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THE WIRELESS WORLD

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JANY 1917

How to Become a Wireless Operator

—

How to Learn the Morse Code

—

The Telephone Receiver

This Magazine can be sent free to our troops abroad by leaving it at a Post Office

The Human Morse Code

by R. G. Micklam

THE present article is an attempt to put before the reader a simplified system of committing the Morse Code to memory, by the use of a succession of what may be termed mnemonic groups.

We take a mental passage to Egypt, therefore, and seat ourselves directly in front of the Pyramid of Cheops. We note, as we do so, a group of Arabs standing by, who had evidently received a radiogram from England apprising them of our advent, for no sooner are we comfortably ensconced than they race away and begin scrambling up the face of this 6,000-year-old monument. Having reached their appointed places, they squat down simultaneously, clasping their arms round their shins and sinking their chins on to their knees, so that they appear to us, some 500 feet away, like a collection of glorified full-stops, their blue galabiehs forming a pleasing contrast against the light brown ridges of the Pyramid. We notice, too, that they have arranged themselves in a symmetrical group, as Fig. 1, and we turn to a Dragoman standing by to ask what this figure may mean. He tells us the Arabs take us for mere tourists (Pshaw !) and want to earn " backsheesh." Well, nobody begrudges an honest man a mouthful of bread : on the other hand, by quite a happy coincidence the Arabic word for bread is "EISH" and these cunning fellows have so grouped themselves as to portray in Morse Code the four letters composing that word, since one dot (·) represents the letter E, two dots (··) represent I, three dots (···) S and four dots (····) H, and if this is how we are to learn the Morse alphabet, it promises to be quite a simple matter.

The second evolution appears to be the preliminary to a precipitate roll down the oblique face of the Pyramid, as the six men composing the three upper groups suddenly straighten themselves out, as in Fig. 2, and we are on the point of wirelessing to beg them not on any account to break their Egyptian necks for the mere gratification of our unworthy selves, when we are given to understand they threaten nothing more violent or deadly than the representation of three further code letters, the topmost man now describing himself to a T (—), the second two making out that they represent M (— —), while the third three aver it is *they* and not *we* who should be surprised, since they collectively represent O ! (— — —). On learning this, however, we begin to feel just a trifle uneasy in our minds, for it can hardly have been a second coincidence that, by a combination of the two groupings, it should have spelt out the word " EISHTMO," which is the Arabic

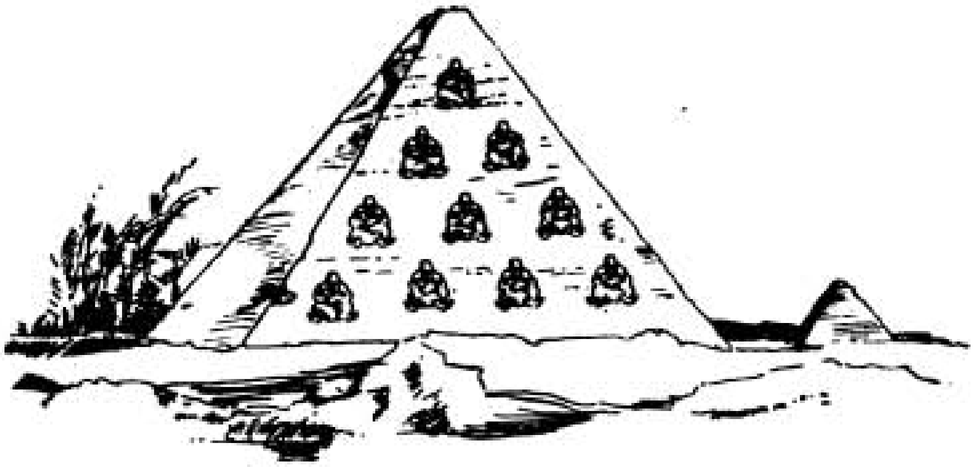


FIG. 1.

equivalent for "Insult him." If these saucy sons of Ham are laughing up their sleeves at us, they will not get their mouthful of "eish" after all. . . . And yet what recks it ? We are out for intellectual recreation and have the satisfaction of memorising in these two groups no less than seven letters of the Morse alphabet.

The Arabs now call upon several more of their sun-scorched brethren to join them, and, thus reinforced, proceed to entertain us with a third grouping, a picturesque one withal, for we here get a combined figure of squatting and lying (latter adjective refers to position, not to characteristic) Egyptians, and this is how they appear to us as Fig. 3, which is certainly not a complicated figure, yet it helps us to tuck away in the recesses of our brain-boxes six more letters, viz. :—

(A) · —	(U) · · —	(V) · · · —
(N) — ·	(D) — · ·	(B) — · · ·

Happily these form no equivocal word in Arabic (nor, forsooth, in any other civilised language), so we conclude we have been entertaining unworthy suspicions of our desert friends. While we are mentally registering the six symbols, however, the top two sets of men begin quarrelling and approach each other in a menacing attitude, but as we are at the safe distance of 500 feet from the seat of disturbance, we content ourselves with merely adding another letter to the tablets of our memories, for the conjunction of the two opposing factions represents the letter P (· — — ·). Meanwhile the two couples commence stealthily to manœuvre round one another, so that, although they began thus · — — · they presently stand thus — · · —. It is all quite fortuitous, of course, still we manage to profit by the chance grouping, since — · · — is X and gives us an Xtra letter—though this is no Xcuse for perpetrating an Xecrable joke.

Do we realise that we are already considerably more than half way through the alphabet ?

Not without casualties, however, for in the fracas above alluded to three men are injured : the first is therefore gently laid down, a dark-visaged brother sits at his head, fanning him with the tail end of his robe, while another

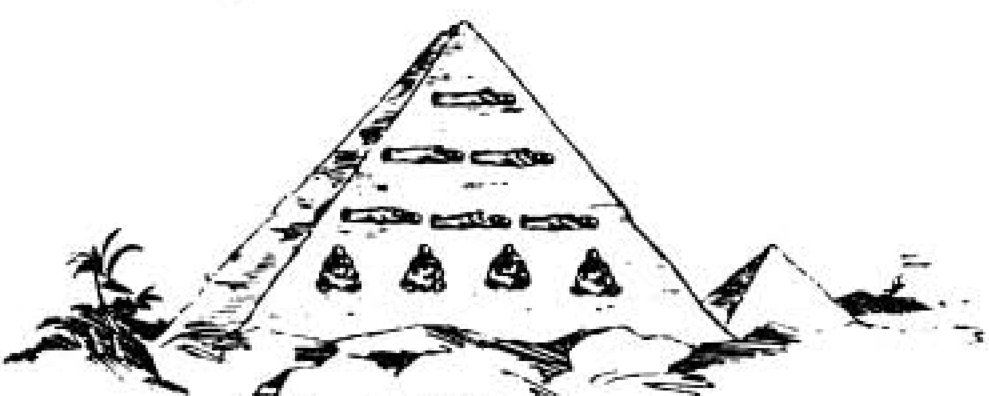


FIG. 2.

