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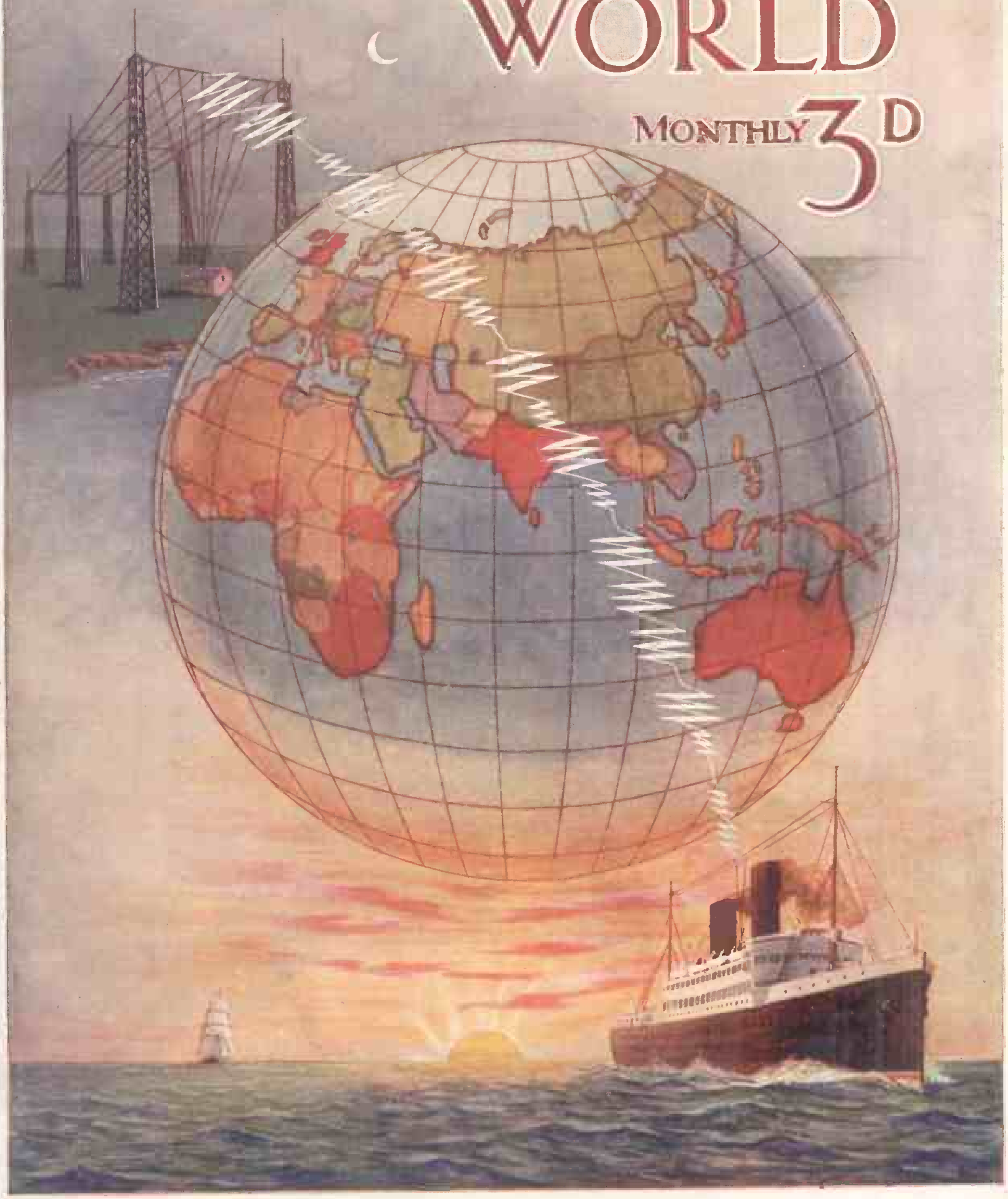
WIRELESS WORLD

MONTHLY 3D



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

CONTENTS.

THE WIRELESS WORLD

Vol. 3.—No. 32. (New Series) November, 1915. Subscription 5/0 per annum post free. Price 3d. Post Free 5d.

SPECIAL DOUBLE NUMBER

A Wireless Innovation for Christmastide

WITH the "lights out" order in full swing and hours of darkness ever increasing, a large majority of our readers are certain to be turning their thoughts towards the comforts of the home fireside. Wireless amateurs have had to submit, for patriotic reasons, to a curtailment of their hobby in the suspension of all those experiments which really form one of the most interesting sections of the pursuit. For the same reasons we have ourselves been obliged to eliminate some of our regular features and modify others which specifically refer to experimentation and practical work.

With the view of compensating our readers for the omission of many items from our bill-of-fare which would have been very agreeable to their palate had we been able to "serve" them, we have prepared a Christmas Double Number after a fashion which has never been before attempted. Whilst all the regular features will remain, the introduction of a number of original articles, Christmas stories and special scientific papers will considerably augment the interest which an abundance of appreciative comments shows us to be well maintained by our ordinary numbers.

A notable feature will consist of a brightly written story covering the twenty years (more or less) which have elapsed since Senatore Marconi landed with his little black box on the shores of England.

Turning to the side of fiction, it is not an easy matter to combine first-class literary workmanship and correct wireless technology. We are glad to say that we have been able to secure both of these by enlisting the services of Mr. William le Queux, whose writings and attainments are too well known to need laudation here. We may remind any readers who may chance to have forgotten the fact, that Mr. William le Queux before the commencement of the war possessed a well-equipped wireless installation of his own, besides holding the Postmaster-General's certificate of proficiency in radio-telegraphy.

It would be impossible here to enumerate the many miscellaneous features of the Double Number. Our advertising pages contain a synopsis of its contents and we have no hesitation in stating that WIRELESS WORLD readers could find no more acceptable Christmas momento for transmission to their friends.

One feature of the issue will make a practically world-wide appeal. Readers would be surprised if they knew the number of applications that have been received by us for an adequate delineation of Senatore Marconi. The photogravure which will form our presentation plate has been pronounced by those intimately acquainted with the great Italian inventor to be one of the most successful portraits of the many taken by the Dover Street Studios. Not only sober scientists who know the debt of gratitude which the world owes to this distinguished son of Italy, but every schoolboy, scout or student will welcome the pictorial representation of the man whose name stands for the new science, which owes the major part of its development to him.

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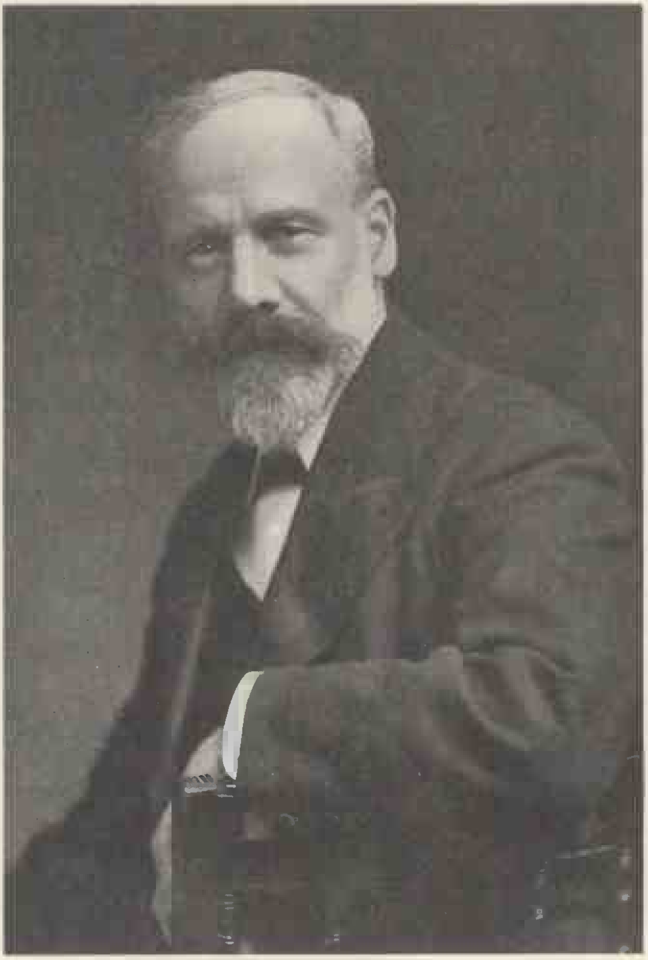


SIR WILLIAM SLINGO

Personalities in the Wireless World

SIR WILLIAM SLINGO

SIR WILLIAM SLINGO, upon whom His Majesty the King has recently bestowed the honour of Knighthood, was born in London on May 25th, 1855, and commenced his career as a telegraph clerk in 1870. He has always taken a deep and active interest in radiotelegraphy. In 1876 he founded the Telegraphic School of Science at the General Post Office, and he remained Principal of this school until 1898. He was for a number of years head of the Electrical Department at the People's Palace, now known as the East London Technical College, and took a leading part in the formation of the City and Guilds of London Institute. While employed in the Central Telegraph Office he became Consulting Engineer to the Drapers' Company and other bodies. On the closing of the Telegraphists' School of Science, Sir William's services were transferred to the Engineering Department of the Post Office with the rank of First Class Technical Officer. In this capacity he had charge of various classes of work, including the establishment of Hughes Duplex working between London and the Continent, and designed the system for protecting telegraph and telephone plant from fire and the system of secondary battery working now in extensive use in the United Kingdom. At the close of 1903 Sir William was promoted to the position of Superintending Engineer of the North Wales District, with headquarters at Liverpool, where exceptional calls were made upon his technical and administrative abilities. In September, 1910, he returned to London to carry out the responsible duties appertaining to the supervision of the work involved in the preparation of the inventory and valuation of the National Telephone Company's plant. In January, 1911, he was appointed Assistant Engineer-in-Chief, and in March, 1912, he was further advanced to the position of Engineer-in-Chief, in succession to Major O'Meara, C.M.G., R.E.

In the year 1913 Sir William's activities included work in connection with the Holt Parliamentary Committee on Post Office servants' wages and conditions of employment. He was also engaged on the scheme for providing an underground railway in London for the transmission of mails, and the laying of the Anglo-Irish loaded telephone cable.

In 1914 Sir William served on no fewer than six important Government Committees, including the Committee on State Research in Wireless Telegraphy, the Imperial Wireless Committee, the Committee on High Speed Telegraphy, the Telephone Finance Committee and the Electric Mains Explosions Committee.

Since the outbreak of war in August, 1914, the duties of the Engineer-in-Chief have naturally been of a responsible character in connection with the provision and maintenance of communication services. The importance of wireless work in this time of national emergency will be realised, and it is interesting to note that within two or three days of the outbreak of war 2,916 licensed and about 800 unlicensed wireless stations were closed under Sir William Slingo's directions.

Sir William Slingo has a world-wide reputation as an author. He was joint author, with Mr. A. Brooker, of *Electrical Engineering*, which is still a standard work. It was first published in 1890, and has since then run through many editions, each edition numbering several thousand copies. Sir William was for some time editor of *Knowledge*, a widely-circulating scientific weekly, and he has contributed extensively to the technical and lay Press.

British Association and Radiotelegraphic Investigations

REPORT OF THE COMMITTEE, CONSISTING OF SIR OLIVER LODGE (*Chairman*), DR. W. H. ECCLES (*Secretary*), MR. SIDNEY G. BROWN, DR. C. CHREE, PROFESSOR A. S. EDDINGTON, DR. ERSKINE-MURRAY, PROFESSORS J. A. FLEMING, G. W. O. HOWE, H. M. MACDONALD, AND J. W. NICHOLSON, SIR HENRY NORMAN, CAPTAIN H. R. SANKEY, PROFESSOR A. SCHUSTER, SIR NAPIER SHAW, AND PROFESSORS S. P. THOMPSON, AND H. H. TURNER.

Effect of the War on the Work of the Committee.

THE war has had a very direct effect on radiotelegraphic investigations. About the beginning of August, 1914, private wireless telegraph stations throughout the Empire nearly all stopped collecting statistics, while naval and other Government stations stopped all merely scientific observing. The radiotelegraphic stations in Russia, Germany, and neighbouring countries doubtless discontinued the filling up of our forms as soon as mobilisation began. A few stations in India, Australia, Canada, the West Indies, and the United States are, however, still at work. In the last-named country about thirty stations are making observations.

The Committee's programme for the collection of statistics three days a week in all parts of the English-speaking world, and in a few other countries, was planned to embrace one complete round of the seasons. The fact that the programme has been interrupted after only three months of work diminishes greatly the scientific value of such statistics as have been collected. It also implies considerable financial loss. A large batch of forms was distributed to our Navy in July; in clearing for action these forms would probably be wasted. The German edition was distributed in June. The Russian edition also was probably distributed before the outbreak of war.

The extensive scheme of special observations projected for the occasion of the solar eclipse failed almost completely in the countries in which the eclipse was visible. A small amount of work was done in Norway and Sweden. All the necessary forms had been printed, and some had been circulated, before the war started. The financial loss to the Committee in this respect exceeds a hundred pounds.

The day-by-day statistics collected in the period April to July have been partially analysed. The conclusions drawn from these observations are described below. Apart from any scientific value they possess they yield information which will guide the Committee, when the time comes, to further attacks on the problems concerned. A similar thought may be set down as consolation for the eclipse failure.

ANALYSIS OF RECORDS OF STRAYS.

Diurnal Variations.

The principal and most universal fact is that the strays heard in the dark hours are much more numerous and louder than those heard during daylight. If curves be drawn showing the amount of disturbance to telegraphic work from hour to hour, two types of curve stand out; one in which the changes from day to night and night to day conditions are somewhat abrupt, and another in which the changes are much more gradual. The former curves might be called "trough-shaped," the latter "U-shaped." The former type is met with at sea and on islands at a considerable distance from the mainland, the other on the mainland, especially in the tropics. The lowest point of the U or of the trough usually falls a little after midday, and the highest point of the convex part of the curve occurs a little after midnight, in nearly all stations north of the Equator. The only exception to this rule is found in some records from Lagos, Nigeria, where the curve showing the intensity of disturbance is lowest about seven in the morning and rises during the daylight hours. Unless local weather conditions are producing great disturbance, the change from night to day conditions and *vice versa* in stations north of the Equator lags behind the sunrise and the sunset. At some stations south of the Equator—*e.g.*, Cocos Island, the opposite rule seems to be usual. These regular and universal diurnal variations have an average magnitude which is represented on the arbitrary scale used in the forms by figures like 2 in the day and 5 at night in tropical latitudes, or 0·3 in the day and 3 at night in temperate latitudes. These figures are greatly affected by local meteorological conditions, which in fact frequently overwhelm all the statements set forth above.

Periods of Excessive Disturbance.

Occasionally the radiotelegraphic work at a station is rendered almost or quite impossible for a period, by strays of vigour and number greatly exceeding the average. These occurrences are for brevity called "X storms," the term "X" being an alternative designation for "stray" or "atmospheric." When an X storm happens in the day and lasts more than an hour or two, it may completely alter the character of the curve of that day's disturbances and even make the day portion of the curve higher than the night portion. An analysis of the records has shown that X storms occur within the same two or three days over very wide areas. Occasionally X storms are reported almost simultaneously at places several hundred miles apart, but more usually the X storms occurring at such distances are separated by several hours. Some of the European, American, and Canadian X storms have been compared with the meteorological records and charts for the two continents. The comparison has shown very plainly that periods of severe strays coincide with periods of low barometer, high wind velocity, rapid change of temperature, great rainfall, and, especially, rapid barometer fluctuations. In low latitudes the barometer fluctuations during violent X storms can usually be followed on any ordinary instrument. The worst X storm in the European records was accompanied by the rapid movement of a low-pressure system in a north-easterly direction. In twenty-four hours the eye of the cyclone moved from a point south-west of Lisbon to the North Sea, and in another twenty-four hours into the Gulf of Bothnia. The worst X storm in the American records was also accompanied by the exceptionally rapid movement eastward from the Pacific of a cyclonic depression with steep pressure gradients. A report from a Californian station of the Marconi Wireless Telegraph Company of America on this latter occasion states that the barometer was fluctuating between 29·44 and 29·52 inches very rapidly, the variations being accompanied by gusts of wind which attained the velocity of 70 miles per hour. The disturbance produced in the telephones by the strays amounted to a roar. On this occasion, between 1 p.m. and night, the strays rapidly diminished as the wind fell and the barometer rose. These meteorological conditions are precisely those that accompany or precede thunderstorms and line squalls; and, in fact, the records of the Meteorological Offices, and of the observers reporting to the Committee, all lead to the conclusion that X storms are often associated with thunderstorms at places not very far distant. Sometimes all the symptoms of thunder weather except thunder and lightning may be present in a locality and a heavy X storm be recorded—*e.g.*, Mr. P. H. Burns, Superintendent of Telegraphs in the Bahamas, reports that he has often been experiencing an X storm when a sudden shift of wind to the north-west (wind velocity about twenty miles per hour) has taken place and been followed by heavy rain, a calm, low temperature, lessened humidity, and a total disappearance of strays—all without thunder or lightning. To some extent these are symptoms of the passage of a small secondary or V depression such as might not be recorded on synoptic charts.

It is well known that the unstable atmospheric conditions bringing thunder weather sometimes move at a relatively slow rate from place to place, and may have their movements traced by the ordinary methods of meteorology. The analysis of the radiotelegraphic records shows that such convective weather can be anticipated several days in advance. This is particularly well borne out by some of the Malta records when taken together with some abstracts of the meteorological conditions kindly supplied by Dr. T. Agius, in charge of the Observatory at Valetta :

Strays bad ...	All Aug. 22nd and 23rd, 1914	Greatest rainfall of month Aug. 24th.
,, ,, ...	Nights of Sept. 22nd and 23rd and day of 24th	,, ,, ,, Sept. 25th.
,, ,, ...	All Oct. 6th and 7th	,, ,, ,, Oct. 9th.
,, ,, ...	All day Nov. 12th	,, ,, ,, Nov 13th.
,, ,, ...	Dec. 26th and 27th	Greatest fall in temperature, lowest barometer Dec. 28th.
,, ,, ...	Jan. 20th, 1915	Greatest rainfall Jan. 21st.
,, ,, ...	May 27th and 28th, 1915	,, ,, May 31st.

A report received from the wireless telegraph station of the Government of Australia situated at Esperance states that during the day-time rain is preceded in at least 80 per cent. of cases by intermittent disturbances. Strays of varying strengths may be heard from 6 a.m. to sunset for one or more consecutive days prior to rain. The following instances may be quoted :

Feb. 13th, 1915	Strays strength	2A from 6 a.m. to 6 p.m.
Feb. 14th, 1915	,, ,,	3A from 6 a.m. to 10 a.m. and 4A from then till 5 p.m.
Feb. 15th, 1915	,, ,,	3A from 6 a.m. to 1 p.m. and 3C from 1 p.m. to 7 p.m.

On February 15th, 16th, 17th, and 18th, 167 points of rain were recorded, of which only 3 points fell on the 15th. On February 23rd, 1915, strays were of strength 3A from 6 a.m. to 6 p.m. On February 24th 129 points of rain fell.

This conclusion is borne out in other ways by some of the records forwarded to the Committee. There is evidence that north-west winds on our Atlantic coasts, especially in the winter, are associated with strong strays at Irish stations and at sea. The atmospheric convection produced by the land may be sufficient to account for this. Mr. R. Ricci, of the Marconi Co., who has made reports on two trips round the world, during which he made especially careful daily observations, states that in mid-ocean strays are, as a rule, very few and feeble both in the day and in the night; but that when the edge of a mountainous continent is approached strong, and even continuous, strays are normal. In this something must depend on the direction of the prevailing wind relative to the land—a matter that will be inquired into later.

It may be mentioned here as very significant that the months of the greatest X storms in the Mediterranean are shown by the records to be September and October, the months of cyclonic weather.

As a whole the statistics show that there appear to be two kinds of X storm occurring in the day-time : (1) Those produced by convective conditions in the atmosphere within, perhaps, a hundred miles of the station, which may be termed local X storms ; (2) Those originating at a distance. Regarding the first class, they may occur almost simultaneously over a whole continent, but this is only because convective conditions happen to be ruling all over that area. Stations not too far outside the boundary of such a region also receive many strays, but apparently their distance must be limited to within 200 miles of the disturbed regions. In general, we may conclude that the observation of strays in the daytime constitutes a method of feeling the fringe of a region of convective weather, and so anticipating thunder and rain a day or two in advance. Of course, this ability to prophesy the advent of thunder weather is well known and is as old as wireless telegraphy itself ; but hitherto it has been thought that the electric discharges at a great distance were responsible for the strays heard at the station attempting to prophesy. The present analysis indicates, rather, that, at any rate in the daytime, the strays are frequently due to very local discharges, often too weak to give noticeable lightning or thunder, but definitely indicative of an approaching period of instability in the atmosphere.

The second kind of X storm is not of strictly local origin, but is sometimes traceable in the stray observations made hourly at the Malta station of the Eastern Telegraph Co., and the Sierra Leone station of the African Direct Telegraph Co. There is evidence that on certain occasions the same cause is affecting both stations, though they are separated by 2,500 miles, mostly across mountain and desert.

As regards disturbances observed at night-time, these are also frequently very local and due to convective weather, but there is probably a greater proportion of non-local storms than appears in the day records. In this connection may be noted a report from Australian stations that the worst and most continuous type of disturbance (apart from local thunderstorms) occurs on calm nights when the sky is blue and starry.

As a contrast to the prevalence of strays during convective weather may be instanced the fact, reported by Lieut. E. R. Macpherson from Sierra Leone, that a very dry wind which blows periodically for several days on the West Coast of Africa causes an almost complete cessation of strays immediately it starts, and allows of their resumption immediately it stops. On the other hand, the monsoon period on the same coast is one marked by great X storms.

Correlation of Records at Distant Stations.

The daily records of strays received at the above-mentioned stations in Malta and Sierra Leone have been examined carefully for the period August, 1914, to May, 1915, inclusive. This period has been treated in four sections of two and a half months each. It will be sufficient to give the following figures, which refer to the night hours 10 p.m. to 2 a.m., Greenwich mean time :

graphic time signals within range of the observer. Comparison of the records made in the British Isles has shown that on an average night many of the strong strays are heard by all the observers, and on days free from X storms the same remark applies. Coincidences have also been noticed between pairs of American stations not too widely separated. The analysis for very distant stations has not yet been carried out except for a very few in Europe. For example, in the month of June, 1914, coincidences have been traced in the strays heard at Southampton and Dresden, Gibraltar and Dresden Guildford and Malta. A proper investigation of the meteorological conditions accompanying or determining the periods when strays are heard simultaneously at places very wide apart has not yet been made.

Auroral Displays and Strays.

By the kindness of General Geo. P. Scriven, Chief Signal Officer of the United States Army, the Committee have been able to obtain reports from Officers in the Wireless Telegraph stations of Alaska concerning the presence or absence of any connection between auroral displays and disturbances due to natural electric waves or atmospheric discharges. At six stations special observations have been made during the later months of the past winter. Various types of aurora were watched, but nearly all the observers reported that the appearance or disappearance of auroræ caused no unusual

Mean M.	14·13	14·24	12·85	13·70
Probable error	±·64	±·67	±·57	±·53
Mean S. L.	28·68	19·90	14·87	26·31
Probable error	±·69	±·78	±·68	±·68
Standard Deviation, M.	8·34	8·66	7·28	6·78
„ „ S. L.	8·94	10·17	8·77	8·79
Correlation Coefficient	0·18	0·36	0·14	—0·25
Probable error	±·075	±·067	±·075	±·073

M. indicates Malta ; S. L. indicates Sierra Leone.

Graphic Records.

Many observers have made for the Committee precise observations of individual strays by making, on lines graduated to represent time, marks corresponding to each stray as heard in the telephones, the zero of time being fixed by aid of radiotele-

disturbances. The best months for such observations in Alaska would, it is stated, be October and November. The systematic work had not then been started, but one telegraphist reports that during this period of more brilliant display the only thing noticed in the radiotelegraphic apparatus was a trifle more electrical disturbance than occurred when there was no aurora.

