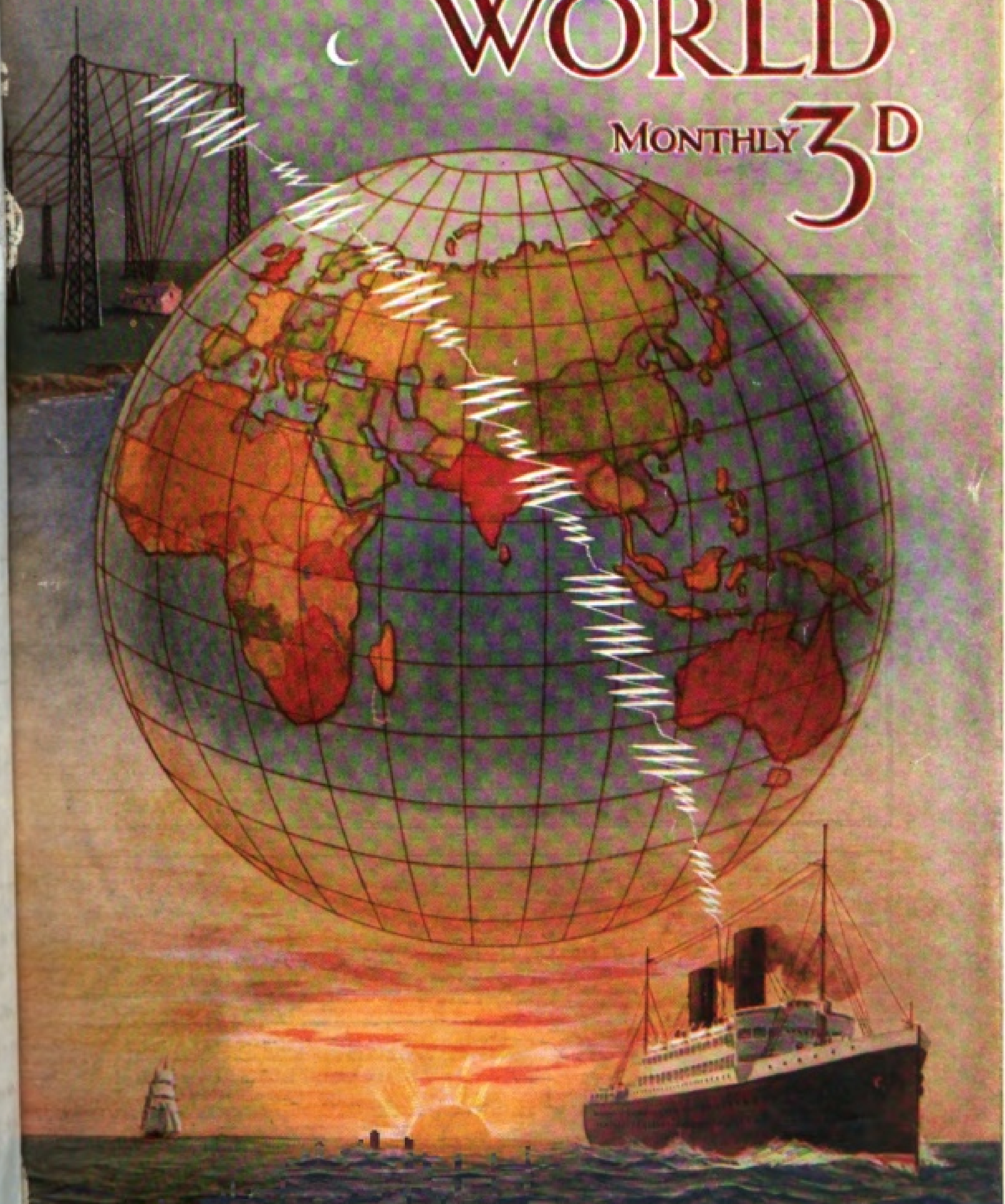
WIRELESS WORLD

MONTHLY 3D



Cubitt Concrete Construction Company

260 GRAY'S INN ROAD, W.C.

SPECIALISTS IN REINFORCED CONCRETE WORK OF EVERY DESCRIPTION

REINFORCED CONCRETE CUPOLA
At Union of London and Smith's Bank, Hull.

WIRELESS TELEGRAPHY

THE BRITISH SCHOOL OF TELEGRAPHY, Ltd.

Telephone: **BRITXTON 215.** **179 CLAPHAM ROAD, LONDON, S.W.**

YOUNG MEN, 18 to 24 years of age, trained for the Wireless Telegraph Service.

¶ The School specialises in the Marconi System. It is fully equipped, having two Stations fitted with 1½ K.W. Standard Marconi Sets (supplied and fitted by the Marconi Wireless Telegraph Company). It is recognised by the Company as a training School for Candidates for their Service.

¶ The most successful School of Wireless Telegraphy in the Kingdom owned and controlled by Telegraph men.

¶ 88 % of our Students obtained the Government Certificate of Competency during the past year.

¶ A knowledge of a foreign language is a recommendation. Day and Evening tuition. Fees moderate and inclusive.

For illustrated prospectus, post free, write **ARTHUR W. WARD, Manager.**

Silk and Cotton Covered H.C. Copper Wire, Resistance Wires, Fuse Wire Binding Wires Charcoal Iron Core Wire, Asbestos Covered Wire.

P. ORMISTON & SONS, 79 CLERKENWELL ROAD LONDON, E.C.

"Ormiston, London" **Established 1793.** *13259 Central.*

Braided and Twisted Wires, Bare Copper Strand & Flexibles of any construction, Wire Ropes & Cords, down to the finest sizes, in Galvanized Steel, Phosphor Bronze etc.

POSTAGE ABROAD 6d. EXTRA.

POST PAID 4/6

MORSE LEARNERS' TELEGRAPH KEY.

Made in Solid Brass, and Mounted on Polished Mahogany Base. British Make. Guaranteed.

EVERY TELEGRAPH LEARNER SHOULD HAVE ONE.

Manufacturer: **E. COULDWELL, 16 Church St., Maryhill, GLASGOW**

The Wireless World.

With which is incorporated "The Marconigraph."

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

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

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

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

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

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

CONTENTS.

JOHNSON & PHILLIPS L^D

CHARLTON, KENT

◆

MAKE A SPECIALITY OF

SWITCHBOARDS

FOR HIGH FREQUENCY FOR WIRELESS TELEGRAPH INSTALLATIONS

◆

TRANSFORMERS
HOT WIRE AMMETERS
FREQUENCY METERS

Silvertown Rubber Tiling

is the

Ideal Floor Covering

For **Ships, Yachts, Public Buildings, Banks, Bathrooms, etc.,** being most durable, artistic, noiseless and pleasant to walk upon, non-absorbent and sanitary.

Illustrated Catalogue on Application.

The INDIA-RUBBER, GUTTA PERCHA & TELEGRAPH WORKS CO., LTD
100-106 Cannon Street, London, E.C.
Works: SILVERTOWN LONDON, E.

OAK FLOORINGS

HARDWOODS FOR HIGH CLASS JOINERY

C. B. N. Snewin & Sons, Ltd.

BACK HILL LONDON, E.C.

DAVIS & TIMMINS,

LIMITED,

KING'S CROSS, LONDON, N.

TRADE DAVIS & TIMMINS LIMITED MARK.

Established 1876.

METAL THREAD SCREWS

Nuts, Bolts, Terminals, &c.

Telephone: Central 11070.
Telegrams: "Conductivity, London."

PHOSPHOR BRONZE

STRIP, RODS, SHEETS, TUBES, ETC.

Large Stocks Kept

T. W. YOUNG, LTD.

84-86 CITY ROAD, LONDON, E.C.

Telegrams: "WUZOG, LONDON."
Telephone: 606 LONDON WALL.

THE WIRELESS WORLD
with which is incorporated
The MARCONIGRAPH

Vol. 1.—No. 2. (NEW SERIES) May, 1913. Subscription 5/0 per annum post free. Price 3d. Post Free 5d.

"The Wireless World" and its Reception.

IN presenting the first number of THE WIRELESS WORLD last month, we do not think we were unduly sanguine in thinking that it would occupy a place in periodical literature which has hitherto been left unfilled. Its reception has justified the opinion that the magazine would meet a distinct need, and the cordial welcome which it has received from all quarters and from the technical and general Press encourages us to look for the rapid achievement of our object to make it "a magazine for everyman." The first number had an issue of fifty thousand copies, but, large as this quantity may appear, it was by no means too large to cope with the demand. An encouraging feature was the numerous "repeat" orders from newsagents and booksellers in all parts of the country. These facts are worth mentioning because they illustrate more strikingly than anything else can the great public interest in the subject of wireless telegraphy, and their eagerness to read about it when the subject is presented in such a manner that it will not be beyond their scope.

Gratifying, however, as is the measure of approval gauged through the circulation figures, that alone would fail to assure us if it were not for the generous letters of appreciation and congratulation that have reached us from readers, some of them old friends through the *Marconigraph*, and many more newly-formed acquaintances, to all of whom we return our best thanks for their kind messages. We welcome their support, not merely as readers, but as critics, correspondents and collaborators in the task which we have undertaken.

We are particularly impressed by the welcome of our scheme for the free instruction in wireless telegraphy of Territorials and of lads connected with the Boy Scouts Association and Church Lads Brigade, etc. This scheme has the approval of Lieut.-General Sir Robert Baden-Powell and Major-General E. C. Bethune, the Director-General of the Territorial Forces, and the inspiring messages which these leaders addressed to the members of their organisations through the WIRELESS WORLD last month has met with a gratifying response. In some centres Boy Scouts have decided to establish "wireless classes," which will be under the control of one or two of their senior colleagues; the basis of instruction at these classes to be the series of articles which commences in the present number.

The "amateur's" interest in wireless telegraphy is now so great that all over the country there are hundreds of young men investigating its mysteries merely as a scientific hobby. This is a spirit which should be encouraged, and we are willing to guide and assist honest investigators in their studies. With this object in view we have opened a "Question and Answer" section in THE WIRELESS WORLD, and we invite amateurs to communicate with us upon points concerning which they desire information.

M. GASTON PÉRIER.

Personalities in the Wireless World

M. GASTON PÉRIER

Managing Director of the Société Anonyme Internationale de Télégraphie sans Fil.

IT may be counted to the advantage of any young industry that there should be associated with it men of great business capacity. But wireless telegraphy has been fortunate in that such men were readily to be found; men who could gauge its capabilities and its importance to mankind. Among these is M. Gaston Périer.

When the new discovery was yet a phenomenon, almost, one might say, a chimaera, M. Périer became interested. Hereafter he followed intently every movement in its rapid development, and so was of the first in the field with practical assistance for establishing it on a working basis.

Born at the Hague in 1875, Gaston Périer was hardly 21 years of age when he obtained an honours degree as Doctor of Laws at the Brussels University. It had always been the intention that he should become a barrister; so now that his college training was over he was articled to Maître Beernaert, and for a long time practised under this eminent statesman, whose recent death is still fresh in our memory. As is the case with most young lawyers, or at least with those determined to make a mark in their profession, he specialised in his subjects, and devoted himself, as much as was in his power, to cases dealing with business transactions. In this way he gained a very real and extensive knowledge of the management of a large house of business and the conditions of commercial life.

So it was that when Colonel Thys asked M. Périer to collaborate with him in the management of a vast array of colonial and financial enterprises, he was able to take up the position of an active and influential business man, and be of immense assistance to his father-in-law. It was in this connection that he became interested in wireless telegraphy, for Colonel Thys is President of La Compagnie de Télégraphie Sans Fil, of Brussels. Then the Marconi International Marine Communication Company, Ltd., the new enterprise, was fortunate enough to obtain his services as secretary. Later, in 1908, he was appointed one of the Directors, combining this with the functions he already exercised; a few weeks ago he was appointed as Managing Director of the new Société Anonyme Internationale de Télégraphie sans Fil. Besides this he is on the Board of Directors of the Deutsche Betriebs Gesellschaft für Drahtlose Telegraphie, m.b.H., of Berlin. Further, as collaborator with Colonel Thys and M. Travailleur, M. Périer has done much for the development of wireless telegraphy in Belgium and other Continental countries.

But other people have been anxious to secure the help of M. Périer's brilliant business capacity. He is a Director, and negotiates the colonial affairs of the Banque d'Outremer, and is a Director of the following companies:—The Compagnie du Katanga, the Oriental Congo Company, The Intertropical Anglo-Belgian Trading Company, The Compagnie du Lomani, The S.A.B. du Haut-Congo, The Société Coloniale Anversoise, The Antwerp Telephone and Electrical Works, The Etablissements Hutchinson de Paris (Rubber and Tyres), the General Sandur Mining Company, Limited, and the Central Africa Railway Company.

In conclusion, let us add that M. Périer has obtained a high place among his compatriots, not only for his quality as a captain of finance and industry, but as a man of probity, intellect and good-fellowship.

EPISODES OF THE MONTH

OUR FRONT COVER. THE DERELICTS COMMITTEE REPORT. HOW WIRELESS HAS MINIMISED THE DANGER FROM DERELICTS. THE VOYAGE OF THE "NEW ZEALAND."

THE jagged white streak across the cover of this magazine will be read by telegraphists at a glance; others, unless they have a friend acquainted with the Morse Code, will wonder what it means. The key is simple; ▬ is a dash, and ▪ is a dot. Hence the streak spells :—

-- .- .-. -.-. --- -. ..

M A R C O N I

But since the message is being sent from the land station (artistically representing Poldhu) to the ship, the letters were actually sent in the reverse order, spelling INOCRAM, which looks like a code word.

* * *

The streak tempts us to some further reflection. The artist has evidently meant to portray the conception of a wireless station at night sending a message to a ship enjoying the beauties of sunshine; the streak just stretches half-way round the globe. Apart from the fact that there is no record of a wireless message having been received at that distance, it would appear at first sight that the length of the message—namely, about 12,400 miles (half the circumference of the earth)—is a stretch of artistic licence. In reality, however, the message is far longer, which we proceed to show. Good operators can send and receive wireless messages at the rate of thirty words a minute, or, in other words, one Morse word in two seconds (an average word being considered to be five letters). Here we have seven letters; the time taken to send this word is, therefore, $\frac{7}{5} \times 2$ or 2·8 seconds. Now, wireless waves travel at the rate of 188,000 miles a second; hence a simple calculation will show that the real length of the streak is 526,400 miles, more than twice the distance to the moon. In the same way it can be shown that each dot is 9,400 miles long, and each dash 28,200 miles long. When it is decided to send a dot the telegraph key is depressed for only the one-twentieth of a second. As a result a series of trains of electro-magnetic waves is produced, the total duration of the series being one-twentieth of a second, and the first train will be 9,400 miles away before the last train leaves the wireless station.

* * *

The problem of the protection of shipping from derelicts, which has recently been considered by a Departmental Committee appointed by the Board of Trade, is one which, while apparently easy of solution, in reality presents considerable practical difficulties. The committee which sat in 1894 held that the danger of collision with derelicts in the open sea was very small, but the number of vessels—and presumably the number of derelicts—has increased since 1894. The present committee reduce this judgment to the statement that "the number of dangerous derelicts on the high seas is not great," and point out that the danger is chiefly confined to the western portion of the North Atlantic, and that most of the derelicts are of American origin. Wireless telegraphy has in the meantime been developed, and has already been installed upon a large number of steamships, and the committee appear to have, from the outset, borne particularly in mind the possibilities of wireless telegraphy and its bearing on the question of disseminating to ship masters and others information as to derelicts sighted and the increased probability of finding derelicts by vessels despatched to remove them. They review in their report the steps which have been taken to minimise the extent of danger caused by derelicts, and here it is obvious that, by an improvement in the system of collecting and distributing, information received by wireless telegraphy can effect an appreciable diminution of the danger.

During the year ended 31st August, 1912, only nine reports of derelicts and wreckage were addressed by masters of ships to the coast stations, and 131 messages were sent from the stations to passing ships warning them of the dangers. The small number of reports addressed to the coast stations is apparently due to the fact that the masters of vessels fitted with wireless apparatus report to a large extent to their owners either direct or *viâ* other vessels. The staff of the coast stations were instructed by the General Post Office in March, 1910, to receive any messages relating to derelicts sent by passing ships, and to signal the information to other ships proceeding on the North and South Atlantic and North Sea routes, as the case may be, for a period of four days after receipt of the information. In the existing practice of reporting and publishing information concerning derelicts a certain amount of overlapping exists. This is a defect which has engaged the attention of the committee, who are of opinion that it might be remedied by means of a conference of the bodies concerned in the collection of news relating to derelicts. It is strongly urged in the report that a central body for the reception and dissemination of information should be established, and that every facility should be given to this body.

* * *

Great importance is attached to the employment of wireless telegraphy in the receipt of information and the issue of warnings to ship masters as well as to the notification to bodies in possession of means of removing or destroying the dangers. Various methods are at present adopted in sending by wireless telegraphy reports which relate to derelicts and floating wreckage in the North Atlantic. One method is for ships sighting the dangers to send reports to other ships by way of warning, and for retransmission to the shore. No charge is made on anyone in connection with the ship to ship messages, which are treated by the Marconi Company as masters' service messages. Reports are also sent from ships addressed to the Post Office Coast Stations, which retransmit them to passing vessels and to the Admiralty, Lloyd's and the Meteorological Office, the only charge arising out of these reports is the Inland telegraph charge for retransmission to Lloyd's. In the case of messages sent from ship *viâ* the coast stations, specifically addressed to Lloyd's or steamship companies, a charge for the use of the coast stations arises, and is borne by the addressees, together with the Inland telegraph charge. Lloyd's have also to pay the ship station charge. Reports are also sent from His Majesty's ships to the Naval wireless stations and the military, or *vice versâ*. The extension of wireless telegraphy on ships of the mercantile marine is an additional means of safeguarding life and property from the danger of floating derelicts which the committee have not failed to realise, and it would be an advantage if the steamers of the general lighthouse authorities and certain outlying lighthouses and lightships could be fitted with wireless telegraphy to warn masters of sunken wreckage in home waters. The co-operation which the committee would like to see between the British Navy and the Mercantile Marine with regard to wireless telegraph communications is not always practicable, owing to the difference maintained between the wave length of the commercial stations and those of the naval stations.

* * *

Messages from Wellington, dated April 12th, reporting the arrival of the battle-cruiser *New Zealand*, announced that "long before she entered the harbour a message of welcome, sent by the Governor of the Dominion, was taken in by her wireless installation." The importance of this achievement is not immediately evident in the message, for it is an ordinary everyday occurrence for communication to pass between a ship and land long before the ship enters harbour. But read in conjunction with other reports of the voyage of this notable vessel, the remarkable work of the wireless telegraph station on board soon becomes apparent. When on her way from South Africa to Australia, the *New Zealand* was able to keep in simultaneous wireless communication between the two continents, enabling Lord Gladstone and Lord Denman, the respective Governors-General of South Africa and Australia, to exchange greetings. For a wireless message to cover the long expanse of water between South Africa and Australia with only one relay is an achievement which opens vast possibilities in overseas communication.

CARTOON OF THE MONTH

Wireless Terms Illustrated

II—Continuous Waves

Gold Coast Cameos

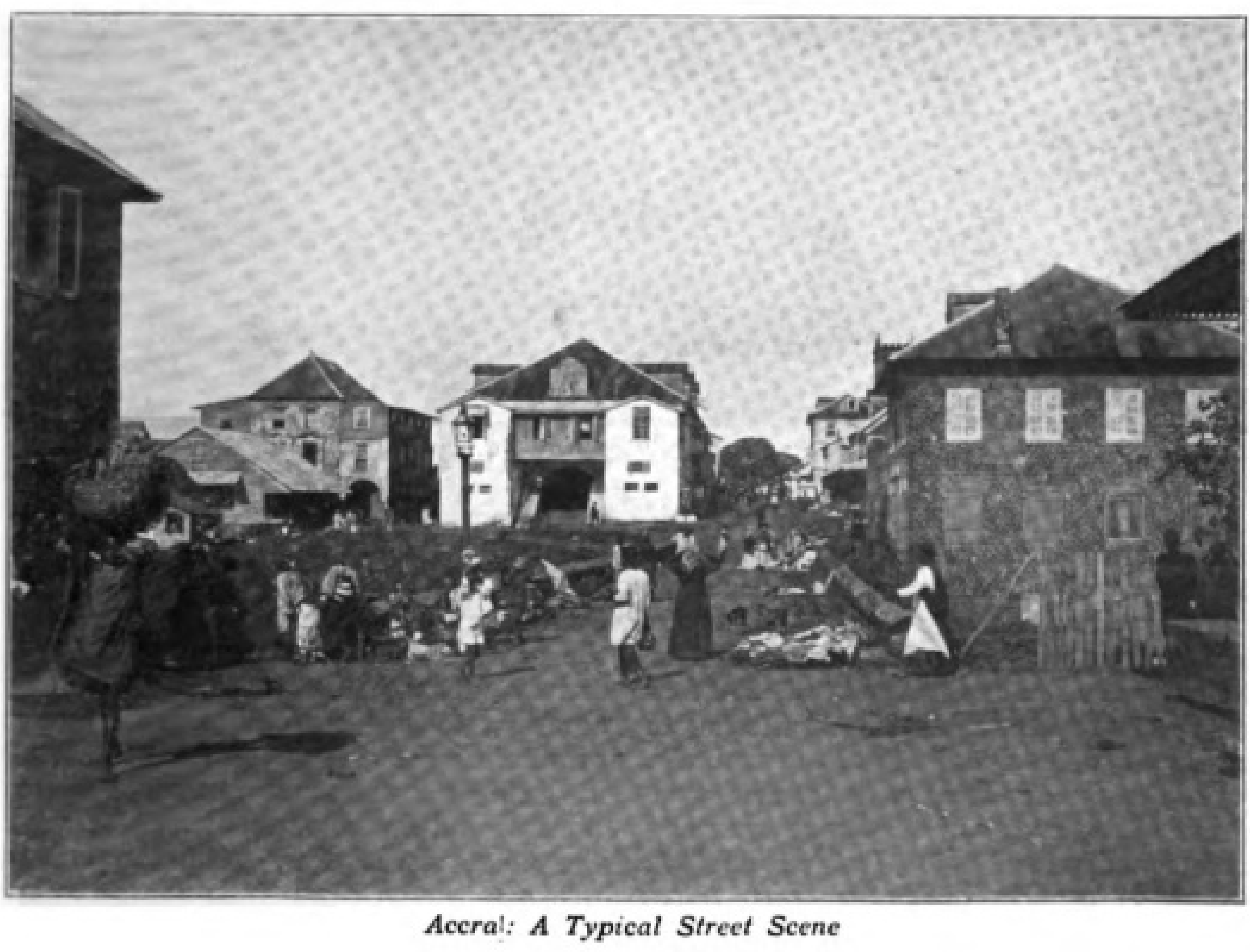
The Wireless Telegraph Station at Accra

Life on the Gold Coast. The Natives and Wireless Telegraphy. Scenes in Accra. The New Station.

PROGRESS on the Gold Coast is like a recurring decimal—it goes on everlastingly, but never quite accomplishes anything. This, at least, is the general impression that strikes the luckless wight whom fortune sends to that quarter of the globe.

The establishment of a wireless station at Accra, however, seems an earnest of better things to come. Though not yet officially open—the first message was one of congratulation exchanged on Christmas Eve between the Governor and Commander-in-Chief, Sir Hugh Clifford, K.C.M.G., aboard the s.s. *Falaba*, and Major Bryan—the prospects for a public service are so promising that the question of opening stations at Sekondi and Coomassie is already under consideration. Successful experiments, in fact, have been conducted between Accra and Coomassie, a distance of 130 miles through dense bush, a portable set with two 70-ft. masts and a valve receiver having proved highly efficient for the purpose.

There is a big field for wireless telegraphy on the Gold Coast; in the service of many industries in course of development it should prove invaluable. In addition to its military uses, the Accra station will prove of uncommon service to shipping. The coast surf is



Accra: A Typical Street Scene

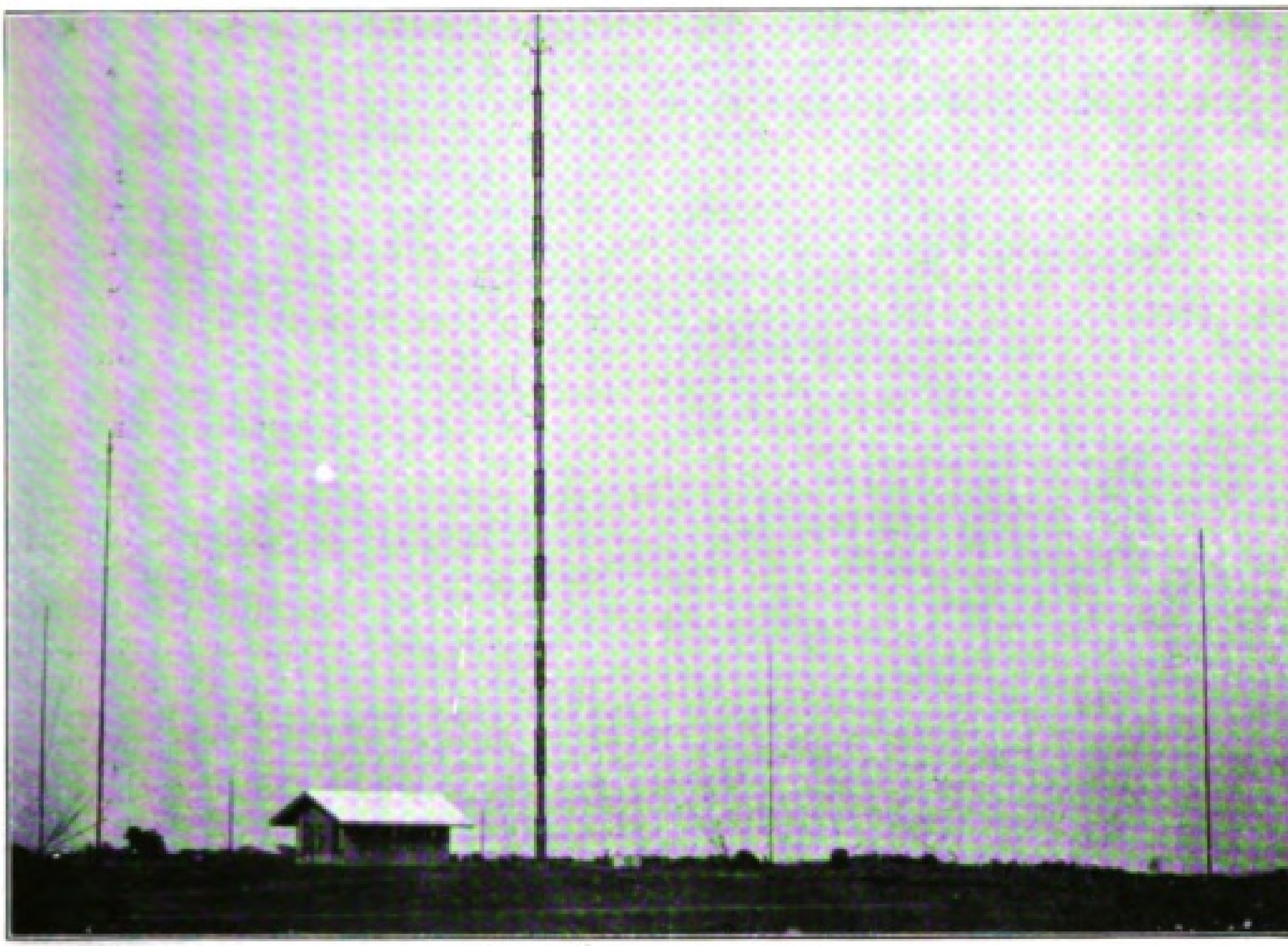
at times so heavy that communication between ship and shore is frequently impossible for lengthy periods, during which business men ashore simply sit and fume to the grave detriment of their health in such an undesirable climate. Occasionally, too, an incoming ship has to report a case of yellow fever on board, and her officers being forbidden to land under the circumstances, communication can only be carried out by wireless.