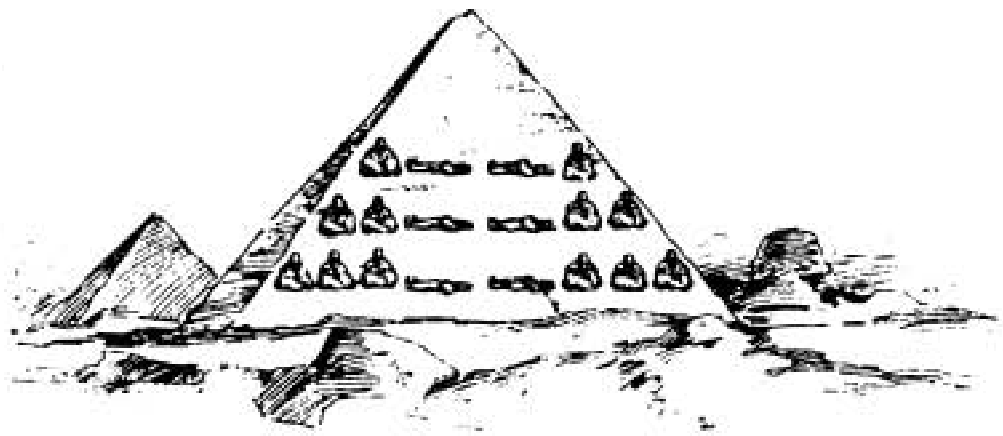


FIG. 3.

sits at the injured man's feet and tickles his toes with a spike of camel grass, and we simply cannot resist the temptation of placing another letter in our mental warehouse—viz., R, for the three men are now grouped thus · — ·. The two other wounded fellows call out faintly for "water" (they dare not make it "whisky and soda," being strict Mohammedans), so they are likewise tenderly laid out, head to head, and one of the onlookers sits between them, giving each alternately a sip of water out of his inverted tarboosh, hastily filled from the pump of Mena House Hotel close by; thus the group becomes — · —, and as it must be a hopelessly diseased wind that cannot manage to blow somebody some good somehow, we so far take advantage of the woes of these two unhappy wretches as to add the letter K to our rapidly growing Morse alphabet, thereby accounting for 17 out of the 26 letters.

Another group composed of six men evolves itself as in Fig. 4, but the component parts thereof immediately begin a 120° in the shade argument. As far as our obliging Dragoman is able to make out from this distance and the echoes thrown back from the face of the Pyramid, they are talking about cricket and the left-hand three cannot convince the right-hand trio that "W. G." was the greatest cricketer the world has ever seen. We, having no doubts about the fact, take the chance of identifying the late champion with his Morse initials, though he wouldn't have thought we knew much about cricket if we had only allowed him four stumps and two balls for a county match, · — — — — ·.

The pantomime is here rudely interrupted by the sound of a buzzing airship propeller, and, looking up, we descry a beautiful monoplane gracefully winging its way across the cerulean vault, heading straight for the summit of our Pyramid, behind which it presently disappears. We recollect this is the French aviator, *De Vol Plané*, attempting to win the £5,000 prize by making the circuit of the world, upside down, without descending once for petrol, but in the midst of our speculations as to his chances of success we are recalled to the business in hand by a sudden shuffle on the part of our acrobatic friends. They have

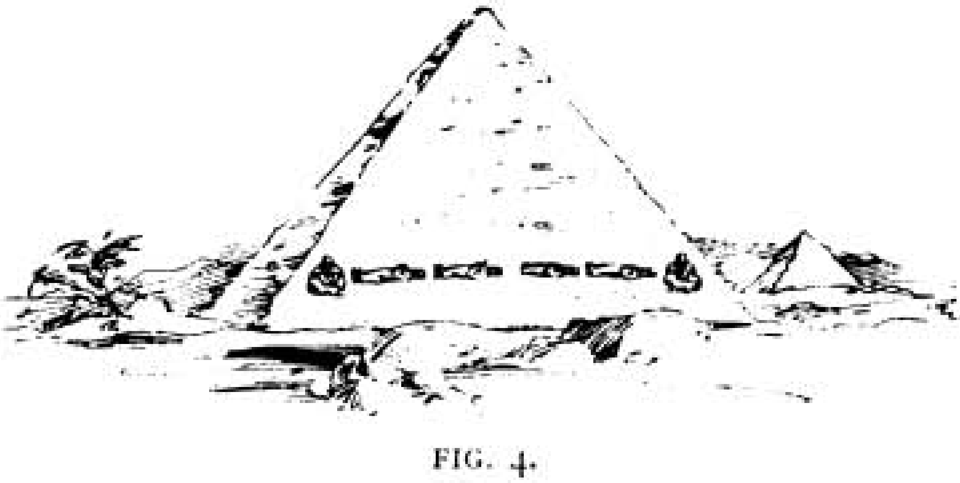


FIG. 4.

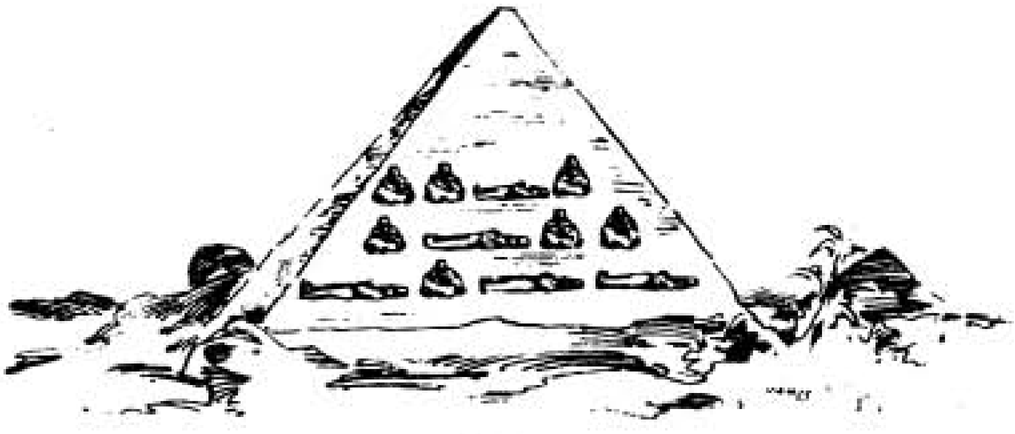


FIG. 5.

forgotten their cricket controversy and hastily thrown themselves into a curious group, as Fig. 5, which seems, to us, just a horrid jumble of people, until Mr. Know-all, our Dragoman, explains that the group represents the three letters F L Y, which is appropriate enough in the circumstances, as we feel bound to admit ; and get mentally busy again.

Our dusky entertainers now complete the alphabet (what, *already ?*) with a quadruple group, for which, to our chagrin, we are able to find no mnemonic peg whatever (Fig. 6), but which we are told represents the four letters C J Q Z, and I defy any man to make anything approaching an intelligible word out of that.

I conclude this article by drawing attention to a very curious fact in connection with the Morse Code—viz., that in distributing his symbols over the alphabet, Mr. Samuel Finley Breeze Morse (to give him his full name) did not, in many cases, allocate the *shortest symbols* to the *most frequently used letters*, the amount of divergence from the ideal distribution being shown in the subjoined diagram.

Counting the dot as 1 and the dash as 2, we get a specific time-value for each Morse signal, and it will be seen that column four of the diagram represents the correct progressive order of the ideal Morse alphabet, beginning with a single dot valued at 1 and ending with a symbol composed of a dot and three dashes valued at 7. Thus, the letter E, which is by far the most frequently used letter in the alphabet, is rightly given the shortest Morse signal : T being the next letter in order of frequency is awarded the next shortest signal, and so on, until we find Z, the least employed letter, deservedly saddled for its laziness with one of the longest Morse signals.

But by Mr. Morse's allocation, as will be seen on reference to column five of the diagram, only 14 out of the 26 letters are correctly suited, with corresponding loss of time in transmission, and it may be observed in this connection that the Morse Code is in use on no less than 95 per cent. of the telegraph lines of the world.

It seems almost a pity that advantage was not taken of the advent of Wireless Telegraphy to redistribute the Morse symbols on the ideal basis here demonstrated.

