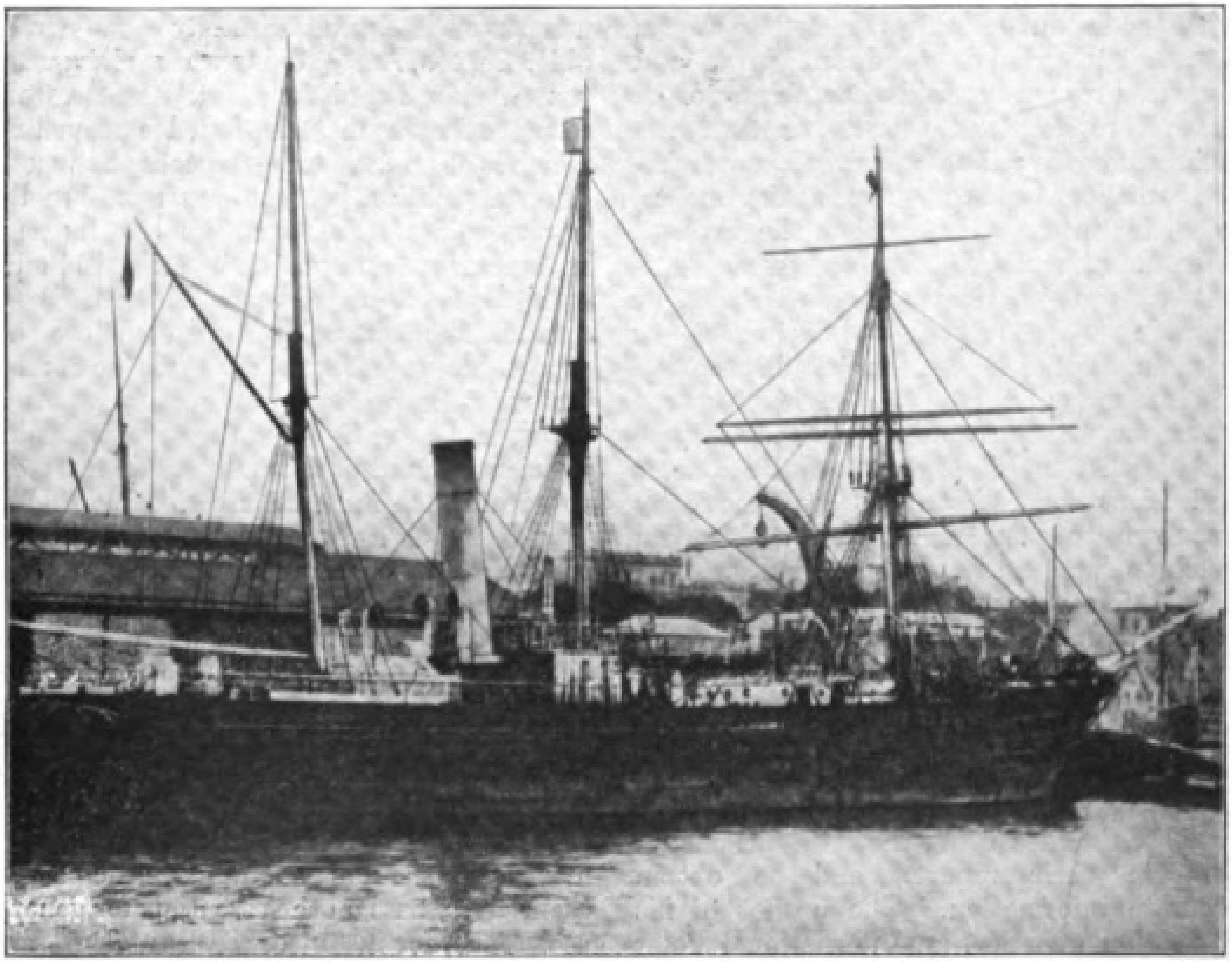
Now Man attains his birthright! He has found
The alchemy that, mingling Light with Sound,
Gives to the wandering ear a still, small voice,
Translating human speech. "O Earth! rejoice,
"E'en now through space,"—so the glad cry is hurled,
"Man speaks with Man; soon *World* shall speak with
World!"

Bernard C. White

A History of Polar Exploration

THE PART WIRELESS HAS PLAYED. ITS FUTURE RÔLE IN POLAR RESEARCH.

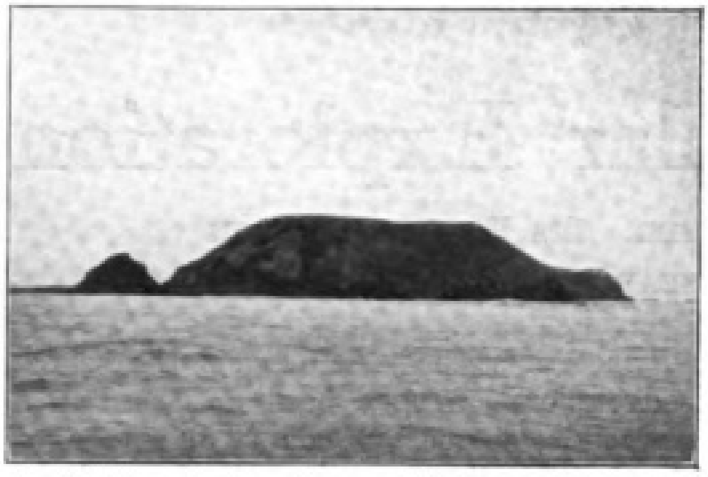
THE recent death of Viscount Sidmouth has brought out the interesting fact that he was one of the last to say " Good-bye " to Benjamin Franklin, when the great explorer started out on his hapless mission to discover the North-West Passage. This is an unwelcome reminder of the price which we have paid for our polar discovery. At the same time we can take comfort from the knowledge that such a price need never be required again. It has been paid once and for all, for, with the advance of science, the dangers of research and exploration have been mitigated in a marvellous degree. Of course, danger is not all passed. Far from it: the fate of the Scott Antarctic Expedition is sufficient to warn us against taking too optimistic a view. Nevertheless aviation, the use of electricity, the thousand and one appliances of the modern scientist, and, by no means least, the invention of wireless telegraphy, avert many of the perils which beforetime stared the adventurer in the face. In the early



By kind permission of] *[" The World's Work."*

THE " AURORA "

Built originally for whaling, this vessel has taken part in more than one voyage of Polar Discovery, for she was one of the relief vessels to the ill-fated Greely Expedition. Afterwards she was chartered by Dr. Mawson for her present work.



By kind permission of] [*"The World's Work."*

MACQUARIE ISLAND

A general view of this gaunt mass of rock.

days of exploration *robur et aes triplex* were his only *vade mecum*; now he augments his daring with scientific knowledge and a scientific equipment. He has the example and experience of many predecessors to aid him. The annals of Arctic discovery are thick with the names of heroes, many of whom, although they did wonderful work and passed through untold hardships, often death, are practically unknown and uncommemorated; but the world, nevertheless, makes use of their achievements. Who, for instance, remembers the work of John Rutt, who, in 1527, sought the North-west Passage to China, or John Davis, or Captain Waymouth, or Luke Fox, or Captain James? Even Collinson and M'Clure are only known to the few, yet the latter was the first to discover and traverse the North-West Passage. Sir John Barrow and Lieutenant Weyprecht are practically unknown to popular fame, yet they did much to further the work under discussion, for the former in 1818 was instrumental in passing a law through the English Parliament for the promotion of Polar discovery, and the latter, in 1875, was the first to start the idea of appointing ten international circum-Polar stations for establishing synchronous meteorological and magnetic observations, the idea being that stations should compare their reports, and so obtain accurate information. The upshot of his suggestion was that an International Polar Conference was held at Hamburg in 1879, under Dr. Geog Neumayer, and another at Berne in 1880, when various nations agreed to build twelve such stations, and this plan was eventually carried out. This did much to establish sound premises for the work of future explorers.

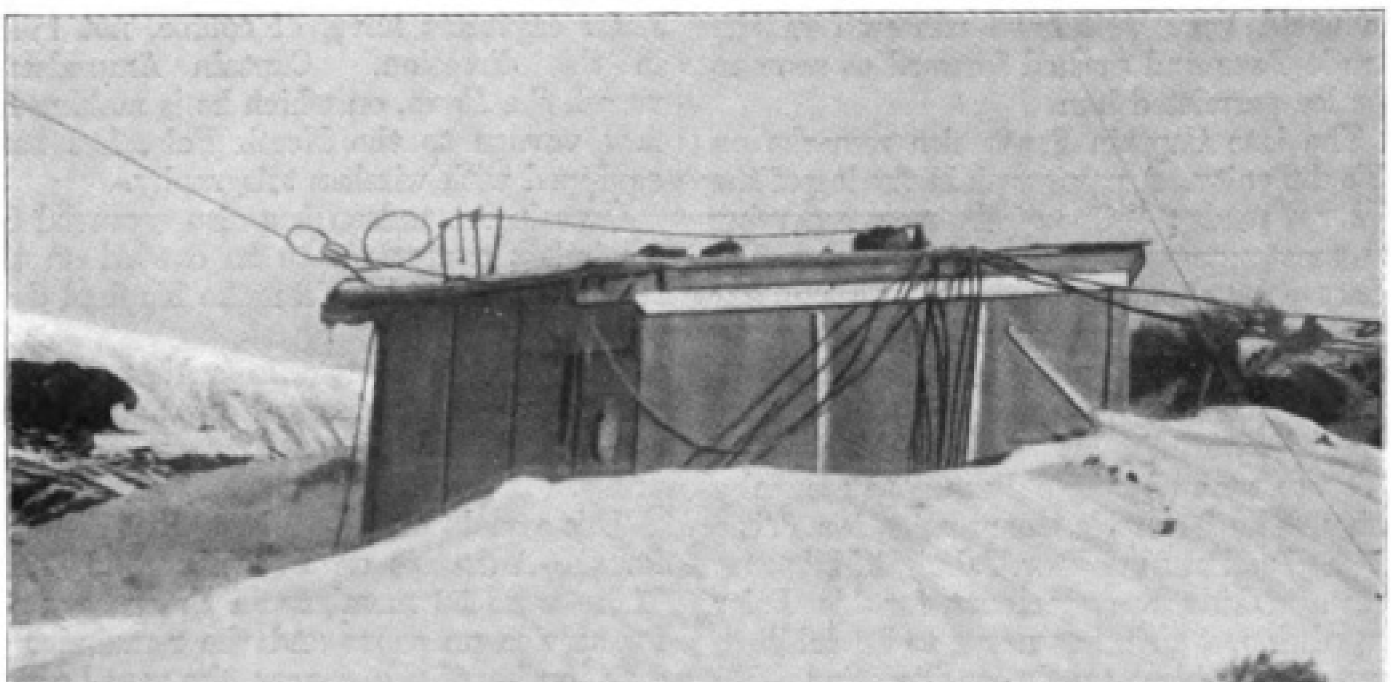
Of these it is difficult to mention individuals, expeditions and intrepid explorers become so numerous from this time to the present day, but there is a danger that while the fame of Nansen, Amundsen, Peary, Shackleton and Scott is ringing in our ears, the noble work of Scorsby, Parry, Austin and Major-General Greely is likely to be overlooked. This should not be, for the investigations, experience, and, above all, their records, alone made the more brilliant work of their successors possible, and it is not too much to say that these successors would themselves acknowledge their indebtedness to these pioneers of discovery. Scorsby, for instance, left to posterity writings which are still in the guide book of the geographer. They are to the explorer what Dr. Johnson's Dictionary is to the lexicographer, for although a large part of it is out of date, fundamentally it is unassailable. So, too, Austin did marvels of organisation in his expedition, and made special advance in the matter of sledge travelling, which is of no little importance if the success of an expedition is to be ensured. Finally, Parry paid special attention to hygienic arrangements, and obtained besides valuable scientific results. "Scientific results!" the remark has often been made; "we are always hearing about these scientific results, but what they exactly are nobody seems to know, and even if they are very interesting to scientists and professors they do not seem to be of much material use to the world at large." This is a poor argument, but it is one somewhat difficult to controvert, for, as the objectors justly remark, the data gained is usually only of use to experts. But it should be remembered that this is no proof of its worthlessness, for all admit that knowledge must of necessity only belong to the few who can grasp its value. Nevertheless, it becomes public property through such channels, for those few "elect," while they may keep the long-sounding principles to themselves, pass on the essentials for general use. Take, for instance, wireless telegraphy. It is only the scientist or the engineer who understands about the laws controlling electro-magnetic waves, and the many principles of sound, light and heat, magnetism, and kindred subjects upon which the invention is based. The operator need only acquire a tithe of this knowledge in order to work the instruments, and the general public who benefit by the invention knows practically nothing at all. But no one would dare to say that the patient research carried on in the laboratory and study which has discovered these laws has been waste of time and the lives spent in such research have been useless.

It is the same in Polar research: there is no limit to the extent in which the knowledge acquired may be used. We will take one instance. Fossil remains of mammoths have been discovered within the Arctic zone, thereby abundantly proving that at one time these regions of snow and ice were under the influence of torrid heat, and this fact, more than any other, has proved the assumption correct that at different times the earth passed through phases of extreme heat and extreme cold before it reached the equitable temperature which enabled mankind to exist.

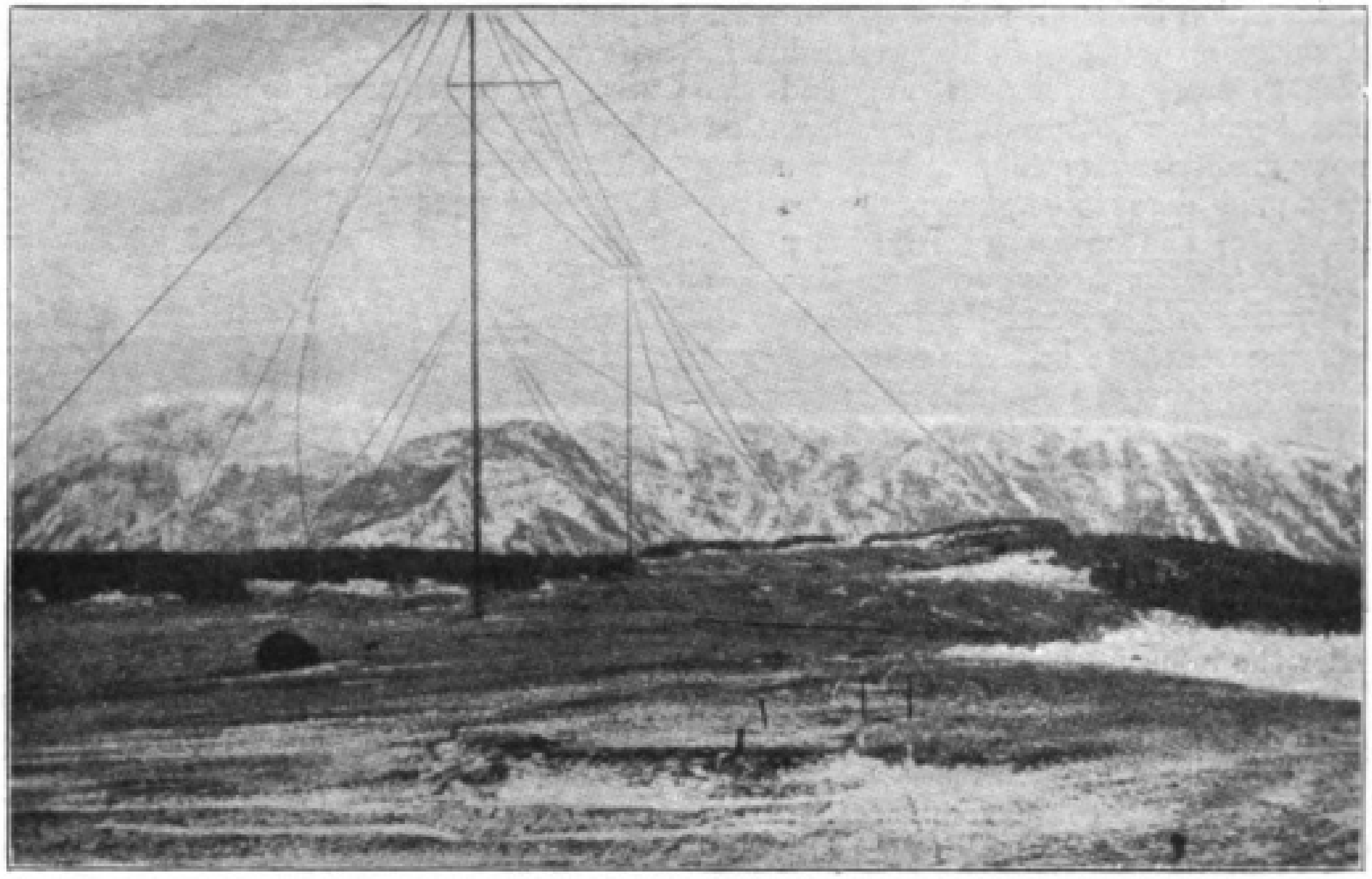
But it is not so much with the actual results of Polar research that we are concerned as the means to be employed so that it may be carried on with the minimum of danger to the valuable lives spent in such work. And here, perhaps, wireless telegraphy has a use which makes it one of the most effective agents and the greatest safeguard that can be employed in such work. It is reasonable to suppose that had Captain Scott's expedition been equipped with a wireless station the brave men who lie buried beneath Antarctic snows would have completed a triumphant journey and would have themselves received the reward of their heroic labours from an enthusiastic and grateful nation. They were only eleven miles from the One Ton Depôt, where there was a store of food, and had they only been able to communicate they could have received assistance, for some of the party had quitted it to return to the ship but a few days before the disaster overtook their fellows.

The record of Dr. Mawson, who is at present encamped in Arctic surroundings in Adelie Land, are sufficient proof of this; but before discussing his experience it is worth while to consider how great is the need of an exploratory party for some means of communication with a permanent base.

It was this want which hindered Captain Young in his Polar work, for a report concludes: "At Upernavik the *Pandora*, after a stormy and dangerous passage, arrived to find that the last ship had sailed for Europe. As there was no means, therefore, of communicating with England, and as



THE TRANSMITTING STATION, MACQUARIE ISLAND.
The Wireless Cabin banked up with snow in the land of perennial winter. Despite the severe climatic conditions the apparatus worked splendidly.



THE WIRELESS STATION ON NORTH HEAD, MACQUARIE ISLAND.
This is doing such important meteorological work that it is to be taken on by the Australian Government.

without such communication Captain Young did not feel authorised to winter in the north, a supply of fresh water was taken on board and the ship steered for home." As it was, he had to leave his work uncompleted when he could very well have wintered in the Arctic Zone and pushed forward as soon as the ice permitted him.

The late Captain Scott also remarks on this difficulty. A paragraph in the log of the *Nimrod* reads: "One of the most annoying circumstances was that until we had a solid sheet of ice about us we could not set up our meteorological screen nor communicate regularly with the magnetic huts, nor, in fact, properly carry out any of the routine scientific work."

These were not the only men to recognise the need of reliable communication. The great Russian navigator, Admiral Makaroff, when making arrangements for his Polar expedition, which was never to be fulfilled, gave this subject much consideration. He even corresponded with Nansen as to a system of signals by which they could get in touch with each other amongst the ice. (It should be explained that his aim was to render assistance in case of accidents to the Nansen expedition, which at that time was being fitted out.) His idea was clear, and had he lived in this age of wireless telegraphy there is no doubt that he would have made use of the invention to fulfil his purpose. Later explorers have, of course, not failed in this direction. Captain Amundsen's vessel, the *Fram*, on which he is making his new voyage to the North Pole, has been equipped with wireless telegraphy.

Captain Amundsen has also arranged for a wireless equipment to be carried on the sledges in which he will make his final dash to the Pole.

But the most notable achievement of wireless in Polar exploration is the record established by Dr. Mawson and his party.

This expedition left Hobart, New Zealand, for the Antarctic on December 2nd, 1911. There were 52 members in the party; 31 for service on shore and the remainder to serve on board the *Aurora*, the vessel carrying them to their destination. The purpose of the expedition was the exploration of the coastal region of the Antarctic Continent lying south of Australia, for Dr. Mawson believes that a scientific examination and accurate survey of the region will be likely to prove the possibilities of great economic development. The *Aurora* is a vessel which has long since made her maiden trip to Polar regions, for thirty-six years ago she took part in the search for the ill-fated Greely Expedition. She is a whaler, heavily timbered to withstand enormous ice-pressure, and is well supplied with all things needful for her present purpose. On arrival at the mainland of unknown Australian Antarctica the shore parties were distributed as follows:

Mr. Ainsworth, of the Commonwealth Metereological Service, and a party of four were landed at Macquarie Island on December 13th, 1911. One of the four was Mr. A. J. Sawyer, at the time member of the Gisborne and Wellington Telegraph Staffs, who resigned in 1908 to take up "wireless," and was afterwards commissioned to superintend and man the proposed wireless station on the island. His description of the difficulties encountered in his work is interesting:

"All stores and wireless equipment had to be landed through the surf—not a difficult proceeding, but a wet and cold one. A barrel containing a part of the wireless equipment came adrift and we thought it was lost for good. But it was cast up on the shore two days later, though the contents were scarcely improved by the long immersion. Owing to the fearful gales and bad weather the task of erecting the wireless plant was a difficult one. We had to haul everything up a 300-foot hill, and several minor accidents occurred during the work of transit, while a good many of the instruments had to be repaired before the actual work of erection could be proceeded with. Throughout, my only assistant was a Sydney wireless amateur, who, however, made himself invaluable to me.

"On the 6th of February everything was ready for the initial trial. Unfortunately, a violent hurricane sprang up that afternoon, carried the aerials away, and damaged the masts, but in a week's time repairs had been effected, and on the 13th communication was established with shipping and Sydney."

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DR. MAWSON'S MAIN BASE IN KING GEORGE V. LAND.

This is a very fine harbour, and there is ample evidence of land as well as ice. Dr. Mawson, with seventeen men, has continued scientific investigations here for over two years.

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HAULING STORES UP AN ICE-CLIFF.

A scene at Dr. Mawson's second base, where the party under Mr. Wild wintered on a moving glacier, a most daring exploit which, however, was attended by no misfortune.

Dr. Mawson and the remainder of the party had meanwhile set out for the lesser known district further south. They successfully weathered the stormy conditions of the "Roaring Forties, Howling Fifties and Shrieking Sixties," and eventually discovered a magnificent harbour, afterwards named Commonwealth Bay, where it was decided to establish a base. Pro visions, coal, and Greenland sledge dogs for eighteen men were landed, and the ceremony of hoisting the British flag in the new territory was performed. It was called King George V. Land. Afterwards, a wireless station was erected here, which has been working successfully since January, 1913.

This station supplies meteorological data each night to Melbourne and Wellington by wireless, and has proved so valuable that it has been taken over from the Expedition by the Commonwealth of Australia, and will in all probability be maintained by them. Several excellent results in the way of long-distance communication have been recorded; for instance, messages were transmitted to and received from Port Moresby land station, 2,800 miles away; Suva land station, 2,400 miles; Freemantle land station, 2,200 miles; also from the steamers *Manuka* and *Cooma*, both over 2,300 miles distant.

At Macquarie Island the *Aurora* bumped heavily on rocks and sustained severe damage, which necessitated almost continual work at the pumps, and subsequently cost £2,000 to repair.

The *Aurora* then sailed westward, to land the third party of eight men, but the ship covered 1,100 miles without being able to find a landing-place. Where icefloes did not intervene they were thwarted by unscalable ice-cliffs, and when their supply of coal began to run short they were forced to consider the advisability of returning to Australia with their ambitions unfulfilled. But such a prospect went hard against the grain, so the little company took their lives in their hands and elected rather be "dumped" on a glacier with their camp 17 miles distant from land, and with 200 fathoms of water beneath them. As it was discovered on Sir Ernest Shackleton's birthday this ice-tongue, which is 120 miles long, was named the Shackleton Glacier, while the adjoining land, which was afterwards explored by the party, has been loyally christened Queen Mary Land. The danger of this Antarctic escapade is evident, for had the ice-tongue broken away during the vernal thaw the whole party would inevitably have been lost. As it is, their work under Mr. Frank Wild justified the hazard, for they have returned to Australia with the charting of a great part of the Antarctic coast completed and much research accomplished in oceanography.

But it was imperative that Wild and his men should be relieved, for the season was late, and a vessel penetrating the pack ice under such conditions is likely to be frozen in and jammed among the bergs in the darkness. As the efforts of the search parties to discover the missing explorers were unsuccessful, Capt. Davis decided to proceed to Wild, and had already proceeded some distance along the coast in the teeth of fearful gales when a wireless message was received from Adelie Land, saying that Mawson had come in alone.