The Accra Marconi station, which will be worked by the Post Office, will be open daily between 8 a.m. and 4 p.m., and at such other hours as occasion demands. Owing to the plague of white ants, which demolish everything in the nature of wood, timber is used very sparingly in the construction of the station. The mast is of steel, 200 feet in height, and the building itself of concrete bricks. The main aerial is of the umbrella type, the second being a twin wire type aerial. The length of the wave normally transmitted will be 300 metres, but the station is capable of transmitting waves varying in length from 600 to 900 metres.

The equipment consists of a 5-kw. set driven by an oil engine. No special features distinguish the power plant. The prime mover is a 5 h.p. oil engine, to which is direct-coupled a 3-kw. continuous current dynamo, having a pressure regulation suitable for enabling it to be used to charge the accumulator battery of 54 cells. The motor alternator consists of a continuous current motor, designed to run off the accumulator battery and to drive a disc discharger mounted on an extension of its shaft. The transformer is designed to afford a transformation ratio of either 300 to 10,000 or 300 to 5,000 as desired.

A Saturday Evening Shopping Scene at Accra

Some clue to the lack of progress on the Gold Coast is to be found in the attitude of the seasoned old timers towards the new arrivals. One thousand seven hundred only, according to the latest census, is the number of white men out of a population of 1,502,900 in the 80,000 square mile area of the Colony, Ashanti and Protectorate, of which Accra is the chief town. Nor, with the sort of welcome they get, are these numbers likely to increase by leaps and bounds. The



View of the Accra Station

The Station Building

climate on the coast is notoriously "the deuce," though they express it at greater length and with astonishing eloquence out there. There goes a story, probably quite exaggerated, of a gentleman who came out from foggy, yet salubrious, England to stir things up on the coast. He observed on his

Picking Palm Kernels on the Gold Coast

arrival that the flags ashore—exceptionally numerous they were, too, on this occasion—were all at half-mast, and was informed that an official had died. Later a gloomy deputation—the "welcome" committee—came aboard and, standing at a distance to avoid fear of contamination—so they incidentally let fall during their remarks—hinted that not only had the official expired of fever, but that scores of the inhabitants were doing likewise. To this diplomacy they put the credit that the threatened increase of one in the white population never came about. The discreet traveller, like the illustrious Duke of York, of whom it is recorded about his men that he marched them up, and marched them down, and marched them back again, returned whence he had come as speedily as circumstances permitted.

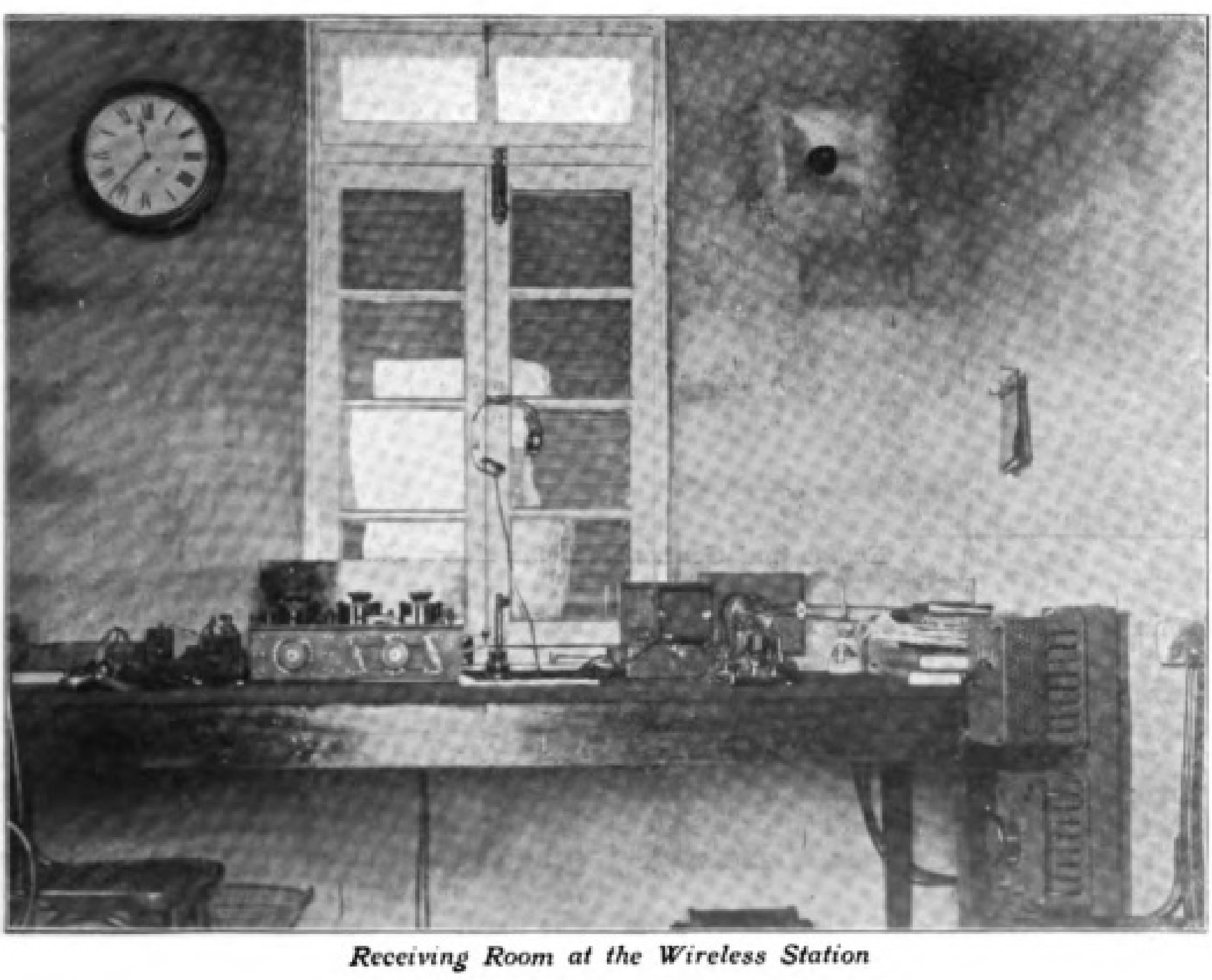
The newcomer is regaled with stories of death and burial in four-foot coffins, in which bodies are doubled up, the actual local economy being rendered necessary from the fact, according to tradition, that the trees on the coast are so short that it is impossible to obtain more than a four-foot length of wood from them. Initiated into Coast life in this depressing fashion, the newcomer feels it incumbent upon him in his letters home to keep up the "agony." So the dog has got rather a worse name than he ought to have.

A more serious barrier to progress in this region is the lack of facilities for transport. There is a Government railway covering the 168 miles between Sekondi and Coomassie, and a line over the 40 miles between Accra and Mangoase is under construction. Some progress is being made in road construction, and there are now about 200 miles kept up for vehicular traffic, and some 1,800 miles maintained as tracks and bridle paths. The work of cutting paths into the bush is slow and difficult. Commonly trees are over 200 feet high; some are over 400 feet high. Of the barrier that faces the roadmaker Miss Mary Kingsley wrote: "In the light of brightest noon the forest-wall stands dark against the dull blue sky; in the depth of the darkest night you can see it stand darker still, against the stars; on moonlight nights and on tornado nights, when you see the forest-wall by the lightning light, it looks as if it had been done over with a coat of tar."

There are in the Colony 1,424 miles of telegraph line and fifty offices, and telephone exchanges at Accra, Cape Coast, Sekondi, Tarquah and Dodowa. But the difficulty of laying line through the bush is immense and militates against its extensive use. There are other disadvantages, too. Alfred Kinnear, the war correspondent, thus described the uncertainty of the field telegraph service during the Ashanti campaign: "Very frequently the line was 'disturbed.' A passing tornado, which in West Africa consist of a hurly-burly of thunder, lightning, and the deluge, promptly created a disturbance in the line of communication. Perhaps a tree would fall and break the cable, and, in any event, the electricians had to count with one permanent foe—the extreme humidity of the atmosphere and ground. To another and more humorous foe they had also to look. This was a muddle-headed superstition of the natives, as well as a love of 'loot' which forms so deep a vein of native life. Whole lengths extending from twenty to forty feet of wire were 'cut,' and the material twisted into bracelets and necklets for the decoration of the dusky village beauties of both sexes. . . This will account for the brevity of the description given of the occupation of Coomassie, as well as the surrender of its King."

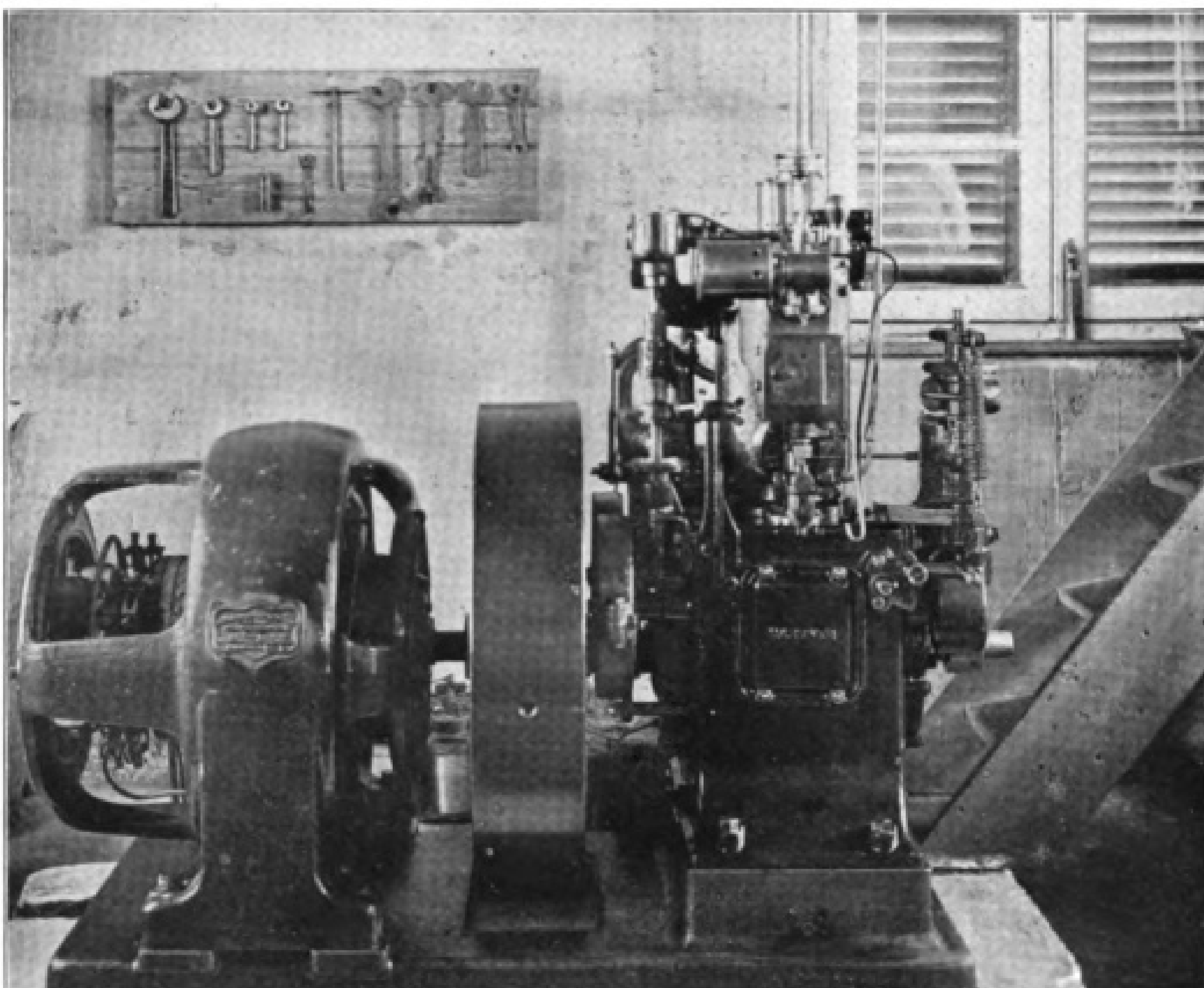
Horses cannot live on the Gold Coast, owing to the ravages of the tsetse fly. There is little wheeled traffic, but the bicycle has become quite fashionable. The general mode of travel is by hammock, and there is nothing more picturesque than the stately progression of a heavy man swaying gently between the bending poles which strain from the shoulders of his team of dusky carriers. Most of the work of transportation—indeed, the bulk of the work of any kind—is done by women, and everything is carried on the head. Send your "boy" for a bottle of whisky—a very popular "food" on the West Coast—and he brings it back on his head; on the road to school the youngster carries his slate on his woolly cranium.

A little digging or some dilatory carpentry is the utmost effort to be got out of the native as a rule. He loves the lazy life, and, living in a hut little better than a shed, contrives to earn about 1s. 6d. a day and live at the rate of 5s. to 6s. a month. Gin and his wives are his chief diversions. Gin is plentiful, and wives are to be had from £5 upwards, according to the age, position and state of



Receiving Room at the Wireless Station the black girl to be taken in wedlock. The Fantee of the Coast is excruciatingly funny as a dude; he is somewhat of a quick-change artist, too. He comes to work in European clothes, a pith helmet, and an umbrella to keep off the sun; on quitting work he dons a loin cloth and a broad smile. He is an expert at theft, and has a distinct partiality for bicycles, lead and clothes. He is, moreover, a master of terminological inexactitude. Lying is as ingrained in him as thirst. Reminiscent of the French-while-you-wait books of our youth, he will excuse a day's absence from work (and there are many, for he is a work-shy individual) on the plea that his "mother's sister's aunt died," or is dying; and when reproached for making use of his distant relations in this fashion, will solemnly assure you: "*Me no li, massa.*"

So frequently does the native stray from the paths of rectitude that a very sharp eye has to be kept on him. The law is administered by District Commissioners, who are Europeans, and they, in the absence of other responsible Government officials, assume various administrative duties. The District Commissioners preside over courts which deal with petty offences, but in the courts the judge is assisted by a jury of natives. The native witness will lie with the facial innocence of a Reynolds cherub, but his toes betray him. They are constantly on the move as he lies stalwartly, and judge and counsel watch not his eyes but his toes. The witness box is built to facilitate this, for "so prominent a part do the toes play in the search after truth," says one writer, "that the witness-box, from the feet to the knees of its occupant, is constructed open," and adds that as a preliminary to an orgy of lying he takes the oath by heating two pieces of iron together, remarking: "If I tell a lie, I go



Engine and Generator at the Accra Station in bush, and snake bite me, I die. I tell lie, go in canoe, and I die. I tell lie, what I eat poison, I die." But in spite of it all he, like the light that lies in woman's eyes, lies, and lies, and lies.

The native rather enjoys a period of prison —it is so restful. That prison has no terrors may be guessed from the story of a warder who became inebriated while in charge of two prisoners. He managed to get them to the gaol, when he discovered that he had left his gun behind him. One of the prisoners promptly guarded the warder, and the other, doubtless with some little glee (for the native is not allowed a gun, and a white man is liable for a £20 fine if he sells him one), went back for the weapon. On returning, the trio found to their dismay that the gaol was locked. Obligingly the native climbed over the wall—and was later summoned for breaking into prison! He took his punishment in the light of a summer holiday.

Portable Receiving Set at Coomassie

In the centre is Mr. Geary, Chief Engineer of the Gold Coast Telegraphs, with Mr. J. Robertson, Telegraph Instructor, on the right, and Mr. C. James, the Marconi Engineer in Charge, on the left. The natives were engaged on mast work.

The native boy rather fancies himself as a vocalist, a "gift" that has been "developed" under the tuition of the missionaries. The European bears with him patiently as a rule, but it was rather too much when a young "blood" who had been engaged in the wireless station on the erection of the masts celebrated their completion by climbing aloft and bellowing hymns, interspersed with variations of "God Save the King." "Patriotic, but irritating," was the only balm to his soul after the violent reception with which he met when he set foot on the ground again. The native, as a rule, has more respect for the wireless, believing that by some witchcraft the wind brings the message until the wires catch it.

Snakes, scorpions, hyænas, mosquitoes, flying cockroaches and sandflies complete the happy family amongst which the Europeans live, and of whose presence they are constantly and unpleasantly reminded.

Thursdays bring a variation in an uncommonly dull daily menu, for the incoming steamer brings "chop" in the form of refrigerated butter and other delicacies; palm oil "chop" which is a special dish reserved exclusively for Sundays. The *Gold Coast Leader*, a sheet due wholly to native enterprise, provides the colony with breakfast-table topics day by day. Beyond that there is little to encourage one to live.

The last bolts on the Accra mast were fixed by the Postmaster-General, Mr. Somerville, Mr. Crewe, Mr. Rolkstein, Mr. Micklewright and operator Miles.

The following letter, dated February 10th, was sent by Mr. J. Somerville, the Postmaster-General of Accra, to Mr. C. James, the engineer in charge of the construction of the station:

> I have the honour to inform you that the wireless station at Accra erected by you has been inspected and passed as in every way satisfactory.
>
> (2) I have to congratulate you on the efficient way the work has been done and especially on the way you have overcome the numerous difficulties that are incidental to carrying out work in this country.
>
> (3) I regret the delays that have occasioned your staying in the country much longer than was originally expected. I should perhaps mention that these delays arose from circumstances over which you had no control.
>
> (4) I offer you especially my congratulations on having erected the mast with unskilled native labour without any accident.

A Visit to Macedonia

During the Balkan War

By B. St. J. S.

The Author has recently returned from a tour through Servia and parts of Macedonia in Servian occupation. He describes his experiences and impressions.

A COUNTRY in a state of war presents features of absorbing interest to the visitor, and Servia is no exception. Having just returned from a trip in Servia, and parts of Macedonia in Servian occupation, perhaps I may be permitted to record some casual impressions of the country, and of the attitude of a people at this supreme crisis of their destiny. It is certainly appropriate to do so in THE WIRELESS WORLD, because one of the things that interested me most was wireless telegraphy. I had heard a good deal about portable wireless telegraph apparatus for military purposes, but I had never seen this marvellous invention as it is used during war time until I encountered a Marconi station at Nisch.

This history and character of the people of Servia are epitomised in Belgrade, the seat of the Government, which would be impressive even to the casual visitor in times of peace. This city affords an arresting contrast to the great European capitals. It does not offer the pleasures, the refinements, the luxuries of the latter; it gives us no picture of great sections of the community passing their days in idle amusements. The buildings may be crude, yet no man who had eyes to see and ears to hear could doubt that he was in a city of real men. Belgrade impresses the visitor as a city of simple, hardy, strong people, building up a national life amid incredibly difficult conditions, and working out their destiny with patience and courage hardly ever excelled.

Here the existence of a state of war is evident only in the national spirit and the return of the wounded; it is on the journey from Philippopolis onwards to Adrianople that the havoc of war is most notable. The railway route from Nisch till Philippopolis is reached is comparatively devoid of incident. On the other hand, the journey from Nisch towards Kumanova and Uskub, which form the centre of the second zone of Servian operations, is full of dramatic interest. Even Nisch, old frontier town in Northern Albania, is a seething camp full of wounded being taken back to Belgrade, while the very air is pungent with the odour of iodoform. Ox wagons for transporting provisions come pouring in from the country side, some laden with wheat and maize, others with oats, rye, and tobacco. Sometimes great vats of wine (a peculiar brand, made from a species of prune grown in large quantities round about) and wagons filled with barrels of brandy rumble heavily along, while occasional herds of swine and goats are driven in from the country side to replenish the commissariat. Fat goats and pigs they are, too, for beech forests abound in Servia, and throughout the Balkans generally, and the fallen beech nuts give a rich pasturage to the livestock who are allowed to roam at will and nose out the fallen fruit.

But travelling is awful—worse now than at the beginning of the war, and then it was bad enough. A journey, which in the ordinary course of events would have taken twelve hours cannot be timed to finish under, possibly, two days—perhaps three. The country side is entirely deserted, and practically the only signs of human occupation is to be found in the sentries who, at regular intervals, guard the entire railway route.

The whole region is chiefly given up to

agriculture, except in the more mountainous districts, and even here the low slopes of the hills are prepared for cultivation, usually for vines. But now everything is in a state of chaos; the fields are neglected for want of overseers, and the women, who act as labourers, have not the heart to continue their work. As a matter of fact, numbers of them were at the time I visited the country with their husbands at the front, and to a large extent the transport work and the commissariat were in their hands.

Owing to the augmented traffic, and the passing and repassing of innumerable and heavy vehicles, the roads, which are generally constructed of beaten clay, instead of being properly metalled with stone, have been pounded into mud, often knee-deep in places.

At the commencement of war everything was dried up and parched by the summer heat, and the present quagmire was then nothing but a maelstrom of dust. It covered everything; it got in the eyes of the traveller and made them smart and tingle, while it burnt the throat and parched the lips and mouth; nor could the torment be assuaged by drinking, for water, and in fact every beverage, was practically unprocurable.

But the fertility of Albanian soil is remarkable; wherever the surface of the ground has been scratched with the primitive instruments in use amongst these primitive people it yields abundantly crops of wheat, maize, and tobacco. It is a pity that more up-to-date methods of cultivation cannot be introduced. Attempts have been made in this direction by foreigners, but the people seem to be unable to appreciate these advantages, and the only incident of the employment of modern methods that came to my notice was the discovery of an up-to-date threshing machine in the courtyard of a Pasha's house, which had been recently evacuated. The chances are this man was

A 1·5-k.w. Marconi Cart Station at Nisch in communication with a station of smaller type at Uskub—160 kilometres an Albanian—possibly an emigrant from the south—for the southern Albanians are an extraordinarily clever race.

But the Balkans as a people, and amongst these must be included the Montenegrins

1·5-k.w. Station at Uskub with Surgeons of the British Red Cross Contingent

and Servians, are not an economical lot; they only pay sufficient attention to agriculture to secure a sufficiency for their immediate needs, with the result that only about three-fourths of the land is cultivated. This is due, not so much to their indolence, as to their restlessness. They have this characteristic with the Montenegrins; all the vices and virtues of a border tribe, they are hardy, courageous, and, in a clumsy way, strategists.

There is nothing about the Serb to suggest military efficiency. For the most part these improvised soldiers are clad in rough and ready-made uniforms. Some are provided with military boots, but many wear only native-made mocassins, and all have their trousers tucked inside their socks.

But the war has brought out all the finest qualities of the race. They have stuck to it in spite of vast and overwhelming difficulties, which would have struck terror into a less hardened race. Their food supply has scarcely been sufficient to replenish the exhausted energy caused by the fatigues of war. Under favourable conditions each man gets a kilo loaf of bread, but such bread is of a very low quality—nothing more than a mixture of flour and rye. This is augmented by eight grammes of meat, and, what is perhaps of still greater advantage, soup can generally be obtained from the canteen. This is most necessary, for some hot nourishment does more than anything to increase vitality, and so counteract the cold, which is very severe, especially at night, because it is often accompanied with heavy rainfall, and consequent humidity.

At Vrania the country becomes more mountainous, and continues so until Uskub is reached. This, no doubt, accounts for some of the Servian successes, as the difficult nature of the country, affording greater scope for guerilla warfare, equalises the chances of invader and defender, and makes the outcome of success less dependent on generalship. Such a statement must not be taken too literally, for clever handling of troops and strategic manœuvring have played a most important part in bringing out the present results, but it must not be forgotten that a great part of the Servian army is composed of raw recruits, and these, though honest and obedient, and with a certain aptitude for the game, are at the best only a poor substitute for trained material. When to this is added the fact that Vrania and Uskub and Kumanovo are all of them strongly fortified and garrisoned positions, the victories of the Servians in this campaign must be looked upon as little short of marvellous.

Perhaps the secret of their success is the fact that the war appeals to the populace in

Servian National Dance

two ways; it is to them not only a war of national aggrandisement, but also a religious crusade, in fact there is little doubt that it is this secondary view of the case which appeals most strongly to the lower classes.

They are not as a whole a religious people, but they are intensely conservative and impressionable, with a tendency to superstition. Furthermore, the history of their church is wrapped up with the history of their nation. When the past history of Servia and the national pride of the Servians is remembered, it is easy to understand the rejoicing that took place when Uskub was captured.

This little town is all the world to Servia. For centuries it was the capital of her Tsars, guard over the city. The craggy heights come out sharp against the sky line, while their base is hidden by thick woods of beech and fir. I know not what condition prevails now, but a few weeks ago the heights were covered with snow, and the effect was awe-inspiring beyond words. Through the valley runs the Roman aqueduct, which remains from the days when Scuppi was a town of some importance and considered worthy of the patronage of Justinian. This is what Servia has regained for herself. Uskub is of

A scene in the Native Market, Uskub. A Bulgar Peasant girl in gala costume is selling native pottery

and it was a sad day for the little Balkan nation when, in the fourteenth century, the Turks, after the capture of Constantinople in 1345, overran the whole of the Balkan Peninsula, occupying town after town till Servia's capital was forced to acknowledge Turkish rule. Uskub is situated on the left bank of the River Varda, at the foot of a wide valley dividing the ranges of Shar Planina and Karadagh, and its position is most picturesque. As one looks out from the old citadel, the surrounding hills seem to close her in like Nature's bulwarks keeping great strategical importance, for here is the junction of the railways between Nisch and Mitrovitza and Salonika. The command of a railway is always a matter of supreme importance in modern warfare, for, as Lord Kitchener, who has probably more experience of railway warfare than any soldier living, has laid down as axiomatic, "there is nothing more difficult permanently to destroy than a railway." Of course this has not been accomplished solely by the efforts of raw recruits or an enthusiastic peasantry. These have only been made use of by the

Servian army to accomplish their purpose, and it goes without saying that the Servian standing army is composed of very different material. It is highly trained and efficiently equipped, and stands next to Bulgaria in this respect. For instance, its artillery is estimated to consist of 228 quick-firing field guns and 36 quick-firing mountain guns, besides a fair stock of older weapons, which are held as a reserve.

