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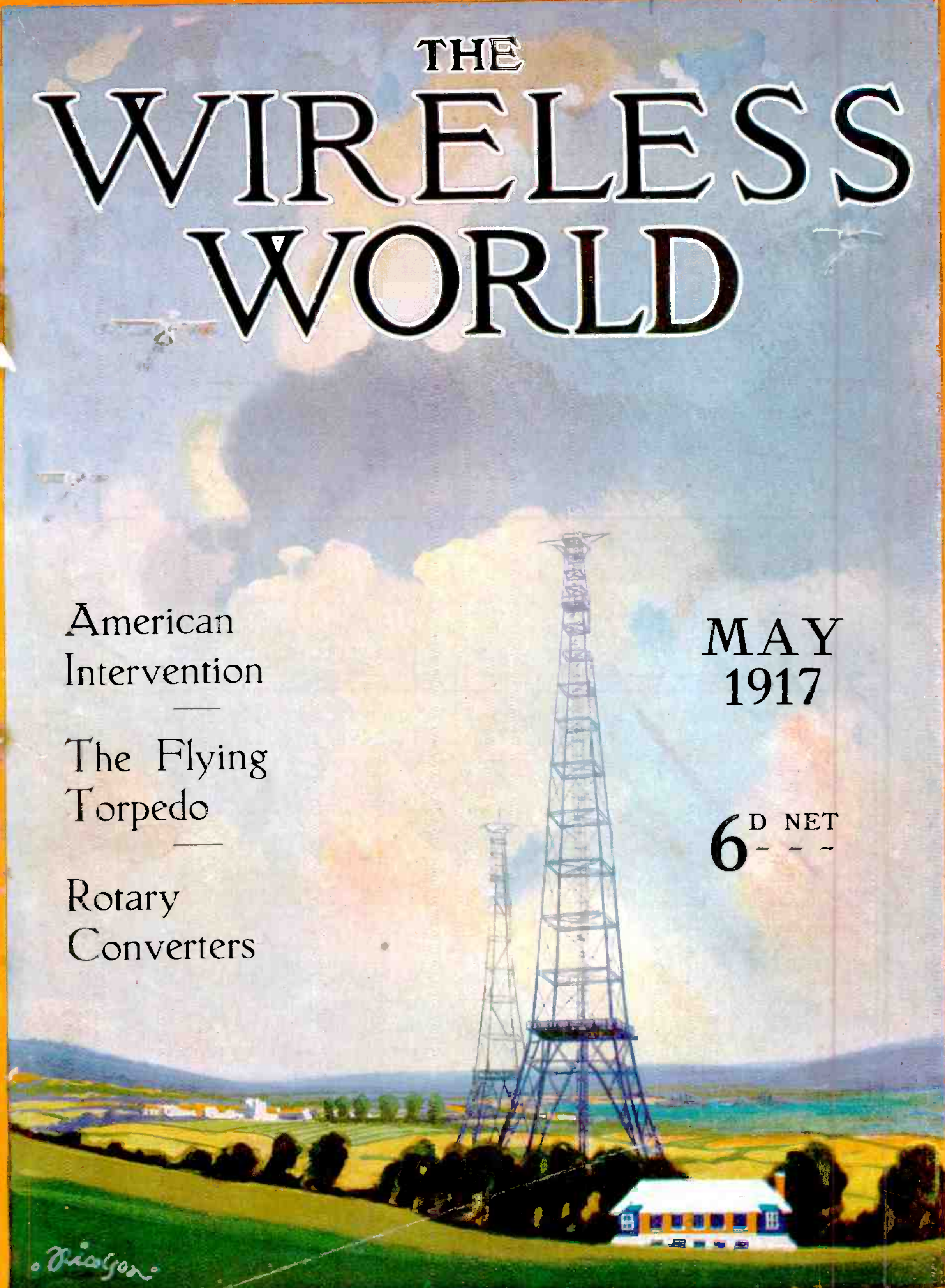

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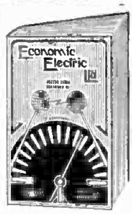

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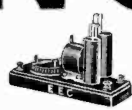

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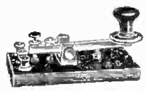
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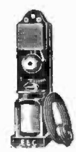
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The
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Volume V. No. 50. MAY, 1917.

Wireless with the Eskimos

Diary of a Voyage to Baffin's Land and Hudson's Bay

By DOUGLAS R. P. COATS.

(EDITORIAL NOTE: *The first part of this interesting Diary appeared in our April issue.*)

Aug. 14th.—A glorious day and quite warm. Much of the ice had left the harbour—blown out during the night by a favourable breeze. Mr. F——, the missionary, brought his Eskimo men to see the wireless apparatus, explaining it to them in their own tongue. Their eyes opened wide when I touched the key which produces a loud spark, and I think they left me with an idea in their minds that I was gifted with some mysterious if not evil power. I was told by Mr. F—— that the story which they would tell their friends on shore would be generally disbelieved and that if they spoke of such things as communication through space—or over wires for that matter—there was a risk of not only their veracity but their sanity being called in question.

At five o'clock in the evening we weighed anchor and left Lake Harbour, taking Mr. F—— with us. Extremely heavy ice was encountered outside, but the *Nascopie* easily forced her way through it. At dusk we sighted and soon succeeded in reaching a schooner lying patiently in wait for a favourable breeze to open up the ice for her. We hailed her and learned that she belonged to New Bedford, which port she had left in June, but as she wanted no assistance we resumed our journey.

Aug. 15th.—We arrived at Wakeham Bay in the afternoon. The Hudson's Bay Company has a competitor here in Messrs. Revillon Frères, generally known as the French Company. The two trading posts are situated at some little distance from each other on a plain surrounded by lofty hills. The ground was certainly greener than that at Lake Harbour, but bare enough all the same. One of our rafts was swamped in the evening, luckily near the shore. The two boats of which it was constructed filled and sank, wetting the cargo and tumbling several passengers into the icy water. All reached shore, however, and managed to beach the raft and bale out the boats.

Aug. 16th.—I went ashore in the morning and visited the H.B.C. post, afterwards climbing one of the hills, descending on the other side and returning along the beach to the motor boat which took me out to my ship. We left Wakeham Bay at six p.m.

Aug. 17th.—We made slow progress all day through ice and dense fog, blowing our whistle, although in practically deserted waters. Another steamer's horn sounded quite close to us at about one o'clock in the afternoon, and I learned by wireless that the s.s. *Adventure* was passing us on her way out up the straits. She reported "All well," and gave us a scanty extract from news which she had received from the station at Port Nelson.

Aug. 18th.—Spent the day in heavy ice and fog. We saw two bears on the ice, but the fog made them appear a long way off.

Aug. 19th.—I produced a special edition of the "Lyre" to commemorate Miss N——'s fifteenth birthday. We arrived at Cape Dorset, Baffin's Land, in the afternoon.

Aug. 20th.—Went ashore in the afternoon and walked over the hills. The

[Photo: Underwood & Underwood.

A GROUP OF ESKIMO GIRLS.

[Photo: Underwood & Underwood.

AN ESKIMO IGLOO.

Eskimos all shook hands with us when we landed, and put on their broadest smiles. Many of the native ladies were tattooed on the face, and smoked short clay pipes, doing the bulk of the work as usual. I saw a white bear tethered by a chain to a heavy piece of rock behind the H.B.C. post. He seemed a good-natured beast, though I did not approach close enough to put his friendly appearance to the test. Having taken afternoon tea at the post, we returned to the *Nascopie.*

Aug. 21st.—A big row-boat put out from shore filled with a varied and highly scented assortment of Eskimo families and dogs, also a white polar bear. Captain Mack was taking the latter to St. John's with the intention of presenting it to Bowring Park.

At 10.0 a.m. we left Cape Dorset for Wolstenholme. A light snowstorm was encountered just after lunch, and for the remainder of the afternoon we steamed against a strong wind and a choppy sea. Land was made early in the evening, high and broken land merging into dark and ominous storm clouds. At nine p.m. we anchored in the shelter of Cape Wolstenholme, seeing nothing ahead of us but a small and flickering light which we knew to belong to the post.

Aug. 22nd.—I went ashore in the morning and met Mr. Chalmers, in charge of the post, and his assistants. The post is built upon a plain which may at some time have been the bed of a river, for high hills rose on either side, running more or less parallel to each other and for some distance. I was shown some fine examples of native carving in ivory, the specimens which I saw included kyacks with complete outfits of hunting weapons, komatiks (sleighs), and various animals figured in bas-relief on walrus tusks. I lunched at the post upon tinker pie. The correct name of the tinker, according to *Cartwright's Journal*, is the "razor-billed" auk. It is a kind of duck, and in size about equal to a pigeon. The flesh when cooked is of dark brown colour, somewhat fishy in flavour, and abominably tough—if that which I tasted was correctly served.

I played a few tunes on a fiddle belonging to Mr. Chalmers, and listened while a half-breed boy rendered "Dixie" and other pieces on an accordion. After lunch I tried my hand at paddling a kyack, and succeeded in running up on a submerged rock and narrowly escaping being capsized, a mishap which would have been unfortunate for me, as my feet were well jammed into the inside of the boat so as not to be easily withdrawn.

The *Prickly Heat* took me back to the ship, which we only succeeded in reaching after many false starts and sudden stoppages due to sparking plug trouble.

Aug. 23rd.—We left Wolstenholme in the morning. Our white bear broke loose in the afternoon, and after devouring several "tinkers" which had been shot on the previous day by Captain Mack, it started on a tour of the deck. Our second mate managed to throw a noose about Bruin's neck and lead him back to captivity.

Aug. 24th.—We ran all day in fine weather.

Aug. 25th.—We arrived at Churchill just after lunch. The entrance to the harbour was marked by a high "beacon" built of wood. The ruins of an old stone fort could be seen on the shore, a relic of stirring days in this locality when foreign rivalry was keen, and one's claims had to be backed by arms and an ability to use them. The North-West Mounted Police have a barracks here, and their white buildings with red roofs appeared very smart-looking after some of the more dingy shacks which we had seen elsewhere. The land was greener than any we had seen so far, and less hilly.

We anchored at the mouth of the river, and in doing so were unfortunate enough to lose one anchor with seventy-five fathoms of cable, this mishap being attributed to a rotten link. The H.B.C.'s post is some two or three miles up the river, but the news of our arrival soon brought the boys down to us. One or two North-West Mounted Police fellows came aboard also, and extremely fine chaps they were too.

Aug. 26th.—I remained on board all day, and among other jobs repaired two damaged spark plugs for the *Prickly Heat*.

Aug. 27th.—I went up to the post in the motor boat with Rev. F—— and Capt. Mack. Going alongside a tiny wharf, we were received by the Rev. S——, a missionary, who took us to his house and later to see his church. Grass was growing in abundance ashore here, and many kinds of flowers, while stunted-looking lettuces grew in rows in a little garden patch. The missionary and his family complained of an extremely poor winter hunt, and told us they had tasted no fresh meat for fourteen months! Many of the Eskimo and Indians have suffered terribly with scurvy on account of this lack of fresh deer meat, and general bad times had been experienced. Mrs. S—— said she had tried fox meat and found it good eating—until she discovered that those animals were feeding upon dogs which had died of scurvy! The pay of missionaries in this part of the world is ridiculously meagre, and with rising food prices, their outlook is one of harder struggle than ever. No unprejudiced mind can dispute the beneficial results of missionary influence upon the Eskimo in Baffin's Land and around the shores of Hudson's Bay. The visitor has only to refer to men who have spent often many years among the native folk and who have seen the decline of the medicine-man's power with the advance of Christianity to become convinced of the good work which is being done. The real value of missionary labour had often been doubted by me, and I questioned many white men up here upon the subject. I found that in every case where the verdict was not likely to be biassed, it was distinctly in commendation of the missionary. But Darwin, of course, found practically the same thing to be true of missionaries years ago, and at the extreme south of this same continent.

We were taken to the church, a grey-painted structure with a tiny belfry. The walls inside were adorned with texts in the Eskimo characters as well as in our own language. The red and gold altar cloth was the work of Mrs. S——, and did her great credit in the beauty of its design and in the richness of its embroidery. We were obliged to leave very early on account of the tide, which had already left the *Prickly Heat* high and dry, so after a hurried visit to the H.B.C. store we went down to the shore and pushed our boat into deep water—Captain Mack getting his legs very wet in this operation, and the ladies who accompanied us having to be ferried out in a canoe.

The *Prickly Heat* jumped alarmingly in the choppy waves, which had risen with a fresh breeze, and most of us were wet with spray by the time the *Nascopie* was gained. The current rushed past the ship at a terrific rate, and the motor-boat had a hard time in battling against it as we rounded her stern and came up to the ladder on the other side.

[*Photo: Underwood & Underwood.*

ESKIMOS AND THEIR SUMMER TENTS.

[*Photo: Underwood & Underwood*

CUTTING UP A WHALE.

Aug. 28th.—The schooner *Fort York* came alongside and took off some of our York cargo. She was a smart little ship, fitted with an oil engine in charge of a German engineer. I am not sure which was the more interesting to us—the engine or the engineer. The latter was a decent fellow enough, and maintained a discreet silence when the conversation concerned the great war.

Aug. 29th.—I was awakened by the blowing of a fog-horn, and found that the *Fort York* was off, taking our prospective brides, who were standing on her deck waving handkerchiefs. The steam launch *Don* was busy all day dragging for our lost anchor, and succeeded in locating it just before dusk, enabling the mate to bring it aboard with the aid of our other anchor.

Aug. 30th.—We left Churchill for Chesterfield at seven o'clock in the morning, the weather being fine all day.

Aug. 31st.—The weather remained fine though cold. Our compass needle behaved very badly, and caused the ship's officers considerable discomfort. We were at this time said to be within five hundred miles of the Magnetic North Pole, and in these regions the compass, which is such a blessing and a necessity to mariners elsewhere, becomes totally unreliable. We sighted low land in the afternoon, and entered Chesterfield Inlet in the evening, anchoring off the H.B.C. post. The Aurora Borealis was to be seen in all parts of Hudson's Bay on any fine night, and on this particular night appeared as a wonderful curtain in the sky, changing hue and shape in a sort of wave motion which passed across it as folds will traverse a heavy curtain when shaken. I noticed no "static" effects in my telephones, at which I was somewhat surprised, as the magnificence of the Aurora made me expect manifestations of some "atmospheric" disturbance. On other occasions during the trip I tried the visible effect of wireless transmission upon the "streamer" form of

Aurora, but did not observe the deflection noted by Mr. David Sarnoff in an article in an American popular scientific monthly a year or two back, though certainly Mr. Sarnoff's experiments were made in higher latitudes.

Sept. 1st.—I went ashore in the morning in the motor-boat with Capt. Mack and others, landing on a solid rock in front of the post where the natives were engaged in carrying cargo. We went to the Catholic Mission and stayed to lunch with the two French priests, Fathers Le Blanc and Turquetil. A big Eskimo sat in one corner of the room, and when he moved I saw that his feet were missing, compelling him to walk on his knees. Both feet, we were told, had been frost-bitten and amputated. What dignity the poor fellow lost on account of his awkward locomotion was made up to him in the title by which he was known. The " Duke of York " is surely an uncommonly fine name to be borne by an Eskimo ! We paid a visit to his ducal mansion after lunch—a very small tent of seal-skin, but boasting a wooden door where an ordinary flap might have been expected. We did not enter, contenting ourselves with admiring the interior from without.

We visited the H.B.C. store, where I bought a curio in the shape of a wee kyack constructed after the fashion, so I was told, of those used by the Eskimo in the Arctic Ocean, though practically identical with the Hudson's Bay kyack.

We all returned to the ship in time for supper.

Sept. 2nd.—We left Chesterfield at about 5 p.m., steering roughly by the sun, the compass being useless.

Sept. 3rd.—We ran slowly during the morning through fog, which cleared later.

Sept. 4th.—At 5 p.m. we came within range of the Government wireless station at Port Nelson.

Sept. 5th.—I received news dated August 31st from Port Nelson while lying at anchor in York Roads. Invitations arrived from shore for us to attend the weddings of the two ladies who left us at Churchill.

Sept. 6th.—Received more war news from Nelson. The schooner *Fort York* was all day taking off our cargo.

Sept. 7th.—We received another sheet of news from Port Nelson. While launching a 14-ton motor-boat, called the *Patricia*, which we had brought from Montreal, the sheer legs arrangement which had been erected for the job broke with a crash, and let the *Patricia* fall on her side in the water. She soon filled and sank, and although she was raised almost to the surface by means of a grapple on our anchor cable, she broke away again and could not be recovered.

Sept. 8th.—The morning was marked by dense fog, so that the *Fort York* was prevented from coming out until the evening. She reached us at dusk, and had only just anchored when a gale of wind arose and started her pitching so heavily that she broke away from one anchor and had to throw out the other.

Sept. 9th.—The gale continued all day and gave the schooner an exceedingly rough time. Her anchor held, however, and when I turned in at night I could see her lights twinkling away astern of us. A steamer arrived in the afternoon and lay about a couple of miles from us. Wireless communication proved her to be the *Bellaventure* taking stores to Nelson for the men engaged upon the new Government railway and docks work there. All prevented from attending to-day's wedding.

(To be continued.)

PERSONALITIES IN THE WIRELESS WORLD

J. ERSKINE MURRAY, D.Sc.

THIS month we are pleased to be able to present our readers with a portrait of the well-known wireless expert, Dr. James Erskine Murray. Dr. Murray was born in Edinburgh on October 24th, 1868, and after a course of six years' study under the late Lord Kelvin at Glasgow University entered Trinity College, Cambridge, as a research student. From 1896 to 1898 he was Assistant Professor of Physics and Electrical Engineer in the Heriot-Watt College, Edinburgh, and in 1898 he was appointed experimental assistant to Senatore Marconi.

At this time the coherer (now, of course, quite obsolete so far as practical wireless work is concerned) was the sole reliable detector in everyday use, and Dr. Murray had much to do with some of the most interesting experimental work then carried out. After serving two years in this capacity he took up the post of Lecturer and Demonstrator in Physics and Electrical Engineering at the University College, Nottingham, and in 1905 he was appointed to the lectureship in Electrical Engineering at the George Coates' Technical College, Paisley. In 1905 he took up Consulting work in Radiotelegraphy, and from 1907 to 1909 held the post of Lecturer at the Northampton Institute, London, During his tenure of this position he delivered a large number of lectures and gave many practical demonstrations in Radiotelegraphy, as many of our readers will remember. He has contributed to numerous learned societies, and is the author of several works on Wireless Telegraphy, perhaps the best known being "A Handbook of Wireless Telegraphy." In 1913 he joined the firm of Clark, Ford & Taylor, consulting engineers, and the firm is now Clark, Ford, Taylor & Erskine Murray.

The Use of Time Signals for the Determination of Longitude

By LIEUT. L. M. RUST

THE following notes were suggested by Mr. F. B. Cooke's article on " Australasian Time Signals " in the March issue of THE WIRELESS WORLD, to which we would refer the reader. One of the principal practical difficulties in the wireless application of the method of coincidences for checking longitude is in connection with the length of the transmitted dots. If the dots are sharp enough to allow of the coincidences between the clock beats and received dots being accurately observed (using the method of coincidences as usually applied), it is found that they do not " carry " well. This effect is almost entirely a physiological one, and depends to a great extent on the relative strength of signals and atmospherics. It may easily be reproduced with buzzer signals, using a method similar to that described below in another connection. The explanation given by Mr. Cooke that it " takes a definite time to charge the aerial fully " does not hold, as the following considerations will show. Stations beyond the normal range of the Arlington U.S.A. time signals report that they are frequently able to hear him transmitting the weather report which follows the time signals, when the time signals have not been heard at all. Now these signals consist of a series of dots at one-second intervals (various dots being missed to mark the minutes and half-minutes), and, though they are comparatively short, they are certainly over 1/100th second in length. The spark frequency of Arlington is 1,000 per second, and hence there must be at least ten *complete* wave trains per dot—*i.e.*, the aerial must be fully " charged " (using Mr. Cooke's phraseology) and discharged ten times. It is also well recognised by those who have practical experience of long-distance wireless communication that a *sine qua non* of good sending for long-distance services is firm dots. Dots which would be classed by an operator as light are shown by spark recorders to consist of several complete wave-trains.

The difficulty as to light dots, of course, applies as much to continuous-wave as to spark transmission ; in fact, in the case of arc transmission it would be accentuated for the following reason. It would be difficult to avoid some slight arcing at the relay key of an arc set, which in the case of very short beats (or silences) would make them badly defined. The arcing might not be sufficient to be noticed on ordinary sending, although it is a matter of common experience that the signals transmitted by arc sets often lack that clear, well-defined quality which helps the readability of signals so much.

By the use of one of the methods outlined below, it would be possible to use firm dots and yet observe the coincidences accurately, though it would be necessary to ensure that the dots were of equal length, and the receiving station clocks might require slight modification. In all these methods it would be necessary (in order to avoid a click each time the contact at the pendulum is made or broken) to use a telephone transformer, which would be connected in the receiving circuit in the usual manner.

Method 1. Clock pendulum (Fig. 1) fitted with contact maker arranged to make contact every swing. Length of contact to be regular and variable in length from about 1/100th to 1/10th seconds. Resistance shunted across contact maker to be adjustable, so that weak, but clear signals are heard in the telephones (which are in circuit with it and the telephone transformer) when contacts are open, strengthening to full strength when the received dots coincide with the period of contact.

Method 2. Clock pendulum (Fig. 2) fitted with contact maker, as in method 1, but contacts arranged so that on making circuit they connect across the telephones (which are connected across the low-resistance winding of the telephone transformer) a shunt resistance of variable value. Hence the coincidences of dots and contacts would be marked by a missed or weakened dot.

Method 3. Clock pendulum (Fig. 3) fitted with a contact breaker, which is arranged to break circuit for a regular period adjustable in length from about 1/100th to 1/10th seconds. Shunt resistance to be adjustable so that weak, but clear signals are heard when the shunt circuit is made, strengthening to full strength when the received dots coincide with the period when it is broken by the contact breaker.

Method 4. Contact breaker (Fig. 4) fitted to clock pendulum as in method 3, but arranged so that on breaking circuit it puts a high resistance in series with the telephones. The coincidences would be marked, as in method 2, by a missed or weakened dot.

Figure 5 will make it clear that by using methods 1 and 3 not only can the coincidences be accurately noted, even if the length of dots and contacts be comparatively long, but it is also possible to differentiate between an exact and inexact coincidence, and, of course, the same principle applies to methods 2 and 4.

In this diagram, although the length of the dots and relative position at each second are shown correctly to scale, the space separating each second is compressed. It will be noted that in both cases shown an inexact coincidence is marked by one more dot (in which a portion comes through full strength) than in the case of an exact coincidence; but with certain relative lengths of dot and contact the reverse would be the case.

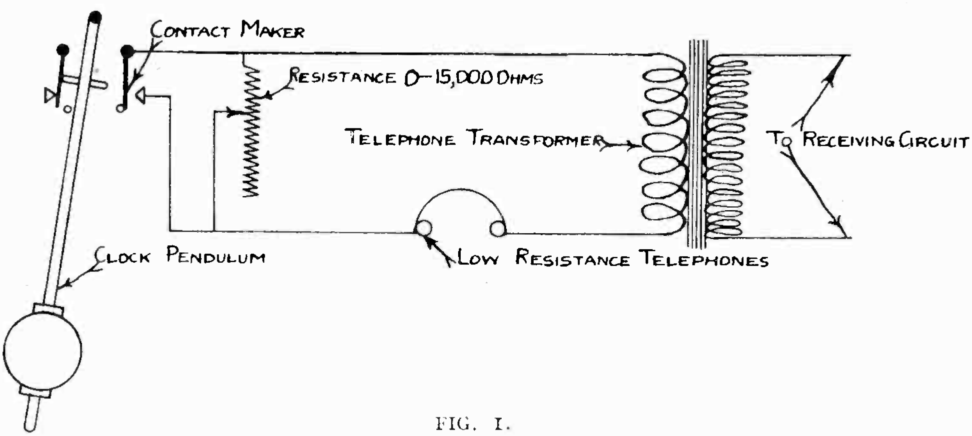


FIG. 1.