The first disaster to overtake the three heroes was the death of Lieut. Ninnis, which occurred when the three men were 300 miles from the main base. The unfortunate man with a team of dogs and nearly all the food was suddenly precipitated down a crevasse, and, it is believed, instantly killed. The position of the two survivors was thus rendered desperate, and they instantly retraced their steps. For 35 days they struggled on without adequate provisions. Then, on January 17th, Mertz died from privation. For another three weeks Dr. Mawson continued his lonely journey, and finally reached the base on February 7th.

With this news came the order for the *Aurora* to return at once and take off the whole expedition. But an effort to do this was frustrated by the tempestuous conditions, and Capt. Davis, using his own discretion, determined first to relieve the heroic little band stationed on the far-off glacier to the west. "On February 9th," so his report runs, "we were brought up by heavy ice, and it appeared unlikely that we should get through at all. The presence of countless bergs made navigation in the darkness almost impossible, and as daylight came we were thankful that we had passed another night without disaster. These experiences continued until February 23. The morning of that day dawned bright and clear, and we calculated that we ought to be near Wild's base. So, with eyes glued to our glasses, we searched the coast and perceived a little hut on the

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PLOUGHING THROUGH PACK-ICE.

This is very dangerous work, especially if the severer season is setting in, for in the darkness the ship is liable to be frozen in and crushed by the pressure of the newly forming ice.

glacier with a solitary figure outside it. Soon there were eight gesticulating black figures, and we knew that the whole of the party was safe and sound. Then began the work of bringing aboard the members and all their specimens and collections, and this we did in the remarkably short space of six hours."

With the rescued the *Aurora* then sailed for Hobart, arriving there in March, 1913. But Dr. Mawson and his party, which includes six of the men sent out by the *Aurora* to search for their leader, have been forced to spend another year in the Antarctic. They are well supplied with coal and food, and their scientific equipment, and there is no reason to suppose that they are running any further risks by the delay. Besides, they have the wireless to keep them in touch with the outer world, and from the reports that reach us from time to time they find an invaluable aid both to their work and recreation. It is an unfailing source of cheerfulness, for to be able to "talk" to "passers-by" is the most exhilarating tonic that men in their position can have. Not only can they "talk" themselves, but they can hear other stations at work. "They get messages which Wellington, Melbourne and Sydney exchange with each other. Sometimes they hear warships 'talking,' sometimes luxurious liners. They are a little party of outcasts in a deadly wilderness, listening eagerly to the tag ends of the world's conversation. Occasionally Dr. Mawson discusses through Macquerie Island and Hobart how Sydney shall dispose of certain scientific specimens already brought back to Australia by the *Aurora*. They send news of the weather, of the good spirits they manage to keep up, and of the team dogs' puppies. More than this, they have sent New Year's greetings to their compatriots, loyal messages on Empire Day, and they have already conveyed their sympathy to Lady Scott on the loss of her gallant husband. But perhaps their most noteworthy achievement is the publication of an Antarctic newspaper, with, as the saying runs, 'all the latest news.'"

With such experiences to guide them we doubt whether any explorers of the future will organise an important expedition without including an adequate wireless equipment. Captain Amundsen has, as we have already seen, taken the hint; so has the relief expedition which was sent out to obtain news of the ill-fated Schroeder-Stranz Expedition, and which arranged to set up wireless communication with the German Colony at Cross Bay *via* the station at Spitzbergen. A party of scientists from the United States who chartered a Newfoundland vessel and sailed last summer to carry out observations in the Arctic Zone, installed powerful instruments on the ship so as to keep in touch with the new radio station at Wolfsteinholm, on Hudson Strait. Then there is Dr. Vilhjalmar Stefansson, well known for Polar exploits, who recently left civilisation for another four years' Arctic exploration. He intends to establish a primary base on Herschel Island, and a secondary base on the southwest corner of Northern Victoria Land. Wireless stations will be erected at both points, and will be capable of sending 1,000 miles, so that not only may the members of the expedition be able to communicate with each other, but will also be in direct communication with a large slice of the world. Finally it is reported that the new French Arctic Expedition, under M. de Payer, an officer of reserve and Member of the Geographical Society, has been entrusted by the French Government with an important scientific mission, which is to include the establishment of a Government station within the Arctic Zone, which is to be in constant communication with France by means of wireless telegraphy.

Such is the history of wireless as regards Polar exploration, and it is not too much to say that it has opened up and made possible, without grave risks to life, a vast field of achievement in Polar research.

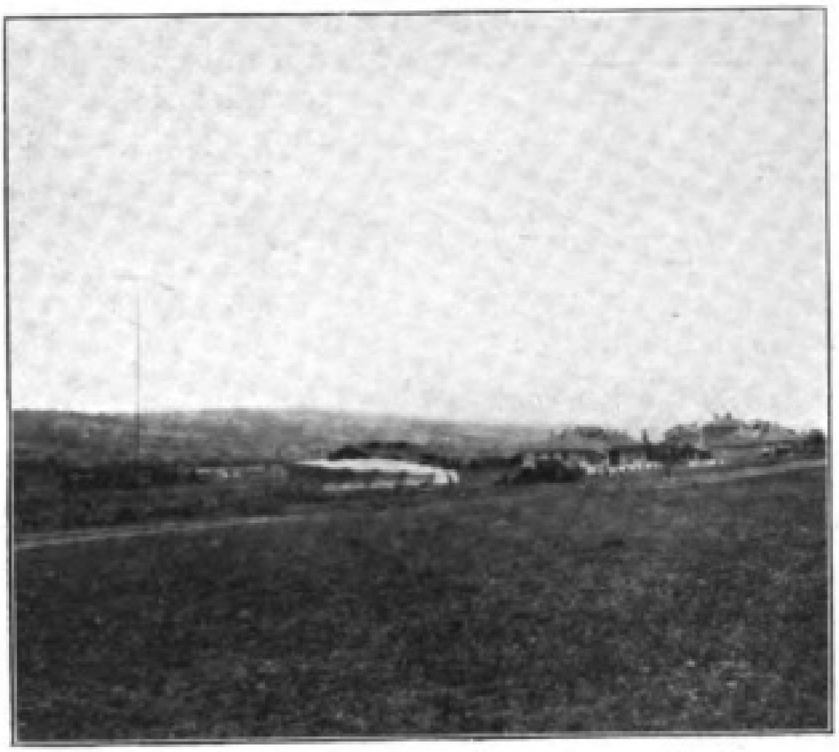
An Austrian Antarctic expedition proposes to leave Trieste early in June in the steamer *Oesterreich*. After touching Buenos Ayres the party will proceed to South Georgia, where an intermediate wireless telegraphy station will be installed which will enable the ship to keep in communication with th' outer world.

In Terra, Pax

Wireless with the Roumanian Army

EVENTS to-day move so fast that Plevna has almost become nothing more than a memory to the average Englishman; but the Balkan peoples will long remember it as the scene of one of the bloodiest battles of that internecine strife. To think that glory should cost such a price, and that some of the flower of Balkan manhood stained the disordered field with good red blood, to win a bubble reputation even in the cannon's mouth. Plevna would be well forgotten if it were only the scene of human sacrifice, for what is military glory to those who mourn the dead? Fortunately Plevna can boast a better fame than this, for during the war the Marconi apparatus stationed here did much more than merely assist in the conflict. It was the means of bringing relief to the suffering, courage to the despondent, and, best of all, it was the means of assisting the well-disciplined army to concentrate its forces and organise its plan of campaign to such good purpose that, like a modern Hercules, it throttled the many-headed snake of war.

But Plevna was not alone to enjoy the advantage of a wireless telegraph station, for the Roumanian army made extensive use of wireless telegraphy during the campaign in Bulgaria. The stations used were of the Marconi system, 1·5 kw. type, having a range of transmission of 250 kilometres (about 155 miles). These were distributed amongst the Commanders of the Army Corps, the Commanders of the Depôts, the Commander-General of the Army, and one station was erected at Bucharest, by means of which the War Office was able to keep in direct touch with the movements of the army in Bulgaria. Each of the above-mentioned Commanders were provided with one station, with the exception of the Commander-General of the Army, who had two stations. In all, seven Marconi portable sets were supplied, and these ensured regular radiotelegraphic communications between the country and the various Roumanian Commanders in the field. Up to August 1st, about 6,000 telegrams were handled and about 120,000 words were dealt with.



Headquarters of Roumanian General Staff at Plevna.

Such service is perhaps one of the greatest that an invention can offer mankind. All the world acknowledges the debt of gratitude it owes to Mr. Marconi for the security he has gained for those travelling by sea, but, well deserved as this gratitude undoubtedly is, the added cause for thankfulness here alluded to should not be forgotten. For, remember, wireless telegraphy has revolutionised military warfare, and has brought the science of military tactics to such a degree of exactness that in the hands of a skilled commander it is practically possible to eliminate mischance.

The Measurement of Decrement

By J. ST. VINCENT PLETTS

SOME time ago, when investigating the oscillations in coupled circuits which were not in tune, I deduced an expression for the decrement in a particular case, which differed from that in general use, and, although I have not yet considered mathematically the complete case, experiment shows that my expression applies equally well to it.

The expression which I obtained may be arrived at in the following way :

If we have a circuit with inductance L, resistance R and capacity K, and if in this circuit we induce an alternating potential of maximum value E, and frequency $q/2\pi$, then :

$$L\frac{dc}{dt}+Rc+\frac{1}{K}\int c\,dt=E\sin qt.$$

If v is the voltage across the condenser $c=K\dot{v}$ and therefore :

$$LK\ddot{v}+RK\dot{v}+v=E\sin qt.$$

If we neglect the initial transitory terms the solution of this equation can be shown to be of the form :

$$v=V\sin(qt-\theta).$$

Now if we assume that the resistance, R, is so small that it has no effect upon the natural frequency $p/2\pi$ of our circuit, we shall have $p=1/\sqrt{LK}$, so that, putting the above value of v into our previous equation and rearranging, we get :

$$\frac{E}{LK}\sin qt=V\left\{(p^2-q^2)\sin(qt-\theta)+\frac{Rq}{L}\cos(qt-\theta)\right\}$$

$$=V\sqrt{(p^2-q^2)^2+\left(\frac{Rq}{L}\right)^2}\sin(qt-\phi)$$

where ϕ is some other phase difference due to the combination of the sine and cosine terms.

If now we neglect the sines, and take simply the maximum values, we see that he maximum current :

$$C=KVq$$

$$=\frac{Eq}{L\sqrt{(p^2-q^2)^2+\left(\frac{Rq}{L}\right)^2}}$$

This, of course, is the equation for the resonance curve, and when $p=q$ gives the maximum value :

$$C_m=\frac{E}{R}$$

From this we obtain :

$$\frac{C}{C_m}=\frac{Rq}{L\sqrt{(p^2-q^2)^2+\left(\frac{Rq}{L}\right)^2}}$$

But if δ is the decrement

$$\frac{R}{L}=\frac{\delta q}{\pi}$$

and therefore

$$\left(\frac{\delta q}{\pi}\right)^2\left(1-\frac{C^2}{C_m^2}\right)=\frac{C^2}{C_m^2}(p^2-q^2)^2$$

$$\delta=\pi\left(\frac{p^2}{q^2}-1\right)\sqrt{\frac{C^2}{C_m^2-C^2}}$$

It is obvious, since the decrement must always be positive and the expression has been obtained by taking the square root, that we can write it in the form :

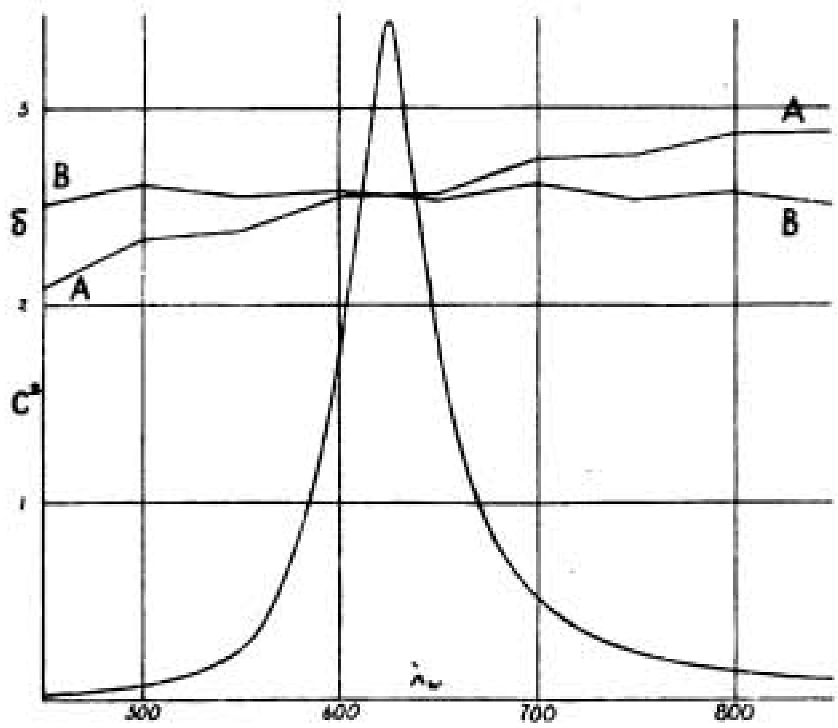
$$\delta=\pi\left(1-\frac{\lambda^2}{\lambda_w^2}\right)\sqrt{\frac{C^2}{C_m^2-C^2}}$$

where λ_w and λ are the wave lengths of our circuit and of the circuit inducing the potential in it (or, in other words, of the wavemeter and the circuit under measurement) respectively. I need hardly add that the ordinary expression for the decrement is :

$$\delta=2\pi\left(1-\frac{\lambda}{\lambda_w}\right)\sqrt{\frac{C^2}{C_m^2-C^2}}$$

and that the two expressions are identical if the two wave lengths are very near together, because the difference between unity and a number near unity is half the difference between unity and the square of that number.

I am, of course, aware that the new expression has been obtained on the assumption that the circuit under measurement has no decrement, but if this assumption be made in the old expression it does not produce the new one. It therefore seemed probable that an erroneous expression had come into general use owing to the continental habit of dealing with the decrement per half period, and that if the true expression were used the necessity for taking the two wave lengths close together would disappear. This point could obviously be settled experimentally. In the accompanying figure I give a resonance curve, which was taken from an impulsed circuit some years ago, together with the values of the decrement, calculated from this curve by the old (A) and the new (B) formulæ, for each value of λ_w. It will be seen that the latter gives a practically constant value



for the decrement, and, what is of much more importance, enables all the observations to be compared, and the mean value and probable error to be determined.

With resonance curves taken from ordinary wireless circuits when in operation, it will very often be found that the decrement given by this new formula is a constant on one side of the curve but not on the other. This appears to be due to the presence of another wave of insufficient amplitude to make itself otherwise visible on the resonance curve. In such cases it seems probable that, if the constants be determined from one side of the curve, and the other side be calculated from these constants, the difference between the observed and the calculated curves will give the otherwise invisible resonance curve of the other wave length.

SCIENTIFIC NOTE

MEASUREMENTS OF RADIO-TRANSMITTED ENERGY.—An interesting article by Mr. M. Reich on some results of quantitive radiotransmission observations recently appeared in *Physikalische Zeitschrift*. Measurements were made simultaneously of the current strength in an antenna at a sending station, and in a tuned antenna at the receiving station. The ratio of received to sent current was measured at various wave-lengths, and also at various distances; that is, between different pairs of stations. Over a short distance (7 km.) the observed received current was about 15 per cent. short of the computed received current with 1-km. waves, neglecting absorption, this loss being possibly attributable to imperfect ground conduction. With quarter-kilometre waves the loss increased to about 33 per cent. Over long distances (a few hundred kilometres) the observed received current was only about half of the computed received current. The indicated loss was thus about 50 per cent. The loss was found to increase with the frequency, being greatest on short wave-lengths. Over hilly country it was greater than over flat alluvial soil. At night time the loss was in general considerably less than in the daytime, but was subject to greater fluctuations. About sunset the received current strength was found to undergo marked fluctuations. The particular sunset observations indicated two marked *maxima*, separated by about ten minutes of time. In this case both stations seem to be approximately on the same meridian, and the date seems to have been at the end of November. These two rapidly-succeeding maxima, with a depression between them, might be explained by the solar shadow-wall theory. If so, the phenomenon of sunset double maximum should disappear at solstices, so far as concerns this particular pair of stations.

Safety of Life at Sea

Compulsory Wireless Telegraphy

THE London International Conference on the Safety of Life at Sea, by which the Convention signed on January 20th has been drawn up, met for the first time on November 12th, 1913, at the Foreign Office, and has been sitting continuously since, except for a short break at Christmas. The suggestion that such a Conference should be held emanated from the German Emperor, and the task of convening it was undertaken by the British Government. The following States have been represented: Great Britain, Germany, the United States, Australia, Austria - Hungary, Belgium, Canada, Denmark, Spain, France, Italy, Japan, Norway, the Netherlands, Russia, Sweden, and New Zealand. The delegations from the different States were composed, not of the representatives of the shipping trade, but of administrators, experts and jurists.

Lord Mersey was appointed Chairman of the Conference. To deal with the specific subjects submitted to it the Conference appointed five sub-committees, together with a sixth sub-committee for drafting the Convention, which was to embody the recommendations of the Committees as approved by the whole Conference. The Committees and their respective chairmen were as follows:

Certificates Committee—Dr. von Koerner, principal German delegate.

International Drafting Committee—M. Guernier, principal French delegate.

Construction Committee—Admiral Capps, U.S.A.

Boats and Safety Appliances Committee—Sir John Biles (Great Britain).

Wireless Telegraphy Committee — Mr. Moggridge (Great Britain).

Safety of Navigation Committee—Sir Norman Hill (Great Britain).

The Conference agreed that the actual text of the Convention, which contains no fewer than 74 articles, should not be officially published until February 15th., in order to give the Delegations of the various contracting States time to communicate it to their respective Governments.

An outline of the principal results achieved was, however, indicated in the speech in which Lord Mersey moved the adoption of the Convention at the meeting of the Conference on January 19th; and the Conference resolved that the substance of this speech should be communicated to the Press as summarising the principal provisions of the Convention.

The following extract from the speech of Lord Mersey relates to wireless telegraphy:

The Convention provides that all merchant vessels of the Contracting States when engaged upon international (including Colonial) voyages, whether steamers or sailing vessels, and whether they carry passengers or not, must be equipped with wireless telegraphy apparatus if they have on board 50 persons or more (except where the number is exceptionally and temporarily increased to 50 or more owing to causes beyond the masters' control). The Contracting States have, however, discretion to make suitable exemptions from the requirement to carry wireless apparatus in certain cases, of which the most important is that of vessels which in the course of their voyage do not go more than 150 sea miles from the nearest land. The classification of the vessels, required by the Convention to be provided with wireless apparatus, follows the categories contemplated by the Radiotelegraphic Convention. The precise classification is too complex to be summarised, but, broadly speaking, the fast passenger steamers are placed in the first category, other steamships intended to carry 25 passengers or more in the second category, and all other vessels required to be fitted with wireless apparatus in the third category. It need hardly be said that the owner of any vessel placed in the second or third categories can claim that his ship shall be placed in a higher category, if it complies with all the requirements.

A continuous watch for wireless telegraphy purposes is to be kept by all vessels required to be fitted with wireless apparatus, as soon as the Government of the State to which the vessels belong is satisfied that such watch will be useful for the purpose of saving life at sea; and meanwhile (subject to a transitional period for fitting wireless installations and obtaining the necessary staff) the following vessels will be required to maintain a continuous watch, in addition, of course, to all vessels placed in the first category:

(1) Vessels of more than 13 knots, which carry 200 or more passengers, and which make voyages of more than 500 miles between two consecutive ports;

(2) Vessels in the second category during the time they are more than 500 miles from land;

(3) Other vessels, required to be fitted with wireless apparatus, which are engaged in the transatlantic trade, or whose voyage takes them more than 1,000 miles from land.

Vessels placed in the second category, but not required to keep continuous watch, are nevertheless required to keep such watch for at least seven hours a day, besides the watch of ten minutes in each other hour required by the Radiotelegraphic Convention. Vessels concerned with the fishing and whaling trade are not required to keep a continuous watch. The continuous watch may be kept by certificated operators or by watchers qualified to receive and understand signals of distress, and provision is made for the possibility of the future invention of an automatic apparatus which will take the place of watchers. The wireless installations must have a range of at least 100 miles and an emergency apparatus, placed in conditions of the greatest safety possible, must be provided unless the main installation is placed in the highest part of the ship, and in the conditions of the greatest safety possible. The Convention provides that the master of a ship in distress shall have the right to call to his assistance from amongst the vessels which have answered his appeal for help the vessels which he thinks can best render assistance, and the other vessels which have received the call may then proceed on their way. A transitional period is provided to enable wireless apparatus to be fitted and operators and watchers obtained.

AERIAL CONDUCTORS

PARTICULARS of Patent No. 4514, relating to improvements in aerial conductors for use in wireless telegraphy granted to Marconi's Wireless Telegraph Co. and Mr. C. S. Franklin, have now been published.

It is known that an aerial consisting of one or more turns of wire wound in the shape of a rectangle or other polygon and placed with its plane vertical to the earth has good directional properties for transmitting and receiving electromagnetic waves, but is a very inefficient radiator or absorber of these waves. It is also known that the radiation and absorption are greatly improved by employing one turn enclosing as large an area as possible and by inserting a small condenser in series with the aerial so that the latter is in tune with the wave to be transmitted or received. Even when this is done the dimensions of the aerial are still small compared with the wave length, and the aerial is therefore an inefficient radiator and absorber of electromagnetic waves. According to this invention condensers are introduced at approximately equal distances all round the closed aerial circuit, the capacity of each condenser being so adjusted that for the particular wave-length to be used it just compensates for the inductance of the part of the circuit joining it to the next condenser. The condensers may be conveniently placed in waterproof cases at the tops of masts which support the aerial, and in practice coils of high inductance should be placed in parallel with each condenser to prevent electrostatic charges accumulating. If desired, the earth may be made to form the lower side of the rectangle or polygon. The distance between the two extreme parts of such an aerial circuit may be as great as half a wave-length and the aerial will then be a very powerful radiator and absorber of electromagnetic waves and at the same time will have the good directional properties of a small closed circuit.

Dr. Filippi with his exploring party for the Western Himalayas is near Skardo. He is erecting a wireless installation with which to secure communication with the radio station at Lahore.

The British Coast Wireless Service

Post Office Re-organisation Scheme.

THE design of the new Post Office station at Fishguard (G.R.L.), which was opened for commercial work on September 8th, 1913, and replaced the station at Rosslare, possesses many features of interest. It is one of the stations which come within the reorganisation scheme of the wireless coast stations undertaken by the Post Office to put the coast communication upon a satisfactory basis. The station has been erected at the top of the cliffs near the harbour village, and as an addition to the facilities at Fishguard Harbour it will be of great convenience alike to the travelling public and the Great Western Railway Company. The construction of the buildings was undertaken by the railway company, and the Post Office provided the equipment, which is on the Marconi principle. The range of the station is reckoned to be about 250 miles in the daytime, but it has taken traffic up to 1,200 miles at night. The necessary power is obtained from the Great Western Railway Company's generating station at the harbour. The high mast reared among the cliffs forms a landmark for miles around.