But I was told that Servia, when preparing for war, included among her purchases four Marconi wireless stations. Before the purchase was completed trials were made of the apparatus at Belgrade. The stations were all of the latest portable wagon type, and were scheduled to have a range of 150 kilometres over normally flat country, although I was informed that during the campaign they often established communication over a distance of more than 160 kilometres, and on one occasion there was a mountain range of between 1,400 and 1,800 metres between. The preliminary tests were made as severe as possible, and included a trial run of 100 kilometres over a truly eastern type of road —that is to say, no road at all, but a series of ruts and ditches, with here and there a boulder to negotiate. This was in order to ascertain the durability of the wagons, and the security of the wireless apparatus inside. The results, however, were entirely successful. The interest taken in these trials was truly remarkable, and it was necessary to post sentries round the apparatus to keep the curious country folk at a distance.

The stations were taken into immediate use, and the Servian soldiery showed a very intelligent comprehension of the methods of erection and the working of them. So much so, that within a week of their arrival the corps who had charge of them were able to erect and dismantle them without the slightest difficulty. This speaks volumes for the simplicity and quality of the apparatus.

There is one particularly interesting novelty of the new stations. This is an ingenious arrangement which enables the operator to send on three different waves without stopping to make any adjustments, the whole transmitting apparatus being automatically adjusted to a different wave by the movement of a switch. A receiver connected to another three-way switch, enables the man at the other end to read the message quite as easily.

A simple analogy would show this clearly. Suppose a man could only read a message from a white lamp, whilst another could read white, red and green lamps in indiscriminate order, the man capable of reading all the coloured lamps would get the message, whilst the other man would only get disjointed words, utterly meaningless. The importance of such an arrangement, where secrecy is required, is very obvious.

It was by means of wireless telegraphy that the foundation of an autonomous Albania was announced to the world, when on November 12th, 1912, the flag of a new nation—the black spread eagle on a red ground—was hoisted over the Government buildings at Durazzo. But perhaps to the general public its most important use was its service to the war correspondents. Much of the news that would have otherwise been censored—and the censorship has been rigorous to the last degree—was passed through to various papers by a roundabout route of wireless telegraphy, chiefly by means of ship stations. Such was the means employed by the well-known war correspondent, Mr. Donohoe, who telegraphed important despatches to the *Daily Chronicle* through the steamship *Dacia*, and the *Daily News* correspondent, who made use of the *Principesa Maria* for the same purpose.

But now the war seems to be almost over. There is a general feeling that things have gone far enough, and all the belligerents are tired out. How matters will finally be settled, it is difficult to predict. However this may be, one thing the writer does know, and that only too well, the correspondents and hangers-on in the campaign are wearied out. The game is played out, and peace alone can alleviate the wide-spread havoc and misery which are the wages of war.

COST OF MARCONI COMMITTEE.—Mr. Robertson (Parliamentary Secretary to the Board of Trade) in reply to Sir J. D. Rees, stated in the House of Commons at the beginning of April that he understood that the cost to date of the Select Committee on the Marconi Contract chargeable to the House of Commons Vote was approximately £970, and to the Stationery Office Vote £1,100.

Adrianople and the First Wireless Siege

THE Siege of Adrianople will go down in history not only as a fine example of gallant defence by Turkish soldiers against the attacking armies, but it will secure a special niche because there, for the first time in warfare, wireless telegraphy played a notable part in aiding the brave defenders of the besieged city.

We are not yet able to give our readers the whole story of an event to which belongs the unique distinction of signalising the "first wireless siege," but we know sufficient of the experiences of the garrison to warrant the belief that the story, when it is told, will be one of absorbing interest.

It is impossible not to contrast this siege with others of which one reads in military history, or which are within recollection of persons who are with us to-day. Such a contrast emphasises the advantage which Adrianople enjoyed when compared, say, with Paris, during the last siege of which the city was only able to maintain communication with the external world by means of balloons and carrier pigeons. Sixty-four balloons ascended from Paris during the siege of 1870–1871. Two of these were blown out to sea and were never heard of again; several on their descent were taken by the Prussians, and a good many were fired at while in the air.

Adrianople was not dependent upon this unreliable means of communication, however, for, through the medium of a Marconi station,

A View of Adrianople

the Government at Constantinople was kept in touch with all that passed in and around the city. Than Shukri Pasha, who with his gallant Turks kept his flag flying over Adrianople during one hundred and fifty-three stubborn days, no man knows better the value of, and the consolation afforded by, a wireless equipment.

With the portable wireless station, the only one with which Adrianople was equipped, Shukri Pasha had means of daily communication with the capital. Situated on the hill by the clock-tower, a prominent point in the besieged city, the little station did its work well, and encouraged the commander in a wonderful defence that first aroused the astonishment and then won the admiration of the whole world. Constantinople was kept constantly informed by wireless of Adrianople's losses during the bombardment, and it was with a pang of regret that, on the final assault, when the daily allowance of bread in the city was estricted to less than four ounces per head, made of millet, with a little barley and an admixture of cinders, one read the Lion of Adrianople's last message determining, ere he surrendered himself and his army, to blow up the wireless telegraph station.

The Institution of Electrical Engineers will hold a summer meeting in Paris commencing on May 20th. Among those who have promised papers is Commandant Ferrié, whose subject will be wireless telegraphy.

At the regular monthly meeting of the Institute of Radio Engineers, New York, held on March 5th, Dr. L. W. Austin, of the National Bureau of Standards, Washington, in a paper described some experimental experiences of his recent work on "The Variation with Frequency of Condenser Resistances." The Institute of Radio Engineers, which was formed by the consolidation of the Society of Wireless Engineers and the Wireless Institute, is now well on in its second year. The membership is still growing rapidly, and meetings are held on the first Wednesday of each month at the Colombia University.

PRIZE STORY COMPETITION FOR NAVAL WIRELESS TELEGRAPHISTS.

Two essentials that are required to tell a good story are picturesque descriptive powers and vivid imagination. Those who are familiar with many of the naval "yarns" that are current need not be reminded that the officers and men of His Majesty's Navy are not devoid of these gifts. With a view of encouraging naval wireless telegraphists to display their talent in this respect, and to give their colleagues in the naval maritime services the benefit of their experiences, but not of a technical nature, we have decided to offer a prize of £3 3s. (three guineas) for a story entitled:

"THE LIFE OF A NAVAL WIRELESS TELEGRAPHIST."

This story should deal with the conditions f service and relate any interesting episodes; it should be about 2,000 words in length, and should be accompanied by suitable photographs.

The manuscript should contain the name and address of the author, but a *nom-de-plume* may be used for publication. The story which obtains the prize will be published in THE WIRELESS WORLD. Manuscripts and photographs should be in the hands of the Editor, THE WIRELESS WORLD, Marconi House, Strand, London, W.C., not later than June 7th.

The Share Market

London, *April 23rd.*

Business has been restrained during the past month by the delay in bringing about a cessation of the hostilities in the Balkans. The prices of the various Marconi issues to-day are: Ordinary, $4\frac{3}{16}$; Preference, $3\frac{9}{16}$; Canadian, 15s. 6d; Spanish, $\frac{18}{16}$; American, $1\frac{1}{2}$.

Efficiencies in Wireless Telegraphy

By W. H. ECCLES, D.Sc., M.I.E.E.

Below is the first portion of an article in which efficiency coefficients are sketched and defined. It is pointed out that the transformations that are undergone by the energy supplied to the transmitting plant by the time that it is converted into vibration of the operator's ear-drum are so numerous that in order to estimate the efficiency of the signalling process as a whole the transformations have to be followed out in each system separately.

THE efficiency, electrical or mechanical, of any machine or process is usually defined as the ratio of power utilised to power expended. This mode of reckoning efficiencies has to be abandoned when, as in the study of the processes of wireless telegraphy, there is enormous and unavoidable contrast between the great power used at a sending station to make a signal and the minute power that reaches the ear of the receiving operator. Moreover, the transformations that are undergone by the energy supplied to the transmitting plant by the time that it is, in part, converted into vibration of the operator's ear-drum are so numerous and so different in the different systems of radio-telegraphy that in order to get an estimate of the efficiency of the signalling process as a whole the various steps of the transformations have to be followed out in each system separately.

ESTIMATING EFFICIENCIES.

Thus, in order to study the question scientifically, we are compelled to estimate the efficiency, and to introduce the efficiency-coefficient, at each step of the transformation. In a spark set, for instance, if we start with the power to the transformer, we have then to trace out in order the power to the spark-circuit, the power to the antenna, the power to the waves, the power to the receiving antenna, the power to the detector, the power to the telephones, and the power to the ear, and finally we arrive with a plethora of "efficiencies."

We will proceed to trace the power through these steps. For all systems a convenient starting point is that where the essentially "telegraph" part of the plant joins up to the machine or the mains that supply the station. Different systems of radio-telegraphy require different supply currents—a Poulsen arc requires direct current at, say, 600 volts; a spark plant requires alternating current at perhaps 200 volts, with a frequency of 50; and, whether the power can be bought from outside the station, or has to be generated by steam in the station buildings, we must take a point just behind the metering-point in the first case as the beginning of the plant essential to the particular system under consideration. As the processes the energy passes through are so different in different systems, we will first take, for the sake of definiteness, a typical small spark station, and we will outline the stages through which the energy passes in its journey from the mains to the receiving operator's ear.

IN A SPARK STATION.

In a spark station the alternating current supplied is raised to the voltage required for sparking by means of a commercial transformer. The high-pressure current in each half-cycle charges the bank of condensers up to the sparking P.D., thereby storing energy in their dielectric in the electrostatic form—*i.e.*, the magnetic energy in the iron of the transformer becomes electric energy in the glass of the condensers. The spark-gap at last breaks down, and the condensers discharge through it with oscillation. In the charging process there are losses in the windings and in the iron of the transformer, and in the oscillating stage there are losses in the resistance of the conductors, in the glass of the condensers, and in the spark-gap. The first two can be reduced to insignificance, but the energy lost as heat, etc., in the spark is inevitably a large proportion of the whole energy of the train of oscillations.

Passing on, the oscillations in the primary are found to induce similar currents in the secondary (*i.e.*, the aerial) circuit to an extent which is dependent on the coupling between the two circuits. In any case, if the spark is kept going steadily, power is drawn steadily from the supply, passed on to the antenna, and disposed of by the latter. We may define the EFFICIENCY OF GENERATION OF ANTENNA OSCILLATIONS as the ratio

$$\frac{\text{Power delivered to antenna}}{\text{Power supplied to transformer}}$$

Now the question arises, How does the antenna dispose of the energy delivered to it? It disposes of it in three ways: in the first place usefully in making electric waves which travel outwards from the antenna; secondly, wastefully, in generating currents in the earth around the antenna; and thirdly, also wastefully, in producing joulean heat in its own substance. The quantity of the energy disposed of in these three ways may be taken as proportional to the square of the amount of current; and by the definition of the term "radiation resistance," we may say that the proportion of energy used in wave-making (which is the true function of the antenna) to that spent in joulean waste is equal to the ratio of the radiation resistance to the ohmic resistance; and thus, we may define the RADIATION EFFICIENCY OF ANTENNA as the ratio:

$$\frac{\text{Radiation resistance}}{\text{Total resistance of antenna}}$$

The useful energy is now carried away from the antenna in the form of electromagnetic waves. If the energy despatched from the antenna in a definite small period of time be considered, it is easily seen to become distributed over a space which increases with the distance from the antenna. Besides this dispersion, it may, as it goes, suffer absorption in the air, and in the surface of the land and sea; and finally, the portion of it which arrives within the absorbing range of the receiving aerial is absorbed and produces oscillations in that aerial.

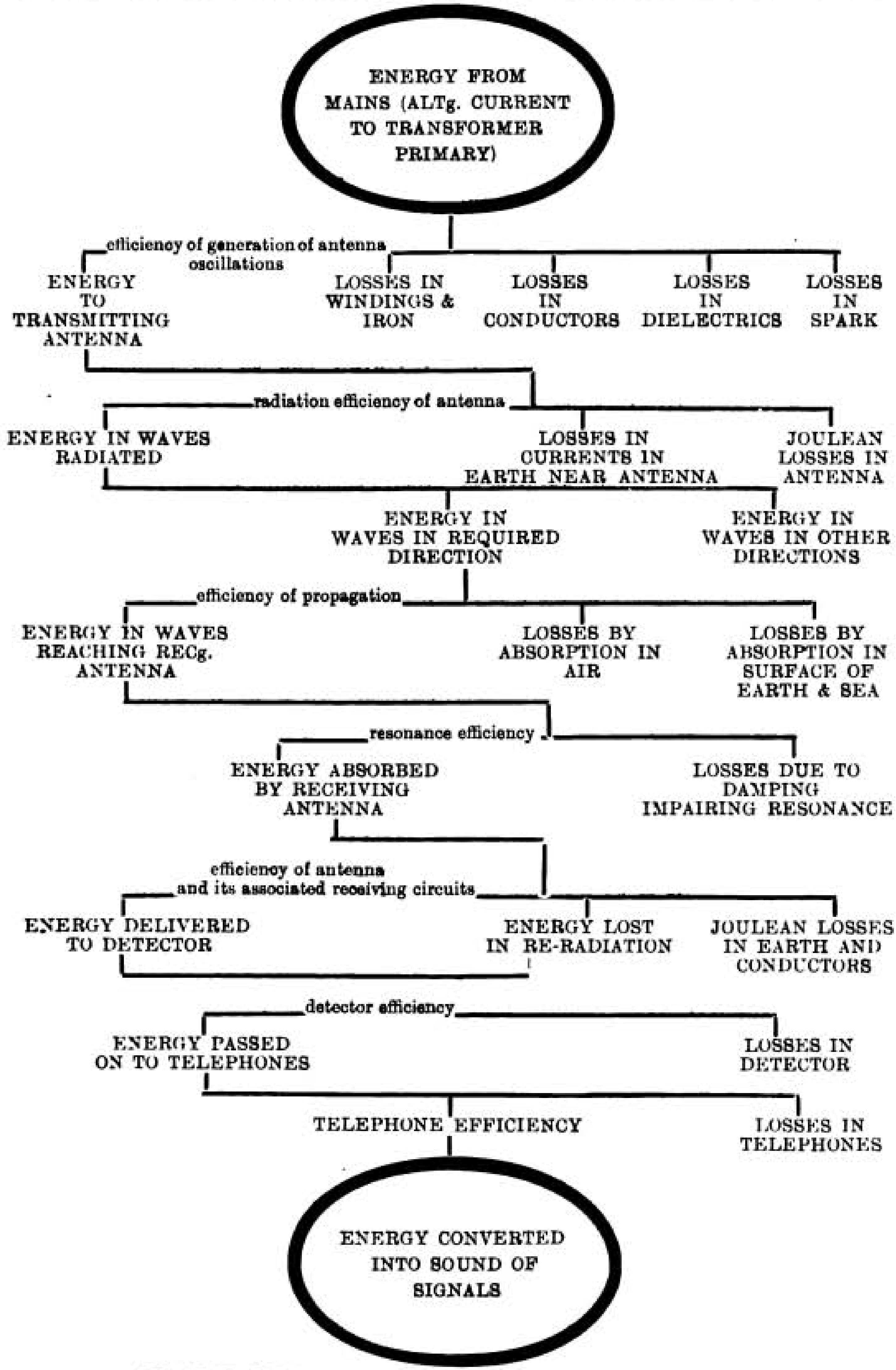
Of course, only a very small fraction of the energy dispatched from the transmitting antenna reaches the receiving antenna; and if we were to reckon the efficiency of transmission by estimating that fraction, we should arrive at a figure of the order of 10-14. This would be an absurd way of reckoning the efficiency of transmission. It is therefore better to adopt some such definition as: THE EFFICIENCY OF PROPAGATION in any particular case is the ratio:

$$\frac{\text{Actual mean energy density near receiving antenna}}{\text{Mean energy density in the same region if absorption did not occur between the stations}}$$

The receiving aerial has oscillations excited in it by the waves, and this is equivalent to an absorption of energy from the waves. If the receiving apparatus has the same natural period of vibration as the incoming waves (*i.e.*, shortly, if it is "in tune" with the waves) the energy absorbed will be greater than if it were "out of tune" with them. This leads to the conception of an "efficiency of resonance." But supposing the receiving antenna to be in perfect tune with the waves, we have to remember also that the resonance-effects are more exalted with undamped waves than with damped waves. Thus, in order to define the resonance efficiency of a given antenna for a given kind of damped wave, it is best for us to imagine the sending antenna caused to emit first the given damped waves and afterwards waves of pure sine-form, *with equal powers*; and then to suppose for the sake of argument that the efficiency of propagation is unity, and define the RESONANCE EFFICIENCY as the ratio:

$$\frac{\text{Energy absorbed from the damped waves during a large number of trains}}{\text{Energy absorbed from the pure sine-waves in the same time}}$$

It is especially important here to keep in mind the proviso that the pure sine-waves


ENERGY FROM MAINS (ALTg. CURRENT TO TRANSFORMER PRIMARY)
efficiency of generation of antenna oscillations
ENERGY TO TRANSMITTING ANTENNA
LOSSES IN WINDINGS & IRON
LOSSES IN CONDUCTORS
LOSSES IN DIELECTRICS
LOSSES IN SPARK
radiation efficiency of antenna
ENERGY IN WAVES RADIATED
LOSSES IN CURRENTS IN EARTH NEAR ANTENNA
JOULEAN LOSSES IN ANTENNA
ENERGY IN WAVES IN REQUIRED DIRECTION
ENERGY IN WAVES IN OTHER DIRECTIONS
efficiency of propagation
ENERGY IN WAVES REACHING RECg. ANTENNA
LOSSES BY ABSORPTION IN AIR
LOSSES BY ABSORPTION IN SURFACE OF EARTH & SEA
resonance efficiency
ENERGY ABSORBED BY RECEIVING ANTENNA
LOSSES DUE TO DAMPING IMPAIRING RESONANCE
efficiency of antenna and its associated receiving circuits
ENERGY DELIVERED TO DETECTOR
ENERGY LOST IN RE-RADIATION
JOULEAN LOSSES IN EARTH AND CONDUCTORS
detector efficiency
ENERGY PASSED ON TO TELEPHONES
LOSSES IN DETECTOR
TELEPHONE EFFICIENCY
LOSSES IN TELEPHONES
ENERGY CONVERTED INTO SOUND OF SIGNALS

imagined for the sake of the definition are despatched from the same antenna with the same average energy-rate as the damped waves under examination.

The energy absorbed by the receiving antenna is now in part passed across the coupling coils to the detector; but only in part, for some of it is dissipated by the antenna resistance. Here again the total amount of resistance can be divided into two parts—radiation resistance and ohmic resistance; that is to say, some of the energy is re-radiated, and some of it is dissipated in joulean waste. It is precisely because some of it is re-radiated that the well-known law arises that the absorbing power of an antenna is proportional to its radiating power. Here again an efficiency might be introduced, but it is good enough to repeat the mode of treatment already adopted, in the analogous question connected with the transmitting process. That is, we lump together all the processes intervening between the absorption of the energy from the waves and the delivery of the energy to the detector, and we define the EFFICIENCY OF THE ANTENNA AND ITS ASSOCIATED RECEIVING CIRCUITS as the ratio:

$$\frac{\text{Rate of energy-delivery to the detector}}{\text{Rate of energy-absorption from the waves}}$$

Although we have not yet finished the list of efficiencies to be considered, it is well to pause in order to notice a convenient coefficient which arises if we look broadly at the whole process of the transmission of energy from the transformer-secondary to the terminals to the detector. This coefficient may be called the OVER-ALL HIGH-FREQUENCY EFFICIENCY. It includes efficiency of generation of oscillations, the radiation efficiency of antenna, the efficiency of propagation, the resonance efficiency, and the efficiency of the antenna and its associated receiving circuits; and it is, in fact, the continued product of all five.

To resume, we know that the energy deivered in the form of oscillations at the detector terminals is converted by the physical processes of the detector into direct current, which passes to the telephones. The proportion converted is, of course, called the DETECTOR EFFICIENCY. In the telephones this direct current produces sound, which affects the ear of the operator. This is the last purely mechanical link in the long chain of transformations of energy involved in wireless signalling. We may define the EFFICIENCY OF THE TELEPHONE RECEIVER as the ratio:

$$\frac{\text{Rate of energy-emission as sound}}{\text{Rate of energy-delivery to telephones}}$$

The magnitude of this efficiency depends, of course, both on the construction of the telephones and on the character of the pulses which it receives. Last of all, we have to take into account the magnitude of the sensation produced in the telegraph-operator's brain, as a proportion of the energy of the sound-waves from the vibrating diaphragm of the telephone. This is a physiological matter, and all we need notice about it is that this efficiency depends greatly on the pitch of the note used in musical sparks, and, of course, also on the average keenness of hearing of the operator.

The efficiency coefficients briefly sketched and defined above must now be discussed *seriatim*. To many of them values may roughly be assigned which are different for different systems of wireless telegraphy; and in this way we may gain a notion of some of the points of strength and weakness of the various systems.

It is necessary to point out, however—and the reader ought to keep in mind the fact—that mere efficiency is not a dominating criterion of the practical or even economic value of a system. It might happen, for instance, that a system which was very efficient in our sense of the word would be very inconvenient or slow in operation, or might be expensive in installation and in renewals.

(*To be continued.*)

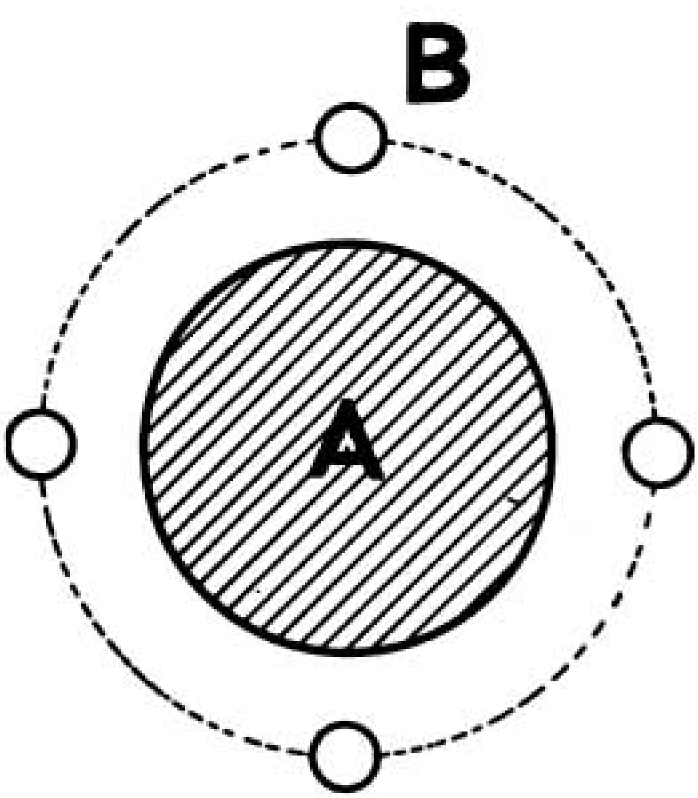
The Compagnie de Télégraphie Sans Fil, in Brussels, has just been transformed, and under its new shape will in future be known as "Société Anonyme Internationale de Télégraphie Sans Fil."

The Molecular Structure of Insulators

By H. M. DOWSET

The Author examines the molecular structure of certain insulators with a view of determining the properties of insulation of such substances as mica, porcelain or ebonite.

THE average electrical engineer looks upon a piece of mica, porcelain or ebonite with a certain amount of friendly respect, for they are insulators, whereas he is a conductor, and many a time they may have stood between him and a coroner's inquest. But as a rule he knows very little about them. What gives these substances the property of insulation ?



We may find an answer to this question if we examine their molecular structure.

In the course of a series of very interesting lectures recently delivered at the Royal Institution, Sir J. J. Thomson described the atom as consisting of a spherical positive nucleus A, surrounded by a moving belt of equally spaced free electrons or negative charges B. It is the motion of these free electrons which constitutes an electric current, and conductivity is the property of transferring them from one atom to another.

In a good insulator, therefore, this interchange does not take place.

The atoms of the inactive gases, Helium, Neon, Argon, Krypton and Xenon, are not supposed to have any free electrons, but all other insulating elements have either (1) a very tight hold of them, or (2) the atoms are well spaced apart so that their mutual action tending to free each other's electrons is weak.

Sulphur is an example of the first class. In its amorphous state with its atoms fairly close together it has a resistivity of 4×10^{15} or 2×10^{21} that of copper. This figure is so large that if it were not for its chemical activity one would be inclined to think that sulphur could have no free electrons.

Selenium is similar to sulphur. Measured in the dark, its resistivity is 2×10^{16} or 10^{22} that of copper.

The vapours of the good conducting metals and all gases are examples of the second class. They are all insulators.

ATOMIC GROUPINGS.

If now we consider the effects of atomic groupings on insulation, we have to note that the free electrons in the molecule of a simple element, or in the molecule of a compound, are supposed to be the chemical bonds which hold the atoms together. They are therefore less free in this state, and for this reason the molecule is a better insulator than the atom.

In fact, conductivity in liquids and gases involves a breaking up of the molecules before it can take place.

We next pass to molecular groupings. The molecules may either assemble, each one independent of the other, when the substance is said to be amorphous, or they may assemble in a number of independent groups, or they may all pack close together, each one as it were gearing into the other. The substance then is crystalline and has a definite structure.

Although there are many good insulators, such as mica and quartz, which have a structure, the structureless state, indicating molecular independence, is essentially that which gives best insulation.

When sulphur is changed from the amorphous to the crystalline state its insulation falls.

The change is much more marked with silicon. As an amorphous brown powder it is a good insulator, but the steel grey crystals are conductors.

Again, selenium in the dark is an insulator, but when exposed to light it receives a structure, and becomes a conductor.

One of the best insulating materials is glass. The whole aim of its manufacture is to ensure that it shall be structureless. Glass is composed of a number of substances which are not chemically combined, but are in mutual solution. Ordinary window glass, for instance, consists of sand, limestone, salt cake, and a few auxiliary substances, silica and lime predominating.

IN LIQUID SOLUTION.

Now, in a liquid solution the molecules of the different substances diffuse evenly all through the volume as in a gas. Each molecule is as well separated from molecules of its own kind as it can possibly be, and there is no structure. Such is the case when glass is molten. The whole effort of the manufacturer is to retain this state when the glass solidifies.

As the temperature of the liquid falls, one constituent tends to solidify before another, as their freezing points are not all the same. This tendency must be checked, otherwise the material becomes crystalline.