The 27-day Period of Magnetic Variations.

Such of the radiotelegraphic records as were suitable for the purpose have been analysed with a view to detecting a 27-day period in the cases: days with many strays, nights with many strays, nights with few strays. No trace of this period or of any nearly equal period has as yet been found, but the matter cannot be regarded as settled till more numerous and more continuous records are available.

The Committee desire to express their cordial thanks for the help extended to them by the Government Departments, companies, and private individuals named below. The list refers to those whose co-operation has been of importance in the matters described in the preceding pages, and does not include the names of those who have helped in other investigations. The assistance of the latter will be duly acknowledged in future Reports.

The British Admiralty and Post Office; the Colonial Office; the Governments of Australia, Canada, and New Zealand; the War Department and the Navy Department of the United States of America; and the Telegraph Department of the Dutch East Indies; the Marconi Companies in England, Canada, and the United States and the Marconi International Marine Communication Co.; the Eastern Telegraph, Eastern Extension, and African Direct Telegraph Companies; H. Barkhausen, W. G. Cady, E. T. Cottingham, D. O. Davies, E. H. Dixon, E. D. Evens, J. P. Fennelly, A. Gorham, F. Kilbitz, J. R. Lamming, L. H. Lomas, F. A. Love, E. R. Macpherson, T. J. Matthews, W. E. Nicoll, F. E. Norris, R. Ricci, D. Rintoul, C. Ross, A. Hoyt Taylor.

A Little Problem

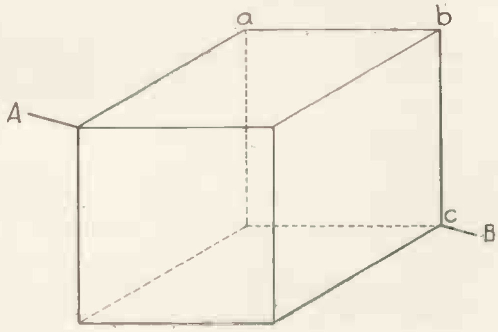
THE following letter has been received from a correspondent, and the query contained in it would in the ordinary course have been dealt with in the "Questions and Answers" column. As, however, the problem in question is one of great interest, it has occurred to us that it would be a pity to publish the answer at the same time as the question, and we therefore publish the problem alone in this issue, reserving the answer for the December number. Our correspondent has been answered through the post.

"The following may be of interest to "readers of THE WIRELESS WORLD. The "question was set to an advanced class of "electrical engineers in a well-known college "in Liverpool, and successfully baffled the "great majority of the students, as so far "it has done me. I have arrived at several "different results (by different methods), "each apparently correct, but, as one only "can be the correct answer, I should be "very interested in the orthodox manner "of setting about such a problem, which, "on the face of it, looks so simple. Here it "is:—

"Consider the cube to be constructed of "a series of wires representing the edges— "i.e., *a* to *b* = one wire, *b* to *c* is another, etc. "Each has a resistance of 1 ohm. What is "the total resistance *A* to *B*?

"It might also be interesting to know "how to set about the question if, instead "of being constructed of a series of wires, it "were made of sheet metal, each side being "1 ohm resistance. Of course, direct cur- "rent is employed in each case."

Amateurs who think they know all about Ohm's Law and its application will perhaps be interested to work out the total resistance.



Digest of Wireless Literature

ABSTRACTS OF IMPORTANT ORIGINAL ARTICLES DEALING WITH WIRELESS TELEGRAPHY AND COMMUNICATIONS READ BEFORE SCIENTIFIC SOCIETIES.

THE WIRELESS DIRECTION-FINDER.

In a recent issue of the *Electrician* Dr. E. Bellini contributes an interesting article entitled "Some Details of the Direction-finder." Commencing with a simple description of the Bellini-Tosi Radiogoniometer, the writer says that at the beginning of 1912 the Marconi Company took over the enterprise of the direction-finder and the apparatus was subjected to some modification. Previous to this the wave-length used had generally been 100 metres, but the Marconi Company thought that this wave-length presented difficulties from the commercial point of view. First, it was necessary to instal "radiophares," which would necessitate an expense in installation and in handling that most States would not accept; secondly, it was necessary to instal on board of the ships, for their reciprocal direction finding, sending stations radiating the same wave of 100 metres, whence there would be supplementary charges for the shipping companies.

The Marconi Company estimated that it would be more convenient to give to the syntonising devices of the direction-finder such an amplitude that the commercial waves of 300 and 600 metres could be received. So all the existing shore and ship stations became immediately available for the use of the direction-finder and no special transmitting stations either on the coast or on the ships, except in special cases, were required. In these exceptional cases the "radiophares" could conveniently radiate a wave-length of 450 metres.

Arising from the adoption of the wave-lengths above referred to, certain modifications were made in the aerials. All the direction-finder aerial installation on board was reduced to four wires suspended from a special porcelain insulator and stretched so as to form the edges of a pyramid with a square base.

The tuning appliances had also to be changed, and a condenser was inserted in the base of each triangle. The chief difficulty of this condenser syntonisation was found in the construction of the two condensers. These must practically have the same capacity, especially in the case of feebly damped waves. If the two condensers are not equal, the phases of the currents in the two aerials and connected fixed coils do not coincide, and the ratio of their intensities is not what it should be. Hence, inside the fixed coils an elliptical rotating field is obtained, instead of an alternating field of constant direction. The reception takes place, more or less, for every position of the exploring coil; the determination of the direction of the sending station is, therefore, uncertain, and the errors can consequently be large. The condensers must be acted upon at the same time, by turning only one handle. Good results were obtained by using condensers of the plane sliding plate type. Dr. Bellini next deals with the coupling of the circuits and the important influence this has upon the exactness of the bearings given by the direction-finder. This influence was small in the case of open-top aerials, but with closed-top aerials the influence of coupling is much more important. The construction of the direction-finder was, therefore, modified in its dimensions so as to give good results for all the waves and for all aerials met with in practice.

In the ship installations of the direction-finder it is sometimes difficult to find room for the aerials and radiogoniometer. It would, therefore, be convenient to be able to place the radiogoniometer far from the aerial if necessary. Experiments were made to ascertain if this were possible. From results obtained it was found that the radiogoniometer must be placed as close as possible to the aerial installation; and in any case the connecting wires have to be placed at the edges of a square-based prism of about 50 cm. side.

It has been remarked since the first installations that the bearings given by the direction-finder installed in land stations were generally more exact than those given by the same apparatus placed on board ship. A first cause of error was found in the ordinary aerial, the oscillations of which acted as a secondary source of oscillations. It is sufficient, however, to disconnect this aerial from the earth during the observations at the direction-finder to suppress this cause of error. But other causes remained which were difficult to ascertain, as it was necessary to make methodical experiments upon ships manœuvring only in view of these experiments. As this was difficult to obtain, a long time elapsed before positive results were obtained. The writer then deals with the experiments just mentioned and the influence of the metallic masses of the ship, showing how it was found possible to eliminate the effects of this. The article concludes with a table showing a number of excellent results obtained on board the Wilson Line steamer *Eskimo*, making the service between Hull and Christiania.

* * *

AN AERO-RADIO SYSTEM FOR AMERICAN DEFENCE.

Mr. John Hays Hammond, Junior, in a recent issue of the American publication *Flying*, outlined a proposal for a new system of coastal defence in America, in which aeroplane patrols, in conjunction with wireless stations, would keep a keen look along the coast. It would be a matter of years, not months, says Mr. Hammond, before the United States could increase its military organisation to a point where it would be equal to the standard of a possible enemy. Even with all the money which that nation had available, time is the thing which counts in the first phases of modern war. In proportion to what would have to be done, time is so short that all the dollars on earth could not increase the speed of manufacture of necessary arms to supply the imminent demand. Mr. Hammond's idea is to apply radio-systems to aeroplanes and establish aero-scouting districts along the United States seaboard in such a way as to provide an invaluable unit of defence. It must be borne in mind that the coast line in question is so extensive, and the American Navy at present of such small size and comparatively slow speed, that it is essential to develop scouting facilities of extraordinary efficiency. With a scout system such as Mr. Hammond outlines, land forces could co-operate with the fleet in preventing landing operations on the part of the enemy. Aerial information would be the only sort by which the intent of the enemy's manœuvres and the ultimate objective could be ascertained.

In the plan put forward there are forty-four areas which cover the whole coast of the country. In each of these it is proposed to erect a wireless station connected by land lines with the other stations. Each of the aero-scouts will be equipped with a radio transmitter of sixty miles daylight range. It will not have receiving apparatus, as the noise of the motor and propeller would be too great to permit the operator to hear. While aloft each of the scouts would be in constant communication with the central radio station, which in turn is connected with the existing land system by telephone or telegraph. Scouts covering such an extended front would be able to discover and report upon the movements of the enemy's ships, their number and disposition and their strategical formation. Then, equipped with such valuable information, it would be comparatively easy to concentrate our forces at decisive points to meet the invader.

Aeroplanes cost approximately £1,500 apiece, so that forty-four would cost roughly £66,000. Radio transmitters and receivers at £40 apiece would mean a total of £1,760. The receiving stations and aeroplane sheds, costing £120 each would total £5,280. The receiving aerials and masts at £50 make a sum of £2,200, and then there is a final sum of £4,460. This makes a grand total of expenditure of £79,700.

To man the system properly it would require three shifts of aviators, or 132 men, and 40 telegraphists. With a system such as that outlined it would be possible in time of war for Washington to know every hour and a half the exact conditions along the entire coast-line.

IRON LOSSES AT HIGH FREQUENCIES.

Among the papers read at the recent British Association meeting was one by Mr. N. W. McLachlan, B.Sc.Eng., entitled "The Heating of Iron when Magnetised at very High Frequencies." The paper described experiments illustrating the heat produced when iron is magnetised by very high frequency alternating currents, *e.g.*, 2×10^5 to 5×10^5 periods per second.

The magnetising current was obtained by using a Poulsen arc generator connected across the town mains (240 volts). In order to demonstrate the extent of the losses, a magnetic heater or boiler, consisting of a solenoid wound on a glass tube containing water and a number of iron strips or wires, was inserted in the shunt circuit of the generator. A short time after the shunt circuit was closed the water began to boil.

An experiment was also arranged to show the variation in permeability of iron with variation in temperature. A ring of Lohys (mild steel) was insulated with asbestos and wound with a number of turns of copper wire. This was connected in the shunt circuit of the generator. By passing a large current through the windings of the ring, thereby obtaining a strong magnetising force, the magnetisation losses were such that a rapid rise in temperature was produced, causing the iron to attain a bright red heat. The variation in permeability corresponding to the rise in temperature may be followed by observing the current in the shunt circuit and the voltage across the terminals of the ring.

In the discussion following the reading of the paper, Professor Gisbert Kapp drew attention to the fact that the losses observed were extremely high compared with what was encountered at ordinary frequencies. It had long been a puzzle to those familiar with ordinary alternating current work as to how it was possible, in view of hysteresis and skin effects, to use in wireless work frequencies of a quarter of a million or so in circuits containing iron. They were often told by wireless engineers that the usual rules did not apply at high frequencies, but apparently from the author's figures this was incorrect. Professor Howe said that the discrepancy pointed out by Professor Kapp arose because the formula quoted by the author gave simply the skin losses. As the frequency rose the flux was, in fact, more and more confined to the skin, so that less and less iron was really involved in the phenomenon.

Professor Perry said that the formulæ used with low frequency currents were derived from one deduced by Sir J. J. Thomson. The complete formulæ contained a factor e^x, which in the case of low frequencies, could be replaced by a first approximation, but the exponential had to be retained when the frequency was high.

* * *

WIRELESS RECEIVING STATIONS.

Part 46 of the *Harmsworth Self-Educator* contains a long article on Wireless Receiving Stations from the pen of Mr. Thorne Baker. After touching on resonance and tuning, the writer deals with receiving circuits in general, and gives simple diagrams of various forms of circuit in use. Speaking of detectors, Mr. Baker says that the currents which have to be detected are exceedingly small, in some cases amounting to small fractions of a micro-ampere (one millionth of an ampere). Minute as these currents are, they appear to be capable of producing heat; in fact, the micro-ammeters used to measure the currents received are often dependent on the heating of a fine wire. The coherer receiver is then mentioned, and is followed by a description of the Marconi magnetic detector. The crystal, electrolytic and valve detectors are in turn considered, and brief descriptions are given of the Einthoven galvanometer, the Orling relay and the Brown relay. Speaking of this last, the writer says that by its means it is possible so greatly to magnify the sounds in the telephone receiver that the receiver can be placed on a table or hung on a wall, and the signals will be audible anywhere in the room.

The measurement of waves and wavemeters next occupy the reader's attention, and the use of long wave-lengths for long distance communication is briefly considered. Paragraphs follow dealing with portable sets, wireless in airships and aeroplanes, wireless in submarines, and the wireless compass, and an interesting little note is given regarding transmission of wireless signals without aerials.

In the Rubber Region of South America

Wireless Telegraphy in Bolivia

By "GRINGO"

IF reference be made to a map of South America one may perhaps find marked approximately in Long. 66° W. Lat. 11° S. on the Rio Beni the town of Riberalta, having a population of about 2,500, where has lately been established one of the wireless stations contracted for by Marconi's Wireless Telegraph Co., Ltd., for the Bolivian Government. As might be presumed, the journey from England to Riberalta is long and tedious, to say nothing of expensive. Leaving Liverpool on 1st July in one of the Booth Line steamships and calling at Havre, Vigo, Leixões (for Oporto), Lisbon, and Madeira, we arrived on the 19th July at Pará, where a number of passengers disembarked, and cargo, consisting of bags of salt, casks of wine and cases of onions, was discharged. We cleared from Pará in the afternoon of 22nd July, and all those who were making their first acquaintance with the Amazon looked forward to an interesting time to Manaos, but I think after twenty-four hours everyone on board with the exception of the captain, officers and pilots, had lost all interest in the scenery, which consisted in mile after mile of forest, with an occasional hut built up on piles along the banks. In the morning of 26th July we arrived at Manaos, the ship's destination, 5,600 odd miles from Liverpool, where passengers prepared to leave, get their luggage through the customs, and hunt up hotels or friends. After attending to our baggage and getting settled in an hotel, the next question was to find out the most convenient river steamer wherein to continue our journey to Porto Velho on the Rio Madeira; we were advised there would be one up from Pará on 2nd or 3rd August. Accordingly we held ourselves in readiness to proceed by it, but on making further inquiries on the 2nd we were told this steamer had met with an accident on the way, but perhaps to-morrow we could leave; we called again at steamer office next day, and received a similar reply; finally another boat was put into commission, and we were notified to be on board by the night of the 7th, and after a sleepless night amidst the din of loading we got under way following morning. After being accustomed to English hours for meals, the times on these river steamers are rather disconcerting at first, as coffee is served 6 till 7 a.m., lunch 10.30 a.m., dinner 4.30 p.m., and tea or coffee again 8 p.m., and it is advisable for anyone with a good appetite not to be misled during the course of the two principal meals into laying down his knife and fork to look at anything of interest on the river bank behind him; if you must look round keep a grip on knife and fork, otherwise the plate is immediately snapped up by the attendants and carried away; there is evidently some ulterior motive here, as it is against their nature to hurry over anything else. There is no unseemly haste about the progress of steamers and launches on the Amazon and its tributaries, because it does not pay, for this reason: it is not every day that those who live at scattered intervals along the banks have an opportunity of conversing with those from the more populous centres, consequently when a steamer calls at one of these places and they have cargo for shipment they expect the *commandante* to come ashore and have a yarn and drink, or else the solitary ones come aboard the steamer for like purpose, all of which goes a long way towards the ship getting the business of the freight. During these stops, mosquitoes and other fly pests get busy with the passengers and *vice versa*; whilst the boat is in motion the mosquitoes are not such a nuisance owing to the slight breeze created by move-

Porto Velho.

ment. On the morning of the 15th August we arrived at Porto Velho, and left the steamer without any feelings of regret. Porto Velho, on the Rio Madeira, is a terminus of the Madeira-Mamoré Railway to which it owes its origin; it consists of a fine locomotive repair shop, well designed mosquito-proof offices and quarters for the staff, a good hospital and a high power Marconi station communicating with Manaos and other places in the Acre region of Brazil, and now also with Riberalta in Bolivia. The other terminus of the line is at present at Guayaramerin, 364 kilometres distant in a south-westerly direction. During the construction of this line, which took about four years to build and was opened in 1912, the loss of life was enormous owing to malaria, black-water fever, beri-beri and various other tropical diseases, as testified by the official statistics and the groups of graves at frequent intervals alongside the track; quinine is still kept on the tables at meal time in the messes.

After a delay in Porto Velho of twelve days, we took train at 8.20 a.m. on the 27th August, reaching Abuná (137 miles) same evening at 5.30, where the train stops for the night. In the ordinary course we should have proceeded next morning, but owing to some further delay did not leave till 7.45 a.m. on the 30th, arriving at Villa Murtinho (58 miles from Abuná) 12.40 p.m. Villa Murtinho is situated at the junction of the rivers Beni and Mamoré, which together form the Madeira river, and here passengers for the Beni leave the train. After lunch we crossed the Mamoré to Villa Bella on the Bolivian side, a small town of 300 odd inhabitants, possessing a customs house and offices of several commercial houses engaged in the rubber business. We were informed we should have to stay here overnight, so set about finding a place to put up in. The hotel accommodation in Villa Bella is not exactly palatial, but the ants, beetles and rats seemed to find it to their satisfaction—it at least affords cover from the rain if one selects a good part in the roof below which to sling a hammock or set a camp bed. The room we occupied was in a block of huts constructed of tree bark nailed to uprights and roofed with a thatch of palm leaves and having an earth floor covered with bark—in places. There were no sanitary arrangements whatever, no furniture, and the rate was, with three very inferior meals, 10 *bolivianos* (16s. 8d.) per head per day. The walls of these huts were of the "open ventilated" type (cracks in the bark varying in width up to ¾ inch) and the natives in the street and next room took full advantage of the fact to watch us settle down; had they understood English they might have picked up some useful additions to their vocabulary. Owing to someone in the next room moaning throughout the night in the throes of fever our first night's sleep was not a success, neither was that of the following night on account of our neighbours having got hold of a guitar and some alcohol.

Natives in a Canoe.

During the afternoon of the 2nd September we left in a motor *batelone* (large cumbersome boat) for Cachuela Esperanza, about 30 miles up the Beni, arriving there 6 p.m., where we had to get out and walk about 700 metres round the rapids to a steam launch on upper side. Next day the crew were busy loading mast sections on the launch and a *batelone*; when the *commandante* thought he had sufficient sections in the hold he ordered the hatch covers to be put on, but the engineer of the launch thought the hold would take more, the *commandante* thought not, so they proceeded to bet on it one bottle of whisky (13s. 4d.) for every other section that could be stowed in hold—the upshot was the engineer was three bottles of whisky to the good, and we left for Riberalta that evening, 80 odd miles up river, and also that night made our first acquaintance with *charque*. *Charque* is meat cut into layers, dried in the sun and lashed with a strip of thong into bundles; we had seen these bundles pitched off the train at various camps along the line on to the dust, where they were walked on and spat on, and upon making inquiries as to what they were we were told we would find out later on. The greater part of the following day was spent in cutting and loading firewood, and in a hopeless endeavour to escape the attentions of flies; these flies came on duty at sunrise, and the place where they had bitten was marked by a small blood blister which itched for hours, the mark remaining two or three days. At dusk the flies "handed over" to the mosquitoes, and the only way to get peace was to retire to bed under a net. There was one particularly dirty member of the crew of the launch whose hands were covered with sores: this turned out to be the cook. I discovered this when I saw him mixing up the dough to

A Rubber Gatherer.

make bread. In the afternoon of 5th September we arrived at Riberalta, 6,610 miles from Liverpool, having taken 67 days for the journey. Riberalta stands in a clearing on a level piece of ground about 60 or 70 feet above low river level ; the town is laid out in 100 metre square blocks with streets 15 and 20 metres wide, the houses being built of adobe or split bamboo or bark and roofed with tiles, corrugated iron or palm thatch. It is (or was) the seat of the *Delegacion Nacional de Territorie de Colonias*, the *Delegado* being the President's representative in the region ; there is also a garrison, power-driven *Delegacion* workshop, steam sawmill, brickworks, ice-making plant, and a mixed population comprised of Spaniards, French, Italians, Germans, Swiss, Greeks, Turks, Japs, Chinese, Chilians, Danes, Peruvians, Colombians, Brazilians, Barbadians and one Englishman, whilst there are Spanish, French, and German Consuls. The imports include all kinds of merchandise, but the sole exports at present are rubber and caoutchouc, and there is a North American syndicate negotiating with a view to taking up the exportation of cedar, which is very abundant on the Beni, though whether this can be done profitably is questionable owing to excessive freights on rail and river. There are seven firms having offices and stores in Riberalta, and rubber lands in the region, two of these being Bolivian houses, four German, and one with head office in Paris ; there are no English concerns. The gathering and preparation of the rubber latex is rather a laborious process, as it is all done by hand and the trees are scattered about in the forest, not in plantations as in the East. It is accomplished in the following way :—the labourer sets out with a number of small cans and an axe with which to make incisions in the trees, and at the lowest point of these incisions he fixes one of the small cans into which the latex drains ; after some time he returns and collects these tins and proceeds to coagulate the latex as follows : a fire is made on the ground, using a certain kind of nut as fuel, and over the fire is placed a cone-shaped sheet iron funnel with an opening in the apex through which the smoke and heat issue, and over this opening a stick is supported horizontally and free to rotate, and on this stick some of the latex is poured and coagulated by the smoke and heat, layer after layer being laid on till the ball is of the required size, some of these weighing 150 lbs., though they vary a lot. The making of these balls is not continuous, however, from the first layer to the last, as time has to be allowed between layers to give the moisture a chance to dry out ; fresh

Early Work on the Station.

Typical South American Jungle Scenery.

rubber sent from Riberalta loses 4 per cent. in weight sometimes by the time it reaches Pará. Rubber is used in the district to make boots, tobacco pouches and rainproof ponchos; to make boots a block of wood is cut out to the shape of the foot and the latex coagulated on it as above; for ponchos a very light cotton cloth is used and served with a layer or two of rubber, or better still caoutchouc; this makes a light waterproof coat which folds into a small space. The following figures will give an idea of cost of various articles in Riberalta, though prices of some of these fluctuated from time to time: 1 lb. tin jam, 5s. 10d.; tin condensed milk, 2s. 6d.; sparklet syphon (2s. 6d. size), £1 9s. 2d.; 1 lb. tin biscuits, 5s.; whisky, per bottle, 13s. 4d. to 20s.; British and German beer, per bottle, 10s.; ginger ale, 4s. 2d.; five gallon tin gasoline, £2 18s. 4d.; five gallon tin kerosine, £1 8s. 4d. to £2 16s. 8d.; nails, 5s. per lb., etc.