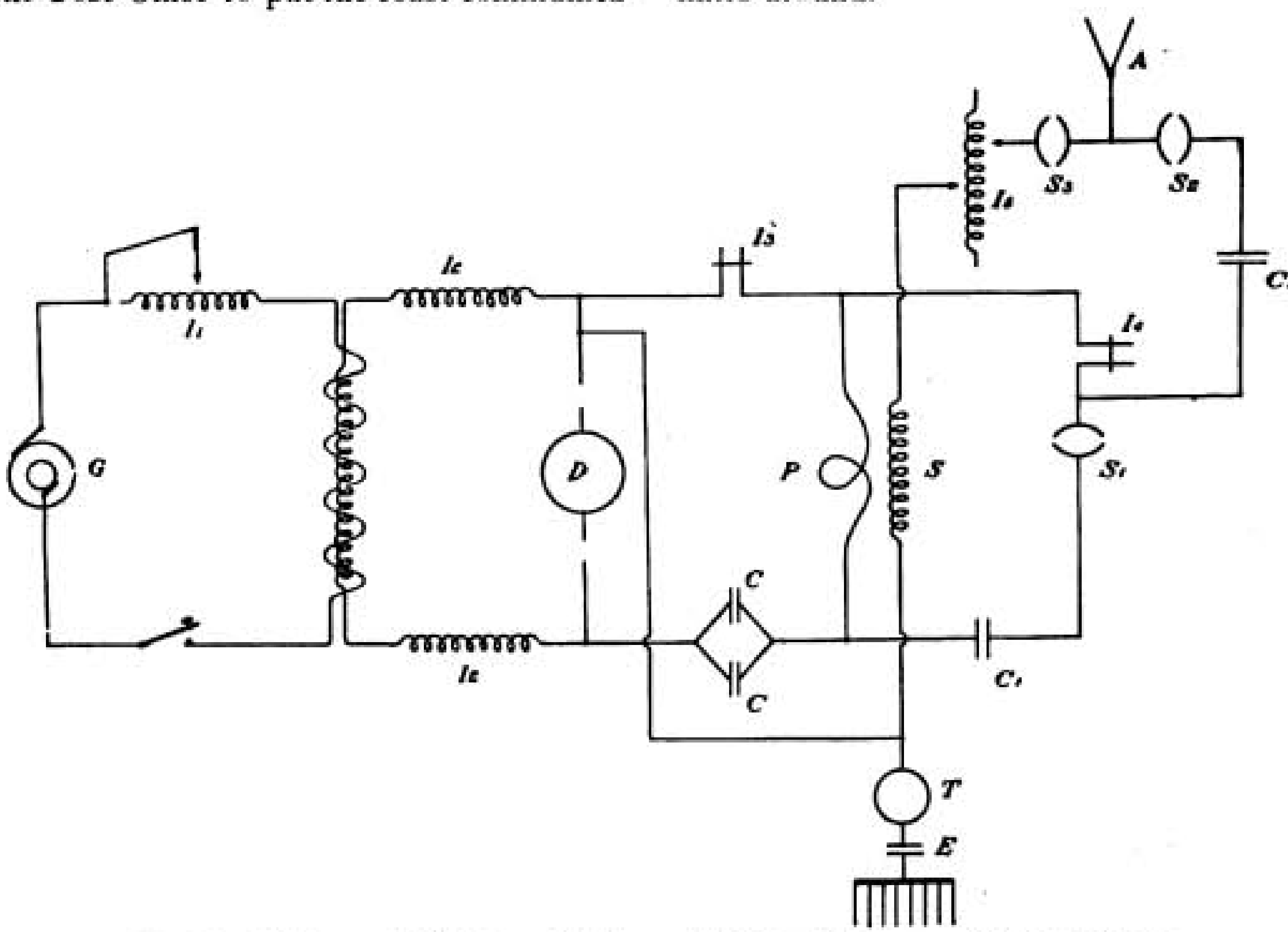


Fig. 1. Fishguard Wireless Station. Skeleton Diagram of Connections.

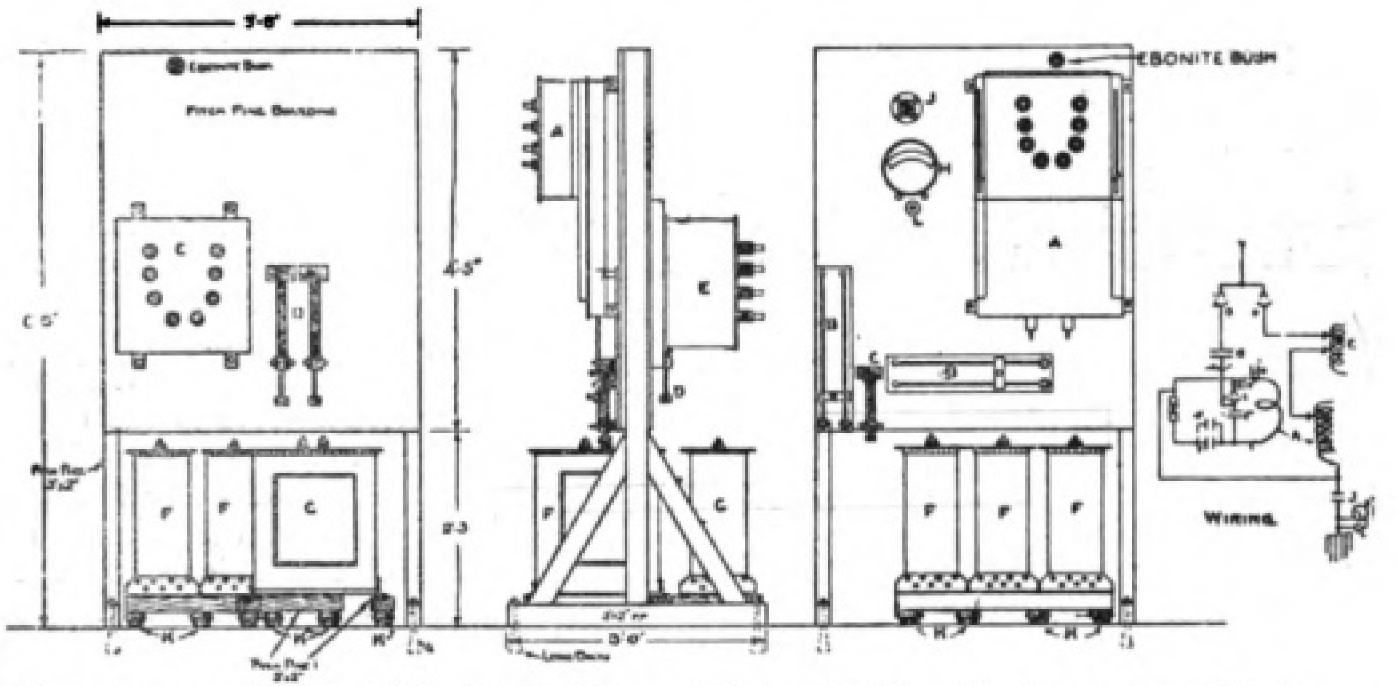
The design of the station is described in the *Post Office Electrical Engineers' Journal*, by E. S. Perrin and F. W. Davey, and we would like to acknowledge the courtesy of the editor of the Journal for permitting us to make the following abstract, and for the loan of diagrams and photographs from which the accompanying illustrations are made.

The skeleton diagram of connections is given in Fig. 1.

The arrangement is similar to that installed at North Foreland, but the power used is greater.

G is the alternator supplying 3 kw. power at a voltage which can be regulated between 200 and 400 through an iron core choke, I_1, to the primary of a high-tension transformer. The secondary of the transformer is connected through two air core chokes to a rotary disc discharger, D, which is fitted with 12 studs. Round the disc discharger are formed two circuits, one tuned to a 600-metre wave consisting of the discharger, and thence through I_4, I_3, T and E to earth. The connections between S_1 and the earth connection on D are common to the primary and aerial systems.

In this design the energy radiated on the 300 metre wave is very much less than that radiated on the 600-metre wave. The station, however, is normally designed to work on 600-metre, and the arrangement allows for resonance working on the 300-metre wave, with sufficient power on the latter to work the Great Western Railway boats, without interfering with the neighbouring stations, at St. Just and Seaforth.



A. Transformer oscillation W.T. No. 1.
B. Inductance W.T. No. 1.
C. Switch wave changing No. 1.
D. Switch wave changing No. 2.
E. Inductance W.T. No. 5.
F. Condenser W.T. No. 10.
G. Condenser W.T. No. 2.
H. Ammeter aeriel No. 1.
J. Discharger earth,
K. Insulators' mess-room No. 3.
L. Switch tumbler No. 1.

Fig. 2. Fishguard Wireless Station. Arrangement of Apparatus.

D, condensers, C, C, the primary of an oscillation transformer, P, and an inductance, I_3; the other (when the switch, S_1, is closed), tuned to a 300-metre wave, consisting of the disc discharger, D, condensers, C, C and C, and inductances, I_4 and I_3. The 600-metre aerial circuit (operative when the switch, S_3, is closed) is inductively coupled to the 600-metre closed circuit through the oscillation transformer, P.S. Included in the aerial circuit is a variable inductance, I_5, a thermoammeter, T, and an earth arrester gap, E.

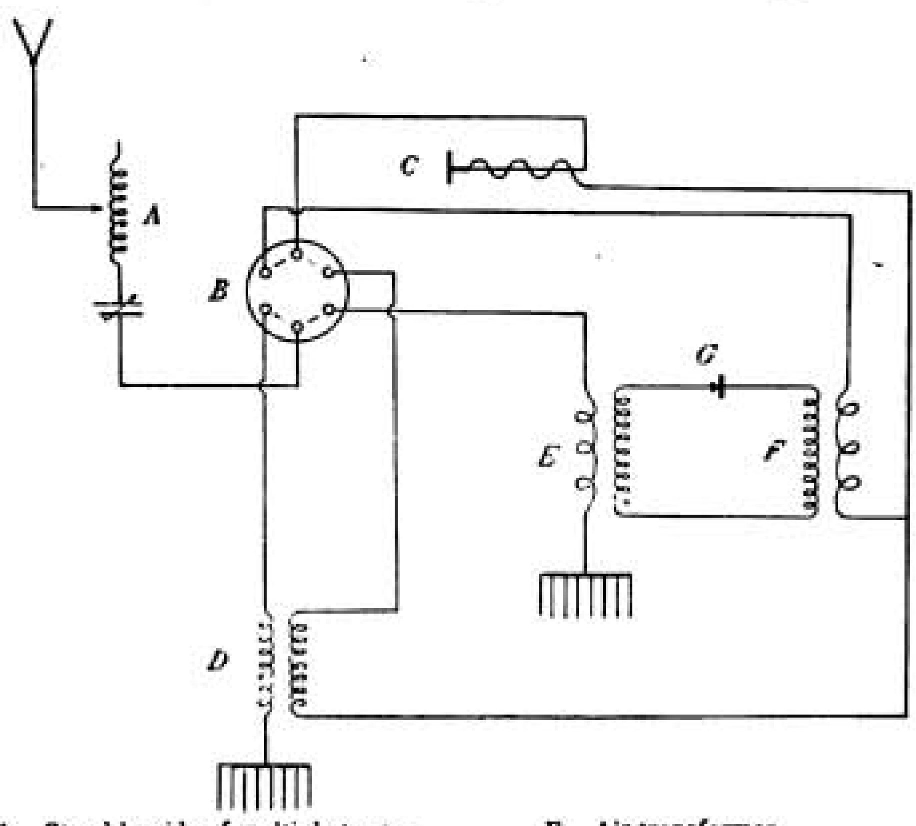
The same aerial is used for 300 as for 600 metres, but in the former case direct coupling is adopted, S_3, is open and S_2 is closed, and the aerial is joined through a condenser, C_2, The direct current mains are led into the building and go straight to the main switch; from thence they go to the motor side of the motor alternator through a motor starter, controlled by a tumbler switch placed close to the operator.

The alternating current mains go from the alternator to a switch fitted on the power board, and from thence to the primary of the transformer, the transmitting key and iron core inductance being in circuit. The power is broken directly on the transmitting key, no electro-magnetic key being used, as difficulty was anticipated with the adjustment of an electro-magnetic key at such high frequency. The connections on the H.T. side of the transformer have already been explained, and Fig. 2 shows the manner in which the apparatus is disposed.

The mast is an ordinary three part ship's mast, 150 ft. high. It was recovered from the old Seaforth Wireless Station, and after being overhauled and repainted was erected by the Sectional Engineer at Fishguard. The anchorages are made up of bent railway metals set in concrete. They form a cheap and effective anchorage, as the rails could be obtained on the spot from the Great Western Railway Company. The stays are four $2\frac{7}{8}$ G.I. stay wire for the mainmast, four $\frac{7}{8}$ G.I. stay wire for the topmast, and four $\frac{7}{8}$ G.I. stay wire for the topgallant mast. It was originally intended to put up four cages to form an umbrella aerial, but later it was decided that the mast was not strong enough to withstand the pull of the cages in such an exposed position, and single wires were used. The aerial is insulated from the mast and the poles carrying the extension by vulcanised strop insulators.

The earth consists of twenty-four plates $2\frac{1}{2}$ ft. by 5 ft. of stout galvanised iron placed vertically in the ground and bolted together to form two semicircles of 20 ft. radius. $\frac{7}{18}$ copper H.D. wires are soldered to the plates, three to each plate, the outside wire being common to two plates. The wires converge from the earth plates to a central point, and are carried above the ground and bunched at the central point. The bunched wires are fixed by means of a globe porcelain insulator to the top of a 10-ft. light creosoted pole. The two earth systems are connected together and a common wire is led into the building to the earth arrester gap. The ground at Fishguard is very rocky, and this type of earth was adopted to provide a capacity earth in addition to the ordinary earth.

The receiving gear is connected across the earth arrester gap, and consists of a multiple tuner which can be worked with either a magnetic or a crystal detector. The skeleton diagram of connections is given in Fig. 3.



A. Stand-by side of multiple tuner.
B. Six-terminal 2-pos. switch.
C. Telephone
D. Primary and secondary of magnetic detector.
E. Air transformer.
F. Telephone transformer.
G. Crystal detector

Fig. 3. Fishguard Wireless Station. Receiving Circuit Diagram.

It will be observed that in switching over to the crystal an air transformer is joined across the detector terminals in place of the primary coil of the magnetic detector. As the multiple tuner is designed to work normally with the magnetic detector the inductance of the primary of the air transformer is made the same as that of the primary of the magnetic detector.

Low-resistance telephones are used for both magnetic and crystal working by the aid of a telephone transformer for the latter.

Another of the stations comprised in the coast station reorganisation scheme is that at St. Just, in Cornwall, particulars of which are also given in the *Post Office Electrical Engineers' Journal.*

It was originally intended that power for this station should be derived from a high-voltage supply to the mines in the district, but as the mains were not run it was found

The four lower ends of the wires are bunched and taken to a Bradfield insulator fixed in the wall of the building, and the inside of the Bradfield connected to the internal apparatus.

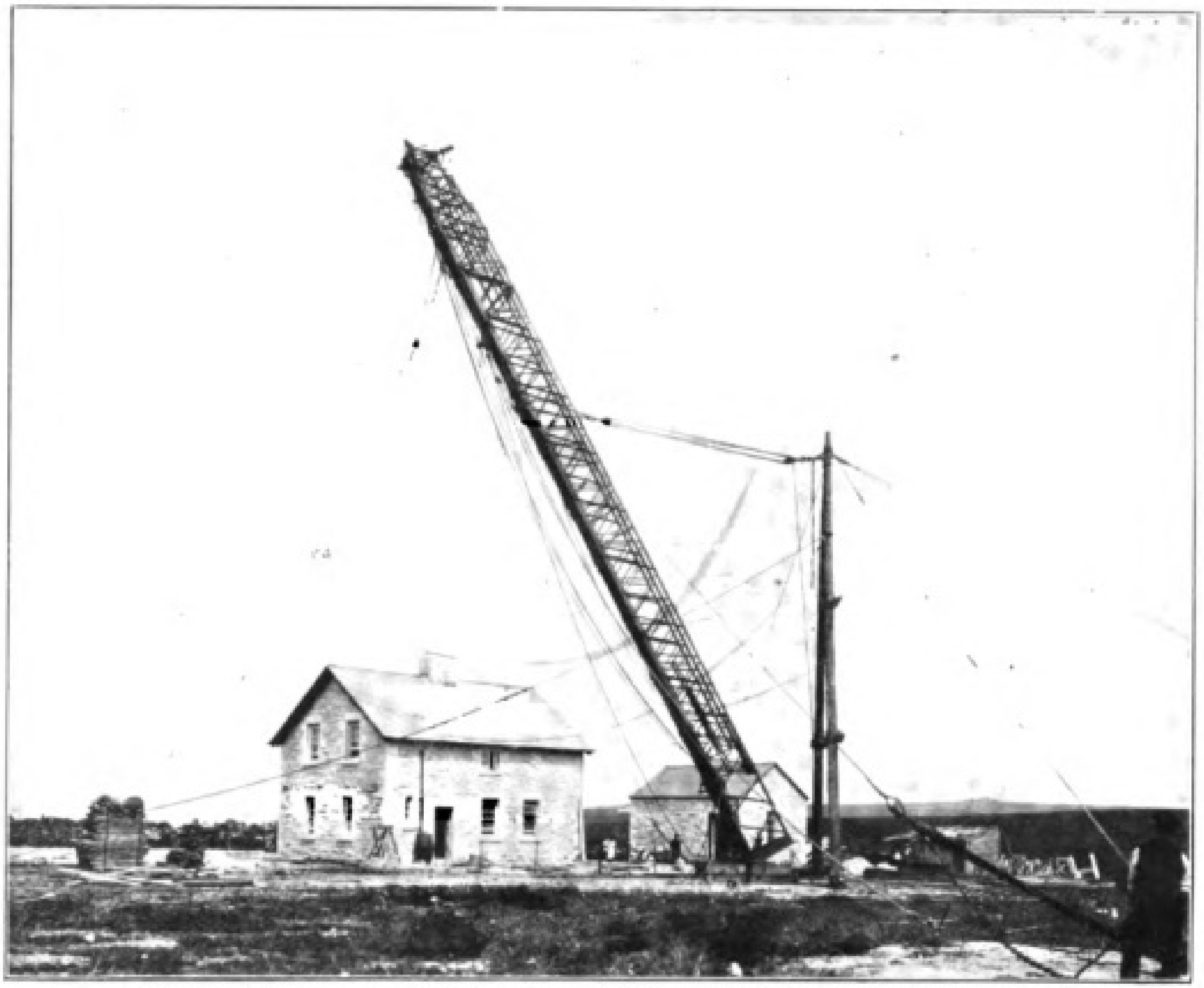


Fig 4. St. Just. Erecting one of the three-section lattice Girder Masts.

necessary to convert the transformer house into an engine and battery room, and to arrange for prime movers and batteries with the necessary accessories.

In the case of both Fishguard and St. Just the instrument room, where the operating is done, is kept well away from the power room. The motor generator is started up by a remote control switch operating an automatic starter. This assures the necessary silence during reception of messages though the motor generator may be running.

The diagram of connections and general lay-out of the internal transmitting plant follows closely the lines of Fishguard. The fundamental differences are greater power—5 kw. instead of 3 k.w.—and the provision of two aerials, one for the 600-metre wave and one for the 300-metre wave, instead of only one.

Two 200-ft. lattice girder steel masts support the aerials.

Each mast is in three sections, the sections telescoping into one another. Fig. 4 shows the three sections nearly in position.

In raising the mast an axle was fitted to one side of the mast at the base and this was mounted so as to allow the mast to rotate in a vertical plane during erection.

When the three sections were in position the two inner sections were lifted vertically to the top of the outer section and the two outside sections bolted together. The innermost section was then lifted to the top of the second section and the second and third sections similarly bolted together. The completed masts are shown in Fig. 5.

There are three sets of four stays to each mast, the stays being $2\frac{1}{2}''$ steel rope.

A pulley is fitted at the top of each mast and over these run the halyards for supporting the aerial. The anchorages consist of reinforced concrete blocks.

The 600-metre aerial is triangular in shape, the base of the triangle being at the top; each side consists of a cage made of six wires of 7/19 H.D. copper. The two side cages are anchored down to ringbolts set in concrete in the ground.

The aerials are insulated from the mast and the ground by vulcanised strop insulators. Leads are taken from the bottom of the two legs to a Bradfield insulator fitted in the roof of the power room.

It was originally intended to strengthen the roof and to anchor the aerials to it, but this idea was abandoned. A special platform is built on the roof of the power room. The leads from the 600-metre aerial go to one of the outside insulators, and the lead from the 300-metre aerial goes to the other, the earth leads being joined to the centre one. The inside terminals of these insulators go to corresponding points of the internal apparatus.

The 300-metre aerial consists of two parallel wires 160 ft. in length and separated by wooden spreaders at the top and bottom.

The earth system consists of two sets of ten galvanised iron plates, each 6 ft. by 3 ft. arranged in two segments of a circle of 80 ft. radius having as centre the mid-point between the masts. The plates are buried as vertical as possible without having recourse to blasting the ground, which is of a rocky nature. The longer edges are placed horizontally and bolted together at the upper corners so as to form a continuous sheet. To the centre of each plate a lead of bare 100-lb. H.D. copper wire is soldered, the wire being passed in and out through three holes in the plate so as to form a good mechanical as well as a good electrical joint.

The earth leads are carried over short posts projecting 2 ft. above ground 5 ft. from the centre of each plate, and thence in a single span to a special earth bar carried on insulators on the roof platform over the high-tension room in the operating house.

A wire connecting each set of earth leads is carried to the centre insulator in the roof, the under side of the insulator being connected to the earth arrester gap. The earth bars on the platform consist of T. iron carried on third rail insulators.

The prime movers are two semi-high-speed engines, each capable of developing 10 H.P. at 800 revs. They are fitted with overhead valve gear and govern on the throttle.

In each engine the carburetter is of the

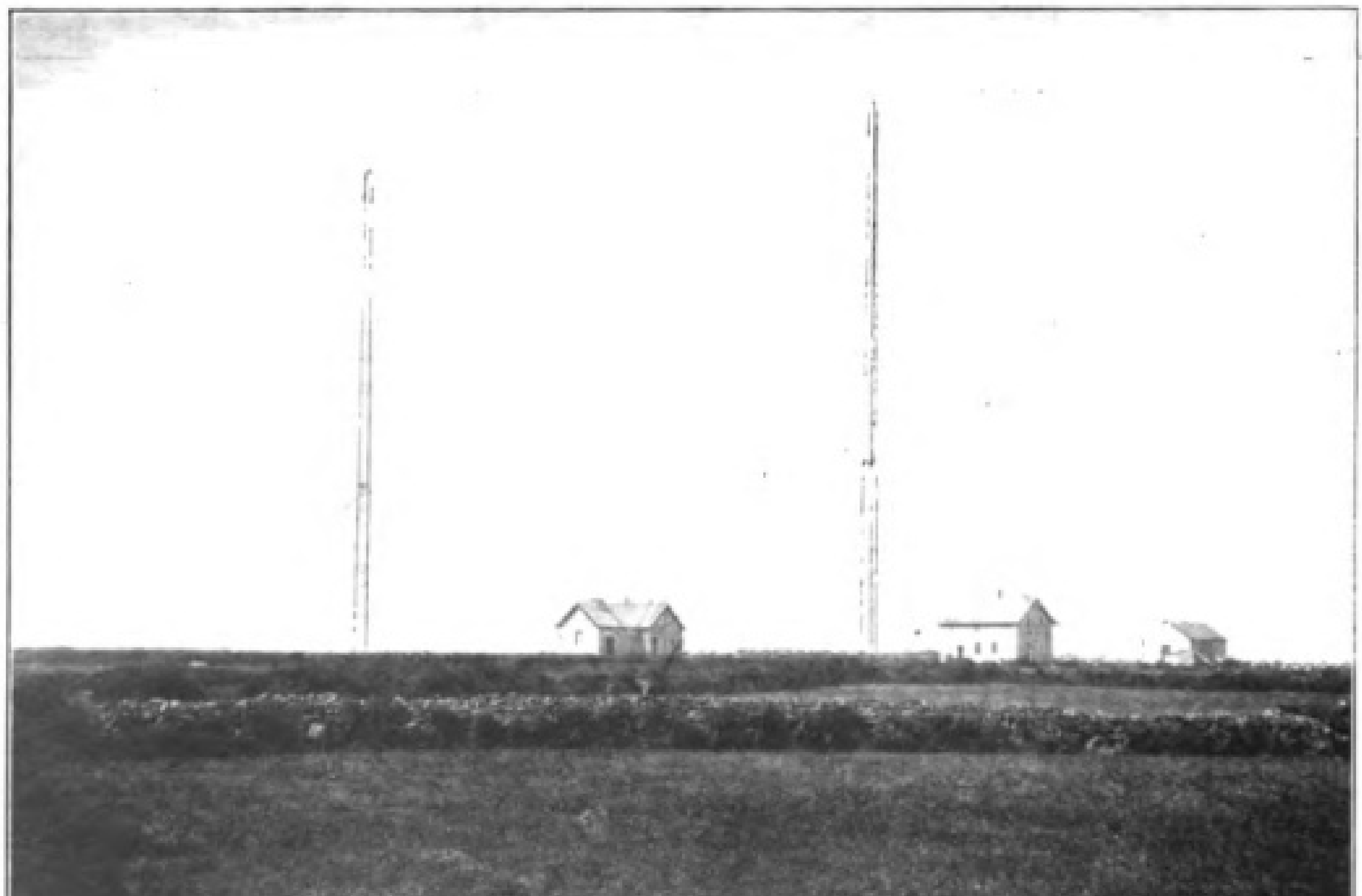


Fig. 5. St. Just Wireless Telegraph Station. The Masts completed.

single-jet automatic type and fitted with exhaust heated vaporiser. The carburetter is arranged for a petrol start and is turned over to paraffin when it warms up. High-tension magneto ignition is employed. Each prime mover is connected to a D.C. generator designed for an output of 5 kw. at 100 to 140 volts at a speed not exceeding 700 revs. per minute. The D.C. generator charges a battery of 52 cells suitable for a discharge of 378 ampère-hours at the 9-hour rate. The battery supplies energy to a motor alternator; the motor is 100 to 140-volt compound wound of sufficient power to drive the alternator and disc discharger; the alternator is designed to give a single-phase current at 300 volts, 200 periods per second and a total output of 5 kw. at unity power factor. Spare armatures are provided for all the machines.