The manufacturer, therefore, at a certain stage of cooling chills the solution rapidly, so that the particles of those substances which solidify first have no time to move together through the resistance of the liquid before the whole is solidified.

The congealed solid, therefore, has its molecules in the same relative position as when the material was in the liquid state. It remains a perfect mixture, and it is this discontinuity of similar substance which is principally responsible for its high insulation.

Glass can be made from a large variety of substances. Even the best conducting elements can enter into its composition and contribute to the production of a good insulator, simply due to the way their molecules are arranged in the material.

The different kinds of glass naturally show different degrees of insulation, according to the resistivities of the elements composing them. Those containing silica and lime are the best, having a maximum resistivity of 2×10^{14}, while those containing lead or alkali are the worst. What is known as conducting glass is very rich in alkali, and has a resistivity of 10^{8}, that is 2×10^{14} as much as copper, so that it is still very much of an insulator.

Glass may either be cast in moulds, rolled, whirled into discs or blown into cylinders. The cylinders may later on be cut, opened out and annealed into flat plates. It is the blowing process, as we should expect, which produces the best insulator, for this method strains the material until the molecules very nearly part company.

Pitch, rubber, ebonite and porcelain are other examples of insulators whose molecules show various degrees of independence in their arrangements. Pitch is an extremely viscous fluid—structureless, like glass.

Caoutchouc or rubber, in the raw state, consists of minute transparent globules, about 1/25,000th inch in diameter, suspended in the sap of various trees and shrubs.

CAOUTCHOUC.

In all the processes which the caoutchouc goes through from the raw state to the finished article, the coagulation and drying of the sap, the cutting up, crushing, heating and kneading of the raw rubber, the essential character of the self-contained caoutchouc globules is maintained. This structural independence of the units results in a want of structure in the aggregate, which tends to produce a good insulator.

When rubber is vulcanised by treating with sulphur, the sulphur appears to enter into the substance of the globules without breaking them down.

Sulphur melts at 115° C. Vulcanising begins to take place at 140° C., and is carried on to 150° C. This is below the temperature at which the caoutchouc globules break down and run into a liquid, namely 200° C. As the sulphur combines with each globule independently, when used in small quantities it does not alter very much the general character of the physical properties of the rubber. It increases the strength, flexibility and insulation. Excess of sulphur results in the hard, black insulating material, ebonite. The resistivity of rubber is about 2×10^9, and of ebonite about 2×10^{15}.

The native rocks furnish another example. Limestone, white marble and iceland spar have all the same chemical composition. The first named is an amorphous rock, the second has every grain a crystal, and iceland spar is found in large crystals. They rank as insulators in the order named, the order of structural development. Marble has a resistivity of 7×10^{14}, which is about one-tenth that of limestone, and twice that of iceland spar.

In conclusion we may explain why the diamond offers an interesting exception to the general rule as regards structure.

An octahedral crystal, it is a good insulator. Heated in an electric arc, it swells up and takes the appearance of coke. It becomes a structureless solid with more space between its molecules than before, and yet it is changed into a good conductor. The reason is this:

The effect of heat is to weaken the hold of the atom on its free electrons. The diamond has been formed under intense heat and intense pressure.

The tendency of the former is to rob the carbon of its free electrons, and of the latter to induce a more intimate cohesion between its atoms owing to the absence of these electrons than could be obtained before. This greater cohesion, however, avails nothing as regards conductivity, owing to the want of electrons to conduct, but it is so strong that it requires the energy of excessive heat—heat from a Bunsen burner is not enough—before they part company, and take back the normal number of electrons to their respective orbits.

LOCAL ABSORPTION IN "WIRELESS."

Writing in the *Electrical World*, Mr. A. H. Taylor describes some experiments on this subject, from which he draws certain conclusions which are of particular interest to amateurs and others who have to deal with small-power working. By "local absorption" he refers to certain phenomena caused by purely local conditions at the sending or receiving stations, these being kept distinct from the phenomena of "general" absorption of electromagnetic waves by the medium traversed, which—from the results obtained by Austin at sea—the writer does not consider of serious importance for short distance working unless very short wavelengths are employed.

The local effects to which he refers include those produced by the proximity of power-, lighting-, and telephone- and telegraph-circuits, and of grounded conductors, such as gas, steam, and water pipes. He mentions that in certain experiments it was found at the transmitting end that a particular wave-length set up serious surges in the lighting-circuits of the building, though these circuits had no connection with the "wireless" power-leads. These surges made themselves evident by the burning-out of several tungsten lamps, and though—when thus noticed—they were obviated by altering the free oscillations of the lighting-circuit by putting two one-microfarad condensers across the lines at two points found by trial, the writer points out that it would be quite possible for a considerable amount of aerial-energy to be absorbed and wasted in this way without attention being called to it. Moreover, the same waste might easily occur in the neighbourhood of aerials used for reception only. Further experiments are described, in one of which it was brought out that in some cases the presence of insulated overhead circuits may be beneficial to reception on small aerials near to such circuits. In general, however, such circuits would absorb energy and would not reradiate it to the aerial. In a building containing grounded circuits the writer concludes that it is best to locate the receiving apparatus as *high* as possible in the building. Referring to the large condensers used for protecting the circuits, as above-described, the writer wisely recommends that they should be provided with fuses to prevent short-circuit in the event of a puncture.

The War Office Committee on Wireless Telegraphy

As already reported, a committee was appointed by the War Office in August of last year to consider recent developments in wireless telegraphy and telephony, more especially with reference to the desirability of their extended application for military uses in the field. The integral part of the enquiry was the determination of the particular system most suitable for the requirements of the British Army, and in this connection a visit to the Marconi works at Chelmsford by members of the Commission was arranged for April 8th, 1913. The members of the Committee who were visitors on this occasion were Sir Henry Norman, M.P., Chairman of the Committee, Major R. H. Boys, D.S.O., R.E., Mr. E. Russell Clarke, Col. R. D. Whigham, D.S.O., of the General Staff, Col. Hippisley, and Capt. Louis Vaughan, Secretary of the Committee.

The first item was the erection of the three different types of portable masts, which are respectively 105 ft., 70 ft. and 30 ft. high. After this an aerial was attached to one of the masts and to the cart station in the marquee erected for the purpose. The Committee then inspected the stations, trying the engine, and examining the apparatus. These stations are of ½ kw. and 1½ kw., the former having a guaranteed range of 35 miles over normally flat country. The apparatus is carried on two two-wheeled carriages, the total weight of each carriage being, when ready for transport, about 600 lbs. They are so arranged that they can either be drawn separately by hand or limbered together and drawn by one or two horses. But in case of necessity where, for instance, wheeled transport becomes impossible, the station can be quickly dismounted and the apparatus divided up into a number of smaller loads which can be carried by hand. The heaviest of such packages is about 85 lbs., and the best method of hand transport is to sling each load on a mast section, which can then be carried between two men. The total number of such loads for each station is eight. The staff usually required to manipulate such a station is four, though it can, if necessity compels, be erected and worked by a minimum of two. The station can be erected within ten minutes.

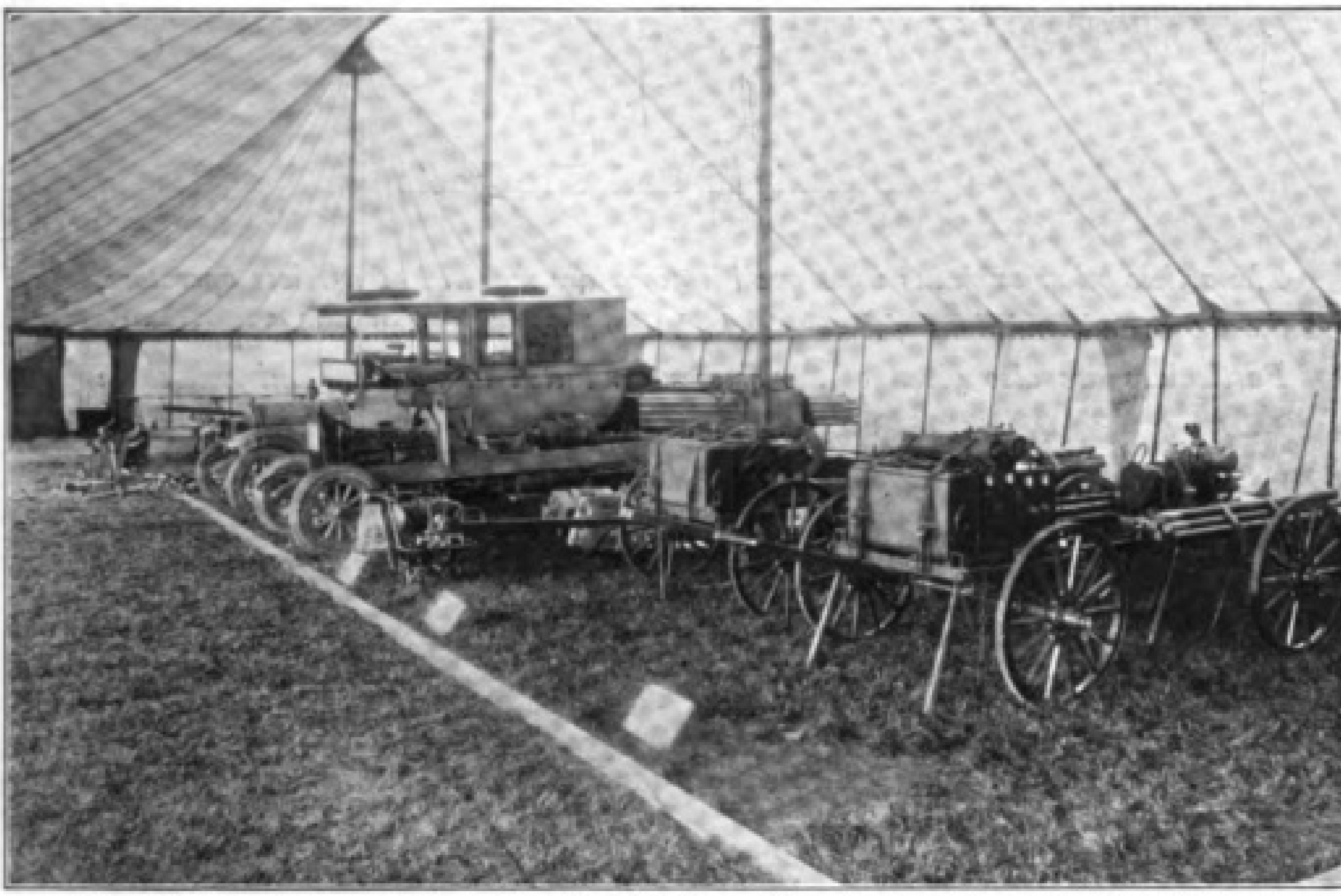
The 1½-kw. station is of much greater range, and elaboration. The *personnel* for such station is at eight men, but here again in times of necessity it can be easily worked by three, nor does it take much longer to erect than the ½-kw. station —twenty minutes being a good outside time limit. The masts are two, each 70 ft. in height, supported on a horizontal antenna. The generating set is a two-cylinder, eight horse-power, air-cooled, petrol engine, driving a high-frequency 1½-kw. self-exciting alternator. The transmitting wave-length is reckoned between 700 and 1,300 metres, and the receiving wave-length between 450 and 1,400.

The 1½-kw. motor-car station was then very carefully examined. This is similar in construction to the type just described, except that here the whole of the transmitting and receiving apparatus, including the generating group, is conveniently fitted up in the body of the car, while the trailer which accompanies the car carries the two masts with their derricks and earth gear.

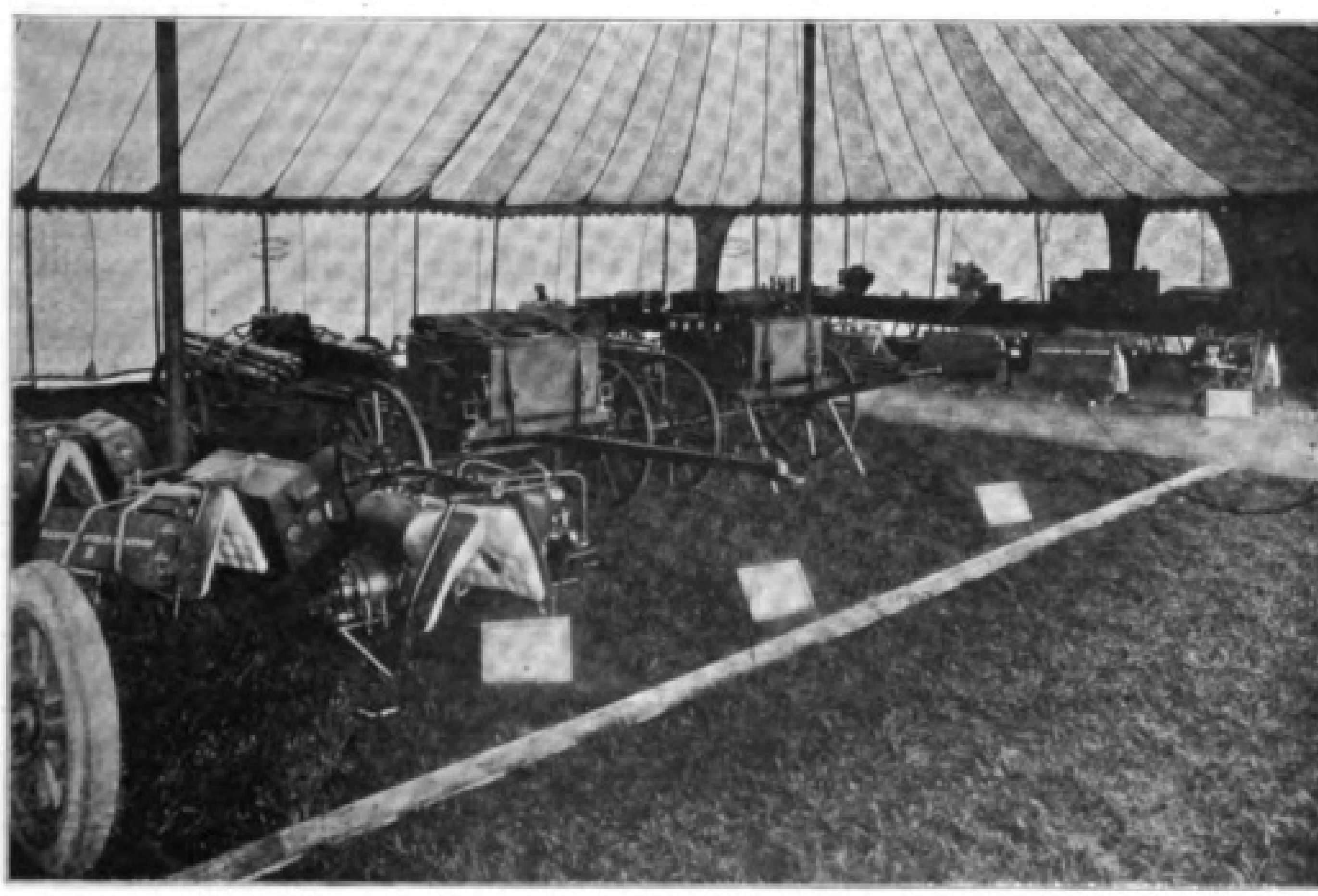
After this an inspection was made of the various small parts of the engines, which were laid out for examination.

Following this the Committee adjourned to the test room to inspect the 3-kw. set which has been commissioned by the Italian Government, and which at the moment was undergoing the preliminary tests. Lunch was then served, and the opportunity was taken to send the motor-car station up to Broomfield in order that a test might be made of the clearness and tune of the signals received therefrom. After this the Committee made a tour of the works and saw the various parts of the field station in the course of manufacture.

Arrangement of Portable Field Stations for War Office Committee at the Marconi Works



From left to right: 1·5-kw Motor Car Station; Chassis for 1·5 Motor Car Station, showing generator and drive; two types of ·5-kw. Landing Stations



The ·5-kw. Pack Station is shown to the left of the Landing Stations

The Wireless Operator

Qualifications and Prospects

The article below explains what qualifications are required of wireless operators, the nature and conditions of the work which they have to carry on, and the prospects. Particulars are also given of the classes conducted at the Marconi School in London.

"WHAT is your boy going to be ?" Every father knows the question that is fired at him from all sides when his son is about to leave school ; knows, too, the worry it causes him. Scarcely having given a serious thought to the matter before, he commences to button-hole his friends and ask their "personal experience" of this or that business or profession. He receives cold comfort. Every field, he finds, is overcrowded. The Bar, Medicine, Engineering—they all mean a long apprenticeship or heavy premiums and the unalluring prospect of the lad having to lead the "simple life" or of being dependent on his parents for years after he makes his first entry into the salary-earning arena. Dismayed at the barrier that confronts him the parent begins dismally to study books on what to do with our offspring, and ends by becoming thoroughly pessimistic.

PROSPECTS OF THE SERVICE.

Yet there is one profession which is not overcrowded—one which will appeal strongly to the young man of mechanical bent. To enter upon it necessitates no lengthy and costly training, neither does it mean months of weary waiting for a situation when that training is completed. Above all it offers, what every young man of spirit desires, independence of financial assistance from his parents the moment his training is completed.

Springing into existence when wireless telegraphy was recognised to have a commercial application, the new career—that of wireless operator—made an instant appeal to hundreds of young men throughout the country. Thousands of others were vaguely interested in it, but hesitated to embark on a career that the pessimists croaked "would not last."

In the face of the pessimists wireless telegraphy has made progress in every quarter of the globe. Hundreds of land stations exist, and a glance at Lloyd's Register shows that thousands of vessels are fitted with the new invention. Even so, radiotelegraphy is barely out of its cradle. Every week sees a new land station in the course of erection ; every month, as the pages of THE WIRELESS WORLD show, reveals a lengthy list of ships in course of fitment.

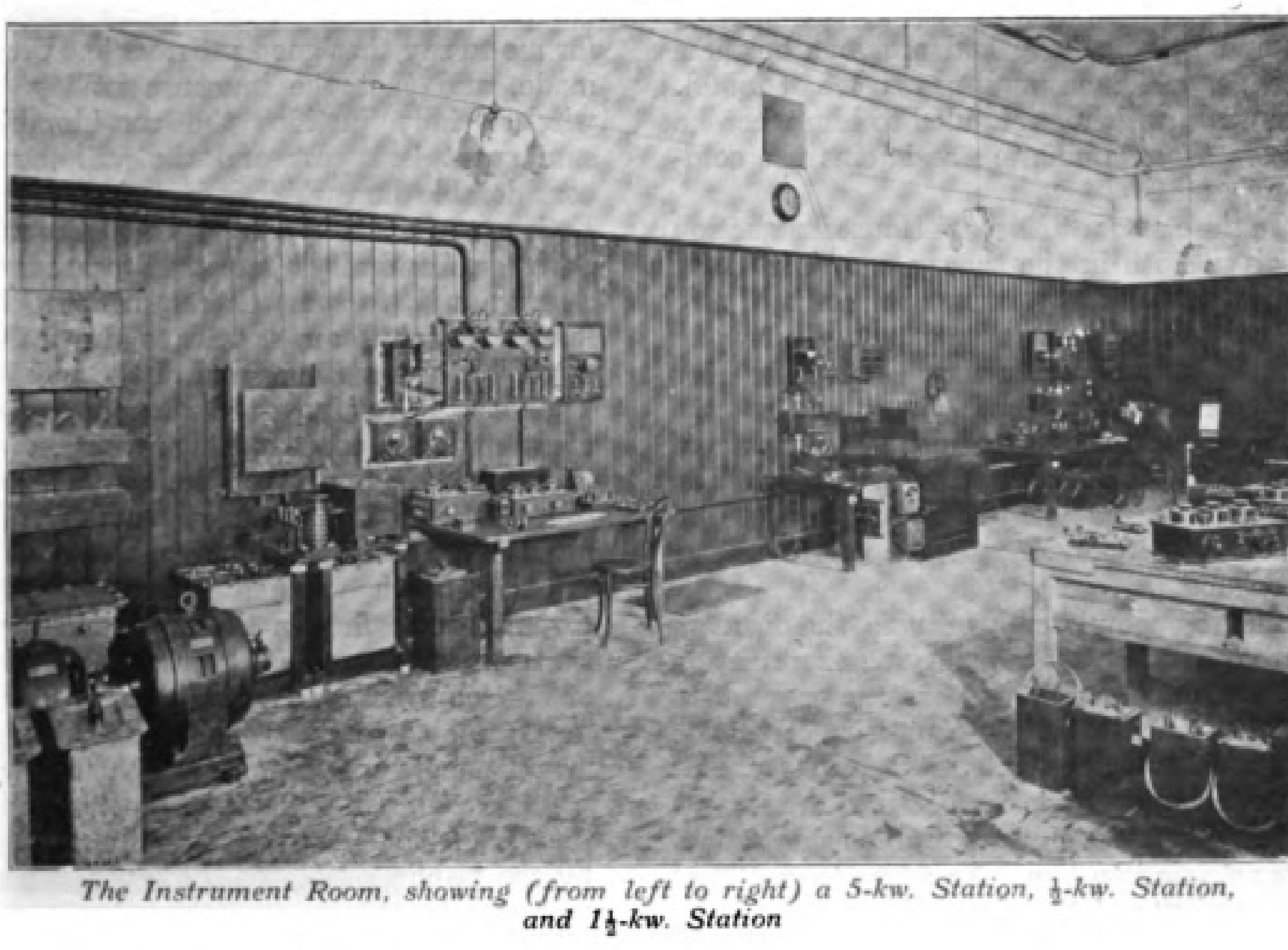
AND THE DUTIES.

The life of a wireless man runs on agreeable lines. If drafted to a passenger vessel the operator usually takes the honorary rank of a junior officer. Signing the ship's articles as a member of the crew he is, of course, subject to the disciplinary regulations of the ship—a terrible-looking official phrase which implies no more restriction than he would be subjected to in any business house. He receives a wage that compares favourably with that paid to telegraphists in the home Government and cable services and substantially in advance of and increasing more rapidly than that paid to railway telegraphists. His hours, where two operators are employed, are regular, but where he is in sole charge long and irregular hours will occasionally be his lot.

The wireless man is not expected to be a

Views of the School for Operators at Marconi House, London, where day and evening classes are carried on.

Training Wireless Telegraph Operators at Marconi House



The Instrument Room, showing (from left to right) a 5-kw. Station, ½-kw. Station, and 1½-kw. Station prodigy. Entering on his career between the age of 19 and 24, a pretty sound general knowledge, clear handwriting, and the "wit to learn" are essential. If he knows anything of electricity and magnetism, of foreign languages, or of telegraphic work, he will have everything in his favour.

On entering their new premises in the Strand last May Marconi's Wireless Telegraph Co., Ltd., established a school in the building for the training of wireless telegraphy operators. The classes proved so popular that it became imperative that the accommodation, which had been limited for 60 students at day and evening classes, should be immediately increased. Last month, therefore, the school was transferred from the top of Marconi House to the basement, where accommodation is now found for 125 students.

Three distinct classes are held in the school. The day class is for students who have generally had some previous land line or cable telegraphic experience, and serve about two months on trial as learners in order to acquire a working knowledge of the Marconi system of wireless telegraphy.

The evening classes, which are held three evenings a week, from 7.30 p.m. to 10 p.m., are open to students between the ages of 19 and 24 who have had previous business experience. Each pupil pays a fee of 2s. 6d. per week, which is refunded to him when he passes the examination and joins the company's staff.

In the classes at Marconi House instruction is given both in the theory and practice of wireless telegraphy. The beginner is first taken through an elementary course in magnetism and electricity. When familiar with the theory he is instructed in the sending and receiving of signals by means of the Morse sounder, buzzer and telephones. Later he learns how to adjust apparatus, to trace and remove faults, and to repair breakdowns.

Having completed his course, the operator is required to pass a qualifying examination set by the Company's instructor and to obtain the Postmaster-General's certificate of proficiency in wireless telegraphy. This done the operator is drafted into the service of the Marconi Company and his tuition fees are returned to him. No fewer than 130 of the students of the classes have passed the Postmaster-General's examination since the opening of the London school in June, 1912, and have obtained employment in the Company's service. The Company's school at Liverpool has been in existence since 1903, and a large number of students have passed through it into the Company's service.

A word in conclusion about the prospects. The operator starts as a junior and gains promotion to the rank of senior. After a term at sea, he may qualify for a shore appointment or for a travelling inspectorship, with special pay. If he fits himself for it, a position on the engineering staff of the Company may be his. The steadily increasing adoption of radiotelegraphy is from time to time opening up valuable appointments in many parts of the world, not only on land, but on warships, yachts, and even airships.

THE ADMIRALTY AND WIRELESS.—In the course of his speech in introducing the Navy Estimates in the House of Commons on March 26th, Mr. Winston Churchill, the First Lord of the Admiralty, made the following statement:

> The development of wireless telegraphy in seagoing ships and in the shore stations of the Admiralty has during the year been very satisfactory. All the details are strictly confidential, and it is sufficient for me to say that good progress has been made, and that the immense utility of wireless fully justifies the considerable sum spent last year and the still more considerable sum which is included in the Estimates for this year. In one respect, however, Admiralty interests have suffered a grave and, to some extent, irreparable loss to which I am bound to draw the attention of the House and of the public. The delay in ratifying the Marconi agreement and the consequent prevention of all progress in the Imperial chain of wireless stations has deprived us of the advantages in regard to wave-length and priority which we had hoped to gain through being first in the field, and now that the company has refused to carry out the contract, and since it is manifestly impossible to compel them to do so, new arrangements of a different character will have to be devised, and it is possible that additional charges will be incurred by the public. No step, however, which will now be taken can put us back into the position which has been lost.

A Pawn in the Game

(Serial Story)

By BERNARD C. WHITE

Charles Summers, the only son of the Vicar of Sotheby, is an engineer and inventor, His peculiarities arouse comment among the villagers, and his workshop is the subject of so much curious speculation that Doss and Suk, two itinerant pedlars, make it their business to discover its secrets.

CHAPTER I.

INTRODUCTORY.

"PARSON SUMMERS ha' gotten a rum 'un."

A pause.

"I reckon that young man be nobbut a fule."

Another pause.

The speakers were lounging outside the principal inn of Sotheby, a village not far distant from the important country town of Chittingham. They were evidently characters of the place, the one a man, the other a woman; but it was only by the clothes they wore that the sex of either was to be distinguished. Both were old, though there was nothing to indicate the exact number of their years. They were burnt copper colour by exposure to sun and rain, their faces were wrinkled like the dry kernels of hazel nuts, and their gipsy appearance was enhanced by a grime of long standing which engraved itself in the heavy wrinkles lining these two faces. Both, too, were sucking short clay pipes as tanned as their owners—that is to say, as much of the pipes as was visible, for the stems had been worn away by constant use, and only the bowls protruded from between the smokers' lips.