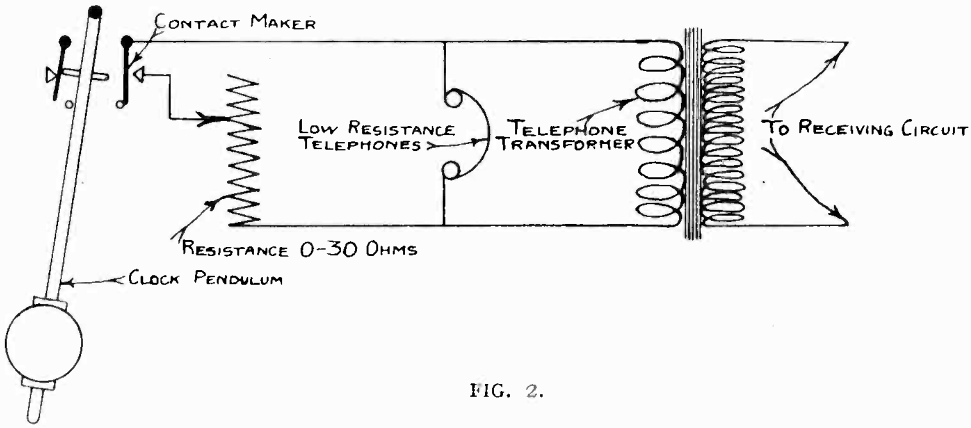


FIG. 2.

This ability to distinguish between exact and inexact coincidences should prove useful, as not only does it make it possible to select the most accurate coincidences, but it would also help to compare the receiving and transmitting clock rates and serve as a check on their steadiness. For example: Suppose that the receiving pendulum was beating seconds, and the transmitting one beating $101\frac{1}{5}$ dots in 100 seconds (or 506 dots in 500 seconds), there should be one exact coincidence followed by four inexact ones. The inexact coincidences immediately next to the exact ones would probably be so nearly exact that the ear would class them as such, and, hence, three exact coincidences would be noted and two inexact ones, or it might be *vice versa*. At any rate, taken over a period of fifteen minutes or so, there would be a regular cycle of recurrence of exact and inexact coincidences if the clock rates were steady.

It will also be noted from the diagram that the louder portions of the end dots, in both cases of inexact coincidences, are very short (·005 second in both cases), and it may be objected that no difference would be heard between them and an ordinary weak dot.

Given a high spark frequency, and what an operator would class as "Medium readable signals, X's rather strong," it should be possible to distinguish an overlap of dot and contact of only ·002 second, and with light X's of ·001 second, as the following experiment (which is easy to carry out) shows.

Referring to Figure 6: A was a telephone transformer connected to a receiving set, which was tuned to a very long wave in order to receive atmospherics; the strength of the atmospherics being modified as desired by varying the couplings. Coupled loosely to the telephone transformer, with a variable coupling, was a small iron core inductance B, in circuit with which was an air core transformer C, and a contact maker D, which was arranged to make contact about once a second for about ·04 second. The other winding of the air core transformer was connected in a high note buzzer (E) circuit. In series with the telephones F (120 ohm) was placed another contact maker G, which made contact for a period which was adjustable from ·0005 to ·002 second. Shunting G was a resistance H, variable from 0 to about 15,000 ohms. Both G and D were rotary contact makers, D making one revolution per second, and the speed and contact length of G were arranged so that not more than one contact occurred during the time that D was making contact (·04 second).

The resistance H was set at zero, the contact maker G thus being shorted. The couplings B and C (starting with very loose couplings) were then gradually tightened, until the dots formed by D were continuously and clearly audible above the atmospherics. With contact maker G opened, the resistance H was adjusted until the dots were very weak, but still quite clear; the relative strength of signals and atmospherics was not altered by this adjustment, and so the dots still remained continuously audible above the atmospherics. Contact maker G was next put in operation and adjusted to give a contact of about ·002 second, which contact overlapped some of the dots. It was found quite possible to distinguish with confidence the dots which were overlapped by the contact, and which sounded like a dot with a click superimposed on them. The resistance H was then disconnected, and it was found impossible to distinguish consistently the overlapping of a dot and a contact, which sounded as a click, and was difficult to distinguish from sharp atmospherics. This difficulty was accentuated owing to the fact that the ear was not prepared for the click, as in the case where weak dots were coming through all the time. The resistance H was then set at zero, the contact maker G was put in circuit with contact maker D and transformers B and C, and thus dots of ·002 second length were generated. It was found quite impossible to follow these through the atmospherics, though when the latter were taken off (by disconnecting the receiving aerial) they were quite distinctly heard. This case, of course, is equivalent to that encountered when very short transmitted dots are used. The dots were more difficult to follow through the atmospherics because the latter were coming through full strength all the time, and were not weakened in the intervals between the contacts, as in the first case.

It was found that with a relative strength of signals to atmospherics that would be classed by an operator as "Good readable signals, few X's," the overlap of dot and contact could be consistently distinguished down to a contact shorter than ·001 second.

An alternative method to those described above is given below. It might prove useful when signals of recordable strength are obtainable, and it could be adapted (using microphones) to clocks which are not fitted with contacts, but would, of course, necessitate the use of amplifying devices. The signals and microphone clicks could

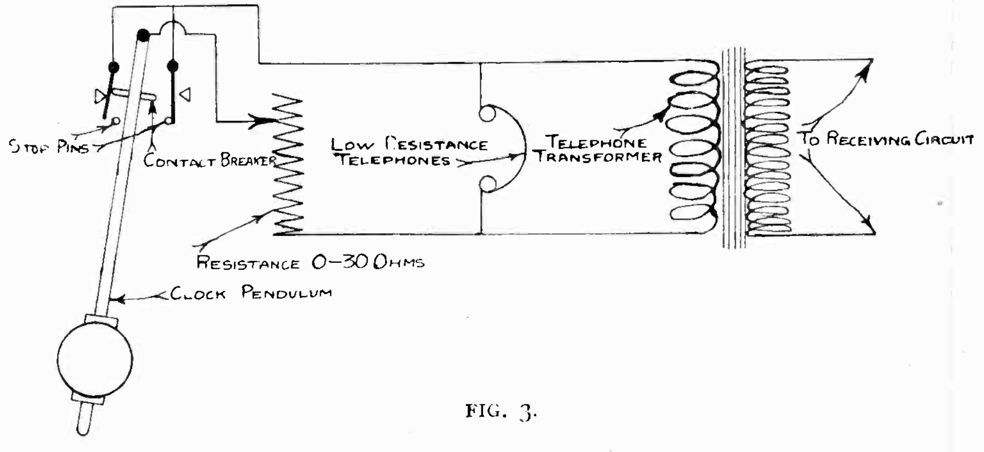


FIG. 3.

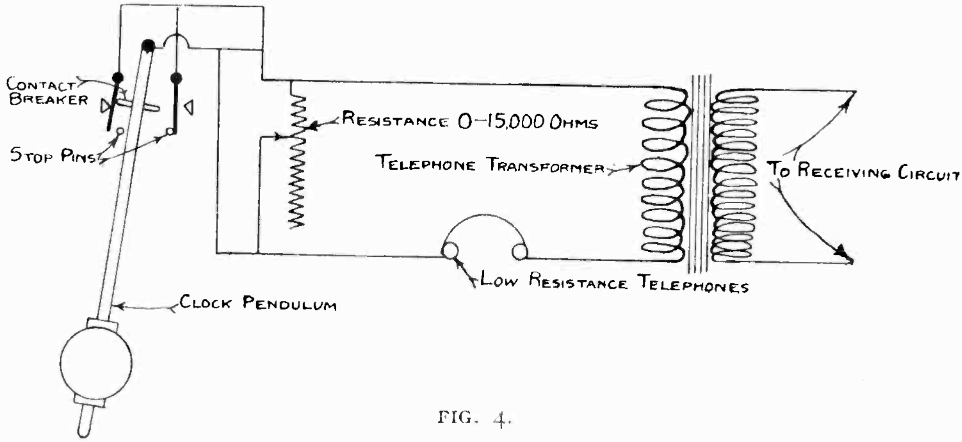


FIG. 4.

be magnified up, and recorded by means of a dictaphone on a wax cylinder. The cylinder could then be run over with the reproducer several times at any convenient speed, which should enable the coincidences to be accurately judged.

In connection with dictaphone working, when the recorded signals are sufficiently loud, it is possible to distinguish and measure their impress on the wax cylinder. By suitably controlling the driving mechanism of a dictaphone by a clock, it should thus be possible to design a form of chronograph which would possess the advantage of having no relay lag.

Even very loud telephone signals, which would make a distinctly visible impression on the wax cylinders, are generated by a very small current. Hence the chronograph could be connected directly in a clock contact or other similar circuit, without damaging the contacts. This chronograph might be used also for checking dot and contact lengths, etc., and even in certain cases for directly recording time signals.

Towards the end of his article Mr. Cooke speaks of getting better signals from continuous-wave stations than spark stations at the same distance from the receiving

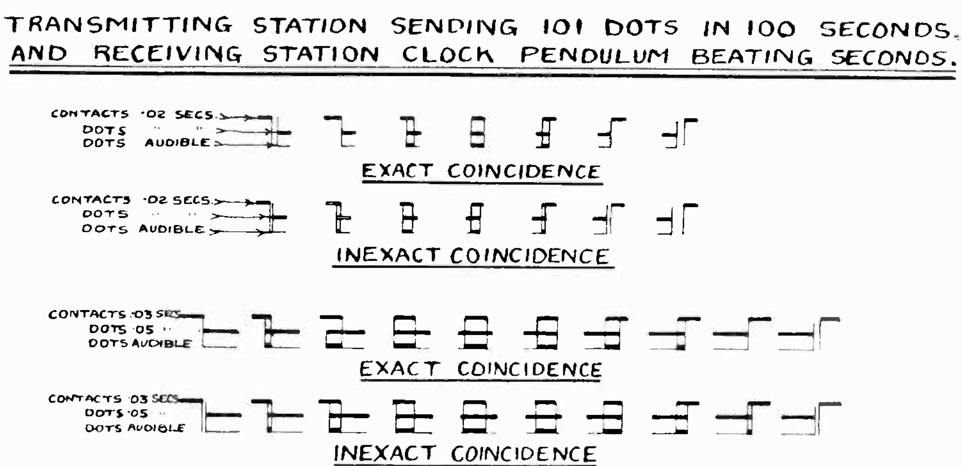


FIG. 5.

station, and of equal power. He attributes this to the inefficiency (owing to the excessive "loading" of the aerial) of the spark sets. An examination of the receiving-circuit diagrams he gives would lead one to think that the inefficiency is rather in the "receiving circuit for spark signals" than in the spark-transmitting station. Comparing the action of the valves, arranged as shown in the respective diagrams: in the arrangement used for spark signals it is not far wrong to say that (as an examination of the various characteristic curves of the valve would bear out) the action is equivalent to that of an amplifier, amplifying rectified signals from a rectifier which is comparatively inefficient for weak signals. Hence this arrangement is comparatively inefficient for weak signals.

In the case of the receiving circuit for arc signals, however, the action of the local oscillations greatly improves the efficiency of the arrangement for weak signals.

As a case in point, Mr. Cooke mentions receiving in Sydney, Australia, louder signals from Honolulu arc than from Honolulu spark set, which probably is to some extent attributable to the causes mentioned above, as signals from Honolulu spark set have been picked up in Europe frequently (in the winter), and on several occasions have been of recordable strength, while, as far as the writer knows, Honolulu arc set has never been definitely heard in Europe. The Honolulu spark set transmitting aerial is, of course, of the directional type, and the direction of Australia is very far removed from that in which the maximum radiation takes place. This point also probably, has some bearing on the matter.

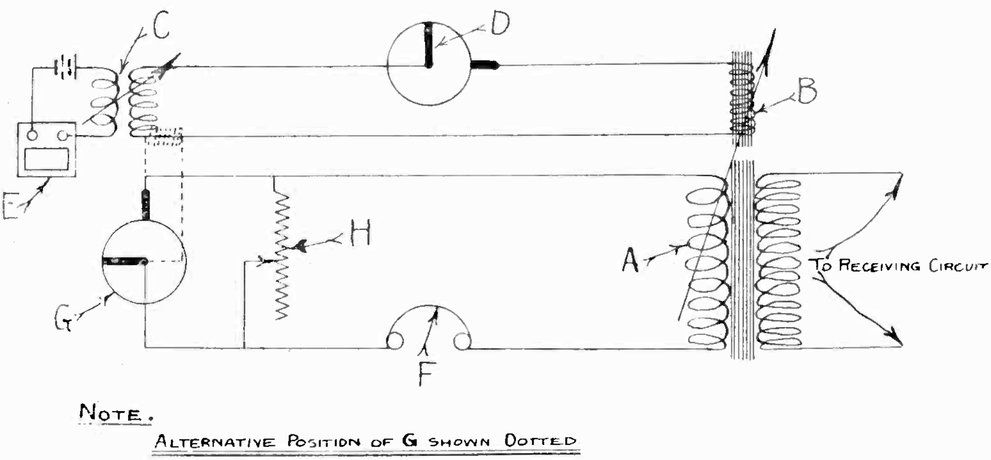


FIG. 6.

Another U.S. Naval Station

THE Senate Committee of the Naval Forces, after reporting the Pagett Bill making naval appropriations for the coming year, recommended increases aggregating $167,000,000. One of the items in this increase was for $400,000 for a radio station at Porto Rico.—(*Electrical World.*)

Digest of Wireless Literature

Americans and Pure Research.

In the Digest for February we were able to reproduce some interesting remarks by Professor Glazebrook, emphasising the importance of pure research. This subject has also been occupying the attention of Americans within the last few months, and in a recent issue of the *General Electric Review* we find an account of an address delivered by Dr. W. R. Whitney at the Alumni Dinner of the Massachusetts Institute of Technology on January 6th. Dr. Whitney, it may be mentioned, is the Director of the Research Laboratory of the General Electric Company of America. In the address Dr. Whitney makes an urgent plea for the better recognition of the value of scientific research work and a more liberal treatment of those engaged in this pursuit. Particularly he emphasises the point that the results obtained by many great men are not obtained by haphazard methods, but only by highly trained men through persistent effort. Most of the foundations of the world's great advances in experimental knowledge have been laid, said Dr. Whitney, by men who were set apart and supported by the Government, or some more or less public institution, where, for very long periods (usually for life), they were encouraged to delve into the unknown. Think of Davy and Faraday in the Royal Institution ; of Graham, Ramsay, Rayleigh, J. J. Thomson and Kelvin in English institutions ; of Pasteur in the Sorbonne and Pasteur Institute, of the Curies, of Dumas and Berthelot and others of France ; of Helmholtz, Bunsen, Hertz, Woehler, Hofmann, Ostwald, Hayer and others in German universities ; of Berzelius, van'tHoff, Mendelejeff, Arrhenius and a score of men from the universities of other countries. Most of these are men of our time and known to our country. They were in some ways supported in their research work by their countries. How many such cases can we cite for America ? In a few colleges one or two men are now permitted to carry out a little research work when it does not interfere with routine teaching. It was not long ago that research, if done at all in some of our colleges, had to be done surreptitiously. At this same time other countries were paying their best scientists to continue research, and schools of research were being maintained in almost every large German and university city. Dr. Whitney went on to say that there is something distinctive in research, which can best be covered by the word "trying." It seems to convey an impression of following the suggestions of Nature instead of attempting to force some single preconceived path to the exclusion of others. Many of our real advances come to us from the development of new phenomena which are in no sense sought for the purpose. The foundation is laid at times when thought of the object gained is impossible. The knowledge may be sought a long time before the value of it is realised. It is the calling of this kind of knowledge that we as a whole should encourage. . . . When Professor Hertz was making observations which were based on the effect of one sparking gap on another at a distance, and concluded that he was dealing with electric waves in space, he was not trying to improve the telegraph or telephone. He was like an inquisitive child, making what to him were interesting experiments. He was well trained to observe, but otherwise he was like a youth guided solely by the interest in the new things he was finding. When he added to our knowledge the few simple effects which he observed, the result of trying things, he had laid the foundation for a Marconi. His ability was no accident, his service no unaided or unsupported thing. He had been trained by Helmholtz, and all his life he was employed in German universities to do pure research work and to encourage others to do it likewise. This is the important point. Dr. Whitney said he did not believe it is commonly realised (particularly in America) how generally the world's greatest discoveries were disclosed in their first stages by men who were highly trained and experienced in experimenting. We do not appreciate the fact that usually the long strides in advance are made by careful, painstaking observations of matters not at the time particularly prominent or comprehensible to the layman. A Swedish professor in a lecture once noticed that wire carrying electricity made a magnetic needle move when brought near it. He studied this little thing because he liked it. Another professor in France quickly went on with this little phenomenon, finding out how in general electricity and magnets were related. Then a couple of Germans used the principle for communication at a distance, and we soon had electro-magnetic telegraphy.

In addition to this, such men as Professor Henry contributed to the study of the electro-magnet. Is it an accident that all these men, Oersted, Ampère, Gaust, Wener and Henry were in educational institutions, in this way mature and highly educated men? Perhaps the two names which first occur to the student of the electrical brook are Volta and Galvani. Here again we have trained observers and teachers. Each of them, but two, were over forty when he did the work here referred to. I mention this to show that in such cases maturity in age and education has been common, and that we must get out of the way of thinking that great advances by original thought and work emanate usually from the young and untrained mind or are the accidents of time and environment.

* * * * * *

A New High Power Station.

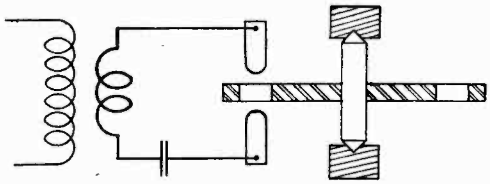
A recent number of *The Scientific American* contains the report of the opening of the United States Naval Radio Station at Chollas Heights, near San Diego. The opening of the station, which took place on January 26th, marks the completion, says our contemporary, of the most powerful plant of its kind in America. The occasion of the dedication of the San Diego station brought to that city a number of men prominent in radio work in and out of the naval service, and among them were Lieutenant-Commander George Sweet, Lieutenant-Commander Stanford Hooper, aide to the chief of the naval radio service, Lieutenant Ernest Swanson, fort commander, and Dr. L. W. Austin. At the San Diego station there are three 600 feet towers, weighing in all over one million pounds. They are claimed to be the largest radio aerial towers in the world, and are triangular in section, having a width of 150 feet at the base and 8 feet at the apex. They are placed 1,100 feet apart, the bases of the legs of the towers being insulated with porcelain embedded in concrete. The design of the towers is similar to that which appears on our new cover.

In the construction of the earth connection 25 miles of piping and copper cable have been laid within the 72 acres comprising the station site. The continuous wave method is employed in this equipment, current for the arc being provided by a 200 kw. 1,000 volt direct current generator driven by a 300 h.p. 2,200 volt 60-cycle induction motor. The station represents an expenditure by the Government of £60,000, and about two years have been occupied in the erection and equipping of the plant. The messages between the station and Arlington on the opening day were sent by Lieutenant-Commander Hooper, who used a silver-plated telegraph key prepared for the occasion, and later presented to him as a souvenir. The station will be in charge of Lieutenant John Ashley, who will have a capable staff of radio electricians under him to carry out the station's work.

* * * * * *

A New Patent for Spark Gaps.

A new form of rotary gap is described in our contemporary, *The Popular Science Monthly*, for March. A rotary spark gap, or one upon which a cooling air blast is blown, is generally more regular in operation than a simple open stationary-electrode device. To secure uniform sparking the condition of the gap and the electrodes must remain stationary. If ionised gas collects between the sparking points the breakdown voltage of the gap will be reduced and sparks will pass prematurely. The same unfortunate result occurs when the electrodes become overheated and tend to produce arcs. The effect of such a regular spark is to reduce efficiency and to make the production of a clear signal-tone impossible. The new form of spark gap has been devised by H. Shoemaker, and is disclosed in U.S. Patent 1170853 for 1916. A novel feature is that between two stationary electrodes is inserted a rotary disc of mica, glass, porcelain, or some other such insulator, pivoted on a shaft and supported on bearings as shown. At equal distances around the disc, and a few inches from the outer edge, are drilled a series of holes such as indicated in the sketch. These holes pass in front of the spark gap electrodes, and sparks can pass only when a hole is directly between the electrodes; thus by rotating the insulating disc the effect of a rotary spark gap may be had, without any difficulties of insulating moving parts. The disc may be driven by an electro motor, and the patent suggests making it a sort of air-driven turbine.



A NEW ROTARY GAP.

* * * *

Radio-Telephony and Static Interference.

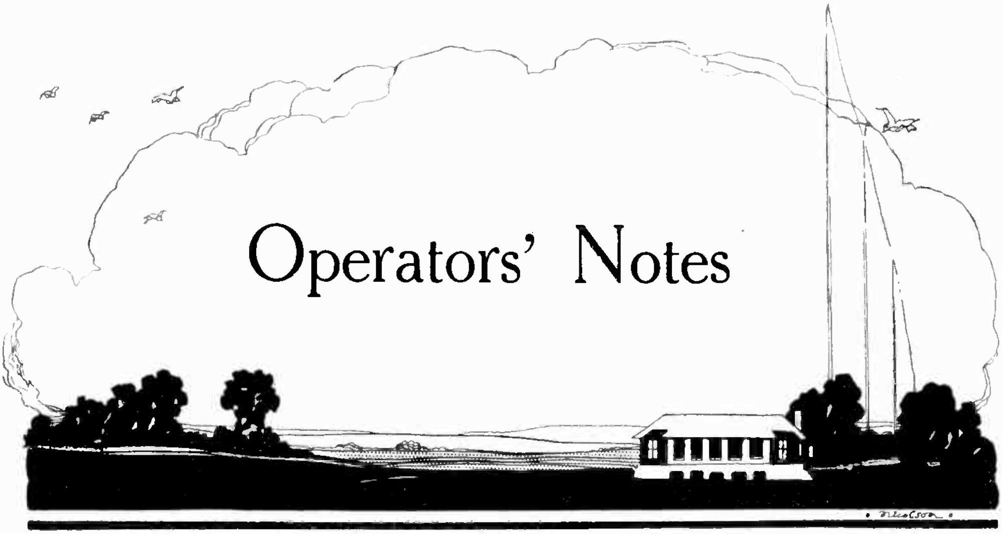
Radio-telephony has one great advantage over radio-telegraphy in the matter of stray elimination. It is well known that speech can be carried on, after a fashion, even under very serious difficulties; for example, in extremely noisy localities. The ease in understanding speech under such conditions is due particularly to our lifelong practice, since it is rather unusual (in cities at least) to carry on speech under conditions of even approximate silence. Then, too, there is what may be termed the "assistance of context." By this is meant the ability of the average listener-in "filling in" lost words in a conversation by judging what word placed in the gap would give sense to the entire sentence. This assistance is much greater than is usually believed, as can be easily shown by the common experience in listening to names over a telephone. Whereas ordinary conversation is carried on over normal telephone lines without any particular difficulty, the moment names or figures (that is, material lacking assisting context) are given great difficulty is experienced, and the percentage of errors rises markedly.