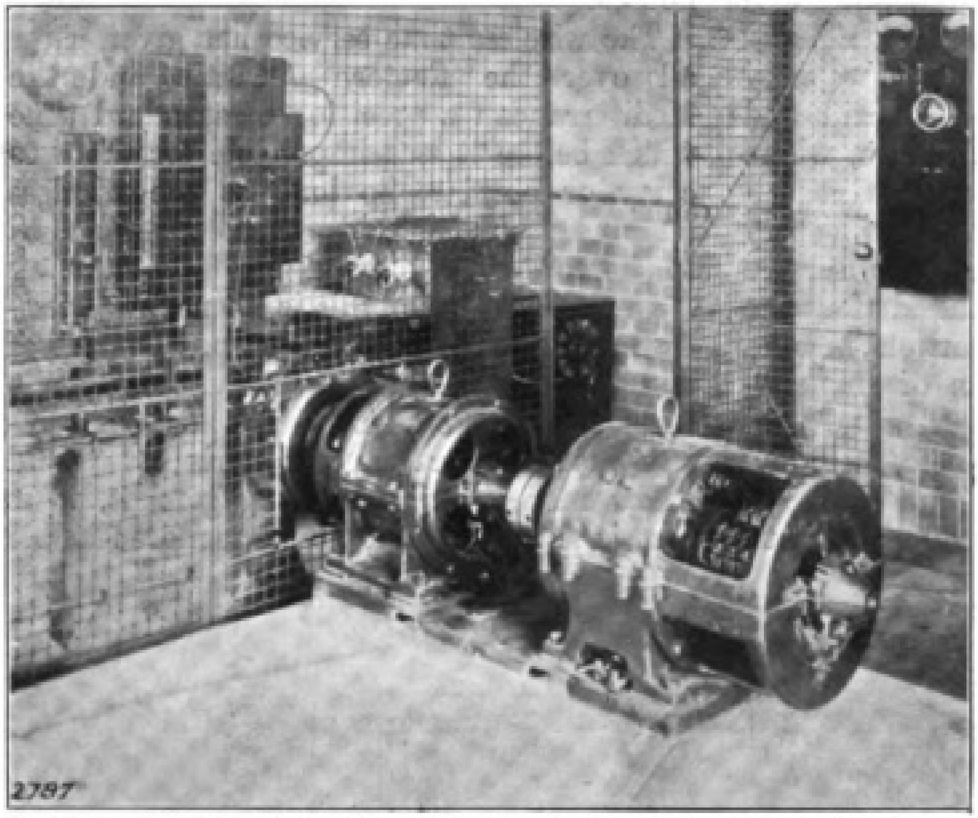


Fig. 6. St. Just Wireless Station Motor Alternator fitted with Rotating-disc Discharger and High-tension Apparatus.

With regard to the receiving set in conjunction with the multiple tuner, either a magnetic detector or crystal detector may be used. The arrangement of the air-transformer, with a split secondary winding having the telephones at the split and the crystal detector across the outer terminals, was suggested by Mr. J. E. Taylor, and follows the arrangement used for coherer jiggers. This set has, however, only been installed temporarily, and will be superseded later by a standard set as at Fishguard.

In tuning up the station and testing with Crookhaven, 200 miles west, the signals were given: "Clear as a bell and very strong." A boat, 300 miles west, gave the signals as strong. It is impossible to say exactly at present what the range of the station is, but it is considerably in excess of that of Fishguard.

The following is a list of the stations which comprise the Post Office scheme :—

CULLERCOATS.

NORTH FORELAND.—The power plant to be duplicated and the existing apparatus improved.

NITON.—A new station to be built to replace the existing one and the power to be increased from ¼ kw. to 1½ kw.

LIZARD.—A new station to be built at St. Just to replace the Lizard, and the power to be increased from ½ kw. to 5 kw.

ROSSLARE.—A new station to be built at Fishguard to replace the Rosslare station and the power to be 3 kw. instead of ½ kw.

MALIN HEAD.—A new station to be built to replace the existing one and the power to be increased from ½ kw. to 5 kw.

VALENCIA.—A new 10 kw. station to be built on Valencia Island.

A musical note is provided for the last five stations, the spark frequencies being 300, 400, 300, 400 and 600, respectively in the order given.

Malin Head will follow closely the design of St. Just, but there will be only one mast and one aerial instead of two.

Malin Head, Valencia, and Niton Wireless Stations will be completed early this year.

A Time-Signal Receiver

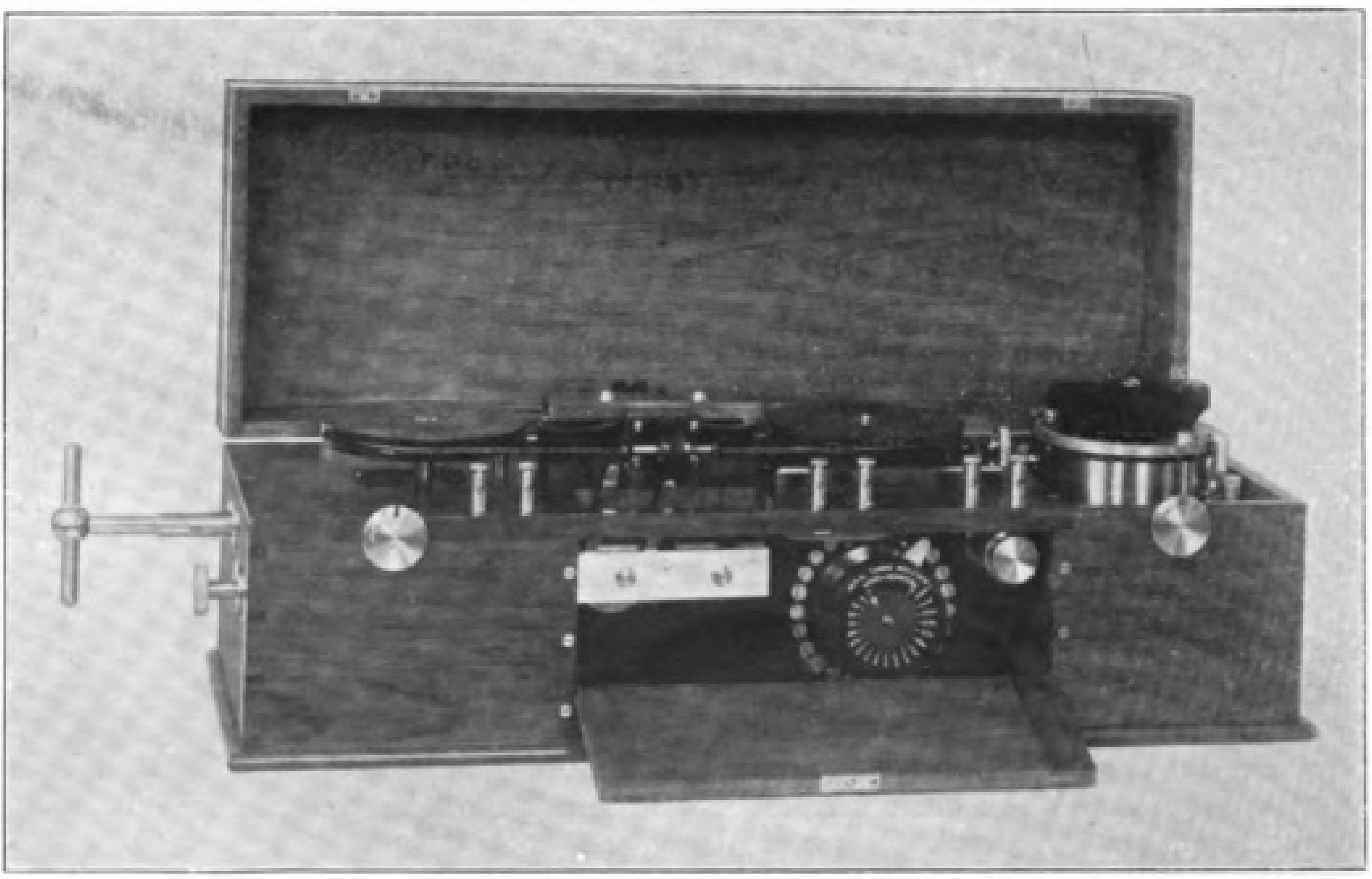
IT will come as welcome news to a great many readers of this magazine that there is now available a complete Time-Signal receiving set which is manufactured in the Marconi Works at Chelmsford. The type which is here described has already been supplied to a number of "amateurs" and others who wish to receive time signals, and among the most prominent users we may mention the observatories of Madrid and Ucele, the latter a town in Belgium, where the Royal Observatory is situated.

We need not here enter into the history of the establishment of the time service which has created the demand for the apparatus we describe in this article, beyond saying that it is the outcome of an international conference held at Paris, and that it has been welcomed by scientists, including the Astronomer Royal.

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.

The wireless time service has given ships all over the Eastern Atlantic and the Mediterranean a precision of standard time which before it was impossible for them to carry or obtain. So long as the wireless remains at work the chronometer is relegated to the position of a stand-by.

In times of peace this is no mean advantage to the security of the ship. In time of war it may well prove invaluable. While there may be some doubt whether the wireless receivers or the chronometers would suffer more in a naval engagement, it is certain at least that it would be more feasible



The Marconi Time-Signal Receiver.

to re-establish the wireless than the chronometers. Moreover, a ship beyond the range of wireless time signals—if such a thing be possible in the near future—is able to exchange its knowledge of Greenwich time with any ship in range. Wireless has played a spectacular part in mitigating disaster at sea; it seems destined in the future to play the better part of preventing it, by ensuring that a ship need never be in doubt about its longitude. These advantages are not now exclusively enjoyed by ships, for, with the Marconi Time-Signal Receiver, it is just as simple a matter to receive the signals on land as it is on board ship. Indeed, the work of the Brazil-Bolivia Boundary Commission described in the December number of THE WIRELESS WORLD, and referred to again in this issue under "Notes of the Month," furnishes a striking illustration of the use to which the apparatus may be put and the advantages accruing from its use.

There can be no question, therefore, as to the need for the Marconi Time-Signal Receiver. The apparatus has been carefully designed and constructed, and in every respect well maintains the high standard of all apparatus manufactured at the famous Chelmsford works.

It is an entirely self-contained apparatus, the detector, tuning condenser and inductance being mounted in the same case, which measures 1 foot 10½ inches by 7¾ inches by 8¼ inches over all.

The magnetic detector consists of a soft iron band moving at a uniform rate in the magnetic field provided by two permanent magnets; this band passes through a glass tube carrying a primary winding connected to the aerial circuit through terminals, while a secondary winding connected to the headgear telephones is carried on an ebonite bobbin placed over the centre of the primary. The band is composed of a large number of strands of fine gauge silk-covered soft iron wire, loosely twisted together, and covered with vaseline; it passes as an endless band round two ebonite pulleys—one driven by clockwork in the base of the instrument, and the other running free.

The arrangement of primary and secondary windings with their corresponding terminals is duplicated on the receiver, so that in the event of damage to the windings on one side the opposite set can be employed.

A hinged lid is fitted on the case to protect the band, windings and other external parts from dust or breakage.

The aerial tuning inductance comprises a solenoid winding of insulated wire with tappings leading to a controller switch with 21 contacts, giving a wide range of finely graduated adjustment. The tuning condenser is of the disc pattern, giving continuously-variable adjustment over the range of capacity required.

The method of connecting up and using the instruments is very simple. It is necessary to point out that the receiver should not be connected directly to the aerial when the aerial is also being used for transmitting; in such cases it should be connected by a suitable switch.

The range of wave-lengths received on this instrument is approximately from 100 to 2,500 metres, but the limits of this range will vary with the aerial installed, the minimum wave-length received by the detector being a little more than half the fundamental wave-length of the aerial.

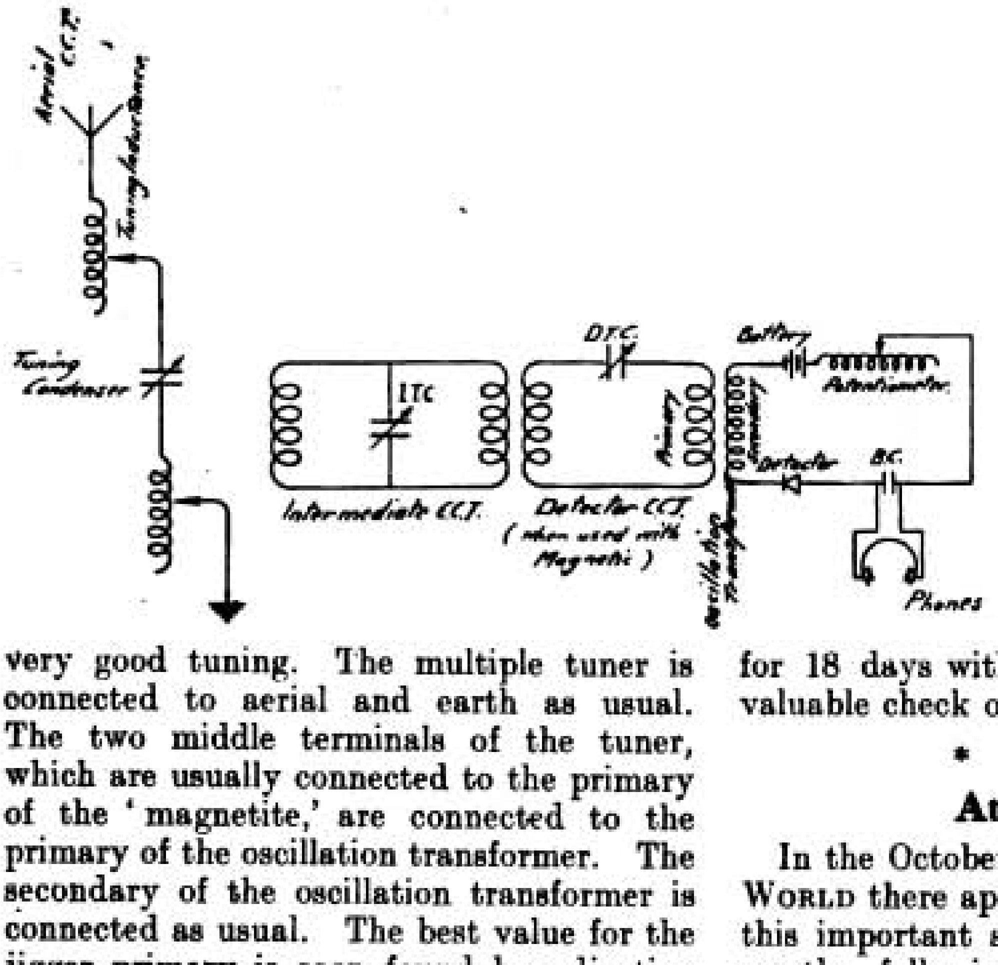
Another form of this apparatus which will be even cheaper than that described will be ready shortly.

The *Financial Times* is informed by the Canadian Government Emigration Office that when the new chain in wireless stations, now in course of construction by the Canadian Government, is finished and in operation it will be possible for a passenger on any incoming steamship to communicate from mid-ocean as far inland as Fort William. In connection with supplementing the service the wireless station on the Tarte Pier is to be newly equipped with apparatus having a longer range. All down the river and gulf the Government stations are in regular operation, while the new ones being built at Toronto, Kingston and Port Burwell will soon be completed, and the latter will be in operation during the winter. With eight powerful stations on the Great Lakes operating in conjunction with those at Montreal, Quebec and on the sea, the wireless system on Canadian waterways will thus be complete and second to none in range and efficiency.

Practical Problems

On Tuning.

"SYNTONY," writing from the s.s. *Chagres* in the Caribbean Sea, on October 21st, states: "The communication which you published in your October issue, signed 'Operator,' interested me very much. To supplement his experience I may remark that by using an oscillation transformer in conjunction with the multiple tuner and a crystal detector I have obtained



very good tuning. The multiple tuner is connected to aerial and earth as usual. The two middle terminals of the tuner, which are usually connected to the primary of the 'magnetite,' are connected to the primary of the oscillation transformer. The secondary of the oscillation transformer is connected as usual. The best value for the jigger primary is soon found by adjusting till signals are strongest, and when found needs very little adjusting. By using the 'tune' side of the multiple (making full use of the intensifier handle) and loose coupling the jigger, jamming even at night can be very nearly overcome, and X's 'come in' no stronger than they would on the magnetic.

"As an example:—In working Bowden, Jamaica, the signals of s.s. *Prinz Auguste Wilhelm* could be completely 'tuned out,' although this could not be done on the magnetic detector working with the multiple tuner. (D S B was much nearer than Bowden.)"

* * *

Checking Chronometers.

Mr. A. W. Wyett writes from the *Mooltan* as follows: "Allow me to report a novel occurrence, which I think is the first on record. When off Cape Guardafui, the captain of the Shaw, Saville & Albion s.s. *Waimana* sent an M S G for G M T. The following was adopted to transmit same to him. A fixed time was sent across to the *Waimana*, whose second officer 'stood by' his chronometers, and the operator was standing by, waiting for me to send the word 'stop.' Our second officer gave me a minute's warning, and on the stroke of the aforesaid fixed time I sent 'stop.' This was repeated, and both times was highly successful. As the *Waimana* was at sea for 18 days without a time ball it was a valuable check on her chronometers."

* * *

Atmospherics.

In the October number of THE WIRELESS WORLD there appeared a communication on this important subject, which has brought us the following remarks from R. A. S. Writing from Basreh on November 9th, 1913, he states:

"I should like to contribute my experience in the Persian Gulf. During six months' observations I found that the conditions here are more varied than those mentioned by W. P. S. Whilst lying at Busreh, I noticed that the strength of signals of the station at Jask (bearing S.E. by E. from Busreh) would be strong enough to read with the telephones 2 feet away for a period of about one minute, then decrease until signals were inaudible for a period of about a minute, increasing again until signals were strong, during which time I also noticed that the strength of signals of Port Said remained constant. (Port Said bearing W. by N. from Busreh). I also noticed at times that the strength of signals from both stations would increase and decrease simultaneously, whilst at other times the conditions were similar to those mentioned by W. S. P., during which time the strength of signals from ships in the Red Sea remained constant. At first I thought it must be due either to the hot or damp winds experienced during the hot weather, but since the cool weather has set in the same conditions occur, as they do also when the atmosphere is dry. I do not see how it can be the ether surging, as I have known signals to be inaudible for an hour or more then increase to strong signals from the above-mentioned places simultaneously. I hope this information may be of some value to all who may be interested in the investigation of the phenomena of such conditions."

* * *

Mr. W. P. Spurgeon writes to us as follows: "In the October number of THE WIRELESS WORLD you kindly published a letter from me in which I suggested that there may exist some relationship between the variations in solar phenomena and the conditions of the earth's atmosphere for wireless purposes. In the November number Dr. Eccles remarks: 'There is nothing unreasonable in supposing that the sun, let us say, may send us occasional electric waves,' and goes on to add that electric discharges may be produced in the formation and collapse of a solar prominence of sufficient magnitude to create waves which would affect a wireless receiver, thus forming a proportion of our strays. It was not exactly in that light, however, that the idea had presented itself to me. It has long been an observed fact that the variations in solar phenomena—sunspots, faculæ, prominences and the corona—correspond very closely with the earth's magnetic and electrical variations, and also with the auroral displays, though the exact nature of the connection still needs to be discovered. It seems therefore quite probable that the link which obviously exists between the sun and the earth in those respects should also exist in respect to atmospheric conditions as affecting radiotelegraphy. This supposition was recently supported by a short notice in one of the daily papers on Dr. Mawson's expedition. It was stated that the station at Macquarie Island experienced the greatest difficulty in communicating with Hobart when the auroral displays were most intense—at times finding communication quite impossible. It was not stated whether the difficulty was due to strays or a weakening of the received signals—an interesting point. Of course, the difficulty may not have been due to the auroræ directly, but possibly to some accompanying phenomena. It is just conceivable that the auroral discharges (if the term is permissible) may produce electric waves which would affect a wireless receiver; but as they are more in the nature of the glow of a vacuum tube, it is not very probable—though, as I say, just possible—that anything in the form of oscillations would be produced. However, these are the points which need observation and not mere supposition.

"The investigation of the causes of the variation in the strength of received signals will probably be more difficult than that of atmospherics, for the former phenomenon is of a momentary character, and often only observed while receiving from another station, when it would be difficult accurately to record the changes; while the latter, much to the annoyance of the operator, affords plenty of time for detailed observation. In my former letter I remarked that the variation in signal strength gave the impression of a rapid motion of the ether. Of course, it was only an impression, as any motion sufficient to affect signals in that way would at once betray itself in causing a variation in light waves—a variation not discoverable in optical measurements. It is quite probable that the effect is due to a bank of ionised air passing between the stations, and by its reflecting a portion of the wave energy reducing the received energy to a greater or less extent, proportional to the degree of its ionisation. Here, again, observation is needed.

"One is very pleased to note that such bodies as the Admiralty, the Post Office, and the Marconi Co. will be assisting the investigations of the B.A. Committee. As Dr. Eccles says, one will be surprised and disappointed if some interesting and valuable data is not shortly forthcoming, and an announcement by the Committee as to the line of investigation is eagerly awaited."

NOTES OF THE MONTH

GREETINGS BY WIRELESS. DETERMINING LONGITUDE BY MEANS OF WIRELESS. RADIO-TELEPHONY AND TELEPATHY. TRAINING OF TERRITORIALS. THE SHARE MARKET.

AT the New Year we always expect to receive some report of the part wireless telegraphy has played in the season's festivities, and as usual we were not disappointed, though the information reached us too late for publication in the last issue of THE WIRELESS WORLD. As was to be expected this effective method of sending greetings was largely utilised by those who had friends at sea; and only those who have been forced to make a voyage at a time which is usually given up to family reunions and convivialities can realise the delight which such messages bring to their recipients. They were more numerous than ever this year, and have easily established a record.

* * *

News was received in London early last month from the Bolivian Survey Commission, dated Abuna River, November 25th, announcing the fact that Commander Herbert A. Edwards, the officer who was lent by the British Government for a period of three years, to command that Commission, has once more reached civilisation and completed over 200 miles of frontier survey. Commander Edwards and his party, whose duty was to survey mostly unknown country, the disputed frontier between Bolivia and Brazil, had travelled up the Abuna River to a settlement called Santa Rosa, whence they cut across country to meet another section of the Commission. Both parties then returned down the Abuna on the completion of the survey. The work of the Commission was described in the December number of THE WIRELESS WORLD, and the interesting fact which we are now able to announce forms a useful supplement to that article.

* * *

The great achievement of the expedition is that they fixed all their longitudes by time signals sent by wireless telegraphy from the Marconi station Porto Velho, situated 120 miles from the base of operations. A party was left at Porto Velho, and, by the courtesy of the Brazilian Government, time-signals were sent every night. Commander Edwards carried with him a receiving set and a long wire, which was rigged up on trees. He has proved that wireless telegraphy will enable the explorer to dispense with chronometers, and easily and accurately fix all longitudes. Commander Edwards says this will begin a new era in exploratory surveying. He eulogises the work of a wireless expert, Mr. Chapman, who laboured night and day to make the experiment successful. In the course of his work this gentleman had terrible experiences with hornets, ants, and other pests. He was provided with climbing irons on his legs in order to ascend the highest trees. The Commissioners have still to erect boundary marks along a portion of the frontier, but the commencement of the rains will render it impossible to deal, this year, with a section of forty miles of frontier which it was hoped would be covered during the present season.

* * *

Mr. Burton F. Babcock, of Syracuse, New York, has called attention in the *Electrical World* to what is described as "some interesting original observations concerning radio-telephony." He states: "I believe it has been my good fortune to make a discovery in wireless electricity which will astonish the civilised world when it has been thoroughly tested. A few hundred volts of wireless, controlled into small, strong continuous current only a few inches in diameter, will not only convey sound in the form of ordinary conversation, but will transfer thought from brain to brain. When accustomed to this method of communication a conversation can be carried on at a distance of several miles without any audible sounds whatever. Bodily pain inflicted on one person in the current is instantly felt by the other to almost an equal extent. Please notify some expert electricians in order that all may learn its possibilities." In publishing this extract from our contemporary, we have only one comment to make. There are many who believe—and who shall say that they are indubitably wrong?—that the next great discovery in science will have to do with the correlation of the theory of wave-motion and the scattered facts of telepathy. We do not scoff at them or their belief; but neither we, nor they, will be disposed, we think, to feel that the great tidings for which they wait have come from Syracuse, New York.