Doss and Suk were brother and sister, pedlars by profession, and vagabonds by inclination. Year in and year out they were to be found in the neighbourhood, hawking unconsidered trifles of ribbons, bootlaces, buttons, screws and all the impedimenta of a country Autolycus. Who were their parents nobody knew, nor indeed had anyone heard them mention the name of a single kinsman. They seemed to be derelicts thrown up on the country side, and not even the longest memory in the village could remember them in any other conditions or under any other circumstances. They had no home, and where they slept was equally a mystery with their parentage. A barn or loft or some broken-down shed served to shelter them no doubt during the wintry nights, and a hayrick or the hedgerow, or even the open field, was sufficient for their needs in summer. Only once had either of them been ill, and on that occasion it was Suk, who had sunk down on the floor of the very inn where they were now sitting, overcome with ague, which later had developed into pleurisy. She was taken off to the village hospital, and for weeks her life was in danger. All through the period of her illness her brother wandered disconsolately about the village, a solitary and unkempt figure, neither speaking to anyone nor welcoming the approaches of compassionate neighbours. Each evening he would inquire at the hospital for news of his sister, and on receiving it would slink back again into the darkness of unfrequented paths, only to return on the morrow to make the same inquiries and go his way again. When at last his sister was discharged, the pair of them departed from Sotheby, nor did they return till Suk's white face was once more as begrimed and brown and withered as her brother's, and they were to be seen as of old, carrying their pedlar's packs and journeying from cottage to cottage to sell their wares, or tell the fortunes of their more credulous clients.

Now it was late autumn, and the two had

been taking their usual glass of ale at the conclusion of the day's work. It was not late enough for the farm labourers' return om work, and they were alone, sitting on the bench outside the "Albion Arms." For the best part of an hour they had sat there when their silence was broken by the words which open this chapter. Doss was the first speaker, and his sister's reply shows the difference in their characters. The little femininity that remained with her gave her a sharper outlook on life and a more acrimonious tone. Whoever she could not understand was "a fule," and she had but expressed the general opinion of Sotheby's women kind when she applied this epithet to Parson Summers' son. Her unequivocal verdict had nearly put an end to the conversation, if such it could be termed, for it required a supreme effort of thought on Doss's part to break down so decisive a statement and continue the discussion with his companion. After another long spell of silence he spat on the ground and remarked:

"Mebbe he's a fule, but he is a larned fule. Only yester' mornin' I was a-sellin' a comb to Bettie—she be Parson's new maid—when he cum'd out of his workshop. Such a moither yer never did see! His hands were black as ole Tinker Bill's, and the Almighty alone knows what he had been a-doing, such a buzzin' and wuzzin' inside that shed as if a whole skip of bees had a-been swaarming."

He stopped, and was meditatively taking the pipe out of his mouth to knock out the ash, when his eye caught sight of a slim figure turning down the bend of the road opposite. The pipe remained unemptied, for Doss, seizing the worn bowl in his hands, pointed with the stem at the figure.

"Thar goes!"

Doss looked up sharply and craned forward so as not to lose any of the excitement caused by the passer-by. Without a doubt it was Charles Summers taking his short evening walk. At his heels was the white and black spaniel which always accompanied his master on these occasions. The figure was that of a young man, tall and slight, with a rather pronounced stoop, accentuated at the moment by his thoughtful attitude, as he looked blindly ahead, his eye fixed on some imaginary spot a few yards in front of him. His hands were clutching the tails of his coat, pulling it down from his shoulders, and giving him an odd appearance, which helped to substantiate the verdict of Suk. Doss, as he pointed him out, raised his voice above his usual guttural monotone, and this caused the innkeeper and his wife to come to the door. At the same time one or two of the usual evening customers strolled up, and it was not long before the knot of villagers with the pedlars in the centre were discussing the merits and demerits of the Parson's son. He was a main topic of conversation in the village, for ever since a child his aloofness had been the occasion of gossip, and now that his engagement to Mr. Thrale's daughter had become known he had more than ever formed the basis of Sotheby's conversation.

Summers was unconscious of all this, as he made his way along the village street and turned up at last into a bye lane leading out into the open country. He was engrossed in an engineering problem that he had set himself to solve. Figures and equations jerked like demons on his mental horizon, and would not solve themselves into the regular battalions which obey the laws of mathematics. At last he gave up the struggle, and allowed himself to drift into lighter fancies. His thoughts went back to his childhood—not so very far back, perhaps, if time is to be counted by length of years, but to him who had crowded as much into his thirty odd summers as circumstances would permit, it seemed to him to be very distant now. He was the only son of a kindly, indulgent, easy-going father, who had humoured him in all his caprices, and from whom he had inherited an intellect above the ordinary. But it was to his mother that Summers owed his force of character, and it was this force which bade him forego the path of least resistance—that is to say, the comfortable existence of a country life—and compete for an existence, it might be a prize, in the crowded profession of engineering. His ambition had all been that way. As a little boy it had shown itself in an inordinate love of trains and mechanical toys; later it had urged him, when he might have been birds' nesting or fishing, to make long tramps towards Chittingham, and sit for hours on a five-barred gate where he could watch the trains steaming into the junction, his notebook and pencil ready to take down the names and numbers of the engines and note details of valve gears, or working pressures, or wheel arrangements. Then had come school life and its manifold interests, when cogs and nuts and rivets and springs had to be put aside, except in the leisure hour, and he had to apply himself to the mastering of Latin and Greek and their dread intricacies, with only school-boy games to vary the monotony of this irksome work. At that time his one solace and El-Dorado was his locker—and what a locker it was! A tool chest, a laboratory and a factory, all in one. It was well that the careful headmaster never had a chance of peeping inside it, for had he done so, he would have had no option but to confiscate the entire contents in the interests of public safety. In fact, it was only a magnificent Providence that averted disaster, for pycric acid hobnobbed with tin filings, phosphorus and magnesium wire and mercury were in dangerous proximity the one to the other, while the whole was buried in an indescribable confusion of springs and gimlets and copper wire, and the other appurtenances of the engineer.

But young Summers' classical training did not last for long. After the Rev. Edward Summers had gleaned as a harvest for good money lavishly expended a series of reports which the most optimistic could not but construe as depressing, and which, as the years advanced, grew more and more lugubrious in tone, the fact was at length borne in upon him that his son was not fitted for a classical or scholastic career, and that further efforts in this direction were likely to result in failure. In accordance, therefore, with his generous principle of *laissez faire* (but under the circumstances he must be considered to have acted wisely), he allowed his son to take up engineering, and entered him as a student of a technical college. He was rewarded by his son's greater happiness, and if not brilliant, at least solid success.

These were the days which Summers was thinking of at this moment, and a smile enlivened his somewhat phlegmatic face as his thoughts passed from one episode to another in his career. He was now walking swiftly, his steps according with his mental activity, but he was still entirely unconscious of his surroundings. Gyp, the spaniel, was allowed to scamper along unheeded, his nose close to the ground as he foraged in the hedgerow for anything that might turn up, while now and again he would dart through the hedge and shuffle breathlessly after some hare which he had disturbed in his exploration. Suddenly Summers came to a standstill. In his cogitation he had hit upon an episode which gave him a clue towards the solution of his present difficulty. Yes, it was quite clear he could get the effect he wanted by using that old formula. He breathed a great sigh of relief and looked around him. His whole attitude changed. With re-awakened energy he shook himself as though to get rid of his premeditation. A sharp whistle, and Gyp was at his side; then with a "Cheeroh, mannikin!" to his faithful ally, he started for a run across the hills, and returned home as the evening closed in, breathless and refreshed, and, by one more difficulty solved, a younger man.

CHAPTER II.

THE "DEVIL'S SMITHY."

The following morning found Charles Summers eagerly engaged in his workshop. It was a Saturday, the most important day of the week for him. As a parson's son, and that parson vicar of the neighbourhood, he could not count Sunday in his reckoning, for there were services which demanded his presence, and primitive village prejudices which had to be considered, to say nothing of a standing engagement to tea at Thrale Hall. On Saturdays, however, the case was different. The firm which engaged his services as an engineer, and which had extensive works for electrical appliances at Chittingham, dispensed with those services for the last day of the week, and this gave Summers an opportunity for working out ideas which an oftentimes leisurely week allowed him to develop in his fertile brain. On this particular day he had been up when the morning was still young, and before breakfast was ready had done sufficient work to make an ordinary navvy wish himself dead. Fortunately for the inmates of the Vicarage, his workshop was situated at some distance from the house; otherwise their matutinal slumbers would often have been disturbed by hideous noises, as for instance a series of filings as would have set all their teeth on edge, or perhaps the roar of a Bunsen burner as the operator pedalled the bellows and worked glass tubes into most intricate and gordian knots, or blew it out into globes of crystallised fire. Not that all Summers' work was of a noisy description. He would spend hours upon hours manipulating delicate machinery and making adjustments with particles of wire and silver and platinum. Even jewels came into the scheme of workmanship, and all this was labour so delicate that the mending of a butterfly's wing would have been a clumsy employment compared to it. Then, too, there were the diagrams, which he often had to work out—sheets and sheets of them, which, if one had opened the doors of an ancient press standing in one corner of his room, would have been found heaped together in indescribable confusion. Nor did the press contain them all; they were jabbed on nails sticking out from the rows of dusty shelves, they littered the table in front of the big window, and a variety of drawing boards stacked one against the other behind the door were covered with similar expanses of fair white linen marked with dismal complications of faint blue lines. But there was one part of the room which was in striking contrast to the disorder of its general arrangement. This was a large recess containing a table of polished oak, and lit by a skylight which at this time was shuttered by dark blue curtains drawn closely across. There was nothing remarkable about the table. Except for a wide margin, it was entirely occupied by a polished oak chest reaching up to the average height of a man. It seemed to be inviolate, with not so much as a speck of dust or a sign of use, and might have been some altar set up to an unknown god that no one dare approach or lay profane fingers upon. The covered chest in the centre evidently contained something peculiarly precious, which was evidenced by the fact that it had twin nickel locks of a design out of the ordinary, even in this age of cunning locksmiths, But the chest, remarkable enough in itself. was insignificant compared with the model swung above it; from it were stretched flexible wires reaching to either wall of the recess, and securely fastened to hooks provided for that purpose. It was a model of an airship, with the envelope already inflated. From appearances the balloon was made of goldbeater's skin, and very lovely it looked, like some semi-transparent bubble poised half-way between floor and ceiling. From it swung, by fine steel wires, a small ribbed car, brilliant in appearance and perfect in workmanship. The narrow steel bands forming the body of this car were plaited together, the ends of each being welded together over a narrow elliptical steel ring, somewhat pointed at either end, and projecting beyond the balloon itself. To the casual observer the model was just nothing more than a variation of the ordinary type of airship. But there was one thing which even he would have noticed as out of the common. This was a special apparatus fixed to the prow—a cylindrical nickel tube curved back from the pointed end and surmounted at the top a large nickel knob, from which projected two long narrow funnels. They looked for all the world like the horns of some gigantic snail, except that they stared out in a fixed, defiant way very different from the nervous retractile organs of a mollusk. But there were other apparatus than that which formed the distinguishing furniture of the recess. Beneath the table was a large oblong box. It might have been a locker or a tool chest so far as could be judged from outside appearances, but a handle to the door betokened that it was a cupboard. If it had been opened it would have disclosed an imposing array of electrical apparatus—a spark discharger, a half-plate condenser, coils of heavy insulated wire, an arrester terminal, could easily have been distinguished, while below the broad shelf was fixed a ship's dynamo. This was enough to show the nature of the apparatus. It was nothing more nor less than a wireless installation, and the whole locker a silencer cabin, such as is used on board ship. To confirm this theory it was only necessary to draw back the blue curtains from the skylight, and above were visible the aerials and masts which, to the uninitiated, form always the outward and visible sign of the invisible spirit of radiotelegraphy. Summers himself was now concentrating all his attention on this wonderful toy. Nervously he pulled the cords and drew back the blue curtains to let in the autumn sun. Then as a precaution he carefully washed his hands, and proceeded to unlock the chest, using a key fixed to his watch chain. Still with infinite care he removed the cover of the chest, and there in front of him was a medley of apparatus that for perplexity was sufficient to bring dismay to the heart of any but the daring inventor. Putting the cover down by the side of the table, he sat himself before his wonderful instrument, examining it with a critical eye as he adjusted first this wire, then that, or polished the units of the intricacy. Presently he touched a lever, and the whole apparatus underwent a swift change. It might have been that a wizard had used his spell, and from chaos had created a fairy city of ivory palaces and ebony citadels, laid out in perfect precision and geometrical design. Now the complicated jumble of pegs and cubes and wires was spread over the table to form a keyboard —not unlike a backgammon-table, or even it might be compared to the keyboard of a whimsical piano wherein all the flat notes were black, and the sharps, following a zig-zag course entirely their own, were white. Besides this was another kind of note. Little brass knobs dotted here, there and everywhere, which seemed, and indeed were, capable of playing a tune all on their own, But Summers had no intention of practising on this wonderful instrument. To his experienced eye it was not yet complete, and he busied himself with adding yet more notes, and more white sharps and more brass knobs to the wonderful array. Long he spent bending over his treasure, fixing and refixing, making cunning rivets and attaching delicate wires, shaping the notes to fit one into the other like a Chinese puzzle, and lastly fixing the little brass knobs into sockets especially prepared for their reception. At length he desisted from the engrossing work, and rose from his stooping posture, bending backwards with his hands on his hips, to give relaxation to the strained muscles, and smiling to himself with a well-satisfied air as he looked at the labour of his hands and of his head. Finally he slightly re-adjusted the apparatus, moved the lever again so that everything tumbled back into its original muddled position, then replaced the cover, and turned the key.

After that he went to breakfast. The family were already at the table as he entered the room, that is to say if two persons could be rightly termed a family. His father was invisible behind the voluminous leaves of *The Times*, but certain long-drawn sips at his coffee and the tinkling of knife and fork on the plate advertised his presence and occupation. Miss Summers was seated exactly opposite her father. She was older than Charles, and already betrayed evidences of a religious bias, and a complacent acceptance of spinsterhood. Not that she was ugly, or thin, or angular, or wore spectacles, or had her hair brushed straight back from her forehead and drawn into a twist behind. No such eccentricities marked her out from the common run of womankind. On the contrary, she was rather good-looking, inclined to be buxom, and her fair hair was done in the acceptable mode of curls, held in place by a velvet ribbon; but there was an indefinable air of primness, a set of the lips, and a mincing method of speaking which were sufficient to hint at her opinions and circumstances. She scarcely seemed to notice the advent of her brother, but mechanically helped him to the bacon and eggs, and, without observing the formalities of salutation, straightway commenced breakfast-table talk. There was a regular supply of correspondence to form topics of conversation, news from aunts and cousins to be retailed, and then the more immediate concerns of the neighbourhood. Charles replied in monosyllabic sentences uttered between his infinitely more important occupation of satisfying a voracious and well-deserved hunger. It was only when the third cup of coffee was found to be too hot to be sipped with any degree of comfort that he slipped further under the table and leaned back in an attitude of appreciative ease. By this time the Rev. Summers had finished all three of the leaders in his morning's paper, and had declared with much satisfaction that he disagreed with them all. He threw the paper aside, remarking that journalism was going to the dogs, and he didn't see why, after the expense of threepence and the trouble of reading, he should be treated to such a diet of wind in three spasms. As he had made a similar remark every morning for as long as his children could remember, they thought it unnecessary to make either dissent or assent, but when he passed his cup along, and joined in parochial gossip, the conversation became animated. An easy-going life and a cultured intelligence made him a good conversationalist, and he had the power of investing quite ordinary topics with an interest far beyond their exact merits.

By the way he remarked: "I hear those old vagabonds have once again turned up in the village."

"You mean Doss and Suk?"

"Yes, the old ragamuffins are as queer as their names. I should like to know how they came by them."

Here Charles chimed in: "In the same way that they came by their livelihood, I should think, and heaven alone knows how that is."

"Don't impute such knowledge to the heavens, my dear Charles. Popular opinion has it that the devil takes care of his own, and it strikes me that they came by their names in the same way as they came by their means of sustenance. We shall hear of a good many petty pilferings and sundry missing fowls if they stay in the neighbourhood much longer. I only hope I shall not be called upon to read the burial service over those old scamps. I shall choke when it comes to 'In sure and certain hope'; but there is one thing to be thankful for—they have no relatives to write them a lying epitaph."

"I think, father," interrupted his daughter, "that you are rather hard on the old people. You must own their lot has not fallen in a fair ground, and as far as I can make out, although their visits are productive of a terrible amount of gossip and scandal-mongery, they have never been found out in thieving or roguery."

"Yes, yes, but what did I say just now: the devil looks after his own. As for the gossip and scandal-mongery, I can tell you all about that. Yesterday I heard old Doss telling Lucy's fortune. It was the cunningest flattery one could conceive. The scoundrel tickled her palm, and babbled nonsense with a shrewd question every now and then, till he had wheedled out of her sundry silver coins, and every item of our private affairs. If I catch him hanging about these parts I shall send him about his business, and threaten him with the police. We shan't hear of him then for a good while."

"Well, I have never found him so bad. He has chopped up a good deal of wood for me at one time and another, and he works well and is respectful."

"That may be, but I wish that you would not have anything to do with him. I'm sure that old rogue breeds mischief as fast as he breeds fleas."

Here the conversation ended. There was nothing more to be said, and the three departed to their various occupations. The Rev. Summers to the construction of his sermon, in which the third article in *The Times* came in particularly handy; Miss Summers to the ordering of the household; and Charles, calling the dog, went once more to his den. Carefully locking the door behind him when he entered, he threw off his coat and lit a great meerschaum, then sat down to a lengthy calculation and the scribbling of multitudes of figures. The work perplexed him somewhat, for he tugged vigorously at the roots of his hair, and spent the larger part of a box of matches in lighting his pipe at various times. The minutes ticked swiftly away, and it was nearly noon before Gyp, who had been sleeping peacefully, roused his master from his occupation by a series of low growls. Looking up, Charles became aware of a figure shuffling by the path running underneath his window. It was the peculiar gait which made him look a second time, and then his suspicions were so much aroused that he set himself to watch subsequent manœuvres. Taking advantage of the thick laurel bushes which divided this part of the garden from the tennis court, Suk was moving this way and that, as though spying out the land. Every now and then her eyes would roam over the house, questioning each window in case she should be observed. Emboldened by her apparent security, she then crept forward some paces till sheltered by a bush larger than the rest, under cover of which she could see into the long, low window of the workshop. Then she remained attentively watching for as long as Charles was apparently engaged in his work; but suddenly he made a movement, and she saw him look up. Quickly she slunk back, retraced her steps, and before Charles had time to open his door and come out to her, she was shuffling up the path leading to the kitchen. Thinking it best not to appear suspicious, he inquired what she wanted.

"Please, sir, I've cum to sell the lasses their fal-lals. Mebbe they be wanting a new ribbon for Sunday, or a button hook, and I knaw they be bound to have it off old Suk than from any of your roguey drapers in Chittingham."

"But your brother only called here yesterday, and they bought all they wanted to then. Didn't he tell you?"

"Na. Doss scarcely mutters a damn to body when he's sober, but jes drinks and drinks and drinks, and arter that he doan't say nothing as what ye could understand. I never heerd that he called here yesterday. I be mortal sorry to have troubled the Vicarage again so soon, but, sir" (and here she pointed to a bare foot surrounded by what had once been a leather shoe) "bain't Miss Summers got some shoes she could give a body? These be quite worn through, for I have tramped many miles in 'em. She be a kind leddy, and mebbe she has, and she'd be doin' Gawd A'mighty service if she give 'em to a poor old body who is nigh worn out with rheumatiz."

Hospitality was the keynote of the Vicarage régime, and it would have been entirely opposed to the usual practice to have sent away a beggar without endeavouring to supply his wants. Charles went back to call his sister, and see if anything could be done for the old woman. Going up to the side door, he found it closed, and waited to ring. Instinct made him turn round, however, to find old Suk shuffling quickly up to his window, her head thrust forward as near to the glass as possible, and her keen eyes dancing as they took in every detail of the workshop. Instantly Charles called to her, and as quickly she resumed her shuffling nonchalant gait and attitude. There was no mistake as to her purpose or intention. The workshop had aroused her curiosity, and she intended to know all about it. Whether there was a deeper purpose underneath this curiosity Charles was unable to say, but it was sufficiently evident that Suk knew she was prying where she had no business to pry. This time Charles spoke roughly and told her to go about her business, at the same time hinting that if she or her brother were found loitering around the vicarage for some time to come, the police would be quickly informed of their whereabouts, and the law would give short shrift to their vagabondage.

Muttering to herself, Suk slunk round and made off as fast as her old legs could carry her, the heels of her worn-out shoes clop-clopping as she made her way down the gravel path.

(To be continued).

INSURANCE BY WIRELESS

THE successful negotiation of an insurance policy when one of the parties was in mid-ocean emphasises the value of wireless telegraphy to business men. Mr. Arthur Philips Williams, on a recent journey between Liverpool and New York by the *Mauretania*, completed a £1,000 transaction between Mid-Atlantic and London in 45 minutes. Considering the usual formalities that attend the taking out of an insurance policy, the transaction seems to have been carried out with commendable promptitude. The details of how it was done, as given by a partner of the insurance brokers concerned, are not uninstructive.

"On arriving at my office to-day," he told a newspaper representative, "I found a long wireless telegram in code from my partner, Mr. Ashley Edwards, who is on the *Mauretania*, stating that a fellow-passenger, a Mr. Arthur P. Williams, desired to insure his life for £1,000, and had completed the usual proposal form of the Commercial Union Company to that effect.

Accompanying the message was the gist of the proposal form filled in by Mr. Williams, with details as to age, etc., and the report of a medical examination by the ship's doctor.

"I got into communication with the Commercial Union Co., who, after due inquiries, instructed me to accept the proposal on their behalf, and advised me that they would 'cover' the transaction immediately.

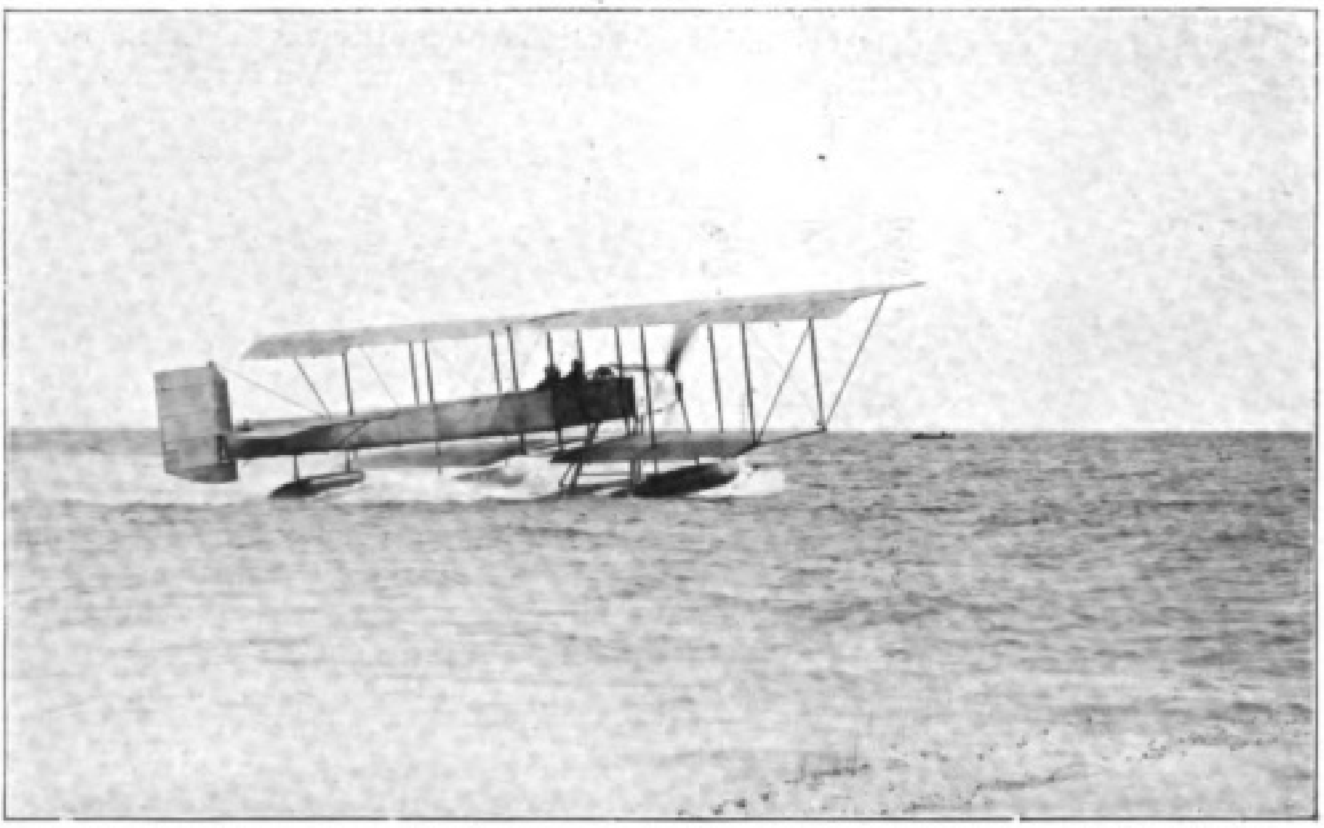
"I despatched a 'wireless' to Mr. Ashley Edwards to this effect, and named the amount of the premium. On receipt of my message Mr. Edwards would collect the premium and hand a cover note to Mr. Williams, and from that moment he would be insured for £1,000.

"The 'wireless' from Mr. Ashley Edwards came in to my office at 10 a.m., and I sent off the acceptance message at 10.45 a.m. I understand that it would reach the *Mauretania* when the Cunarder was 800 miles out to sea."

Wireless in Aircraft

FITTED with wireless with a range of 60 miles, carrying guns and speedy in flight, several hydro-aeroplanes are in course of delivery to the British Government. Such was the information conveyed to the country by Mr. Churchill in his speech on the Navy Estimates.

"We believe," said Mr. Churchill, "that the various types of hydro-aeroplanes which we have evolved and which are now being delivered, some of which will carry guns and which are fitted with wireless with a range of 60 miles, and which can rise and descend in comparatively rough waters, are, to put it very modestly, certainly as good as anything which exists abroad, and from the result of prolonged exercises during the past year at the various naval stations with hydro-aeroplanes and submarines, and in conjunction with the patrol flotilla, we have come to the conclusion that it is necessary that there should be a chain of hydro-aeroplane stations at various points on the British coast-line for naval scouting purposes, and for working with the patrol flotilla Stations are being rapidly established, and a number will be complete in the course of the present year. The problem of carrying aeroplanes in ships is also receiving attention, and a cruiser has been attached for this purpose. Altogether, compared with other navies, the British aeroplane service has started very well; the preliminary difficulties have been surmounted, and we shall now be able to move steadily forward in several promising directions."