There is no doubt, therefore, that understanding a telephone conversation through comparatively heavy strays is a simpler achievement than taking down telegraphic signals under the same conditions.—Dr. A. N. GOLDSMITH in *The Wireless Age*.

[*French Official Photograph.*

A WIRELESS SCHOOL FOR "POILUS" IN A BARN.

Operators' Notes



Efficiency in Operating

The doctrine of efficiency so widely preached and applied in the United States of America has many points of interest to the wireless operator who wishes to make the best of his work and prove himself in advance of his fellows. It may be said briefly to consist in doing all work in the best, most rapid and easiest manner and in cutting down waste of time, material and energy to the lowest point. In some of the large industrial concerns the policy has been carried to such a pitch of perfection that almost incredible quantities of material are turned out and prices reduced to figures which a few years ago were considered impossible to attain. One of the chief reasons for the success of the American motor cars is the application of this doctrine of efficiency.

While the above does not seem to have any direct bearing upon wireless telegraphy we cannot too strongly urge operators to consider their work in this light and endeavour to arrange their duties, apparatus and materials with a view to increasing the facility of working. For instance, on a "one-man" ship, if the operator gives half an hour each evening to his clerical work instead of, as is frequently the case, leaving everything until arrival in first port, he will find his voyage much more pleasant. Further, by giving up one drawer solely to his forms, pencils, pens and other stationery, he will waste no time in getting together the necessary papers when these are needed. To put abstract forms in one drawer, the requisition book in another, telegraph forms on a shelf, and oddments all over the place is a sure road to muddle, inefficiency, and eventual trouble.

In the matter of pencils a few simple rules will greatly facilitate working In our own experience we have known a series of important messages to be interrupted by an appeal from the receiving operator to "wait" while he sharpens his pencil. Such delays are always dangerous, and never more so than at present when the loss of seconds may mean disaster. If the rule is made to keep spare pencils always sharpened and close to hand by the operating table there will be no delay whatever.

If the pencil point should break during reception a spare can be taken out and used without losing a single word. But it is of the utmost importance that immediately after the message is finished the broken pencil should be re-sharpened and returned to its proper place.

With regard to the storage of forms, it is not always easy to keep these tidy when the ship is rolling in heavy weather, unless suitable partitions are made in the stationery drawer. Very little ingenuity is required to design such partitions, and one of the best methods is to obtain from a business stationer's half a dozen or more wire drawer-divisions. These only cost a few pence and can be screwed into place or altered in position as required. They not only encourage tidiness but facilitate working to a degree scarcely realised by those who are not acquainted with their use.

Even more important than the storage of stationery is the proper keeping of tools and spare parts. The arrangement of the tool box should be such that those tools most frequently required are at the top of the box, and those rarely used either at the bottom or else in an allotted drawer where they can be easily found if necessary. How often do we find complete chaos reigning in a cabin and the floor strewn with every imaginable variety of implements in the vain endeavour to find a screwdriver which had been mislaid! Some of the best operators we have known have made simple little racks for the most used tools, such as screwdrivers, spanners, and the like, thus saving themselves much time and trouble in cases of emergency. A little system in storing dusters and cleaning cloths will be found very useful. A cloth used for wiping grease and oil from the transmitting apparatus should never be allowed to come into contact with the more delicate and highly polished receiving gear, although we regret to say that one duster has often been made to serve for all such work.

Some of the large American industrial concerns, ever anxious to cut down all loss and waste of time, have gone the length of employing the cinematograph to take lengthy films of workmen performing certain tasks. When developed these films have been carefully examined by efficiency experts with the object of seeing whether the particular workman makes any superfluous movements during his work. In one factory it was found that a man working a certain machine tool and turning out one small part of a motor car made one or two superfluous movements for every complete action of the machine. As he turned out a large number of parts per hour he made the superfluous movements many hundreds of times in the course of a day and, of course, lost time and energy in this manner. When this was pointed out to him by the experts and a simpler way indicated his output immediately rose 15 or 20 per cent. without any further effort.

By arranging his *procès-verbal* book, sending and receiving forms, pencils and scrap-paper in places where they can be reached with the least movement and exertion, an operator can facilitate his work to a considerable degree, particularly on ships where heavy traffic is handled. Even the position of the operating chair or stool should be considered in this light.

Although what we have said above would appear to be simple and obvious, it is surprising what few men adopt these principles. If it is only for his own sake, the operator should study and apply them, not only to the actual operating but also to the maintenance of the station in the most satisfactory condition.

A Study in "Progress"

Some Reflections on the "Wireless Year-Book" for 1917

In the fourth century B.C. the study of Logic was carried by the subtle Athenians into the realm of Paradox, and philosophers would sometimes exercise their wits by taking some item of everyday life and proving by logical argumentation its impossibility or non-existence. The story goes that a certain practical Roman, to whom a Greek logician proved by a series of syllogisms that it was impossible for a man to walk, baffled in the combat of wits, rose from his couch and stalked out of the room, saying as he went "solvitur ambulando," "*I solve your riddle by walking.*" Whether the story be true or not matters little. Some men, in all ages, have spent their time and wits in proving the impossibility of a certain theory or course of action, and it is usually when they are most busily engaged in this pursuit that a practical pioneer comes along and "solves the riddle" by putting the theory into practice or initiating the action.

Our veteran scientist, Sir Oliver Lodge, recently reminded the readers of the *Nineteenth Century and After* that wireless telegraphy is a case in point. When engaged in controverting some criticisms of his theories as advanced in *Raymond*, he makes the caustic remark: "On the basis of such criticism, wireless telegraphy and "X rays . . . were disbelieved in, until the one was established as a paying concern "and the other was employed in the surgery."

Some late-nineteenth-century sceptics demonstrated all sorts of "impossibilities" in the path of wireless telegraphy, until Senatore Marconi solved the riddle for them by setting the new industry upon its feet and starting it on its career. To-day, although the science is still adolescent, it is "getting into its stride," and the increase in its rate of progress becomes daily more marked. The *Year-Book of Wireless Telegraphy and Telephony*, of which the 1917 edition has just reached our hands, affords plain indications of the rapid increase in pace which characterises the forward march of this applied science. Noting from the editorial preface that the present is its fifth annual appearance, we reached down the issue of 1913 from our shelves for the sake of comparison, and have been considerably impressed by the result.

After a few preliminaries, such as Calendar, etc., we come to the "Record of Development of Wireless Telegraphy and Telephony, and Interesting Items in Relation thereto." From consisting merely of some historical notes, starting with Patent No. 12,039 of 1896, this "Record" has become an epitome of the whole progress of the science from the discovery of "Electro-Magnetic Induction" by Michael Faraday in 1831 to the bridging of the Pacific by a commercial radio service in 1916. The text of the "International Radio-Telegraph Convention" of July 5th, 1912, maintains its place; but is followed in the 1917 issue by the text of the "Safety of Life at Sea Convention" of January 20th, 1914. This Convention, held in London under the chairmanship of Lord Mersey, was directly inspired by the *Titanic* disaster, which shocked the world on April 15th, 1912.

Our attention is next arrested by the "Laws and Regulations affecting Wireless Telegraphy" as at present in force in the various countries of the world. The *Year-Book* of 1913 was a pioneer in this respect. For the first time these Laws and

Regulations were brought together into a single language and in a collective form. In that year the number of countries whose laws found a place in the volume numbered 42. During the four years which have since elapsed, not only have the number of countries whose laws are printed increased from 42 to 56, but the laws which figure in the 1913 volume have been either superseded or drastically modified by subsequent enactments. The result is that, despite the employment in the 1917 *Year-Book* of substantially smaller type than that utilised in 1913, the number of pages devoted to this section alone has increased from 108 to 279. The utility of having in this handy form the text of the ruling Administrative Acts, otherwise only available in Danish, Italian, Norwegian, Spanish, Russian, Japanese, Chinese, etc., will easily be understood by practical men.

If there be any possible demonstration of progress more striking than that inherent in the Laws and Regulations, it will be found in the section devoted to the Stations of the World. Here we have a number of tables showing the various installations, sub-divided into (*a*) Land and (*b*) Ship Stations, giving in each case the call signal letter, the normal range, the wave-length, and the nature and hours of service, together with the charges. The stations are grouped together under the names of their various countries, whilst the latter are arranged in alphabetical order. Here, again, we have, collated, a vast amount of information, which could only be got elsewhere from a number of separate publications, and some of it not available in any other form. The 1913 *Year-Book* required for these particulars only 98 pages, printed in fairly heavy type, whilst in the 1917 edition we find no fewer than 275 pages, wherein the particulars appear in as small a type as is compatible with clearness of lection.

Such figures as these bring home to us in a very tangible way the stupendous progress that has been made in wireless installations, both ashore and afloat. When we remember that even this is far from representing the whole of it, and that we have to add the great volume of field installations used all over the world in connection with our military expeditions, the installations which have been erected upon the great flotilla of new war vessels of every description, and the land stations which are utilised for military or naval purposes (and cannot for obvious reasons be included in the list), besides the vast fleet of aircraft, daily increasing in number, we begin to get some conception of the way in which this new scientific industry has developed since 1913.

It would appear that an essential part of the original plan of the *Wireless Year-Book* consisted of the inclusion of a number of essays from the pens of men acknowledged to be the leading authorities in their own particular branches. We notice that this feature is still retained, and that, whilst the 1913 *Year-Book* devoted 115 pages to such essays, that number is increased in the volume which we are at present reviewing to 183. Two writers contribute both to the 1913 and 1917 volumes. These are Dr. J. A. Fleming and Dr. W. H. Eccles, and the Editor is to be congratulated upon the fact that he has secured the assistance of these two distinguished scientists for every edition of his volume. As a matter of fact, the decision of Judge Meyer, delivered during 1916 in the United States District Court, which settled in favour of the American Marconi Company a long outstanding dispute regarding the relative positions of the Fleming Valve and De Forest Audion, has brought Dr.

Fleming's work even more prominently to the front in the present than in the past volume. A summarised text of this judgment has been included in the *Year-Book*, which also contains an article from Dr. Fleming's pen upon one of the phases of wireless to which he has during recent years given special attention. We refer to the electric arc considered from the point of view of its function as a generator of persistent electric oscillations, and the subject will be found here treated with all the thoroughness characteristic of this eminent authority.

Perhaps the burning question of the moment, with regard to radio-telegraphy, is the theory and working of "Ionic Valves," whose peculiar action and immense possibilities are dealt with in a compendiumistic and masterly monograph from the pen of Dr. Eccles. This fine piece of work, with its numerous diagrams, will be greatly welcomed by numbers of technical investigators and practical men. Space does not permit of more than a passing reference to the able essays of Professor Howe and Dr. E. W. Marchant. But we may accord, *en passant*, a word of special commendation to the description of the "Leading Features of American Marconi Long Distance Stations," contributed by Mr. C. H. Taylor. Any reader, however slightly equipped with technical knowledge, can gather an excellent idea of these wonderful examples of modern electrical engineering from his lucid exposition.

Apart from its utility as a work of general reference, the inclusion of a number of useful tables, data and formulæ, unobtainable in a collective form elsewhere, has from the start rendered the volume invaluable to practical workers in the wireless field. Considerable progress in this respect has been made in the later volume, especially with regard to the matter of selection ; and we notice with pleasure that the direction of this important feature has been placed in the hands of so eminent a working scientist as Dr. J. Erskine Murray.

It is impossible even to enumerate the other features of this interesting volume, but in every case comparison drives home the same lesson of progress. The Bibliography of Current Works on Wireless has increased from five to twelve, and the Biographical Notices from sixteen to twenty-seven pages.

FIRST NEW ZEALAND WIRELESS CORPS. [*Photo: Meyers Bros.*

Wireless Telegraphy In the War

AN EASTERN FABLE EXEMPLIFIED.

THE Germans had founded high hopes upon the road to the East which was to have been opened for them by the Bagdad Railway. General Maude has shattered that dream for them. By a curious coincidence, Bagdad—the locale of their discomfiture—is the *mise en scène* of the typical example of shattered dreams. Readers of the *Arabian Nights* will remember how, in the days of Haroun al Rashid, a certain Arabian merchant bought a tray of glassware for "a thousand pieces of silver." He seated himself in the shade of some houses in the city, and—with the glassware at his feet—set to work to build "Castles in Spain." He would realise a high profit for his ware (thus ran the dream) and by dint of a series of such transactions he would speedily attain to riches. Seduced by the pleasing phantasy of wealth, he let his imagination run riot. He would build a magnificent house and buy trains of male and female slaves ; he would seek in marriage the daughter of the Grand Wezeer. He limned for himself a glowing picture—the beauteous bride brought in by tiring women, at the close of the marriage ceremony, to be displayed to her husband, who would then, in accordance with Eastern custom, see her unveiled for the first time. He would affect (so ran the alluring vision) an attitude of haughty indifference, turning away his face from the lovely damsel who was seeking his favour. He would even go so far as to spurn her with his foot when she, in Oriental fashion, clung to his knees in supplication. So vivid was the dream that he suited the action to the word ! He awoke to the sound of the crash of broken glass, and found that he had destroyed the tray of precious wares upon which the whole of his plans were founded.

Thus it has been with the Germans. They have dreamed a dream of empire and sovereignty in the East, and their vision has been shattered by their own act. Bagdad, which was to have been the centre of their railway, at which they had built a great station and where they had erected a giant wireless installation which maintained communication with Europe, has fallen—let us hope for ever—into the hands of their enemies. They have been forced to destroy with their own hands their magnificent radio *matériel*, which has proved not a whit less brittle than the Oriental glassware of Eastern tradition. Mr. Edward Candler, the Special Press Representative with the Expeditionary Forces in Mesopotamia, recently sent home a description of the thoroughness with which the work of destruction had been carried out. "On the right bank," says he, "we see a scene of scientific havoc. The German wireless, one of the most powerful installations of their system, erected at enormous cost and maintaining direct communication with Berlin, was blown up early on the morning of March 11th, and the engineer who executed the work of destruction did it well and thoroughly. The roof has been carried away, there is a 3 feet crater in the centre of the floor, one of the towering masts has fallen, crushing a wall with its impact, and one of the two great boilers which generated steam for the power house has been blown up. The money spent by the Kaiser's Government upon the erection of this great wireless station, upon the railway buildings, sidings, workshops, water towers, cranes and engineering plant, must have run into millions." In very truth Bagdad has amply maintained its reputation as the shatterer of proud and haughty dreams!

ENEMY WIRELESS ABROAD.

We referred in our April issue, under the heading of "News Leakage," to the question of how far it appears practicable to utilise secret wireless installations, and indicated our reasons for scepticism with regard to them as transmitters of news so far as England is concerned. We feel sure that a fuller knowledge of the principles and practice of radio-telegraphy would convince newspaper writers and readers of the practically insuperable difficulties to such action in this country. To adduce cases which have occurred in other countries is beside the point; the conditions there are usually so different. When we read (for instance) of the discovery of wireless outfits on the *Appam*, whilst she was lying in New York Harbour, we must remember that America was until recently a Neutral Power, whose subjects and foreign guests must necessarily be allowed much greater personal freedom than is possible in belligerent countries like our own. We heard the other day through a telegram from Copenhagen of the discovery in Tsarskoe Selo of a surreptitious wireless plant capable of communicating with Germany. But then this installation was within the precincts of a palace where the ruling authority was a member of the German Royal Family. The installation, moreover, was discovered through the seizure and inspection of the correspondence which had passed between the Tzaritza and Protopopoff, the Prime Minister of Russia, so that it enjoyed a peculiarly favoured position for the exercise of its nefarious practices.

[*Photo: Underwood*

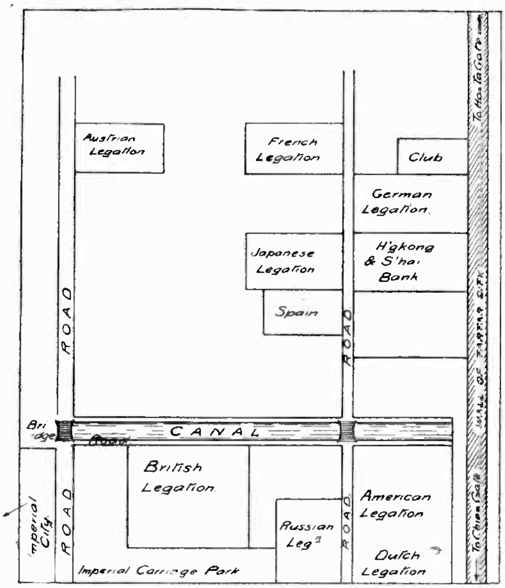
IN THE SHADY STREETS OF BAGDAD.

One further case of the surreptitious use of wireless has been brought to our notice during the past month. This consists of the alleged irregularities in connection with the wireless installation at Amaralina, in the State of Bahia (Brazil). But then this latter is situated in a part of the great South American Republic which swarms with Teutonic emigrants, who run their own German newspapers and practise their own " Kultur."

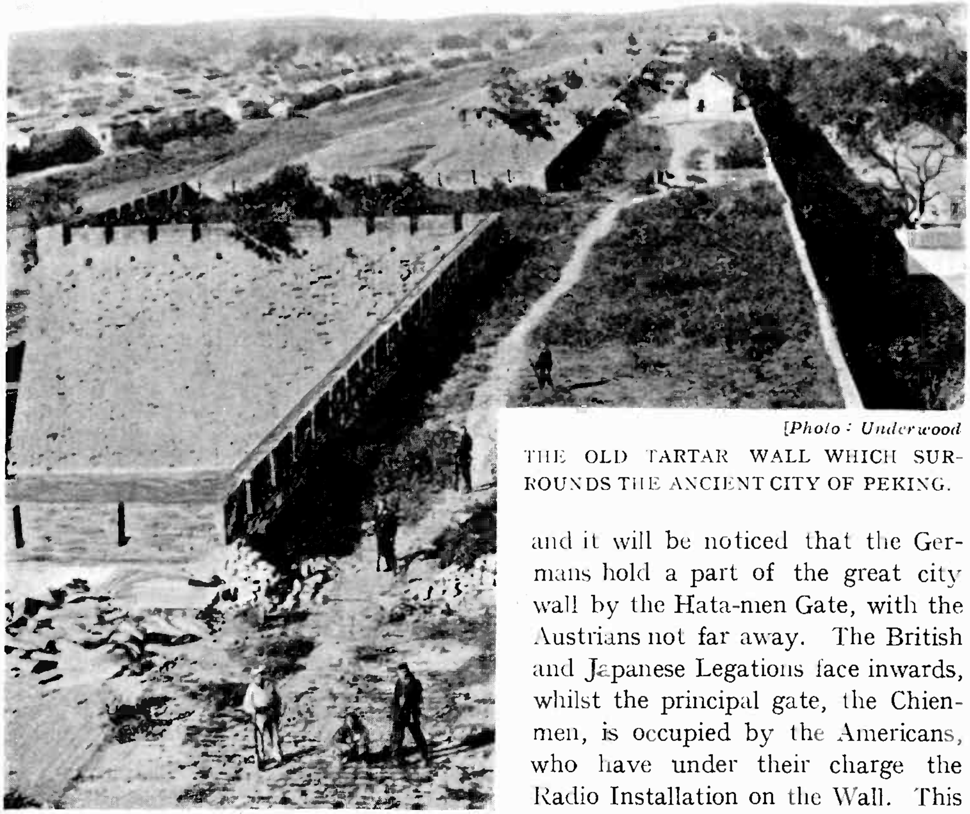
In fine, these various discoveries of enemy practices abroad constitute no reasonable excuse for any apprehension at home, and there is every reason to believe that John Bull, with his traditional regard for " balance," will refuse to be disturbed by imaginary troubles.

Gnashing of Teeth.

" Woe to Nippon," was the sentence with which the Germans greeted the surrender of Kiao Chao, and with it the collapse of their Far Eastern dream of Empire. Quite as galling in its way must be the fact that poor despised China has given them a " slap in the face " by breaking off diplomatic relations. The International action necessitated by the Boxer Rising in the summer of 1900 was seized by Germany as an opportunity for bullying and self-aggrandisement. It was on that occasion that Prince Henry, the Kaiser's brother, was sent out to China with instructions to " Hit out with your mailed fist," and that the German soldiers were first admonished, in plain language, to " act like Huns." For a long time Germany bullied John Chinaman to her heart's content, wrung all sorts of concessions from him, and made every preparation to exploit the Celestial Republic. The situation at Peking has always been peculiar ever since the Chinese were forced to enter into relations with the " Foreign Devils." Since the war it has been stranger than ever. The Legation quarter in that city constitutes a regular little town in itself, a real example of *Imperium in Imperio.* It would be more correct in some ways to call it a fortress ; for it is girt round partly by the " Great Wall " of the Old Tartar City, and partly by a circumvallation of its own, faced by a wide glacis on which the troops of the various Powers perform their military exercises. Under the treaty made by China after the Boxer Rising, each of the Powers had a quarter allotted to his charge, garrisoned by detachments of soldiery drawn from their respective forces. The plan of the Legations, which will be found on this page, indicates the general arrangement,



SKETCH PLAN SHOWING POSITION OF THE FOREIGN LEGATIONS IN PEKING.



[Photo: Underwood

THE OLD TARTAR WALL WHICH SURROUNDS THE ANCIENT CITY OF PEKING.

and it will be noticed that the Germans hold a part of the great city wall by the Hata-men Gate, with the Austrians not far away. The British and Japanese Legations face inwards, whilst the principal gate, the Chien-men, is occupied by the Americans, who have under their charge the Radio Installation on the Wall. This Wireless Station is shared by all the Foreign Representatives, with the exception of the Japanese, who possess a station of their own, situated in their Legation Compound. The situation, under present circumstances, is, as may be easily understood, extremely quaint. There are, of course, no social relations between the soldiers belonging to the belligerent nations, although at the Peking Club you may see the diplomats representing nations at war with one another using the same club rooms and reading the official communiqués of all the warring Powers.

A ROMANCE OF WAR.

The present struggle has afforded endless plots for war romance, of which the following forms a good example. Miss Elsie G. Hancock, *en route* to visit her sister in Shanghai, met on board Mr. Edward Newhouse, of the Public Works Department, Hongkong, returning from leave. Torpedoed in the Mediterranean by an enemy submarine, they were rescued from death by a French gunboat summoned by wireless. Both eventually reached Shanghai in safety, and the result of their adventures was seen at the British Consulate and Shanghai Cathedral, a month or so ago, when the two adventurers were joined in holy matrimony. Mrs. Newhouse treasures as a memento a ship's biscuit issued to her just before they took their places in the boats, and declares that she will never forget the debt she owes to wireless telegraphy.

The Fog of War

How American Intervention affects the Wireless Situation.

SIGNIFICANT telegrams have recently appeared in the Daily Press announcing the measures instituted by President Wilson to secure the full benefit of wireless aid in the war for America, and to prevent its utilisation by the German foe. We learn by cable from New York that acting on instructions from the U.S. Admiralty, the police authorities have ordered the dismantling of all private wireless stations and the confiscation of all apparatus except that utilised for Government purposes, and, indeed, we hear of the seizure of 800 sets in the State of New York during the course of a single day. In acting thus drastically, President Wilson is profiting by British experience. Great Britain declared war on Tuesday, August 4th, and radio precautions were immediately instituted. The successive steps were taken :—

1. The assumption of censorship and control of all wireless messages by the Postmaster-General.

2. Restriction of the use of wireless in the Harbours and Territorial Waters of the U.K. and Channel Islands to vessels of H.B.M. Navy,

3. A Post-Office Proclamation closing all private installations.

Speaking generally, the orders of His Majesty's Ministers have been carried out with admirable loyalty. Individual hardship has resulted, of course, but no private grudge on this account has been allowed to hinder zealous co-operation with the authorities for measures conceived in the public interest. From time to time a few isolated cases of transgression occurred, mainly consisting of offences committed in error, and records of such cases will be found in past issues of THE WIRELESS WORLD. These, however, have long since died out, and the British public has settled down to a stoical endurance of "suspended animation," as far as radiotelegraphic experiments and investigations are concerned.