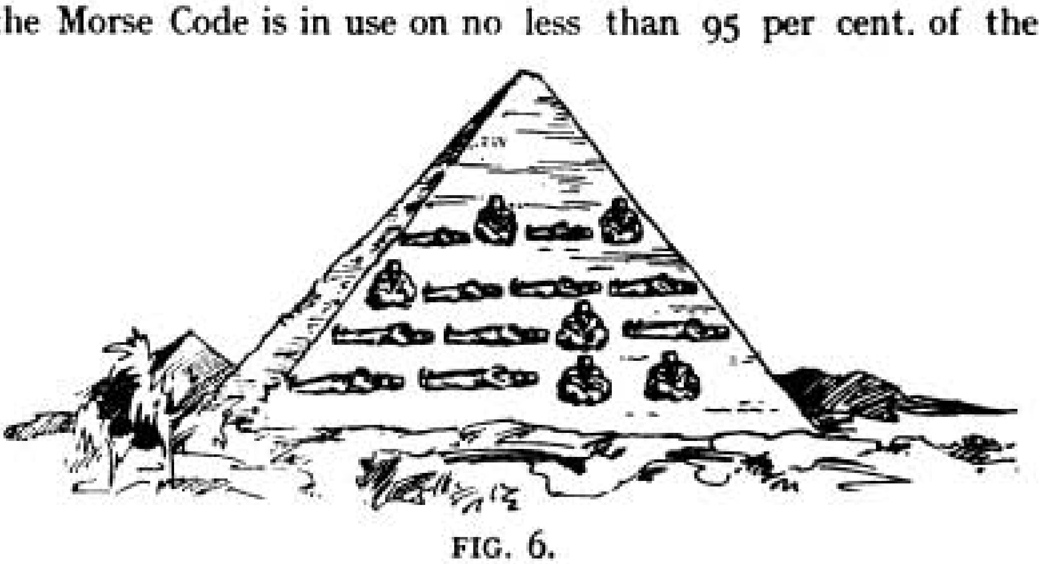


FIG. 6.

English letters in order of frequency.	Present corresponding Morse symbols.	Lines of divergence.	Ideal allocation in order of value.	Shewing where present symbol correct.
E	•		•	Yes
T	—		—	Yes
A	•—		••	No
I	••		•—	No
O	———		—•	No
S	•••		•••	Yes
N	—•		——	No
R	•—•		•—•	Yes
H	••••		••••	Yes
L	•—••		••—	No
D	—••		—••	Yes
C	—•—•		•••—	No
U	••—		—•••	No
F	••—•		••—•	Yes
M	——		•—••	No
G	——•		——•	Yes
W	•——		•——	Yes
K	—•—		—•—	Yes
P	•——•		•——•	Yes
V	•••—		—•—•	No
Y	—•——		——••	No
B	—•••		———	No
X	—••—		—••—	Yes
Q	——•—		——•—	Yes
J	•———		•———	Yes
Z	——••		—•——	No

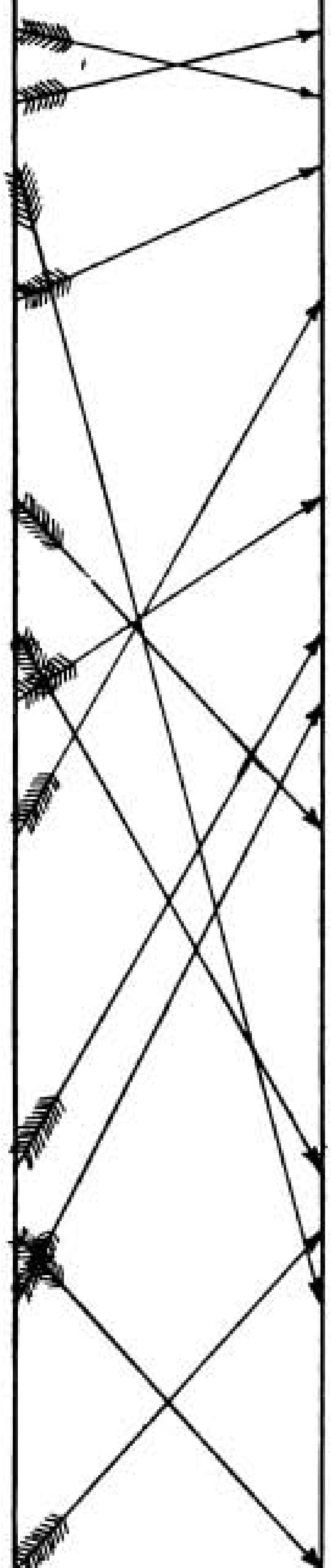


CHART SHOWING DISTRIBUTION OF MORSE SIGNALS

PERSONALITIES IN THE WIRELESS WORLD

LIEUT. BERTRAM HOYLE, M.I.E.E.

THE subject of our biography, Lieut. Bertram Hoyle, is a native of Oldham, and obtained his technical and practical education at the School of Technology, Manchester, of which he is now an Associate. He also entered as a student at the Victoria University, Manchester, and in 1907 obtained the Certificate of that University in Technology, in the Department of Electrical Engineering; and also the Diploma of the School. He has since acquired the degree of M.Sc. Tech. of that University and is an A.M.I.E.E.

Having remained at the School for an extra year of study and research, he was for three years and a half in the service of, first, Messrs. Henry Simon, Ltd., Manchester; and, secondly, Messrs. S. Z. de Ferranti, Ltd., Hollinwood.

In 1911 Mr. Hoyle applied for and obtained a post of Assistant Lecturer and Demonstrator in Electrical Engineering at the School of Technology, Manchester, which he still holds.

Collaborating with Mr. Wm. Cramp, M.Sc. Tech., M.I.E.E., of Manchester, one of his former tutors, Mr. Hoyle presented to the Institution of Electrical Engineers a joint paper, based on their researches, entitled "The Electric Discharge and the Production of Nitric Acid," which won the award of an extra premium of £10; and an interesting abstract of his further researches appeared in our issue for September, 1915, under the title of "The Influence of Temperature and Pressure on the Sensitivity of the Carborundum Crystal Detector" [Vol. III., No. 30, New Series, page 356].

Mr. Hoyle has had charge of the design and erection of the wireless station with which the School of Technology is now equipped; and in peace time he gives lectures in that subject. He enlisted in the early part of 1915 as a motor cycle despatch rider, and after a short training was sent to France, where he served in that capacity at the front.

In September, 1915, however, he was gazetted Lieut. R.N.V.R., and, after necessary formalities between Admiralty and War Office, his transfer went through and in the following month he joined H.M.S. *Excellent*.

The Telephone Receiver in Wireless Telegraphy

By W. H. NOTTAGE, B.Sc.

THE telephone receiver forms a very important part of most wireless telegraphic receiving circuits, forming as it does the last link in the chain between the transmitting and receiving operators—its function being the conversion of the electrical energy in the detector circuit into sound energy.

The efficiency with which this conversion of energy takes place depends on the electrical and mechanical design of the telephone itself and its suitability for the particular circuit with which it is associated.

The construction of the ordinary pattern of telephone receiver is well known.

For wireless telegraphy the watch pattern is universally used, as this form can be worn on the observer's head. It consists of a permanent magnet, usually made of two or more thin pieces of magnet steel. To these are fitted specially shaped pole-pieces round each of which a coil of wire is wound. The pole-pieces are placed so as to be as near to the centre of the diaphragm as possible.

The diaphragm is supported by the rim of the case opposite the faces of the pole-pieces, and at as small a distance from them as possible, without there being any tendency for it to be drawn into actual contact.

For the ordinary size receivers (diameters about 2¼ in.) the diaphragm is 10 or 11 mils thick, but for some well-known patterns, of which the diameter is 1¾ in., the diaphragm is only about half the above thickness.