To show what a boon to Riberalta and the region generally the new Marconi station is, it is only necessary to mention the following facts with regard to telegraphic communication. Before the wireless service was established, out of five cables received from London the following delays between Porto Velho and Riberalta occurred, 13, 8, 13, 12 and 16 days respectively, whereas now cables from London will be received in Riberalta the day after despatch, provided the traffic is not too heavy. Mails from England average about 52 days for the journey if directed *via* Pará and Manaos, but if not so marked they go *via* La Paz, taking about 90 days. Letters from La Paz, the capital of Bolivia, 480 odd miles as the crow flies, seemed to require 50 days, and from Yacuiba in the south of Bolivia 72 days appeared to be the average time. The Marconi station is situated on a cleared piece of land some 5½ hectares in extent on the outskirts of the town, about ten minutes' walk from the *Plaza* and *Delegacion* offices. The building itself, measuring 46 feet by 34 feet with a 6 feet 8 inches verandah all round, is constructed of cedar, double-walled, resting on a brick foundation; drawings were made out for a skeleton framework in sections, the individual members of these sections being cut to requisite lengths at the sawmill, carted to site, pieced together there, and erected and made fast to the brick foundation and then securely bolted together; the inside and outside of sections were then sheeted with tongued and grooved planks, having a space between walls of 4 inches. There are six rooms, viz., engine, transmitting, and receiving rooms, store, engineer's office and public office. The prime mover is a 4 cylinder petrol engine driving the alternator-exciter-disc combination by means of a belt passing through a slot in the dividing wall to the transmitting room. Reception is obtained by either crystal, valve, or magnetic detector. The aerial system, consisting of a long and a short wave aerial, is supported by four 250 feet steel sectional masts, the masts being planted at the corners of a rectangle 800 feet by 200 feet. The earth system is composed of a metal strip laid in a trench running underneath the station from side to side, and to the ends of this strip are connected wires radiating to a semicircle of buried zinc plates. Before this network was fenced round a good deal of annoyance was caused by cattle stampeding across the wires and wrenching them off the strip connection, also when excavating mast foundations cattle were a nuisance, as on several occasions they fell into the holes during the night. The method employed to get them out was by means of planks put into the holes at an angle from the surface, a noose was then put round the beast's horns and the animal thrown on its side on the planks and hauled up. For the erection of the masts the workers were composed of Spaniards, British, West Indians, Bolivians and Brazilians, and of these the Spaniards proved the most satisfactory.

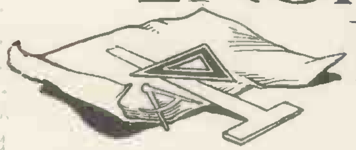
As there was no stone in Riberalta for making concrete for mast and anchor foundations this had to be brought either from Cachuela Esperanze, 80 miles down river, or from Rurrenabaque, 500 miles up river; fortunately we obtained the necessary permission to remove rock from Cachuela on the condition that it was done without blasting; from the date of arrival of the first load till the arrival of the last was three months. Had it been necessary to go to Rurrenabaque, the time occupied would probably have been nine or ten months. Sand was obtained from the opposite bank of Rio Beni before the river rose, as in the rainy season the sand is submerged; this year the Beni rose some 40 feet above its dry season level. The rainy season commences in November and continues till the latter end of March, and during each day of this period heavy rain may be reckoned on, which detracts somewhat from the pleasure of outdoor work. The day temperature throughout the year is fairly equable, seldom rising above 92° F. in the shade and generally falling a few degrees at night; during the dry season, however, "*Surs,*" or cold south winds, occur at intervals, lasting two or three days, when the temperature will drop 30° F. or so in little over an hour sometimes, and comparatively speaking the cold is intense.

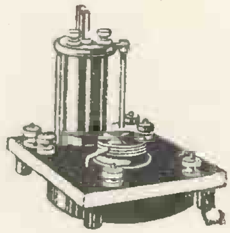
Besides rubber and caoutchouc, there are many other commodities of commercial value in this region, such as coffee, sugar, cacao, coca (from which cocaine is extracted), vanilla, cascarilla (from which quinine is obtained), cotton, and so on, but owing to scarcity of labour and high freights these are not developed to any extent. When these defects are remedied the region should enjoy greater prosperity than even that of the days of the rubber boom.

[*Travelling in Bolivia is at present excessively uncomfortable and fraught with a certain amount of danger, so that the article from the pen of our contributor should prove of more than usual interest to lovers of exploration and those who are fascinated by reading the experiences of people whose business calls them to this little known and rarely visited region.*—ED.]

On the Rio Beni.

The ENGINEERS Note Book





[Under this heading we propose to publish each month communications from our readers dealing with general engineering matters of various kinds in their application to wireless telegraphy, and we would welcome criticisms, remarks and questions relating to the matter published under this heading. We do not hold ourselves responsible for the opinions and statements of our contributors.]

Porcelain Insulators. (II.)

IN the September issue we dealt with the manufacture of porcelain insulators and showed the care that is necessary in selecting and combining the various ingredients. Equal care has to be given to the design. A well-known American expert recently said that the modern electrical porcelain involves more attention to the form of the parts than the most fastidious Greek ever gave his. If in the ancient Greek art the curves were poor, it displeased some of the cultivated eyes—that was all. If in modern electrical porcelain the curves are poor, thousands of people are deprived of light and power.

The testing of insulators after their manufacture is also of paramount importance. The expert to whom we have referred above—Mr. E. E. F. Creighton—recently delivered a paper to the American Institute of Electrical Engineers in which he gave details of a large number of tests of porcelain insulators carried out by means of a high-frequency oscillator. This consisted of a combination of a 60-cycle transformer, a condenser, a spark-gap and an oscillation transformer. Most interesting and instructive results were obtained, many of which will enable the manufacturers to see exactly where the fault lies and how it might be avoided in future. We may instance a test for faults in the skirts of suspension insulators which in many cases gave punctures which traversed a distance nearly twice as great as the thickness of the porcelain. The samples were shown to a porcelain manufacturer, who immediately set the cause of the trouble to the improper use of the tool used in forming the thread on the inner surface of the porcelain. It is probable that the fault could be attributed to insufficient plasticity, which may in turn be due to lack of water, lack of enough ball clay, or to too large particles of flint. It is easy to conceive of the more plastic clay being squeezed out from under the tool, leaving the material directly under the tool of a different consistency from the rest of the body of the porcelain. From this difference in body, weaknesses may be caused either in the rate of drying or in the vitrification due to the improper proportioning of the ingredients in this locality.

Our readers will be well acquainted with the fact that with very high voltages a conductor may often be surrounded with a bluish-violet glow, or "corona." The growth of this corona around the electrodes and on different parts of the insulator has been successfully used as a basis of design. The oscillator with its high frequency is well adapted to bring out the characteristics of design by this method. From some points of view the ideal design of an insulator would be one producing no corona until the arc-over voltage of the insulator was reached. From the practical point of view the laboratory test, unless made under the same conditions as are found in the operation of the insulator, does not necessarily give the best design. For example, if an insulator is to be designed for a very dusty country or where soot and smoke will be deposited on the surface of the porcelain, the conditions call for extra long surfaces for creepage. If an insulator in a clean condition is tested in the laboratory for the appearance of corona, the corona will appear at a comparatively small fraction of the arc-over voltage. Yet, if this insulator is thoroughly coated with a semi-conductor, as would occur in practice, it is quite probable that the apparently faulty design would be far better than one with shorter skirts which in the laboratory tests in a clean condition gives a higher percentage of voltage for the appearance of corona. In brief, one must take into account the use of the insulator and reproduce the operating conditions as far as possible.

Under certain conditions it has been found practicable repeatedly to puncture and weld up the puncture holes in porcelain. There seem to be certain requirements in order successfully to weld up the holes. The best results were obtained by Mr. Cermak in the tests of large porcelain cups which were made up of several different kinds of clay, but all fired at the same time. These cups were partially filled with water, which acted as one electrode, and the other electrode was a wire wrapped around the outside. The punctures noted never took place directly under the wire and therefore no copper vapour was carried directly into the puncture hole. Since the other electrode was water, no metallic vapour could be obtained from this source. The punctured spots in this porcelain appeared as a small bead of clear glass, which actually had greater dielectric strength than the porcelain elsewhere, as no welded punctures were repunctured by a second application of potential.

Comparative tests were also carried out with pieces of porcelain and glass. During these tests a curious feature of the porcelain was remarked. It was found that an increase in the thickness of porcelain from 0·4 in. to three times as much, or 1·2 in., gave an increase in puncture potential from only 74 kilovolts to 91 kilovolts, which is 13 per cent. Three hundred per cent. increase in thickness gives 13 per cent. increase in puncture potential. Although this general condition of increasing the thickness without increasing the puncture potential is known, the small percentage of gain from an increase in thickness may be new to many.

When a puncture has occurred in an insulator, it is often necessary to break up the insulator for the purpose of finding what path the puncture has taken. The following technique has been used to advantage in the examination of the porcelain, and in most cases has indicated the nature of the fault. In many cases the cause of the fault has been traced to a particular condition of manufacture which needs to be improved. In beginning the tests of a piece of porcelain, the first step is to determine the presence of accidental flaws so far as possible.

Soaking in Eosin stain or aniline violet dissolved in alcohol, under vacuum, allows the penetration of the stain into the open air pockets and laminations. A dark stain may be used for this purpose. The stain is then washed off the surface of the insulator. Frequently the cracks will be shown up by the streaks where the stain has soaked into them, and will not wash off. The insulator is then dried and punctured under oil. It is removed from the oil and the oil is washed out with gasoline or some other solvent of oil. The insulator is then thoroughly dried at a temperature above one hundred degrees. It is then immersed in red aniline stain (alcohol solution) and placed under a vacuum. The red stain will penetrate most of the holes and cracks that are opened up by the punctures. In removing the insulator from the stain, it is wiped off and washed off and dried, to prevent discoloration later in handling the broken pieces. The porcelain is then broken up. The original cracks are shown by the dark stain with a layer of red stain on top and the developed cracks are shown by the red stain alone. In some cases it is found difficult or impossible to remove the oil from a crack, and this oil will be found on the surface of the crack as an indicator that the crack was produced by the discharge. Any surface of a broken piece which shows neither stain nor oil, it is natural to infer, is produced by the mechanical strains of the hammer or vise. The alcohol solutions are far more penetrating than solutions in water, such as ink.

A "TALL ORDER."

Extract from a letter to the Editor:

"Please could you send to the above "name and address full particulars of the "wireless system. . . . If you could I "should be only too pleased to receive "them and let you know the results."

Administrative Notes

New Zealand.

Amended radio-telegraphic regulations provide that radio-telegrams to or from ships trading exclusively between ports on the coast of the Dominion of New Zealand, while such ships are voyaging between the Ports of Lyttelton and Wellington, from or to any telegraph-office in the Dominion of New Zealand shall be charged at the rate of 2½d. a word, with a minimum charge of 1s. 3d. for each radio-telegram, equal to a message of six words.

Arrangements have been made to telephone free of charge to the addressee any radio-telegram the address of which includes a telephone number.

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Twenty-seven ship stations are registered in New Zealand and regulations for controlling the use of wireless on British and foreign ships, not registered in New Zealand, while they are in territorial waters were gazetted on the 16th July, 1914, and are now in force.

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Oceania.

We have been advised that since January 1st, 1915, New Caledonia and Tonga have subscribed to the International Radio-telegraph Convention, signed at London on July 5th, 1912.

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South Africa.

A further convenience for mariners is reported from South Africa. We understand that the Union Government wireless station at Slangkop will transmit wireless time signals daily. The signals are sent at 11 o'clock at night, South African time (9 p.m. G.M.T.).

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Sweden.

The *Times* of 10th September last contained the following paragraph:

"The Swedish Government recently asked "the German Government that commercial "telegrams emanating from Sweden might "be sent by wireless telegraphy from Nauen "to New York. This the German Government has assented to, but on condition "that the telegrams be important and that "they do not exceed 25 words in length. "This arrangement is looked upon in "Sweden as extremely important, as it "affords a quicker service than that *via* "Serbia and at the same time avoids the "British cable censorship."

* * *

United States.

We are informed that the Sagaponack station (call letters "WSK") has been temporarily discontinued, and until further notice traffic will be dealt with by the coast stations at Seagate ("WSE") and Siasconset ("WSC") in place of the Sagaponack station.

* * *

The September number of the *Wireless Age* contains the following paragraphs:—

"It is pointed out in a dispatch from "Washington that the opening of the new "United States naval wireless station at "Darien, on the Canal zone, does not add to "the facilities for the transmission of "commercial messages. The new station "will be used exclusively for Government "business. Primarily, it will be used as a "means of directing operations of various "kinds on the Canal zone, and keeping in "communication with ships at sea, but it "will also be used freely by the Department "of Commerce for the sending of its official "messages.

"Out of a total of forty-seven naval radio "stations now in use in various parts of the "United States or its possessions, twenty-"one, it is declared, are open to commercial "messages, the others being reserved strictly "for official business. In the Canal zone "there are two stations—at Balboa and at "Colon—which receive commercial messages, "so that the new station need not enter that "field in order to accommodate the public, "as the facilities are already ample.

"Plans have been made for radio com-"munication between San Francisco and "Manila by way of Honolulu. The section "to Honolulu will not be in operation until "a year from this time."

Correspondence

"The Calculation of Inductances."

To the Editor of THE WIRELESS WORLD.

SIR,—The article on "The Calculation of Inductances," by Mr. Lowey, in your October issue, is of great interest.

Unlike the capacity of a condenser, the self (and mutual) inductances of coils such as are used in wireless circuits can be calculated to a high degree of accuracy by the use of appropriate formulæ. There are a large number of formulæ now available for every conceivable case, but the majority of them, including even the most convenient and easy to work with, are not known as widely as they might be to those who are interested in these matters.

In the case of the capacity of a condenser the formulæ available are not of great accuracy for most of the forms of condensers which are in general use where a dielectric other than air is used, the variability of the dielectric constant for different specimens renders difficult an accurate predetermination of the capacity.

In the case of a coil the inductance depends principally on its geometrical form and can be predetermined with great accuracy, which is an important point for some purposes. The representation of the inductance by a chart or scale such as that described by Mr. Lowey in his article is extremely useful, since it avoids the use of tedious calculations and, therefore, facilitates the process of selecting the most suitable sizes of former and wire for the purpose in view.

Unfortunately the value of Mr. Lowey's chart, which must have entailed considerable work to construct, is somewhat reduced by its inaccuracy, which is apparently due to the fact that Dr. Cohen's formula, on which it is based, is not a suitable one to use for the purpose.

The formula in its original form is intended for the inductance of a multi-layer coil, and the form quoted in *The Year Book of Wireless Telegraphy* has apparently been obtained by eliminating the terms which depend on the number of layers.

In *Formulæ for Mutual and Self Inductance*, bulletin of the Bureau of Standards, U.S.A., Vol. 8, No. 1, the formula is given as an approximate one with an accuracy of a half of one per cent. for $L=2D$.

A much more convenient one to use is that of Professor Nagaoka $L=l(\pi DN)^2 K$ in which the factor F worked out by Mr. Lowey is given directly. A table of the values of this factor to six places of decimals with first and second differences will be found in the pamphlet quoted.

From this it is seen, for example, that the inductance of a solenoid with length equal to its diameter is ·6884 and not ·636 times $l(\pi DN)^2$ as given in the article.

In addressing this letter to you I am prompted not so much with a view to criticism of Mr. Lowey's article but because it shows how useful an exchange of information on subjects like this may be, since it must often happen that one person has access to more extensive or more reliable information than another, and the great labour which has been expended in the derivation of formulæ such as those here mentioned deserves that the results should be made known as widely as possible to all those who are interested.

This exchange of information and ideas can best be carried out in the columns of a journal such as THE WIRELESS WORLD, which is devoted to the subject.

In the matter of practical construction of apparatus a great deal has already appeared, but as regards theoretical points much more might be done. The amateur, who constructs a wireless receiver with the aid of a ginger beer stopper and some empty tins, is never backward in sending a description and photo of it for insertion.

It is to be hoped that in future his ideas or queries on matters of theory will be forwarded for publication with the same assurance, or will receive enlargement from the work of those who do communicate the results of their work, in this direction, to your columns.

I am, Sir,

Yours faithfully,

"FORMULÆ."

Wireless Telegraphy in the War

A résumé of the work which is being accomplished both on land and sea.

OUR contemporary the *Morning Post* recently issued the following communication from their correspondent in Christiania :

" A business man residing here has within "the last few days received messages sent "by wireless telegraphy from America to "Germany and thence in the ordinary way "to Christiania. I learn that there are two "wireless routes between America and Ger- "many—namely, between Tuckerton (New "Jersey) and Eilwese, near Hanover, and "between Sayville (Long Island) and Nauen, "near Berlin. No official information has "been issued to the effect that wireless mes- "sages will be transmitted from America to "Scandinavian countries by way of Ger- "many; and certainly no messages are "accepted for transmission by wireless in "the opposite direction."

The whole situation would appear to have arisen through the fact that the wired lines connecting the Scandinavian countries with America are under British control. The British censors seem to have delayed, and in some cases even to have stopped altogether, business communications thus coming under their control. A certain number of complaints were received by the Norwegian and Swedish Governments, and a meeting was held to consider the situation. The German Government heard of this convention, and put before it an offer to receive the various business telegrams in Germany and transmit them by their long-distance wireless stations to America. The experiment was tried ; but the Germans in their turn seem to have tampered with messages, with the result that (we understand) the arrangement completely broke down. This is only one of many instances from which neutral countries are bound to suffer to some extent when their powerful neighbours are in conflict.

* * *

An interesting point confirming the utility of wireless stations in Germany has recently appeared in the report issued by Vice-Admiral Patty, concerning the operations of the young Australian Navy at the beginning of the war. In the course of August of last year the gallant Admiral was endeavouring to get into touch with the *Scharnhorst* and the *Gneisenau* with the object, of course, of destroying them. He formed an elaborate campaign for getting them at Simpsonshaven. But the German wireless station at Rabaul communicated the movements of the British Fleet to the enemy and frustrated Admiral Patty's manœuvre. When we remember that those two ships destroyed the British Pacific Squadron off the Chilian coast a couple of months later, it will be recognised that this German wireless station fully justified, by this one act, the whole expenditure involved in its erection and maintenance.

* * *

The wireless stations in Africa captured from the Germans are likely to prove by no means the least valuable of the booty taken. The right flank of General Botha's advance northward, commanded by Colonel Myburgh, crowned their efforts by the capture of Tsumeb. The town and garrisons surrendered on demand, and the entire German battery with its full complement of officers and men fell into the British hands. The enormous supplies taken at this town included 5,000 cases of rum and new equipment for 10,000 men. The Germans destroyed their cartridges, but their *wireless apparatus* was so little damaged that it was possible to communicate the same day with the Slangkop Station at Cape Town. When we remember that one of the principal defects in opening up vast tracks of undeveloped country consists of lack of means of communication, the value in the future of those powerful and well equipped stations can hardly be exaggerated.

Our illustration of a typical plan of military operations (which is reproduced by kind permission of the *Illustrated London News*) will serve to indicate the way in which operations of a modern army in the field are assisted by wireless telegraphy. Series of dots represent the main threads of the spider's web formed by the lines of inter-communication between the General Headquarters and the various units. Messages are passed between all parts of the war area by various means of communication —by wireless, by ordinary telegraphic and telephonic lines, by messengers on motor-cycles, or mounted dispatch-riders. All means are employed; but, under the intense concentration of artillery fire which characterises the present-day battle, the only one which can be looked upon as absolutely reliable is wireless. Over and over again it has been found in certain sections almost impossible for orderlies or dispatch-riders to cross a fire-swept zone, whilst telegraphic and telephonic wires are smashed by high explosives almost as soon as they are laid. Only the invisible æther waves remain unaffected, and it is for this reason that more and more on the field of battle, as well as at sea, the reliance of the higher command is leaning towards wireless. As far as aerial reconnaissance is concerned, it is the only form of communication available under *all atmospheric conditions*, and the vast increase in France's aerial fleet, to which we refer below, has necessitated, in the course of this war, the taking over by the French military authorities of the training of their own wireless aeronauts.

* * *

Count Reventlow's letter to the *New York World* on the subject of the German Fleet, its lack of achievements, and the reasons for it, naturally makes great play with the exploits of the *Emden*. We have many times pointed out that the successes won by this raiding cruiser were due to the help of wireless; but it is interesting to learn that our view has been confirmed by the deliberate statement of Captain von Mueller himself. A Mr. Haumann, recently released from four months' internment in Australia, on arriving at Fremantle, gave an interview to a representative of the *Western Australian*. This is well worth reading, if only for the anecdotes told to Mr. Haumann by Captain Mueller instancing the different ways in which wireless had enabled

The "Nerve System" of an Army, being a Plan of a Typical Military Position, Indicating the Important Part Played by Wireless Telegraphy (by kind permission of the "Illustrated London News").

C

Kavalla, which, like Salonika, Forms an Excellent Landing Place for Troops.

him, not only to "play up" his pursuers, but to catch his prizes.

* * *

The most striking feature of the European war which has occurred during the past month consists of the sudden establishment of the Balkan war in the forefront of military operations. From the point of view of the Allies, the principal happening of importance consists of the landing of the British and French troops at Salonika, and we accordingly feel that our readers will appreciate the views reproduced in these pages. Two of them (pages 510 and 511) show the wireless station there taken from different points of view, and it is certain that both permanent land stations and wireless field equipment will play as fully an important part in the forthcoming struggle of Serbia for existence as they have done in other parts of the world. Of our other views, that on page 509 shows a typical street scene in the town, whilst the illustration on page 512 gives a very fair idea of the port itself, the latest scene of operations for the French and British fleets. Our illustration on this page represents Kavalla, the only other port on the Macedonian coast equipped with a wireless station, which is likely to be of service to the Allies in the forthcoming struggle against Bulgaria. Lying under the protection of the island of Thasos, this port is largely immune from the heavy winter gales which severely handicap the navigation of this coast.

* * *

Amongst the many novelties introduced during the course of this wonderful war, for the first time there figures largely in the Press, not only of Great Britain but of the whole world, a number of miscellaneous items generally denominated as "Wireless News." Although by no means confined to news from Germany, but regularly including items from France, Italy, Russia, America, etc., the greatest prominence has been given by the newspaper Press to the "German Wireless." The reason for this is that Germany, whose cables were cut within a few hours of the declaration of war, has had to rely ever since for direct communication with the outside world upon her wireless stations, so that *news direct from Germany is only available by wireless.* The value of direct as against indirect communication is highly valued by the Press. From the point of view of speed reception and reliability, German items sent out from Marconi House have to all intents and purposes no rivals to contend with. The war has, therefore, seen initiated the news service of the "Wireless Press," received at all hours of day and night by radiotelegraphy and subscribed to by every newspaper of importance in London. Its services are continually extending, even under war conditions, and are certain of an immense development and many ramifications after the re-establishment of peace.

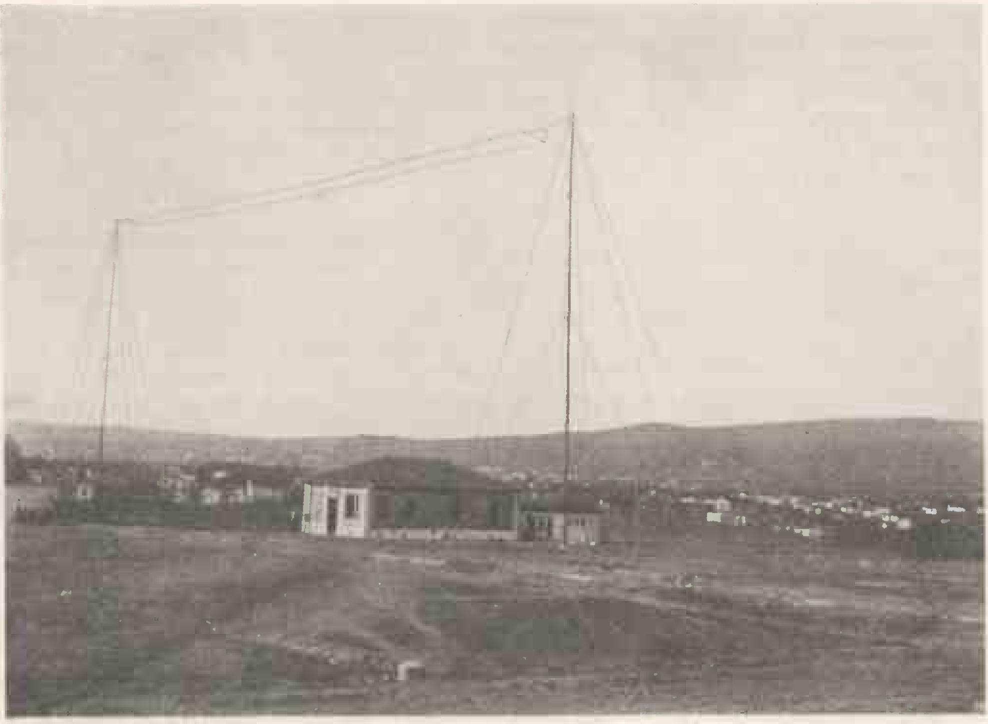
* * *

An interesting account of operations in the Dardanelles appeared in the recent issue of the *Aberdeen Journal*, extracted from a letter written by Mr. E. K. Ogilvie, *wireless operator on one of His Majesty's ships*. Amongst a series of pen pictures drawn by the gallant young operator the following will be found especially interesting to our readers: "Our people know where to draw the line. "There was a tower on a hill, apparently a "mosque or shrine, close beside a defended "village. In spite of the fact that shells "from our ships destroyed everything in "and around the place the tower remained "an object lesson to Germany on principles "of 'right and wrong.'"