We have little doubt that a similar loyalty awaits the proclamation of the American President. At the same time we are open to confess that the "Total "Prohibition" of private wireless in the United States is likely to present much greater difficulties than any we have experienced in this country. *The Year-Book of Wireless Telegraphy and Telephony* for 1917 prints a list of nearly 250 important wireless societies dispersed over the various States of America. Only societies of substantial standing figure in this international work of reference ; there are others of minor importance scattered through all parts of this vast area. When we come to reflect that membership of these societies indicates a wireless enthusiasm for the most part in excess of that of the ordinary amateur we shall realise the sacrifice which radio enthusiasts of the U.S.A. are being asked to make.

We have already referred (under the heading of "Blockaded" in our April issue) to the enormous disability under which Germany is suffering through the blockade of news to which she is subjected. German Ministers openly lament their disadvantage in this respect. We feel sure that people in general have no conception of the serious aggravation of that disadvantage entailed by the entry into the lists of the United States. Long-distance information by cable has long been denied to our enemies, who have been obliged for over two years to rely entirely upon intelligence transmitted by wireless for any reasonably prompt information concerning what is going on outside Europe. Now that the United States have declared war and the sister Republics of South America seem inclined to follow suit, a great curtain has been let down shrouding two-thirds of the world entirely from German ken. For any information as to the happenings behind that curtain Germans must rely upon such information as they can gather through the medium of their enemies' Press, or such belated and unreliable items as eventually filter through devious and indirect channels. The Scandinavian countries and Spain constitute their last link with the outside world; but for the neutrality of these countries the darkness would be absolute.

Let our readers try and put themselves in the German position. All sorts of events favourable to Teutonic aspirations might be happening, and they could know nothing about them; whilst, on the other hand, their enemies have every opportunity of preparing, undetected, strokes of the first magnitude, whose very inception would be undreamed of before the blow fell. Knowledge then comes too late for countervailing effort. Verily the fog of war is settling thick over the mid-European belligerents.

[*Photo: Meyers Bros.*

3RD NEW ZEALAND WIRELESS CORPS.

More Wireless on the Film

A Thrilling Drama of Adventure and Invention

A FEW months ago we described in these pages two lengthy cinematograph films in which wireless played a prominent part. Wireless enthusiasts who are also lovers of the picture theatre will be glad to hear that another " wireless " film is now on show at the leading houses.

The picture in question, which a representative of THE WIRELESS WORLD recently had the pleasure of viewing, is entitled " The Flying Torpedo," and bears the well-known trade mark of " Triangle Plays." It has been the effort of the producers in presenting this play to indicate the dangers of unpreparedness in the United States, and no doubt at the time in which the film was first produced—some months ago, of course, and prior to America's entry into the war—the lesson was badly needed.

The story opens with a picture on the western coast of the great American Republic, and we observe projected on the screen a line of foreign warships on the distant horizon. The enemy has evidently arrived in full strength, and, without warning, shell after shell tears through the sky and explodes with terrific effect in the defenceless coastal town.

Meanwhile, away in the interior, troops are being mobilised and rushed to the coast. Next we are treated to a view of a meeting of the War Inventions Board, where a proposal is put forward and accepted that an offer shall be made of a prize of one million dollars for an invention to repel the invader. The bombardment goes on and the distraught inhabitants, in terror of their lives, flee precipitately to the hills on foot, in motor cars and every kind of conveyance.

The audience is now introduced to one of the leading actors, John Emerson, who plays the part of an eccentric novelist, specialising in sensational detective literature. We see the kindly old novelist pacing his study and absorbed in the problem of how best to give a new turn to his detective fiction, when an interruption is caused by the entry of a servant with the morning paper. The announcement of the million dollar prize immediately arrests his attention, and it suggests a brilliant idea. He has a friend, an inventor, who has experimented successfully with wireless control. Let him invent a wireless-controlled flying torpedo, and the nation would be saved ! The million dollars also would be theirs !

No sooner had the idea occurred to the writer than he rushes off post haste to his friend, whom he finds closeted in the laboratory and surrounded by wireless instruments of every shape and form. The laboratory scene, which frequently figures throughout the story, is well arranged with a most convincing array of radio apparatus. The novelist excitedly outlines his plan and arouses the enthusiasm of his friend, who sees the possibilities of the idea immediately. But, unfortunately, he has no money ! However, the success of the novelist's " thrillers " has been most marked, and in consequence he is able to lend the necessary funds to enable experiments to be started.

Away at the coast the torrent of shells from the enemy fleet has now produced the effect intended, and under the cover of his heavy guns the enemy lands a large force. Yielding under only the utmost pressure and fighting every inch, the American forces are compelled to retire and entrench themselves far back from the seaboard. We see the enemy troops pouring through the towns, spreading ruin as they go, killing and being killed with all the realism of modern warfare, their heavy artillery following them and hurling great projectiles into the American lines.

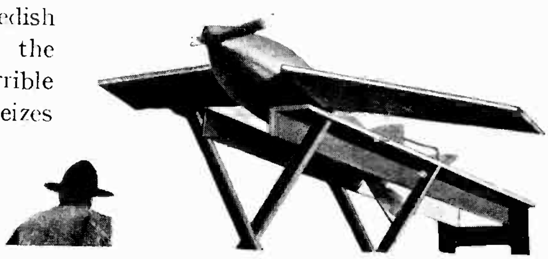
THE ECCENTRIC DETECTIVE.

At last the model of the flying torpedo is completed, and the author, with the inventor and his assistants, proceed to a quiet and secret spot to test its capabilities. A wireless transmitter is erected, and the expectant pioneers joyfully observe how the tiny model skimming through the air can be controlled, turned and made to descend in the exact spot desired. All seems going well, but, unfortunately, these tests are being watched with powerful field glasses by a group of spies.

Realising the value of this invention and how it will upset their plans, the spies plot to steal the model for the enemy, and accordingly we see them stealthily approaching the house by night and entering the laboratory by way of the window. They make away with the model unobserved, and the theft is only discovered next morning when the inventor enters the laboratory.

Some interesting "side-play" takes place between the fiction writer and the little Swedish maid-of-all-work, admirably played by Miss Bessie Love. The little girl is a voracious reader of the novelist's works, and we see her neglecting her duties to peruse the thrilling pages. When she finds that the elderly visitor is none other than her beloved novelist, she follows him everywhere with enraptured countenance, much to the amusement of the audience.

The inventor now receives a threatening anonymous letter, in which he is informed that unless he immediately ceases his experimentations he will be forcibly stopped. He patrietically ignores the threat, and as a consequence one of the spies, entering the laboratory under the pretext of being a telephone inspector, places a small poisonous capsule in the telephone, in such a manner that directly the receiver is lifted the capsule explodes. Directly the devilish device is in position and the supposed inspector has left, a call comes which the inventor immediately answers. Unconscious of the danger, the scientist picks up the receiver, the capsule explodes, and in a few moments the unfortunate man is dead! Panic-stricken, the Swedish maid rushes off to the house of the novelist, and informs him of the terrible fate of her master. The old man seizes his coat and hat, hurries back to the laboratory, and with his detective instincts aroused seeks for some clue. Eventually he finds the broken capsule, and



THE FLYING TORPEDO.

having a thorough knowledge of chemistry is under no misapprehension as to the deadly methods employed by the enemy. A brief consultation takes place, and, still undeterred, the novelist once more finds the sum of money to continue the experiments. But without the stolen model nothing can be done, because in the model alone is hidden the secret. Searching round in his mind the old man picks on a brilliant scheme for tracing the thieves and recovering the precious contrivance. He causes a notice to be inserted in the newspapers to the effect that, in spite of the death of the inventor, the experiments have been carried on as before and a second model is now completed awaiting tests.

THE "MAID-OF-ALL-WORK."

Just as expected, this announcement renews the activities of the spies, who again send an emissary in the guise of a telephone man to place the explosive capsule where it can perform its deadly work.

This time, however, the household is fully on its guard, and the wireman is refused admission when he calls. Foiled in his dastardly plan, the spy returns to the drug store, where his associates have made their headquarters, followed closely by the novelist in swift pursuit. Cleverly posing as a doctor and calling in the help of the little serving-maid, the eccentric old writer soon obtains admission to the back of the drug store, and in due course discovers the model of the torpedo hidden in the basement. A few more dramatic scenes and some swift acting takes place, culminating in a raid by a large force of police and the capture of the whole gang.

Interspersed among these scenes we have vivid pictures of trench warfare, heavy gun-fire, and the pitiful plight of the poor refugees sinking by the wayside in their endeavour to reach safety. Special praise must be given to the realistic artillery fire and the hurling of shells from the huge howitzers.

With the gang of spies safe in custody and the model of the flying torpedo recaptured, the manufacture of the full-sized implements takes place with full speed. Large consignments of the deadly arm are rushed from the factory to the railways and thence by fast trains to points of vantage. In a suitable place the wireless control stations are erected, and we see the winged torpedoes speeding through the air and made to descend with deadly accuracy upon the desired object. One by one the giant pieces of enemy artillery are blown to atoms, trenches demolished in lengthy stretches, and even the guarding fleet off the shore is sent to the bottom, ship by ship. Helplessly overpowered, the enemy is completely routed, and once more peace reigns supreme.

It is almost unnecessary to add that full government recognition is given to all who have been concerned in the preparation of this nation-saving device, and

THE SPIES STEAL THE MODEL.

a deputation from the Senate attends upon the novelist to express the nation's thanks.

Hypercritical patrons of the picture theatre will perhaps be inclined to criticise some of the scenes of warfare. Here in Europe, where we are so close to the scenes of grim conflict, and where a series of official war films have brought home to us the actualities of modern warfare, we are inclined to smile upon the attempts of our distant cousins to depict the struggles of the battlefield. But, taking it as a whole, the film is a wonderful piece of work, splendidly acted as far as all the principals are concerned and admirably staged. All those parts of the film which deal with the technique of wireless are handled with skill and realistic effect, none of the absurdities of early wireless films being present. By the time this article appears, the film, which was "released" on April 2nd, will be showing at a large number of picture theatres in this country, where, no doubt, a large number of our readers will have an opportunity of criticising it for themselves.

Wireless Telegraphy and Aircraft

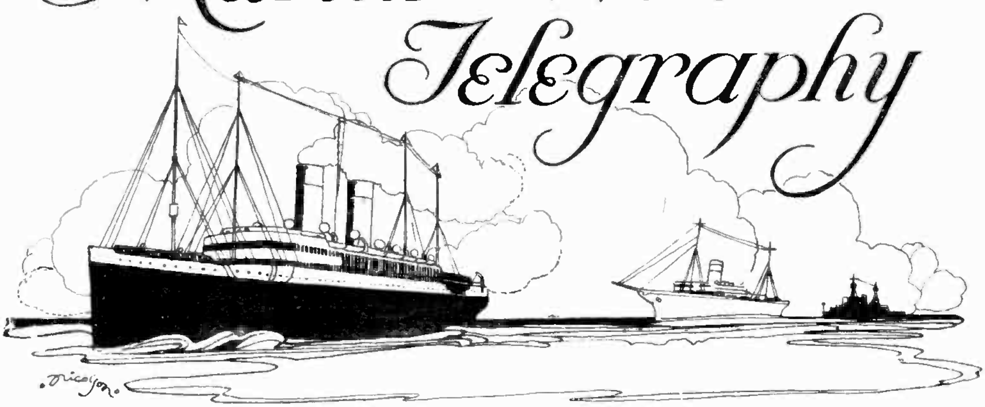
An American Exhibition.

AT the recent Pan-American Aeronautic Exposition, held under the auspices of the Aero Club of America at the Grand Central Palace, New York, during the second week in February, there was brought together a collection of aeroplanes, motors, balloons, and aerial apparatus of every description that America has ever seen. The Exhibition can be said to be the result of a great campaign for adequate aerial defences in the United States, and follows the recent large appropriations by Congress for this important arm.

President Wilson was prevented by the turn of events from opening the Exhibition in person, but sent a radio-telegram directed from Washington to the Wireless Station on the roof of the Palace. "The demonstration of the wonderful progress "made in aeronautics," said the President's message, "evidenced by the first Pan-"American Aeronautic Exposition, marks an epoch-making advance in the triumph "of the men of our day over the forces of nature. This generation has conquered "the hitherto undiscovered method of transportation through the air. This is a "matter of national congratulation that the skill of our country has made this "advancement."

One of the most interesting exhibits was that of the Wright Martin Company, which had on display the original biplane with which the Wrights made their historic flight in 1903. A large space was set aside for exhibition of different types of wireless telegraphic equipment for aeroplanes and balloons, such as are used now in the European countries for directing the artillery and communication by observers. Models of the different types of wireless apparatus using direct and alternating current were shown by the Marconi Company, and a number of other manufacturers. The wireless operators were supplied by the East Side Y.M.C.A., under the direction of Mr. Boehm. We are indebted for the above particulars to the magazine *Motor Travel*, published by the Automobile Club of America.

Maritime Wireless Telegraphy



Shipowners' Tribute to Wireless Telegraphy.

In our issue of January and February, 1917 (pages 778 and 853 of Volume IV.) we called attention to the establishment of new classes for the instruction of wireless telegraphy at Rutherford College, and the following extract from the committee's report presented by Lord Joicey at the meeting of the North of England Steamship Owners' Association will put our readers *au courant* with what has been done.

> By a recent order of the Board of Trade, owners of vessels of 3,000 tons gross and over are obliged to apply for a licence to instal wireless telegraphy on board their ships. The Lord Mayor of Newcastle (Councillor George Lunn), recognising the extreme difficulty with which shipowners will be confronted in the future to obtain operators, invited the Committee of Management to confer with the Newcastle education authorities with a view to establishing a school of wireless telegraphy in Newcastle, with the object of training lads to be ready as the various ships become equipped with the apparatus, in order to render the new regulation duly effective. Conferences were held with the Education Authority, and it was finally agreed by the committee to raise the sum of £2,000 for the necessary equipment of a Department of Wireless Telegraphy at Rutherford College. For this grant the committee were to have the privilege of nominating 25 out of the total number of students, 50 in all, to be accommodated at the school.

The Presidential address which accompanied the presentation of the report forms a very able review of shipping matters in the past, and an intelligent forecast of what is likely to happen after the war. The arguments adduced by Lord Joicey against the permanent nationalisation of British shipping are well worthy the perusal of many who are inclined to come to a hasty judgment on this extremely difficult and vital question.

The Rutherford College Sub-Committee of the Newcastle Educational Authority has authorised the Director to proceed at once with the acquisition of new and up-to-date wireless apparatus at a total cost not exceeding the amount available for the purpose—viz., £2,000, which, as Mr. Gerald Stoney explained, is a gift from the local shipowners. Mr. Wm. D. Owen has been appointed Chief Radio Instructor to the College at a salary of £250 per annum.

A Wireless Man's Narration.

It will readily be understood that the wireless operators on board ship, through whose intermediary passes all the information received and sent out, occupy a peculiarly favourable position, if they have the gift of visualisation, for giving an account of such occurrences as the torpedoing of the vessel which forms their floating home. Our attention has recently been called to an account published in our contemporary, the *Whitby Gazette,* which gives, from the pen of Mr. T. B. Taylor, the wireless operator on the ill-fated *Laconia,* the best account we have seen of the torpedoing of that Cunard Liner on February 25th last.

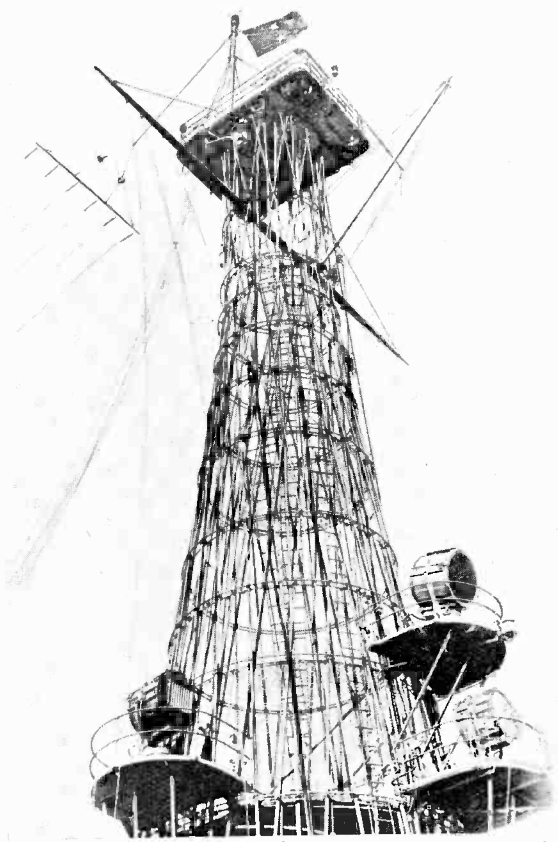
Mr. Taylor had just been relieved and turned in, when the terrible impact of the torpedo on the starboard side shook the ship from stem to stern. He was speedily out of his berth and in the wireless cabin, rendering assistance to the senior telegraphist, Mr. W. J. Donnan. He appears to have been much impressed by the marvellous precision with which the boats were swung out, filled and launched, and the "absolute discipline" maintained. These two young wireless operators continued ceaselessly "to work land stations," apprising them of the number of boats that were adrift. Rockets were fired and signals of distress sent out, the ship's lights being turned full on.

Readers of THE WIRELESS WORLD are familiar with other occasions in which we have pointed out the supreme necessity of letting the rescuing vessels know the number of boats which have been launched with survivors on board. It is often extremely difficult, however well the officers of the ship may handle the little craft, to keep them in touch with one another. The moment separation occurs, it is only by letting the rescuing vessels know how many there are to look out for and by constant inter-communication between the rescuers that danger of missing a boat-load is eliminated. Indeed, in maintaining this constant interchange of information between the near-by vessels until the last straggler comes in, wireless telegraphy exercises one of its most useful functions in rescue work. People in general do not realise this, and seem to imagine that the work of radiotelegraphy is over when rescuing vessels are summoned. This is, of course, very far from being the case.

The two gallant young men appear to have stuck so long to their post wirelessing messages for the guidance of rescuers that all the boats were well away from the vessel before they set to work to try and save themselves. As a result they had to jump from the gun platform, which was already awash, and swim for "a dark object" which they could see ahead. After a few minutes' immersion they gained "what proved to be the captain's boat and were hauled in." They were adrift in this collapsible craft for six or seven hours, spending the time in continuously baling out water and taking alternate turns with the oars. It may easily be understood how glad they were to be picked up and landed, at a port whence, after a warm reception, they proceeded to Liverpool.

An Unwelcome Rencontre.

There are plenty of exciting happenings at sea nowadays well calculated to break the monotony of the longest voyage. A wireless operator in the Merchant Service, in a letter written in mid-voyage, starts by telling us of his comfortable quarters on the bridge deck next door to the chart-room, and then proceeds to narrate the way in which our enemies did their best to dispel his sense of well-being. One morning, about 8 o'clock, when they were sailing quietly along, the officers on watch drew the captain's attention to another vessel about five or six miles ahead of them. Whilst everyone was busily engaged looking for the other vessel and guessing at her identity, a small black object appeared upon the water about a mile away from the object of their interest, and started firing at her. There was no need for any discussion as to what that new arrival might be, and very speedily the captain's orders ran: "All firemen below and turn the ship round." As soon as matters had been thus put in trim our wireless friend was instructed to get his motor going and to send out the S O S signal as quickly as possible. A land station speedily "answered in," and had the intelligence of the submarine's presence and position advised to them. As a matter of fact, it took no more than ten minutes to put on the *qui vive* the various warships and coast stations within call. Whether the enemy craft were in possession of wireless and picked up the operator's message or not it is impossible to say, but the same space of time which sufficed for the interchange of messages witnessed also the disappearance of the hostile craft. The other vessel had in the meantime proceeded out of sight, whilst the English ship continued upon its backward course. In a few hours' time a French destroyer came racing up, inquired the meaning of the S O S signal, and issued instructions that the original course should be resumed, with full speed ahead, all being now clear. The captain came into the wireless cabin and said that, so far as he could make out, the submarine had only had the opportunity of firing seven shots at her intended victim, all of which went wide of the mark. He congratulated the telegraphist on the smartness of his work, adding that it was the "nearest he had ever been in touch with submarines." He "felt sure it "was only due to the wireless "call that they had escaped."



[*Photo: Newspaper Illustrations.*

THE PECULIAR LATTICE MASTS USED IN THE U.S. NAVY. A SPREADER AND A PORTION OF A SIX-WIRE AERIAL CAN BE SEEN IN THE PHOTOGRAPH.

Talking with Mars

Professor Sparkington Gapp's New Achievement

By PERCY W. HARRIS

Illustrated by Lieut. E. G. O. BEUTTLER.

PROFESSOR SPARKINGTON GAPP laid half-a-crown on the edge of the desk.

"Thank you," I said, pocketing the coin.

"That's not for you," replied the eminent scientist. "The coin represents the size of the earth, whilst this shilling," he continued, producing a further sign of wealth from his capacious pocket, "represents the proportionate size of the planet Mars. Now, if I place the shilling upon the mantelpiece and the half-crown on the table, the size of the coins and the intervening distance will give you some idea of the enormous space which separates this interesting planet from our terrestrial clime.

"Mars, as you probably know," continued the Professor, "is the nearest to us of all the planets. In many ways it is thought to resemble the earth, and the investigations of Schiaparelli have given good ground for the belief that our celestial neighbour is inhabited. You will doubtless remember Schiaparelli's discovery of lines on the surface of the planet which he thought to be canals."

"Schiaparelli's name is well known to me as the inventor of a tonic," I said. "I must confess I do not remember his investigations on canals."

"Tonic?" queried the Professor. "I was not aware that the great astronomer was also a chemist!"

"Oh, no," I answered, hastily correcting myself; "I am thinking of sarsaparilla. Now, tell me, how far away is Mars?"

The Professor considered a minute.

"At the present time," he said, "it is about seventy million miles away."

"Then it is outside the London Postal area," I ventured. "Is the distance measured from Charing Cross?"

"No," replied Professor Gapp. "From the War Office, for the reason that, as you know, Mars is the God of War. The distance, however, varies, and at its nearest the planet comes within fifty million miles.

"Now, ever since the possibility of Mars being inhabited began to be considered, scientists have sought in vain for a method of transmitting signals to the planet, so that if there be any inhabitants they can reply. It is quite unnecessary to dwell upon the advantages that would be gained by the interchange of communication. Up to the present time no success has attended the efforts, for the reason that it has been found impossible to make any intelligible signal sufficiently strong to cross the enormous intervening space. With the advent of wireless telegraphy many minds turned to Senatore Marconi's wonderful invention for a solution of the difficulty, but until I tackled the subject myself no success of any kind was attained."

"For what reason?"

"The two great obstacles which have so far barred the use of radiotelegraphy are the impossibility of piercing the conducting strata known as the Heaviside layer, and of providing of sufficient power to transmit the signals.

"I have invited you here this evening," continued the Professor, "in order that you may describe my researches in your next issue.