The function of the diaphragm is two-fold. When a signal current passes through the coils the diaphragm is alternately attracted towards the poles and allowed to spring back, being thus set in vibration. This vibration is then communicated to the air in the neighbourhood, and reacts on the ear.

In the telephone receiver designed by Mr. S. G. Brown (see illustration on page 748) these two functions are separated. In place of a thin diaphragm, a stiff reed is fitted facing the poles, and this is set in vibration by the signal currents. The vibration is communicated to the air by means of a very thin aluminium diaphragm, which is of a conical shape, screwed to the reed at its centre, and fixed to the rim of the case by a circle of thin tissue paper.

This construction enables the reed to be brought much closer to the poles than an ordinary diaphragm can, a special screw adjustment being provided so that the distance can be regulated till the reed is just not pulled over by the magnets. The nearer the reed or diaphragm to the poles the greater the attraction for a given current and the greater the sensitivity of the telephone.

In addition to these forms, which depend for their action on electromagnetic effects, other forms of telephone receivers have been designed, which depend on quite different principles for working, but as they are not used to any great extent they will not be considered here.

The diaphragm of the ordinary receiver has a natural period of vibration of its own, and it will be most sensitive to a current whose period is the same. But the motion is, in general, damped, and the diaphragm, therefore, has a fair sensitivity for a range of frequencies on both sides of the natural period.

Telephones have been designed so that the diaphragm vibrates at a definite frequency with a much less damped motion. Such instruments have a sensitivity, which is high for currents of this frequency, but which rapidly falls off as the frequency changes. They are therefore termed " tuned receivers."

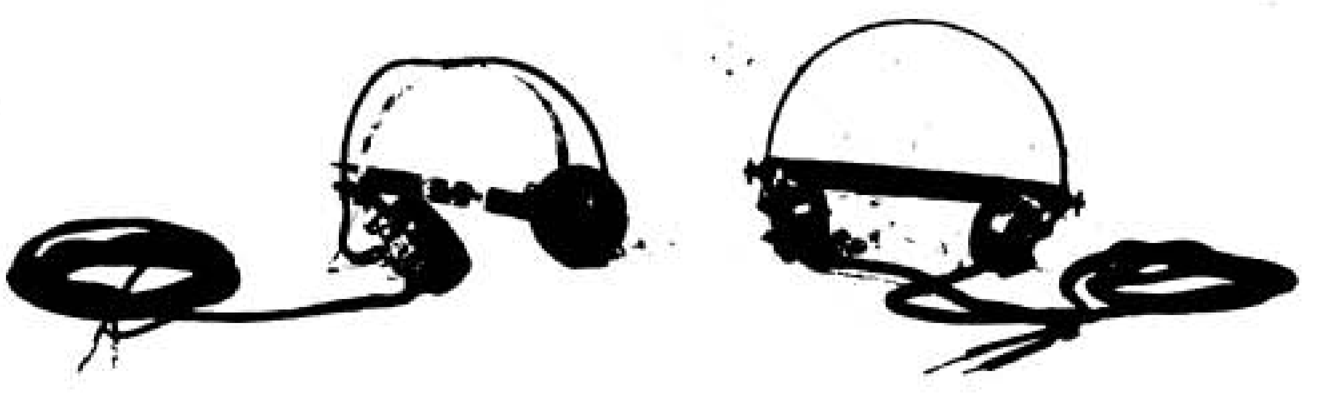
If the signal current were a sinusoidal wave-form, of unvarying frequency, the use of such special forms of telephones would present the advantage of tuning out all but the required signals.

The ordinary signals given by transmitters working by musical or quenched sparks are far from being of sine wave form, so that the tuned telephone has no advantage, since it rejects a considerable part of the energy of the signal besides destroying the distinctive character, due to harmonics, by which it can be picked out from other signals.

The sensitivity of a telephone receiver varies with the frequency of the signals acting on it. In THE WIRELESS WORLD for September, 1916, a curve is reproduced on page 444, showing the change in sensitivity for a pair of telephones as measured by the U.S. Bureau of Standards. The sensitivity is measured by the voltage at the terminals (or the current through the coils) required to give signals of a certain standard of audibility.

It is evident that the results of such a test give the sensitivity of the telephone and observer's ear in combination.

It is noticed that as the frequency gets higher the voltage required becomes smaller, so that the sensitivity increases rapidly with the frequency for the range of frequencies used in the test. Beyond a certain value the sensitivity will decrease,



TWO MODERN TELEPHONE RECEIVERS USED IN WIRELESS WORK. THAT ON THE RIGHT HAS ALUMINIUM CASES AND EBONITE-COVERED HEADBANDS.

since most people are unable to hear notes of higher frequency than about 20,000 to 40,000.

The telephone diaphragm, having a natural period of vibration, which, for usual patterns, is about 1,000 periods per second, will show a decreasing sensitivity above this point.

By tuning the electrical circuit of the telephone to the frequency of the spark increased sensitivity is obtained without losing all the energy of the harmonics. This is effected by connecting a condenser in parallel with the coils.

For exact tuning, or where a variety of notes are likely to be required, a variable condenser may be used, but in most cases a fixed condenser will increase the strength of signals for a considerable range in frequencies.

The capacity of the condenser is obtained from the formula :

$$4 \pi^2 n^2 LK = 1,$$

where L is the inductance of the telephone in henrys ;

K is the capacity in farads,

n is the frequency in periods per second.

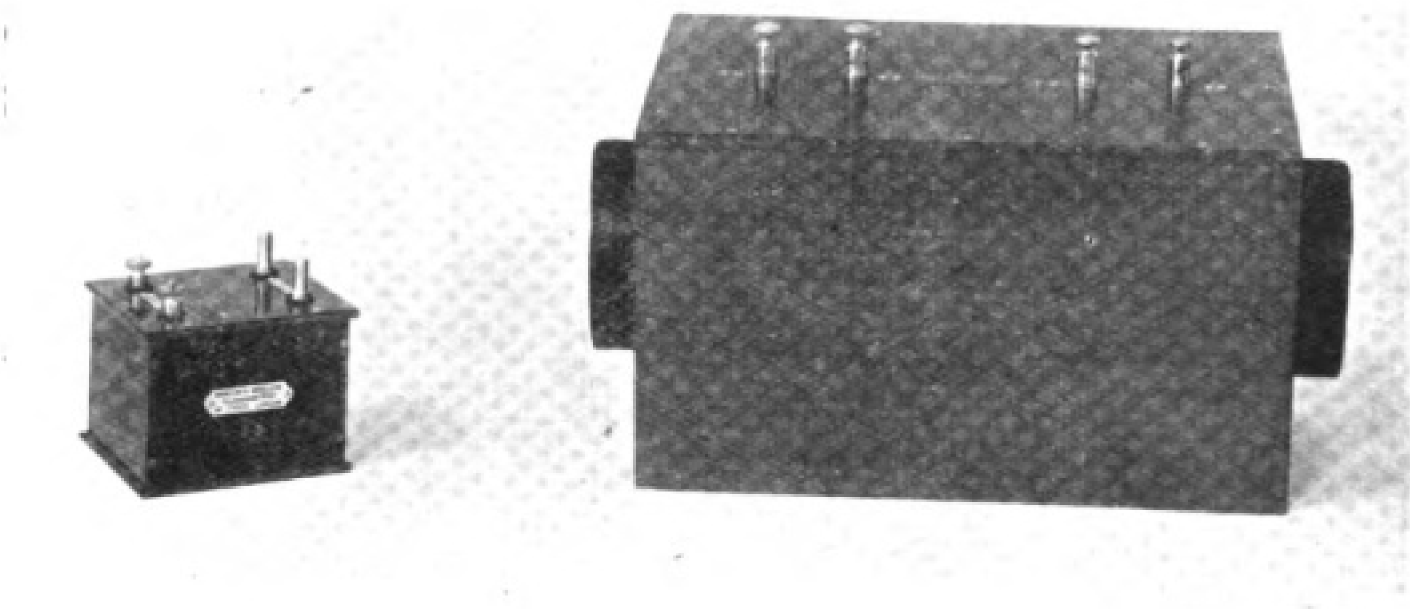
In order that a telephone receiver should give the maximum effect when associated with a particular circuit it is necessary that its windings should be suited for connection with it.