* * *

Few points in the conduct of the present war are more interesting and instructive than the ingenuity which is being devoted to devising novel methods of breaking down the enemy's resistance. The accounts which have recently been allowed to appear in the daily papers dealing with the new aerial fleets of France emphasise the rapid development of this branch of our Allies' military activities. The spread of the wings of these aerial dreadnoughts is 70 feet, and the body will comfortably hold 12 men, although the normal crew will only number 6. The average speed is about 80 miles an hour, and in stability, rapidity, carrying

Salonika: A Typical Street Scene.



Aerial and General View of Wireless Station at Salonika.

power and endurance these new machines are vastly superior to the German zeppelins. The smaller biplanes which, driven at a speed of 100 miles an hour, act the part of "destroyer" auxiliaries to these dreadnoughts of the air, indicate that real fleets cruising as composite units are now possible, and when we come to consider that the whole science of military aviation is the result of 6 years' growth, we shall realise the rapidity of progress made. Of course, it is hardly necessary nowadays to point out that these new organisations have only been brought within the field of "practical politics" by the advent and development of wireless telegraphy, whose experts have had their ingenuity kept continually on the *qui vive* to respond to the fresh demand made by the new conditions under which their science is called upon to work.

* * *

Mr. Allan Baddeley contributes a very interesting paper to a recent issue of the *Fortnightly Review* dealing with the Navy past and present. He draws a very fascinating picture of old time single ship cruising in distant and tropical seas. The essence of the attractiveness of these conditions is contained in the little sentence *there was no harassing wireless*. Upon this depended all the peace of mind engendered in the captain and his officers. "Remoteness from direct authority, the charm of the roving life amidst the genial ports, the hospitality universally extended to the sailor in his wanderings, all tended to induce a state of acquiescence in routine, an eminently human refusal to bother about the possibility of war." Wireless has altered all this, every ship now is in immediate connection with the officer commanding the Fleet or Squadron, he himself remains directly in touch with headquarters. The result is that the British Navy of to-day is an almost perfect machine, whose magnificent qualities have recently aroused a pæan of admiration amongst the French visitors accorded the privilege permitted to no Englishman.

* * *

In our September issue we published an account from the wireless operator of the *Trent* describing the final destruction of the

Königsberg. A further account is given in a letter by Chief Paymaster Charles Spedding of the *Laconia*. He states that "the "bottling up business was all bunkum; the "ship had the choice of five rivers or rather "river mouths to come down, and in order "to get at her it was necessary to run the "gauntlet of a miniature Dardanelles." His description is a very graphic one, and one weird feature in connection with the German vessel's final destruction consisted of the fact that neither the *Königsberg* nor the ships bombarding her could see the object at which they were firing; all had to be done by direction either from aircraft or observation posts. His description of the gallantry of the occupants of the British aeroplanes and the way in which they controlled the British gun fire by wireless is well worth reading:—

"During the second day of action an "incident occurred which calls forth one's "admiration of the pluck and presence of "mind of Flight-Commander Cull and "Wireless Expert Arnold, who were in the "aeroplane that the Germans brought down. "When it was seen that there was something "wrong with the plane, the spotting correc- "tions still continued, and the last message "read as follows: 'Carry on, you are "'hitting her every time forward. We have "'been hit. Coming down on water. Send "'a boat.' A few seconds later the aero- "plane (a land machine) crashed into the "water throwing Arnold out. Cull ex- "tricated himself with great difficulty under "water a minute and a half after she struck. "He had a very narrow escape indeed. "Had these two officers not put the guns on "to the *Königsberg* in time a different ending "of the whole action might have resulted."

* * *

It is not often that a wireless station is "frozen out" for lack of news, yet such appears to have been the case with a German wireless station established at Gross Bay, situated in the Polar regions. The Christiania correspondent of *France de Demains* states that a German settlement had been located here since 1908, when Count Zeppelin established an airship station at Spitzbergen; its object was to exploit the copper deposits of this region, despite the prior British claims supported by the Government. News travels slowly, and we have only just heard that in October, 1914, a British vessel took refuge in Gross Bay from an autumn tempest. The wireless station had not been working for some time on account of bad weather, and the men in charge, who had no idea that war was declared, saluted the cruiser by hoisting the German flag. The glee of the British sailor in having something tangible to "go for" can easily be imagined. The ubiquity of these German wireless stations is quite marvellous, and we are constantly hearing of their presence in all sorts of unexpected quarters. Perhaps if Mr. Savage Landor were once again to make his adventurous way through Tibet he would find German wireless stations on the "roof of the world."

* * *

The *Indian Pioneer Mail* gives some interesting details of the fall of the German post of Bukoba in East Africa, where the enemy had built strong forts, a powerful wireless station and other erections. The enemy put up a stout fight, and the British frontiersmen, under the command of Lieutenant-Colonel D. P. Driscoll, D.S.O., had hard work to make their way up a steep ascent through dense plantations. Eventually, the British worked themselves into a strong attacking position and rushed the fortifications.

* * *

The British nation has recently been profoundly touched by the kind sympathy displayed by the Danish authorities and

Salonika: The Wireless Station Building.

The Water Front at Salonik.

people on the occasion of the Germans' dastardly attack upon a British submarine grounded and helpless on the neutral shores of Denmark. It is, therefore, with some peculiar gratification that we learned recently of the preservation of a Danish crew, victims to German submarine piracy, through the means of wireless. The Danish schooner *Jason*, of Svendborg, had been torpedoed, and the seamen on board her were in danger of perishing when a wireless call at 11 p.m. was received from a neighbouring lightship by some vessels near by, which proceeded to the scene of the disaster and rescued them all.

* * *

The *New York World* was made responsible for the recent exposure of the German intrigues connected with the Sayville station. Their revelations, however, extended considerably beyond this one item. It is alleged on their authority that the Telefunken Wireless Company, acting under instructions from the German Foreign Office, endeavoured to instal for the American Government stations in the Philippine Islands located on positions mapped out by the German Foreign Office. Moreover, according to our enterprising American contemporary, Herr Bredow, General Manager of the Telefunken Company, attempted in 1913 to gain complete control of the wireless plants of South and Central America working in connection with Sayville. Evidence adduced also tends to show that Germany in 1911 made strenuous efforts to obtain permanent land stations in the neighbourhood of Nicaragua with a view to the great utility which would be possessed by them in the event of the Panama Canal being fortified. We would refer our readers for full details as to the methods pursued in the United States by the unscrupulous Teuton to the absorbing article commencing on page 515 of this issue.

* * *

The deliberation with which the great German war plot, which we are now engaged in crushing, was systematically prepared and laboured for many years, has already been made abundantly clear. But additional evidence is continually being brought to light, and we have a fresh exemplification in the discovery of a secret wireless plant in the island of Bréhat, one of the lesser known islets off the French coast, an installation connected with a well-laid plot against our Gallic Ally.

A certain apparently guileless, venerable, and bespectacled German professor visited this pretty little island on the pretence of scientific research, and purchased an old mill on an eminence commanding an extensive view of the tiny Archipelago. Here have been discovered unmistakable preparations for establishing a wireless station, and the details of a daring project for the invasion of France from the sea operating from this point have since come to light. With Great Britain neutral, the French Fleet was to have been "suitably accounted for," and a large number of transports were to convey thither two army corps from Bremen and Hamburg. Thus was to have been established an island stronghold, forming an organised centre for Germans rejoining the Colours from the United States and South America, and it was estimated that a German army of about 200,000 men would, within a short time after the outbreak of hostilities, be operating from this point in Brittany, thus taking the French armies in the rear. Of course this was one of the plots which was frustrated immediately it was made evident that the standard of Great Britain was being unfurled against the encroachments of the modern Huns.

* * *

An interesting account of an interview with the captain of a British transport has recently come through from Montreal. Whilst engaged in transporting troops to the Dardanelles one day in the late spring of this year, a wireless call for assistance was received from a sister transport which was being attacked by an enemy torpedo boat. Captain Edward Thomas asked for wireless instructions, and in view of the fact that he himself had troops on Board, was promptly ordered to "clear out!" In the meantime the enemy torpedo boat found that the wireless of the helpless vessel they were attacking had summoned British destroyers from about 12 miles away. For over 40 miles the enemy was able to keep away from the British ships of war, but eventually he was obliged to beach his boat on an island in such haste that when the British pursuers arrived they found the engines still running. This isle of refuge was only a square mile in area, so that the exciting man-hunt which ensued on the arrival of the British was speedily and completely successful. The gallant captain closed his interview with the Canadian reporter with a reference to the remarkably effective co-operation of the Fleet with the landing forces in the Dardanelles, and with expressions of admiration of the marvellous shooting made by the gunners of the *Queen Elizabeth*.

* * *

Our illustration below depicts a sight which is now common on every battlefield—namely, the erection of the wireless masts as part of the great nerve system whose centre is the General Headquarters and whose ramifications are dealt with on p. 507 of this issue.

NOTES OF THE MONTH

THE Northampton Polytechnic Institute, of St. John Street, London, E.C., has favoured us with a copy of their recently issued "Announcements" for the session 1915–16, in which we notice that there are day and evening courses in various subjects. These include engineering (civil, mechanical and electrical), whilst this subject is further subdivided under the headings automobile work, aeronautics and radio-telegraphy. We are informed that in the electrical engineering department various transformers and motors of special types have been added, and a Tirrell regulator and a Mercury Arc rectifier installed. The instrument equipment has also been extended.

* * *

The following paragraph, taken from the tenth annual report of the Meteorological Committee to the Lords Commissioners of His Majesty's Treasury, for the year ended March 31st, 1915, may be of interest to our readers :—

"During the first seven months of the "year the arrangements for the collection "of information by wireless from Atlantic "liners were carried out on lines indicated "in previous reports. The number of mes-"sages received was well maintained. A "further improvement in the direction of "avoiding delay in transmission can be put "on record. The percentage of morning "reports which reached the office in time "for inclusion in the current issue of the "Daily Weather Report increased to 9·4 "per cent., as compared with 7 per cent. "for 1913 and 5 per cent. for 1912."

* * *

Mr. Godfrey Isaacs, Managing Director of the Marconi Wireless Telegraph Co., made the interesting statement recently to the London News Agency that had it not been for the war we should now have been telephoning by wireless to New York.

He was approached on the subject, he said, as the outcome of the successful experiments of the United States Navy Department in telephoning by wireless from Arlington, Virginia, to Mare Island, California, a distance of 2,500 miles. "Our "experiments," he added, "have been "interrupted by the war, as our stations are "now used for Government work. But we "have carried our experiments far enough to "know that undoubtedly after the war "we shall be able to talk to New York."

"Senatore Marconi has been experiment-"ing with Wireless Telephony for a long "time. There is nothing new in being able "to telephone by wireless over a long dis-"tance. The great point is to make it a "practical proposition. It is to that end "that Senatore Marconi's experiments have "been directed, and to make it more "efficient and turn it to practical commercial "account."

* * *

For the first time in the history of the automobile it has been demonstrated that a car can be started from a distance by means of wireless. This was proved recently when the motor of a model 83 Overland was started every five minutes by a wireless impulse from the Overland headquarters five miles away. A complete wireless outfit consisting of motor generator, transformers, relays and other details was installed in the show windows of the Overland depôt. This was connected with an aerial on the roof of the building, and by stepping up the alternating current from 110 volts to 16,000 volts the apparatus made it possible to send messages 300 miles. The Overland car on exhibition five miles away was fitted up with the necessary receiving and other apparatus.

The Quenching of Sayville

THE CLOSE OF A SORDID STORY

By Special Permission of the "Wireless Age"

WITH the control of the German-owned Sayville wireless station now in the hands of the United States Government and its operation governed by American naval officers, details of the acts which led to the seizure reported in the August issue are rapidly coming to light. Accusations of neutrality violation have followed thick and fast and people hitherto respected by their neighbours have been placed in the limelight of suspicion. Even the sinking of the *Lusitania* has been connected with the operations of the station and the country has been stirred from end to end by disclosures made in unexpected quarters. That the principal evidence upon which the seizure was made was supplied by an amateur makes the story just that much more dramatic to our readers, and bears out an oft-repeated contention that the amateur is a valuable member of the community and entitled to serious consideration.

The story properly begins back in the early part of July, when the first rumble of suspicion came from Washington officials and found its way into the newspapers. It had been repeatedly hinted in certain quarters that the Government might refuse to issue a new licence for the new and more powerful equipment then being installed at Sayville. Persistent rumours of messages of a military character sent under cover of ordinary commercial dispatches in plain English and German caused the situation to be viewed from an angle more serious than that which concerned the right of the Government to refuse to grant the new licence on the ground that no belligerent nation or its agents has the right to establish a wireless station in a neutral country after war has been declared. Some of the messages filed had been rejected by the naval censors on the ground that they were too obviously not what they pretended to be. For example, orders from America to buy cotton in Germany impressed the censors as entirely unworthy of being intended to be taken at their face value by those to whom they were addressed. Other commercial orders, or pretended commercial orders, that could not in the nature of things be executed in Germany on account of the present commercial isolation of that country were rejected also. Certain messages to persons in America to execute orders for goods that could not be shipped to German ports or would be useless in Germany in this time of war, if it were possible to get them into German territory, shared the same fate.

The fear was expressed that through apparently harmless messages the Sayville station might be used to communicate military information to German submarines. In answer, Dr. Karl G. Frank, of the Atlantic Communication Company, which owns the station, said he did not consider this intimation worthy of serious consideration, for what it claimed was a physical impossibility. "In the first place," he said, "the wave-length used at Sayville is eight or ten thousand metres, whereas the wireless equipment of submarines would produce a very much shorter wave-length." When this statement appeared wireless men called attention to the fact that information sent first to Nauen could easily be re-transmitted to the submersibles through one of the several types of equipment installed at Nauen.

And so the situation stood when, on July 9th, the United States Government announced that in the future the plant would be conducted by American naval officers in the interests of its proprietors. The official memorandum from the Secretary of Commerce stated that the new licence had been refused because it had been learned that the Atlantic Communication Company is owned by the Telefunken Company of Germany, the controlling interest in which is owned by powerful German electrical concerns. Dr. Frank was identified as the New York representative of these controlling companies and Prof. J. Zenneck, who had been conducting so-called experiments at Sayville, was known to be a captain of marines in the German army and had been during the present war in the trenches in Belgium. The opinion of the department as stated was : " To grant a licence for a new station, erected since the war began, with German apparatus, avowedly under German ownership and control, communicating avowedly with stations known to be under the control of the Imperial German Government . . . would be an unneutral act."

The seizure of the station was characterised a " precautionary measure " and rested as such in the public mind for ten days. Then, on a Sunday morning, New Yorkers were startled by reading in their newspapers what was announced by the *World*, " the real reasons " for taking over Sayville. Investigation by the Secret Service, the account said, had established a definite probability that unneutral uses were being made of the station, the exact nature and extent of these uses remaining an official secret.

Great was the astonishment of readers when they learned that, in the course of the investigation by the Secret Service, phonographic records were taken by Charles E. Apgar, owner of a wireless experimental station at Westfield, N.J., for fourteen successive nights of every message, every signal, sent out from Sayville. These " canned " messages established the truth about Sayville. They showed exactly what had been transmitted ; their comparison with the messages as they were submitted for approval to the censor showed the impotence of anything but Government operation.

By specific statute provision the contents of messages sent by wireless must be held inviolate. It can be said, however, that the " canning " of the messages sent from Sayville from June 7th to 21st inclusive showed these significant things :

That striking variations from the customary methods of sending were recorded, the possibility of system in these variations being made apparent.

That in the repeating of messages and in the sending of " message checks " there were similar variations from customary practice, with a similar possibility of system.

That these variations, undetected by the Government operators at Arlington and Fire Island, who " listened in " nightly on Sayville, were made unmistakable by the phonograph.

That the mechanical transmission of messages could be interrupted at any time and repetitions or interpolations of words by key could be easily effected.

That the possibilities for such codes as acrostics and " time spacing " were great under the circumstances, and that no censorship could prevent their use.

In long-distance transmission what is known as a Wheatstone tape machine is used. This punches out the dots and dashes on a strip of paper, the sending itself being mechanical. By the closing of a switch, however, it is possible to cut in on such transmission and to send by key, as, for instance, when it is necessary to repeat a word. To repeat mechanically it is necessary to stop sending and move the tape back until the perforations symbolising the desired word are reached.

The phonograph records showed that such repetitions as this were frequently made with so little loss of time that they must have been done by key. In the same way it would be possible, furthermore, to add a word or two, or even a sentence, in the middle or at the end of a message with no record to show for it.

The usual custom in long-distance sending is to repeat each word. For example, a message beginning : " Pr. 3. W. 16 to " (name and address), etc., would be sent thus : " Pr. 3 Pr. 3., W. 16. W. 16, to to," etc.

In the " canning " of the Sayville messages it was found that this custom was frequently varied. Sometimes a message would start : " Pr. Pr. 3. Pr. 3." Sometimes a word would be repeated twice instead of once. Sometimes there would be still other variations in sending that became apparent in the faithful reproduction of the phonograph.

An operator taking down the message by ear could easily miss the possible significance of these variations. With his attention centred on getting the meaning, he would regard the repetition as being intended merely to make the symbol clear.

Numerous instances appeared where the messages were not always repeated in the order of their sending. Messages Nos. 73, 74, 75 and 76 would be sent, then Nos. 78, 79, 80, and so on. After a score or more of messages had been repeated, No. 77 would appear. Sometimes the missing message would come after only two or three others had been repeated. On one occasion 48 had been sent again before it appeared.

Another nightly custom that offered similar opportunities, apparently, was in the "message checks." These are reports back to the Nauen station of the messages, by number, "received complete" the night before. These reports would read, for example: "Received complete 191 till 196, 199 till 210," etc. What had happened to messages Nos. 197 and 198 would not appear, and there seemed a possibility of coding in that.

Each night, also, after the transmission was at an end, there was always "talk" of how the signals had come in, of static conditions of the night, between what hours signals had been strongest, and matters of that sort.

When Dr. Frank, of the Atlantic Communication Company, read the revelations published by the *World* he gave out an interview which quoted him as saying:

"That Mr. Apgar can record messages "sent out by wireless on a phonograph "cylinder is hardly worth discussing. That "is physically impossible. I have never "heard of its being done. If Mr. Apgar "has accomplished it, he should get his "idea patented and perhaps we will buy it."

Dr. Frank thereby indicated that he was not acquainted with articles appearing in wireless magazines. On several occasions during the past year reference has been made to the dictaphone receivers installed by the American Marconi Company in its new trans-oceanic stations. A number of these records have been in use for some time in the Marconi School in New York for code practice and others have been used in the New York trans-oceanic offices to acquaint former cable operators with fast trans-oceanic wireless work.

Among wireless men the dictaphone, or phonographic wax cylinder, method of recording is known as a development that made possible the reception of signals at a speed greater than the most expert operator could achieve.

Dr. Frank's declaration was read with amused interest by Charles E. Apgar. By way of reply he produced a letter, written under date of February 5th, 1914, on stationery of the Atlantic Communication Company, of which Dr. Frank was then, as now, secretary and treasurer. The letter read:

"Mr. Charles E. Apgar, No. 549 Carleton
"Road, Westfield, N.J.:

"Dear Sir: Your letter of the 30th ult. "addressed to Mr. A. F. Seelig has come "to hand and we have noted its contents "with interest. In answer we beg to say "that we have no objection to your re-"ceiving our Sayville press in the way you "have done so far. We can, however, not "allow you to publish what you receive, "neither private messages nor press. It "would interest us to receive one or two "of the phonographic records you have "taken, and we would be much obliged if "you would favour us with the same.

"Yours very truly,
"ATLANTIC COMMUNICATION COMPANY,
"Operating Department,
"H. Boehme."

On the letter Mr. Apgar had written this memorandum:

"Monday, Feb. 9th, 1914."

"Delivered personally to Mr. Boehme "two phonographic records of Sayville "(W S L) sending, dated Nov. 3rd, '13, "and Nov. 12th, '13, for test of results."

"I think," said Mr. Apgar, "that ought "to show Dr. Frank it is his own fault if "he never heard of making phonographic "records of wireless messages. This letter "was written eighteen months ago. The "records that were delivered at that time "were made three months earlier, and, in-"cidentally, in the course of the second "month of my experiments in recording "messages. You can see my experience "with Sayville 'sending' began a long, "long time before I did my work for the "Government."

How I Cornered Sayville

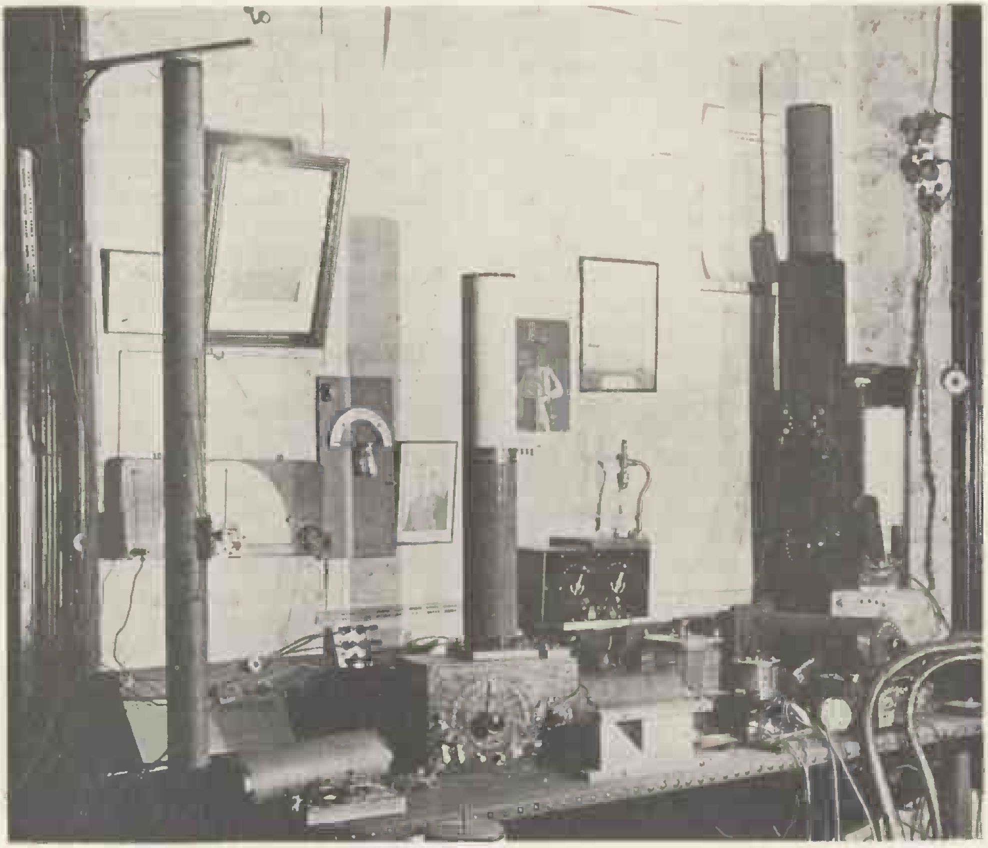
By CHAS E. APGAR

By Special Permission of the "Wireless Age"

THERE is comparatively little I can add to what has been so well set down by this magazine's Editor. My part in the Secret Service work has been told and the circumstances which led to my employment faithfully related; what, then, will probably interest my fellow readers most are a few of the details connected with making the records and a description of my equipment.