"Your readers will perhaps be interested in the line of reasoning I took when first approaching the problem. Since Dr. Eccles and other great scientists have shown conclusively that wireless waves are prevented from passing out into space by the Heaviside layer, it is perfectly evident that some new form of wave must be found which is not obstructed by this particular stratum. Revolving the question in my mind, it suddenly occurred to me that waves of light, although they are themselves electro-magnetic waves, pass with great ease through this layer, as is proved by the fact that the light of the sun, moon, and stars reaches the earth's surface. But as the only difference between light and wireless waves is that the former are of very much higher frequency than the latter, I immediately began an investigation which resulted in the discovery that so long as waves do not exceed some fifteen or twenty metres in length, they pass unhindered through the conducting layer."

"Marvellous!" I ejaculated.

"Yes," replied Professor Gapp. "When you come into the laboratory I will show you the apparatus I devised for generating these short waves. However, to continue, there still remains the problem of power, as the amount of energy required to cover the enormous distance is infinitely greater than that used on the highest power land station for ordinary purposes. The solution of this difficulty I must ascribe to a lucky accident."

"How did that happen?" I asked with great interest.

"Well, it came about in this way. One evening I had been attending a meeting of the Society for Investigating the Influences of Alcohol, and, much against my will, had taken part in a number of physiological experiments. On the way home the earth was in a peculiar state of undulation, and as a result I was precipitated forcibly upon my nose. This brought home to me the

"THE EARTH WAS IN A PECULIAR STATE OF UNDULATION."

enormous amount of latent energy stored within the earth, and suggested the solution at which I finally arrived.

"To cut a long story short, after having solved the two great problems, my assistants and I set to work to devise the plant in the laboratory, and on its completion last night I was able, not only to transmit signals to Mars, but also, what is far more interesting, to receive intelligible signals in return."

By this time I was all agog with excitement. Wireless communication with Mars! Surely this was the greatest achievement in the whole realm of science! And here was I, a mere journalist, in the presence of the great scientist whose name would soon be ringing throughout the whole of civilisation (and also Germany), and who held the key to the tremendous secrets of life of another globe. Truly no more exciting experience than that through which I was about to pass could possibly occur in the rest of my life.

"You have really communicated with Mars?" I queried, scarcely believing my ears.

"Without a shadow of doubt," replied the Professor. "I got an M.S.G. through at 11.30 last night, and at 12 o'clock I received an under-charge memo for the previous message. We have arranged to stand by at a quarter to seven this evening, which gives me a quarter of an hour," said the great scientist, consulting his watch, "to show you the laboratory and explain the apparatus. If you will come this way, I think you will see much of interest to readers of THE WIRELESS WORLD."

Passing through the door into the glass-roofed, white-tiled laboratory, I was dazzled with the glittering array of polished apparatus and glass bulbs. Serious young men in spectacles (medically unfit) passed hither and thither turning this handle and adjusting that, and generally preparing for the striking experience that was about to take place. I was gazing around upon the collection of glittering instruments, when a dismal howl from the corner of the laboratory sent a shudder down my spine and set all my teeth on edge.

"What on earth is that?" I gasped.

"Oh! that is only one of the oscillating valves," answered Professor Gapp. "On certain adjustments the new valves howl with considerable energy. Only the other evening I was placed in a most embarrassing position when showing a young lady round this laboratory. I had just opened the door and shown her in when two or three of the valves said 'bow-wow' with great emphasis. I lost a very good friend in that way," sighed the Professor.

"I see a great deal of apparatus here," I remarked, gazing around; "but I do not perceive the great power plant and whirring dynamos that I expected!"

"No, they are quite unnecessary with the present apparatus," answered my guide. "Oscillations are generated in this large bank of valves, and by doubling the circuit back upon one another, each valve amplifies its own energy up to the point required. As a result, the magnetic field surrounding the bulbs is so strong that you can fry eggs in it."

"Really," I said, "most remarkable! But whence do you derive all the power for the amplification? I understand how the oscillating valves can amplify their own energy, but the power for amplification must, of course, be drawn from some source?"

"That is precisely where the earth comes in. When working the plant I have a gang of labourers outside continually shovelling earth into a large hopper from which the energy is squeezed out through a small slit in the form of an electric current. This is then led into the laboratory by the leads on the right."

"This is really most fascinating," I exclaimed. "But how about the short wave-length? I notice the oscillatory circuits here seem quite normal."

"Yes," answered the Professor. "They closely resemble those in common use. In this circuit," he went on, patting a large inductance and bank of condensers, "we generate oscillations of a frequency of one million. The oscillatory currents are then led to a specially designed frequency multiplier, doubled back upon itself and turned upside down. From this the currents are led to the aerial, which then vibrates to a harmonic. So as to get the maximum energy in the direction required the aerial is made of directive form. The aerial mast is balanced on a ball-and-socket joint, and moves by clockwork at a regular speed, so that as the planet rises each day the aerial follows its motion."

As the Professor was speaking an electric bell started to ring, and the assistants of the laboratory immediately sprang to their posts. Outside, in the darkness, we could hear the scurrying of the gardeners and the scraping of the shovels as they feverishly threw clods of soil into the energy producer. Several banks of oscillating valves started to glow brilliantly, while others set up a series of plaintive howls. Within a few moments a strong smell of burning greeted my nostrils, and a young assistant stepped forward and touched me on the shoulder.

"Excuse me, sir," he said, "but your coat tails are in the magnetic field and are burning. If you will allow me I will release you!" and producing a pair of scissors, he severed a number of lines of force which had become entangled with my coat buttons.

"Is everything in order?" asked the Professor.

"Everything," was the assistant's answer. "Will you take the key?"

"No," replied the scientist. "My young friend here is an expert telegraphist, and perhaps he will favour us."

Shivering with delight, I took my seat at the operating table, placed the 'phones upon my head and called "Mars!" three times, then "de" followed by "Earth" three times. Almost before the call had finished a high piping note answered, "Earth de Mars send Time Rush."

"They want a time rush," I said, turning to the Professor in alarm. "What shall we send?"

"I don't know," replied Professor Gapp with obvious concern. "I don't know what the distance is exactly, and it varies every minute in any case. Tell them we cannot give the exact distance!"

I started the "ta-ti-ta-ti-ta" again, and informed Mars accordingly.

"You must work strictly according to handbook," came the reply. "Where are you bound?"

I turned to the Professor once more. "Where are we bound?" I asked.

"Goodness knows," replied the scientist. "We are careering through space at a terrific speed, but as the orbit of the earth is an ellipse, we cannot be said to be bound anywhere."

"Bound nowhere," I spelt out on the key.

"What is your speed ?" was the next question, whereupon I indicated that our speed was 66,579 miles per hour.

The next inquiry from Mars was unfortunately interrupted by a violent fit of coughing on the part of the Professor, to whom the intensely strong smell of ozone due to the brushing of the apparatus was undoubtedly irritating. I was therefore forced to ask for a "repeat."

"Is that the junior ?" asked the Martian operator.

"No," I replied. "This is a representative of THE WIRELESS WORLD. Why ?"

"You do not seem able to read, and your sending is rotten," came the signals. "You have not sent a proper time rush yet, although I have asked you several times. Please refer to paragraph 70 of Handbook, and send (B) position of the earth in convenient form, and (C) next port of call."

At this point I took off the 'phones and had a short consultation with the Professor. We were both very worried. It was quite evident that we could have no communication with Mars unless we complied with regulations, and the details asked for were most difficult to obtain. Take for instance, the next port of call. I suggested to the Professor that we should send "Heaven," but he pointed out that in my case, at any rate, this would probably be inaccurate, and as the two of us were bound for different places, which would represent our respective next ports of call, we were in something of a dilemma.

"And what about the position of the earth in convenient form ?" I asked at length.

"Well, that is a matter of opinion," answered Professor Gapp. "Sir Robert Ball says ——" Here the great scientist was interrupted by another fit of coughing.

"Have one of these glycerine jujubes," I said, producing a bag out of my pocket.

At this point I regret to say the experiments suddenly terminated. It so happened that I was using an electrolytic detector containing nitric acid, and unfortunately one of the glycerine jujubes fell into the nitric acid, immediately forming nitro-glycerine, which ignited in the surrounding magnetic field. There was a violent explosion and I knew no more.

. . . .

A uniformed nurse near my bed was remarking that the mental case from the great explosion was showing a marked improvement, and after a great effort I managed to ask a question.

"Where is Professor Gapp ?" I queried.

"I believe he is making good progress," replied the nurse with an encouraging smile. "He came down in Lincoln's Inn Fields."

"Where am I then ?" I asked in alarm.

"This is Torquay General Hospital," answered the attendant. "You came down on the beach outside. Now go to sleep again !"

I obeyed.

An Outline of the Design of a Wireless Station

By BERTRAM HOYLE, M.Sc.Tech., A.M.I.E.E., Lieut. R.N.V.R.,
H.M.S. "Excellent," 1917.

(*Continued from page 50 of our April issue*).

THE connection between inductance and the battery of condensers is made as inductionless as possible by running thin copper strip bus bars, separated by sufficient micanite to withstand the p.d. between them. In this way the strips can be run within $\frac{1}{4}$ in. of one another.

13. *Primary Condenser* K_1.—$K_1 = 0{\cdot}1248$ mfd. It is best to split this up into sections. Thus when plate glass and sheet zinc are used a convenient form is an arrangement similar to an accumulator. Oil cooling forms one prominent feature, and also aids in suppressing brush discharges from the edges of the zinc electrodes over the plate glass.

Moscichi tubular condensers are very efficient H.T. condensers, and owing to the special construction, whereby a very high dielectric stress is rendered safe, they occupy comparatively little room. A battery of plate-glass condensers is taken in the present example, as they form the standard British practice.

Taking the S.I.C. of plate glass to be 5·6 and $V_{1\,max.} = 42{,}420$ volts, let $t =$ 1·25 cms., the thickness of the glass.

Then where N = total number of metal plates (there being $\frac{N+1}{2}$ connected to one pole and $\frac{N-1}{2}$ to the other)

and A = effective area of one face of metal, say 50 × 40 cms.
= 2,000 cms.² of plate.

$$\text{Then } (N-1) = \frac{K \text{ (mfds.)} \times 4\pi \,.\, t \,.\, \times 9 \times 10^5}{A \,.\, \times \text{S.I.C}}$$

$$= \frac{0{\cdot}1248 \times 4\pi \times 1{\cdot}25 \times 9 \times 10^5}{2{,}000 \times 5{\cdot}6}$$

$$= 157{\cdot}5.$$

Say $N = 157$ active *whole* plates.

Now for distribution: Assume fourteen container boxes; place twelve metal plates in each box (Nos. 1 to 13), and in the fourteenth box have about sixteen metal plates suitably arranged for adding a spare plate or two.

The spare condenser battery units will be duplicates of the twelve plate boxes.

[NOTE.—When there are twelve metal plates in one box, there are only eleven active whole plates, so that in the above there are

$$13 \times 11 = 143$$
$$1 \times 16 = 16$$
$$\text{Total} \quad 159$$

equivalent active whole plates.]

This subdivision wastes some glass as well as metal plate, because one surface becomes inactive; but this subdivision is necessary for cooling, and ease of replacing damaged sections.

Probably in testing the value of L_1K_1 finally, it would be found necessary to adjust L_1 somewhat; due to the unavoidable inductance of the connections, and naccuracies in building up K_1.

Current flowing into the condenser battery is 407 amperes, and it is as well to notice what the actual plate currents and amperes per box amount to.

There are eighty and seventy-nine plates in the battery:

Total current	=407 amperes.
Current per box	=$407/_{14}$=29 amperes.
Current per plate	=$407/_{80}$=5·1 amperes.

This is pointed out to show how important it is not to cut the dimensions of each individual electrode lug too fine either in breadth or thickness of metal plate, and to make ample provision in the bus bars to each box for the current required.

14. *The Transmitting Key.*—A consideration of the transformer primary current will make it evident that a high speed key cannot be inserted in that circuit; since high-speed means lightness of moving parts, and the currents in that circuit are too large to be dealt with by light contacts.

The high-tension side of the transformer carries only 2·81 amperes, so that an air-blast double break key will work in that circuit provided that there is sufficient blast to blow out the arc rapidly. These keys are worked electromagnetically by current made and broken in the operating coils by means of punched tape, in an automatic sender, and by an ordinary hand-operated signalling key for hand sending.

The automatic sending enables the speed to be pushed up to 100 words per minute or more. For this speed the H.T. key must be very light, and the break poles must be provided with a strong air blast to blow out the arc.

15. *Disc Discharger.*—This is a synchronous spark-gap, generally designed to have one stud per pole of the alternator and gives one spark per half period of the alternating current supply.

Current is led to two heavy phosphor-bronze discs, which are slowly rotated through insulated shafts. These discs are fixed relative to one another, and are capable of rotating angularly about the disc as centre.

The phase adjustment of these discs relatively to the studs on the main disc, regulates the energy of the discharge, by controlling the voltage at which the sparks can pass.

The peripheral velocity is very high, and good cooling of the studs on the disc is obtained. Very good illustrations of these discs have appeared from time to time in THE WIRELESS WORLD.

16. *High-Tension Transformer.*—There is nothing very special about this beyond the fact that the frequency (300) is much higher than that used in most commercial transformers.

17. *Protective Air Core Choke Coils.*—If an ordinary transformer be connected to a high-frequency oscillatory circuit without special protection, the end turns will

soon break down. This is due to the high frequency voltage applied to each terminal from the oscillatory circuit not being able to distribute itself over the whole transformer winding on account of the enormous inductance of the secondary circuit. It, therefore, piles up voltage on a few of the end turns, which, if not specially protected will break down.

The simplest form of protection is afforded by connecting single layer air core inductive choke coils to each terminal.

These coils must each have sufficient total inductance to take practically all the high-frequency wave front and keep it out of the transformer end turns.

They generally have an inductance of the order of 20×10^6 cms. each.

Using the inductance formula of Lorenz, and the tables of function " Q " given in the December, 1916, number by the author : $L_s = an^2Q$.

Take No. 20 S.W.G. wire D.C.C., which in single layer coils will safely carry the three amperes secondary current necessary.

Take $n = 600$ turns.

$a = 10$ cm. radius.

$b = 60$ cms. axial length.

From table: $Q = 5{\cdot}733$ for $\frac{2a}{b} = 0{\cdot}333$ by interpolation between 5·684 and 5·832.

$$\therefore L_s = 10 \times (600)^2 \times 5{\cdot}733$$
$$= 20{\cdot}61 \times 10^6 \text{ cms.}$$

which is about correct.

The absolute inductance not being required the ΔL correction is not applied.

18. *Secondary Oscillatory Circuit.*—From the data of the station obtained so far it will be seen that

$L_2 = 516{,}700$ cms.	$K_2 = 0{\cdot}0049$ mfd.
$V_{2\ \text{R.M.S.}} = 22{,}730$ volts.	$V_{2\ \text{max.}} = 185{,}500$ volts.
$I_{2\ \text{R.M.S.}} = 71{\cdot}65$ amperes.	$I_{2\ \text{max.}} = 571$ amperes.

The aerial capacity and arrangement has already been disposed of in Paragraph 5.

The aerial transmitting inductance will be divided into two portions, one fixed in value and coupled to the primary, the other variable and remote from the two coupling coils.

Since the diameter of the primary is considerable, there is no need for the two circuits in coupling to be concentric and superimposed.

(i.) Fixed coil, coupled to primary :

Again using Lorenz's formula and the tables referred to for function " Q " the requisite number and diameter of turns for a given inductance are found by trial and error.

Let the large coil be about 470,000 to 500,000 cms. inductance, the remainder, with slight overplus, being in the adjustable coil.

Using the same stranding as before $^7/_{22}$ S.W.G. there will be

$$\frac{71{\cdot}65}{7 \times 0{\cdot}528} = 19{\cdot}38 \text{ cords, say 20.}$$

Circumference necessary $= 0{\cdot}35 \times 20 = 7$ cms.

Whence $d=2{\cdot}23$ cms.

Now this diameter is too small for the necessary stability of former, so $^3/_{22}$ strand will be tried.

This makes 47 cords necessary, and each cord occupying, say, 0·25 cms. the circumference will be $47 \times 0{\cdot}25 = 11{\cdot}75$ cms.

Whence diameter $=3{\cdot}74$ cms., say $d=3{\cdot}75$ cms.

Dimensions of coil for the given inductance [say 480,000 cms.]:

Take $D=7{\cdot}5$, $d=3{\cdot}75$ $\frac{d}{D}=0{\cdot}50$; let $a=100$, $b=120$, $n=16$.

Then $\frac{2a}{b}=1{\cdot}666$ and from table of function Q the value of Q by interpolation is 18·755.

For $\frac{d}{D}=0{\cdot}5$ the correction from table A is $-{\cdot}1363$, and for $n=16$ the correction from table B is $+{\cdot}2885$.

$$L_s = an^2Q$$
$$= 100 \times 16^2 \times 18{\cdot}755$$
$$= 480{,}000 \text{ cms.}$$
$$\Delta L = 4\pi an(A+B)$$
$$= 4\pi 100 \times 16(0{\cdot}1522)$$
$$= 3{,}120 \text{ cms.}$$
$$\text{True } L = 476{,}880 \text{ cms., say } 477{,}000 \text{ cms.}$$

This leaves 39,700 cms. over for the minimum amount to be put into the variable inductance.

(ii.) Dimensions of the coil for the variable inductance [say, 55,000 cms.]:

For this it is necessary to use copper tube [which for this current should have a diameter of at least 3·75 cms. with 2 mm. walls].

It is advisable to avoid sharp turns and also too thick a wall, both of which lead to excessive eddy currents and consequent heating.

Let tube have $d=3{\cdot}75$ cms., and spacing apart such that $D=5{\cdot}0$ cms., $n=12$, and breadth $b=60$ cms.

$$\frac{2a}{b}=1{\cdot}00. \qquad \therefore Q=13{\cdot}589.$$
$$A=0{\cdot}2691. \qquad B=0{\cdot}2753.$$
$$\therefore L_s = an^2Q$$
$$= 30 \times 144 \times 13{\cdot}589 = 58{,}750 \text{ cms.}$$
$$\Delta L = 4\pi an(A+B)$$
$$= 4\pi\, 30 \times 12(0{\cdot}5444) = 2{,}462 \text{ cms.}$$
$$\text{True } L = L_s - \Delta L = 56{,}288 \text{ cms.}$$

Thus L_2 can be varied from 477,000 cms. to 477,000+56,300 cms. or 533,300 cms. Using cms. and microfarads.

$$\lambda \text{ minimum} = 59{\cdot}6\sqrt{L_{2\,\text{min.}}K_2}$$
$$= 2{,}880 \text{ metres.}$$
$$\lambda \text{ maximum} = 59{\cdot}6\sqrt{L_{2\,\text{max.}}K_2}$$
$$= 3{,}045 \text{ metres.}$$

(To be continued.)

Notes of the Month

War-Strain

Even those of us who pursue our avocations ashore feel at times the severity of the long-continued—though often sub-conscious—strain. The effect, therefore, upon the mentality of those actually engaged in the struggle must be many times more severe; and some of the cases which from time to time come under the purview of the police courts are directly attributable thereto. Only the other day, a young man who had in pre-war days given no evidence of mental disease was indicted for the theft of a motor cycle. In the early days of the conflict he left the merchant service to become a wireless operator in the Royal Navy, and after being discharged for some technical offence, joined the Royal Flying Corps, in whose ranks he served his country against the *Boches* on the Western Front. On July 22nd, 1915, he was admitted to Netley Hospital, and within a month was sent home on sick leave, eventually having to be placed for a time in Menston Asylum. After an apparent recovery he went to work on munitions at Bradford, subsequently securing a post as wireless operator on a Liverpool ship. Whilst engaged in this latter capacity he married a girl after but four days' acquaintance. He did not give satisfaction in his wireless job; was discharged, and has lived at home ever since. The whole story came out in the police court, which he attended in a wireless operator's uniform. The magistrate found it extremely difficult to decide what ought to be done, and eventually remanded him to Armley, there to remain for the time being, under a doctor's supervision. We understand that the marriage has been declared null and void on account of his mental condition.

En avant, la Science!

Our French allies have recently shuffled the cards as far as their War Ministry is concerned. M. Ribot has become the Premier and Secretary for Foreign Affairs, whilst the Ministry for War has fallen to M. Painlevé. The latter is an example of one of those rare cases in which scientific attainments have brought a man to the forefront in public affairs. As a child he was a mathematical prodigy, and when he wishes to indulge in his natural bent for humour he jokes mathematically—when he can find anyone sufficiently advanced in the subject to joke with. M. Painlevé initiated, under a former Ministry, the useful function of collecting and utilising scientific invention for war purposes, and his successes in this direction have been remarkable. It is naturally impossible to give particulars, the work being essentially secret; but French improvements in wireless telegraphy, in aircraft, in artillery, explosives and means for meeting Zeppelin attacks owe much to this Minister's great technical knowledge and keen scientific brain.

Among the Operators

A Torpedoed Hospital Ship.

OPERATOR H. W. TAYLOR.

Among the many dastardly deeds of the German submarines the torpedoing of the large hospital ship *Asturias* is one of the worst. This palatial vessel, which in peace time ran between Southampton and Buenos Ayres, carried two operators, Messrs. Harry White Taylor and Frank James Topp.

Mr. Taylor is a Devonshire man, having been born at Newton Abbott 26 years ago. After being educated in his native town, he entered the services of the Great Western Railway Company, where he was employed for five years. His preliminary wireless training was received at the British School of Telegraphy, Clapham Road, and in 1913 he entered the Marconi's Company's London School. On appointment to the staff Mr. Taylor served upon the s.s. *Drina*, and later upon the s.s. *San Lorenzo*, s.s. *Remuera* and s.s. *Moldavia*. In July, 1915, he was appointed to the s.s. *Marquette*, which was torpedoed some two months later, and from which he fortunately escaped without injury. After carrying out some special duties, Mr. Taylor was appointed to the s.s. *Asturias*, only to be torpedoed for the second time. We are very pleased to say that both he and his assistant suffered no injury in this, his second experience of uncivilised warfare.

The junior operator, Mr. Frank James Topp, is a Surrey man, his home being at Addlestone. But 18 years of age, he was educated at Bromley, Chertsey and Kingston-on-Thames, and was trained in wireless at the Marconi House School. The s.s. *Asturias* was his first ship, and we congratulate him upon his fortunate escape.

* * * * * *

s.s. "Mendi."

We have still to announce the loss of two other brave operators who gave up their lives at the post of duty. These are Messrs. Harold Mole, who was drowned in the sinking of the s.s. *Mendi*, and Ernest Marshall, who is missing and presumed to be drowned in the loss of another vessel. Mr. Mole, a Manchester man, was 26 years of age, and was educated at Stockport. On leaving school he took up a business position in Manchester, and later studied for wireless telegraphy at the Manchester Wireless Telegraph Training College, where he obtained his first-class certificate. Mr. Mole entered the Marconi House School in April, 1913, and in due course was appointed to the s.s. *Corsican*. After one trip on this vessel he transferred to the s.s. *Baltic*, and later served on a number of other vessels. He was appointed to the s.s. *Mendi* in October last, and lost his life when this vessel was sunk as a result of collision. We are sure our readers will join with us in expressing our heartfelt sympathy to Mr. Mole's relatives, and we trust that the fact that he, in common with those others whose names are mentioned on this page, died bravely at his post in the services of his country will afford some consolation.

THE LATE OPERATOR H. MOLE.

Operator Ernest Marshall, who also hailed from Manchester, was 26 years old. Educated in Manchester, he took up a clerical position on leaving school, and later studied at the City School of Telegraphy, Manchester. In January, 1916, he entered the Marconi House School, and was appointed to the s.s. *Malwa* shortly afterwards. From this vessel he transferred to the s.s. *Arabic*, and then to the s.s. *Shenandoah*, which was mined and sunk last year. From this vessel Mr. Marshall fortunately escaped without injury, and then served for several trips on the s.s. *Pretorian*. On leaving the s.s. *Pretorian* he was appointed to another vessel, which was torpedoed and sunk in March. It is presumed that he was drowned when the vessel was lost. We are sure our readers will join with us in expressing sincere sympathy with his relatives in their time of trouble.