A Short" Hydroplane of the type supplied by Messrs. Short Bros., of Eastchurch, to the Admiralty.

British progress, as Mr. Churchill indicated, has been steady. There are now 40 naval aeroplanes with 60 pilots, as compared with 5 aeroplanes and 4 trained pilots in March last year. By July, when the naval manœuvres take place, there will exist 75 machines and 75 pilots, and by the end of the year it is anticipated that the strength will be a hundred each of men and machines and that the combined strength of the naval and military air fleets will be not far short of 300 machines.

Free Instruction in Wireless Telegraphy

DETAILS OF PRIZE SCHEME

IN our last issue we announced that a course of instruction in Wireless Telegraphy would be given by means of a series of articles in THE WIRELESS WORLD, at the completion of which examinations would be held and certificates and prizes awarded.

We are now able to give full details with regard to this scheme. The articles (of which the first appears in this issue) have been so framed that anyone having no previous knowledge of electricity will be able, if the articles are followed carefully each month, to understand fully the practical working of a portable wireless telegraph apparatus, in theory and practice, and with a little experience in working will be able to operate such a set successfully.

Those competing for prizes will be divided into three categories :—

1. Members of Territorial units and recognised cadet battalions.
2. Members of Church Lads' Brigade and Boys' Brigade, and recognised cadet corps.
3. Members of the Boy Scouts Association.

On the completion of the series of eleven articles, examinations will be held under proper supervision for those in the above categories who wish to offer themselves.

On the result of this examination proficiency certificates will be given by the Marconi Company to those qualifying.

The following prizes will also be awarded :

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

The following conditions must be observed :—

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

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

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

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

The following conditions must be observed :—

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

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

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

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

The following conditions must be observed :—

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

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

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

Further details as to date and places of examination will be published from time to time in THE WIRELESS WORLD.

A column will be opened for correspondence on the subject of these articles, and any difficulties which arise from time to time will be there dealt with.

Additional prizes will be given should the number competing in any of the three classes warrant such a course being taken.

Instruction in Wireless Telegraphy

I. ELEMENTARY ELECTRICITY AND MAGNETISM.

IN a course of instruction on wireless telegraphy, dealing, as it does, at every point with the principles of magnetism and electricity, a knowledge of these prinples must either be assumed or be imparted by way of introduction. In this article we will indicate the kind of knowledge of magnetism and electricity needed, and which should be supplemented by a study of standard text-books on the subject.

MAGNETISM.

1. **Permanent Magnets.**—The lodestone is a natural magnet, and if a piece of hard steel is rubbed by it or another magnet it will be found to act in the same way as the natural magnet itself; that is to say, it will point north and south when freely suspended and will attract iron filings. The piece of steel is then "magnetised," and is known as a permanent magnet. One end of the magnet is called the North (N) Pole and the other the South (S) Pole.

If a straight coil is made by wrapping wire round, say, a pencil, and a current of electricity from a battery (the meaning of these words will be explained later) is passed through the coil it will be found that the coil behaves exactly as if it were a magnet.

If we insert a rod of hard steel into the coil and pass the current as before the steel rod will become a permanent magnet. **There are, therefore, two ways of making a permanent magnet.**

2. **Electro-Magnets.**—If, instead of the steel, we insert a rod of soft iron into the coil it also becomes a magnet, but it is only magnetic so long as the current lasts. **This is called an electro-magnet.**

3. **Magnetic Induction.**—As a magnet is made to enter a coil of wire electricity will be induced in the wire, but only so long as the magnet is moved. As the magnet is pulled out of the coil a current flows in the reverse direction. In this experiment the ends of the coil are joined together.

This effect is known as **magnetic induction.**

If we replace the magnet in this experiment by another coil through which we pass a current, thus (as previously explained) turning it into a magnet, we can obtain an "induced current" in the second coil either by moving the one coil in and out of the other or by keeping one permanently inside the other and by making and breaking the current in the first coil. This effect is further increased if the smaller coil surrounds a piece of soft iron. The smaller coil is called the primary coil and the larger the secondary coil.

This experiment illustrates the principle of the transformer or induction coil, which will be dealt with later.

4. **Production of Electricity by Magnetism.**—If a bar magnet is covered by a piece of paper in which a quantity of iron filings has been spread the filings become magnetised by induction and take up definite positions on curved lines on the surface of the paper.

If the magnet is replaced by a spiral of wire through which a current of electricity is passed a similar result will be obtained.

The space over which this effect is felt is called the **field of magnetic force** or the **magnetic field,** and the lines in which the filings tend to arrange themselves are called **lines of force.** We thus see that a magnetic field is made up of a number of lines of magnetic force, these lines being more concentrated at the poles of the magnet or coil.

If we move a coil in a magnetic field a current of electricity flows in the coil, but only so long as movement is taking place, or, if we keep the coil stationary and move the N. or S. poles of a magnet near it, a similar flow takes place. The deduction we can make from this experiment is **that when magnetic lines of force cross or are crossed by a conductor, electricity is induced in the conductor, and a current of electricity will flow if the conductors are joined so as to form a closed circuit.**

ELECTRICITY.

5. **Static Electricity.**—If we take a piece of amber (the Greek for which is Ἠλέκτρον), from which the name electricity is derived) and rub it with a piece of silk we find that the amber has acquired the property of attracting very light objects, such as fragments of paper, cork, cotton-wool, or pith balls.

Other substances have the same property ; for example, resin, sealing-wax, glass, etc.

These substances when thus rubbed are said to be electrified—that is to say, to have a charge of electricity.

Another peculiar property can also be made apparent, namely, the amber and silk will attract **each other** as well as pieces of paper or a pith ball, but the silk will repel another piece of silk similarly treated, as also will the two pieces of electrified amber. Since amber and silk have no effect on each other unless electrified, these qualities of attraction and repulsion must be due to the electric charges, and it will be found that there are two kinds of charges of electricity of opposite qualities, and that the rubbed amber or glass has one of these charges, while sealing-wax becomes charged with the opposite quality. These are commonly called **positive and negative** charges, and their symbols are plus (+) and minus (—) respectively, and it is found that like charges repel and unlike charges attract each other.

6. If we bring two equally and oppositely charged bodies in contact their charges unite and the bodies are said to be discharged.

It is necessary in making any experiments of this kind that all the apparatus should be perfectly dry ; even a damp atmosphere will render it difficult successfully to carry out such experiments.

7. If an electrified glass rod is passed gently through the hand we find that the rod will no longer attract the fragments of paper or cork. This shows that the electric charge on the rod has been conducted away by the hand and from this we get the term " conductor " for any substance capable of conducting a charge of electricity from one place to another.

8. **Conductors and Insulators.** — All metals are conductors, those most commonly in use being copper, brass, aluminium, iron, etc. To a much lesser extent, the human body and water (except the purest distilled water) are conductors.

The substances which will not conduct electricity are called insulators, and for this purpose the chief materials used in electrical apparatus are glass, porcelain, ebonite, silk, rubber, oils, dry wood, string, and cotton.

9. **Static Induction.—When a body positively charged is brought near another body which is not charged a negative charge is produced in the latter. This effect is called static induction.** Thus, if we touch a piece of paper with an electrified rod and then take another rod which has not been rubbed and hold it to the paper we find that the paper is attracted. This shows that

the paper must have been electrified by contact with the first rod, and consequently induced an opposite charge in and was attracted by the second rod.

10. **Condensers.**—Static induction is the principle underlying the construction of "condensers." A simple type of condenser consists of a glass plate covered with tinfoil on each side, leaving a margin of glass uncovered at the edges.

This condenser must be supported so that the tinfoil does not touch any other object.

If one side is touched with a glass rod which has been rubbed with a piece of silk as described above, it will be found that this side has been charged positively, and that the other side has been charged negatively by static induction.

If the glass and the surrounding atmosphere are dry these charges can be retained for a considerable time.

The object of the tinfoil is simply to distribute the charge over the whole surface.

Now if we take two pieces of wire and join them respectively to the "coats" of tinfoil and touch them together, the charges on each side will unite, and the condenser is said to be discharged. If a sufficiently large charge has been put into the condenser it will not be necessary actually to connect the two coatings, for when the opposite ends of the connecting wires are brought near enough sparks will pass between the ends and the condenser will be found to be discharged, just as if the wires had actually touched.

The object of leaving a margin of glass round the tinfoil is to ensure a large insulating surface between the coatings of the condenser.

This condenser is called Franklin's pane. Another familiar form of condenser is known as the Leyden jar, which is fully described in the text-books.

11. **Production of Electricity by Chemical Action.**—Electricity can be produced in an entirely different manner to the ways described in paragraphs 4 and 5.

If we take a plate of zinc and another of copper and immerse them in a jar containing dilute sulphuric acid, and we join the two plates by means of a wire, a current of electricity will flow from the copper plate to the zinc plate through the wire. This can be shown by making the current thus produced pass through a coil of wire, which, as already explained, will then act as a magnet, and will therefore deflect the needle of a pocket compass if brought near it.

Such an apparatus for producing electricity is called a voltaic cell. Other substances and other liquids can be used for the purpose. Thus, instead of copper and zinc in sulphuric acid, we can use graphite and zinc in a solution of bichromate of potash (or sal ammoniac), and other combinations can be used for special purposes. These are called primary cells, and a number of such cells joined together is called a primary battery.

12. **Storage of Electricity.**—A simple form of storage cell consists of two plates of lead immersed in dilute sulphuric acid and connected to the copper and zinc plates of a primary cell. The electricity passes into the storage cell, and the lead plate connected to the positive or copper plate of the voltaic cell will be coated with a brown deposit. If the wires are removed the storage cell will retain the electricity in it, and a current will flow when its two plates are connected by a wire. This second cell is called a storage cell, secondary cell, or accumulator.

13. **Potential or Voltage.**—We have been considering a current of electricity flowing in a conductor. This expression is illustrated by the following analogy: Two vessels are joined together by a pipe from the bottom of each, in which a tap is fitted. If we fill one full of water and open the tap the water will flow through the pipe until the water stands at the same level in both vessels. This flow is due to the difference of level in the first instance, which causes a pressure against the tap.

With electricity a similar thing occurs.

When two different parts of a conductor have a difference of electric pressure a current will flow from that part which has the greater pressure to the other part, until the pressure is equal throughout the conductor. This pressure is called "potential" or "voltage."

14. **Current.**—From the foregoing we get the following definitions :—

(1) A current of electricity flows whenever there is a difference of potential in a circuit.

(2) A current of electricity always flows from a higher to a lower potential.

From this we can say that in the experiment described in paragraph 11 the zinc plate is at a lower potential than the copper plate because the current flows from the copper plate to the zinc plate in the external circuit (although in the cell itself the current is generated on the zinc plate and flows through the sulphuric acid to the copper plate). Hence in voltaic cells and accumulators the plate or plates of lower potential are called negative plates, and those of higher potential positive plates. Thus the current may be considered to leave the cell which produces it at the positive pole and re-enter it at the negative pole.

15. **Resistance.**—In paragraph 8 we have explained the meaning of conductors and insulators or non-conductors. Although no substance is either a perfect conductor, or a perfect insulator, but all possess both qualities in a varying degree, yet the property chiefly possessed by conductors is known as "conductivity," and that by insulators as "resistance." Even the best conductors, however, offer a certain amount of resistance to the flow of electricity, but very much less than that of non-conductors, and conversely even the best insulators have a certain amount of conductivity.

Resistance is the property which a body possesses of opposing the flow of electricity through it. This can be compared with the resistance which friction offers to the flow of water through a pipe. A small pipe will offer more resistance than a large pipe, a long pipe will offer more resistance than a short pipe, and a pipe with a rough interior surface will offer more resistance than a pipe with a smooth surface. Similarly with electricity, the resistance of a conductor is increased as:

(1) The diameter is decreased;

(2) The length is increased;

(3) A less suitable material is used.

16. **Electrical Units.**—These three important factors of electricity—namely, the current, the pressure or voltage, and the resistance—are measured by the following units:

The unit of current, or rate of flow, is the **ampêre,** corresponding in the water analogy with gallons per second.

The unit of pressure is the **volt,** corresponding with the difference of water level.

The unit of resistance is the **ohm**, corresponding with the friction in the pipe.

These units are the three simple units used in all electrical calculations, and they bear a certain relation to each other, known as Ohm's law.

The statement of this law is as follows .—

The current flowing through a circuit is directly proportional to the potential and inversely proportional to the resistance between the ends of the circuit. This law may be stated in other words thus :—

$$\text{Current} = \frac{\text{Voltage.}}{\text{Resistance.}}$$

$$\text{Voltage} = \text{Current} \times \text{Resistance.}$$

$$\text{Resistance} = \frac{\text{Voltage.}}{\text{Current.}}$$

That is to say, the more pressure we apply the greater the current, and the more resistance there is the less the current.

There are, however, two other units which we must take into consideration—one is the unit of capacity or **Farad,** and the other is the unit of induction or **Henry.**

17. **Capacity.**—The quality of "capacity" can be explained by the following illustration :—

A football bladder will normally hold a

definite quantity of water; if, however, the water is forced into the bladder under pressure it will hold a greater quantity than before owing to the elasticity of the bladder itself.

The difference between the quantity of water it will hold normally and the quantity it will hold under a given pressure is the equivalent of the electrical capacity of a condenser. If the walls of the bladder are thinner or are made of a more elastic material, although the amount it will hold normally will be the same, the amount it will hold under the same pressure as before will be greater. So with a condenser the capacity will be increased as the thickness of the glass plate is reduced, or if a more electrically elastic material is substituted for the glass.

18. **Inductance.**—All stationary bodies show a tendency to oppose being put in motion. This is called "inertia." Similarly all bodies when in motion show a tendency to oppose being stopped. This is known as "momentum." It is wel lknown that it takes a considerable time for a train to get up full speed. This is due to inertia. Also a train travelling at full speed takes a considerable time to be brought to a standstill. This is due to momentum. In the same way there is a tendency in a circuit to oppose a current commencing to flow through it and to oppose its stopping. This quality is called **inductance. Inductance opposes any change in the flow of electricity in a circuit,** just as inertia or momentum opposes any change in the motion of a train.

Inductance is really due to the magnetic field produced by the current in the circuit, and, as explained in paragraphs 3 and 4, the magnetic field can be varied by the form of the circuit, and so we find that inductance is dependent upon the form of the circuits. Thus a straight piece of wire would have very little inductance, but the same wire wound into a coil would have much more. We have seen that such a coil will produce marked magnetic effects, either by itself or still more with an iron core inside it; whereas a straight wire will be found to give only feeble magnetic effect. So we find that the inductance of the circuit has a direct bearing upon the magnetic effect of that circuit, and that the introduction of an iron core into the coil of wire increases its inductance still further in exactly the same way as it increased the magnetic effect.

19. **Power.**—The amount of power which an electric current exerts depends on its rate of flow in ampères and on its pressure in volts. The **watt** is the product of one ampère and one volt, and is the unit of power. The kilowatt, or 1,000 watts, is almost exactly one and a third horse-power.

II. Morse Alphabet or Code.

We give below the alphabet and numerals in the Morse code, and in our next issue we will give punctuations and general abbreviations commonly used in Morse communication.

The method by which signals are sent in wireless telegraphy is the same as that used for land and cable telegraphy—namely, the Morse code.

The Morse code as used by all countries

a	· —	n	— ·
ä	· — · —	ñ	— — · — —
á or å	· — — · —	o	— — —
b	— · · ·	ö	— — — ·
c	— · — ·	p	· — — ·
ch	— — — —	q	— — · —
d	— · ·	r	· — ·
e	·	s	· · ·
é	· · — · ·	t	—
f	· · — ·	u	· · —
g	— — ·	ü	· · — —
h	· · · ·	v	· · · —
i	· ·	w	· — —
j	· — — —	x	— · · —
k	— · —	y	— · — —
l	· — · ·	z	— — · ·
m	— —		

1	· — — — —	6	— · · · ·
2	· · — — —	7	— — · · ·
3	· · · — —	8	— — — · ·
4	· · · · —	9	— — — — ·
5	· · · · ·	0	— — — — —

except America is called the "Continental Morse," and is a dot and dash system throughout, with a maximum of four elements in any letter; an element is either a dot or a dash.

Whatever the speed at which signals are sent, the following rules must be remembered and strictly adhered to:

A dash is equal in length to three dots.

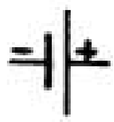
A space between two elements in a letter s equal in length to one dot.

The space between letters in a word is equal in length to a dash.

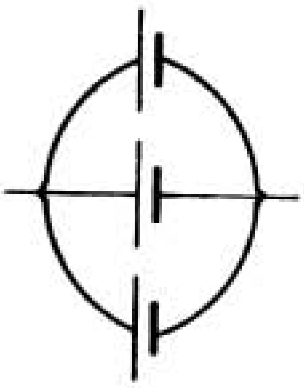
The space between words in a sentence is equal in length to two dashes.

It is of the utmost importance to learners, when practising sending in Morse, that these rules should on no account be disregarded, as it will easily be understood that the sending and receiving of messages commercially would be difficult between men who had been taught different systems of spacing.

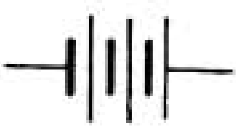
SYMBOLS USED IN DIAGRAMS OF WIRELESS TELEGRAPHY CIRCUITS.



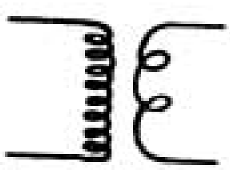
Primary or Secondary Cell.



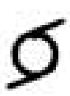
Battery of 3 Cells in "Parallel."



Battery of 3 Cells in Series.

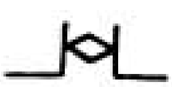


Transformer or Induction Coil.

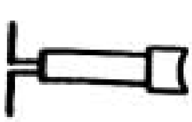


Direct Current Dynamos.

Spark Gap.



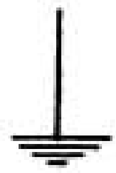
Crystal Detector.



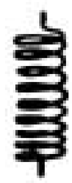
Telephone.

Manipulating Key.

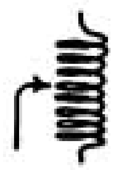
Aerial Wire or Antenna.



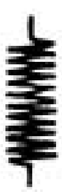
Earth Connection.



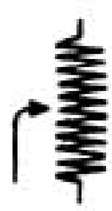
Coil having chiefly the quality of Inductance.



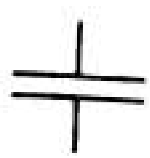
Coil in which the Inductance can be varied.



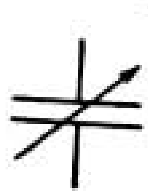
Rheostat. Coil having Resistance.



Coil in which the Resistance can be varied.



Condenser having the quality of Capacity.



Condenser the Capacity of which can be varied.

An Amateur's Experiences

By LESLIE H. B. STAVELEY

The Author describes his apparatus and its work, and he concludes with a few useful hints for amateurs

IT is some four or five years ago since I first started "wireless" experiments, my aim being then to receive signals from a friend about a quarter of a mile away. I shall never forget my feelings when I first got "Seaforth." In those days I used an aerial 70 ft. long and 20 ft. average height, a silicon detector, and 1,000 ohm 'phone. My next improvement was to instal a double-slide tuning coil. I then used three different kinds of aerials, until about three years ago I first heard Paris. My aerial was then four wires 40 ft. long and an average height of 30 ft. On this aerial I could just hear Poldhu and Cleethorpes.

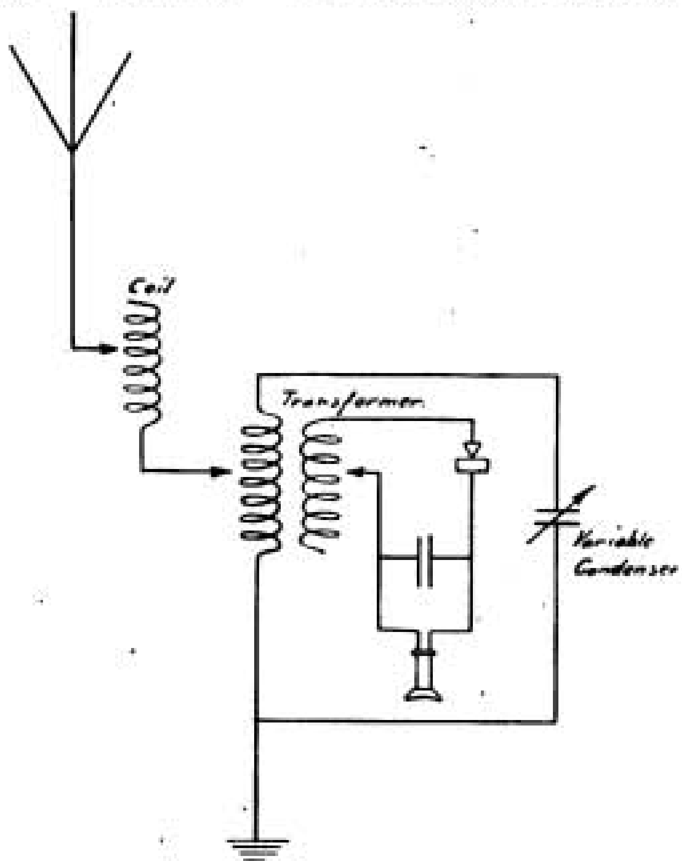


Fig. 1.

About twelve or eighteen months ago I put up my last aerial. It was slung between two poles 45 ft. high and 35 ft. apart; the aerial was 60 ft. long, the extra 25 ft. hanging vertically down; the aerial itself consisted of eight wires, No. 16 s.w.g. bare copper wire, arranged in two four-wire "sausages," 4 ft. diameter. The lead in was from the highest end.

Of the poles one was constructed of two 16 ft. sections of 3 in. by 3 in. joist and one 17 ft. section of 2 in. by 2 in. These were bolted together, and the resulting height, allowing for overlapping of sections, was 45 ft. There are stays from each section, which consist of steel clothes-line. The total cost of this pole was 9s. The other was a 30 ft. scaffold pole, with a 16 ft. section of 2 in. by 2 in. joist bolted on, and steel stays as on the first-named pole.

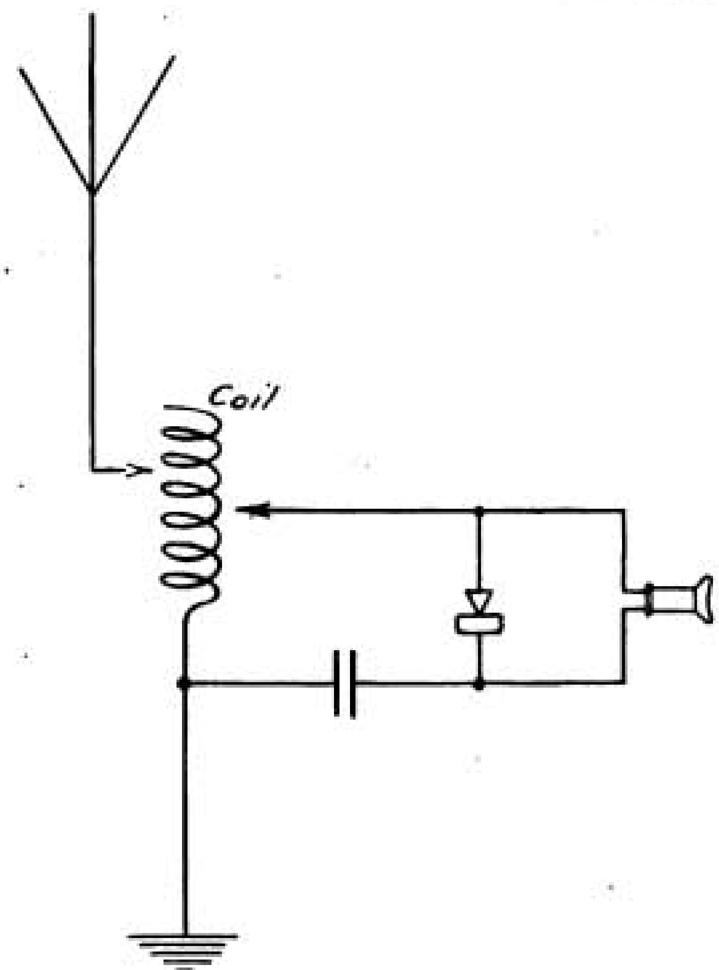


Fig. 2.

With regard to my instruments. I started, as I have said, with a detector and 1,000 ohm 'phone, connected direct on to the aerial and ground. I then added a double-slide tuning coil, using the connections shown in Fig. 1. For a considerable time I used this with a silicon detector—the one I had used from the beginning. My next improvement was to use a detector consisting of a piece of galena, on which rests a small spring of No. 36 s.w.g. copper wire, which I replace at least once a week, owing to the point oxidising. My next addition was a variable condenser, which I connected across the ends of my tuning coil.

Last summer I made a "Doughnut" oscillation transformer, but could not get very satisfactory results with it, and so made a transformer with a secondary which slides in and out of the primary. With this I get nearly twice as far as I did with my tuning coil.

My latest experiments are testing the efficiency of tellurium and zincite as a detector, and up to the present I have found them about as good as a good silicon detector.

Fig. 3 shows my apparatus assembled as a portable set, which contains a loose couple transformer and a detector (galena) and in the box which constitutes the base is a load coil and a variable condenser. The whole tunes to about 4,000 metres and measures 12 in. by 10 in. by 8 in. The connections are shown in Fig. 2.

The portable set has been designed for use in conjunction with some scouts. The aerial is two wires of No. 19 s.w.g. bare copper wire, slung between two masts at any convenient distance apart, each consisting of six 6 ft. scout poles joined by means of brass ferrule joints and stayed at every joint above the second. This gives very satisfactory results, and I have received up to 1,000 miles by it.

My station is at Liscard, Cheshire, just three miles from Seaforth.

It is, in my opinion, advisable for an amateur to start receiving on a tuning coil, or else, if he starts with a transformer and no experience of adjusting instruments, he may be a month without getting any signals.

My sending consists of a motor-cycle coil, condensers, and sending loose coupler, with the secondary *fixed* outside the primary. My licence allows me 10 watts on a wave-length of 100 metres. If I think the natural wave-length of my aerial is too great I insert a condenser—usually a variable one—in series with the ground. This apparatus, with my portable set gives me a range, under all conditions, of at least five miles. I have been heard up to fifteen miles.