First, let me deal with the attempts to discredit the use of the records:

It has been stated in several New York papers that as the phonographic records did not reach Washington till after the Sayville station had been taken over by the Government, they did not play any important part in securing certain desired information. Replying to this, I will say that the records were made each night, between 11 p.m. and 2 a.m. The next morning I immediately transcribed the recorded messages and delivered them personally to Chief Flynn in New York, or sent them to him in Washington; hence they were filed with the Secret Service a very few hours after being sent out by Sayville, which enabled practically immediate comparison with the censored messages, as well as with those received by other wireless operators of the



Mr. Apgar's Station.

Government who were "listening in," presumably at Arlington and elsewhere.

Just bef.re this special work began L. R. Krumm, Chief Radio Inspector of the port of New York, visited my station and after many hours of actual experience with the receiving instrument pronounced the station of the highest efficiency. Many phonographic records were demonstrated to him; hence when Chief Flynn of the Secret Service consulted him concerning the best method to get Sayville undeniably on record, he requested me to call at his office "on an important matter."

I was immediately introduced to the head of the Secret Service in New York, who told me to "get busy." Needless to state, perhaps, it was some pleasure at least to aid in taking the "Say" out of Sayville.

Mr. Charles E. Apgar.

When I was asked to execute this commission, or whatever you want to call it, no time was allowed for extended preparation. The interview was held at eleven in the morning and I was instructed to begin work the same evening. Scouring New York for "blanks" meant some tall hustling, but before sundown I had secured a number sufficient for a night or two. Subsequently during the period of action it became necessary for me to go several times in person to the Edison Company at Orange to replenish my supply of wax cylinders.

In regard to the operation, Sayville was never very generous with her 11 p.m. test signal Vs, and it meant working fast to utilise these in securing perfect tuning. There were several circuits to be looked after, their various condensers, inductances, batteries—everything, had to be practically in perfect harmony the instant Sayville began sending. That not a single message was missed and hundreds were recorded is evidence that every instrument and device of my home-made set did its duty fully and promptly; which is to me, of course, very gratifying.

To avoid the loss of a single word, which seemed likely in substituting a new blank for the record just filled, two phonograph machines were used. When the record on one machine was filled it was only necessary to switch the amplifone receiver from one machine to the other. The filled record was then replaced by a fresh blank and everything put in readiness for the next switch-over. This method made practicable a continuous record without loss of a signal.

The cylinders were consecutively numbered and when the work was finished a complete tabulation by message numbers was made. This was supplemented by a tabulation which revealed instantly on which cylinder any particular message could be found.

Of course, during the two weeks I recorded considerable static along with the message signals; other irregularities, too, were registered, particularly Sayville's many "breaks," due to poor spark. These breaks and the usual tuning-up signals all appear clearly on the cylinders. The phonographic record reveals some significant things; for example, when a break occurred in the middle of a long German word, three attempts were made to get through with this word before the message was continued. I was not a little interested to discover that "tape" sending could take care of such unusual interruptions.

Now as to my equipment.

There is nothing about it which might be termed remarkable; but unquestionably it is efficient for an amateur plant. The photograph of my station tells the whole story, the hook-up being the simplest form of the Armstrong circuit. Referring to the photograph which is reproduced at the foot of p. 518 and clearly indicates the general features, the equipment is quickly described. The vertical and horizontal inductances to the left of the photograph are primary loading; vertical inductance in centre on loose-coupler, secondary loading; vertical and horizontal inductances to right, boxed and open, are in the wing circuit. The slide condenser in the foreground is connected to grid of audion valve detector; the small variable rotary condenser across secondary and loading of loose-coupler; the other variable rotary condenser across receiving phones. The loud-speaking phone is in the amplifying circuit—on battery box to the right. When the records were made the amplifying circuit receiver, without the horn, was placed directly over the phonograph's recorder. The box containing the wireless receiver and amplifier, also transmitter, does not happen to show in the photograph.

Excepting the regular receiving phones and the valve detector, all my instruments are home-made. The set without "loading" will easily tune to 4,000 metre wavelengths and over; with loading, 10,000 metre wave-lengths are secured.

I have two aerials, a short one on the house, 55 feet long, four wires spaced 2 feet apart, and a long aerial in the trees measuring about 600 feet, four wires fan shape, starting 10 feet apart and graduating down to 18 inches, suspended at an average height of 50 feet; both of these aerials are well below the tree-tops.

THE SAN FRANCISCO TELEGRAPH TOURNAMENT.

UNDER the heading Foreign and Colonial Notes in our October Number we mentioned the Telegraph Championship Tournament which was held on August 27th and 28th at the International Exposition at San Francisco. We are now able to give the result. On August 27th the call for the first wireless tournament was sounded at Moose Hall, San Francisco. The cream of the competing bodies of wireless operators on the Pacific Coast took their seats on the official stage. Mr. J. L. McKinnon, representing the Federal Telegraph Company, won the toss for the choice of first transmission, making a speed of 31¼ words per minute. Mr. A. E. Gerhard, the Marconi representative, was on the receiving end. The same messages were retransmitted by Mr. Gerhard at a speed of 32½ words per minute with Mr. McKinnon on the receiving end. Through an unaccountable error the same messages transmitted by Mr. McKinnon were given to Mr. Gerhard for transmission. This retransmission no doubt proved a decided advantage to Mr. McKinnon in receiving, as all the messages had previously been transmitted by him. On completion of the contest the judges reported the Marconi entry far superior in both transmission and reception. The officiating judges were United States Radio Inspector in charge at San Francisco, United States Radio Engineer at Washington, and the Engineer in Charge of the Electrical Department of the Postal Telegraph Company at San Francisco.

Maritime Wireless Telegraphy

YET another lamentable disaster has happened to the Portuguese Navy, a disaster which has resulted in the loss of the cruiser *Republica,* which but a short time ago sailed from the arsenal, where she had been laid up for three years undergoing important repairs. The officer who had command of this ship is a distinguished sailor, one of the most experienced in the Navy, and the wreck appears to have been due to the thick mist which prevailed along the coast.

The *Republica,* which was steaming north, ran ashore between Cape Roca and Peniche in Portugal, 15 miles from Lamparoeira Point, opposite the Conceica Fort.

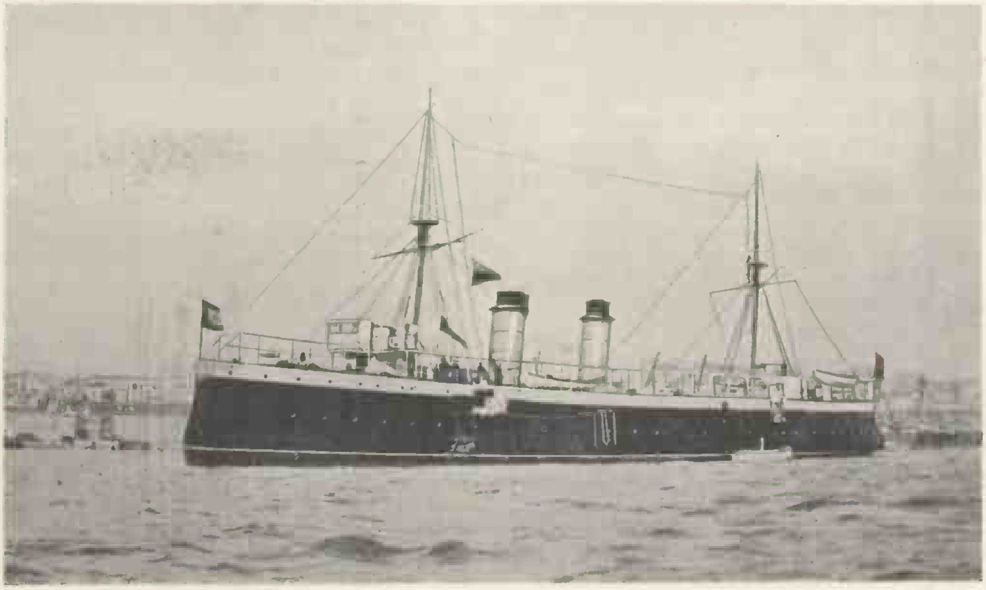
The steamer *San Miguel,* homeward bound from the Azores, was advised of the wreck by wireless, and immediately set out to search for the *Republica.* The former vessel was on her way from Madeira to Lisbon and was then about 20 miles distant from the bar. She sent a message to the *Republica* asking what help was needed. The Commander of the cruiser replied that he required a large kedger and a towing cable. Immediately the whole of the crew of the *San Miguel* started preparing what was needed. The *Republica* was on the rocks with her bow to the west with the sea rising and breaking from amidships to the stern.

The *San Miguel* finally came alongside at 8.30 p.m. Her captain regretted that he had been unable to save the cruiser in spite of the efforts and willingness of the crew and officers of his ship, which rapidly got ready to afford all help.

Mr. Antonio Viveiro Reis, the Wireless Operator aboard the *San Miguel,* remained nearly 10 hours at his post.

* * *

It was extremely fortunate for the schooner *Emma F. Angell* that the s.s. *Bermudian* happened to pass near her last August, when the former vessel was caught in a storm off Fire Island and battered by the seas and gale until she was compelled to fly distress signals. The United States Coast Guard



Portuguese Cruiser "Republica."

Service steamship *Seneca* had previously set out in search of the distressed vessel but was unable to locate her. Wireless telegraphy, however, relieved the situation. On the arrival of the *Bermudian* this ship was able to communicate to the *Seneca* by wireless the position of the *Emma F. Angell* (which was not fitted with wireless). When the *Seneca* came alongside the storm-swept craft, the pumps of the latter were just keeping her afloat. She was taken in tow and was brought to a safe anchor inside Sandy Hook.

* * *

A wireless telegraphic message was recently received from the Captain of the steamer *Koningin Emma*, one of the newest and finest boats of the Netherland Steamship Co., reporting that she had struck a mine in the North Sea. Luckily there was time for the wireless operator on board to advise the wireless station at Scheveningen, and several vessels went to the assistance of the stricken boat. All the passengers and baggage were saved, whilst the ship herself was taken in tow, but she eventually sank. The *Koningin Emma* was a steel twin screw steamer, 9,181 tons, and was on a voyage from Java to Holland.

* * *

By wireless telegraph recently a report reached Halifax, Nova Scotia, that the steamer *Sant Anna* was on fire as the result of two explosions and required assistance; the position was given as on the western side of the Atlantic, and the nearest land would be Cape Race on the coast of Newfoundland, 450 miles away. The steamer *Ancona* arrived eight hours after the fire started, and took aboard 105 of the passengers. The *Sant Anna* is a liner of 9,350 tons belonging to the Compagnie Générale Transatlantique, and was on her way from the Mediterranean to New York. She is a four deck steamer, and was built in 1910.

* * *

The *Athinai*, outward bound from New York to Piræus, the port of Athens, recently scattered broadcast a wireless call for help. She was on fire. The *Tuscania* received the distress signal and in due course arrived to succour the stricken vessel. The crew on the *Athinai* were in a worn-out state. A fight for more than twenty-four hours had told on them. There were no chemical fire extinguishers or other up-to-date appliances on board. The English seamen (from the *Tuscania*), however, brought a smoke helmet, with air pumps, tubes and telephonic attachments, as since the war began all British vessels have been prepared for emergencies. Once again wireless telegraphy has demonstrated its utility in saving life. There is not the shadow of a doubt but that the 408 survivors of the Greek steamer would have lost their lives had it not been for the promptitude of the *Tuscania's* commander in answering the call for help. The last seen of the *Athinai* was when she was afire from stem to stern and listing heavily to starboard. Her sea cocks were open and her holds fast filling with water.

* * *

We hear from New York that the ships of the Standard Oil Company are replacing their German "Telefunken" wireless apparatus with fresh installations supplied by the Marconi Wireless Telegraph Company of America.

The installing of the apparatus upon the twenty-two "Standard Oil and New Jersey" ships has already begun, and the new vessels to be fitted out include the following:—*The Ardmore, Baton Rouge, Bayway, Bradford, Brindilla, Caddo, Corning, Cushing, Dayton, De Soto, Moreni, Motano, Muskegee, Petrolite, Pioneer, Polarine, Princeton, Somerset, Matinicock, Standard, Communipaw*, and *Glenpool*.

In addition to the above, other lines are now under contract to rent from the Marconi Company, including a number of coastwise vessels, besides lines on the Pacific Coast and on the Great Lakes. The arrangement is that the Marconi Company supplies the equipment, assumes responsibility for the correct working of the apparatus, trains and employs operators, and relieves the shipping company of all concern with the transmission. Many of the agreements just signed with the steamship lines run for a number of years, and the new development is regarded as the most important in American marine wireless affairs since the Marconi Co. acquired the United Wireless Telegraph business in 1912.

Wireless in the Courts.

NEWCASTLE and district seems to be the most active centre of police court activity with regard to the illegal possession of wireless apparatus.

Clifton Gosman, an apprentice fitter working at Gateshead, was charged at the Newcastle Police Court recently with having had in his possession, without the written permission of the Postmaster-General, certain apparatus intended to be used as a component part of an installation for the receiving of messages by wireless telegraphy, contrary to the Defence of the Realm Act. According to the evidence for the prosecution, there was no suggestion that there was any wireless installation on the defendant's premises, nor was it suggested that there had been any attempt to set such up. Defendant had called voluntarily at the detective office and handed over minor articles to the police. The deputy town clerk, who conducted the prosecution, stated that although there was no aggravating feature about the case, at the same time it was an inherently grave one. Members of the public who had still wireless apparatus in their possession should at once communicate with the postal authorities in order that they might put themselves in a proper position with regard to the matter. The penalty for not complying with the present regulations was £100 or six months' imprisonment without the option of a fine. Defendant pleaded that he had not read the regulations and he did not know that parts of the apparatus had to be reported. When the detective visited his house it was covered with dust, showing that it had not been used for some time. In imposing a penalty of 20s., in default 13 days' imprisonment, the Chairman said now that so many cases had been before the court and that so much publicity had been given to them, those brought before the Bench in future would be treated in a different way from the present case.

* * *

At the Gateshead Court recently a young man named Frederick Askew was fined £1 for being in possession of a wireless telegraph apparatus. When a detective called at the house, the accused produced the parts in his possession from an overcoat pocket and stated that a friend of his had the other portions of the set which they had bought between them for 25s. An assistant engineer from the Post Office said that the other parts of the instrument would be capable of receiving (but not transmitting) messages from a long distance. The Mayor warned the young man that he had rendered himself liable to a fine of £100.

* * *

A more serious case was dealt with at the Blyth Police Court when a labourer, William Thompson, was sentenced to the maximum penalty of six months' imprisonment in the second division for having in his possession a wireless apparatus capable of receiving and transmitting messages. Sergeant Ormston gave evidence of having found the apparatus in Thompson's house, and described the room in which he found it as more like an electrical engineer's shop than that of an ordinary house. Mr. Henry Dunthorpe, a post office expert, said that the apparatus could transmit messages over a radius of five miles under favourable circumstances. Under ordinary circumstances it would have a radius of about two miles. To do this the apparatus would require an aerial, and he found among the things handed to the police material from which an aerial could be made. The defendant stated that he made electrical experiments a hobby, but that he was not using the apparatus as a wireless telegraph instrument. The major part was used in developing the idea of steering ships at sea from the shore. He was experimenting on this subject with a model yacht on Ridley Park Lake. Defendant's solicitor contended that Thompson had no motive prejudicial to the interests of the State and, whilst a technical offence had been committed, the case did not call for a very severe penalty. He thought the Bench would agree that the defendant, who was an Englishman, had no desire to be a traitor to his country and that he did not keep the instrument for any wrong motive. The Chairman said the Bench, in considering the case, could not forget the man's extraordinary ability, and were of opinion that these gifts must be of grave danger and menace to the State if used in the wrong direction. Therefore the Bench had decided to inflict the maximum penalty.

A charge against Thompson of stealing 26 lb. of brass for use in his electrical experiments was then preferred, and for this offence he was sentenced to one month's imprisonment, also in the second division, the two terms of punishment to run concurrently.

* * *

Castle Eden, in county Durham, has evidently developed a taste for "limelight." In a recent issue of THE WIRELESS WORLD a report appeared of a prosecution for the possession of a wireless apparatus contrary to the provisions of the Defence of the Realm Act. The culprit *then* was a school teacher; the culprit *now* is a school teacher. George Robert Lindhay, aged 54, was brought before the magistrates charged with having wireless apparatus in his possession without the permission of the Postmaster-General. Defendant stated that he possessed the small apparatus in question, which he had been in the habit of using during the past ten years to teach the principles of wireless to his scholars. A police-constable visited the school, and the apparatus was handed over to him. It could not receive messages, but was able to transmit them to a certain extent. One of the engineers gave evidence to the effect that as the apparatus stood it was practically useless for receiving messages from any modern station. It could transmit, he said, but the range would be extremely limited. After hearing the evidence, the Chairman said that the Bench was not satisfied that the summons had been taken out against the right party, and under the circumstances they dismissed the case. He ordered, however, that the apparatus be left in the care of the police, and hoped that other instruments kept in similar conditions would be brought in at once.

* * *

At Prahran, Victoria, Matthew Henry Read, a mechanic in the Postal Department, was charged with having in his possession apparatus capable of being used for tapping wireless telegraphic messages. In commenting on the case the Chairman said that he thought defendant did not intend to aid the enemy, but nevertheless these illicit practices must cease. The defendant was fined £20 and £4 4s. costs.

* * *

People still do not seem to realise the gravity of defying the official regulations during this time of crisis. Orders have been given that no person shall use or possess a wireless telegraphic apparatus or component part or parts thereof capable of being used for transmitting or receiving wireless signals. Yet we learn that on August 5th last, over a year after the war had started, R. Evans was charged at Sydney, Australia, with having in his possession apparatus capable of being used for tapping wireless messages. The magistrate on imposing the sentence commented on the seriousness of refusing to abide by official regulations. He fined the defendant £50 or in default sentenced him to six months' imprisonment. It is indeed strange that when the nation is engaged in a war as desperate as any in which we have previously taken up arms, people are still found wanting in ordinary common sense. They well deserve the punishments meted out to them.

IMPORTANT NOTICE.

Newspapers for Neutral Countries.

BY a recent order newspapers may no longer be posted to addresses in neutral countries by private persons. It is explained that this step has been taken to prevent the use of newspapers as a code for conveying information to the enemy. The authorities will, however, permit newspapers to go through the mails if sent from the offices of the publishers, or their agents. As the WIRELESS WORLD falls within the category of this prohibition the publishers (at Marconi House, Strand, London, W.C.) will be pleased to forward the magazine post free to any neutral country at the rate of 5s. per annum or for shorter periods at a pro-rata charge.

CARTOON OF THE MONTH

"WIRELESS OPERATORS MUST NOT SWEAR."
United States Official Regulations.

The Calculation of Mutual Inductance

By W. H. NOTTAGE, B.Sc.

In the design of a radio-telegraphic receiver of the inductively-coupled circuit type an estimate of the maximum and minimum coupling which can be obtained from a given arrangement of the coils is very useful.

There are many formulas by which the mutual inductance, on which the coupling depends, can be calculated to any desired degree of accuracy, but in most cases the calculations required are very lengthy, and therefore are seldom undertaken.

If we confine our attention to the single-layer coils which are alone used for the inductances of receivers, and only require an accuracy within 1 per cent., or, at most, that given by four-figure logarithm tables, the following method will be found applicable to all cases and easily carried out.

The mutual inductance of two coils is given approximately by the formula

$$M = n_1 n_2 M_0$$

where n_1 n_2 are the total number of turns of wire on the two respective coils, and M_0 is the mutual inductance between two single circles of the same diameters as the coils, and situated at the same distance apart as the middle turns of the two coils.

In order to calculate M_0 there are a large number of formulas available, the best one to use in any given case depending on whether the circles are near together or far apart.

A convenient formula for many cases is

$$M = 16\pi^2 \sqrt{Aa}\, q^{3/2} (1 + e)$$

where A and a are the radii of the two circles, and d the axial distance between them :

$$q = \frac{l}{2} + 2\left(\frac{l}{2}\right)^5 + 15\left(\frac{l}{2}\right)^9$$

$$l = \frac{1 - \sqrt{k^1}}{1 + \sqrt{k^1}} \quad k^1 = \frac{r_2}{r_1} = \frac{\sqrt{(A - a) + d^2}}{\sqrt{(A + a) + d^2}}$$

$$e = 3q^4 - 4q^6 + 9q^8 - 12q^{10}$$

If the dimensions be expressed in centimetres the inductance will be in centimetres.

The above formula is due to Prof. Nagaoka, and calculations made by it are made less tedious by a table which has been prepared by him giving the differences between q and $\frac{l}{2}$, and also the value of $1+e$ for certain values of q. The tables are too long to reproduce here, but will be found in the "Formulas for Calculation of Mutual and Self-inductance," by Rosa & Grover, Bulletin of the Bureau of Standards, U.S.A. Vol. 8, No. 1.

It will be noticed, however, that for a given value of $\frac{r_2}{r_1}$, which is the ratio between the least and greatest distance between the two circles, the value of the expression $q^{3/2}(1+e)$ is a constant and independent of the actual dimensions of the circles.

In order to facilitate the calculation of mutual inductance the writer has worked out the values of this constant for various ratios of $\frac{r_2}{r_1}$, making use, however, of other similar formulas, to be found in the article quoted, where they are more convenient.

These values are reproduced here :

k^1 or $\frac{r_2}{r_1}$	γ	k^1 or $\frac{r_2}{r_1}$	γ	k^1 or $\frac{r_2}{r_1}$	γ
·01	50·3	·16	15·8	·50	3·97
·02	41·5	·18	14·5	·55	3·19
·03	36·7	·20	13·3	·60	2·53
·04	32·8	·22	12·2	·65	1·96
·05	30·0	·24	11·2	·70	1·48
·06	27·7	·26	10·4	·75	1·05
·07	25·9	·28	9·55	·80	·735
·08	24·2	·30	8·82	·85	·457
·09	22·5	·34	7·55	·90	·239
·10	21·2	·38	6·46	·95	·092
·12	19·3	·40	5·96	1·00	·0
·14	17·5	·45	4·88		

The inductance of two circles is given by $M = \sqrt{Aa}\,\gamma$ where A and a are the radii of the circles in centimetres and the inductance is in centimetres. To bring the inductance to microhenries divide by 1,000.