TELEPHONE RECEIVER OF S. G. BROWN WITH REED AND SEPARATE DIAPHRAGM.

Thus, if the current in the circuit be small, due to the high resistance of the various parts, the telephone coils should have a large number of turns in order that the small current may produce a large enough magnetic effect. This large number of turns will naturally have a high resistance.

Inserting the telephones in the circuit will naturally reduce the strength of signals due to this resistance, but if the proportions are properly chosen the ultimate strength of signals will be greatest by using these receivers.

The resistance, of itself, is of no value in making the telephones suitable for the circuit, but as a matter of convenience of description it is



TELEPHONE TRANSFORMERS. THAT ON THE RIGHT IS OF THE TYPE USED IN HIGH-POWER STATIONS.

usual to describe telephones by their resistances, as "high or low resistance telephones."

For a circuit where due to its low resistance a large current is obtained the telephones should have fewer turns, in order that their resistance may be kept within reasonable limits.

In place of high-resistance telephones a telephone transformer may be used in conjunction with low-resistance telephones, and has advantages in many cases.

In order to detect very minute currents the number of turns of wire required on the telephone coil becomes so great that a very fine wire must be used. This increases the difficulty of the manufacture, and hence raises the cost. Moreover, the thickness of insulation required cannot be reduced in the same ratio as the diameter of the wire, so that a coil of fine wire will have a smaller ratio of winding space usefully occupied with the conductor to what one wound with larger wire will have.

In the telephone transformer there is no restriction as to the size of the coils as there is in a head-gear telephone, and the proportions are chosen so that wire of a reasonable diameter may be used.

It is usual to use a central core of soft iron wire, and to wind the "high-resistance winding" over this, the "low-resistance winding" being outside. The dimensions may vary within wide limits, the size being determined by the relative importance of efficiency and compactness for the circuit.

In a high-power station the telephone transformer may be of large size, but in an ordinary receiving circuit one of about 4 or 5 in. side is the most convenient size.

It is usual to connect condensers in parallel with each winding of the transformer, their values being given by the formula above, the frequency to which the transformer is tuned being that of the average note likely to be received.

By using variable condensers exact tuning to the note is possible, with a consequent increase in selectiveness.

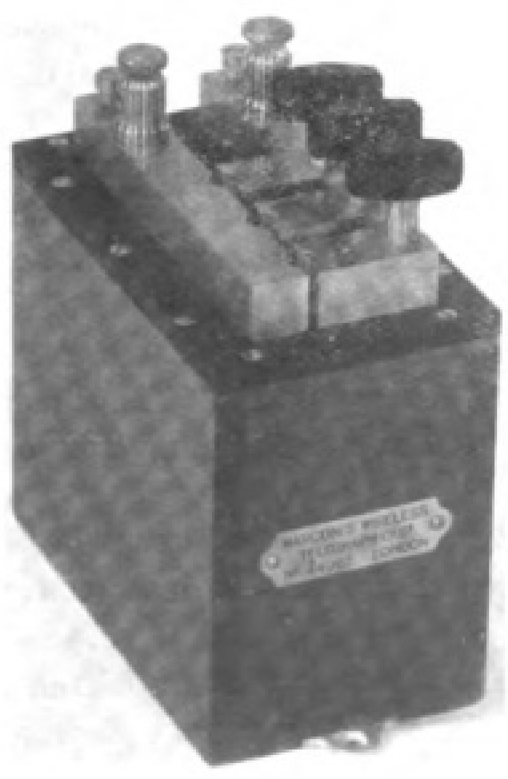
The condensers used for tuning telephones or transformers must have a high efficiency. Condensers of low efficiency, which show absorption, give the note heard a muffled sound, due to the fact that the higher harmonics are reduced in a greater proportion than the fundamental, in addition to the actual strength of signals being reduced. It is usual to use mica condensers where fixed capacities are used; for variable capacities ebonite disc condensers are suitable.

The telephone-transformer is practically essential in circuits using magnifying valves, since the place for the telephone is in the same circuit as the high-voltage battery used for applying a potential to the sheath. By using the transformer all danger of shocks from accidentally touching the terminals of the instrument is obviated and the electrostatic capacity effects are reduced.

In carrying out tests on strength of wireless signals under various conditions, in many cases much valuable information can be obtained if a large number of stations can record observations at the same time. It is obviously impossible to provide all these stations with the delicate instruments which find a place in large laboratories, and in most cases it is only possible to use the receiving apparatus with the smallest possible additions. This allows stations having other work to do to take part in the tests as occasion offers.

One method for estimating the relative strength of signals is to connect a resistance in parallel with the telephone winding and adjust it until the signals are just audible, the standard adopted being the point when dots and dashes can just be distinguished.

This standard is not a constant quantity, since it depends on the sensitivity of the observer's ear, which varies from time to time, and also on the freedom from interfering sounds which render the distinguishing of a readable from an unreadable signal more difficult.



A TELEPHONE CONDENSER.

The relative strength of two signals is measured by the ratio of the currents required to produce them in the telephone.

When the telephone is shunted by a resistance, R, the current flowing through the telephone is given by

$$I_t = I_o \frac{R}{\sqrt{(R+R_t)^2 + (2\pi n L_t)^2}}$$

where I_o=current in leads from detector to telephone and shunt;

R_t=resistance of telephone in ohms;

L_t=inductance of telephone in henrys;

R=resistance of shunt.

R_t and L_t must be measured at the frequency n of the signals being used.

When the shunt is removed the total current from the detector should be unchanged, as otherwise the conditions will be different and no comparison can be made :

For this $I_x = I_0$ where I_x is the current in the unshunted telephone.

Therefore the ratio of the two currents is

$$\frac{R}{\sqrt{(R+R_t) + (2\pi n L_t)^2}}$$

and by comparing the values given by this formula for different signals their relative strength may be estimated.

In the above formula it has been assumed that the resistance and inductance of the telephone are constant quantities for any particular frequency.

Since the coils are wound on the iron pole-pieces the inductance will depend on the current flowing through them, and therefore will not be constant.

Drs. Kenelly and Pierce in a paper on " The Impedance of Telephone Receivers as Affected by the Motion of their Diaphragms " * give measurements of the inductance and resistance of certain telephone receivers at various frequencies, the voltage at their terminals being kept constant. They show that not only do these quantities vary with the frequency, but they have different values according as the diaphragm is free to vibrate, or fixed so as to be unable to move.

Terming the values obtained with the diaphragm fixed the " damped " values and the others the " free " values, the difference between them is termed the " motional " inductance or resistance respectively.

From curves given in the paper it is seen that the motional resistance reaches a maximum value at a point before the natural frequency of the diaphragm is reached and passes through zero at the natural frequency to a minimum at a slightly higher value.

The reactance, on the other hand, passes through a sharp minimum at the natural frequency.

The following table, taken from one given in the paper referred to, will show these variations.

RESISTANCE AND REACTANCE OF A WATCH CASE RECEIVER AT DIFFERENT FREQUENCIES WITH 0·3 VOLT AT TERMINALS OF RECEIVER.