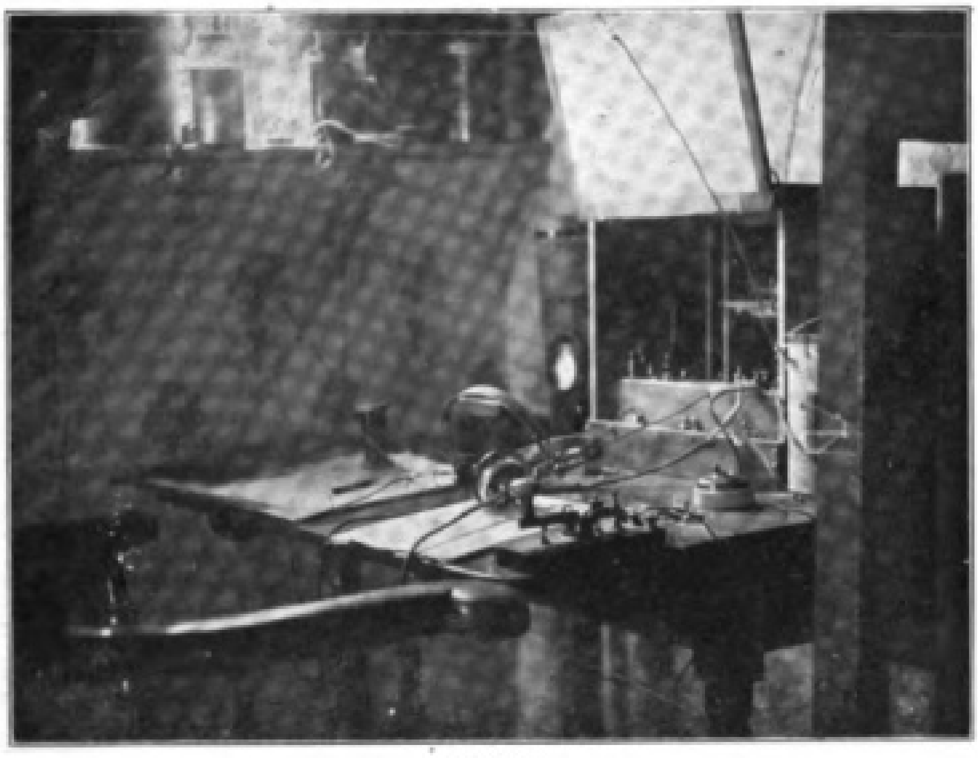


Fig. 3.

AMATEUR NEWS

THE station shown in the accompanying illustration should have a special interest for our scout readers, inasmuch as it was installed by Scout G. C. Cook, of the 1st Kingston Hill troop, assisted by Scouts R. E. Furniss and R. W. Bowshill, who made the apparatus solely through information obtained from the *Marconigraph*. Scout Cook is shown demonstrating his apparatus before a great rally of scouts at Kingston-on-Thames, on the occasion of an inspection by the Chief Scout, Lieut.-Gen. Sir Robert Baden-Powell. We understand that it works exceedingly well, and that messages have been received over long distances.

Scout G. C. Cook, of the 1st Kingston Hill Troop, operating a station which he himself constructed.

* * *

The association movement among amateurs interested in wireless telegraphy is growing apace. One of these associations is the Cheshire Radiographic and Scientific Society, which came into existence in February last with the object of promoting the interests of amateur experimenters in wireless telegraphy and kindred subjects by comparison of experiences. Fortnightly meetings of this Society are held at the temporary headquarters of the Hon. Secretary, Mr. R. J. Thompson, Broad Street, Sale. A paper is read and discussed at each meeting. On April 12th Mr. Thompson read a paper and conducted experiments on high frequency phenomena. On April 16th Mr. P. C. Carlett, M.Sc., read a paper on the subject of Condensers. The Society are purchasing standard testing instruments and a lantern, etc.

* * *

The St. Paul's Troop of Boy Scouts, Bournemouth, are evidently determined to make a bold bid for some of the prizes which we are offering in connection with the series of instructional articles now appearing in this magazine. A special "wireless class" has been formed, and our articles will be the basis of instruction. The Association are to be congratulated upon the excellent step which they have taken, which can be held out as an example to other associations to follow. The instructors to the class are Mr. C. H. Woodward and Mr. H. C. Binden, and these gentlemen recently delivered an interesting and instructive lecture on the subject, during the course of which they drew particular attention to THE WIRELESS WORLD scheme, and to the inspiring message of approval from the Chief Scout, Sir R. S. S. Baden-Powell.

* * *

Wireless communication was established during the past month between Taplow, Buckinghamshire, and Shirley, near Croydon, by the London Wireless Telegraph Company of the Royal Engineers (Territorials) as part of their Easter training. The detachment at Shirley was with the headquarters of an imaginary invading army, and the men at Taplow were attached to a cavalry brigade operating in Berkshire and Buckinghamshire. Constant messages were exchanged between the Army wireless field stations employed at the two places.

* * *

A meeting for the formation of the Birmingham Amateur Wireless Association was held on April 1st, at Queen's College. There was an attendance of about forty, and the chair was occupied by Mr. W. F. Baxter Bartram. The following officers were elected: President, Captain A. Handley, of the Territorial Wireless Company attached to the Southern Army; Treasurer, Mr. P. Stanley Beaufort; Hon. Secretary, Mr. J. B. Tucker; Committee: Messrs. W. B. Bartram, H. Beresford, A. H. Handford, J. Littley, G. N. Lloyd, F. Perry, L. Ray, and J. J. Shaw. A fixed club-room has not yet been obtained, but negotiations are on foot, and it is hoped that the Society will very shortly be able to settle in rooms where lectures by authorities on the subject will be given, also papers by members. A club aerial will be erected, and various types of instruments installed. The subscription was fixed at 5s. for the current year. Mr. L. Ray kindly offered the Society the use of a room capable of holding forty people, until a club-room was obtained. The address of the Secretary is Brentwood, Alderbrook Road, Solihull, Birmingham.

* * *

The first meeting of the Liverpool Wireless Association was held recently, the chair being taken by Mr. Z. Tomlinson, of Aigburth. The lines upon which the Association was proposed to be worked were fully set forth by Mr. S. Frith (Crosby). It is intended that a room shall be taken in the centre of the city as a clubroom, and that permission be applied for, and a plant erected for the benefit of the members. The annual subscription has been fixed at 5s. It is intended to hold meetings, lectures, debates, exhibitions and also outside excursions, etc., and a cordial invitation is extended to all persons interested in Wireless Telegraphy to apply for membership. Mr. S. Frith, of 6, Cambridge Road, Great Crosby, Liverpool, has been appointed hon. secretary for the new-formed Liverpool and District Amateur Wireless Association, which is the first of the kind in the country. Mr. Frith won the first prize in 1907 in the Harmsworth Electrical Examination, open to the United Kingdom.

Patent Record.

The following patents have been applied for since we went to press with the April number of this magazine:—

No. 7,396. March 28th. Graham & Latham, Ltd., and Bernhard F. Sobatka. Self-inductance or tuning coils.

No. 7,502. March 29th. Ernest S. Heurtley. Wireless telegraphy.

No. 7,610. March 31st. Guglielmo Marconi and Charles S. Franklin. Transmitting apparatus for use in wireless telegraphy and telephony.

No. 7,847. April 3rd. Richard Cartwright. Wireless-controlled vessels.

No. 7,977. April 4th. Graham & Latham, Ltd., L. J. Graham and Bernhard F. Sobatka. Detector for use in wireless telegraphy.

QUESTIONS AND ANSWERS

We invite our readers to send us questions on technical and general problems that arise in the course of their work or in their study. To enable us to reply in the current number such questions should reach us by the 12th of the month.

U. S. E.—*Wire in Tuner.*—Why is the wire in the detector circuit of the multiple tuner thicker than that in the intermediate and aerial circuits ?—*Answer.*—Since the detector circuit of the tuner has to have in series with it the primary of the detector, which is of considerable resistance in itself, it is advantageous to keep down the resistance of the coil in the tuner, so as to keep the total resistance of the circuit within suitable limits. But more important than this point is the fact that the use of the thicker wire makes the coil (which has a definite number of turns governed by the fixed amount of inductance required in it) longer axially than if it were wound of the thinner wire, and this increase of axial length produces a more tubular field and enables the spherically-wound coil of the intermediate circuit to be more closely linked with it.

* * *

P. J. R.—*The Static Transformer.*—Instead of using the convertor with transformer, as in the 1½-kw. set, would it not be possible to have an armature with a secondary winding, so doing away with the transformer, taking two tappings off the separate slip-rings, so admitting of 300 and 600 metre waves being used ?—*Answer.*—It cannot be said that what you suggest is absolutely impossible, but it would be a backward step. The whole advantage of a static transformer—and it is a very great advantage—lies in the fact that the long fine-wire windings which are necessary in order to produce the high voltage from the low voltage are stationary, and can therefore be thoroughly insulated—by immersion in oil, for instance—and moreover are not subjected to the strain of rapid rotation. Also, since the windings have not to be rotated, they can be made of thicker wire, since the extra weight and bulk do not matter, and thus the ohmic losses can be reduced. If the machine which you suggest had been under your care for some time we think that you would have been very pleased if you invented the static transformer, with its increased cheapness and its freedom from breakdown.

* * *

B. R. L.—*The 'Phone Condenser.*—What is the influence of the 'phone condenser on the oscillatory currents of the receiving circuit when used with the Marconi Magnetic Detector ?—*Answer.*—The currents in the secondary circuit of the magnetic detector are not, strictly speaking, oscillating currents. The oscillations of the incoming wave are transformed, by the action of the detector, into pulses of alternating-current, the major portion of which is of the frequency of the discharges producing the wave-trains at the transmitter—*i.e.*, of the frequency of the wave-trains instead of the actual waves. Mixed up with this frequency—which is, of course, quite a low one—there are frequencies which are multiples of this, namely, the harmonics of the transmitter-note. The effect of the telephone-condenser is to bring the telephone-circuit more or less into resonance with some of these harmonic frequencies, and thus to alter the characteristic quality or timbre of the sound produced ; or, in certain cases, it may be adjusted to give resonance with the fundamental note itself. In such a case there is said to be " note-tuning." As a general rule, however, the 'phone condenser is used to modify the quality of the signal so as to suit the ear, without actually strengthening the sound.

* * *

E. W. B.—*Tuning.*—I am using a " plain-aerial " transmitter and an inductively-coupled receiver (crystal) with switch-contact tuning. Knowing that the plain-aerial system is considered to give a practically untuned wave-train, I am puzzled to find that I not only get fairly sharp tuning on the primary, but also have to short-circuit the greater part of my secondary circuit.—*Answer*.—The plain-aerial wave-train, though comparatively "untuned," nevertheless has a definite wave-length of its own—namely, about four times the actual length of aerial; it is therefore susceptible, to a certain extent, to tuning at the receiver.* But with the peculiar type of receiving jigger which your drawing shows there are so many effects possible which may mask themselves in the disguise of "tuning." For instance, all the time you are varying your circuits with the intention of tuning, you are also varying the coupling between the two circuits; and you must remember that it is possible to weaken signals by too tight a coupling just as by too loose a coupling. You would be in a far better position to find out what is actually happening if you made or bought some form of wave-meter, with which you could investigate the condition of each circuit separately.

* * *

W. M.—*The Crystallite Detector*.—Can you offer any explanation of the following peculiarity of the crystallite detector? The detector consists of contact between zincite and bornite. As is well known, crystallite detectors have a way of losing their sensitiveness for no apparent reason; and to enable the operator to ascertain if the detector is still sensitive at any time when no signalling is going on a buzzer and cell are made use of. These are placed some distance from the receiving circuit so that the sound is not heard except in the telephones when the detector is sensitive. On discovering, through the sudden cessation of signalling, that the detector has gone "off," I very frequently find that on pressing the push, and so starting the buzzer, the detector is again rendered sensitive; also that very strong signals will sometimes have this effect.—*Answer*.—We think that when a zincite-bornite detector is adjusted for maximum sensitivity, much of the effect is produced by a species of coherer-action between the two crystals. A true crystal receiver acts not in virtue of any coherer action, but by the rectifying power of the crystal. If the crystallite-receiver contact happens to cohere permanently, the receiver will lose the additional sensitiveness due to coherer-action; and the effect of buzzer signals, or of strong ordinary signals, would probably be to restore the extra sensitiveness by breaking the coherence either by a tiny spark or by a thermo-electric effect. Both these things might, of course, produce coherence instead of de-coherence; this is probably what happens in those cases when you find that the buzzer signals will not restore the sensitiveness. Bornite is not a very satisfactory substance to work with; it is so friable. Why not try a zincite-tellurium contact?

* * *

G. L.—*Hundred Yards Range*.—(1) How far will a ¼-in. spark-coil send messages? Will it send 100 yards? (2) Which is the better receiver to use with a telephone having a resistance of a few ohms—silicon or galena? (3) What size of aerial is needed to work about 100 yards?—*Answer*.—Our inquirer must be warned against expecting final and definite answers to questions of this nature. In the hands of an expert the mechanism of an electric bell, driven by a 4-volt battery, can be made to give good communication over a mile or so when the receiver is properly designed. On the other hand, that same mechanism might easily fail to communicate from one room to another when in less expert hands or with less perfectly-designed receiving apparatus. An ordinary motor-car ignition coil, in combination with a little aerial not more than 30 feet in height, can maintain communication over five or more miles with a good receiver; but such a coil used in conjunction with a badly-designed receiver, or with imperfect tuning, might often fail to work over a hundred yards. Again, such a transmitter, even if used properly and in conjunction with a good receiver, might have its range enormously decreased if set up in the midst of houses, for the short waves suitable for such a small aerial would be seriously hampered by such obstructions. In such a case it would probably be better to increase the height of the aerials rather than the amount of power used.

A telephone with "a few ohms resistance" does not sound very suitable for wireless reception. To be of much service it should have enough ampère-turns to give about 150 ohms resistance, and even then is only

* See article on "Syntony" in the *Year-Book*, just published.

really suitable for use with a very low-resistance receiver such as the Marconi Magnetic Detector. If such a telephone has to be used with a crystal receiver, it ought to be helped by the use of a telephone-transformer, which is really a small induction coil reversed so as to form a "step-down" transformer; the crystal circuit being connected to the fine-wire winding and the telephone to the thick-wire primary winding. The fine-wire winding should be shunted by a condenser. If such a telephone transformer is not to be used, in spite of the fact that a high-resistance receiver, such as a crystal, is employed, then the telephone itself should be wound to have a resistance of the order of eight thousand ohms. If, however, the magnetic detector is used—and for steady communication between a pair of stations there is no equal to the magnetic for simplicity and regularity—then the low-resistance 'phones of about 150 ohms are all that is required. If you will neither make nor purchase a "magnetic," we should recommend you to use, as your standard receiver, a carborundum crystal with a properly-designed circuit and telephone or telephone and transformer, keeping the various more eccentric crystals for experimental work, where uniform and reliable results are not so necessary. If you wish to get the best results possible with your very low resistance telephone and one of the two crystals you mention, you had better choose the alternative which has the lower resistance—namely, galena.

* * *

A. E. M.—*Wireless Telephony.*—Will you kindly explain how the timbre of a sound is conveyed by wireless telephony? It is fairly clear how pitch and intensity can be conveyed, but I do not see how the quality of a sound (as of different voices) is communicated.—*Answer.*— The characteristic timbre of a voice depends on the character of the vowel-sounds. Each of these vowel sounds has a fundamental frequency; thus the *u* in the word *rude* corresponds to a frequency of 176, while the *a* in *father* corresponds to one of 1,188 (Helmholtz).

In speaking or singing, the vocal chords produce the note of the voice, and the function of the mouth is so to modify this note as to produce the required vowel-sound. The note has a certain fundamental frequency, accompanied by a whole series of harmonic frequencies (which are simple multiples of the fundamental), and also by a series of other "partials" or "overtones" which are not simple multiples. Amongst all these series of frequencies, a vowel-sound finds one which is very near to its own value. The frequency of a vowel-sound is not absolutely rigid; it is capable of modification within certain limits; so when the mouth is set to produce a certain vowel-sound, it modifies this to agree with one of the partials in the note produced by the vocal chords; this particular partial is therefore strengthened by resonance with the cavity of the mouth, and the note leaves the mouth with this vowel-sound impressed on it. The pitch of the spoken vowel is determined by the fundamental of the vocal-chord note, which forms the bulk of the sound. The timbre or quality of the sound is determined by the relative values of the fundamental and the various partials, and also by the relative phases of these. All these frequencies, of different amplitudes and different phases, combine into a sound-wave of irregular form—a Fourier's series of mixed waves—which on reaching the ear once more resolved into its component waves.

When the transmitter of a telephone—whether wireless or otherwise—is spoken into, the result is that an electrical disturbance is sent out which has exactly the characteristics of this irregular wave; and, if communication is good, the disturbance maintains all these characteristics throughout its journey and, on reaching the receiver, is converted once more into the irregular sound-wave to which it corresponds. Finally, this latter is resolved by the ear into component waves, and the whole entity of the sound—pitch, timbre and vowel-sound—is recognised by the brain. If the communication is not good, the true form of the compound-wave may not be impressed on the electric disturbance; or, if so impressed, it may lose some of its true form either during its journey or at its re-conversion at the receiver; in this case, the received sound is imperfect, articulation may be blurred, and the quality of the voice may be lost.

For a comparison between the merits of

the wireless and the ordinary telephone, in respect to this point, see the first part of Dr. Erskine-Murray's article in the "Year-Book of Wireless Telegraph and Telephony."

* * *

H. E. H. B.—*Arrangement of Apparatus.*—Having purchased the following apparatus, I should be pleased to know how it may be arranged to give the best results. An aerial wire of height 40 feet and length 60 feet is available. The apparatus consists of 2,000 ohm telephones, various crystal detectors, sliding inductance, small fixed condenser, variable condenser with oil dielectric, and an inductively-coupled receiver with variable primary and secondary. Is this latter a desirable instrument, or would the direct-coupled gear be more satisfactory ?—*Answer.*—It is practically impossible to give a definite reply without a more quantitative description of the apparatus at your disposal. The inductively-coupled receiver (or rather "jigger") will be the most satisfactory, if it is properly designed. For use with crystal receivers and others of high-resistance, such as the Fleming valve, the secondary winding should be very long compared with the primary, so that it requires only a very small capacity to put it in tune with the various wave-lengths which you wish to receive ; probably both your condensers are far too big for this purpose. A suitable jigger-secondary would require a condenser somewhere of the order of a millionth of a microfarad, and this should be variable ; though in your case, since the jigger-secondary itself is variable, this is not so essential. You could easily make a suitable condenser, but the question arises as to whether the secondary you have is sufficiently long. It may be taken as a general rule that the more inductance and the less capacity you have in the crystal jigger-secondary circuit the better the results. If you have a wave-meter at your disposal—which everyone who experiments in wireless should have—you will be able to find your way.

Your jigger-primary should be at one end of the secondary, not at the centre, and you should take care that it is the other end of the secondary which is connected to the crystal.

It is not clear whether your jigger has a variable coupling ; if it has not, then you must adjust the coupling by varying the number of turns in your variable primary, and re-tuning by your sliding inductance in your aerial circuit.

With some of your crystal detectors you will require a 6-volt battery and a potentiometer, which should have a maximum resistance of about 500 ohms.

With such a short aerial you are not likely to require a tuning-condenser in series with your aerial, more especially since you appear to have a continuously-variable inductance ; with the more usual tuning-inductance, variable in steps only, a tuning-condenser is useful for accurate tuning in between the steps.

Your small fixed condenser might do for the shunt-condenser across the telephones, though it would be a matter of luck if it is the optimum value. Possibly your variable-condenser might be better here, if it is large enough.

The circuits as outlined above may be summed up as follows : aerial, tuning-inductance (possibly tuning-condenser), jigger-primary, earth ; forming your primary or aerial circuit. Jigger-secondary, with coupling to primary at bottom end ; small (preferable variable) condenser across ends of secondary, forming the oscillating secondary circuit which must tune to the received wave. One side of crystal connected to top end of secondary, the other side through the telephones (shunted by a suitable condenser) to the slider of the potentiometer which is across the battery. Then the correct side of the battery (according to the connection of the crystal) to the bottom end (*i.e.*, the end to which the primary has its coupling) of jigger-secondary. If you are using a crystal which does not require an external EMF, the battery and potentiometer will, of course, be cut out.

We repeat once more the advisability of using a wave-meter wherever you can, exciting the various circuits by means of a buzzer, or else excite the wave-meter itself, and use it as a transmitter of variable wave-length.

Do not forget that your crystal circuit is connected in parallel with the capacity across the jigger-secondary, so that this capacity will be affected by that of the circuit.

The Imperial Wireless Scheme.

Select Committee Inquiry.

THE Select Committee which is inquiring into the Marconi contract resumed its sittings on Tuesday, March 25th. During the course of the inquiry Mr. Harold Smith, Mr. G. Terrell and Mr. A. Gordon Harvey resigned from the Committee. Sir F. Banbury, Mr. J. G. Butcher and Sir Walter Essex were appointed in their stead.

Sir Rufus Isaacs was the first witness called. In response to the chairman's question whether he had any negotiation with the Postmaster-General in connection with the Marconi agreement, he denied that he had ever had any negotiation, direct or indirect, of any sort or kind, with any officials, with any member of the Government, or with anybody connected with the negotiation from beginning to end. He had not taken any part whatsoever in advising on the agreement; it never came before him at all, and he knew nothing until just before the contract was announced. Up to March 7th, the date when the agreement was signed, he never had any dealings in either the English Marconi Company, the Canadian company, or the Spanish company, or any companies of any sort connected either with the Marconi or any wireless enterprise. He was anxious that there should be no sort of suggestion made hereafter that his denial was incomplete, and he wanted to make it quite clear that he had never dealt in options or in syndicates, or had any interest in any option or syndicate or in any share transaction of any sort or kind, either in his own or anybody else's name, or in that of any company.

The first he heard of the American company or any transaction with the American company was on the return of Mr. Godfrey Isaacs from America. On April 9th his brother told him that he had made himself responsible for taking over a very large number of shares in the American Marconi Company, and asked witness if he and his brother Harry would take any of the shares, not, however, to relieve Mr. Godfrey Isaacs, who offered them as a good investment. He made particular inquiry, and carefully assured himself that the American company had nothing to do with the English company, and was not interested in its profits and operations. He made up his mind not to take any shares in the company.

On April 17th witness met Mr. Harry Isaacs, who insisted that the shares were going to rise, and that they formed an excellent investment. He bought from him 10,000 shares at 2. That was six weeks after the announcement had been published in the Press of the acceptance of the tender of the English company by the Government. On April 9th, if he had accepted his brother's offer, he could have bought them at $1\frac{1}{16}$ "I was dealing in my own name," added witness.

On the next day, the 18th, the shares rose as high as 3. On that day the American company authorised the issue of new capital.

"One of the questions I put to my brother when he was pointing out the advantages of investing in these shares was whether the public would get all the same information as had been given to me as to the arrangements made in America. He told me that they certainly would, and that the board would issue a circular. A circular was issued, and the public knew as much as I knew. On the 19th of AprilImy asked broker what was the price of American shares. He was very anxious that I should sell out. I advised him to sell, and he sold for me altogether about 5,000 shares. All these transactions were made in my name, and the accounts rendered in my own name, as I have done through my broker for years."

Sir Rufus Isaacs then described how he authorised the sale of the shares on June 20th. "My proportion of the sale was 3,570 shares, averaging £3 6s. 6d. each," he said.

Applying the profit made on 3,570 shares sold to reducing the price paid for 6,430 shares, the result is that the 6,430 shares stand me at a cost of £1 5s. 6d. per share. That is the balance of the whole transaction.

The Chairman: When you were making your speech in the House in October last did the thought occur to you that you could get rid of some of these rumours if you had mentioned your investment in the American Marconis? Because, being Marconis, you can easily understand that one company might be confused with another?

Sir Rufus Isaacs: It did not occur to me, and it does not occur to me now. I will assume that the person who circulated these rumours had information. There were entries in books in my name, and contract notes and accounts; I assume, therefore, that somebody had information. What I want to know, and am entitled to know, is what person, with that information before him, wrote the lies, which were built up on some such foundation? Who is that person?—that is what I want to know.

The Chairman: You thought that your investments in American Marconis did not form a proper topic for remarks?

Sir Rufus Isaacs: I thought it was a proper thing to tell the committee about. What I felt I should do in the speech was to deal with four specific charges which were made. I did not want in any way to confuse any question which was being raised with regard to other matters with these charges—two of them of a very grave character. I wanted the House of Commons and the public to know that there was absolutely no foundation of any sort for any of those statements. I am sure that if anyone had said in October, when I made that speech, that it would be some six months before I should be called before the Committee he would have been laughed at and ridiculed. But at the time that this took place I certainly thought that it would be a very short time before we should be examined. I hope you will not think that I am in any way criticising. I do not intend for a moment to do that, and I do not think there would be any justification. I have stated quite clearly that there is no truth in the rumours. May I add this? At this time, last October, no one had ever suggested that any transaction in any other company—either Spanish or Canadian or American—would in any way savour of corruption, or was the subject matter of criticism of Ministers. The whole of the suggestion from beginning to end was limited to speculation before the acceptance of the tender of March 7th was announced in the public Press on March 8th. That was the statement to which I directed myself.

Mr. Lloyd George was next examined. He explained his position with reference to the negotiations, and the circumstances in which he acquired the shares from Sir Rufus Isaacs. He said: "Perhaps I had better state here that I have never held any interest of any sort or kind either before or after April 17th in the contracting company. Up to April 17th I had not acquired any interest of any sort or kind in any wireless enterprise in this or any other country, and I wish this denial to be of the most public character. I never trafficked or dealt in any shares of the British Marconi Company at any time, either before or after April 17th, neither directly nor indirectly, neither myself nor through anybody else, and beyond what you, sir, have stated to the Committee to-day quite accurately, I never bought or sold or held any interest in any shares in any other wireless concern." If there was any suggestion of corruption, he continued, he would like to have it made perfectly clear while he was in the chair. What were the conditions at the moment the investment was made? The terms of the contract had been announced six weeks before that date in the public Press. It is true that a formal contract had to be entered into, but the real terms of the contract had been announced before. The public knew all about it, and its effect must have been fully understood.

"The British Navy had equipped Marconi apparatus under a contract entered into, not by the present Government, but by the Unionist Government, on most, if not all, the British cruisers. The British Mercantile Marine was equipped with the Marconi apparatus, and I think many foreign countries. It was in this country a large and important industry employing thousands of British hands. That was all that I knew about Marconi wireless at that time. All this atmosphere of suspicion which has been created—I am not entering into that now—has all come into existence since then. So much for the question of the character of the investment itself. There was nothing in Marconi wireless that would not have made it a reputable, respectable, and good investment for any person in this country."

Mr. Herbert Samuel, the Postmaster-General, was next called. He gave a complete denial of the rumours that he was financially interested in any of the Marconi companies, or any telephone or telegraph companies in any part of the world.

Mr. Faber asked Mr. Samuel, in view of the fact that he had never held any shares in any Marconi Company, why he did not say that on October 11th in the House of Commons? Why did he restrict himself to dealing with the English Marconi Company?