The value of $\frac{r_2}{r_1}$ can either be obtained from the formula

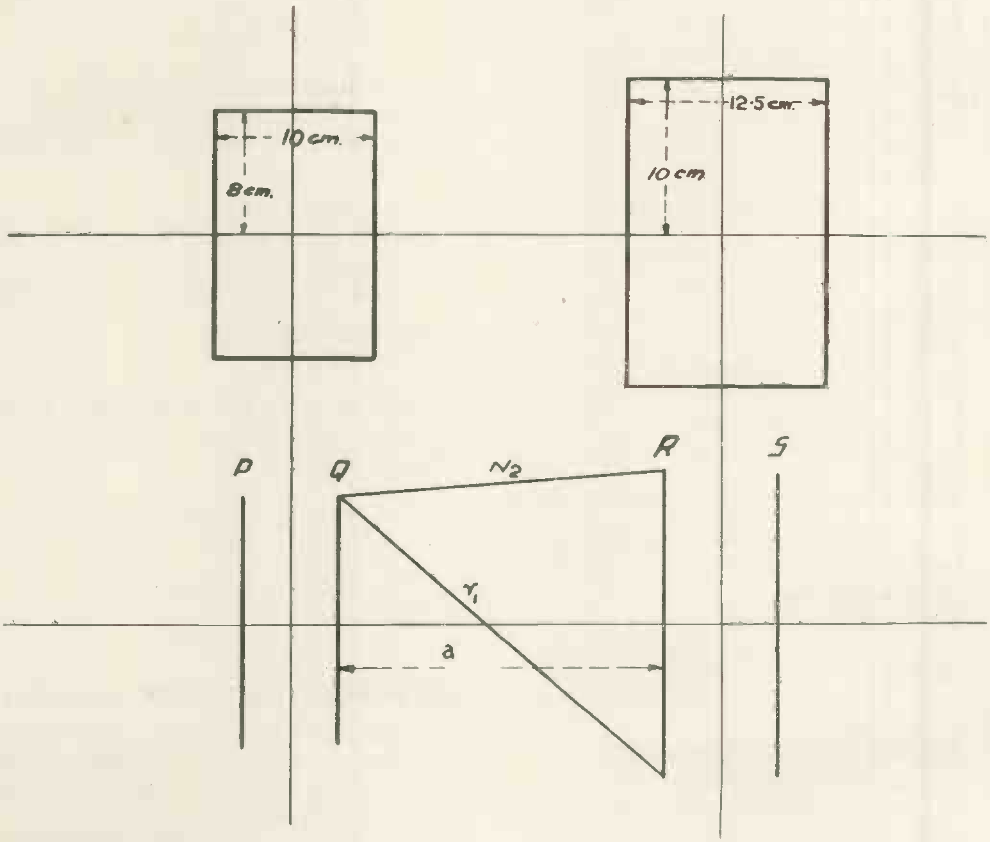
$$\frac{r_2}{r_1} = \frac{\sqrt{(A - a)^2 + d^2}}{\sqrt{(A + a)^2 + d^2}}$$

or can be measured on a diagram drawn to scale (see figure).

It can be shown that any single layer coil of breadth b can be replaced for purposes of this calculation by two equivalent circles at a distance apart, $2g$

$$\text{where } g^2 = \frac{b^2}{12} \text{ or } g = \cdot 2887\, b.$$

These circles are equidistant from the middle turn of the coil—that is, they are each at a distance g from it.



The mutual inductance of two coils can now be obtained by first calculating the mutual inductance between two circles of the same radius at a distance apart, equal to that of the middle turns of the coils, and multiplying by $n_1\, n_2$

$$M = M_0,\ n_1\, n_2.$$

Where the two coils are far apart this will give a correct value, but if the coils are close the following calculation should be made.

Having obtained the positions of the circles, which may be called P and Q for one coil and R and S for the other, work out by the formula already given the following :

Mutual inductance between P and R,
P and S,
Q and R,
Q and S.

Take the mean of the above and multiply

by n_1 n_2, to give the mutual inductance of the two coils.

As an example we will calculate the mutual inductance between the following coils, both being wound with 20 turns per cm., as shown in the diagram.

1st Coil :
Radius $= A = 10$ cm.
Breadth $= b_1 = 12{\cdot}5$ cm.
No. of turns $= n_1 = 250$.

Distance between equivalent circles P and Q and the middle turn of coil :

$$= g_1 = {\cdot}2887\ b_1 = 3{\cdot}60 \text{ cm.}$$

2nd Coil :
Radius $= a = 8$ cm.
Breadth $= b_2 = 10$ cm.
No. of turns $= n_2 = 200$.

$${\cdot}2887\ b_2 = g_2 = 2{\cdot}9 \text{ cm.}$$

Distance between centres of coils :

$$= d = 27{\cdot}5 \text{ cm.}$$

From the above
Distance between :
P and $R = 26{\cdot}8$ cm.
P and $S = 34{\cdot}0$ cm.
Q and $R = 21{\cdot}0$ cm.
Q and $S = 28{\cdot}2$ cm.

The values of $k^1 = \frac{r_2}{r_1}$ for these four circles may be either calculated from the formula given above or obtained from measurements on a scale-drawing.

For Q and R we have

$$k^1 = \frac{r_2}{r_1} = \frac{\sqrt{(10-8)^2+(21)^2}}{\sqrt{(10+8)^2+(21)^2}} = \frac{\sqrt{445}}{\sqrt{765}}$$
$$= {\cdot}762.$$

Similarly for P and R, $k^1 = {\cdot}833$.
" " P and S, $k^1 = {\cdot}885$.
" " Q and S, $k^1 = {\cdot}845$.

From the table the following values of γ are obtained :

For circles P and R $\gamma = {\cdot}55$.
" P and S $\gamma = {\cdot}304$.
" Q and R $\gamma = {\cdot}97$.
" Q and S $\gamma = {\cdot}485$.

The mean value of the above $= {\cdot}577$ whence the mutual inductance between the coils is

$${\cdot}577 \times \sqrt{10 \times 8} \times 200 \times 250.$$
$$= 258{,}000 \text{ centimetres.}$$
or 258 microhenries.

If the mutual inductance had been calculated for two circles at the centres of the coil instead of for the four equivalent circles we should obtain :

$$\frac{r_2}{r_1} = \frac{\sqrt{(10-8)^2+(27{\cdot}5)^2}}{\sqrt{(10+8)^2+(27{\cdot}5)^2}}$$
$= {\cdot}84$, for which $\gamma = {\cdot}513$.

The mutual inductance given by this value would be 11·25 per cent. too small.

The coupling between the coils can now be calculated.

Inductance of 1st coil :
= 8 times inductance of a coil 10 cm. diameter 6·25 cm. long
$= 1433 \times 8 = 11460$ mhy. approximately.

Inductance of 2nd coil :
$= 5857$ mhys.

(see table on page 124 in the May, 1915, number of THE WIRELESS WORLD).

The coupling is

$$\frac{M}{\sqrt{L_1, L_2}} = \frac{258}{\sqrt{5857 \times 11460}}$$
$$= 0315 \text{ or } 3{\cdot}15 \text{ per cent.}$$

ARCHÆOLOGICAL RESEARCH.

THE GREEK : " They have found iron wires at Athens in excavation among ancient ruins, proving that the ancient Greeks understood telegraphy."

THE EGYPTIAN : " But at Cairo it is more remarkable. They have made excavations and found nothing ! "

THE GREEK : " Found nothing ! What does that prove ? "

THE EGYPTIAN : " Why, that the ancient Egyptians understood wireless telegraphy ! " —From *Le Rire*.

HARVARD UNIVERSITY

New Cruft High Tension Laboratory, showing Steel Wireless Towers.

Doings of Operators

THE extremely interesting letter which we published in the October issue from Petty Officer L. T. N. Sanderson has received such a favourable reception from our readers that we think a few notes concerning the gentleman in question will not be amiss in this column.

Mr. Sanderson, who was born at Wandsworth twenty-eight years ago, makes his home when in England at South Norwood, not far from London. His school days were spent at Beddington, a pretty spot in Surrey, and upon reaching an age when the question of a career arose, he entered the services of the Commercial Cable Company. It was not long, however, before the fascination of "wireless" seized upon him, and in June, 1910, Mr. Sanderson entered the Marconi Company's Liverpool School, from which he was appointed to the operating staff shortly afterwards. During the last five years he has served on board a large number of liners, most of his trips being to the South and East. At the beginning of this year Mr. Sanderson, with a number of his fellow-operators, was selected for special war duty, and, as he has related in his letter, proceeded to the Dardanelles for duty on the Peninsula. No doubt by the time this paragraph appears he will have been through many further exciting adventures, which we hope he will record at a convenient opportunity.

Petty Officer L. T. N. Sanderson.

* * *

In these times so much attention is concentrated on naval and military affairs that an "ordinary" wreck is liable to be overlooked. In the case of the *Highland Warrior*, which was wrecked recently off the coast of Spain, there are a number of features of particular interest to wireless men, and as the operator, Mr. Leonard C. Fox, had an exciting time, we give below a short account.

The *Highland Warrior*, a well-known Nelson liner engaged in the South American trade, encountered early in October, when in the neighbourhood of Corunna, a dense fog, which made an accurate determination of her position impossible. In the early hours of the morning of the third, just when everything seemed calm and quiet and the wireless operator was busily engaged in transcribing Press, a crash and a violent shock woke everyone to the grim reality of a disaster. So violent was the blow that Mr. Fox, who a moment before had been sitting quietly at the instrument table, was thrown right out of the cabin against the rail. As nothing but this rail guarded the upper deck from the well of the ship, Mr. Fox had a narrow escape from death. The order to send the "S.O.S." call was of course immediately given, and brought instant response from a number of stations within range. In spite of the fog and the difficulty of making known the exact location of the *Highland Warrior*, but few hours elapsed before aid arrived, and all passengers were removed to safety. One rather unusual instance of the value of wireless may be quoted in connection with the arrival of the first rescue ship. The anxious watchers on the wrecked vessel suddenly observed a steamer looming through the fog and apparently coming to their rescue. Great was the dismay when the vessel made no attempt to stop, but was

Operator L. C. Fox.

about to pass by. Rockets were sent up, and detonators fired, all with no effect; even although it was known that this was the vessel that had announced by wireless that she was coming to the rescue. A rapid exchange of wireless signals brought to light the curious fact that although the rescuing vessel could clearly be seen from the wreck, yet she herself could neither see the rockets nor hear the explosive signals. She was promptly directed by wireless, and in a short while had arrived on the scene and taken off all the passengers and done all that was required of her.

Mr. Fox, who is twenty-four years of age, is now back in England none the worse for his exciting adventure. His services with the Marconi Company date from 1912, when he joined the London School after having had Post Office experience. Amongst the vessels on which Mr. Fox has served may be mentioned the *Calabria*, *Paparoa*, *Chantala*, and *Kashgar*.

* * *

It is with the deepest regret that we have to record the death of Operator Frank Avory, as the result of an accident. Mr. Avory was senior operator of the ss. *Chaudiere*, belonging to the Royal Mail Steam Packet Company, and together with several of the officers and engineers was bathing from the ship's side when at anchor in St. Kitts. Mr. Avory unfortunately dived into the water simultaneously with another officer and collided with him. Apparently stunned, he appeared to recover, but later in the evening the pains became more severe, and a sleeping draught was administered. By the next morning Mr. Avory seemed much better, but after a few hours he dropped into a state of unconsciousness, from which he never recovered. Everything possible was done, and the ship was headed with all speed for Bermuda, in order that an operation might be performed, and all arrangements were made by wireless; but before that port could be reached Mr. Avory had passed away.

The funeral took place on Friday afternoon, September 17th, in Pembroke Cemetery, Bermuda, all officers and engineers off duty attending. The late gentleman was a native of Peckham, and joined the Marconi Company in 1912. Prior to joining the ss. *Chaudiere* he served on the ss. *Tyrolia*, and had been senior operator of the *Chaudiere* for nearly eighteen months at the time of the accident. We offer our deepest sympathy to the relatives of Mr. Avory in their terrible bereavement.

The Late Operator F. Avory.

QUESTIONS AND ANSWERS

Readers are invited to send questions on technical and general problems that arise in the course of their work or in their study to the Editor, THE WIRELESS WORLD, *Marconi House, Strand, London, W.C. Such questions must be accompanied by the name and address of the writer, otherwise they will remain unanswered: and it must be clearly understood that owing to the Defence of the Realm Act we are totally unable to answer any questions on the construction of apparatus during the present emergency.*

D. M. P. (Farnham Royal).—The number of Joules stored in a condenser is given by the formula :—

$$J = \frac{1}{2}CV^2.$$

G. E. G. (Aldeburgh-on-Sea).—Before we can recommend a book to you on the subject you mention, we need to have some idea of your knowledge of the subject. Wireless engineering comprises so much that it cannot be said that any book deals fully with it. Before a student can become a wireless engineer he must have a good theoretical and practical knowledge of electrical engineering, and in addition must be acquainted with the theory of wireless telegraphy. If you will write and inform us to what extent you are acquainted with these things, we may be able to help you. Meanwhile, we would suggest that you study Dr. Fleming's "Pocket Book," which you will find advertised in this number. It contains much that it is essential to know as a wireless engineer. Question 2.—As far as wireless telegraphy itself is concerned, we do not think there is anything nearer than London.

F. J. B. (Henfield, Sussex).—In a receiver using the electrolytic detector, the current passing through the telephones is in some measure proportional to the amplitude of the received waves. Question 2.—The answer to this depends upon what you would call a "comparatively small antenna," also upon the sensitivity of the ammeter. Speaking generally, the answer is "Yes." Question 3.—We do not think you quite understand the principle of the electrolytic detector, or you would not ask this and the following question. The purpose of the local battery is to polarise the electrodes of the detector, and the voltage applied has to be carefully adjusted by means of a potentiometer or series resistance. There is but one adjustment with each detector which will give the best result. If the voltage is too low the detector will be insensitive, and if it is too high there will be a roaring sound in the telephones. The particular voltage which gives the best result depends on the design of the detector.

W. R. L. (Bridgend, Glam.) writes : "In a wireless transmitting apparatus 'guard lamps' are used to prevent high frequency currents from getting back into the low-frequency circuit and damaging the windings of the converter. I can quite understand the action of the guard lamps. but fail to see how high-frequency currents can get back at all. I would point out that it can hardly be due to inductance (as has been explained to me), since the circuits are of such a highly different frequency."

Answer.—Our correspondent starts off with an erroneous statement. The guard lamps are not used to prevent high-frequency currents getting back into the low-frequency circuit—that is the duty of the air-core chokes—but to prevent any high-frequency currents which might happen to get back into the low-frequency circuit from penetrating the windings of the converter. However, that is not exactly the point. High-frequency currents may slip into the low-frequency circuit by many ways, only a few of which we can indicate here. As an example, we may instance a case which came under the personal observation of the writer. Owing to the proximity of some wires, a high-frequency current from the aerial sparked across the receiving leads, through the magnetic detector, down the telephone short-circuiting leads, and then sparked across to the key. The trouble took some minutes to trace, as may be imagined. Again, in the case of a transmitter with a disc discharger, faulty insulation of the disc may cause a leak of high-frequency current into the low-frequency circuit. Moisture or dirt on the air-core chokes may cause sparking-over of high-frequency currents into the transformer, and a breakdown of the insulation, followed by leakage into the low-tension circuit.

"ARCHIMEDES" (St. Vincent, Cape Verde Is.).—We think you have misunderstood the equation. If *C* and *L* are in mfds. and mhys. respectively, *CL* must be divided by 10^{12} to give the result that would be obtained with *C* and *L* in absolute units. Have another look at it!

G. R. (Dordrecht, Holland).—(1) "Wireless Telegraphy," by A. B. Rolfe-Martin, obtainable from the Wireless Press, Ltd. (2) From Marconi's Wireless Telegraph Co., Ltd. Such valves require carefully designed receivers, and unless an amateur be experienced, he is not likely to get the best results from them. (3) The distance that can be transmitted by a given spark-coil depends upon the aerial, the wave-length used, the receiving aerial, and the sensitivity of the receiving instruments.

C. B. P. M. (Delft, Holland).—Many thanks for your letter. We are only too pleased to be of assistance. With regard to your first query about the inductance and capacity of your aerial, there is a very much simpler way of working this out. If you will turn to page 734 of the February, 1915, issue of THE WIRELESS WORLD, you will find particulars. Once you have calculated the *L* and *C* of your aerial, you can turn to the Instructional Articles on the Receiver. These will tell you how to calculate the inductance of your tuning coils, and you can then calculate what inductance you must add or subtract to obtain any particular wave-length. With regard to your second question, we do not quite understand what you mean. Fibre and ebonite insulation is better than wood coated with shellac varnish. Bad insulation both decreases the strength of signals and prevents sharp tuning. Question 3.—The Perikon detector is not a very high-resistance detector, and you should get fair results with a 400 ohm. headpiece. but higher resistance telephones would be better. We are afraid we have not space here to deal with telephone transformers. Question 4.—With regard to the position of the telephones this depends on the particular scheme of connections. There is generally not much to choose either way. Question 5.—Your scheme of connections is a very good one. Write to us again if the above information is not sufficient.

R. T. (Service T.S.F. Militaire Belge).—We regret that we have no curve available which shows what you require. In the case of a plain aerial, the spark resistance depends not only on the length of the gap, but on the quantity of electricity conveyed across it, and to some extent on the material of which the electrodes are composed. The amount of electricity which passes across the gap depends on the capacity of the aerial and the voltage to which it is charged. If the size of the spark-gap be made too large, the insulation of the antenna is endangered, and there will be large losses through brush discharges. A given gap will break down at a lower voltage with pointed electrodes than with spherical electrodes, and easier with small spheres than with large ones. It has been proved that, with an increasing spark length, the resistance of the spark between iron balls increases rapidly when compared with that between brass or zinc balls. A number of gaps in series will break down easier than a single gap of a length equal to the sum of the series gaps. The total resistance of the series of gaps will also be less than that of the single gap.

Instructional Article

NEW SERIES (No. 3)

The following series, of which the article below forms the third part, is designed to provide wireless telegraphists, amateurs, and technical students generally, with clear and precise instruction in technical mathematics, in order that they may be enabled to read and understand the more advanced technical articles which appear from time to time.

Algebra.

FACTORISATION.

12. The simplest case of factorisation is when we have an expression, each term of which is divisible by a common factor. For example, in the expression $3x^3-9x^2+6x$, we can divide each of the three terms by $3x$, thus getting the factors $3x\,(x^2-3x+2)$.

We shall find, by what follows, that the second of these factors can be again split up into the two factors $(x-2)\,(x-1)$, and so we get as the final factors $3x\,(x-2)\,(x-1)$.

13. In multiplying $(x+a)$ by $(x+b)$, we proceed as follows :—

$$\begin{array}{l} x+a \\ x+b \\ \hline x^2+ax \\ \qquad bx+ab \\ \hline x^2+ax+bx+ab \\ =x^2+(a+b)x+ab \end{array}$$

We see from this that the product of two such simple factors, each consisting of " x plus something " is a three term, or trinomial expression consisting of (x^2) plus (an x term) plus (a third term not containing x). Also, the coefficient of x^2 is 1 ; the coefficient of x is the *sum* of the two " somethings " ; and the third term is the *product* of the two " somethings."

Looking at it from the other point of view—namely, that the factors of $x^2+(a+b)x+ab$ are $(x+a)\,(x+b)$, we find the rule that the factors of any expression of the form x^2+px+q are $(x+a)\,(x+b)$, such that $(a+b)=p$ and $ab=q$.

Applying this to the expression x^2-3x+2 in §12, we see that we can split it up into two factors $(x+a)\,(x+b)$ *if* we can find values of a and b such that $a+b=-3$ and $ab=+2$. Such values are obviously -2 and -1, as $(-2)+(-1)=-3$ and $(-2)\times(-1)=+2$.

Thus x^2-3x+2 can be split up into the two factors : $[x+(-2)]\,[x+(-1)]$
$=(x-2)\,(x-1)$

14. The matter is rather more complicated when the coefficient of x is not unity, as for example in the expression $6x^2+11x-10$. In this case we might have a pair of factors $(6x+a)\,(x+b)$, or we might have a pair $(3x+c)\,(2x+d)$, as with either of these pairs we should get the $6x^2$ on multiplying them together.

The only other guide we have at present is the fact that the term *not* containing x is -10. Now this term results from the multiplication of the two terms a and b (or c and d), and so we know that $a\times b$ (or $c\times d$) equals -10. Thus a and b (or c and d) might be (± 5) and (∓ 2) or (± 10) and (∓ 1), the decisive point which finally picks out the correct factors being the fact that the coefficient of x must be $+11$.

Thus the possible factors are those in the following list :—

$(6x+10)\,(x-1)$	$+4x$	or	$(3x+10)\,(2x-1)$	$+17x$
$(6x-10)\,(x+1)$	$-4x$		$(3x-10)\,(2x+1)$	$-17x$
$(6x+1)\,(x-10)$	$-59x$		$(3x+1)\,(2x-10)$	$-28x$
$(6x-1)\,(x+10)$	$+59x$		$(3x-1)\,(2x+10)$	$+28x$
$(6x+5)\,(x-2)$	$-7x$		$(3x+5)\,(2x-2)$	$+4x$
$(6x-5)\,(x+2)$	$+7x$		$(3x-5)\,(2x+2)$	$-4x$
$(6x+2)\,(x-5)$	$-28x$		$(3x+2)\,(2x-5)$	$-11x$
$(6x-2)\,(x+5)$	$+28x$		$(3x-2)\,(2x+5)$	$+11x$

Any of these pairs of factors, when multiplied together, will give us the $6x^2$ term, and also the -10 term, and what we have to do is to pick out that particular pair which will also give us the term $+11x$. Considering the first pair of factors $(6x+10)\,(x-1)$ we see that when these are multiplied out we shall get one x term when multiplying $6x$ by -1, and another when multiplying $+10$ by x, and the sum of these two products (in this case $-6x+10x=+4x$) is the x term in the final product.

The column to the right of the factors gives this x term for each pair of factors, and we see that the pair which gives us the $+11x$ we are wanting is $(3x-2)(2x+5)$.

Thus the factors of $6x^2+11x-10$ are $(3x-2)(2x+5)$.

An expression such as we have just factorised, in which there is no higher power of x than x^2 can be factorised as follows :—

Factorise the x^2 term, and also the term which does not contain x. Then fit these factors together in pairs until a pair is found which will give, on multiplication, the x term of the given expression. If two such factors can be found, then they are the factors of the given expression.

15. In conjunction with this subject, it will be useful to note the following standard factors :—

$$a^2+2ab+b^2=(a+b)^2$$
$$a^2-2ab+b^2=(a-b)^2$$
$$a^2-b^2=(a+b)(a-b)$$
$$a^3+b^3=(a+b)(a^2-ab+b^2)$$
$$a^3-b^3=(a-b)(a^2+ab+b^2)$$

PROGRESSIONS OR SERIES.

Arithmetical Progression.

16. A series of terms, each of which differs from the next by a common difference is called an Arithmetical Progression, written for short as A.P. For example :—

$3+5\frac{1}{2}+8+10\frac{1}{2}+13+15\frac{1}{2}+\ldots$ is an A.P. in which the first term is 3 and the common difference is $2\frac{1}{2}$.

For the purpose of deriving some formulæ which can be applied to any A.P. we will take a series having a first term a and a common difference d :—

$$a+(a+d)+(a+2d)+(a+3d)+\ldots$$

Now the 1st term $=a+0\times d$
,, ,, 2nd ,, $=a+1\times d$
,, ,, 3rd ,, $=a+2\times d$
,, ,, 4th ,, $=a+3\times d$, and so on.

It will be noticed that in each case the coefficient of d is less by 1 than the number of the term, and so—

The nth term is $a+(n-1)d$ where n has any value we wish.

17. Fig. 4 represents the first seven terms of this series ; XY represents the first term a, and the distances yz, $y'z'$, $y''z''$, etc., represent the values d, $2d$, $3d$ . . . etc. X′Y′ represents the last term $a+6d$.

It is obvious that the average length of these seven lines can not only be obtained by adding up the lengths of all seven lines and dividing by 7, but it can also be found from the mean of the first and last lines—*i.e.*,

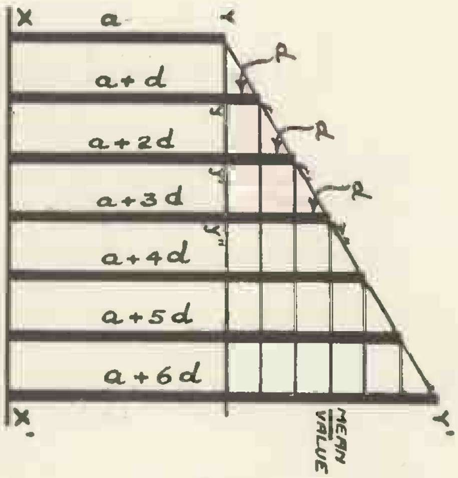


Fig. 4.

$$\frac{XY+X'Y'}{2}=\frac{a+(a+6d)}{2}=\frac{2a+6d}{2}=a+3d.$$

Thus the mean value of the terms of such a series *in which the terms increase regularly* is equal to the mean of the first and last terms, or $\frac{\text{(first term+last term)}}{2}$.