Frequency.		Resistance, Ohms.			Reactance, Ohms.		
Cycles per second.	Radians per second.	Free.	Damped.	Motional.	Free.	Damped.	Motional.
n	ω	R'	R	$R'-R$	x'	x	$x'-x$
451	2,834	135	136	— 1	115·7	118·5	— 2·8
653	4,102	163	160	3	150·3	149·5	·8
849·5	5,340	194	184	10	172·5	174·7	— 2·2
903	5,674	212	189	23	160	180·5	—20·5
923	5,800	192	191	1	137·8	182·5	—44·7
945	5,938	168	193	—25	160·1	184·5	—24·4
1,020	6,408	188	200	—12	191·1	191·7	— 0·6
1,250	7,854	214·5	220	— 5·5	210·6	212	1·4

* *Proceedings of the American Academy of Arts and Sciences*, Vol. XLVIII, No. 6, September 1912.

The natural frequency of the above receiver was 923 vibrations per second, and its direct current resistance 81·4 ohms.

In this investigation a sine-wave current was used, but the actual signals in the telephone of a radiotelegraphic receiving circuit are not of this form, so that the values of resistance and inductance would differ somewhat for the two cases.

In measurement of the strength of signals by the shunted telephone method it is obvious that inserting the direct-current values of inductance and resistance will lead to large errors, and therefore the values measured at the frequency of the signals should be used, the current strength being kept as near that of the signals as is possible for the particular method of measurement used.

In another paper by Dr. Kenelly and Mr. H. O. Taylor the results of an investigation of the motion of the diaphragm at various parts of its surface are given.

A diaphragm clamped at the edge is capable of vibrating with a maximum amplitude at its centre diminishing to zero at the clamped edge, or with one or more nodal circles or nodal diameters.

The first mode of vibration is the fundamental, and has the lowest period of vibration of the series. The results of the investigation quoted showed that this fundamental mode was alone obtained for ordinary telephone diaphragms set in vibration electrically.

Further Notes on "Jungleland"

By a coincidence at the same time that we published our article on "Wireless *versus* Wire in Jungleland" there appeared in our contemporary, *The Wireless Age*, an article explaining how the great network of wireless stations in Brazil serves that country. If you will take an atlas in hand (says Mr. J. L. Barttro in the article in question) you will be able to follow to better advantage the progress of the wireless as I learned it while employed in radio in Brazil. Beginning at Para at the mouth of the Amazon, radio stations have been erected as far as the Pacific Coast, with installations at Manaos, Santarem, Iquitos, Quito, Lima, Porto Velho, Senna Madureira, Rio Branco, Cruzeiro de Sul and Xapury. For your information it may be well to state that Porto Velho, or, wirelessly speaking, P.V., is at San Antonio Falls, 700 miles up the Madeira River, and the balance of the southern stations are in the Acre rubber district, located between the Purus River and Madeira.

Messages from the government officials in Rio de Janeiro are transmitted to their subordinates along the western border in large volume. This is especially true of the wireless and of the relay from Para on, 2,500 to 3,000 words being the average traffic business transacted in four hours from that place to Senna each morning. After making the river trip from Para to Porto Velho, which takes two long, hot, tiresome weeks, or the month's journey from Para to Senna up the smaller rivers, one is particularly impressed with the speed and ease of communication effected by wireless. As for Rio Branco and Cruzeiro, it is fatiguing even to think of the time and unpleasant features involved in a trip to them. Mail does not arrive with the morning sun in these places. But the morning messenger does bring the telegrams to the sub-prefect in his little thatched office in the rubber wilds.

Digest of Wireless Literature

Lord Kelvin and Wireless.

In a lecture on "Some Aspects of Lord Kelvin's Life and Work," delivered by Dr. Alexander Russell before the Institution of Electrical Engineers on November 9th, an interesting review of the work of this famous scientist was given. Speaking of Lord Kelvin's researches in connection with electric oscillations, Dr. Russell said that in 1853 Thomson read an epoch-making paper on the "Oscillatory Discharge of a Leyden Jar," to the Glasgow Philosophical Society. Six years previously Helmholtz had discussed a puzzling phenomenon he had noticed when a steel knitting needle was magnetised by the discharge current from a Leyden jar. In some cases the needle was left magnetised with the north pole at one end, and sometimes with the north pole at the other. If the discharge were oscillatory this would explain these results. Thomson proved mathematically that this was true in certain cases, and obtained a formula by means of which the rapidity of the oscillations can be computed. He suggested also that an experimental verification of this might be obtained by means of Wheatstone's revolving mirror. Fedderson did this in 1859. The invention of the oscillograph has enabled us to study these discharge currents in detail and prove that Thomson's theory is very approximately correct. The great practical importance of this paper lies in the fact that it led many physicists to study the problems of oscillatory discharge most carefully, and wireless telegraphy was the direct although unexpected outcome of their labours. It has to be remembered, however, that Thomson's theory is not complete. Of the energy originally stored in the jar we know that some is radiated into space. In many cases this amount is negligibly small, and Thomson's theory is directly applicable. But he did not show how the radiated energy could be taken into account or state the limitations of his formulæ.

Another section of interest to radiotelegraphists is that connected with Lord Kelvin's work on "High Frequency Resistance." In his presidential address to the Institution in 1889, Thomson explained the variation in the density of a high-frequency current in a cylindrical conductor over its cross-section. He supposed that the conductor was either at a great distance away from the conductor for the return current or that it was the inner conductor of a concentric main. He points out that at very high frequencies the current is practically confined to the surface of the conductor. This result might have been deduced from Willoughby Smith's experiments on the screening effect of metals. He gives a formula for the effective resistance of the conductor and also a table calculated by Magnus Maclean of the numerical values of the functions in terms of which the solution is expressed.

* * * * * *

Crystal Detectors.

At a recent meeting of the Physical Society at the Imperial College of Science a paper entitled "The Influence of the Time Element on the Resistance of a Solid Rectifying Contact" was read by Mr. D. Owen, B.A., B.Sc.

The resistance at a solid rectifying contact, and consequently the exact shape of the resistance characteristic, depends upon the time for which the testing current is allowed to flow. A series of characteristics were given corresponding to durations of contact extending over the range one forty-thousandth of a second to 30 seconds. The following conclusions were drawn :—

1. That the variation of resistance with voltage may be attributed entirely to thermal effects.

2. That the characteristic obtained by applying the testing voltage for one-hundredth of a second is, at moderate voltages, materially the same as that which would be found at the expiry of a period of the order of a millionth of a second.

3. That the sensibility of a wireless receiving circuit (in which the rectifying contact is used) does not differ very appreciably from that deduced from a slow period characteristic.

4. That an important fraction of the contact-resistance resides in a stratum of molecular thickness at the interface of the two elements of the contact ; and that it is in this region alone that rectifying action at very high frequencies is effected.

Professor G. W. O. Howe thought the experimental method of Mr. Owen was the correct way to tackle the problem of high-frequency phenomena, and was preferable to taking oscillograph records at low commercial frequencies and attempting to deduce from them what will happen at very much higher frequencies. What is the limit to the number of times per second that the ball may be struck for the results still to apply to one impact only ? From one point of view the results were disappointing, inasmuch as it had been necessary to introduce a mysterious stratum of molecular thickness, and the problem arises as to what these layers consist of ; what are their properties, and why is the thermal effect largely confined to them ?

Dr. H. S. Allen asked if any attempt had been made to remove surface films from the contacts. Professor Milikan had recently obtained very simple results in photo-electricity by working in a high vacuum so as to remove all films of moisture. Could this not be done in Mr. Owen's experiments ?