"Because it was only the English Marconi Company that was in question. I regarded it and still regard it as a question of charges made only in relation to the company which was contracting with the Government," said Mr. Samuel.

He closed his evidence with the following statement:

"If at some later date it is found that grave injury has been done to the Imperial interests by this delay in constructing wireless stations, my duty is to make it clear that I have left undone nothing I could do to obviate that. That is why I protested. The stations might have been half-built by now."

Evidence was then given by brokers, and on Monday, April 10th, Mr. Godfrey Isaacs, managing director of the British Marconi Company, went into the witness chair.

The Chairman said that he was asked to attend that day to give only such evidence as bore upon any dealings in the shares of the British or any other Marconi company by the Attorney-General, the Postmaster-General, the Chancellor of the Exchequer, or by any member of the Government or Government official. He wished to ask, first, what occurred between him and his brothers, Sir Rufus and Mr. Harry Isaacs, at lunch on the day he returned from America?

The witness said that he would like to tell the Committee what did take place in America so that they might better understand what his position was when he returned. Mr. Marconi and he decided to go to America upon hearing that the Judge of the Supreme Court had fixed March 25th for the hearing of the action against the United Wireless Telegraph Company provided that they would give an undertaking to be there. When they arrived in New York he received visits from an attorney representing a committee of shareholders in the United Wireless Company, who had between them subscribed a certain sum of money with the object of taking the affairs of their company out of bankruptcy, reforming the company, and fighting the action pending.

As the result of discussions an arrangement appeared likely, and he realised that there would be an opportunity of taking over the whole of the tangible assets of the United Wireless Company. These were considerable and important. They really covered practically the whole of the wireless business of America. They had practically 500 installations on board ships and 72 telegraph stations all round the coast of America. He naturally appreciated the fact that to take over those assets would require a substantial sum of money, and he also realised that there was a possibility of very big business in America provided his company had money. The American sent a telegram to no matter what part of the world with as little hesitation as we would send a halfpenny postcard. But to create a long-distance telegraph service to all parts of the world without the means of collecting and distributing messages in America would be like playing *Hamlet* without the Prince of Denmark. He determined that there were two courses open—either to arrange with a company like the Western Union Telegraph and Cable Company, or that we ourselves—

A Member: You say "we ourselves"——

The witness said that when dealing with America he spoke as a director of the American company. The other alternative was to compete with the Western Union by constructing wireless stations throughout America and doing their own inland telegraph service. He preferred arrangement to competition. He called a meeting of his American directors and put before them the whole of his scheme—first, for taking over the tangible assets of the United Wireless Company, and secondly, for the construction of high-power stations to communicate with the different parts of the world, and, perhaps, failing an arrangement with the Western Union, for the construction of small stations to create an internal telegraph service. He informed the directors that in order to carry out that scheme they would want a very large increase of capital.

He would like to clear up one or two points in doubt about their capital. At that time, dealing in round figures, it was $1,600,000 issued. He told his American directors he would require them to sanction an increase to $10,000,000—$1,400,000 to carry out the contemplated arrangements with the United Wireless Company and $7,000,000 of liquid capital for work he had proposed. The American directors looked upon his scheme as a little bold, but they thought they would like to see it carried through. They assured him, however, that in their opinion there would be no possibility of raising a single dollar of that capital in America. They reminded him that the face value of every share had been reduced from $100 to $25, and that the company had never been able to pay a dividend. Further, the United Wireless had an issued capital of $20,000,000 in $10 shares which had been sold at from $30 to $40. It was not likely, in the directors' opinion, that anybody in America would put another dollar into wireless telegraphy for some time at all events, and they would not agree to any increase of capital unless Mr. Marconi and he undertook to see that the whole was subscribed.

Mr. Marconi personally hesitated very much about giving any such undertaking; £1,400,000 was a very large amount to be responsible for. Mr. Marconi and he conferred in private, and he told Mr. Marconi that in his opinion he would have no difficulty in placing £1,400,000. Mr. Marconi had great confidence in his opinion, but nevertheless did not like taking a responsibility of that amount for the English company, and asked him whether he personally would take 500,000, leaving the company's responsibility 900,000. He said that if he would he would take the other responsibility. He (the witness) agreed, saying he was perfectly confident he could place them quite easily. At that time, again dealing in round figures, the English company held 35,000 shares in the American company. There were, therefore, 29,000 shares in the hands of other persons, making a total of 64,000 shares of $25 each. Each one of those, under a scheme which he had submitted to the American company, would be entitled by conversion to five shares of five dollars each, and each of those five-dollar shares would be entitled to subscribe for five additional shares of five dollars. Therefore, every original shareholder would be the owner of 30 shares provided he paid £25 for 25 new shares. At least there was that right, but his directors were confident that the shareholders would in all probability never even get to hear of the increase of capital, and that, whether they did or not, they would not take it up.

But after the American directors had agreed to the increase of the capital to $10,000,000, after he had successfully carried through the agreements with the shareholders' reorganisation committee of the United Wireless, and after many interviews with the Western Union Cable Company, in which he made them understand that either he was going to compete with them by putting up stations—that they had decided to increase their capital for that purpose—or have a reasonable working arrangement, join them, in fact, as a telegraph organisation, they eventually came to the conclusion that it would be wise to enter into an arrangement, and after long negotiation they came to terms.

The agreement was entered into. It was signed at about half-past 8 o'clock on the night of April 1st, 1912, and he sailed for London on the *Mauretania* at 2 o'clock in the morning on April 2nd. Having entered into his arrangements with the board of the American company and with Mr. Marconi, he then set to work to place his 500,000 shares, leaving the company with the responsibility of the 900,000. If the shareholders did not take them up, he intended making an issue in London to their English shareholders of a further 500,000 to 600,000 of the shares at par. If the American shareholders took up all their shares, his company were still responsible for £875,000.

But they could not have afforded to take up 875,000 shares in the American company and hold them. Therefore, had they been called upon to take up the whole of the shares, having placed 500,000, there would remain 900,000. Of those they would not keep more than 300,000 at the outside. He was not sure they would have continued to keep those. They would have received five shares for every one they originally held by means of conversion, which would have given 175,000, and they would, perhaps, have increased their holding by 100,000 or 200,000, but he did not think they would have kept more than that. They would therefore have had at least 500,000 or 600,000 shares to place with their own shareholders here.

The witness further stated that while he was still in America he called in Mr. Heybourn and gave him the general outlines of his programme with regard to placing 500,000 of the shares on the English market. His desire was that the shares should be placed at a small premium, and that they should remain so until the business of the company had developed. Therefore, in arranging to place with Mr. Heybourn 250,000 shares in all, at par, which was in England 1 1-16, or in American money $5, he made it a condition that they should be supplied principally to dealers in wireless shares on the English market at a price not exceeding $1\frac{1}{4}$, which he thought was the price at which the shares might fairly be introduced on the English market. He also placed 150,000 of the shares upon the same terms and at the same price in America with bankers and others.

On Monday, April 8th, he arrived in London with about 100,000 shares unplaced. He invited his two brothers, Sir Rufus Isaacs and Mr. Harry Isaacs, to lunch with him on the following day. He told them what had happened in America. He gave them his opinion of the prospects of the company, and said that in his belief the shares would be a very good and sound investment, that he had 100,000 still to place, that it did not matter to him who took up those shares, and that it was open to them to have any number they liked. His brother Rufus did not care to take any of the shares, and as he had an appointment he left early. His brother Harry, who remained and talked over the matter with him, took a different view of the shares from Rufus, and eventually said he would like to have 50,000. That left him with 50,000 of the shares unplaced. By the following evening, April 10th, he had placed the whole of the balance of the shares. His seven directors took 2,500 each. Mr. Marconi was away in America, and he telegraphed to him and Mr. Marconi replied that he would take 10,000 shares. He himself took the same number as had been taken by each of the other directors — 2,500. He took those shares as an investment, exactly in the same way as he had advised others to take them as an investment. He had never bought or sold a share, and was not interested in the least in the market price of the shares, except to deplore very much that the market should have run away, as it was damaging to his company and created extremely difficult circumstances for himself.

On April 17th or 18th Mr. Heybourn came to him and said that the demand for the shares, principally from America, was so great that the price was already long past $1\frac{1}{4}$, that therefore it would be absurd of him to place them at $1\frac{1}{4}$, and he asked his consent to increase the price from $1\frac{1}{4}$ to $1\frac{1}{2}$. He did not like the suggestion, not because he did not think it was perfectly reasonable in the circumstances, but because he had not placed his own 100,000 shares at a profit, and had no desire to make any profit on them. Eventually he agreed with Mr. Heybourn that he should increase the price of the shares to $1\frac{1}{2}$ provided that he paid $1\frac{1}{4}$ for them, instead of 1 1-16, because there was no reason why Mr. Heybourn should reap the benefit of circumstances over which he had no control and could not have foreseen. Accordingly it was agreed that Mr. Heybourn should have the 250,000 shares at $1\frac{1}{4}$ and that the contracts should be sent straight to the company, so that the additional profit of £60,000 or so should go to the company. In his opinion he was perfectly entitled to have taken that profit for himself had he chosen so to do. But he preferred that all the profit should go to the company. He did not make any profit out of his company in any way whatever, other than the percentage which was paid him on the

profits in addition to the salary he got for his services.

On April 18th Mr. Heybourn telephoned to him that there was a great demand for the shares on the market, and he bid $2\frac{1}{8}$ for 50,000 more shares, and they were sold to him at that price. Later on in the afternoon Mr. Heybourn again telephoned that the demand for the shares was far greater than it had been in the morning, and asked for an additional 50,000 shares at $2\frac{7}{16}$. All these shares were sold to Mr. Heybourn on behalf of the company. He had nothing whatever to do with the market. He did not control it.

The Chairman : You told us what occurred at the luncheon between you and your two brothers. Had you anything to do with the sale of shares to Sir Rufus Isaacs, which took place afterwards ?—I had nothing to do with it. I did not know of it until about the month of October.

You know, of course, of the rumours that were circulated throughout the summer ? Have you any knowledge of any transactions with the British Marconi Company or the American Marconi Company on the part of any of the Ministers of the Crown ? —No ; I have no knowledge at all. I was constantly hearing of the rumours. The first I heard of them was in the month of April. Directly I returned from America I was informed that there was a very strong attack to be made on the Marconi contract with the Government. It was talked about very freely. I was also told there was a very strong syndicate which was promoting or had been endeavouring to promote the Poulsen Company, and that they were strongly supported by influential persons, among whom were members of Parliament, who would assist them in preventing the Marconi contract being carried through. I took very little notice of these rumours ; I scarcely believed them at the time, but they were being constantly repeated to me. I was sent a document which I think has considerable importance, and which I will hand to the Committee. It is a prospectus of a Poulsen radio-telegraph and telephone system which is marked " Private and confidential " and dated March 5th, 1912, two days prior to the acceptance of the tender of the Marconi Company by the Postmaster-General. There are only two names on the prospectus. One of them is the expert engineer who reports on the Poulsen system, and that engineer is A. A. Campbell Swinton, who was warmly recommended by Sir Henry Norman as one of those expert engineers who was well qualified to advise the Committee as to the best wireless system for the Government to adopt. The other name on the document is that of the printer. I endeavoured to find out on whose behalf the prospectus had been printed and by whose instructions and to whom Mr. Campbell Swinton had reported. The only reply I was able to get was that the strictest injunctions had been given that no information was to be supplied by either of these people to anybody, and that all the papers connected with it were to be destroyed. Therefore, so far as I was concerned, the door was closed ; but by means of the two names on the prospectus I think the Committee will be able to obtain a great deal more information than they have yet had which will throw light upon two matters—first, the attack upon the Marconi Company ; and, secondly, the rumours and charges made against Ministers. I heard in July that those who were connected with this syndicate were arranging an attack upon Ministers in order to make it doubly sure that the contract should not go through Parliament.

I have never repeated any names because I have never had the authority of anybody to use names. I have never repeated any of the rumours because I could not substantiate them. But I have now received a letter which I think will help the Committee. It is a report made to me in order that I might have a record of what was said and in order that I might refer to it and give a name. It is written from 70 Ennismore Gardens, and dated April 8th of this year :

DEAR MR. ISAACS,—It might interest you to know of an incident which occurred to me, and which in my opinion has some bearing on the attitude of the great proportion of those people who have been so loud in their denunciation of the Marconi Company's contract with the Post Office. I was present at a dinner party in the West End last May, and was very interested in the conversation of a gentleman who was explaining to those about him the worthlessness of the Marconi system in comparison with that of the Poulsen. After dinner I asked him if he could tell me more of the merits of the two systems, and if he considered the shares of the Marconi Company to be too high. He told me that he was confident that the shares of the Marconi Company would fall to 30s. or £2; that he had several clients who, on his advice, were bears on Marconi shares, and that, although these clients had substantial profits on their transactions, he was advising them not to close, as the shares were bound to fall to the price he had mentioned. He further told me that he and his friends were very confident about the merits of the Poulsen system, which, in his opinion, was far in advance of the Marconi. He told me that there was going to be a great outcry in the House of Commons against the Marconi Company's contract with the Government, and he mentioned the names of two members of Parliament who were to take a prominent part in the discussion. One of the members whose names he mentioned has, in fact, been very much in evidence in the discussions which have subsequently taken place, and the impression left on my mind is that a certain section of people interested in the Poulsen Syndicate have been devoting their attention to preventing the ratification of the Marconi Company's contract with the Government to serve their own ends. The gentleman who gave me this information was a stockbroker. I have listened for nearly a year to the wildest rumours against the Marconi Company and against the contract, and those rumours have almost invariably come from people who were personally interested in the Poulsen syndicate, or from persons whose interest it was to see a fall in Marconi shares. I have written you on this subject because it seemed so apparent that most of this outcry against the Marconi Company's contract originated from those who were trying to run another system.—With kind regards, believe me, ERNEST G. HAWKINGS.

Mr. Butcher: Who is Mr. Hawkings?

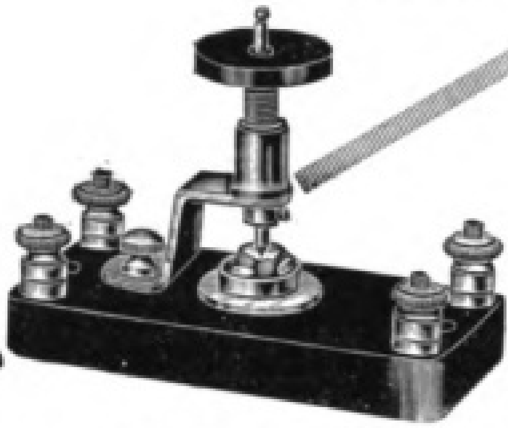
Mr. Godfrey Isaacs: He is a member of the Stock Exchange. Mr. Hawkings has said that he is quite prepared to come here and to name the two members of Parliament and the stockbroker, and to give any further information he can on the subject. If the Committee probes this matter through Mr. Hawkings and this prospectus and Mr. Campbell Swinton I believe they will get a good deal of information to lead them to trace the originators of all the rumours as to the attack on the Marconi contract and the slanders and attacks on Ministers.

The Chairman: Did you offer any advantage or favour to any Minister or Government official in connection with the negotiation of the agreement?

I never did; it would be the last thing I should ever dream of doing, and I should be very sorry if it were possible to do anything of that kind in this country.

Witness was in the chair during the greater part of four days, and he was followed by Mr. Harry Isaacs, who said he did not know that his brother, Sir Rufus had sold any shares to Mr. Lloyd George until his brother came before the Committee and made the fact known. He had no knowledge as to how Sir Rufus dealt with his portion of shares. He (witness) had not had any Marconi dealings prior to April 19th, 1912. Sir Rufus sold 2,000 shares on his advice. He had repeatedly heard the rumours about Ministers, but treated them as ridiculous. He could not give any idea as to their origin.

Mr. Ernest Hawkings, in his evidence, declared that in his letter to Mr. Godfrey Isaacs he did not mean the two members of Parliament, to serve their own ends, were trying to prevent a ratification of the contract.



Detector Condenser No. 220

When ordering your WIRELESS APPARATUS specify MURDOCK, which is built well, works like it's built, suitable for all experimental purposes, and fully licensed by MARCONI CO., LTD.

Do not invest your money in cheap Apparatus, which never give satisfaction.

MURDOCK APPARATUS means the most obtainable at fair prices, in actual value of materials, of workmanship, of operation.

Write for special descriptive folder.

Trade inquiries solicited.

AMERICAN IMPORTING CO.
8 Long Lane, London, E.C.

Sole Agents for
W. J. Murdock Co., Chelsea, Mass.

The Radio-Telegraphist's Guide and Log-Book

A MANUAL OF WIRELESS TELEGRAPHY FOR THE USE OF OPERATORS

By W. H. MARCHANT

WITH 90 ILLUSTRATIONS

Pocket Size 4/6 net. (Postage 3d.)

WIRELESS TELEGRAPHY AND TELEPHONY.
By W. J. White, A.M.I.E.E. Second Edition, enlarged. With 100 Illustrations. 2/6 net (postage 3d.)

WHITTAKER'S ELECTRICAL ENGINEER'S POCKET-BOOK.
Edited by Kenelm Edgcumbe, A.M.I.C.E., M.I.E.E. Third Edition, entirely re-written and enlarged. With 180 Illustrations. Leather, gilt edges, 5/- net (postage 4d.).

WHITTAKER'S ARITHMETIC OF ELECTRICAL ENGINEERING.
For Technical Students and Engineers. Containing 72 Worked Examples and 300 Exercises. With numerous Illustrations, 1/- net (postage 3d.).

TECHNICAL CATALOGUE POST FREE

WHITTAKER & CO.,
2 White Hart Street, London, E.C.

The Post Office Electrical Engineers' Journal

Part 1, Vol. VI. April, 1913.

STANDARD CABLE MEASUREMENTS ... ... By B. S. Cohen, A.M.I.E.E.
TELEPHONIC DEVELOPMENT ... ... By W. H. Gunston
POWER PLANT FOR WIRELESS STATIONS ... By J. Coxon, A.M.I.E.E.
HEAVY RENEWAL WORK ... ... By J. W. Barber
ALTERNATE CURRENT MEASUREMENTS ... ... By F. Addey, B.Sc.
CIRCUIT PLANS ... ... By T. Howlett
AERIAL LOADING ... ... By J. Whitehead
Etc. Etc. Etc.

Annual Subscription **5/-** Post Free.

PUBLISHERS - - H. ALABASTER GATEHOUSE & CO., 4 LUDGATE HILL, E.C

Readers of **The Wireless World** interested in all matters relating to Telegraphy should read

THE ELECTRICIAN,

A Weekly Journal, Price 6d., wherein appears everything of interest on these subjects.

THE PRACTICAL WIRELESS SLIDE RULE. By Dr. H. R. BELCHER HICKMAN.
2s. 6d. net, post free **2s. 9d.** An indispensable companion to all who have calculations to make in Radio-Telegraphy.
HINTS ON WIRELESS TELEGRAPH DESIGNS FOR AMATEURS. By ALFREC. New and Enlarged Edition.
Very fully illustrated. Cloth, **2/6** net, post free, **2/9.**
INTERNATIONAL RADIO-TELEGRAPH CONVENTION AND SERVICE REGULATIONS (London Revision, 1912.)
Original French Text and Technically-accurate Translation. Cloth **5/-** net, post free **5/6.**
ELECTRICAL TESTING FOR TELEGRAPH ENGINEERS By J. Elton Young. New edition. **10/6** net, post **11/-.**
Of al Booksellers, or of THE ELECTRICIAN PRINTING & PUBLISHING Co., SALISBURY COURT, FLEET ST., LONDON, ENGLAND

Manual of Wireless Telegraphy

FOR THE USE OF NAVAL ELECTRICIANS

By COMMANDER S. S. ROBISON, U.S. Navy

An Excellent Textbook for Marconi Students. Recommended by the leading teachers. Cloth 8vo. New Edit. 212 pp. Illustrated. 7s. 6d. net or *7s. 10d. Post free from*
S. RENTOUL & CO., Ltd.
36 Maiden Lane, Strand, LONDON.

Our Bookshelf

"THE YEAR-BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY, 1913," published by the Marconi Press Agency, Ltd., Marconi House, Strand, London, W.C. 2s. 6d. net.

The publication of this book is a timely reminder of the enormous development of wireless telegraphy. Both in the popular mind and in practice the subject has become so widely established that a thorough digest of information has become an absolute necessity if those who are concerned with wireless telegraphy in one way or another are to keep pace with its rapid progress.

To satisfy the requirements of all interests within a volume of reasonable dimensions was the problem to be faced in the compilation of the year-book. The aim of the publishers has been to produce a volume which shall be at once indispensable to those concerned in wireless telegraphy—whether technically or commercially—and contain information sufficient to make intelligible to the general public the immense variety of matters relating to the subject. Whether his interest be in the purely scientific side or the commercial, whether he desire to know the wireless stations of the world or the rates for a message, or to understand the laws and regulations governing wireless telegraphy all over the world, the inquirer should find in a book of this kind all the facts stated concisely and authoritatively, and we do not think that he will be in any way disappointed.

The year-book opens with a calendar, and is followed by a concise chronological record of progress in wireless telegraphy since 1896. This should prove a very convenient and time-saving reference section. Next follows what many will regard as the most important feature of the work, and one which alone would make it indispensable—namely, the administrative section. This contains the London Convention of 1912, the laws and regulations of the principal countries concerning wireless telegraphy, all carefully prepared in English. Then there is a complete list of land and ship stations of the world, with their call letters, ranges, wave-lengths, the nature of the service hours of opening and changes, set out in a form which makes reference easy. Other features are an article by Mr. Arthur R. Hinks, M.A., Chief Assistant of Cambridge Observatory, on "Wireless Time Signals"; "Distress Signalling," by Mr. G. E. Turnbull, and a mass of useful data. As might be expected, the technical section is particularly strong, and some of the leading experts have contributed. Professor J. A. Fleming, F.R.S., Dr. W. H. Eccles, Capt. H. Riall Sankey, and others no less well known are among the authors of signed articles. Major J. E. Cochrane deals with military wireless telegraphy, and wireless telephony has been dealt with by Dr. J. Erskine-Murray. Almost every branch of the subject has been covered. There is much valuable technical data and a large number of useful formulæ and equations. A very full glossary of technical terms in English, French, German, Italian, and Spanish completes a valuable section.

Brief biographies are given of prominent people in the world of wireless telegraphy, and articles on the part the invention plays in ocean journalism and weather forecasting render the book attractive reading.

Many illustrations distinguish the volume, and one very valuable feature is a new and revised map of wireless stations of the world. Every care has been taken to make this map thoroughly up-to-date and reliable.

The year-book should go on the bookshelf as a standard work of reference on the subject of wireless telegraphy and telephony.

* * *

"THE STEAMSHIP CONQUEST OF THE WORLD," by Frederick A. Talbot. (London: William Heinemann, 6s. net.)

Many of the old romantic attractions of the sea are gone. Its mystery exists no more. The merchant sailor, with jovial good humour and rollicking sportiveness, returned from his long voyage in one of the East or West Indiamen, or the famous Australian or China fast-sailing clippers, in his picturesque dress, with his pockets full of money, with many thrilling yarns to spin of the wonderful sights he has seen, or the perils he has gone through, is no longer the hero of his native village—the sure captor of its fairest belle. His time of continued absence is now, in most cases, short. He has, when he returns, nothing thrilling to tell, and his dress no longer differentiates him so markedly from the working landsman. This great transformation is in no small measure due to the progress of steam navigation, the development of which is told by Mr. Talbot in the interesting volume under review. The reader is made familiar with all that there is to be known about the construction and detail of a steamship, but the author has wisely broadened the scope of the subject by dealing with various other influences which materially affect the welfare and safety of the ocean-travelling public. We turn with pleasure to the chapter dealing with wireless telegraphy, in which the author has compressed within about a dozen pages a description of this wonderful invention, which has been one of the most remarkable factors in changing the conditions of ocean travelling. He draws attention to the extraordinary lead which the British Mercantile Marine enjoys in the advantages of wireless telegraphy, due to the commendable enterprise of the Marconi Companies. The other chapters in this book are as well written as that dealing with wireless telegraphy. Although the North Atlantic figures largely in the volume, this is due to the fact that it is the busiest of the seven seas. It is where new developments and revolutionary inventions invariably receive their commercial ocean-going baptism, and any book dealing with the subject of steam navigation in which the North Atlantic did not figure prominently would be lacking in interest. We can heartily recommend Mr. Talbot's book, which is interesting alike for the excellence of the text and the character of the many illustrations.

* * *

"THE ELECTRICAL TRADES DIRECTORY AND HANDBOOK, 1913." (London: The Electrician Printing and Publishing Co., Ltd. 15s. net.)

Familiarly known as the "Big Blue Book," the thirty-first issue of this invaluable annual is in every way as complete as its predecessors. Included in the contents are complete notes of the year's progress in electric traction, electric power, the application of electric driving to industrial works, also developments in submarine and land telegraphy, as well as a record of radiotelegraphy progress of 1912. In addition, the salient features of telephone progress in the United Kingdom in 1912 (including the purchase of the National Telephone Co.'s system by the Post Office), the development of the steam turbine and the internal combustion engine, the progress made in arc and metal filament lamp improvements, etc., are set out, and a summary of parliamentary work in the past session so far as legislation has affected the electrical industry. A record of the proceedings of the Marconi Agreement Inquiry up to the adjournment is also given. The law of electric lighting, electric power, electric traction, telegraphs and telephones is fully dealt with, and a full digest, specially prepared for the "Directory and Handbook" by Mr. A. C. Curtis-Hayward, A.I.E.E., solicitor, is given. There are in all over 2,200 pages in the Big Blue Book, every line having undergone careful and thorough revision up to the moment of publication. For over thirty years this valuable and exhaustive work has occupied the first place as a reliable book of reference for a great and growing industry, international in character; and the 1913 edition, now published, shows no slackening of effort to keep up the high repute of the work.

The wireless telegraph station at Port Stanley, Falkland Islands, has been opened to public service. European business to and from Port Stanley will be handled through the station located on the Cerro at Montevideo, Uruguay, which is 1,243 miles distant.

The following vessels have been equipped by the Debeg Co. during the past month. The letters in parenthesis denote the call letters of the stations: *Baiha Castillo* (DBK), of the Hamburg Sudamerik; *Dampschif-fahrts Gesellschaft*, the *Peter Rickmers* (D P M), and *Ellen Rickmers* (DEX), of the Rickmers Reismuhlen; the *Mera* (DMX), of the Kosmos Linie; the *Hesperus* (DHX), of the Deutsch-Amer. Petrol. Casellchaft; the *Sardinia* (DSI), of the Hapeg Line; and the *Lichtenfels* (DLS), of the Hansa Line.