Expressing this in our chosen notation, we see that the mean value of n terms of an A.P. equals

$$\frac{\text{(1st term}+n\text{th term)}}{2}=\frac{a+\{a+(n-1)d\}}{2}$$
$$=\frac{2a+(n-1)d}{2}.$$

Now the sum of any number of terms of *any* series *must* equal the mean value of the terms multiplied by the number of terms there are in the series, and so the sum of n terms of an A.P. equals

$$S_n=\frac{2a+(n-1)d}{2}\times n$$
$$=\frac{n}{2}\{2a+(n-1)d\}$$

or $$S_n=\frac{n}{2}(a+l)$$

where l is the last term of the series we are summing.

EXAMPLE.

The first term of an A.P. is 1·7 and the seventh term is $-0{\cdot}7$. Find the common difference and the sum of the first nine terms.

We are here told that $a=1{\cdot}7$ and that $l=-0{\cdot}7$ when $n=7$.

Thus

$$l=a+(n-1)\,d$$

$$-0{\cdot}7=1{\cdot}7+(7-1)d=1{\cdot}7+6d$$

Therefore

$$6d=-0{\cdot}7-1{\cdot}7=-2{\cdot}4$$

or $$d=\frac{-2{\cdot}4}{6}=-0{\cdot}4. \quad \textit{Ans.}$$

The series must therefore be

$$1{\cdot}7+1{\cdot}3+0{\cdot}9+0{\cdot}5+0{\cdot}1-0{\cdot}3-0{\cdot}7-1{\cdot}1-1{\cdot}5-\ldots$$

The ninth term is $a+8d=1{\cdot}7+8\times(-0{\cdot}4)$
$=1{\cdot}7-3{\cdot}2$
$=-1{\cdot}5$

Now the sum of the first nine terms

$$=S_9=\frac{n}{2}(a+l)$$

$$=\frac{9}{2}(1{\cdot}7-1{\cdot}5)=\frac{9}{2}\times 0{\cdot}2$$

$$S_9=0{\cdot}9. \quad \textit{Ans.}$$

Otherwise

$$S_9=\frac{n}{2}\{2a+(n-1)d\}$$

$$\frac{9}{2}\{(2\times 1{\cdot}7)+8(-0{\cdot}4)\}$$

$$=\frac{9}{2}(3{\cdot}4-3{\cdot}2)=\frac{9}{2}\times{\cdot}2$$

$$S_9=0{\cdot}9. \quad \textit{As before.}$$

EXAMPLE.

Find the sum of the first 73 natural numbers:

We have here to sum $1+2+3+4+\ldots$ to 73 terms, so that $a=1$, $d=1$, $n=73$, and $l=73$.

Therefore

$$S_{73}=\frac{n}{2}(a+l)$$

$$=\frac{73}{2}(1+73)=\frac{73}{2}\times 74$$

$$=\frac{73}{2}\times 37$$

$$S_{73}=2701. \quad \textit{Ans.}$$

GEOMETRICAL PROGRESSION.

18. In Geometrical Progression [written for short as G.P.], instead of neighbouring terms having a common *difference* d, they have a common *ratio* r; that is, each term multiplied by a common ratio gives the next term.

For instance, the series $2+4+8+16+32+64+\ldots$ is a G.P. in which the first term is 2, and the common ratio is 2.

Just as, in the case of A.P., we took the series $a+(a+d)+(a+2d)+\ldots$ for the purpose of finding general formulæ applicable to all A.P.'s, so in the case of G.P. we take the series $a+ar+ar^2+ar^3+\ldots$ in order to find some general formulæ applicable to all G.P.'s.

Note that the second term is ar^1
,, third ,, ar^2
,, fourth ,, ar^3

and so the index of r is in every case less by 1 than the number of the term.

Thus the nth term $=l=ar^{n-1}$.

19. To find the sum of a number of terms of a G.P. is not quite as simple as it was for an A.P. Take, for example, a series of five terms, $1+3+9+27+81$, in which $a=1$ and $r=3$.

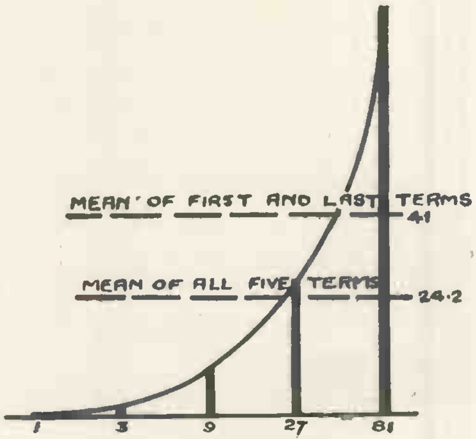


Fig. 5.

Drawing a diagram as before (Fig. 5), we see that the value of successive terms increases more and more rapidly the farther we continue the series. The mean value of the first five terms is

$$\frac{1+3+9+27+81}{5}=\frac{121}{5}=24{\cdot}2,$$

whereas the mean of the first and last terms is

$$\frac{1+81}{2}=\frac{82}{2}=41.$$

Thus to find the sum of a G.P. we cannot

$$S_n = a + ar + ar^2 + ar^3 + \ldots\ldots ar^{n-2} + ar^{n-1}.$$

From this

$$r \times S_n = \quad ar + ar^2 + ar^3 + ar^4 + \ldots ar^{n-2} + ar^{n-1} + ar^n$$

On multiplying each term by r.

take the mean of the first and last terms and multiply by the number of terms, as we did for an A.P., but we must find some other method.

We will find the sum of the first n terms of our general series $a+ar+ar^2+\ldots$ We have seen that the nth term is ar^{n-1}, and so the $(n-1)$th term is ar^{n-2}, and so on (*see above*).

Subtracting $S_n - rS_n = a - ar^n = a(1-r^n)$, all the intermediate terms cancelling out,

or $\qquad S_n\ (1-r) = a.(1-r^n)$

$$S_n = \frac{a(1-r^n)}{1-r}$$

If we had carried out the above subtraction the other way round—that is, subtracted S_n from rS_n—we should have got

$$rS_n - S_n = ar^n - a$$

$$S_n(r-1) = a(r^n-1) \text{ or } S_n = \frac{a(r^n-1)}{r-1}$$

To show that these two formulæ will give the same result we will apply each of them to finding the sum of the first five terms of the series $1+3+9+27+81+\ldots$ in which $a=1$, $r=3$, and $n=5$.

$$S_n = \frac{a(1-r^n)}{1-r} = \frac{1(1-3^5)}{1-3} = \frac{1(1-243)}{-2} = \frac{-242}{-2} = 121$$

$$S_n = \frac{a(r^n-1)}{r-1} = \frac{1(3^5-1)}{3-1} = \frac{1(243-1)}{3-1} = \frac{242}{2} = 121$$

The only choice between the two formulæ

$$S_n = \frac{a(r^n-1)}{r-1} \text{ and } S_n = \frac{a(1-r^n)}{1-r}$$

is one of convenience. It will be found that if r is less than 1, the $(1-r^n)$ form is the more convenient of the two, and *vice versa*.

EXAMPLE.

The fifth term of a G.P. is 8, and the seventh term is 2. Find the sum of the first 10 terms.

To do this we must first find the first term a and the common ratio r.

The 5th term $= ar^4 = 8$

and „ 7th „ $= ar^6 = 2$.

Dividing the 7th term by the 5th

$$\frac{ar^6}{ar^4} = r^2 = \frac{2}{8} = \frac{1}{4}.$$

$$\text{Therefore } r = \sqrt{\frac{1}{4}} = \frac{1}{2}.$$

Now $ar^4=8$ and substituting in this the value $r=\frac{1}{2}$ which we have just found we get $a(\frac{1}{2})4=8$

$$a \times \frac{1}{16} = 8$$

$$a = 8 \times 16 = 128$$

Sum of 10 terms

$$= S_{10} = \frac{a(1-r^n)}{1-r}$$

$$= \frac{128\{1-(\frac{1}{2})^{10}\}}{1-\frac{1}{2}}$$

$$= \frac{128(1-\frac{1}{1024})}{1-\frac{1}{2}}$$

$$= \frac{128 \times \frac{1023}{1024}}{\frac{1}{2}}$$

$$= 128 \times \frac{1023}{1024} \times 2$$

which cancels out to

$$\frac{1023}{4} = 255\tfrac{3}{4}. \quad \textit{Ans.}$$

20. *Summation to Infinity.*—If we have any A.P., say $2+4+6+8+\ldots$, we see that the sum of an infinite number of terms (called "the sum to infinity") is infinitely great; the more terms we add the greater will be the final sum, and as, to sum to infinity, we keep on adding terms for ever, we shall get an infinitely great result for the summation. In other words, the sum to infinity *is* infinity, written as ∞. If the common difference had been negative, the sum to infinity would have been *minus* infinity instead of *plus* infinity.

In the case of a G.P. in which the common ratio r is greater than 1, either positive or negative, the sum to infinity is again infinitely great. If, however, the common ratio is less than 1, the terms get smaller as we proceed, and we shall find that the sum of the terms will gradually approach a certain definite *limit* as more and more terms are taken.

Consider, for example, the series $4+2+1+\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\ldots$ where $a=4$ and $r=\frac{1}{2}$.

The sum of the first 3 terms is 7,

„ 4 „ $7\frac{1}{2}$,

„ 5 „ $7\frac{3}{4}$,

„ 6 „ $7\frac{7}{8}$,

and we see that the value of the sum is gradually approaching 8, though if we go on adding terms for an hour or two we shall never quite get to 8.

Returning to our original expression for the sum of a G.P.

$$S_n=\frac{a(1-r^n)}{1-r},$$

we can obtain from it an expression giving the sum to infinity, or S_∞, for the case when r is less than 1.

Inside the bracket in the top line we have r^n, which is in this case r^∞. Now if we keep on multiplying a fraction by itself, it becomes smaller and smaller each time; for example, $\frac{1}{2}$ becomes $\frac{1}{4}, \frac{1}{8}, \frac{1}{16}, \frac{1}{32}, \frac{1}{64} \ldots$ after successive multiplications. If we keep on multiplying thus an infinite number of times—that is, if we kept on for ever—we should eventually arrive at a result *infinitely small*, which we say is 0. Thus, if r is less than 1, $r^\infty=0$.

$$\text{But } S_\infty=\frac{a(1-r^\infty)}{1-r}=\frac{a(1-0)}{1-r}=\frac{a}{1-r}.$$

EXAMPLE.

Find the sum to infinity of $0{\cdot}7\dot{5}\dot{6}$. This decimal can be written as 0·756565656 . . . and so

$$S_\infty=0{\cdot}7+0{\cdot}056+0{\cdot}00056+0{\cdot}0000056+\ldots$$

$$=\frac{7}{10}+\frac{56}{1000}+\frac{56}{100000}+\frac{56}{10000000}+\ldots$$

$$=\frac{7}{10}+\left\{\begin{array}{l}\text{sum to infinity of a series whose}\\ \text{first term } a=\frac{56}{1000} \text{ and whose}\\ \text{common ratio } r=\frac{1}{100}\end{array}\right\}$$

$$=\frac{7}{10}+\left\{\frac{a}{1-r}\right\}$$

$$=\frac{7}{10}+\left(\frac{\frac{56}{1000}}{1-\frac{1}{100}}\right)$$

$$=\frac{7}{10}+\left(\frac{\frac{56}{1000}}{\frac{99}{100}}\right)$$

$$=\frac{7}{10}+\left(\frac{56}{1000}\times\frac{100}{99}\right)$$

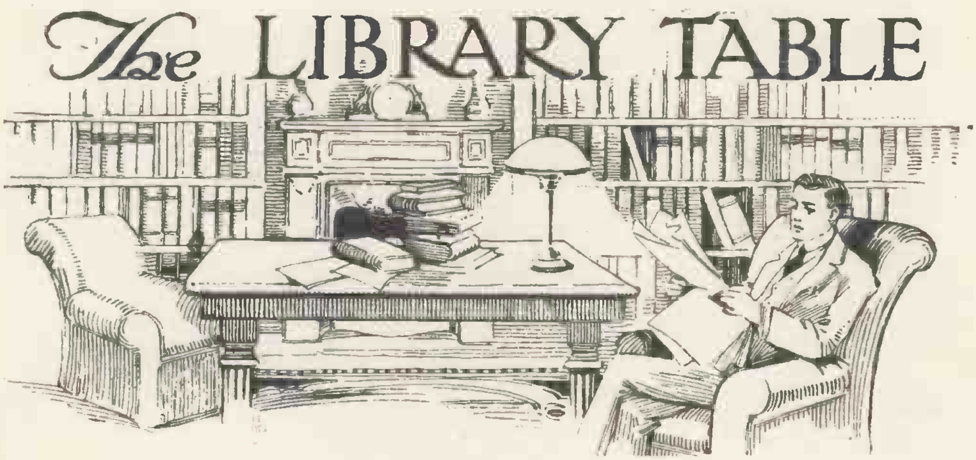
$$=\frac{7}{10}+\frac{56}{990}=\frac{693+56}{990}$$

$$=\frac{749}{990} \quad \textit{Ans.}$$

This result agrees with the fraction obtained by means of the ordinary arithmetical rule for turning a mixed decimal into a fraction. This arithmetical rule is :—" subtract the non-recurring figures from the whole decimal, and place the number so obtained over as many nines as there are recurring figures, followed by as many noughts as there are non-recurring figures in the decimal." Thus :—756 minus 7 equals 749 and the bottom line of the fraction will have two nines followed by one nought or 990. Thus we get $\frac{749}{990}$

In our last issue (on p. 483) we published an obituary notice of Sec. Lieut. W. A. B. K. Ward, together with the only portrait at our

disposal at that time. We have since received the above photograph, taken just prior to his decease.



"THE AEROPLANE: A CONCISE SCIENTIFIC STUDY." By A. Fage, A.R.C.Sc. London: Charles Griffin & Co., Ltd. 6s. net.

This volume, which forms one of Griffin's Aeronautical Series, is, as its sub-title indicates, a scientific work rather than an addition to the already numerous class of "popular" treatises. The important part played by aeroplanes in the present war, and the resulting great increase in their output, has turned the attention of many skilled engineers towards the study of aeronautics, and the appearance of Mr. Fage's book will be welcomed in many quarters.

As the author points out in the preface, the fundamental principles of mechanics are unalterable, although the many interpretations and practical applications of such laws are the fruit of scientific labour. The new science of aviation, which has necessitated a fuller understanding of the dynamics of the air, must now be regarded as a branch of engineering, although each step forward into the realm of aeronautical research seems but to reveal an ever-increasing unexplored region. Commencing with a consideration of winds, wind velocity, and similar objects, the book goes on to deal with streamline bodies and struts, the principles, design, and structure of wings, the general construction of aeroplanes, and many other points. Equilibrium and stability each have chapters devoted to their consideration, and the propeller is very carefully treated. A final chapter is given to aeronautical engines.

Although this book is primarily for those who have at least some acquaintance with engineering, there are many parts which afford much interest to the lay reader, particularly in Chapter 4, where the general construction is considered. The volume is well illustrated with photographs and diagrams.

* * *

"BRAZIL (1913)." By J. C. Oakenfull. Frome, Somerset: Butler & Tanner. 7s. 6d. net.

The commercial resources and possibilities of the great South American continent have engaged the attention of Europeans very considerably of late years. We have before us a very useful handbook dealing particularly with the trade of this continent. Chapters appear on the administration, the history, and the climate, whilst the book is lavishly furnished with maps and plans of cities. What will specially appeal to those interested in radio-telegraphy is a chapter with a subsection headed "Wireless Telegraphy," which contains a list of the principal wireless stations in Brazil, together with the radius of each and stations with which each can communicate.

* * *

"ALTERNATING CURRENT WORK." By W. Perren Maycock, M.I.E.E. London: Whittaker & Co. 6s. net.

The author of this book is well known as a lucid writer on electrical subjects, and the new volume from his pen will further add to the reputation he has acquired in this respect. Although a sound knowledge of the principles of alternating current work is required by every wireless engineer, and should be possessed by the serious wireless amateur, it is to be regretted that few of the latter have given much attention to the subject. There is perhaps some excuse for the average amateur who avoids the study of alternating currents, for most of the books dealing with them are full of mathematics and appear, on the surface at least, to be very difficult and "dry."

Professor Maycock is to be congratulated on producing a book in which mathematics have been introduced only where absolutely essential. What mathematics do appear are very simple and should be easily understood by the great majority of our readers. To quote the author's words: "The Calculus "has not been allowed to show its fearsome "face within these pages, and the very little "trigonometry that has been used is briefly "explained."

A special feature of the book is the use of mechanical analogies in explaining such matters as inductance, capacity, resistance, and combinations of these. For class instruction models constructed as described will be found invaluable. A further welcome feature are the questions set at convenient intervals throughout the volume, and these will be found of great assistance to the home student.

The treatment of all matters, even the most difficult, is throughout the book very clear and interesting. Whilst theory is fully considered, practical matters have not been overlooked, and illustrations of modern alternators, transformers, motors, etc., are interspersed where necessary. Numerous well-drawn diagrams are also provided. We can strongly recommend this book to all who desire to take up the study of alternating currents.

* * *

"THE WONDERLAND OF EGYPT." By Percy R. Salmon, F.R.P.S. London: The Religious Tract Society. 2s. 6d.

Ever since the occupation of Egypt by the British in 1882, when Sir Garnet Wolseley's army defeated Arabi Pasha and restored the authority of the Khedive, the interest of Britain has been more or less centred on that "Land of the Pharaohs." As is so ably explained in the prefatory note at the beginning of the book, "At first "the intention of the British was simply "to restore the power of the Khedive, to "give his Highness friendly advice, and "withdraw the British troops as quickly "as possible. . . . Few people can really "understand our position in the country, as "it was so singular. Egypt appeared to "be ours, but it was not." We are all quite familiar with the dramatic announcement which was made in December, 1914, to the effect that the Khedive had left Egypt for Constantinople, and that the British had decided unreservedly to take over the administration of the country. Henceforth Egypt became a British Protectorate under a new ruler called the Sultan, and a new flag. The book before us is very well written, and illustrated with some good drawings and coloured pictures. A short account of the hieroglyphics is given, together with a chapter on tomb and papyrus pictures. The book contains a good deal of interest to Egyptologists, and the development of the country by the proposed erection of wireless telegraph stations should make an appeal to all those concerned with the art of radio-telegraphy.

* * *

"AERO ENGINES." By G. A. Burls, M.Inst.C.E. London: Chas. Griffin & Co., Ltd. 8s. 6d. net.

The general public does not perhaps fully realise what aviation owes to modern improvements in the internal combustion engine. For years no success could be achieved in artificial flight through lack of an engine with both high power and light weight, and it was not until the invention by Daimler of the small high-speed petrol engine that any real advance was made. It is interesting to consider that the early stationary petrol engines weighed upwards of 1,000 lb. per b.h.p., whereas a modern aeroplane engine weighs something in the neighbourhood of $2\frac{3}{4}$ lb. per b.h.p. This fact will indicate the enormous advance which has been made of recent years.

Mr. Burls, in this volume, which is also one of Griffin's Aeronautical Series, treats exhaustively of aeronautical engines of all types. The book is excellently illustrated with photographs, diagrams, and folding plates, and will no doubt appeal to a wide circle of readers interested in aviation.

* * *

"THE BOOK OF FRANCE" (1915). Edited by Winifred Stephens. London: Macmillan & Co.; and Paris: Edouard Champion. 5s. net.

The object of the "Book of France" is fourfold. Primarily it is intended to raise money in aid of the invaded Departments of France. But it is also hoped that the book will serve to show what perhaps is not enough realised in this country—namely, the sorrows France is suffering and the services she is rendering to the cause of civilisation. The book should also afford a memento of the cruellest war humanity has ever known, and an example of high literary and artistic excellence. For it contains contributions from the pen, the pencil, and the brush of French authors and artists of the first eminence.

The book is further intended to bind even yet more closely together the allied countries of France and England, for with the humility of true courtesy English writers no less eminent than their French confrères have consented to render into English the French contributions to this book. The French originals and the English versions appear side by side.

The invaded districts of France have suffered no less than Belgium from the appalling cruelty and wantonness of the brutal German soldiers. Proceeds from the sale of this book will go to a fund which is intended in some measure to ameliorate the sufferings of those unfortunate enough to live in the districts which have experienced the fury of the Hun. We trust our readers will not forget our obligation to France, and especially the ties of friendship which now so happily exist between the two nations, and will purchase a copy of the book, thus adding their quota to the relief of suffering and distress.

* * *

"ELEMENTARY PRACTICAL MAGNETISM AND ELECTRICITY." By J. C. Kirkman, B.Sc. London: George G. Harrap & Co. 1s. 6d. net.

This little book is designed for use by students in the laboratory, as a guide to practical work. Theory is dealt with only so far as it concerns the particular experiments described, as it is presumed that the reader is either attending classes for theoretical instruction, or else possesses the needful knowledge. The author lays emphasis on the need for accuracy in performing the experiments and also on the advisability of making clear and concise records of work done. The experiments described are arranged in the order found most suitable in the author's own classes, and the later experiments presuppose a knowledge gained in the earlier part of the book. Each chapter is prefixed by a list of the apparatus required, and appendices contain additional information on the experiments, together with some useful tables. The book should be very helpful to teachers and students in the coming autumn and winter technical classes.

* * *

"SEA, LAND, AND AIR STRATEGY." By Col. Sir George Aston, K.C.B. 1914. London: John Murray. 10s. 6d. net.

The issue of this book last year was most opportune, coming as it did when half Europe was engaged in deadly warfare. Its primary object appears to be that of a comparison between the relative value of sea strategy, land strategy, and air strategy. Many of our readers will recall the famous dictum of Von der Goltz quoted on the title-page of the book: "Whoever writes on strategy and tactics ought not in his theory to neglect the point of view of his own people. He should give us national strategy and national tactics." Col. Aston's experience has been wide, for he has spent thirty-five years of his life both with the Fleet and with the Army, so that he holds probably a unique position, which permits him to treat his subject from both points of view. His chapters on air strategy are largely speculative, because, of course, they were written before the outbreak of the present war, which has thrown so much light on the usefulness of aeronautics in war time. Altogether the book forms a monument to the energy and devotion of its author, and should be read by all who are interested with strategical progress and tactics.

Foreign and Colonial Notes

China.

The expansion of China through Western civilisation and influence increases annually. There has recently been inaugurated at Hong Kong a wireless telegraph service for communication with ships and coast stations within the radius of 500 to 700 miles in daytime and over 1,300 miles at night. The Post Office department of the colonial government is in charge of the services, and the Post Office at Hong Kong deals with the local business.

* * *

Cocos Island.

It is understood that the wireless station at Cocos Island which was destroyed by the German raiding cruiser *Emden* is again in full working order.

* * *

Haiti.

Despatches reporting the revolutionary troubles in Cap Haiten, Haiti, contain information to the effect that a wireless station has been erected on the roof of the American Legation in that city.

* * *

India.

Dr. Filippo de Filippi, the Italian explorer, recently lectured at Bombay before the Royal Geographical Society on his expedition to the Karakorum and Central Asia in 1913–14. The subject is most entrancing, and great interest was shown by the audience. He proceeded further in his task than other well-known explorers of the Central Asian district—Sir Francis Younghusband, Dr. and Mrs. Workman and the Duke of the Abruzzi. It is interesting to record that Dr. Filippi related how he determined longitude by means of wireless time signals transmitted from Lahore.

* * *

New Zealand.

In the Postmaster-General's letter presenting the annual report of the Post and Telegraph Department for the year 1914 to both Houses of the General Assembly of New Zealand the following paragraph appears to call for notice :—

"The radio-telegraph system, although "suffering from loss of ordinary business, "has proved its usefulness in connection "with matters affected by the war, and, "among other things, has proved of great "utility in communicating with our Forces "in Samoa."

The Postmaster-General reports that the two high-power and the three low-power stations of the Dominion have continued to work satisfactorily.