* * *

Paris and Washington are 279 feet farther away from one another than they were a year ago, or at any rate than they were believed to be a year ago. Such appears to be the net result of the attempts made by MM. Renaud and Bourgeois and the calculators of the French and United States Naval Departments to arrive at a new and more precise determination, by the aid of wireless telegraphy, of the difference in longitude between Paris and Washington. The radio-telegraphic messages were sent out respectively by the wireless stations at the Eiffel Tower and at Arlington, U.S.A., between which is a distance of 6,175 kilometres, or approximately 3,860 miles. From each station 300 signals were sent out, spaced at time intervals varying from 1 sec. to one-one hundred and twentieth of a second. Out of twelve trials to effect this interchange of messages three were quite useless, five were fair, and two only, the series sent on March 28th and on April 1st, were completely satisfactory. The time of the double transmission between the two stations, the round trip, as the Americans would say, was estimated as either 0.066 sec. or 0.063 sec., and the latter of these figures was accepted as the more accurate.

* * *

A report appears in the Press that it is proposed to hold a conference at the War Office with a view of formulating a scheme for the efficient training and practice of wireless telegraphy detachments of the Territorial Force. If the report is correct it certainly marks a step in the right direction. In developments of this kind the Territorials frequently go ahead with an enthusiasm backed up by genuine scientific attainment. This is perhaps peculiarly the case with wireless, in connection with which several corps have equipments. The Royal Engineers may justly claim to have kept themselves well abreast of the latest developments in this direction, but between this and controlling the progress of the Territorials—many of them very advanced students in this branch—there is a distinction with a difference which the War Office has done well to recognise. A satisfactory result of the proposed conference would be the elevation of Territorials really proficient in wireless to some sort of special position as instructors instead of allowing them to continue to some extent *in statu pupillari*. Meanwhile attention may be drawn to the announcement which appears on another page regarding the examination which we propose to hold for those members of the Territorial Forces who have followed the series of instructional articles that have appeared in this magazine during the past months.

* * *

That magnificent gift of the Colony of New Zealand to the Mother Country, in the shape of a battle cruiser for service in the Imperial Navy, recently made a short stay at Port of Spain, Trinidad. Wireless news was received two days before she was due announcing the date of her arrival, and she duly dropped anchor to the very minute advised. The people of Trinidad were not lacking in their appreciation of the visit, and the following wireless message from the captain of the *New Zealand*, received by the Governor after the vessel's departure, is an acknowledgment of Trinidad's efforts: "Good-bye; we leave Trinidad with regret after a most delightful stay, and we are all most grateful for what has been done for us."

The Share Market.

January 21st.

There has been a decided recovery in the Marconi Share market due to a better state of stock markets, and also to the Convention signed by the Maritime Powers with reference to a more universal use of wireless installations on ships.

Closing prices to-day are:—Marconi Ordinary, £3 17s. 6d.; Marconi Preference, £3 2s. 6d.; Canadian Marconi, 9s. 6d.; Spanish and General, 11s. 3d.; American Marconi, £1 1s. 3d.: Marconi International, £1 11s. 3d.

Maritime Wireless Telegraphy

DURING the winter months fresh records of disaster and rescue-work are always added to the annals of the sea; but it is comforting to learn that the percentage of life saved is continually on the increase. As a matter of fact, such a statement errs on the side of an under-estimate, for it is not too much to say that this percentage has increased by leaps and bounds since the advent of wireless telegraphy, and the more widely this great safeguard is adopted the greater will be the increased security of those travelling by sea. Two particular instances of its efficacy have recently come to the notice of the public—the one is the rescue of the steamship *Tasman*, the other is that of the oilship *Oklahoma*.

* * *

On Monday, December 29th, news came through to the wireless station at Melbourne that the *Tasman*, a passenger vessel trading between Australia and Batavia and belonging to the Koninklijke Paketraart Maatschappij, had run ashore near Bramble Bay in the Gulf of Papua. She was in a dangerous position, her bottom ripped up on the jagged points of the sunken reefs which make this part of the coast particularly difficult to navigate, and the message went on to say that there was already fifteen feet of water in the hold, and that it was gaining rapidly. As soon as the information was received it was distributed broadcast to the ports, and as a result a Japanese steamer left Thursday Island without delay and raced under full steam to the assistance of the disabled vessel.

* * *

By this time the heavy seas which had been raging were somewhat abated, so that the rescuing vessel was able, after many strenuous attempts, to get the *Tasman* safely off the reef, when it was found that, though badly damaged, she might yet be able to finish the journey under her own steam; this she did, and safely reached Soerabaya, her ultimate destination. The adventure, which, to the gratification of everyone, terminated so happily, was of particular interest to the public owing to the fact that the celebrated prima donna, Mme. Nordica, was on board the *Tasman*.

* * *

The first news of the wreck of the *Oklahoma* was received in New York on Sunday, January 4th, when a wireless message came through from the Spanish steamer *Manuel Calvo* that a steamer with some undistinguishable name was sinking to the south of Nantucket. The difficulty of identifying the vessel caused the gravest anxiety, for she reported that the *Oklahoma* had already lowered lifeboats, which had been swamped, and the *Manuel Calvo* was unable to render any assistance, although she was standing by. But the exact state of affairs came to light a few days later when the British freight steamer *Gregory* reached New York with five of the crew of the *Oklahoma* aboard. They were found in a small boat on Sunday afternoon a few miles from the scene of the disaster.

* * *

The survivors told a harrowing story of hardship and suffering. The *Oklahoma* was struck early on Sunday morning by a gigantic wave which broke her in two. Many of the men were asleep in their berths, when a crashing and rending sound warned them that disaster had overtaken the ship. They rushed on deck to find the after half of the vessel sinking, with the propellers whirling high in the air. The two boats were thrown rather than lowered into the sea, and into these the majority of the crew of 32 sprang. By a miracle they escaped being cut to pieces by the screw, which a few moments later plunged beneath the seas with the rest of the stern half of the steamer. One of the boats, containing 11 men, capsized. It righted, however, and six men succeeded in climbing into it. They kept the boat floating by baling the icy water with their hands until the afternoon when they were sighted and rescued by the *Gregory*. The second boat was picked up by the revenue cutter *Seneca*. It contained three bodies only.

Captain Gunter, of the *Oklahoma*, and seven other survivors were taken on board the Hamburg and American freighter *Bavaria*, and reached Boston safely on January 7th. They were only rescued in the nick of time, for the forward part of the hull of the wrecked tanker on which they had taken refuge was on the verge of sinking, and the whole of the evidence goes to prove that their ultimate safety is due entirely to the services rendered by wireless telegraphy, for although the *Calvo* did her level best to help the crew of the *Oklahoma* she was powerless to effect rescue, for this could only be achieved by the more powerful ships which she summoned by her wireless, and, as reports show, these arrived not a moment too soon.

* * *

Even as we go to press the report has come through of another maritime disaster during the recent storms. On January 13th the Royal Mail steamer *Cobequid* ran aground on the sunken Trinity reefs, near Yarmouth, just at the entrance to the Bay of Fundy. It appears that the vessel lost its bearings in a blizzard and struck the reef at 5 a.m. on Tuesday morning (January 13th). Immediately, Captain Lawson, the commander of the *Cobequid*, ordered the wireless operator to send out the S.O.S. signal, which was received by the wireless station at Cape Sable, whence the message was distributed broadcast. It was immediately received by the *Kronprinzessin Cecilie*, and on its receipt the vessel went to the aid of the distressed ship. Some difficulty, however, was experienced in finding her, owing to the fact that the *Cobequid* was 100 miles out of her bearing. In the meantime other vessels engaged in the search, notably the *Belvedere*, which at the time of receiving the news was making her way from Belfast to New York, while the Government steamer *Laurier*, another, the *Lansdowne*, and two tugs besides the Revenue cutter *Woodbury* (which was cruising 100 miles away) joined in the search. A little later the coastal steamers *Westport* and *John L. Cann*, also put out. When the *Cobequid* was reached she was found still clinging to the ledges, but there was a large hole in her stern, and terrific seas were sweeping over her. The inrushing water had disabled the engines and stopped the working of the dynamos, while the vessel was sheathed in ice. Soon other vessels came within sight, including the British steamer *Rappahannock* (which helped in saving the survivors of the burning steamer *Volturno* in mid-Atlantic in October last) and the steamship *Aberdeen*.

J. W. Hitchner, Senior Wireless Operator on board s.s. "Cobequid"

* * *

As soon as the violence of the storm had abated somewhat the work of rescue commenced, the *Westport* and the *John L. Cann* taking the most active part, while the other vessels stood round so as to act as a breakwater against the high sea. While those on board the *Cobequid* were being lowered by ropes into the lifeboats, the most dextrous handling was required to prevent such small craft being capsized. The first boatload left for the rescuing steamers at seven o'clock on Thursday morning (January 15th), and by 7.30 all had been taken aboard the ships, except the captain and eleven of the men who elected to remain in the hope that they might save some part of the cargo. Later in the day, however, they, too, were taken off by the s.s. *Aberdeen*. Of the total number of passengers and crew, the *Westport* saved seventy-two and the *John L. Cann* twenty-four. Thus ends happily the tale of one of the most exciting and difficult of rescues in the annuals of the sea, which, but for the services of wireless telegraphy, could never have been achieved. How else could the search have been instituted for the lost vessel, or so many sister ships have responded so quickly and efficiently to the call for aid?

Mr. Ernest Shrimpton, Junior Operator s.s. "Cobequid"

Contract News

Marconi's Wireless Telegraph Company are fitting the steamship *Prudente* (call letters SRV) belonging to the Lloyd Brazileiro line with a 1 kw. set. The vessel is engaged in the Brazilian coastal trade.

* * *

Standard ½ kw. ship sets with emergency gear have been installed by the Marconi Wireless Telegraph Company of Canada, Ltd., on the *Lurcher* lightship and the Fisheries Protection cruiser *Simcoe*. Both vessels belong to the Canadian Government, and additional interest is given to the announcement by the fact that one of the first tasks that the installation on the *Lurcher* was called upon to perform was to assist in the rescue of the steamship *Cobequid*, which on January 13th ult. ran ashore on the Trinity Ledges, which guard the entrance to the Bay of Fundy, where the *Lurcher* is stationed. The call letters of the *Lurcher* are VDR, those of the *Simcoe* VDS.

* * *

Messrs. Holliday Bros., of Quebec, have arranged for the installation of a 1½ kw. and emergency set on their steamship *Aranmore* by the Marconi Wireless Telegraph Company of Canada.

Orders have been received by the Société Anonyme Internationale de Télégraphie sans Fil to equip the following Vessels :—

Name of Vessel.	Owners.
Arakan	Rotterdamsche Lloyd
Djember	" "
Insulinde	" "
Jacatra	" "
Banka	Stoomvaart Maatschappij Nederland
Baweau	" " " "
Boeroe	" " " "
Prins der Nederlanden	" " " "
Riouw	" " " "
Roepat	" " " "
Rondo	" " " "
Rotti	" " " "
Francoli	Linea Tintore (Barcelona)
Torre-Blanca	" " "
Tubantia	Koninklijke Hollansche Lloyd
Guine	Empreza Nacional de Navegaçao
Witte Zee	Smit Sleepdienst
Zwarte Zee	" "
Statendam	Holland Amerika Lijn
Noordwijk	Erhardt and Dekkers (Rotterdam)
TJI Kembang	Java China Japan Line
TJI Bondari	" "
Colgate	W. Wilhelmsen (Toensberg)
Shoss	" " "
M. S. Elbrus	Société Anonyme d'Armement d'Industrie et de Commerce
Rotterdam	The American Petroleum Company

The following Vessels have been equipped by the Debeg Co.:—

Name of Vessel.	Owners.	Type of Installation.	Call Letters.
Thessaloniki	National Steam Navigation Co. of Greece	1½ kw. and emergency	SVK
Frederick VIII.	Det Forenede Dampskibselskab	" "	—
Werdenfels	Hansa Line	" "	DWF
Marksburg	" "	" "	DMU
Kattenturm	" "	" "	DNT
Arensburg	" "	" "	DAG
Stolzenfels	" "	" "	DOE
Delphia	D.A.P.G.	" "	DPH
Italia	Kunstmann Line	" "	DJL
Pfalz	Lloyd Line	" "	DPA
Bolama	Empreza Nacional de Navegaçao	½ kw. and emergency	CSO
Loanda	" " "	" "	CSL
Funchal	" " "	" "	CSF
Sitges	Sitges Freres	" "	EFS

La Compagnie Française Maritime et Coloniale de Télégraphie sans Fil has received orders to equip the following vessels :—

Name of Vessel.	Owners.
Antilles	La Compagnie Générale Transatlantique
Haiti	
Puerto-Rico	
Saint Domingue	
Duc d'Aumale	
Martinique	
Moise	
Ville de Barcelone	
Ville de Bone	
Ville de Madrid	
Ville de Naples	
Ville d'Oran	
Ville de Tunis	
Amiral Villaret de Joyeuse	La Compagnie des Chargeurs Réunis
Amiral Rigault de Genouilly	
Amiral Sallandrouze de Lamornaix	
Amiral Troude	
Augo	
Bougainville	
Champlain	
Dupleix	
Ceylan	
Malte	
Ouessant	
Theodore Mantz	La Compagnie de Navigation Mixte
Corsica	La Compagnie Fraissinet
Corte II.	
Golo	
Iberia	
Italia	
Liamone	
Numidia	
Anatolie	La Compagnie de Navigation Paquet
Ionie	
Medie	
Mingrelie	
Phrygie	

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

SHIPS FITTED WITH $1\frac{1}{2}$ KW. AND EMERGENCY APPARATUS.

Name of Vessel.	Owners.
Salamis	Andrew Weir & Co.
Barneson	" "
Highland Enterprise ..	Nelson Line
Highland Heather	" "
Westmeath	New Zealand Shipping Co.
Calgarian	Allan Line
Chinkoa	British India Steam Navigation Co.
Palermo	P. & O. Line
Llanstephan Castle	Union Castle Line
Star of Victoria	J. P. Corry & Co.
Crown of Toledo	Prentice, Service & Henderson
Patrician	T. & J. Harrison
San Fraterno	Eagle Oil Transport Co., Ltd.
San Eduardo	" " "

SHIPS FITTED WITH $\frac{1}{2}$ KW. AND EMERGENCY APPARATUS.

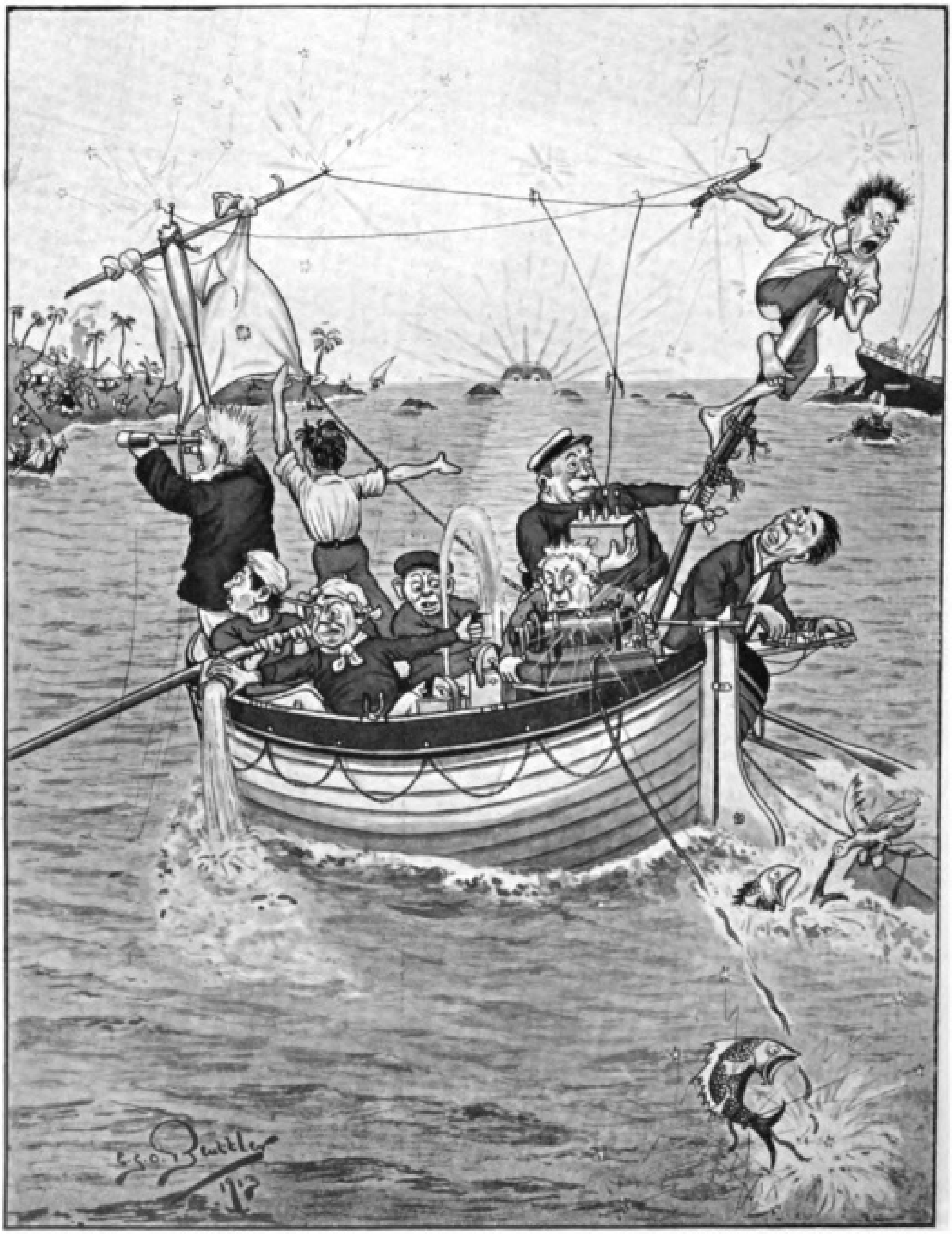
Moto	Pelton Steamship Company
Linnet	Liverpool Salvage Association
Filey	Hull Steam Fishing and Ice Co.
Bempton	" " "
Potaro (refit)	Royal Mail Steam Packet Company

A $\frac{1}{2}$ kw. and emergency set has also been installed in the South Wales Wireless College, Cardiff, belonging to the Northern Wireless Schools, Ltd.

The New Lightship "ALARM" now in position on the Mersey Bar Station. She has a light of 40,000 candle-power and is fitted with a Wireless Installation and a Submarine Bell. A Wireless Installation has also been erected at the Dock Office to place both the Bar and the Formby Lightship in communication with the Dock Office Building.

CARTOON OF THE MONTH

WIRELESS WORRIES—II.



A Shipwrecked Boat's Crew attempting to send an "S.O.S." Message with the Emergency Gear.

A Successful Venture in Wireless Telegraphy by the Rotterdam River Police

SOMEHOW it seems disrespectful to think of Holland as a country which harbours thieves and vagabonds. To the popular imagination it is flat and green, with many canals and streams traversing the country, and here and there a windmill, while the people are a placid and contented race, clothed, according to their sex, either in baggy trousers or voluminous petticoats, some of them smoking huge cigars or mammoth pipes. But the recent notice which the Rotterdam police have brought upon themselves by their enterprising venture into wireless telegraphy has tended to dispel that illusion. Rotterdam police. What are they there for ?

It must needs be that where police are required there wrongdoers and lawbreakers exist, but they will be cute folk who will elude these vigilant agents of the Dutch law, and if they succeed in doing so, they will ymerit their freedom, for the fact that the have escaped justice will show them to be exttemely clever knaves.

This prologue has been inspired by an account which we have received of the suc cessful installation of wireless telegraphy on two of the small boats and on the floating

The Steamboat of the Rotterdam River Police, the "Politie II.," fitted with Marconi apparatus offices of the Rotterdam river police. The task was undertaken by the Société Anonyme Internationale de Télégraphie sans Fil, although, owing to the nature of the requirements, the work was of no little difficulty. Everything has gone smoothly, and the latest reports show nothing but praise as regards the working of the apparatus. The reason for its installation was the fact that the work of the police in this large harbour was considerably impeded by the amount of time wasted in the transmission of information and in waiting for instructions from headquarters. Now the boats can make their way to any part in the harbour, and either send information by wireless to headquarters and receive instructions, or they could be called up at any moment to take a part in some of the many plans which are set on foot and which require instant carrying out. The chief difficulty in the installation of the wireless was not so much that of distance, for the maximum amount of range required was about 10 kilometres, but in the need there was to overcome any obstructions which might happen to lie between any two of the vessels, such as buildings, large steamers, bridges, etc., and another necessity was to prevent any interference from the high-power stations in the neighbourhood. Perhaps the intricate nature of the work will be understood when the class of vessel in which the installations were installed has been described. The two police boats are very small. One is a motor boat about 20 metres in length, provided with two hinged masts 10 metres high, the distance between them being also 10 metres. The idea of the hinged mast is obvious, namely, in order that the vessels may be able to pass under the arches of the low bridges which connect one part of the harbour with another, for, as every geographer knows well, Rotterdam is built on the delta of a river, and consequently the harbour is divided up, as it were, into sections by the diverging outlets. The other craft is an electric boat even smaller than its colleague, and provided with only one hinged mast of about the same height. The floating office, as our illustration shows, is a much larger affair, and the installation of a wireless set here was not nearly so difficult, for the mast which the office carries stands over 20 metres above the water line. On all three vessels it was decided to adopt a short range apparatus, and the wave length in each case was from about 80 to 100 metres. In this way any possible interference with the larger stations was avoided, and it was found that if the receiving and transmitting apparatus had been slightly readjusted that communication could be established and would work well—it did not matter in what part of the harbour any of the three craft might be. The S.A.I.T. may well be congratulated on the successful solution of a somewhat difficult problem.

The Floating Office of the Rotterdam River Police with the Electric Motor Boat, "Politie I," in the foreground—both fitted with Wireless.

A Pawn in the Game

(*Serial Story*)

By BERNARD C. WHITE

For Synopsis of the Characters in this story, see previous issues of Magazine.

CHAPTER XI.—(*cont.*)

A KINGDOM FOR A STAGE.

"YOU will reach Caister to-morrow morning, and I hope, as it is for the honour of your country, you will not object to hard work, and if necessary, over-work. We rely on your invention to give us a chance of self-defence, and as you may well guess, should it prove of any success to us you will be more than adequately indemnified for your trouble, and I have no reason to doubt but that you will win the thanks and gratitude of your country. As soon as anything is known with regard to the diplomatic situation you shall be informed. At present I have told you all there is to tell you. Now, good-night, Mr. Summers; I think I will take charge of these papers until to-morrow, so I have made arrangements for you to call here before you go to Caister."

Charles thanked him, and placing himself once more in the hands of his attendants, he re-entered the motor-car and was whizzed to a private hotel in Victoria, where a comfortable suite of rooms was awaiting him. He much wanted to write to his people in order to relieve any fears they might have on his account, but he was told that such a course could not be permitted until he received the sanction of the War Office. Therefore he had to be content with smoking his soul out in cigarettes and with the company of his far from rosy thoughts.

Nevertheless his was the better part as compared with that of the monotonous waiting for news his people were forced to endure; for he was called to action, and after the few hours at the hotel had dragged by, he had little time to think of anything but his work.

The following day, as had been arranged, he saw Sir Henry, and received back his bundle of papers. At the same time he asked about correspondence, and he was allowed to write a vague letter containing a certain amount of reassurance to his father, but he was told that in future all correspondence would have to be censored, and he was on no account to inform his people or anybody of his whereabouts, while any letters that they should send to him were to be forwarded to the War Office, and thence they would be despatched to him.