Dr. Eccles said that the subject of contact resistance was of wide importance, apart from its application to electric wave detectors. It had been investigated by Wheatstone and Heaviside in other connections—microphones, for example. It was important also in connection with the contacts at dynamo brushes. There had always been a desire in wireless telegraphy circles for high-frequency characteristic curves. Doubtless, if oscillograph records could be obtained for frequencies of 10 seconds, they would be very like what Mr. Owen gets by his point to point method. He would have been glad if the author had tried similar contacts, *e.g.*, two carbons, two galenas, or even two metals. In these cases there would be no thermo-electric phenomena to confuse the issue. He was not convinced on the question of molecular layer. The author states that " in actual practice the mean diameter of the area of a good rectifying contact is, as a rule, far greater than 10^{-4}cm." Now, if one pictures a piece of metal resting on the zigzag surface of a crystal, it is obvious that actual contact will only occur at points and ridges, and it is surely impossible for anyone to assert what the order of the area of contact is. He preferred to think that the effects were due to the heating of the surface layers of the stuff, due to concentration of the current flow into the narrow regions where actual contact exists. Usually the harder the crystal the better the rectification obtained, due possibly to the greater concentration of current in the smaller and sharper contact points. He thought perhaps too much stress was laid on the high frequency characteristic. When an oscillation passes through the contact of a crystal touching a metal plate, it is the after-effects of the heat developed which produce the thermo-electric currents that affect the telephone. Therefore, while of scientific interest, the high-frequency characteristics are not very essential from the point of view of wireless telegraphy.

Mr. F. E. Smith thought Dr. Allen's suggestion a valuable one. About 14 years ago a paper was read to the Society showing that films of liquid remained attached to solids even up to temperature of 300° C.

Mr. Owen, in reply to Professor Howe, thought there was no mystery connected with the contact layer. We cannot assume complete continuity of material at a contact, as in a weld, since there is never any difficulty in pulling the elements apart.

With respect to the repeated impacts, the time between the impacts was never less than about 8,000 times the duration of contact. The point raised by Dr. Allen required investigation. It was scarcely necessary for him to reply to most of Dr. Eccles' remarks, as they really constituted an independent contribution to the subject.—(*Electrician* report.)

* * * * * *

Radiation Simply Calculated.

In our American contemporary *The Electrical Experimenter*, C. L. Whitney recently published an interesting paper from which the following notes are extracted:

The watts radiated from a flat-top aerial may be found from the equation:

$$P = 1578{\cdot}2 \frac{h^2}{\lambda^2} I^2.$$

Where :—P = power radiated in watts.
h = height of aerial (in feet).
λ = length of emitted wave (in feet).
I = ampères, as measured by hot-wire ammeter in aerial circuit.

This formula is used where the antenna capacity is mostly in the flat-top. For example :

Supposing we have a flat-top aerial 100 feet high with leads brought down from the centre. Our wavelength is, say, 600 metres, or approximately 2,000 feet. The hot-wire ammeter reads 5 ampères.

Then $$P = 1578{\cdot}2 \left(\frac{100^2}{2000^2} 5^2\right)$$

or $$P = 1578{\cdot}2 \frac{10{,}000}{4{,}000{,}000} 25 = 88{\cdot}6375 \text{ watts.}$$

Therefore with a flat-top aerial 100 feet high on 600 meter wave-length, we are radiating approximately 88 watts.

The watts radiated from a vertical aerial is given by the formula :

$$P = 640 \frac{h^2}{\lambda^2} I^2.$$

This formula is applied in the same way as the first.

Now we can calculate the power radiated in still another way, as long as we know the radiation resistance of the aerial, and the number of amperes.

$$P = Ra\ I^2.$$

Where :—Ra = radiation resistance in ohms.

I = Ampères, measured by hot-wire ammeter in ground or aerial lead.

To find the approximate radiation resistance (Ra) of a flat-top aerial we use this formula :

$$1600\ \frac{h^2}{\lambda^2} = Ra \text{ (in ohms)}.$$

Where :—h = height of aerial (in feet).

λ = length of emitted wave (in feet).

We can increase the radiated power by increasing the height of the aerial. Thus if our aerial was 200 feet high instead of 100 feet and the hot-wire ammeter reading remained the same (5 ampères) we would radiate 4 times as much as before, or about 375 watts.

Radiation may also be increased by increasing the number of wires in the flat-top, but the most effective way to increase the radiation (and incidentally the range of the station) is to increase the height of the aerial. We could build an aerial say 100 feet long at a distance of about 10 feet from the ground, and when we connect our transmitting set to this the hot-wire ammeter will show a higher reading than when the set was connected to a high aerial. However, by the above formulæ we can readily see that the power radiated (watts ; not ampères alone) is not high and naturally the distance we can transmit is also curtailed very much.

It is now plain why in some cases one station (call this station No. 1) radiates say, 8 ampères and has a range of say, 200 miles, while another station (call this station No. 2) radiates, say, 5 amperes and works 300 miles as easily as station No. 1 works 200. If it is noticed carefully just how each station's aerial is built and how the leads run (if parallel to iron masts, stacks, etc., in case of a station on a ship) it will be found that the aerial of station No. 1 is either low, or that the leads run parallel to some grounded object and therefore although 8 ampères leaves the station, much of it is lost to the grounded objects. Again the aerial may be low and thus the watts radiated is low, although the hot-wire ammeter shows a high reading. The practice of using hot-wire ammeter readings to compare two or more stations is very misleading, as becomes apparent.

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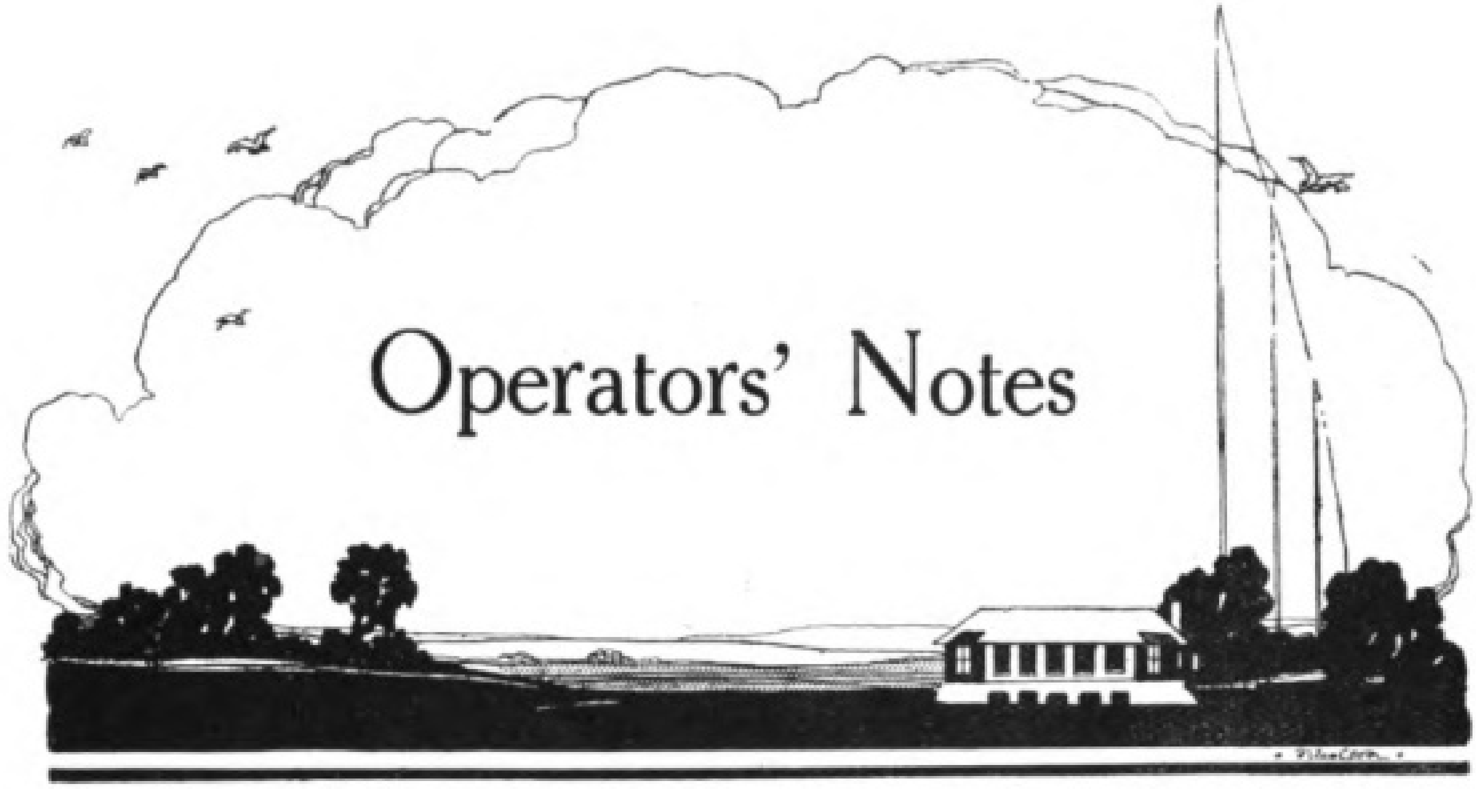
A Simple Test for Moisture in Transformer Oil.