Observations are still being made at New Zealand stations of atmospheric electrical disturbances which interfere with the reception of signals, and the data collected are being communicated to the British Association for the Advancement of Science.

It is interesting to note that on the initiative of the British Post Office arrangements have been concluded by which the certificates of competency, signifying that the holders are competent to act as wireless operators on vessels, issued by any of the self-governing countries of the British Empire shall be recognised throughout the Empire.

* * *

A few weeks ago a wireless operator in New Zealand distinctly heard the two Western Australian stations at Broome and Perth (approximately 3,000 miles from Wellington) testing, but as the staff of the office where these signals were heard were inclined to doubt the genuineness of this, the operator wrote to the station at Broome quoting particulars of what had been heard, and received a letter in reply giving a complete confirmation. Considering that the signals would have to traverse the whole of the continent, including desert, and that they would have been subjected to diffusion, diffraction, absorption, and so on, this record is remarkable.

* * *

United States.

The superior jury of the Panama-Pacific International Exposition has awarded the following medals to the Bureau of Navigation: Radio apparatus, medal of honour; educational demonstration of methods and apparatus for enforcement of the Federal radio law, silver medal.

* * *

In a recent issue the *Electrical World* of New York prints the following paragraphs:—

"The radio station at Arlington, Va., just "across from Washington, D.C., is now "working with the new high-powered "station at Darien, Canal Zone.

"The radio station, which has recently "been put into operation, has three masts "900 ft. apart, each mast being 600 ft. high. "The Arlington station has two masts 450 ft. "high each and one mast 600 ft. high. "The Darien equipment is of the 100-kw. "continuous-oscillation type of apparatus. "The station is situated at the edge of "Gatun Lake, on three little island knolls, "and the foundations and lower part of the "works were constructed before the water "was let into the lakes, a good electrical "'ground' being thus obtained. Comfort-"able quarters for the crew of twenty men "have been erected near the station, twenty "men being detailed there.

"The Darien station is working also with "the two small stations on the Isthmus, one "at Colon and one at Balboa, and when the "high-powered station now being built at "Hawaii is completed Darien will work with "that office, Hawaii in turn communicating "with the Philippines."

* * *

The following is an account as published by our American contemporary the *Wireless Age* of the Tesla/Marconi action now proceeding in the United States:—

"In a suit brought in the United States "District Court in New York City by the "Nikola Tesla Company against the Marconi "Wireless Telegraph Company of America "to have the Marconi tuning patent adjudged "void, as interfering with two of the Tesla "patents, Judge Hand on August 10 "rendered a decision on a motion made by "the Tesla Company to strike out certain "allegations in the answer of the Marconi "Company. He refused to strike out the "allegations in the Marconi answer alleging "the invalidity of the Tesla patents. He "decided that these allegations are good "defenses of the suit, and should, therefore, "remain in the answer.

"Judge Hand, however, decided that as "the allegations in the answer relating to "Judge Veeder's decision sustaining the "validity of the Marconi tuning patent over "the Tesla patents in the suit against the "National Electric Signalling Company is a "legal precedent and can be presented on "the argument in relation to the issues, and "as it was not alleged that the Tesla "Company was in privity with the National "Company, or had control over that suit, "that allegation should not be set up in the "answer.

"The suit of the Tesla Company against "the Marconi Company is a new develop-"ment in the latter's claim to ownership of "all basic patent rights in the transmission "of wireless messages. In a number of "other wireless patent suits against com-"panies and individuals the Marconi Com-"pany is the plaintiff, and, though a defen-"dant in this latest litigation, Edward J. "Nally, vice-president and general manager "of the Marconi Company, believes that the "suit will serve as one of the mediums "through which the Marconi Company "hopes to establish the broad claim of its "right to all basic wireless patents.

"The dispute over patent rights between "the Marconi Company and Mr. Tesla began "in August, 1914, when the Marconi "Company sued Fritz Lowenstein, a German "engineer, alleging that certain wireless "apparatus sold by him to the United States "Navy was made in violation of the Marconi "patent 763, 772. It was announced then "that Tesla would testify for Mr. Lowen-"stein, alleging that the Lowenstein devices "were developed from Tesla patents 645, "576 and 649, 621, which were granted prior "to the Marconi patent.

"In the present suit, Mr. Tesla bases his "action on the allegation that his two patents "were granted in 1900, and that the Marconi "patent was not granted until 1904. The "bill of complaint asks for a decree adjudging "the Marconi patent null and void, and as-"serts that the Marconi patent covers the "inventions and combinations of appa-"ratus described and claimed in the Tesla "patents.

"The answer of the Marconi Company "denies that the Marconi patent covers the

" inventions or combination of apparatus " described in the Tesla patents, and also " denies that it is guilty of any infringement. " The company asserts that its patent was " granted to Guglielmo Marconi on the proof " of independent invention by Mr. Marconi " not in any way due to or based on any " invention of Mr. Tesla.

" Mr. Nally said that he had no reason to " fear the Tesla suit.

" ' The Marconi Company has a right to its " patent,' he said, ' and can establish that " right in the courts. Many individuals and " companies have infringed the Marconi " patents, and others have attempted to " disprove the originality of our inventions, " but when our present litigation shall have " gone through the courts, I am confident " that the leadership of the Marconi Com- " pany in the invention and development " of wireless communication will be estab- " lished.' "

* * *

It is understood that the Navy Department is planning the construction of a new high-power wireless station on Puget Sound. The plant will possess towers 400 feet high. It has not yet been decided where the station will actually be erected, but it is probable that Keyport, near Bremerton, Washington, will finally be fixed upon.

* * *

We understand that since September 1st no new business except Government messages has been, or will be, received at the Tuckerton wireless station until further notice. It was suggested that telegrams for Germany be despatched from Sayville. It is significantly stated that the reason for this order is that atmospheric conditions were poor.

* * *

The *Telegraph and Telephone Age* recently contained the following paragraph :—

" The Carnegie Institute of Technology, " Pittsburg, Pa., is installing a powerful " radio plant in the tower of Machinery " Hall. It will have a very wide operating " range, embracing Honolulu and Eastern " Germany. The station is being installed " for the use of the student radio club, an " organisation of electrical students. The " equipment of the new station consists of a " 10-kilowatt motor-generator set of the " latest type, and an audion detector."

Since the opening of the Panama Canal the wireless stations erected by the United States Government have more than justified their existence. We read in the *Panama Canal Record* that the naval stations at Colon and at Balboa, which were constructed especially for communication with vessels using the Canal or going to its terminal ports, are performing increasingly effective services in facilitating Canal operations. It transpires that more than one half the number of vessels passing through the Canal or arriving at its terminal ports are equipped with wireless apparatus, although only about a quarter of the number of those so equipped have advised the authorities of their approach. The Colon station now deals with about 2,300 messages per month and the Balboa station with about 400, practically all of which comprise messages to or from ships. Of these about one sixth are handled as part of the Canal work for which no charges are made. It is interesting to note that the radii of communication of the stations have extended to as far as 1,500 miles under favourable conditions. The Colon station, amongst its other duties, sends out a news bulletin, a weather forecast and any information relating to navigation.

* * *

High winds were the cause of an accident to a new steel wireless tower at Medford, Mass. It was erected for service at Tufts College, and was blown down across the tracks of the southern division of the Boston and Maine railroad, immediately in front of the White Mountain express, which was approaching at a speed of 40 miles an hour. The tower derailed the former trucks of the locomotive and was literally torn to pieces. Other portions fell across electric light, power, telephone, and tramway wires. The tower was 310 feet high and had nearly been completed when the accident occurred. It was mounted on a reinforced concrete foundation and measured 3 feet 6 inches square, being guyed at 100 foot intervals by three-strand steel wires, the size at the two lower points of attachment being five-eighths of an inch and at the top guying point three-quarters of an inch. About 500 yards of overhead lines were torn down when the tower fell, and fragments of the tower were carried 263 feet by the locomotive.

Amalgamated Wireless (Australasia) Limited

THE half-yearly ordinary general meeting of the Company was held at Sydney on August 31st last, to receive the report and balance sheet of the Directors of the Company for the half-year ended June 30th, 1915, Mr. H. R. Denison, managing director, presiding.

The Directors' report states that trading for the period has naturally been seriously interfered with by the war, and profits from this department have, in consequence, suffered somewhat severely.

The ships' message traffic, particularly referred to in the report of the Directors in March last (see page 203 WIRELESS WORLD, June, 1915), has shown a slight improvement, but is still subject to the peculiar disabilities therein referred to.

The subsidy ships now operated by the Company have been increased by five during the period under review, the total number now standing at eighty-five.

The Directors have had under consideration for some time the extension of the manufacturing plant for the complete manufacture in Australia of wireless telegraph apparatus. This object has been successfully achieved and the Company is now manufacturing the majority of its requirements.

The Directors have maintained a policy of rendering assistance to the Defence Authorities in every possible manner. On the eve of the declaration of war the Company's entire marine and shore organisations, together with factory and training schools, were placed unreservedly at the disposal of the Government. This was acknowledged by a letter from the Prime Minister, in which he stated: "I am to express the Government's high appreciation of your patriotic and generous action."

Positions are kept vacant without loss of seniority for all permanent employees on active service. Over 80 trained men have already been supplied by the Company to the Defence Authorities in Australia, New Zealand and England. Appreciatory letters have been received from the Defence Authorities and from shipowners for assistance rendered by the Company and its officers since the outbreak of war.

The net profit standing at the credit of Profit and Loss Account amounts to £6,001 14s. 7d., from which the Directors propose to recommend the distribution of a dividend of 3½ per cent. for the half-year on the capital of the Company, absorbing £4,900, thus making the full dividend for the past year at the rate of 6 per cent. per annum. This leaves a balance of £1,101 14s. 7d. to be carried forward to next account.

PATENT RECORD.

12630. September 2nd. Arthur H. Morse & the Indo-European Telegraph Co., Ltd. Selective calling devices for use in electric telegraphy. (*Provisional.*)

12882. September 8th. Marconi's Wireless Telegraph Co., Ltd., & George M. Wright. Production of continuous oscillations. (*Provisional.*)

13129. September 14th. Werner Otto. Arrangement for producing short uni-directed high-tension current impulses. (*Complete.*)

13614 and 13615. September 24th. Arthur H. Morse & the Indo-European Telegraph Co., Ltd., Selective devices. (*Provisional.*) Supply of electric energy to wireless telegraphy installations. (*Provisional.*)

13899. September 30th. Murray F. Sueter, R. M. Groves & Basil Binyon. Apparatus for use in wireless telegraphy and the like. (*Provisional.*)

SHARE MARKET REPORT.

LONDON, *October 19th*, 1915.

Business during the last month has been very small in the various Marconi issues. The price of the Ordinary Shares remains unchanged. Canadians are rather easier and Americans have improved on buying from America. Spanish are lower. Marine have improved slightly. There is no special feature to report.

Prices: Marconi (English), Ordinary, £1 18s. 1½d., Preference, £1 15s.; Canadian, 5s. 3d.; American, 17s. 6d.; International Marine, £1 4s. 6d. Spanish and General Wireless Trust, 3s. 6d.

PERSONAL PARAGRAPHS.

Mr. J. G. Robb, who has been connected with the Louisburg, Canada, Station during the past two years in the Engineering Department, has left for his home in England, where he will take up a similar position in the service of the English Marconi Company.

On the evening before his departure, Mr. Johnstone, Officer-in-Charge of the Traffic Department, on behalf of the officers and members of his staff, made Mr. Robb a presentation. The gift was a handsome and costly travelling bag containing pipes, smokes, etc. An address was made by Mr. Johnstone, to which Mr. Robb feelingly replied.

* * *

Our sincere felicitations to Mr. and Mrs. Frederick Atkin on the occasion of their wedding, which took place on the 2nd October last. Mr. Atkin, who is an assistant in the Secretary's Department of the Marconi Company, was married at St. Etheldreda's Church, Fulham, to Miss E. M. Brown of that suburb. The Directors and officials of the Marconi Company showed their goodwill and appreciation of Mr. Atkin's services by presenting him with a handsome canteen of cutlery. We wish them all happiness in their future estate.

* * *

Our readers, with us, will be sorry to hear of the death of Lance-Corporal Baker, Bandsman and Medical Officer's Orderly, No. 1796, D Company, 5th Essex Battalion, which took place in the Dardanelles. No further information as to the nature of his death has come to hand. He was a joiner in the carpenter's shop at the Chelmsford Works of the Marconi Company and a Labour member of the Town Council. He was also an energetic member of the Chelmsford Works Orchestra. We take this opportunity of offering our sincere condolences to his relatives.

* * *

George Foot, of H.M.S. *Impregnable*, has been successful in passing the preliminary naval examination for wireless telegraphy, obtaining the highest number of points of any boy competing. One hundred and twenty-seven lads sat, and only 29 passed. In the final examination on August 4th he succeeded in obtaining sixth place among 27 boys, 15 of whom passed. He is now expected to be transferred to H.M.S. *Vernon* (torpedo school, Portsmouth) for mechanical instruction. We very heartily congratulate the lad on his success, and wish him a very successful career in the Navy.

* * *

We regret to record the death of Warrant Telegraphist Ernest Arthur Sutton, who, according to an *Electrical Review* report, lost his life in the sinking of H.M. Trawler *City of London* in the North Sea on September 14th. Mr. Sutton, who was born at Marlow, Bucks, was enrolled in the Marconi Company's Liverpool School in June, 1910, and in the following month was appointed to the Operating Staff. He left the wireless service shortly afterwards, and took up a position in the General Electric Company, Ltd., of London, where he became assistant manager of one of the departments. After the outbreak of war he offered his services to the Admiralty, and at the time of his death was nominated for further promotion.

* * *

The *Ceylon Observer*, of September 3rd last, printed an account of a farewell function at the Colombo Wireless Station. It appears that Mr. F. T. Hubert had received another appointment, and together with his wife was leaving the district. Gaiety was the keynote on that occasion. The full C.E.V. Wireless Section with Sergeant J. R. Stapleton, O.C. Wireless Station, was present. A band discoursed music whilst refreshments were served *ad libitum*. Major David Rockwood said that Mr. Hubert's work had been highly appreciated, and he wished him all success in the new station. Mr. Hubert suitably replied, and the proceedings closed with the singing of the National Anthem.

* * *

The many friends of Sergt. E. J. Rowland, of the 1/6 Essex Regiment, "A" Company, 161st Brigade, 54th Division, Mediterranean Expeditionary Force, will be sorry to hear that he has been admitted to hospital at Alexandria, suffering from exhaustion and debility. From a letter received by the Marconi Company, it is gathered that he had been in the Gallipoli Peninsula for only about ten days, two of which were spent actually in the firing line. He reports that he had one "close shave," a bullet striking the back of his helmet and just grazing his left ear. He says not only have they the Turks to combat, but they have enemies in the climate and water.

Second Lieut. Powell.

We are informed that Mr. Stanley W. T. Powell, lately a member of the Transfer Department of the Marconi Company, who belonged to the London Scottish Territorials at the outbreak of the war, has obtained his commission as a Second Lieutenant in the Royal Garrison Artillery. Mr. Powell went to France with the London Scottish last autumn, and was invalided home in November last as the result of an injury to his eye caused by the bursting of a shell. We offer our sincere congratulations to Lieutenant Powell on his well-deserved promotion.

* * *

We think the following extract from a letter received by the Marconi Company from Private B. C. Collis, of the London Scottish, may prove of interest to our readers. Private Collis was formerly a member of the Accountants' Department of the Marconi Co. and writes:

". . . . I was wounded in the thigh on Saturday "near Vermelles and Hulloch, when the Scottish "took part in the advance in that quarter. I am "going along quite well, although I am not allowed "to get out of bed yet as the bullet went right "through my thigh; luckily it did not touch the "bone or the artery."

We trust that Private Collis will make a speedy recovery to good health and hope that he will feel none the worse for his trying experience.

Private Collis.

We regret to announce that E. C. Aylett, who was formerly in the employ of the Marconi Company and served in the Machine Shop, has been shot through the nose and had several teeth displaced. He had been doing duty with the East Anglian R.A.M.C. in the Dardanelles when he received his wound. He is now at the Fifth Southern Town Hospital at Portsmouth, and we trust that he will make a speedy recovery.

We are pleased to make mention of the promotion of Mr. Steven B. Balcombe to the rank of Temporary 2nd Lieutenant as and from the 8th October, 1915. Mr. Balcombe was in the service of the Marconi Wireless Telegraph Co., Ltd., and we take this opportunity of offering him on behalf of our readers and ourselves our hearty congratulations on his new appointment.

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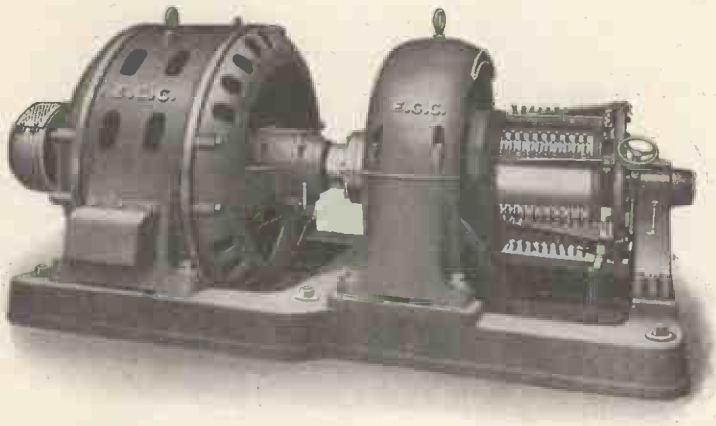

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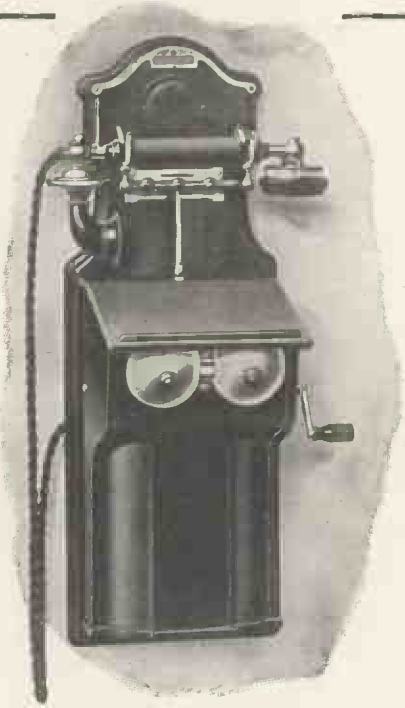

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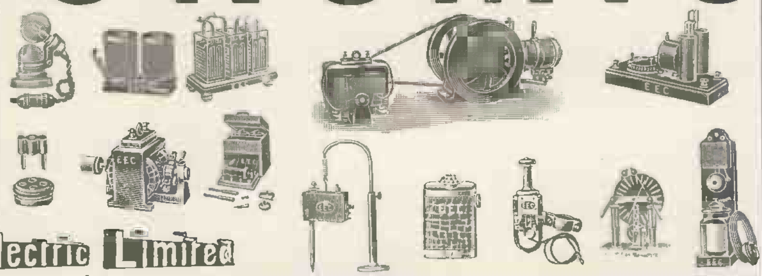

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The Editor will be pleased to receive contributions; and Illustrated Articles will be particularly welcomed. All such as are accepted will be paid for.

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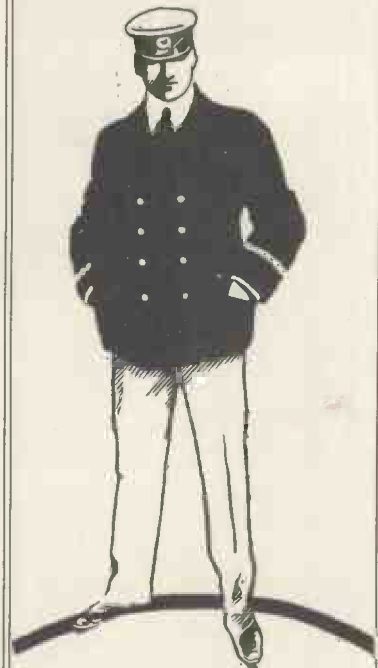

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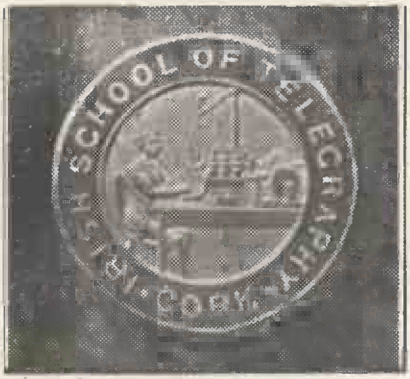

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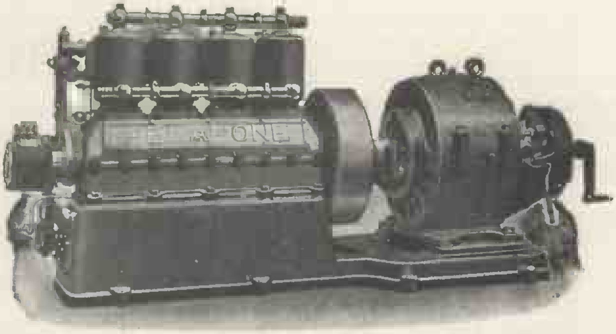

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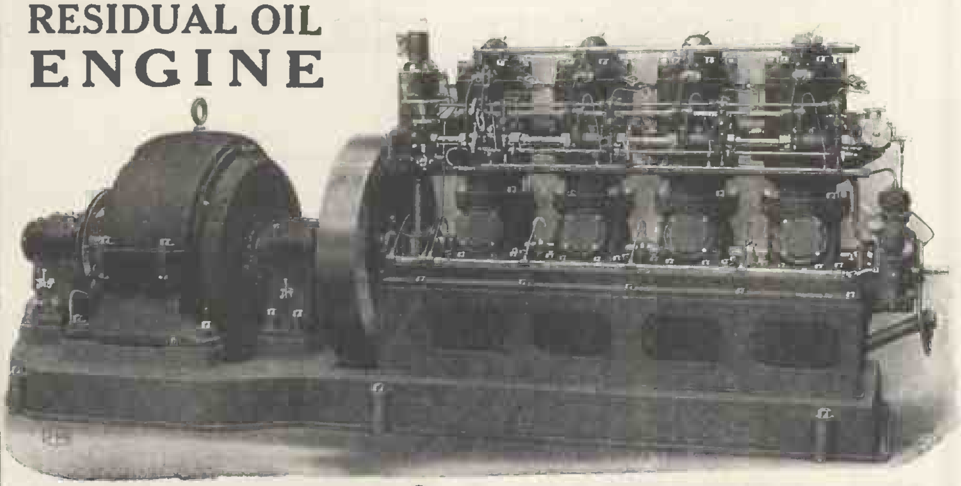

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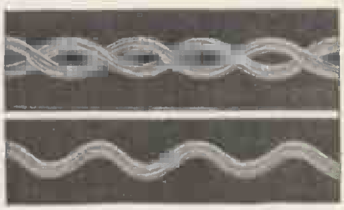

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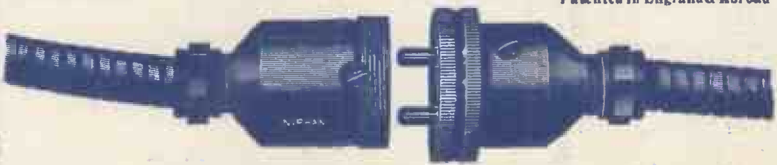
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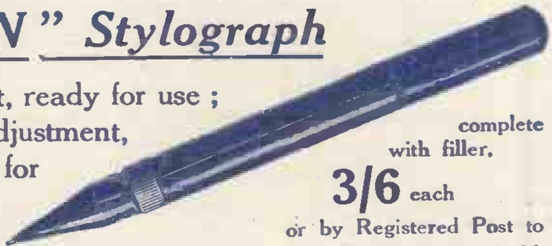

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