Caister is a name rather than a town. It is a miserable collection of straggling cottages, primeval in their construction, and forlorn in appearance. The few fisher people that live here have only one thing to be proud of, the wireless station in the vicinity; and the recent addition of rows of uncomfortable dwellings built for the workmen at the station have not improved the appearance of the place; rather they have made it a sorrier spectacle than ever it was before, for they have introduced an element of forlorn humanity, and thereby accentuated the abomination of desolation. Charles was accommodated in a little bungalow which had been erected especially for his convenience. It was clean but comfortless, and that was the best that could be said for it. Perhaps it was just as well, as it gave him no inclination to take things easily, and he was soon engrossed in his labours. Clever engineers and an able staff of workmen were at his disposal, and it was not long before the skeleton of a powerful airship was constructed in the hangar. Some difficulty was experienced in getting material that was light enough yet strong enough to bear the strain of the work it had to do, and the silk envelope was also a perplexity. These hindrances were, however, ultimately overcome, and in less than three weeks after commencing operations the enthusiastic band of workmen were exultant in the accomplishment of the framework of the machine. But they were not given long in the contemplation of their success; word came while yet the last bolts and switches were being adjusted that war had been declared, and any day the invasion of England might be commenced. Immediate fear was allayed somewhat by private information that the Germans were almost as unprepared for action as England. Mishap after mishap had interfered with their progress, and it was rumoured the Army had abandoned the idea of making an invasion by airship, and were going to rely solely upon their fleet of planes. This was extensive but not sufficiently powerful enough to make an invasion effectual. Therefore they were building as fast as they could, but it would be some weeks before anything like a serviceable number would be in readiness. Thereupon Charles and his men redoubled their energies. Apparatus was designed, constructed and used with incredible swiftness, yet not so fast as to interfere with perfect accuracy and workmanship. At last one night it was decided that a trial spin should take place, and the excitement in the little bungalow was intense. At 12 o'clock Charles took his place in the transmitting room of the station, where a temporary tower had been erected and a switch-board installed therein. Here, besides, was a long distance "sighter" of immense power, which was in itself a triumph of workmanship, representing the combined efforts of the best lens makers in the land to complete.

It had an immense telescopic range, and it worked in conjunction with a searchlight, which threw out a brilliant ray for miles, and would enable the operator to see clearly the manœuvres of the airship. Moreover, a special arrangement had been constructed so that it could be manipulated in conjunction with and at the same time as, the switchboard, so that it could keep in touch with the evolutions of the airship, and follow it about, keeping always its steady beam of light on the vessel, so that there was no danger of the operator losing sight of his machine in the prevailing darkness. Magnificent in the extreme was the sight of this vessel as it slowly emerged from the hangar, and climbed up the ladder of light penetrating into the night. As soon as Charles considered the elevation sufficient he manipulated the keys, and both searchlight and vessel swung round in combined motion, making great sweeps and curves, then plunged swiftly forward out over the sea until the machine looked little more than a mote in a sunbeam, glittering with light and twinkling brilliantly as it became more and more enveloped in the atmosphere. It was a spectacle that would have moved even the uninitiated, but to those who had had a hand in producing it and bringing it to this perfection it was a miracle. The excitement of the onlookers was intense, and reached a climax when Charles, after he was satisfied with the manœuvres, turned it round and steadied it towards the hangar, which it circumscribed, and then as easily as a bird with folded wings glided into the nest prepared for it. There was a roar of applause so exultant that even sleepy Caister outside the sacred precincts of the wireless station was half roused from oblivion by the confused echo of the tumult.

CHAPTER XII.

MUTUAL RELATIONSHIPS.

But to hark back to Sotheby. Things there were very dull indeed. Of course Charles's absence was soon noticed, but it was successfully explained away, and so supplied no source for the eternal stream of village gossip. Nevertheless for the Vicarage people it was a period of suspense which was hardly bearable, and only the ordinary day's work which had to be done afforded anything like a palliative to their strained nerves. With Gwen, however, it was different. She had so little to occupy herself with that she was forced to dwell on the incidents of the last few months, and something very like remorse made them loom appallingly large in the retrospect. They became ugly phantoms, grotesque and fantastic shapes, which lurked in the crevices of her brain, or spread their gloomy forebodings over her imagination. Realising that something had to be done to dispel them or that otherwise she would give way under the strain, she applied herself feverishly to outdoor sports and to the affairs of the house. More often than formerly she made journeys to town, and in fact did everything to take her out of herself. To a degree she was successful, but in the moments when she allowed herself to think the conviction grew upon her that Charles's present predicament was due in a large measure to her own want of thought and inconsiderate talking. But that was not her greatest trouble. She dared not think of her attitude to him on that momentous afternoon of the arrest. What a miserable little egotist she had been, and what suffering she must have caused him! She would have given anything now to cancel that last scene, but it was too late now. It was horrible to think of Charles with only that to look back upon. How she longed to be able to make atonement of some sort for her blind selfishness, but the wish she knew was futile; all she had to do was to grin and bear whatever fate had in store for her.

One consolation, however, she found, and she accepted it in her usual impetuous way. It was one little likely to have reassured Charles had he known of it; but perhaps it was as well he did not, for in his ignorance it did not affect him, and it at least afforded some relief to Gwen—that is to say, Gwen found more and more relief in the companionship of Braithwaite. It was like her to be perfectly unaware of the state of her own feelings, and had the bare idea of such a thing been imputed to her, she would have indignantly denied the reproach.

For the first few weeks after the departure of Charles, the young aide-de-camp had kept aloof as much as possible. Life, young though he was, had already taught him many lessons of the world, and in his intercourse with various women he had mastered all "the rules of the game." He was an apt learner, a keen observer, and he knew to a nicety the right thing to do at the right moment. Therefore he forebore to inflict his, as he guessed it would be, odious presence on the girl, knowing full well that when the first effects of the blow had subsided she would be glad of the society of a man of her own age, who besides had many interests in common with her own, and who knew the ins and outs of the present case. But it must not be imagined that Braithwaite was scheming and underhanded, or endeavouring to supplant Charles. He had no intention of doing such a thing, only he was attracted to the girl; chance had thrown him into her company, and he saw no reason why he should forego the pleasure of her society. He wanted it to be a mutual pleasure, therefore he took the proper means for that end, and ultimately he was successful in re-establishing the old footing of comradeship which had been so dramatically upset. At least, he was successful to a certain degree, but he was not slow to perceive that although to all appearances they were on the same terms of intimacy, there was a "something" which divided them. Gwen was not so spontaneous. She never let herself go as she had done before. Often when it seemed they were particularly friendly, she would suddenly rein herself in and resume the defensive attitude. Such action Braithwaite interpreted to himself as self-consciousness, and to some extent he was right, but the egotist which is in every man blinded him to the fact that this self-consciousness sprang from a finer motive. For Gwen was learning how much her old lover was to her; she missed him terribly. Braithwaite served very well as a substitute, as a means whereby she might disburden herself of some of her present anxieties, but he was to be no more, and it was only when the impetuous girl in her was uppermost that she allowed herself the luxury of his sympathy. Often at such times she would suddenly recollect that she was a woman, with her own responsibilities both to herself and her lover, and then Braithwaite would be thrust again into the background to make what he might of her moodiness.

In this way, she imagined—whenever she gave her actions a moment's thought—that she was playing her proper part as *fiancée* of the man whose ring she wore on her finger. But here it was her ingenuousness which thus deceived her, for had she been more worldly-wise she would have known that no conduct on her part was more likely to urge on the man she did not love. Truth to tell, she was very innocently, and albeit very successfully, playing the part of the coquette, and was fanning the flame of Braithwaite's mild affection into ardour by her frequent gusts of friendliness and disdain. Such was the actual state of affairs; but to themselves, because they were not metaphysicians, it merely seemed that they met and parted like ordinary folk, discussed things in the ordinary way, and generally made the best of present circumstances.

Meanwhile Charles, at Caister, had discarded all personality, and only the scientist in him remained alive. Sterling lover though he was, his personal affairs always came second to his work. Whenever the call of science reached him it became the dominant influence, and there was no room for anything else. All other interests had to be put aside till the call had been answered. It never occurred to him that he was a man before he was a machine, and that as a human entity he had duties and responsibilities which were of equal importance with his scientific work, and that, looked at in its true light, complete absorption in his inventions was somewhat selfish, and not quite fair to his partner. Even if the case had been clearly laid before him, and it had been pointed out that he himself would in a large measure be responsible for any alienation that might occur in Gwen's affections, he would have been utterly at a loss to understand. At heart the most generous of lovers, he deceived himself that all the work he was doing was done for the sake of the woman. So now, as the weeks elapsed, he became more and more absorbed in his schemes to evolve a complete system of aerial defence for Caister. His other life was fast becoming a dream which had slipped away; when it was all over he would come back to his own self. But it was not all over yet. For one thing he had a tremendous scheme in hand for perfecting the guidance of his airship. In his experiments on wireless, and his readings on the subject, he had picked up many fantastic ideas, which at the time seemed to him clever impossibilities, but now that he was gaining proficiency in his new science the more he thought of them the more convinced he became that they were possible, and this conviction had at last resulted in an impulse for invention. Necessity, as the proverb saith, was the mother thereof. When he was conducting experiments with the airship at night, and using the flashlight, he was forced to realise that this method of locating the whereabouts of the vessel was clumsy and dangerous. If he could see it in the blinding rays so could the enemy, and that was not what he wanted. He must find some means which would enable him to locate his vessel without giving his opponents a chance of discovering its whereabouts.

A week of cogitation and the scheme was outlined. A few days later it was planned, and the design almost completed. Then came the worst part of the business; the translation of the ideal into the real. It was one thing to sketch the plan on paper: it was quite another to make it practical, but after many attempts and failures he managed, with the intelligent co-operation of his workmen, to evolve his machine. First of all a species of camera obscura was fixed over the wireless table. In appearance and position it was much like the looking-glass poised over the head of an organist, but at the back was a mechanism which practically defied description. It resembled nothing so much as an intricate spider's web of fine wires passing hither and thither, in a combination of spirals, diagonals and squares. For its manipulation the room had to be in almost perfect darkness, only one adjustable light being installed, so as to throw its rays on the keyboard of the operating table. At the will of the operator it could be turned on the switch-board. Then a delicate machine was fixed in the exact centre of the airship. It was after the nature of a concentrated transmitter, and it worked in connection with a high power coil, and could transmit automatically wireless waves. These were tuned up to a particularly high note, and were treated directionally at right angles to the airship itself. They communicated with a special receiver fixed by Summers behind the glass screen. There the note acted on an electric spark, and thus indicated the position of the airship, for in the darkness the light shone like a glowworm behind the screen and travelled along the fine wires placed there for the purpose. Charles's greatest difficulty was, however, to find a means of indicating the distance the airship might be from the Marconi tower where he was working, and this he could only overcome in a somewhat clumsy fashion, for the time at his disposal did not allow him sufficient latitude to indulge in specious experiments. Therefore he did the best he could with a sighter similar to that used on 16 in. guns, and then when he required to ascertain the distance would send out a flash from the airship, and so could locate it with sufficient accuracy for his purpose. He, nevertheless, found it very difficult to manipulate the additional apparatus in conjunction with the work of directing the airship. Night after night he sat up carrying on experiments and gaining proficiency. It was fascinating work to direct this machine across the wilderness of stars or scudding clouds, and to see nothing as he gazed out into the darkness from the sighter, then to touch the key which would produce the emission of a flash, and to discover the airship a mere golden dot in the lens. Then, again, darkness would prevail, with only the little glow of light in the mirror above his head creeping round and round, now darting straight, now curving to the touch of his fingers on the keys. It was worth living to have accomplished so much, and it was no wonder that in the exuberance of his triumphs he forgot that he was a lover, and a broken-hearted one at that, for he knew that he was on the threshold of achievement, and that this was his own child, the child of his invention. It was his own genius that had created this wonderful star that shone out or hid itself according to his will, silently and powerfully journeying across space, and steering its course between the stars. He had good reason to be proud of his skill.

CHAPTER XIII.

WAR!

News! News! The world was full of it. The newsboys were tearing through the streets of London, snatching ha'pence and delivering newspapers to the passers-by. It was as though the heavens had scattered news-sheets broadcast from the skies. Everybody was buying a paper and scanning its contents. Endless excitement prevailed. It was to be seen in the anxious faces among the little groups of pedestrians discussing the question of the hour. War had been declared. The two greatest nations in the world would soon be at death grips, and the fact was sufficient warranty for the prevailing excitement. Even the news reached Summers, a prisoner in the Marconi tower at Caister; but it was not brought with the melodramatic touch of great printed placards and the hubbub of conversation. Instead, he received it from the officer in command of the station, who had on his part been supplied official information from the War Office. England had been the first to strike the decisive blow, and herein Charles could claim to have done his part in enabling his country to take the offensive; for throughout the period of his work at Caister his progress had been reported to the War Office, while Sir Harry Dever, with other officials of yet more consequence in military matters, had watched several of the trial trips he had made with his airship, and they had convinced themselves that his invention was important enough to give their aerial armament the prestige that was necessary before the government could take this important step. Now everything was in readiness for action: their home squadrons were brought up to full fighting strength, and would effectually prevent the German navy from gaining much advantage in an attempted invasion of England. Their defensive air fleets were concentrated on the south and south-east coasts, and would be sufficient to prevent any effective landing of the German invaders in those parts. The Imperial fleet was also concentrated, and its object was to blockade Heligoland and the other German ports in the Baltic. If need be, it was deemed of sufficient strength to land forces on the German shore which could assemble under cover of the powerful guns until an adequate force had been organised to make an advance on Berlin practicable. This the Germans knew, for England had been at no pains to keep them ignorant. They had given her spies every advantage, and these paltry servants of the Fatherland had made what they deemed to be good use of their opportunities, so that their government had received corroborative reports from several quarters. For these reasons the English defenders felt themselves fairly secure, and on the strength of the added security of Summers' defence they had allowed the Caister position purposely to seem a weak spot in their coast armour. And here the advice of Sir Harry Dever regarding the procedure to be adopted in respect of Charles and his airship was vindicated. Not a whisper of his doings in this out-of-the-way spot had as far as they knew reached foreign ears. As a matter of fact, they were themselves in the dark as to whether anything had been done with the plans their emissaries

Dupont and Beulner had secured, but they were practically convinced nothing could have been accomplished in the time which had elapsed since the theft and the declaration of war; for easy as it may be to build a vessel with the designer at hand to guide and advise, it is infinitely difficult to make out the mechanism from a specification which can neither elaborate or explain its provisions. But cleverly as everything had been thought out and every mischance guarded against, the human mind, and even a collection of minds, is not equal to all emergencies, and an incident was shortly to take place which was to occasion no little alarm. The Germans perceived that by declaring war England had cut the ground of invasion from under their feet. They further foresaw that though they might repel any invasion of England, it would be little to their advantage; for, if it came to a question of a struggle, it was the wealthiest nation which would hang out longest, and in such a contest England would eventually gain the day. They, therefore, decided on a bold plan of action, relying chiefly on the slackness of the first phase of the war to make good their purpose. A fleet of several light cruisers and torpedo boats was sent out from Hamburg to engage the attention of the British warships. The oldest vessels in this class were commissioned for the purpose, and in a dense fog they appeared one night, not far to windward of the enemy. An engagement took place with the foreseen results. Nearly all of the rash German vessels were sunk, and the others put back to port greatly crippled. But in the darkness and general confusion two small continental steamers had slipped by unnoticed, and now stood far out in the North Sea. They were quickly followed by submarines, who quietly took up a position alongside and unloaded what appeared to be a considerable cargo. They then formed a cordon of defence round the continental steamers, while some German battleships, coming up from American waters, received instructions to do the same. Shortly after the unloading a great hammering and noise of building took place on the steamers, and soon it was apparent that a vast stage was being erected right across the upper decks of the vessels, and far out over the bows. When this was accomplished its purpose was soon evident. It formed a stage to allow for the erection of aeroplanes. These were the packages which had been brought on board by the submarines, and cunning workmen were taking part in their construction, for they were completed with amazing swiftness. This final part of the scheme was commenced one night immediately after sunset, and continued practically till dawn. By that time forty planes had been let loose and formed a compact aerial fleet, ready to make a swift descent on England. Each carried three men, and it was reckoned that a force of one hundred and twenty men fully equipped with machine guns reaching a secluded part of England would be able to hold out for sufficient length of time to allow other planes to be dispatched with reinforcements. These were to come direct from the German coast, and would be despatched as soon as news had been received of the departure of the vanguard from the North Sea floating-station. Meanwhile, at that station further supplies of collapsible aeroplanes were to be forwarded by submarine, so that there should be no hindrance in the augmentation of the invading fleet. The obvious destination was the Norfolk coast, and one morning, while yet the light was still blurred and indistinct, they set sail. Caister was unaware of the turn of events until the station received a call from the fleeter of a North Sea fishing squadron. The message was brief, but of sufficient importance to cause a break in the usual quiet routine of the day. It stated that the fleeter in question was cruising off the Dogger Bank when the look-out man had observed some aeroplanes—the exact number was not ascertained—rising far out to the sou'-west by west, believed coming from Germany and heading to England.

Immediately the conclusion was drawn that an invasion by air was imminent, and Charles was warned of the danger. Fortunately everything was in working order, and it was only a few moments before Charles was ready and waiting at his post in the Marconi tower.

But it is one thing to work at your ease and quite another to be fighting, not physically, but mentally, for not only honour but for the safety of one's countrymen, and the strain was so great that beads of perspiration stood out on the operator's brow.

(*To be continued.*)

INSTRUCTION IN WIRELESS TELEGRAPHY
The Tuning Buzzer and Magnetic Detector.

(Tenth 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. The article in the March issue will complete the series and special attention is therefore directed to the notice which appears on p. 708 of this issue. Back numbers of THE WIRELESS WORLD in which the earlier articles have appeared will be sent by the Publisher at Marconi House, Strand, London, W.C., on receipt of remittance of 5d. per copy to cover cost of postage.]

66. In the January article we described a form of tuning buzzer which required two batteries, one for working the vibrator and the other for exciting the oscillatory circuit. This form of buzzer required two vibrating contacts mechanically connected together but electrically independent, operating the two different circuits.

There is no reason, however, why the ordinary single contact buzzer cannot be used for exciting an oscillatory circuit, for by connecting it in such a way that the current passing through the coils of the buzzer is made to pass also through the induction coils of the oscillatory circuit, as shown in Fig. 1, we have practically the same

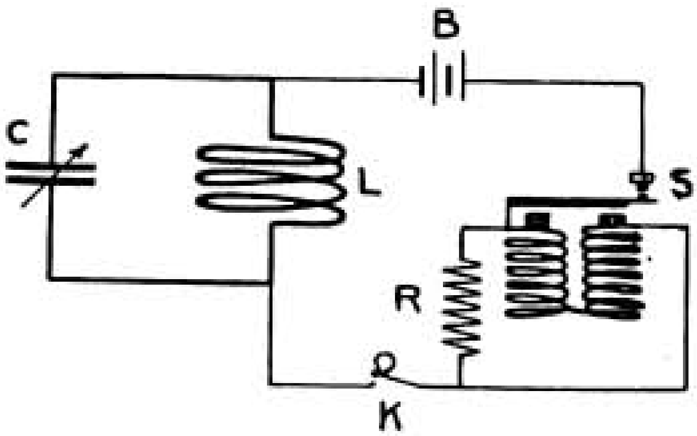


Fig. 1.

conditions as before, because energy will be stored up in the inductance, L, while the current is passing through it, and will be liberated as soon as it is interrupted at the contacts, S, the energy thus liberated giving the oscillatory circuit a kick, and thus causing it to oscillate with its own natural frequency In this case, however, when the contacts, S, are broken, we not only liberate the energy stored up in the inductance, L, but we also liberate the energy which is stored up in the inductive coils of the buzzer itself.

The inductance of these coils is many times greater than the inductance in the oscillatory circuit, and therefore a very much larger amount of energy will be liberated at this point when the circuit is interrupted. If no path is provided in which this energy can dissipate itself, it will form a small arc at the contacts, S, and dissipate itself gradually in this manner.

Unfortunately this arc will also form a path for the energy stored up in the inductance, L, with the result that the energy will be dissipated in the same way without passing through the condenser, so that under these conditions the oscillatory circuit would not be efficiently excited.

If, however, we connect a non-inductive resistance, as shown by R, Fig. 1, across the coils of the buzzer, the liberated energy from the buzzer coils will be absorbed in this resistance, instead of forming an arc at the contacts, S.

The connections shown in the figure are those usually adopted in an ordinary tuning buzzer, and it is obvious that the instrument can be used either to buzz a calibrated closed oscillatory circuit, and so make it emit waves of any desired length for the purpose of testing receivers, etc., or it can be used to buzz any oscillatory circuit in order that the wave-length of that circuit may be measured by means of a wavemeter.

We have now explained briefly the principles which are made use of in the design and application of crystal receivers. There are, however, many other forms of receiver, some of which make use of phenomena entirely different to those already explained; but space will only allow of our describing one such receiver, which has certain practical advantages over the various forms of crystal receivers—namely, the magnetic detector, in which use is made of that property in iron known as magnetic hysteresis.

67. Magnetic Hysteresis.—If a piece of iron be brought near the pole of a magnet, that part which is nearest becomes magnetised to an opposite polarity by magnetic induction.

If it is then removed from this magnetising force, it will still retain a certain amount of the magnetism induced into it, by reason of its "hysteresis" or "retentivity."

In the case of soft iron, this residual magnetism is extremely unstable, and a very small mechanical shock or twist is quite sufficient to destroy it.

In paragraphs 3 and 4 of the May number of THE WIRELESS WORLD, under the heading of "Magnetic Induction," we explained how an electric current could be induced in a coil of wire either by the introduction of a magnet in the coil or by removing a magnet from the coil.

If, then, we wind a coil of wire round a soft iron core and, after magnetising it, we subject it to a mechanical shock, sufficient to destroy its residual magnetism, a current will be induced in the coil of wire. Moreover if we connect a pair of telephones across the coil, thus causing the current induced into it to pass through the telephones, we shall get a click in the telephones when the iron is de-magnetised.

Having de-magnetised the iron, it must be re-magnetised before a similar mechanical shock will produce another current impulse in the coil.

It is obvious that the intensity of the current induced in the coil of wire will depend on the difference between the amount of magnetism in the iron before and after it is subjected to the de-magnetising influence of the mechanical shock.

A very feeble shock will only partially de-magnetise the iron, with the result that a feeble sound is produced in the telephones; but if the shock be sufficiently strong to destroy all the magnetism in the iron, we shall get a maximum sound in the telephones, and any further increase in the strength of the shock cannot further increase the sound produced in the telephones.

We have, however, a means of still further increasing the strength of the current induced in the coil. Owing to its hysteresis the iron will retain its residual magnetism, not only when the magnetising force has been removed, but also when it has been reversed, provided that this reversed magnetising force is not too powerful.

In this case the effect of our subjecting the iron to a mechanical shock is not merely to destroy its residual magnetism, but to allow it to become magnetised in the opposite direction by the influence of the reversed magnetising force.

The intensity of the current induced in the coil will then be proportional to the amount of residual magnetism in the iron which is destroyed *plus* the amount by which it is magnetised in the opposite direction.

It was discovered that if a high frequency oscillatory current were passed through a coil of wire wound round a piece of iron, that it produced an effect on the iron similar to that produced by a mechanical shock.

68. Let us now see how these principles were applied by Mr. Marconi to the magnetic detector.

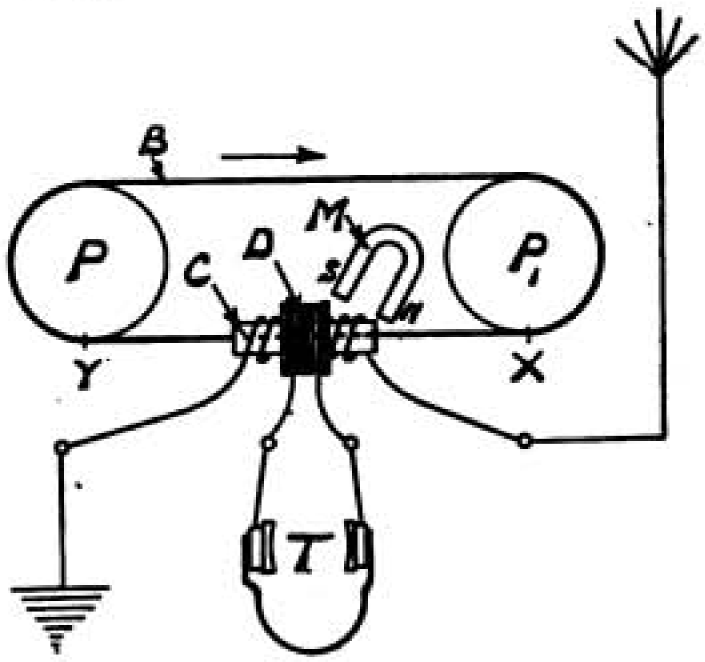


Fig. 2.