THE LATE OPERATOR E. MARSHALL.

Postmaster-General's Report.

THE Annual Report of the Postmaster-General for the year ending March 31st, 1916, has now been issued. The following passage deals with the position of wireless telegraphy :—

" The prohibition of the private use of wireless telegraphy has been maintained, " and effective measures to enforce this prohibition have been taken under the " Defence of the Realm Regulations. All existing private stations, except a few " required for Government work, have been dismantled, and the apparatus has " been taken into post office custody for the period of the war. The use of the coast " stations for private radio-telegrams has been suspended until further notice. They " are reserved for Government purposes and for the exchange of necessary messages " between merchant ships and the owners or agents."

The Iron Ring

A Story of Life at the Front.

TOWARDS midnight the huge howitzer column pants down the pavé. The night is inky. Cimmerian almost. Nothing can be heard above the roar of the tractor motors and the thunderous clank and rumble of the massive caterpillar wheels on the granite cobbles. Not a light shows, and a shiver passes down your spine as you wonder what would happen were you to slip beneath these relentless hurrying wheels. So far twelve tractors have passed with their trails in tow, each trail carrying its part of the mammoth howitzer. Occasionally you hear a shout just audible above the crashing jumble of noise.

Ahead on the horizon a shimmering borealis of fire quivers, where the doughty Rhine defence fortress of Z—— is holding up our brigades with an impassable barrier of iron. The mammoth piece is the reply. She goes one better even than the largest Skoda production in range, calibre and weight of metal, and our gunnery experts are on tenterhooks to see how she behaves when pitted against the massive concrete bastions of the fortress head.

Her twin sister is heading for the aurora by another way—from the south—she'll perhaps be up in time to compete with the one which is now clanking and clattering into the night like some gigantic rattlesnake, towards the wing of flame which lifts and falls like the wing of some beautiful night moth. Yet how very different. Violet mostly, but streaked with ruby and emerald at times. Cordite, lyddite, T.N.T. and other compounds known perhaps to a handful of experts.

If things were quiet the frenzied drumming of the guns would be heard—now like the sound of some mighty throbbing motor, now dying, and again rising in a swift crescendo of thudding thunder.

The darkness shrouds the long creaking string of tractors. When dawn comes the sun will find them "parked" by the roadside, under huge tarpaulins splashed with green, black, orange and crimson in quaint cubist patches.

A few hundred feet overhead they appear to blur and blend into huge smudges which harmonise with grass, earth and tree,—so airmen will tell you.

Through the night the column rumbles swiftly—onward through villages and towns—desolate and stark. Everywhere the odour of plaster, brick and burning wood and the nauseating fumes of explosives. At intervals screened lights can be noticed in the ruins, and in the roadway outside one building, larger than its neighbours, a long line of throbbing cars stand, and from these stretcher-bearers are gently transporting the stretchers with their sobbing burdens. Above the porch two white lights gleam—the Red Cross night signal lights, and flapping gently against the blackened brickwork you notice the tips of flags—the red-crossed white and the Jack hung horizontally.

Each house has its occupants—corps headquarters have been established here. One has been converted into a temporary signal office, and you notice perspiring operators working their instruments on the counters of what three weeks ago was the village baker's shop.

Two buildings further along two three-ton lorries are disgorging mail sacks by tens, and inside in guttering candle light you see the field sorter in his element.

And so the column clatters onward—the howitzer's emplacement has been fixed for her some ten kilometres further on—just behind a smallish knoll two fields distance from the pavé. Gradually the night begins to grey, and the column pull in one by one to the right of the roadway—further movement would be dangerous, as a single prowling Aviatik running the gauntlet of the anti-aircraft guns further up might upset the most carefully laid plans. No mistake must be made. Number one tractor with her trail already looks as if she were rather a biggish wagon with perhaps a load of hay under her grotesque covering. Soon the column is snugged down, and the weary drivers and gun crew are sleeping—they lie down as they stand, and drop oft one by one—till the only wide awake members are the sentries and the corporal of the guard. Lighter traffic streams past with a continuous roar —sometimes it even drowns the devilish chorus out there in front. Just over the fields you can get a glimpse of the hurricane barrage from the Z fort falling some six kilometres off, like some mighty mottled surf breaking on a bleak grey beach. Bursts of white, black, yellow, sepia, and sometimes green, all mingling and hanging low on the tortured field and fallow. In that bit of a valley—its worst, perhaps—it never seems to lift, and nothing living could possibly brave it. A barrier of iron truly. The only way is to crack these massive concrete buttresses and smash guns, gunners and concrete into a ghastly jelly—not till the cupolas are pierced can we make headway. This time next week?—you wonder. The sun gradually climbs up into the heavens, aircraft become active, and a few duels of the real aviation story type are witnessed. A fast enemy scout creates a diversion by dodging the shells of the three guns concentrated on him, comes dangerously near the "parked" column and then, after circling a few times, begins to alternately stand on his head, then on his tail, for the benefit of his spectators, you decide. A fast scout with the regulation blue-white-red "target" on his underside suddenly emerges from a cloud bank and streaks towards the black-crossed enemy scout. Both machine guns rattle—nothing happens; both craft still aloft—the enemy still continues his fancy work, and then suddenly like a swallow he flashes towards his opponent, rises and clears him, and with his throttle full open, he suddenly swirls round and heads for his own lines. The "targeted" craft draws off with a parting rat-a-tat. The anti-aircraft artillery open out, and the sky is again dotted with little fleecy puffs. And so the day wears on. Some enemy machines fall—some in flames and others revolving slowly and helplessly like paper windmills. Some of our machines fall, too, one with her tail blown off, another with her engine blown out by a direct hit from an enemy "77."

All through the day the hell chorus in front goes on—the surf of metal is still breaking out there.

Our advanced patrols are just outside the ring, lying in hedgerows, sheds and ditches. Occasionally a splinter crashes down on a steel helmet, and another silent burden is carried in to the main body which lies hidden in field and ditch some half mile further back. The men lie prone mostly, their drab clothing mud-caked and sodden.

In a small plantation just behind them a brigade of cavalry is lying—horses picketed and off saddled, but everything is ready for a smart "pack-up." Light artillery is in position everywhere. From the windows of ruined cottages the impudent snouts of eighteen-pounders protrude—but they seldom fire. It would be almost like the schoolboy simile of trying to sink a Dreadnought with a peashooter. Medium-heavy and heavy artillery are dug in too—mostly screened with branches and greenery, and some in the open on "dead" ground, where the Z fort observation officers' glasses, prismatics and range finders are rendered useless by friendly knolls and rises in the ground. Aviatiks and Rumplers, however, seldom escape a flash or a smoke puff, and the guns usually cease firing when enemy aircraft appear. They open out again directly the plane is driven off. But the firing is desultory, slow and disappointing—everybody's waiting for the big howitzer to commence her "shoot" and speculating on her chances against the citadel away across the valley there. Will it be another Namur or Liége, or will the Z's mighty cupolas resist even these huge projectiles.

Some of the outposts on the higher ground are congratulating themselves on the excellent view they'll get of the coming "strafe," and the men are straining their ears for the dull boom and the tremor of the ground which will tell them she's fired. Rumours flit from detachment to detachment, and the general impression is "To-morrow"—"Dawn." You hear these words whispered from one steel-helmeted group to another.

Noon comes and the aircraft activity slackens, a low ground mist has begun to wreathe itself over the fields and valley, and observation is difficult.

Gradually the afternoon wears on, and soon the shadows begin to soften and dusk creeps over the face of the land. Soon it is dark. Back a few kilometres on the pavé the long sleeping line of tractors suddenly begin to purr and throb. Suddenly you hear a series of shouts, and the long line of tractors and trails seems to give itself a final shake and rumbles slowly forward. Soon the column is under way, and the cobbles and poplars are trembling as the column gets into its stride.

The gun must be in position, and her "shoot" begun by dawn.

Soon the column is hurrying forward at its best speed. Hurrying onwards as it's been doing nightly for the past week, like some nocturnal cave monster. The emplacement is not far distant now—just another kilometre—you hear someone shouting above the thunder of noise.

Soon the halting place is reached, and the column leaves the cobbles and at last halts on the rising ground to the right of the roadway. Somehow it reminds you of the circus which came yearly to the old town at home with its long procession of wagons—in the night usually—and set up all its gaudy tents and tinsel before light. One night, plodding home, you had seen it arriving; and somehow the howitzer column brings it all back to you.

Meanwhile shadowy figures flit from wagon to wagon, and the noise of hammering, ratchets, and the creak of block and tackle blends with the louder rolling of the artillery.

All through the night the work proceeds till the constellations wane and the eastern horizon greys. Dawn.

You look round and see the mammoth piece assembled and ready for action–

squatting on the rise like some giant dumpy toad—her nose pointing heavenward and to the east.

A few hundred yards behind the tractors are " parked " in a row, looking vague and shadowy in the uncertain light.

A few gunners are hurriedly giving the gun its final overhaul. Suddenly there is a sharp command and the gunners double away from the gun and go " to earth " in a smallish pit almost five hundred yards in the rear. There are other figures in the pit too, and one has a field 'phone strapped to his head. From the pit a species of armoured cable leads to the gun, where it disappears. To the right, running from the pit, there is a second cable, and you follow it to find where it leads. Suddenly you stumble on a tiny tent, and peering inside you discover the howitzer's wireless station. Here the signals from the observing plane are received and relayed by 'phone to the men in the pit. You look upward, and suddenly you pick out a two-seater biplane, the first rays of the sun glinting on his underside and transforming him into the semblance of some dainty silver dragon fly. His altimeter must be registering five thousand feet, you decide. Suddenly the operator in the tent holds a warning hand for silence. " Stand by," he jerks, and an answering whirr comes from the pit. Then follows a pause—a silence of perhaps ten minutes. Then " Ready "—the observing plane is now almost over the fort, and he's having a rough time with the black and brownish enemy shrapnel which is dotting the grey sky above and below him. Then, with unexpected suddenness the operator jerks out the word " Fire "—again the answering whirr, and next second there is a vivid greenish stab from the howitzer, and simultaneously with it the heavens seem to tumble about your ears as the giant shell goes booming eastward ; you can hear the projectile hurtling heavenward on its climb with a hissing noise suggestive of white-hot steel plunged in oil.

Out on the ridges the expectant patrols have just heard the deep boom, and all eyes are fixed on the distant slope, fir clad in places, but appearing more like a brownish grey smudge, which looks just an ordinary piece of ground and not a cunning series of mighty man-made domes bristling with long-range pieces of all calibres. They've heard the shell go shrieking high overhead, and everyone has almost stopped breathing. Then the sound of the shell is lost in the crashing of the barrage, which has never lifted—not for the veriest fraction of a second. Suddenly there is a tremor and nothing more ; you count—one, two—then, your eyes still on the distant ridge, you suddenly see a vast black oily tree of smoke shoot out of nothingness like some tall wizard poplar, and again a tremor—bigger than the last—then, rolling across the valley mists, you hear the deep cracking cough of the bursting projectile. The smoke billows out in dense swirling wreaths and slowly drifts away. It clears—yet the ridge seems to be unaltered—it appears to be just the identical brownish grey piece of land. Then in a flash you notice the iron ring has gaps in it—wide gaps. Then with dramatical swiftness the barrage lifts, stops entirely, and the shell smoke out in front thins. Then suddenly there is a queer sound—a sound which every ditch, spinney and hedgerow takes up—a frenzied cheering and shouts of " Look, look." Everybody is pointing Z-wards, and straining your eyes you pick out a patch of white on the ridge fluttering to the top of what must be a flagstaff, you decide. You can't see the staff, but it must have somehow survived the awful concussion. There must be human beings alive in the fort or the remnant of it.

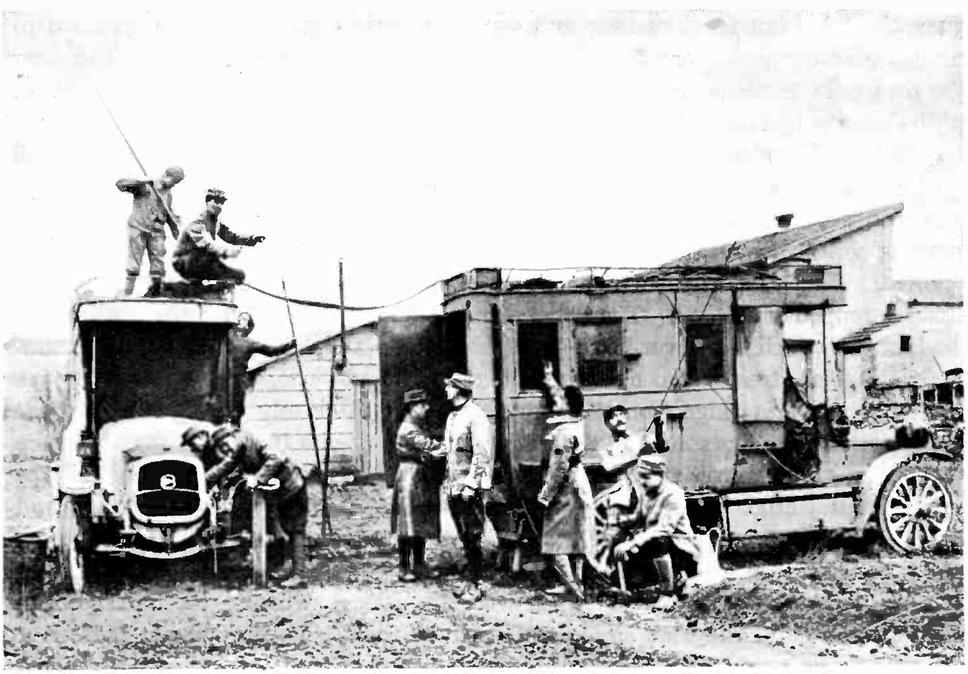
The infantry are already swinging across the valley in extended order—cautiously. Then cantering up behind you notice small groups of horsemen which pass through the lines of infantry and move swiftly on in their van. Behind them—artillery.

At last the distant ridge is gained, and the cavalry officers are confronted with a vast crater, the sides of which are ragged with huge boulders of broken concrete, twisted metal and splashes of crimson, and other things. Suddenly they are confronted by a haggard handful of grey-clad men, who emerge from a gallery leading into the yawning pit and clamber slowly and painfully to the top, when they fall, mostly overcome by concussion and the fumes of the giant projectile. A few remain standing, and one, a smart and soldier-like middle-aged man with the artillery facings and badges of a captain discernible on his grimy uniform, steps forward and tenders the surrender of the fortress.

Meanwhile the main body is swarming eastward, and the crackling of rifle and machine-gun fire is again picked up as our patrols establish touch with the enemy detachments east of the fallen citadel.

The wireless station at the howitzer's emplacement is being packed and dismantled. A grimy gunner is lending a hand—" Not such a bad 'shoot,' Sparks, after all."

PERIKON.



[*French Official Photograph.*

FRENCH MOBILE WIRELESS CARS.

The Rotary Converter

By H. E. PENROSE.

FROM the mass of facts and complicated reactions with which one is confronted when considering the probable action of the (inverted) rotary converter (singe winding type as used with the Marconi Company's standard $1\frac{1}{2}$-kw. set), the points which at first stand out most clearly are :—

(i) The wave of alternating E.M.F. produced at the slip rings appears to approximately follow the Sine law.

(ii) That this alternating E.M.F. is due to the variations of potential difference between certain selected armature coils to which the slip rings are attached by tappings.

(iii) This potential difference at any instant of time during one revolution is due to the relative position of those armature coils bearing the tappings to the D.C. brushes, together with the direction and values of the B.E.M.F.s at that instant.

(iv) If D.C. is supplied to the commutator A.C. may be taken from the slip rings.

(v) If A.C. is supplied to the slip rings, and the armature run up to the necessary speed by using a prime mover, the machine will run as a synchronous motor, and D.C. may be taken from the commutator.

(vi) If the machine be driven by a prime mover, D.C. may be taken from the commutator and A.C. from the slip rings at one and the same time.

The first conclusion arrived at is that relative motion is necessary in order to secure a varying difference of potential between two points on a circuit through which a steady current is flowing. This may be shown by a brief consideration of the potentiometer (see Fig. 1).

Let *A* and *B* represent the two variable arms of a potentiometer, then if *A* and *B* rest on the same point anywhere along *DE*, *V* does not register, because there is no difference of potential between its terminals, *AB*.

Let *AB* rest on *C*, which is a point along *DE* such that the voltage drop along *EC* is equal to that along *CD*. *V* then registers no difference of potential.

Now let the arms, *AB*, be moved in diametrically opposite directions along *CE*, *CD*, such that *A* moves towards *D* and *B* towards *C*. Ignoring the voltage drop along *FE*, *DG*, *V* registers a gradually rising P.D. from zero at *C* to a maximum value, when the arms, *A* and *B*, are at *D* and *E* respectively. This potential difference may be made to fall to zero by bringing *A* and *B* back to *C*, and by continuing the motion of *A* towards *E*, and *B* towards *D*, *V* may be caused to register a maximum P.D. acting in the opposite direction, which again falls to zero on reducing *A* and *B* to *C* once

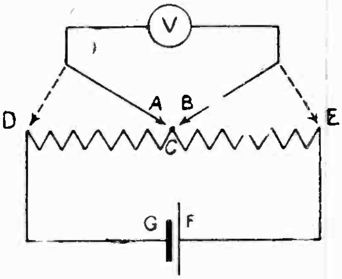


FIG. 1.

more. Thus V shows that one cycle of alternating E.M.F. is produced by the following simultaneous series of motions of AB along DE.

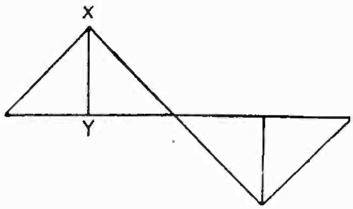


FIG. 2.

A to D, B to E.
A and B back to C.
B continues its motion to AD and A towards E.
A and B back to C.

This may be represented graphically, as in Fig. 2, where XY, the maximum value, represents practically the full P.D. between GF.

Fig. 3 shows a further application of this principle.

Let the copper ring, $CDEF$, be capable of rotation about its centre, and let the fixed brushes, B_1, B_2, B_3, B_4, rest upon it in such a manner that the four equal and parallel circuits, $CDEF$, are created in the ring as follows :—

Circuit $C = B_2$ to B_1
,, $D = B_2$ to B_3
,, $E = B_4$ to B_1
,, $F = B_4$ to B_3

Then it should be seen that if the fixed points, AB, are situated at an angle of 90° apart and joined to a voltmeter, V (which is also capable of rotation on the common centre), V will register the varying potential difference between AB as their position relative to the fixed brushes changes on rotation of the copper ring. Furthermore, it can be shown that one complete revolution of the copper ring causes the voltmeter to register two complete cycles of alternating E.M.F.

Presuming the battery to be supplying an E.M.F. of 10 volts, it becomes obvious that the P.D. falls from maximum to zero through each of the four parallel circuits, and therefore points of equi-potential can be found on C, D, E and F. Again, because the current and resistance are equal in each of the four circuits, the point midway between B_1 B_2 on C must be equi-potential to the corresponding points on D, E and F, wherefore if Y on F be joined to A on C, and X on E be joined to B on D, because all four points are at the same potential, V must be at zero.

Now consider what happens when the copper ring with its tappings, AY, BX, is rotated in a clockwise direction. It becomes evident that the voltage drop between B_2A YB_4 diminishes, whereas the drop between B_4X B_2B increases, wherefore V registers a gradually increasing P.D. between AY and BX, resulting in gradually increasing currents through the voltmeter from circuits C and F to circuits D and E.

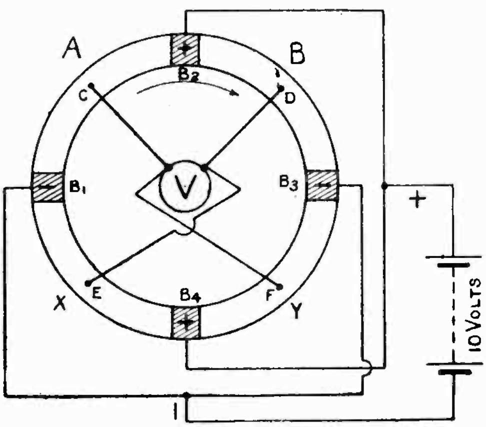


FIG. 3.

The following points should now become clear :—

(i) During the whole of one complete revolution the potential of the point A is always the same as that of Y, and the potential of B always equal to that of X.

A is in parallel with Y. B is in parallel with X.

(ii) The maximum P.D. between the points $A\,Y\,B\,X$ exists when directly under the brushes.

(iii) The minimum (zero) P.D. exists when midway between the brushes. All points are then equi-potential.

(iv) In a complete revolution each tapping passes through four current paths.

(v) Each path produces one alternation.

(vi) The number of cycles produced per revolution depends upon the number of paths through which the tappings are rotated—*i.e.*, 4 paths=4 alternations= 2 cycles, etc.

(vii) The same effect could be produced by—

(*a*) Rotating the brushes round the ring.

(*b*) Sliding the tappings and voltmeter round on the ring.

(viii) The angle at which the tappings are taken must depend upon the number of paths through which they are rotated—*i.e.*,

$$2 \text{ paths } \frac{360^\circ}{2} = 180^\circ$$

$$4 \text{ paths } \frac{360^\circ}{4} = 90^\circ$$

$$8 \text{ paths } \frac{360^\circ}{8} = 45^\circ$$

Now, it is a well-known fact that the armature winding of a motor can be opened out to form one large complete ring (see Fig. 4). Hence it becomes evident that if a motor armature winding be tapped at points a certain number of degrees apart in accordance with the number of paths through it, and the winding rotated, say, by hand, on D.C. being applied to the commutator, the potential difference between the coils bearing the tappings varies both in direction and value as their position relative to the brushes changes during each complete revolution, wherefore

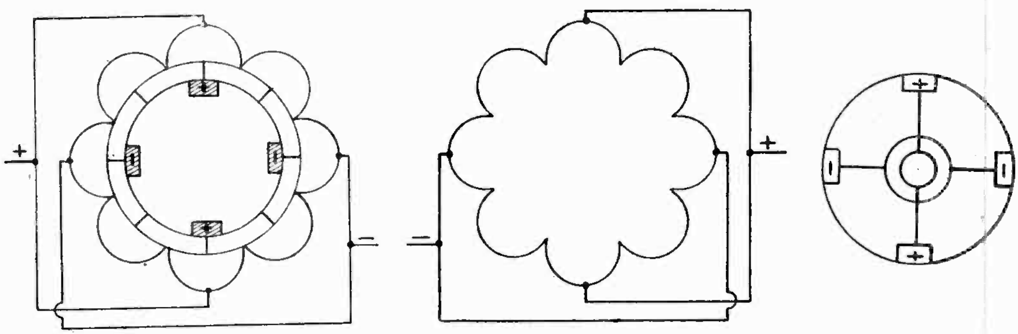


FIG. 4.

the potential between the tappings themselves must vary in unison with that which exists between the coils to which they are attached.

(*To be continued.*)

PERHAPS the most important event in the radio field this year has been the hearings held before the Congressional Committee on the Merchant Marine and Fisheries, which considered the Bill entitled "An Act to Regulate Radio Communication," introduced in both Houses of Congress. The hearings were held during the month of January.