An endless band, B, Fig. 2, consisting of a number of fine strands of iron wire, is passed over two pulleys, P P, one of which is kept slowly rotating by means of clockwork, thus keeping the band continuously moving in the direction indicated by the arrow. The band is made to pass through a small glass tube, C, around which is wound a single layer of insulated copper wire, the two ends of which are connected, one to the aerial and the other to the earth.

A second coil of wire, D, consisting of a very much larger number of turns of wire, is also wound around the glass tube, and across this coil is connected a pair of telephones, T. A single horse-shoe magnet, M, is placed in a position similar to that shown in Fig. 2, with one of its poles (in this case the north pole) close to the band a short distance away from the windings, the other pole a little distance away from the band near the middle of the windings.

Let us now watch the progress of any particular portion of the band while it travels from the point, X, to the point, Y.

It first of all approaches the north pole of the magnet and thereby becomes magnetised as a south pole by magnetic induction. As it proceeds further on its course, it gets further and further away from the magnetising influence of the north pole of the permanent magnet, but, owing to its hysteresis, it will retain a certain amount of magnetism. As it enters the glass tube it commences to come under the weaker influence of the south pole of the magnet, which is tending to make it into a north pole, but unless disturbed it will retain its original residual magnetism.

If, however, an oscillatory current is received by the aerial, this current will pass round the single layer winding on the glass tube and allow the magnetism in the iron to be reversed, thus causing a sudden change in the magnetic field, and thereby inducing a momentary current in the secondary coil, to which the telephones are connected.

If, on the other hand, no oscillations are received in the aerial, the iron will pass through the primary tube without having its magnetic polarity suddenly changed, and therefore no sound will be produced in the telephones.

It will be seen, then, that we have a continuous supply of iron inside the primary tube in such a condition that oscillatory currents passing through the coil of wire will cause it to change its polarity suddenly.

As each spark of the transmitter produces a train of waves, so does each train of waves received by the magnetic detector produce a click in the telephones. Thus the click in the telephones will produce a sound similar in frequency to that produced by the transmitter.

Experience has shown that this detector is quite the most reliable and robust which has yet been invented, but although extremely sensitive it has not got the sensitiveness of the modern crystal detectors. Its reliability, however, makes it a valuable instrument as a stand-by, or in places where experienced operators are not obtainable.

To tune up the magnetic detector to any desired wave-length, an adjustable inductance and an adjustable condenser are joined in series with the de-magnetising or primary winding of the detector.

No tuning is required for the secondary or telephone winding, so that normally the magnetic detector can be regarded as a single circuit receiver.

As this arrangement does not give particularly sharp tuning, an instrument was designed, known as the multiple tuner, through which the oscillations have to pass before reaching the primary winding of the magnetic detector.

The multiple tuner consists of three closed oscillating circuits acting inductively upon each other, each of which is adjustable for wave-length. And a diagram of connections of a simple form of this tuner is shown in Fig. 3.

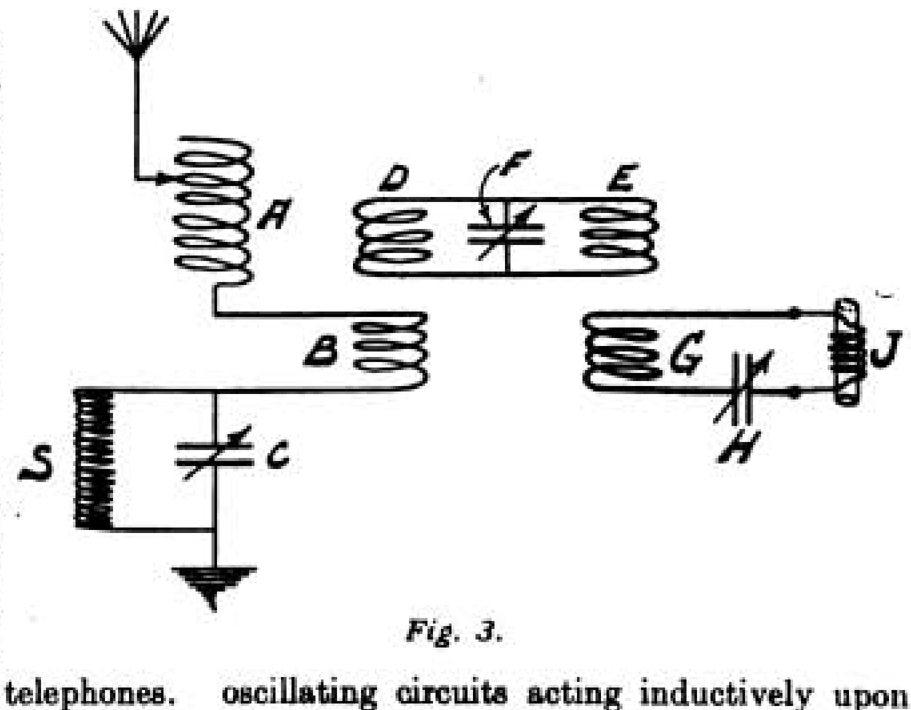


Fig. 3.

As will be seen from the diagram, there are three distinct circuits, namely, the aerial circuit, the intermediate circuit, and the magnetic detector circuit.

Each of these circuits must be in tune with the wave-length it is desired to receive.

The aerial circuit consists of an adjustable inductance, A, an inductive winding, B, and an adjustable condenser, C, all connected in series with one another.

The tuning of the circuit is accomplished by the adjustable inductance and adjustable condenser.

The inductive winding is so placed that any oscillations in it induce similar oscillations in the intermediate circuit, which consists of two inductive windings, D and E, connected in parallel and across an adjustable condenser, F.

Any oscillations induced in the winding, D, will also flow in the winding, E, since the two windings are in parallel, and the wave-length of the circuit is adjusted by changing the capacity of the condenser, F.

The third circuit—the magnetic detector circuit—consists of an inductive winding, G, and an adjustable condenser, H, and by itself is incomplete, but it is completed by connecting across it the primary winding of the magnetic detector as shown by J.

The telephones are connected as described before, across the secondary coil of the magnetic detector.

"ATMOSPHERICS."

Electric disturbances in the atmosphere which affect the receiving apparatus of wireless telegraph stations are known by the name of "atmospherics."

They produce in the telephones noises which, if strong enough, can drown the message which is being received.

Where small aerials are being used these atmospherics are not usually at all troublesome, but where large and high aerials are employed, if measures are not taken to reduce their effect, it would be impossible, sometimes for days together, to communicate at all.

The difficulty in getting rid of "atmospherics" is that they have no particular tune, but will cause the aerial circuit to oscillate to its own natural frequency, so that, no matter to what wave-length the circuit is adjusted, "atmospherics" are still induced in the receiver.

At first sight, therefore, it seems an impossible problem to get rid of them. It has, however, been accomplished as follows: Two receiving circuits are opposed to one another in such a way that if equal effects are produced in each circuit, these effects are neutralised, and therefore produce no sound in the telephones.

If one of these circuits is in tune with the wave-length being received, and the other circuit is out of tune with this wave-length, unequal effects will be produced in the two circuits by the waves, and the signals will be received in the ordinary way.

The "atmospherics," however, as already stated, will affect both circuits equally, so that the effect of the "atmospherics" is neutralised, and they will produce no sound in the telephones.

There is another form of "atmospheric" which is extremely troublesome, should a condenser be connected in series with the aerial for the purpose of tuning.

These atmospherics charge up this condenser in such a way that the charge grows until either the condenser is broken down or until the charge sparks across the two sides of the condenser.

This kind of "atmospheric," however, can very easily be dealt with by connecting a coil of wire, as shown by, S, Fig. 3, from the aerial side of the condenser to earth, which allows the current to pass through the coil of wire to earth instead of charging up the condenser.

It is, however, necessary that this shunt be highly inductive, as otherwise not only would the current caused by the "atmospherics" pass through it, but also the oscillatory currents which it is desired to receive.

For this reason, in nearly all receivers that are provided with an aerial tuning condenser, a coil of wire, known as an inductive shunt, is connected from the "aerial" side of the condenser to earth.

An Announcement.

The course of Instruction in Wireless Telegraphy, which commenced in the May, 1913, number of THE WIRELESS WORLD, will be completed with the final section, which will appear in the next number, in which number there will also be published an announcement concerning the holding of the examinations and the awards to be given to successful candidates.

Administrative Notes

U.S.A. Coast Station.

THE short-distance station at South Wellfleet, Massachusetts, U.S.A., has been discontinued, the service ending on December 31st, 1913. All messages are now sent *via* the station at Boston (call letters WBF).

* * *

Gambia Telegraph Ordinance.

An Ordinance entitled "The Telegraphs Ordinance, 1913," provides for the regulation of telegraphs in the Gambia. Under the Ordinance no person may establish a telegraph station or instal or work any apparatus for wireless telegraphy in the colony except under a licence granted by the Government. Merchant ships in the territorial waters of the colony must not use wireless telegraphy in such a way as to interfere with naval signalling, or with the working of wireless stations established in the colony. Merchant ships must not work wireless telegraphy (except for the purpose of making or answering signals of distress) whilst in any harbour or bay of the colony, except with the special permission of the Governor.

* * *

New Zealand Ship Rates.

The rates for wireless messages between the New Zealand coast stations and most of the ships off the New Zealand coast have been reduced from 10d. to 5d. per word. A statement to this effect was made recently in the House of Representatives by the Hon. R. H. Rhodes (Postmaster-General). The Leader of the Opposition had urged the Postmaster-General to use his influence to have the wireless rates reduced, and Mr. Rhodes said that he had already been in communication with the Board of the Amalgamated Australasian Wireless Company. The latter, he added, had intimated that they were agreeable to comply with his suggestions for reducing the present radiotelegraph rates on board ships operated by the company trading exclusively between Australia and New Zealand, and between ports on the coast of New Zealand; the total charge to be 5d. per word, and divided in the proportion of three-fifths to the coast station and two-fifths to the ship station. In the course of the letter to him, the company said:

"For the exchange of telegrams exclusively between ships to which the reduced rates will apply, we foresee some difficulty in making a similar reduction, because the arrangement at present applies only when they are in communication with the New Zealand coast stations, and not during other parts of their voyage. We think the best arrangement for the time being will be to make a rate of 4d. per word for messages exchanged between any two ships licensed by your administration—*i.e.*, 2d. per word for each ship, and when communicating with ships licensed elsewhere, the present ship tax of 4d. per word should be charged for such other ships, and 2d. per word for the New Zealand ship.

"We propose, if, after a suitable trial, the reduction is justified by a sufficient increase in traffic, to approach the Commonwealth Government with a suggestion to apply similar rates on the Australian coast; and if this is done the reduced ship tax can be applied to all communications between any ships registered in the Dominion or the Commonwealth."

The company suggested that the new rates should come into force on January 1st last.

There is a new word in the English Dictionary—to Marconi—past participle Marconi-ed.

* * *

RESEARCH IN WIRELESS TELEGRAPHY.—With the consent of the Army Council, the Postmaster-General has appointed Lieutenant-Colonel Fowler, Commandant of the Army Signalling School, to be a member of the Committee on Research in Wireless Telegraphy, of which Mr. Hobhouse is chairman.

Practical Hints for Amateurs

A Universal Detector Stand

By A. W. HULBERT

ALTHOUGH a multiple crystal-detector is very useful for quickly selecting various crystals, a universal stand acts just as well, and is not so complicated. The usual type of stand is that with two holders or cups fitted with clamping screws. The disadvantage with this type is that there is only one sound electrical connection between cup and crystal, *i.e.*, where the clamping screw presses tightly against it. This defect is remedied by using spring forceps with a number of teeth, A, Fig. 1, on each side, thus making electrical connection in several places on the crystal.

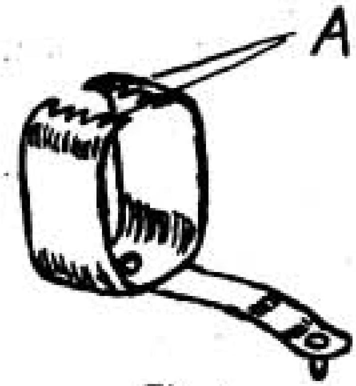


Fig. 1.

A universal stand of this type is constructed as follows, Fig. 2 :—

The base, D, should be of teak wood, stained and polished; a useful size being 9 in. by 6 in. The main pillar, A, is a piece of brass tubing ⅜ in. external diameter cut into three lengths; 1 in., ¾ in. and 1¼ in. respectively.

On each side of the ¾ in. length is a thin strip of brass 3 in. long and ½ in. wide, B B. A similar strip, E, 3 in. long, ½ in. wide and ⅛ in. thick, is placed on top of the 1-in. length of tubing, A.

The complete main pillar, A, fitted with the two strips of brass, B B, and strip, E, is now fixed to the base by means of a brass bolt which runs right through the main pillar; holes being drilled through the brass strips, B B and E, to allow this to be done. The bolt should go right through the base, a nut securing it underneath. A thread should be cut in the strip, E, to take the pressure screw, F. The strip, G, should be of springy brass and bent to the shape shown, G.

It is fastened to B by a bolt which passes through a piece of brass tubing ¾ in. long, X, and clamps, B B, X, and G, together.

The construction of the forceps, AA, can be clearly seen by referring to Fig. 1. They should be cut from springy brass, a good size being ½ in. wide by ¾ in. high overall. The upper forcep should be fastened to the brass strip, G, Fig. 2, a small nut and bolt being used for this purpose.

The lower forcep should be attached to a brass strip 2 in. long and ½ in. wide, which is screwed to the base. A wire runs from here to the terminal, H. The other terminal (not shown) is connected by a wire to the main pillar by means of the brass bolt before mentioned. Some good crystal combinations are, Bornite-zincite, galena-graphite, silicon-zinc, copper or gold point. The gold, copper

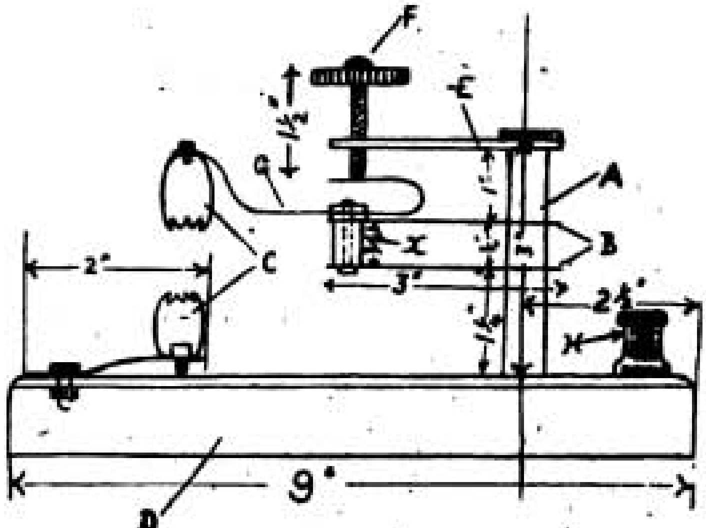


Fig. 2.

and zinc points should be soldered on to small bolts, so that when they are to be used it is only necessary to unscrew the upper forcep and to put the particular pointed wire in its place.

AN AMATEUR'S WIRELESS STATION.

By G. F. STEVEN.

IT is some eight months ago since I first took up the study of wireless telegraphy; and I have had more than the ordinary share of success. I owe my keen interest in wireless to *The Marconigraph*, and to THE WIRELESS WORLD, from which I obtain invaluable help

The Author's Station.

The aerials of my station are of the ordinary flat ship type and consist of two wires 180 ft. long, No. 18 gauge single-strand copper wire, at an average height of 30 ft. This gives me a wave length of about 184 metres. The leads are taken into the workshop where my apparatus is connected through glass tubes, which form perfect insulators. There is a tin plate 3 ft. by 2 ft. buried to a depth of 3 ft. 6 in. for earthing purpose.

I use a crystal detector, which consists of silicon and a gold point. As to tuning instruments, I first made a single slide tuning inductance, which tuned up to about 2,000 metres. This coil was 9 in. long by 4 in. in diameter, and was wound with No. 22 d.c.c. on a postal tube. But I could not cut out signals properly when they were not wanted and I made an oscillation transformer. The primary of this instrument is 4½ in. in diameter and 8 in. long, and is wound with No. 26 enamelled copper wire on a postal tube well coated with shellac varnish. The secondary is 7 in. long and 4 in. in diameter, and is wound with No. 28 enamelled copper wire. A slider on a brass rod is fitted for the variation of the primary, taking in one turn at a time. The secondary, however, is divided into 10 parts, thus ensuring very good tuning. This oscillation transformer will tune in stations up to about 4,000 metres wave length. For stations with greater wave lengths an extra tuning induction is used. The extra induction is 14 in. long and 4½ in. in diameter, is wound with No. 22 enamelled copper wire, and is divided into four parts which in series tune in 6,000 metres. My telephone condenser is made of paraffin waxed paper and tinfoil in an old cigar box fitted with terminals, the capacity of which is ·004 m.f. My telephones are of a well-known make, and are of a total resistance of 2,000 ohms.

My sending apparatus consists of a ¾-in. spark coil, which takes 8 volts 2 amperes. The spark gap, which consisted of two brass balls, has since been changed for one of zinc. The tuning of this set is effected by a helix wound with No. 10 copper wire on an 8 in.

In Camp with the Receiving Set.

frame. The condenser is of the Leyden jar type, and consists of a ¾-pint jar and tinfoil.

I have constructed a portable receiving set, which consists of an oscillation transformer, galena detector, condenser, and telephones, and I took it to the boy scouts' camp last summer. The camp was held among the Cheviot Hills, 500 ft. high above sea level. After erecting two scaffolding poles, I put up the aerials, which were 30 ft. high and 200 ft. long. With my set, using these aerials, I received a great number of signals, both from shore stations and ships, while the time in camp was taken from the Eiffel Tower signals every day, these signals coming in very loud.

AMATEUR NOTES.

"Words" over "Wireless."

Under the above heading we published in our December number some comments on certain controversies which have been going on in one of our contemporaries. One of these referred to the working of certain "schools," which were, apparently, causing some interference with amateur stations in the neighbourhood of London. Our comment has brought us a very sensible and dignified letter from "Ex-Telegraphist," who says: "I believe I opened the subject in a letter wherein I related my own experience of hearing two coast stations widely apart (GLV and GNF) asking amateurs to cease working as traffic was being delayed. In one case a threat to inform the police was made; in the other, I was surprised to find North Foreland could complain of a school near London. It appears from the subsequent correspondence that the schools worried the London area amateurs, and recriminations followed. . . ." He explains that his sole object—one with which we entirely sympathise—in drawing attention to the subject was to beg the amateurs to use every means and take every care to avoid interfering with the course of business carried on by coast stations, not only because it is obviously right that they should be careful in this respect, but for the more selfish reason that such interference, if it becomes a common occurrence, is bound to lead to the impositions of fresh restrictions on amateur transmission.

* * *

Among the amateurs to whom "Ex-Telegraphist" appeals are included, naturally, those schools which, in the controversy following on his original letter, became the object of attack of other writers; and in this regard he concludes in his present communication: "Without detracting in any degree from the admirable work carried on by the schools, may I plead for a strict watch on their part to interfere as little as possible with the public traffic, and to guard zealously the amateurs' privileges?" With this plea, if it is necessary, we heartily concur. It is, of course, a truism to say that no one should be allowed to work a transmitting station who is not able to read Morse rapidly and accurately enough to learn at once if he is in any way interfering with traffic; and, of course, anyone who learns this and fails to attend to this information is unworthy to be allowed the "freedom of the ether."

* * *

Mr. H. W. Pope also writes to us concerning our comments, and we have pleasure in publishing his letter. He states:

"I have just received the December number of The Wireless World, and am very interested in your remarks concerning the letters of 'CQ' which appeared in a contemporary.

"While agreeing with your view that the training schools should retain the more or less free hand that they have enjoyed with regard to experimental signalling, I cannot agree with your disparaging remarks about the more sensitive crystals.

"Without any very 'careful adjustment' I have *always* been able to obtain good, strong, readable signals in London from most English coast stations, let alone 'five times out of ten,' with a detector, using Zincite and Bornite combination.

"As for crystal detectors going out of adjustment, I have often used a detector for several days without any need for readjustment; and, supposing it does go out of adjustment, it is only the work of two seconds at most to select a sensitive position on the crystal.

"The point to be observed in using hypersensitive crystals is to protect them properly during periods of transmission, which can be accomplished with the greatest of ease.

"Having used the magnetic detector commercially for the last eight months, I am fully alive to its value as a reliable and 'foolproof' piece of apparatus, and probably of the most suitable nature for marine commercial work. This being so, intending operators have to be instructed in its use at the several schools that 'CQ' has his 'knife' into.

"Instead, however, of aiming blows at these useful institutions, why does not 'CQ' turn his attention to the capability of tuning out the undesired signals which his instruments should possess, as I am convinced that the tuning of those schools is good, and admits of their being tuned in and out quite easily; and, incidentally, the experience would be useful."

* * *

Mr. Pope has chosen a particularly good and reliable combination—Zincite-Bornite—for which we have the greatest respect. We should be sorry if we were thought to disparage crystal detectors *en masse*. Nothing could be further from our intention. It is true that we are in the habit of advocating the use of only one crystal (carborundum), but this is because we know by experience what an admirable detector this is when properly selected and used with a suitably designed circuit. The amateur, as a rule, takes his carborundum crystal at random, puts it in a circuit which is not suited to it, fails to get good results, and takes to some other far less reliable detector, under the impression that he has given carborundum a proper trial. Probably up to the present the greater number of amateurs have had no idea as to why or how a crystal performs its functions as a detector. Since our recent instructional articles, however, there is no excuse for any of our readers being at a loss to understand this important point, and they will be able to see that a carborundum crystal, for example, should be chosen with as much careful examination into its characteristics as, let us say, an applicant for a vacant post.

* * *

If the supply of carborundum ran out we think we should adopt our correspondent's combination. But the fact that he gets good reliable results with this detector in no way affects the case in point, and we see no reason to modify our remarks. Even in his expert hands we gather that with this particularly reliable combination an occasional "two seconds" is needed for re-adjustment, and these two seconds may easily come at a critical moment in commercial working; in fact, by the general law of pure cussedness they almost invariably do so time themselves. In conclusion, we may frankly admit that our mention, in the paragraph referred to, of one particular combination was due, not so much to a special vindictiveness towards this detector as to an æsthetic pleasure in the sheer beauty of its name.

* * *

Mr. W. J. Fry has also written to us from the rooms of the Wireless Society of London concerning other comments which appeared in our December "Amateur Notes." His letter has unfortunately been crowded out of this number, but, on second thoughts, we question whether its publication would serve any useful purpose. Recriminations such as those referred to by our correspondent, "EX-TELEGRAPHIST," seem to be rather popular in amateur wireless circles, and we should be sorry to encourage them to continue, which would be the effect of publishing Mr. Fry's letter to us.

* * *

A general meeting of the Wireless Society of London was held in the Lecture Hall of the Institution of Electrical Engineers, on January 21st, when the President (Mr. A. A. Campbell Swinton) delivered his inaugural address. By the courtesy of Commandant Ferrié, a Vice-President of the Society, the radio-telegraphic station of the Eiffel Tower, Paris, sent a special wireless message to the Society during the meeting, and arrangements were made to render the message audible to all present. The President's address was mainly concerned with a description of the means devised with the object of securing permanent records of wireless messages that could be taken down and read at leisure and of his own private installation. He predicted that if we were ever to have transatlantic telephony, it would be wireless.

* * *

A meeting of the Liverpool and District Amateur Wireless Association was held on

January 13th, when the chair was taken by Mr. J. T. Matthews, of Chester. A member described the principles, construction, and working of the Wheatstone Bridge, and afterwards several interesting tests were made with a commercial pattern instrument. Miniature receiving outfits seem to be becoming very popular, and an interesting type made by one of the members was shown. Although wound with rather small gauge wire, this was stated to give quite satisfactory results. The automatic sending outfit designed by another member was also on exhibition, and there were various other apparatus and parts brought up for inspection and discussion. As a new session has just commenced, it is opportune for new members to join the association, and all persons interested in "Wireless" are cordially invited to apply for membership to Mr. S. Frith, 6 Cambridge Road, Great Crosby, Liverpool.

* * *

The Annual General Meeting of the Derby Wireless Club was held on January 7th, when there was a large attendance of members. Sir Henry Norman, M.P., was elected President for the ensuing year, Mr. A. Trevelyan Lee was re-elected Hon. Sec., Mr. Wm. Bemrose, Hon. Treas., and Messrs. Mart and Huson, Librarians. The following committee was appointed : Messrs. J. W. Downes, J. Lowe, W. Harris, K. S. Haslam, Drury, Canham and Bowles.