Not only were the provisions of the Bill opposed by the important commercial wireless organisations in this country, but such scientists as Professor Pupin of Columbia University and Professor Kennelly of Harvard University appeared in person and protested vigorously against the enactment of the proposed Bill into law. These gentlemen, as well as others, showed conclusively that Government ownership of wireless communication would effectively retard development in this important art of communication. Professor Kennelly is past-president of the Institute of Radio Engineers and Professor Pupin is its present President.

The Congressional Committee did not report on the hearings, and as the sessions of Congress have ended, no action on the matter has been taken. It is probable, of course, that the Bill may be presented at the next session of Congress; but, if it is, I do not believe that the opposition to such a Bill will be any the less strenuous.

At a meeting of the Institute of Radio Engineers, held on March 7th, 1917, two papers were presented—one by Professor Edward W. Washburn of the University of Illinois, entitled "The Determination of the Audibility Current of a Telephone Receiver with the Aid of the Wheatstone Bridge." This paper dealt with a method of determining the audibility current of a telephone receiver using a Wheatstone bridge with the telephone as indicator. This method differs from the usual shunted telephone method which determines audibility voltage. The paper also described a method whereby an estimated percentage of accuracy can be secured if the telephone resistance and impedance are only very approximately known.

The second paper, by Mr. Ellery W. Stone, discussed "Experiments with Impulse Excitation." In this paper Mr. Stone treats the distinction between "Impulse Excitation" and "Beat Excitation," and considers broadly the conditions under which each of these is brought about. In connection with a type of "Impulse excitation" transmitter the writer also considered the effect of a hydrogen atmosphere in the gap, the construction of the necessarily closely inductive coupler between spark-gap circuit and antenna circuit, the effect of gap separation and "wandering" of the spark, and the effect of the tone circuit shunted around the gap.

I had the honour of attending a dinner given by the Washington section of the Institute of Radio Engineers to its Chairman, Brigadier-General Geo. O. Squier, head of the Signal Corps of the United States Army. The dinner was well attended by radio engineers in civil and government life, and a splendid address was made by the General dealing with the subject of radio. General Squier is one of the most prominent United States members of our profession, and will be recalled as representing the United States Government as an attaché for some time in England

DAVID SARNOFF.

Oscillatory Discharges

Ten little coulombs looking jolly fine,
One was discharged, and then there were nine.

Nine little coulombs made to oscillate,
One jumped a spark gap, and then there were eight.

Eight little coulombs sent off to heaven,
One became earthed, and then there were seven.

Seven little coulombs playing funny tricks,
One strained the ether, and then there were six.

Six little coulombs looking quite alive,
One got damped, and then there were five.

Five little coulombs feeling somewhat sore,
One got resisted, and then there were four.

Four little coulombs in a battery,
Someone switched the current on, and then there were three.

Three little coulombs wondering what to do,
One got polarised, then there were two.

Two little coulombs, after all this fun,
One caught hysteresis, and then there was one.

One little coulomb feeling rather glum,
He was short-circuited, then there was none.

R. C. D.

Instructional Article

NEW SERIES (No. 2).

EDITORIAL NOTE.—In the opening number of the new volume we commenced a new series of valuable instructional articles dealing with Alternating Current Working. These articles, of which the present is the second, are being specially prepared by a wireless expert for wireless students, and will be found to be of great value to all who are interested in wireless telegraphy, either from the theoretical or practical point of view. They will also show the practical application of the instruction in mathematics given in the previous volume.

POWER CURVES.

5. In a continuous current circuit working under steady conditions the rate at which energy is being expended is given by the product of the current and electro-motive force. If the current be in ampères and the E.M.F. in volts the product will be the energy in watts expended in the circuit or the power produced by the dynamo, battery, etc., which supplies it.

We will now consider the power in an alternating current circuit. There are two cases to discuss when considering the power of an alternating current circuit :

(A) when current and voltage are in phase,

(B) ,, ,, ,, ,, ,, out of phase

—that is, when the current lags behind or leads the voltage.

6 (A). Power when current and voltage are in phase.—If the values of an alternating current and E.M.F. are plotted to scale we obtain the curves shown in Fig. 8.

The curves may be considered to be divided up into a large number of sections, each section representing an equal small interval of time, such that the current and voltage for any section may approximately be considered to be constant for that interval.

If the values of current and voltage be multiplied together the product will give the power in the circuit for that interval of time, and by completing the process for the whole curve a power curve for the circuit will be obtained.

It will be observed that current and voltage are both positive or both negative together ; therefore the product is always positive. The curve for 180° to 360° must be drawn on the positive side of zero.

In the example shown the maximum value of the E.M.F. is 10 and the maximum value of the current 5. The maximum value of the power curve is, therefore,

$$5 \times 10 = 50 \text{ watts.}$$

The **average value** of the power curve can be obtained from considerations similar to those by which the average value of current and voltage curves are obtained.

$$\therefore \text{ average value} = W_{av} = \frac{50}{2} = 25 \text{ watts (\textit{see} Article I.).}$$

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In the previous article it was shown that the virtual value of an alternating current $=\frac{\text{max. value}}{\sqrt{2}}$.

$$\therefore C_v = \frac{5}{\sqrt{2}} = \frac{5}{1\cdot41\ldots} = 3\cdot535\ldots$$

and

$$LE_v = \frac{10}{\sqrt{2}} = \frac{10}{1\cdot41\ldots} = 7\cdot071\ldots$$

Multiplying e_v and C_v

$=7\cdot071\ldots\times3\cdot535\ldots$

$=24\cdot999\ldots$ watts.

which agrees with the figure obtained from the curves.

Therefore the average power of an alternating current circuit when current and voltage are in phase

$$=W_{av}=E_v\times C_v.$$

Instruments have been designed (called wattmeters) by which the power in a circuit can be directly measured. If one be connected with an alternating current ammeter and voltmeter in a circuit, then, since the ammeter and voltmeter would indicate virtual ampères and virtual volts, the wattmeter would indicate the product of these two readings.

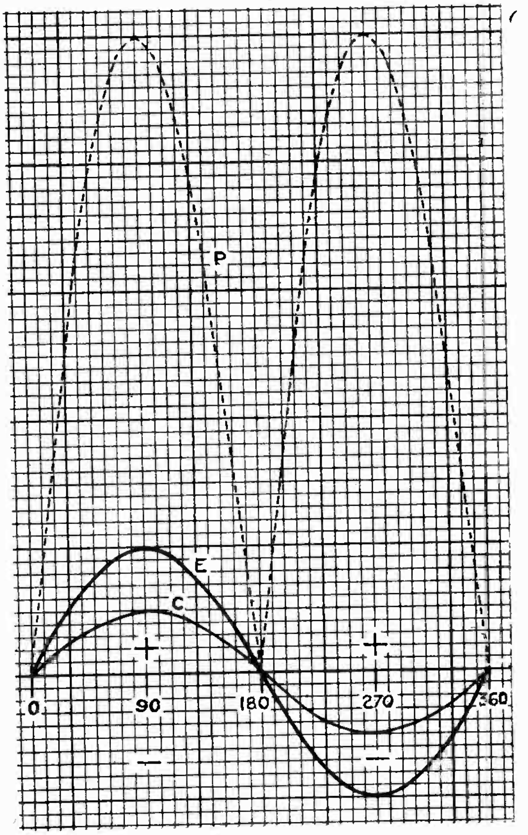


FIG. 8.

7 (B). Current and E.M.F. out of Phase.—(*a*) In Fig. 9 the voltage curve rises to a maximum value before the current curve. This means that the current lags behind the voltage or is out of phase and obtains its maximum value after the voltage. In the diagram shown the current lags behind the voltage by 30°, or the current starts 30° after the voltage.

Proceed to calculate the values of the power curve at various angles over the complete cycle. For 30° the power curve is on the negative side of the axis. Then for 150° the power curve is on the positive side. Continuing as before we obtain another curve on the negative side and another curve on the positive side.

From the curve it is seen that the maximum positive power is 46·61 watts and the maximum negative power is 3·34 watts. Now the negative power is power given out by the circuit to the generator. Therefore the mean power available for useful work is the algebraic sum of the positive and negative power over a given time:

$$=-\frac{3\cdot34}{2}+\frac{46\cdot61}{2}$$

$$=21\cdot6 \text{ watts.}$$

8 (b). Current and Voltage 90 deg. out of Phase.—In Diagram 10 the current and voltage curves are drawn with the current lagging behind the voltage by 90°, that is when the voltage is 0 the current is a maximum and when the voltage is a maximum the current is 0.

Proceeding as before to plot the power curves we find that two are obtained on the positive side of the axis and two on the negative side. The maximum point of the power curve on the positive side is 24·95.

$$\therefore W_{av} = \frac{24 \cdot 95}{2} = 12 \cdot 475.$$

Now the maximum point of the power curve on the negative side is

$$\therefore W_{av} = -\frac{24 \cdot 95}{2} = -12 \cdot 475.$$

But in section 7 (*a*) it is shown that the available power in the circuit is the algebraic sum of the positive power and the negative power.

Therefore the available power

$$= -12 \cdot 475 + 12 \cdot 475$$
$$= 0.$$

9. The sine law equations for the E.M.F. and current when there is a difference in phase are

$$E_v = E_{max.} \sin \theta$$
$$C_v = C_{max.} \sin (\theta \pm \lambda)$$

where $+\lambda$ indicates the angle of lead of a current and $-\lambda$ the angle of lag of a current.

Therefore the power at any instant

$$W = EC = E \sin(\theta) \times C \sin(\theta \pm \lambda)$$

Since $\cos(A-B) - \cos(A+B) = 2 \sin A \sin B$

$$W = \tfrac{1}{2} EC \{\cos \lambda - \cos (2\theta + \lambda)\}.$$

The mean power or true watts

$$= W_{av} = \tfrac{1}{2} EC \cos \lambda.$$

But $C_v = \frac{C_{max.}}{\sqrt{2}}$ and $E_v = \frac{E_{max.}}{\sqrt{2}}$

$\therefore$ average power $= W_{av}$
$= C_v E_v \cos \lambda$,

or **the mean power is equal to the product of the virtual current, the virtual E.M.F.** and the **cosine of the angle of lag or lead.**

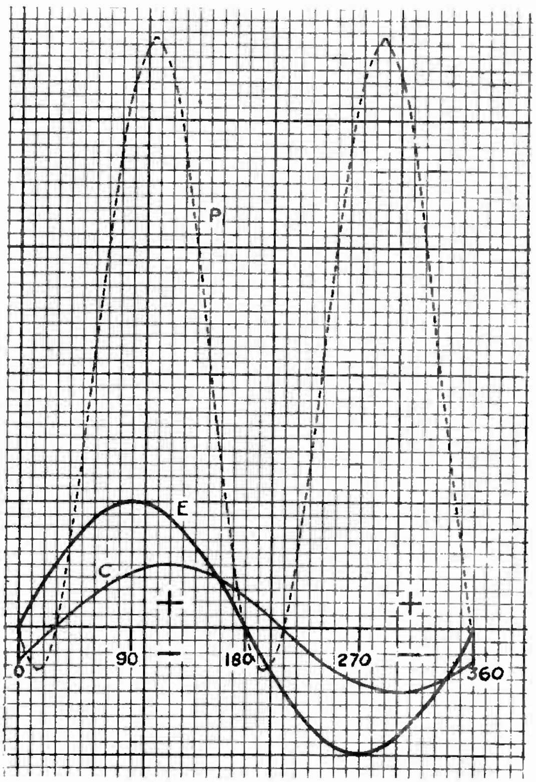
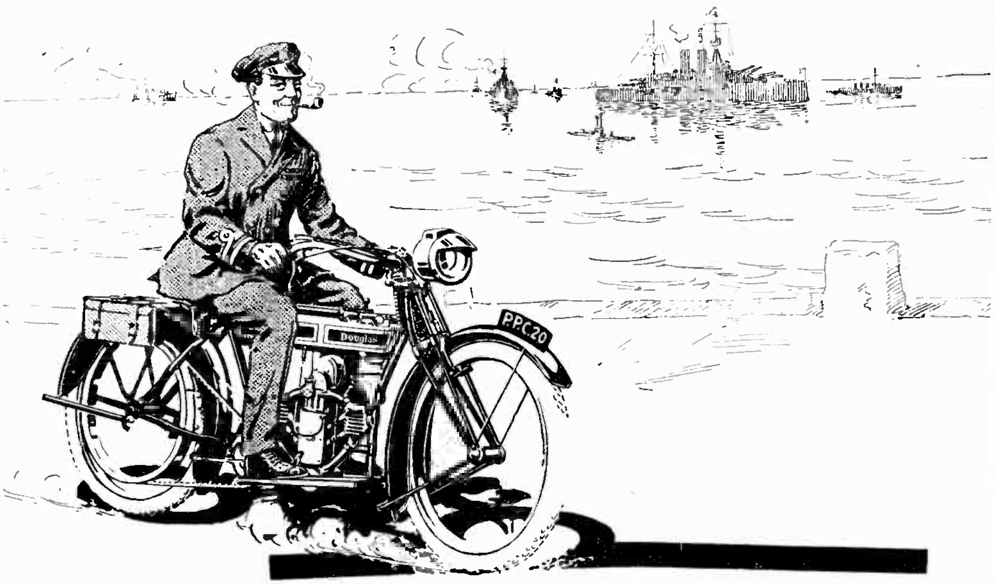


FIG. 9.


P.P.C.20

If the mean power of the three examples given be worked out from the above formula we get (Section 6)

Angle of lag=0° and cos 0°=1.

The mean power is, therefore,

$$W_{av}=E_v \times C_v,$$

Where the angle of lag=30° (Section 7 (*a*))

$$W_{av}=E_v C_v \cos \lambda$$
$$=7{\cdot}071 \times 3{\cdot}535 \times {\cdot}866$$

where ·866=cos 30°

$$=21{\cdot}6 \text{ watts},$$

which agrees with the value previously obtained from the curves —*i.e.*, 21·6.

Taking the case where $\lambda=90°$ (Section 8 (*b*)),

then cos 90°=0

$$W_{av}=7{\cdot}071 \times 3{\cdot}535 \times 0$$
$$=0.$$

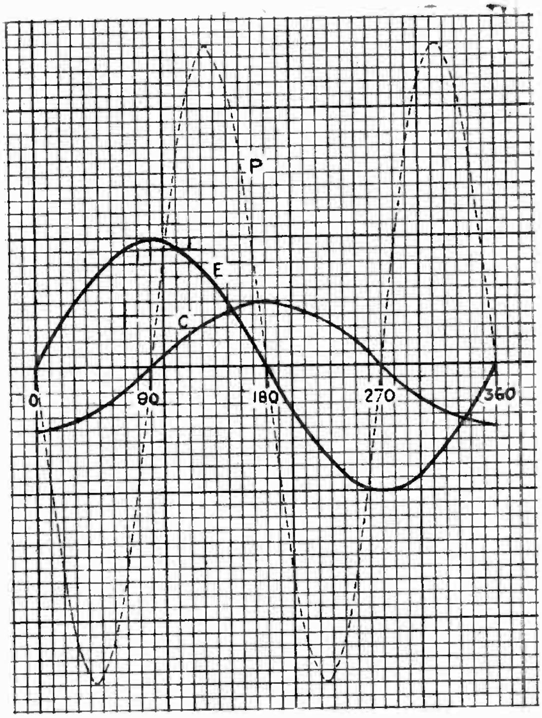


FIG. 10.

10. Power Factor.—From the formula for the mean power in a circuit $W_{av}=E_v\ C_v \cos \lambda$ it will be seen that multiplying $E_v\ C_v$ by a factor less than 1 results in less power in a circuit. Now the product $E_v\ C_v$ is known as the **apparent watts,** and if a wattmeter is connected in the circuit then its reading is termed the **true watts.** Therefore it will be seen that when current and voltage are out of phase the true watts must be less than the apparent watts.

The factor which converts apparent watts into true watts is known as the **power factor** and is equal to **cos** λ.

$$\therefore \cos \lambda = \frac{\text{true watts}}{\text{volt ampères}} = \frac{\text{true watts}}{\text{apparent watts}}.$$

Example.—If an ammeter, voltmeter, and wattmeter indicate 11 ampères, 70 volts, and 700 watts respectively, what is the power factor?

$$\text{Power factor} = \cos \lambda = \frac{700}{70 \times 11} = \frac{700}{770}$$
$$= {\cdot}909.$$

11. Idle Current.—In an alternating current circuit when the current either lags behind or leads the E.M.F. the current can be considered to consist of two currents, one in phase with the E.M.F. and one at 90° with it, or in quadrature with it.

In a similar manner the electromotive force may be considered to consist of two E.M.F.'s, one in phase with the current and one at 90° to it.

A vector diagram * can, therefore, be constructed as in Fig. 11. In constructing vector diagrams it does not matter whether maximum values or R.M.S. values are used, but it is usual to use R.M.S. values.

In the diagram PV represents the voltage and PQ the current lagging behind the voltage by λ.

Now, from the formula

$$W_{av} = E_{max.}\ C_{max.} \cos \lambda$$
$$= E_{max.} \times C_{max.} \cos \lambda,$$

we have $C \cos \lambda$ in phase with E and $C \cos (90° - \lambda)$ or $C \sin \lambda$ at right angles to E.

The projection of PQ on $PV = C \cos \lambda$, and the projection of PQ on $PS = C \sin \lambda$. Since the current PR is in step with the voltage PV, the power

$$= PV \times PR$$
$$= PV \times PQ \times \cos \lambda.$$

Since the current PS is 90° out of phase the power

$$= PV \times PS \times \cos 90° = 0.$$

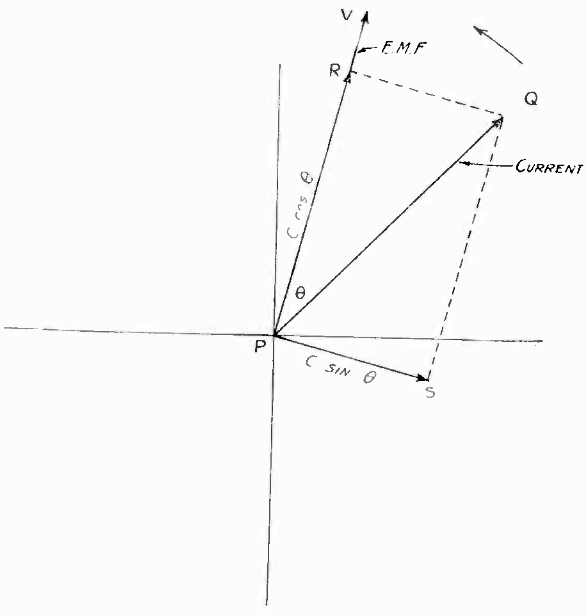


FIG. 11.

Therefore, as current $C \sin \lambda$ (PS) does no work, it is known as the **idle component** or the **wattless component.**

The current $C \cos \lambda$ (PR) is known as the **power** or **watt component.**

When the current lags, as when inductance is in the circuit, the idle component is generally known as the **magnetising current,** as it is this current which produces the magnetic field on which the E.M.F. of self-inductance depends.

If the current leads, as when capacity is present in the circuit, then the idle component is known as the **charging current.**

* See Instructional Article, April 1916.

Correction.

In last month's Instructional Article, p. 64, for "When the E.M.F. is a maximum" read "When the E.M.F. is a minimum and a maximum." On same page, for $E = C_{max.} \sin \theta$, read $C = C_{max.} \sin \theta$.

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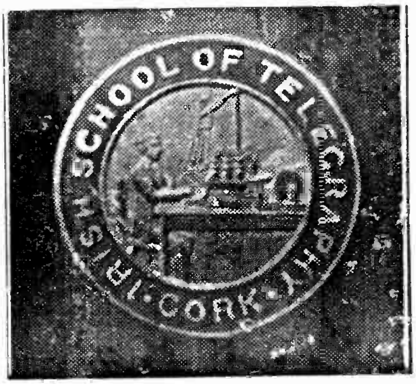

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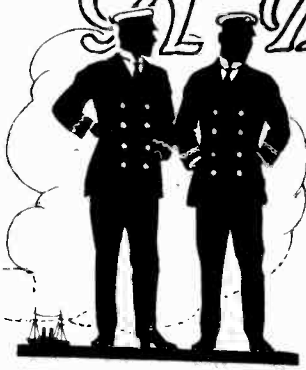

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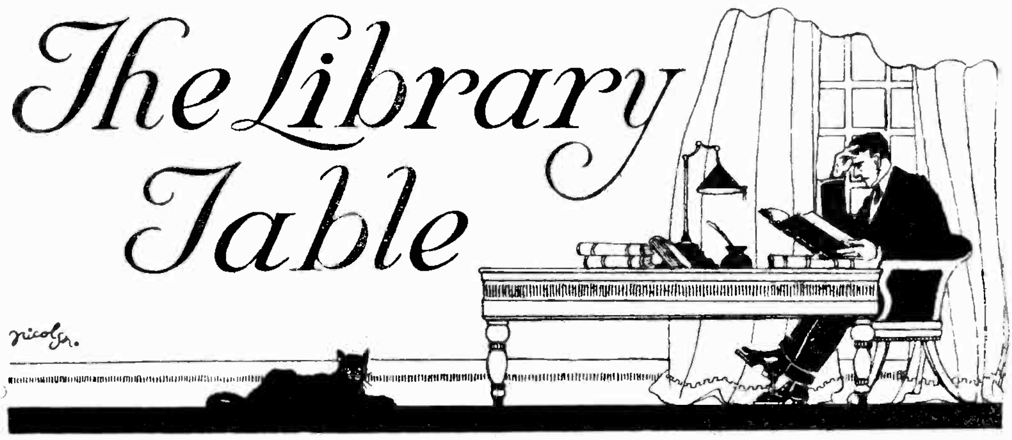

"THE HORNETS: TALES OF THE AIR." By "Hermes." London: Eveleigh Nash Company, Ltd. 3s. 6d.

This collection of tales of the air—some founded on fact, others not, but all good stories—makes some of the best reading it has been our pleasure to come across. There must be few people who have not been stirred by the brilliant deeds of our air service, both military and naval. Here, in England, the gallant actions of the Zeppelin destroyers have aroused enthusiasm and called forth praise as unstinted as it has been well merited. The intensely dramatic sight of a flaming Zeppelin tearing to earth like some gigantic live coal has brought home even to the most unimaginative the daring of the splendid young men in the most wonderful arm of our defences; but it must not be forgotten that brave and daring deeds by the score are performed every day above the fighting line, whether it be in Flanders, on the Russian Front, in the Balkans, or on the arid plains of Mesopotamia.

This book of "flying" stories will do much to make those who perforce must stay at home realise the true spirit of the air and the great romance of wartime aviation. The first of the tales entitled "Ante Bellum" gives a graphic description of an aerodrome and its personnel "on a dewy morning towards the end of July, 1914." It is with a pleasurable feeling that the author is intimately acquainted with the service of which he writes that one peruses these opening pages, which tell of the humours and little worries of the early hours. We learn how the senior instructor is in the habit of referring to the pupils as the "Ham-handed Heroes" "on account of their preliminary extreme clumsiness and heavy-handed method of working the controls of the aeroplane they were learning to fly." We see in our mind's eye a group of young officers bandying jokes whilst the mechanics, busy as bees in a hive, take out from their snug sheds the machines in which the pupils are to fly. As time passes, one by one the machines rise in the air, under the watching eye of the instructor whose great responsibility is perhaps not always recognised by those with whom he works. New machines are tested, a visitor arrives from another aerodrome and other events make up a crowded day. At the close of the chapter we are presented with a little scene at the Mess when, after the customary toast—"Gentlemen: The King," the servants are ordered out, and the Commander, in a manner curt and stern, announces: "I have received a message from the Commander-in-Chief that we are on the point of declaring war with Germany. To-morrow at daybreak all officers will fly to their war stations, irrespective of the weather. You will all report when machines are ready to me at midnight. My secretary will afterwards bring each of you your individual instructions."