Mr. S. Grimwood Taylor, who presided, briefly reviewed the past year's working, and said they all regretted that amateurs would probably not be able to assist very largely with the British Association Radio Committee's scheme of observations. Sunrise, 11 a.m., and sunset, too, are impossible times for most amateurs, but they were all anxious to do whatever they possibly could. With reference to the annual fee likely to be charged for amateur licences, he hoped it would not be unduly prohibitive. A new Act of Parliament would have to be secured by the Postmaster-General in the forthcoming session, and every amateur in the country should join a club and endeavour by joint action to see they were not dealt with too severely. Only about two out of five amateurs belonged to clubs, and the other three were perhaps relying on the clubs to do all the wo· So far as he could see, nothing was likely to be done at all by either amateurs or clubs. They themselves had had no response to their suggestion of a conference, and had therefore dropped the matter altogether. Mr. Taylor also referred in eulogistic terms to the strenuous work done by Mr. Lee, to whose energy the Club mainly owed its strong position. During the past year two successful exhibitions had been held, and more or less amateurish experiments had been made with mirror galvanometers, Brown relays, cartwheel and disc tuners, kite and indoor aerials, and aerials lying on the ground. Two corresponding members had independently reported that "dummy" wires, in proximity to but not in metallic contact with indoor aerials greatly improved signals, but no one else seemed to have yet experimented on these lines. Local transmitting apparatus was of divers types, and an extended range had been achieved by Mr. Bemrose and Mr. Lee. Some discussion was going on regarding the merits of exceptionally fine wire for "aerial inductances." He had experimented with sizes, from No. 18 to 38, and preferred the larger sized wire. However, he did not consider the difference more than 5 per cent. A good pair of 'phones would easily make a difference of 95 per cent. Fleming advised many stranded wire. Mr. Lee, the hon. sec., reported that this was the third year of the Club's existence, and the membership, now over 100, had steadily increased. His multitudinous correspondence came from all parts of the world, India, South Africa, Jamaica, British Honduras, Buenos Aires, Australia and New Zealand, as well as Europe and the British Isles. There were no corresponding members this time last year, but now the number exceeded that of the local members. The hon. treasurer's report showed a good balance in hand, and it was decided to add Dr. J. A. Fleming's and books by other authors to the library.

* * *

A meeting of the Bristol Wireless Association was held on January 10th. The Rev. W. P. Rigby presided, and there was a good attendance of members. An interesting paper on "Wireless Makeshifts" was read, and was followed by discussion. Mr. A. C. Davies has promised to contribute a paper upon "Crystals" at the next meeting, the date of which is February 14th.

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.

P. C. (Aldershot) thanks us for our reply to his question, which he says has helped him greatly; he sends us a diagram of his receiving circuits as he has them now. But we still do not like them. He should try another way, putting his detector in series with his telephones and connecting the two across his tuning-coil. The blocking condenser is not necessary where shown; it might be put right across the telephones, though to get the best results it should be possible to vary the capacity in steps. For transmitting he uses a plain aerial, and wishes to know whether he could get a larger radius by making a jigger. He uses a one-inch spark coil. For small portable sets using very short waves plain aerial is very hard to beat, if well insulated (this is its weak point, especially in wet weather). He might try a jigger; he should find what is the largest capacity which his coil will charge and still give a spark of 1 mm. at least (this depends on the coil and cannot be prophesied from the mere "one-inch spark" datum). Then his jigger primary should be wound so as to give the required wave-length when combined with that capacity. A good ratio for the number of primary turns to the number of secondary turns is 1 to 7.

H. C. B.—Here are replies to remainder of your questions, the first four of which were dealt with in our December number. (5) I have read in "Instruction in Wireless Telegraphy" that a transmitting aerial will not work well with a wave-length more than twice the natural wave-length of the aerial. Does this apply to the receiving aerial as well? (6) Does not the diameter of the wire used for an aerial make a difference to its capacity? If so, why is this not taken into account in finding the natural wave-length of an aerial? (7) I also read in THE WIRELESS WORLD that the power of a station is proportional to the capacity of the condenser, the voltage to which it is charged and the number of times it is charged and discharged per second. Does this last factor have any effect on the range of the station? If so, why? Will you please give me the formula connecting those, and also the units they are in.

Answers.—(5) A receiving aerial works best when its natural wave-length is about three-quarters of the wave-length received, the other quarter being made up by the jigger-primary. As additional inductance is added to tune up to longer waves, the efficiency of the circuit diminishes; but—luckily for amateurs, who want to receive the "big stations" on their little aerials—the effect is not as marked as in the case of the transmitting aerial.

(6) Increase of diameter increases the capacity of a wire, but decreases its inductance; these effects more or less balance, so that the size of the wire has very little to say to its wave-length.

(7) The "power" of a station, here referred to, means the power required to transmit, and obviously depends, among other things, on the number of sparks produced in a second. At the receiving end each spark is heard separately (although the ear blends them into a note or a noise), so that with a telephonic receiver the actual *strength* of the signal is independent of the number of discharges, except in so far as the telephone itself responds more readily to a moderately rapid note than to a widely-spaced succession of "clicks." This, however, has a great effect on the *legibility* of the signals, especially through atmospherics or other interference. Things are altogether different if, instead of a telephonic receiver, we use some kind of integrating detector which sums up the effect of all the discharges contained in a "dot" or a "dash"; in this case the signal strength itself depends on the discharge-frequency.

C. S. S. (Hendon).—(1) What is the best cable to use for the lead in? It will touch the wall. (2) Will a twin-wire aerial with three insulators (each for 10,000 volts) fixed at each end of each wire, and one where the ropes meet, be sufficiently insulated for lightning and for 2-inch coil.

Answer.—(1) Much better to keep it clear of the wall on porcelain insulators, or cleats, using, say, 7/22 I.R.V.B. cable and leading-in either with some leading-in insulator or with a length of the high-tension lead used for motor-car ignition. (2) Plenty, if you are using a jigger; if plain aerial, you may have trouble in wet weather. Watch and see on a wet night.

QUERYMAN.—I have the following instruments set up: Aerials, height about 45 feet, and length about 40 feet; tuning coil, gauge 20 (double slider), 11 inches by 2¾ inches diameter; silicon detector, with brass point; condenser (tinfoil on glass), 12 inches by 12 inches outside, 9 inch by 9 inch tinfoil; and a receiver. A Post Office inspector who examined the installation said: "That to get Eiffel would be child's play, and Germany should be easily got." So far (three weeks) I have had no result, though once I "fancied" various sounds came through from Eiffel, but I fear atmospherics were more probable. Can you inform me approximately how my "sliders" would be for any length (say, 300 metres) wave? If a 600-metre wave is being used, how can I, roughly, tune for it? If both my "sliders" were half-way, what would the wave be tuned for?

Answer.—If the wire is really No. 20, we do not think you have nearly enough inductance to tune to the long waves in question. It would be all right for the short ship waves, etc. For long waves you had better try putting a fixed inductance of at least an equal value in series with it.

If you put both your sliders at the centre point it will be a miracle if you get any signals at all on any wave, for, according to your sketch, this would put your detector-circuit on the same turn as your earth-lead. Your whole arrangement of wiring-up is not at all good; we recommend you to study our Instructional Articles carefully, especially that in the November number. One thing you do not mention, of great importance, and that is the nature of your telephones; we suppose that these are suitable, but if they are not, this would account for everything. If they are, then we recommend you to: increase your tuning-inductance for the long waves; do away with the condenser for the present; put your telephones in series with your detector, and put the two directly across all your tuning-inductance—that is, from aerial to earth; the detector going to aerial and the telephone to earth. The aerial can go permanently to the upper end of the inductance, and one slider (the other can be neglected for the present) can go to earth. Thus you will have an aerial-earth circuit with a variable amount of inductance in it, and your detector will be shunted from aerial to earth with the telephones in series with it. If the worst comes to the worst, you should try a carborundum crystal with battery and potentiometer.

S. F. H. (Battersea).—(1) I have a two-slide inductance coil, 8 inches long, 2 inches diameter, and wound with about 300 feet of wire. How far would that step a 200-metre wave-length aerial up to ? (2) I wish to make a coil with a switch with stops to be able to tune up to 4,000 metres. What wire (size, length) would I want, and what would be the best length between steps ?

Answer.—(1) Impossible to say exactly ; one aerial may be exactly the same as another so far as wave-length is concerned, but quite different so far as its inductance is concerned ; and it is on this value that the wave-length produced by added inductance depends. If yours is a single-wire aerial, the coil you mention might tune up to about 1,700 metres ; if it is a twin-wire (so that its own inductance is less and its capacity more), it would tune, with the same coil, to a longer wave. (2) Remarks on your first query apply here also. You would probably need something like an 8-inch diameter coil, 18 inches long, wound with wire giving 28 turns to the inch.

See reply to " Dens " in this number as to mode of tapping-off.

J. B. (Manchester) has read in Hawkhead's " Handbook of Technical Instruction " how a Marconi set is tuned to give a shorter wave than the natural wave of the aerial plus jigger-secondary, by means of a condenser *in parallel* with the jigger-secondary ; and he wants to know why this plan is adopted instead of the more obvious one of putting a condenser in series with the aerial. It is because the latter plan would result in insulating the aerial from earth, so that lightning and the steady static accumulation on the aerial would have no path to earth. Also, from the nature of the connections to the receiving apparatus (using the earth-arrester as an automatic change-over switch) this plan would leave the condenser always in series with the aerial when used for receiving, and so make it necessary to add an extra amount of tuning-inductance to tune to longer waves.

W. V. H. (Shoeburyness).—I have constructed a small wireless station for receiving, the dimensions of which are as follows :—The aerial is a 4-wire, 35 yards long, with an average height of 30 feet above ground, with leads from centre. The earth wire is soldered to the water pipe. The apparatus is a variable inductance, jigger, variable condensers, silicon-gold detector and single 1,000 ohm telephone (diagram annexed). I get Paris, Norddeich and Cleethorpes loud, especially Paris, but cannot get Poldhu quite loud enough to read. Can you suggest any additions to my apparatus to make Poldhu readable ? It is practically impossible to either lengthen or heighten my aerial. Would adding more wires be of much use ? I also want to construct a wave-meter.

Answer.—We cannot be sure that you are in the habit of getting accurate tuning ; can you so adjust to Poldhu that *any change*—either increasing or decreasing the wave-lengths of your receiving circuits—will cause a corresponding decrease in the signals ? If you cannot, then you should increase your tuning inductances and jigger-coils until you *can*. Also you might try a tighter coupling between primary and secondary ; and try a longer jigger-secondary and *a smaller variable condenser across it* ; also, couple your jigger-primary only to that end of the jigger-secondary which goes to the telephone side of the crystal. Try also a carefully selected Carborundum crystal with battery and potentiometer, and make sure that you are working on the critical point of the crystal so that any adjustment of the potentiometer—whether forward or back—weakens signals. If possible, work with your aerial tuning condenser shorted and tune only on the inductance. You might also try converting your T aerial into an inverted aerial—thus lengthening its wave-length—choosing, if possible, such an end as to convert it into the right directional aerial for Poldhu. A few more wires would add slightly to its receptive powers, especially if you can space them well. Increase your earth by wires running under the aerial and just buried in the ground. A wave-meter consists essentially of a circuit of continuously variable wave-length (within certain limits), provided with a detector of some kind—usually a carborundum crystal and telephone—which will indicate when it is receiving the maximum amount of energy from the circuit whose wave is to be measured. A simple form of wave-meter consists of a fixed inductance (usually coils on a wooden former) across a variable condenser ; telephones, in series with a crystal, are connected across the condenser, the fixed inductance is coupled loosely to some part of the circuit to be tested, and the condenser adjusted until a maximum of sound is heard in the telephones. The wave-length is then read off from the calibration curve of the instrument.

H. R. M. (Hornsey).—Is the shunt inductance necessary in the Marconi multiple tuner and is the instrument patented ?

Answer.—By the words " shunt inductance " you refer, we suppose, to the long, highly-inductive coil which is permanently connected between earth and the side of the aerial-tuning condenser which goes—through the aerial-tuning inductance—to the aerial. For commercial working, at any rate, this coil is essential, for without it the aerial would be insulated from earth except when the aerial-tuning condenser happened to be short-circuited, and the result would be that the aerial would frequently become charged by a gradual accumulation of atmospheric electricity, which would reach a potential enough to puncture the condenser-dielectric or to spark across it and thus produce a noise in the telephones. The instrument is patented.

Answer.—M. V. (Hassocks).—With regard to your transmitting arrangements, as you have plenty of aerial-length to spare and are limited in your wave-length, we recommend you to use less turns in your jigger-secondary. Every foot of wire in this is roughly equivalent to 2 or 2½ feet in the aerial so far as wave-length is concerned, but it does not radiate, and had therefore better be kept as short as possible, provided you can get tight enough coupling. If you make it, say, of four turns instead of ten, you will weaken your coupling ; but you could tighten this again by bringing your primary nearer, especially if you wind the latter so that it could, if required, go right over the secondary. This, of course, would mean abandoning your plan of a flat helix. With four turns in your secondary you would be adding the equivalent of about 30 feet to your aerial. You want a 250-metre wave, so your aerial circuit (a four-wire aerial) should be about $\frac{250}{4\cdot5}$ metres long—*i.e.*, about 180 feet in all ; that is to say, your aerial, apart from the secondary, should be about 150 feet long, *including the down-lead.* The plan we should suggest is as follows : Use your two masts for a long-distance receiving aerial, making this as long and high as possible, and four-fold as before. You cannot make it too long, if you are looking for the big stations. For transmitting, put up a T aerial to the 90 foot mast, at right angles to the big aerial, the arms of the T sloping down, not going to any mast but guyed-out by light lines (insulated, of course, from the arms of the T) going to stakes in the earth at a sufficient distance from the 90 foot mast to keep the ends of the T a good height from the ground. Thus you would have half a T aerial on one side of your mast, and half on the other ; each half consisting of two wires forming the sloping arm and the down-lead ; these two halves would be joined at the leading-in insulator, and would form a whole " twin " T aerial. Each half of the T would be about 90 plus 60 feet (the 60 feet being the sloping arm). By this arrangement the effect of the long aerial on the short would be reduced as much as possible. Your 70 watts should be suitable for such an aerial. Thanks for your kind remarks.

S. F. J. (Thornton Heath).—Read carefully the back numbers of THE WIRELESS WORLD, especially the "Questions and Answers" pages and the instructional articles, and you will find therein all the information you ask for. We cannot repeat over and over again, our space is too valuable.

E. F. B. (Louth).—(1) Not altogether satisfactory, but will do. (2) Can see no possible advantage in this. We should prefer to see the far ends all separate and the near ends all joined. (3) Yes. But do not attach too much importance to statements about hearing signals 10 feet away. If you like, try to magnify your loud signals by inserting your 'phones in a tin canister of the right size; then you may be able to boast, too. (4) Efficiency of condenser depends on the dielectric, which you do not even mention. But in any case the condenser, in the position shown, is only used as a makeshift if you have not enough tuning-inductance to put in your aerial circuit. If you have enough, you are better without the condenser. You might try transferring it to across your telephones. Tubular and vane condensers equally effective. ·00088 microfarad for every square metre of air-gap 1 centimetre thick. (5) How can we possibly tell? You should arrange matters so that you can tighten your coupling until signals begin to *decrease* again; thus you can find the position for strongest possible signals. (6) Two-circuit jigger or else an auto-jigger. Your aerial, with jigger-secondary, will give somewhere about 200 metres. You could reduce by capacity in series if necessary. Yes, or some Leyden jars. (7) Buy two cheap electric bells, remove hammers and gongs, and alter connections so that one may drive the other, the contacts of the latter being entirely free from the battery-circuit. Then use these contacts as a "ticker."

G. A. J. (London, N.).—We do not like your connections at all. Read our instructional articles, especially the November instalment. Your tuning-coil is not enough to tune to the big stations, but should give you the local small ones. But, in any case, your 100 ohms telephones would spoil your results: they are not nearly sensitive enough—unless you use an old ignition-coil as a telephone-transformer. Read our back "Questions and Answers" columns.

"ZETA."—Your connections seem to us terribly complicated and not altogether right. Why not remodel according to our November Instructional article? If you want to get uniform results we advise you to use carborundum, with battery and potentiometer, and make sure that you have so much battery-voltage that you can weaken signals by moving your potentiometer-slider in *either* direction—*i.e.*, increasing or decreasing the applied voltage. With regard to your getting no comparatively short waves (such as ships' waves) read our answer to W. E. D. in this number.

W. E. D. (Brighton).—I am unable to "pick up" signals upon my wireless set from other small stations within a mile or two although the signals I receive from most of the large stations are very plain and distinct, especially G.N.F., which is but seven miles away. The particulars of my installation are as follows: Receiving apparatus, tuning coil, two sliders, 16 inches by 5 inches, but only using one at present, with silicon gold point detector and telephones 2,000-watt each, with small blocking condenser in shunt.

Answer.—The small stations are working with waves about 200 metres long, or less, and your apparatus is quite unsuitable for these. Amateurs do not seem to realise that crystal receivers must be connected to a point of high voltage. Now, when an aerial circuit is resonating to an incoming wave, it has maximum voltage at the top of the aerial and minimum voltage at the earth-lead. So that to use a crystal direct-coupled (*i.e.*, without a jigger), it should, theoretically, be put at the top of the aerial! The only reason why amateurs can get good results by connecting their crystal direct to the aerial-circuit, at the foot of the aerial, is that they are generally trying to receive waves which are enormously long compared to their aerials, so that they have a very large amount of tuning-inductance in series with the aerial, and the potential at the upper end of all this inductance is almost as great as at the top of the aerial itself. When, however, the amateur tries to receive short waves, his own aerial is nearly in tune with them without any extra inductance, and the small amount of inductance required to put it into tune does *not* give the high potential required for the crystal. In such a case two things can be done: either the aerial wave-length can first be reduced by a small condenser *in series*, and a large amount of inductance then added to make up the wave-length required, the crystal being connected to the top end of this inductance; or, better, a small short-wave receiving jigger can be wound. This should have a short primary at one end of a long secondary, the upper end of the secondary giving the high potential and, therefore, going to the crystal. In its simplest form it might be an "auto-jigger" consisting of a single coil (much smaller than yours), a few of the lower turns forming the primary and the whole coil forming the secondary.

C. N. S. (Kingston).—(1) Your first calculation is quite correct; the frequency of the 300-metre wave is one million per second. Your difficulty in reconciling this to the other formula is due to the fact that in the latter one of the *units* is different. If a thing costs *one* pound we can say that its price is *twenty* shillings, but we cannot say that 1 = 20. In the first formula the capacity is measured in microfarads and the inductance in microhenries; in the second, the capacity is still in microfarads, but the inductance is measured in centimetres of inductance. Now, since 1 microhenry = 1,000 centimetres of inductance, and the factor "L" comes under the square root sign, you must divide your second result by the square root of a thousand —*i.e.*, by about 31. (2) A receiving aerial gets its energy from the comparatively small portion of the electromagnetic field immediately surrounding it. In the case, at any rate, of the ordinary transmitting aerial the waves are sent out in all directions in the form of ever-widening circles, and those waves which find no receiving aerial to absorb them pass on and gradually waste themselves. Hence, unless one receiving aerial is so close to another that they both attempt to drain the same small portion of the æther, the presence of the one has no effect on the other.

"DENS" (Brighton) has rewound his tuning inductance (which was formerly one with sliding-contact) so as to use tappings going to a pair of multi-contact switches, using the same wire which formed the original coil. He now finds the disconcerting fact that the coil has in its present condition the power to tune up to 2,000 metres only, whereas in its old state it would tune up to 4,000 metres easily. His suggestion that the bared parts (where the insulation was removed for the sliding-contact) are causing many of the turns to short-circuit seems as good as any we can suggest for the explanation of this strange phenomenon, since he is quite sure that the tappings and switches are free from short-circuit; yet even this explanation fails to appeal to us, since, after rewinding (of course, in a single even layer), the bared places are really less likely to agree with, and touch, each other than before rewinding. His system of tappings (on which he asks an opinion) is the well-known and effective one in which the twenty contacts of the first switch go to the first consecutive twenty turns of the coil, while the twenty contacts of the second switch go one to every twentieth turn of the rest of the coil, which is not further subdivided. As drawn and lettered in his diagram, the maximum number of turns is *not* included when the numbers on the switches show a maximum; this, of course, if actually the case, might explain his strange results, but we can hardly think that it is anything but an error in drawing. The wave-length to which a given coil will tune an aerial depends, of course, on the aerial itself; but if "Dens'" aerial is at all an average one, with a natural wave of, say, 200 metres, we should be rather surprised to find the coil he describes tuning it up to 4,000 metres or more.

Marconi House Notes

FOOTBALL SECTION.

Quit the great event of the football season took place on Saturday, 17th—viz., the match between the Marconi Club and the Oratory Brigade, a direct contest for the leading position in the Western Suburban Alliance. Unfortunately the Marconi Club, though supported by a large number of adherents among the onlookers, and in spite of brilliant play by Ralph Williams and F. Lord, lost by 3 goals to nil.

CRICKET SECTION.

A general meeting of the cricket section was held on January 12th for the election of officers for the coming season. Mr. R. Williams was appointed captain of the first and Mr. Stokes of the second eleven.

THE TENNIS SECTION.

The committee of the Tennis Section are now arranging for the improvement and extension of the tennis courts. Hearty and muscular young men who want genuine exercise are invited to place their arms at the disposal of the committee on Saturdays (for gang work, to assist in the redistribution of the earth's crust).

MUSICAL SOCIETY.

The band contest between the Marconi House Orchestra and the Chelmsford Works Orchestra has been fixed to take place on Saturday, February 21st. Mrs. Godfrey Isaacs has consented to be the judge, and both bands are now working hard to fit themselves for the event.

DEBATING SOCIETY.

The gap in the social associations pointed out by Capt. Sankey at the Marconi dinner has speedily been filled in by the formation of a Debating Society. On Thursday, 8th, it was inaugurated, and the first debate took place the following Thursday.

With Mr. Rattray in the chair, Capt. Sankey opened with a thoughtful and well-balanced address on National Military Service. The debate which followed, if a little lacking in definition, was both interesting and well sustained, revealing several promising debaters and permitting great hopes for the future.

Patent Record.

The following patents have been applied for since we went to press with the January number :

1913.

28,277 & 28,278. December 8th. Wm. H. Shephard and A. E. McKechnie. Line or wireless telegraph systems.

28,409. December 9th. Fred G. Sargent. Wireless telegraphy.

28,413. December 9th. Marconi's W. T. Co., Ltd., and H. J. Round. Receivers for use in wireless telegraphy.

28,602. December 11th. Egmont C. Hoegerstaedt and Harold S. Westcott. Wireless telegraphy.

28,839. December 13th. Olaf Pedersen. H.F. electric current generators.

29,447. December 20th. Josef Schiessler. Apparatus suitable for use in wireless telegraphy or telephony.

29,711. December 24th. John D. L. Bradwell and Geo. Bradwell. Radio-telegraphic or like receiving apparatus.

29,712. December 24th. Roberto C. Galletti. Transmission of wireless signals.

29,902. December 29th. Adrian F. Sykes. Generator of electrical oscillations.

29,946. December 30th. Graf Georg von Arco and Alexander Meissner. Transmitting arrangement for wireless telegraphy and telephony.

1914.

194. January 3rd. Ernest Wilson. Detector for radio-telegraphy or telephony.

252. January 5th. Graf Georg von Arco and Alexander Meissner. Relay arrangements for wireless telegraphy and telephony.

440. January 7th. Percy A. E. Armstrong. Call-up switch for wireless telephones.

739. January 10th. Arthur Booth Webber and the Standard Time Co., Ltd. Device for prolonging the period between the active intermitting electric impulses.

Personal Items.

Mr. René Demont, the representative of the Marconi Company in Bolivia, was recently married in Paris to Miss Virginie Sappen of that city.

In the Scottish Wireless Signal Company, Royal Engineers, Capt. W. C. Easton (from the Scottish Airline Signal Company) has been appointed captain.

On December 24th, 1913, the Marconi Wireless Telegraph Company of America, of which Mr. E. J. Nally is vice-president and general manager, entertained many invited guests and its officials and employes at a Christmas celebration at its offices in the Woolworth Building, New York. There were about 100 persons present, and an enjoyable hour was spent. A luncheon was served, after which "Santa Claus" came in by wireless, and distributed presents to many of those in attendance.

Obituary.

Dr. Henri Simon, Chief of the Radio-telegraphic Service of Switzerland, and a pioneer in the use of X-rays, died at Geneva recently, a victim of these rays. He had endured many surgical operations, having lost one arm and part of the other.