Other stories tell of bombing expeditions, of an unnamed and unsung Zeppelin destroyer, and of the various activities of the flying service. Here and there we get a glimpse of wireless, one of the best accounts of this useful means of communication appearing under the title of "Guns and Duns." It is to be regretted that in more than one story Hermes makes the wireless telegraphist talk after the manner of an East End coster, a form of snobbery which we had hoped was dead. Since the flying services contain some of the flower of British manhood and all classes are to be found in practically all ranks, we must abandon the old idea that anyone below a commissioned rank is "not a gentleman."

* * * * * *

"ELECTRICITY AND THE MOTOR CAR." (Second edition.) By F. H. Hutton. London: Iliffe & Sons, Ltd. 2s. 6d. net.

The increasingly important part played by electricity in modern motor-cars, and the desire of many motorists to understand thoroughly the use and construction of all the devices in their cars, has created a considerable demand for the type of book now before us. The handy little volume, which has been specially written for the amateur motorist, deals with accumulators, ignition, magnetos, lighting systems, starting motors, and, in fact, every application of electricity to motor-cars, not excluding electrical vehicles themselves and electrical transmission.

In the opening chapters considerable attention is paid to the first principles, and, incidentally, we are introduced to one of the best schoolboy "howlers" we have seen. In an examination paper a schoolboy was once asked to describe the different kinds of magnets and his answer was: "There are two kinds of magnets, natural and "artificial—the former are made by God, and the latter are made by man; the "latter are the best."

Even this amount of knowledge about magnetism is uncommon, says the writer of the book, who then goes on to describe the elementary principles of magnetism and their application to electrical devices on the motor-car. A special word of praise must be given to the clear diagrams and illustrations, and a number of excellent British magnetos which have now replaced those imported from Germany prior to the war are clearly described.

In the chapter entitled "Points about Ignition" many welcome and useful hints are given, and throughout the volume the author keeps clearly before him the needs of the average motorist who wishes to make the best of his car. This book should prove of great value, not only to practical motorists but to all who are interested in the mechanical side of motoring.

* * * * * *

"MAP OF THE WIRELESS STATIONS OF THE WORLD." London: The Wireless Press, Ltd. 1s. 6d. net.

Every wireless enthusiast needs a map of the wireless stations of the world, and a great success may be prophesied for this map, which is now published in a much

improved form, mounted on strong linen, and made to fold between convenient covers in such a way that it can be easily inserted in the pocket.

A particularly noteworthy feature of this edition is that the coast stations open to ship and shore communication are shown in red, other land stations not available for this service being printed in black. In order that the whole span of the Pacific may be clearly shown, the Australasian Continent is duplicated, an improvement particularly welcome in view of recent developments in trans-Pacific wireless. Other valuable features are the indication of the main shipping routes with distances between the chief ports clearly marked, and the insertion of smaller sectional maps to show the wireless stations in congested areas, such as around the shores of Great Britain and the United States. It is interesting to note that no less than eight hundred stations figure on this new map which has been revised to December 31st, 1916.

* * * * * *

"THE SHIPPING WORLD YEAR BOOK." Edited by Evan Rowland Jones. London : "The Shipping World" Offices. 1917. 10s. net.

The thirty-first edition of this valuable annual has duly made its appearance, and the publishers are to be congratulated on maintaining the high standard previously achieved. A large number of changes and additions have been made to the volume, for, as the Editor states in the preface, "in no single branch of industry has the "application of State control effected so great a revolution as in the shipping trade."

The section of the volume devoted to a Port and Harbour Directory of the British Isles, the Oversea Dominions and foreign countries has been subjected to very extensive revision and alteration, and now presents a remarkably complete and valuable work of reference. The same remarks apply to the large section devoted to the tariffs of all nations.

Other valuable features are Tables of Freeboards, A Digest of Merchant Shipping Acts, The Aliens Act, and the General Tables including such information as distances from British ports to ports abroad. The excellent coloured map in the pocket at the end is particularly complete and up to date.

Share Market Report

DEALINGS in the various shares of the Marconi issues have been more active during the past month. There has been considerable buying of the American shares of late, and all the prices are well maintained.

Marconi Ordinary, £2 18s. 1½d. ; Marconi Preference, £2 7s. 6d. ; Marconi International Marine, £1 16s. 3d. ; American Marconi, 18s. ; Canadian Marconi, 9s. ; Spanish and General Wireless Trust, 9s. 6d.

Personal Notes

We regret to announce the death of Mr. Milton Hymes, secretary, business and advertising manager of the Experimenter Publishing Company, the publishers of our bright and interesting American contemporary, *The Electrical Experimenter.* Mr. Hymes had just completed a successful advertising trip to the Middle West of the United States, and met his death just after leaving Pittsburg in the fearful wreck on the Pennsylvania Railroad, Altoona, Pa., which caused the death of twenty other passengers. Although only twenty-eight years old his charming personality had made him scores of friends in electrical and advertising circles, and his loss is keenly felt.

* * * * * *

We learn from *The Telegraph and Telephone Age* that Harry Gibbons, a telegraph operator who was employed by various news services in Rochester, N.Y., a few years ago, is reported to have been drowned recently at Genoa, Italy. He was a Marconi operator on a Mediterranean liner.

* * * * * *

We learn from Australia that Mr. E. T. Fisk, managing director of Amalgamated Wireless Australasia, Limited, was recently married to Miss Florence Chudleigh, second daughter of Mr. John Chudleigh, of Killara, N.S.W. The happy pair were the recipients of numerous presents, including a valuable gift from the directors and staff of Amalgamated Wireless Australasia, Ltd. On behalf of our readers many of whom are personally acquainted with Mr. Fisk, we offer our heartiest congratulations.

* * * * *

The accompanying portrait is of Major T. V. Smith, chief wireless officer of the Royal Flying Corps. Major Smith, who has been mentioned in despatches, received the Military Cross at a recent investiture.

MAJOR T. V. SMITH.

* * * * *

Messrs. A. V. Wolfe and A. G. Hill, operators at the Fenchurch Street office of Marconi's Wireless Telegraph Co., Ltd., were recently entertained to dinner by the staff of that office on the occasion of their joining the Army. Following the dinner a very

enjoyable musical evening was spent, and both men were given a hearty send off by their comrades.

* * * * *

On more than one occasion we have referred to the excellent educational facilities which are offered to the boy messengers of the Marconi Company, and, as many of our readers know, some of the keenest youths have qualified as wireless operators by attending the special evening classes. The latest member of the messenger staff to join the ranks of the wireless operators is Mr. C. F. Rainbow, who obtained his Postmaster-General's first-class certificate in March of this year. Mr. Rainbow has now proceeded to sea, and carries with him the good wishes of all his former associates.

C. F. RAINBOW.

* * * * * *

At the examination held on March 16th at the North Eastern School of Wireless Telegraphy, Newcastle-on-Tyne, Miss Florence L. Gateshill, of Newcastle-on-Tyne, obtained the Postmaster-General's first-class certificate in the Marconi, Poulsen and Telefunken systems. Miss Gateshill is said to be the first lady in Great Britain to have obtained the first-class certificate in these three systems.

* * * * * *

A recent visitor to Marconi House was Corporal J. P. Lanning, who prior to joining the Army was a member of the staff of Marconi's Wireless Telegraph Co., Ltd. Corporal Lanning, who was enjoying his first leave after nearly two years' active service, has had many exciting experiences on more than one front, being one of the last men to leave the Gallipoli Peninsula when the British forces were withdrawn.

* * * * * *

We learn from *The Hull Daily Mail* that Second Lieutenant F. C. Harker has been appointed a pilot in the Royal Flying Corps. This young officer in 1914 was a Marconi operator on the Union Castle liner *Durham Castle*, and later he joined the R.N.V.R. He was for some time at the Dardanelles, and later trained at the Curtis Flying School in America.

* * * * * *

Corporal Alex. Dalziel, a wireless operator attached to the Royal Flying Corps, has received the French Médaille Militaire for service in the field. He already holds the D.C.M. Mr. C. R. Tweedale, a wireless operator in the Royal Flying Corps, has also been awarded the Médaille Militaire.

Company Notes

Report of the Directors of the Marconi Wireless Telegraph Company of America

THE operations for the fiscal year show, before allowing for reserves, a net income of $336,040.59, as compared with $288,994.66 for the year 1915.

Receipts for message traffic with ships show an increase for the year of 9 per cent. over the previous year.

The war conditions, preventing the operation of your Transatlantic stations at New Brunswick and Belmar, New Jersey; and at Marion and Chatham, Massachusetts, remain unchanged. The British Admiralty still holds, for military purposes, the English plants constructed for exchange of traffic with this country. The continuance of the war has likewise rendered it impossible to inaugurate our direct service with Scandinavia.

Service with Japan was successfully inaugurated on November 15th last, and an increasing volume of traffic is being handled, under Government censorship, at a tariff one-third lower than that of the submarine cable. On the Pacific, as on the Atlantic, operations are restricted by war conditions, the Japanese stations being controlled by that Government. For the present, therefore, the new service is limited to traffic between San Francisco, Hawaii, and Japan.

Your company continues to manufacture apparatus for use by the United States Army and Navy, and recently has been awarded contracts for a large number of wireless sets of various types.

The litigation involving the vacuum valve detector, invented and patented by Professor Fleming, of London, which patent is owned by this company, has resulted in a decision of the United States District Court; the patent has been sustained and found to be infringed by valves such as the modified form known under the trade name "Audion." An appeal has been taken by the defendant.

The Marconi patent, sustained by Judge Veeder in 1914, is again involved in litigation with the Atlantic Communication Company, and your company awaits an opportunity to examine Mr. Marconi as a witness in its behalf.

This same Marconi patent is in litigation, on the Pacific Coast, where an effort was made, at Seattle, to include a modified form of transmitting apparatus made and sold by Kilbourne & Clark, the defendants. The District Judge in Seattle has been unwilling to include this modified form of transmitting apparatus as being within the sustained claims, and we are appealing the case to the Circuit Court of Appeals.

Under United States Statute of June 25th, 1910, your company is entitled to make claim for damages due to the appropriation of its patented property, by the United States Government. Availing itself of its right, your company began suit in the Court of Claims of the United States in July, 1916, to recover its damages for the infringement of the patents of Lodge, Marconi, and Fleming.

The extent of the rights obtained by rival bidders for government work under this statute of 1910 has been the subject of litigation. The United States District

Court, Southern District of New York, construed the statute to authorise the making and selling by one Simon, a rival, unlicensed bidder for such work, and the Circuit Court of Appeals, Second Circuit, approved the decision. The Marconi Company promptly applied to the Supreme Court of the United States for a writ of certiorari, which was promptly granted. and we have, further, asked that Court to advance the case on its calendar.

When diplomatic relations between the United States and Germany were severed, on February 3rd, 1917, your General Manager promptly telegraphed the President of the United States, as follows :

" The Marconi Wireless Telegraph Company of America, in accordance with the " Act to Regulate Radio Communication approved August thirteenth, nineteen " hundred and twelve, hereby places at the disposal of the Government for use in " any emergency, its entire organisation and personnel, including its high power " and coastal stations wherever situated, its manufactories, workshops, and trained " staff. Myself, associate officials, and staff are subject to your orders or to the " orders of any particular department of the Government which may need our " services. I shall be glad to proceed to Washington for conference if you so desire."

Acknowledgment of the above was received from the President, also from the Secretary of War and the Secretary of the Navy, all of whom expressed their thanks, and their appreciation of the spirit of co-operation displayed by your company. The officers of your company are now in close co-operation with the officers of the various departments of the Government in order to render the best service possible in the event of national emergency.

Recognising the loyal service given by the employees of your company, your directors decided to extend to all employees the benefit of life insurance, and accordingly your company has arranged for policies for $500.00 for all employees who have been in the service of the company for one year and less than five years, and for $1,000.00 for all employees who have been in the service of the company for five years or longer, these amounts being payable to the beneficiaries designated by the employees in the event of death. In the same manner, accident insurance in the sum of $500.00 has been provided for all ship operators who have been in the service of the company for less than one year.

Expenditures and Reserves.

The income from investment of surplus funds, amounting to $98,107.98, decreased $6,824.99 in 1916 in comparison with 1915, due to the fact that $8,961.48 interest was received on stock subscriptions during 1916, while in 1915 $17,922.96 was obtained. This reduction is explained by the fact that the stock previously subscribed for but not issued was, during the year 1916, taken up.

After setting aside all reserves, the net profit for the year amounted to $259,888.80, or an increase of 46·56 per cent. over the profits for the previous year. This amount has been added to the surplus, increasing that account to $801,776.32 at December 31st, 1916, and the Reserve set aside at that date against depreciation amounts to $439,716.63 additional.

Marconi Wireless Telegraph Company of America.

Balance Sheet, December 31st, 1916.

ASSETS.

CURRENT ASSETS :			
Cash :			
At Banks and on Hand	$60,063.34		
Certificates of Deposit	394,500.00		
		$454,563.34	
Accounts Receivable		282,583.38	
Investments at cost (Market Value December 31st, $1,584,258.50)		1,556,441.25	
Inventories at cost		473,143.52	
Total Current Assets and Investments ..			$2,766,731.49
STOCKS IN SUBSIDIARY COMPANIES			48,000.00
FIXED ASSETS :			
High Power Stations		$4,283,454.78	
Coast Stations		415,513.21	
Ship Stations		469,192.79	
Other Real Estate, Buildings and Machinery		126,846.93	
			5,295,007.71
DEFERRED CHARGES			347,001.29
PATENTS, PATENT RIGHTS AND GOODWILL			2,893,889.86
			$11,350,630.35

LIABILITIES AND CAPITAL.

CURRENT LIABILITIES :			
Accounts Payable			109,637.40
CAPITAL STOCK :			
Authorised and Issued—2,000,000 shares of $5 each ..		$10,000,000.00	
Less :			
In Treasury (100 shares)		500.00	
			9,999,500.00
RESERVES :			
For Depreciation of Coast Stations :			
January 1st, 1916	$191,070.55		
Less :			
Amount transferred to Miscellaneous Reserve	9,132.30		
		$181,938.25	
For Depreciation of Ship Stations :			
January 1st, 1916	$75,053.30		
Add :			
Amount set aside from 1916 profits ..	23,459.64		
		98,512.94	
Against Expiration of Patents :			
As at January 1st, 1916	$100,000.00		
Add :			
Amount set aside from 1916 profits ..	50,000.00		
		150,000.00	
Miscellaneous :			
As at January 1st, 1916	$7,291.49		
Add :			
Amount transferred from Coast Stations' Reserves	9,132.30		
Amount set aside from 1916 profits ..	2,692.15		
	$19,115.94		
Less :			
Amount utilised during 1916	9,850.50		
		9,265.44	
			439,716.63
SURPLUS :			
Balance per Certified Accounts, January 1st, 1916	$541,887.52		
Add :			
Net Income for year ended December 31st, 1916, after charging $76,151.79 Reserves		259,888.80	
			801,776.32
			$11,350,630.35

New York, February 27th, 1917. We have examined the Accounts and Records of the Marconi Wireless Telegraph Company of America, and have prepared therefrom the above Balance Sheet and accompanying Summary of Operations for the year 1916, which in our opinion correctly set forth the financial position of the Company at December 31st, 916, and its operations for the year ended that date.

ARTHUR YOUNG & CO.,
Accountants and Auditors.

E. L. W. T. C.

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Questions & Answers

NOTE.—*This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless telegraphy. There are no coupons to fill in and no fees of any kind. At the same time readers would greatly facilitate the work of our experts if they would comply with the following rules.* (1) *Questions should be numbered and written on one side of the paper only, and should not exceed four in number.* (2) *Replies should not be expected in the issue immediately following the receipt of queries, as in the present times of difficulty magazines have to go to press much earlier than formerly.* (3) *Queries should be as clear and concise as possible.* (4) *Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. This will save us needless duplication of answers.* (5) *The Editor cannot undertake to reply to queries by post, even when these are accompanied by a stamped addressed envelope.*

(RADIO), V. H. D., asks how the magnetic detector compares with the crystal.

Answer.—There are a number of crystal detectors which considerably exceed the magnetic detector in sensitiveness, but it yields to none in point of strength and reliability. Properly adjusted it is considerably more sensitive than many experimenters believe, and we have known many cases in which ships using the magnetic detector as a receiver have communicated successfully over a distance of more than 2,000 miles. The great advantage of the magnetic detector is that, once properly adjusted, it needs no attention save an occasional winding of the clockwork. This is an advantage which can only be appreciated by operators who have had to stop in the middle of important work for the purpose of re-adjusting the contact of a crystal detector, which has been broken down by strong atmospherics or nearby interference.

H. W. (H.M.T. ——).—Your question cannot be answered unless you give us further particulars as to the extent of your knowledge and exactly the position you are aiming to fill.

W. G. M. (Llandaff) and a number of other correspondents have written us with regard to obtaining positions in the Marconi Company after the war. Some of the correspondents ask whether their individual cases will be considered on the cessation of hostilities, and others ask whether this or that class of man will be accepted. To all of this we can only reply that it is impossible to foretell what the needs of the Marconi Company will be after the war. We cannot even say whether the present age limit will be altered. There is one rule, however, which is very unlikely to be altered: that every man on joining the Marconi Service must be physically fit. The nature of the duties performed by a wireless operator are such that no man who is not physically fit can possibly carry out the work satisfactorily.

H. G. (Dalston).—The oil in a Mercury Break does not completely quench the spark, although it considerably reduces it. A good quality paraffin lamp oil is frequently used and serves the purpose excellently. The size of the condenser used depends on a number of factors and in one form of very high speed mercury interruptor no condenser whatever is needed.

"A FUTURE OPERATOR" (Tullynessle).—In answer to your first question it is not the practice of the Marconi Company to engage operators under the age you mention. (2) French and Spanish are by far the most useful languages for operators to learn. (3) It is possible for a wireless operator to rise to commissioned rank in the Navy. There is no such thing as "commissioned" rank in the Mercantile Marine. (4) With regard to educational qualifications each case is considered on its own merits.

L. S. (Edinburgh).—Provided the applicant's eyesight is suitably corrected by means of glasses and he is not extremely short sighted he will be able to pass the Marconi Company's Doctor in this respect. (2) Your suggestion that the Marconi Company should have its own Doctor in each large town is scarcely a practicable one, in view of the fact that it is essential that the examining Doctor should be thoroughly acquainted with the Marconi Company's requirements and for other reasons into which we cannot enter here.

R. DE G. E S. (Belem-Para).—We would suggest that you apply to the Omnigraph Manufacturing Company, 39C Cortlandt Street, New York, who will be pleased to give you all particulars regarding their machines.

E. S. (Manchester).—Only an examination by the Company's Doctor would decide the point you mention.

H. T. C. (Ipswich).—We think it best for you to apply to the Naval Recruiting Authorities. They are in a much better position than we are to answer your queries.

J. C. J. (Cardiff).—(1) From time to time vacancies occur for special posts and suitable operators are selected to fill them. (2) In view of the fact that all engineers in the Marconi Company must have served an apprenticeship in engineering or else have passed through a full course at a suitable technical college, not many operators become eligible for a transfer. (3) Once an operator has been engaged his position is permanent—provided he carries out his duties satisfactorily.

R. J. H. (Littlehampton).—If you will peruse our Mathematical Instructional articles recently completed, you will gain an excellent idea of which branches of mathematics are most useful in wireless work. (2) Your second question is not at all clear. Everything depends upon the applicant's abilities. (3) The wireless service of the Navy is controlled by the Admiralty. There are various ranks of wireless telegraphists in the Navy. (4) This again depends upon the man's abilities.

H. A. W. (New Southgate).—As stated on other occasions in these columns, it is not possible to pass the Postmaster General's examination without practical training as well as theoretical study. Why not write to one of the schools offering correspondence courses for full particulars of their postal and finishing courses.

G. H. L. (Navy Yard, New York) experiences a difficulty in calculating capacities of aerials by Professor Howe's method, given on page 685 of THE WIRELESS WORLD, February, 1915, in respect of the potentials due to the images of the wires. Taking the first example, in which the aerial consists of a single horizontal wire 200 feet long with a vertical down lead at the centre 100 feet long, the potential of the horizontal wire due to its own image is equal to that due to a parallel wire of the same length (200 feet) at a distance below the earth equal to the height of wire above the earth. From this the distance between the two equivalent wires is 200 feet. Hence, $l/d=200/200$, and the potential for this ratio is 0·94 from Fig. 20, page 616. The negative sign must be prefixed since the charge induced on the image is opposite in sign to the actual charge on the wire. The potential of the horizontal wire due to the image of the vertical wire will in any case be small, so the following approximation is used as being of sufficient accuracy. Assume the whole charge on the vertical image to be concentrated at its mid-point, say Q (*i.e.*, 50 feet below ground level). The potential of any point on the horizontal wire due to this concentrated charge is given by V=charge/distance, and the average distance of the point Q from all points on the horizontal wire may be taken as the distance from Q to the central point, say R, on either half of the horizontal wire (*i.e.*, the points 50 feet from either end or the junction with the vertical wire). The distance QR is 158 feet, as may be seen by calculation. Hence the potential$=-100/158=0{\cdot}63$, the negative sign being prefixed as before. The potential of the vertical wire due to the horizontal image is found in exactly the same way and must therefore be $-200/158=-1{\cdot}27$. The potential of the vertical wire due to its own image is equal to the charge per unit length (assumed to be unity) as explained on page 681, and therefore is $=-1{\cdot}0$. The second example is worked out in exactly the same way. You will find this subject of capacity of aerials by Professor Howe's method fully dealt with in *The Calculation and Measurement of Inductance and Capacity*, by W. H. Nottage, which has recently been published by "The Wireless Press," the two examples being worked out in detail.

L. W. (Johannesburg).—(1) See our answer to H. A. W. (New Southgate). (2) The Marconi Company does not conduct a postal course in wireless telegraphy. (3) Yes, we can strongly recommend the book you mention.

R. G. A. (Huddersfield).—Write to the Traffic Manager, Marconi International Marine Communication Co., Ltd., Marconi House, W.C.2, for particulars and conditions of employment.

W. H. G. (Leicester).—We have no practical experience with the detector you mention, but we believe the substitution you suggest can be made, although we cannot give you any comparison of sensitiveness with the different metals.

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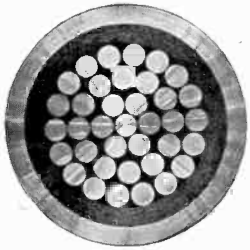

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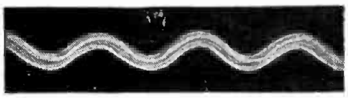

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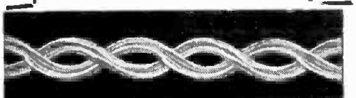

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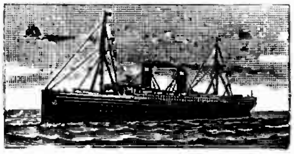

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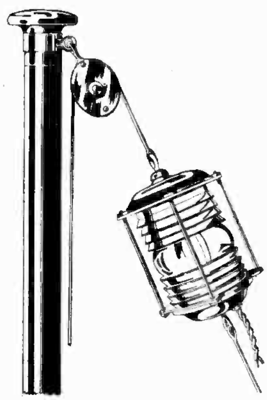

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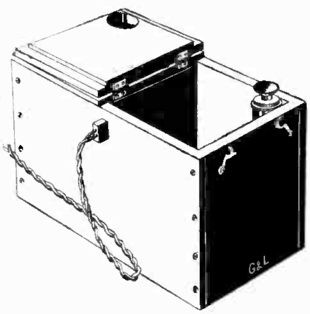

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