While the only thorough test for suitability of oil for transformers and oil switches can be made with high-tension testing apparatus, very good indications of the presence of moisture have been obtained by J. K. Mackie, superintendent of the Connecticut Power Company, as follows : A sample of the oil to be tested is drawn from the bottom of the transformer, oil switch or storage tank. (Samples from the upper parts of the tank are not considered as suitable for the test, as water is heavier than oil and usually collects at the bottom.) In the sample thus taken is placed powdered anhydrous copper sulphate. If moisture is present the copper sulphate will be dissolved, producing a blue colour that will diffuse through the oil if moisture is in suspension. (*Electrical World.*)

Operators' Notes



Some Notes on the Maintenance of Accumulators

By WILLIAM PLATT

SPACE is most valuable on shipboard, and the ship type accumulator has been especially designed to occupy the smallest possible area and give the maximum efficiency. As most operators are aware, the type of cell usually employed is known as the " lead " accumulator, and is made up of four specially formed positive and five negative plates fitted in a lead-lined teak container. Three different types are in use on British steamships carrying Marconi installations—viz., the PW 4 type, manufactured by the Chloride Electrical Storage Co., the " Ship type," manufactured by the Electrical Power Storage Co., and the P.P., manufactured by the D.P. Battery Co. While the process of manufacture may differ considerably, each of these types is known as a " lead " accumulator and, apart from a slight difference in capacity and specific gravity, which must be taken note of, they call for the same general treatment. When cells are sent out from makers, in nearly all cases an instruction sheet accompanies them. This sheet gives figures indicating normal charging rate, maximum voltage, and maximum specific gravity readings. The switchboard charging arrangement is in all cases standard. In series with the dynamo there is a wire resistance of 5 ohms and two 50 c.p. carbon lamps (in parallel).

Suppose we have a battery of 12 cells to charge and these cells show a voltage of 1·9 each, giving 22·8 volts for the whole battery. To find the charging rate through the marine switchboard we must know the voltage of the dynamo, the resistance in the marine switchboard, and the voltage of the battery to be charged. For practical purposes we can ignore the internal resistance of each cell, as this varies somewhat and is in most cases small. To find the resistance of the 50 c.p. carbon filament lamps we must calculate as follows. A carbon filament lamp takes from 3 to 5 watts for each c.p. of light given. Let us, therefore, take the mean of this and say 4. Now 4 times 50=200, therefore our 50 c.p. lamps are taking 200 watts to light them at full power. Now volts multiplied by ampères give watts, so if we divide the figure 200 by our charging pressure we shall get the ampèrage taken by the lamps—*e.g.*, with a dynamo giving 100 volts pressure the current taken by each lamp would be $\frac{200}{100}=2$ amps. This 4 amps is often thought to be the charging rate when using the marine switchboard, but this is wrong, as it does not take into consideration the voltage of the battery to be charged, nor is the 5 ohms of wire resistance in the board reckoned with. By Ohm's law we find that each lamp has a resistance of 50 ohms. Then 2 lamps in parallel will have a resistance equal to the reciprocal of the sum of the separate reciprocals—*i.e.*,

$$\frac{1}{50}+\frac{1}{50}=\frac{2}{50}=\frac{50}{2}=25 \text{ ohms.}$$

Then we have resistance in circuit equal to $5+25=30$ ohms. When we put the accumulators on charge we connect up positive of dynamo to positive of accumulator battery and clearly then the 100 volts pressure must be decreased by the voltage of the cells which represent a back E.M.F., therefore our available charging pressure is $100-22{\cdot}8$ (the voltage of the battery to be charged) $=77{\cdot}2$ volts. Now to find charging current we again use Ohm's law $I=\frac{E}{R}$. In our case $I=\frac{77{\cdot}2}{30}=2{\cdot}5$ ampère charging rate. This rate is small for such a type of cell, and the only time at which it might be used is when accumulators are discharged regularly at a correspondingly low rate. Now some of the switchboards were designed at a time when accumulator batteries were frequently used in connection with working the induction coil, and the discharge rate was a low one. Also at that time 8-cell batteries were used. This arrangement had two important differences—viz., a correspondingly lower discharge rate when working coil and higher charging rate when charging from dynamo. More recently, however, when International Regulations were framed and it was ordered that accumulator batteries should not be used save in cases of emergency, it was necessary to make some arrangement whereby accumulator batteries could be properly discharged and charged up again in a comparatively short time, say, such as the duration of a ship's stay in port. Accordingly an auxiliary panel was designed for use with the marine switchboard, not only to give an increased charging rate, but also to provide a means of discharging the battery. This panel is made up of a 3-ohm wire resistance, and the connections can be explained as follows :—

Firstly, it is in series with the 5-ohm resistance of the marine switchboard and the accumulators, but it is in parallel with the lamps of that board. Now the lamps have, as we know, a resistance of 50 ohms each, or 25 ohms together in parallel. Our 3-ohm resistance will more or less be a " dead short " across these lamps, and in any case will represent 3 ohms or less resistance against 25 ohms without the auxiliary panel. Hence the resistance in circuit when using extra panel is 8 ohms—5 in marine board and 3 in panel. Taking the same figures as before, having 77·2 volts and 8 ohms, therefore the charging rate will be nearly 10 ampères. Suppose now the cells are fully discharged, that is, the voltage has dropped to 1·8 per cell, and the capacity of each cell is 80 ampère-hours, then at a charging rate of 10 ampères it will be necessary to charge for 8 hours before cells will gas properly and a couple of hours' further charge to allow for charging losses.

(To be continued.)

The Calculation and Measurement of Inductance and Capacity*

A New Volume of First Importance to Radio Workers

In the early days of wireless telegraphy, when the transmission of a message over a distance of five miles was counted a wonderful achievement, theorists were working largely in the dark, and the practical worker with his methods of trial and experiment held the field. Many of us can remember the days when jiggers were wound in a peculiar shape, not because any formulæ or calculations indicated that results could best be achieved that way, but simply because it chanced to be a method which " worked." And many experimenters were loath to give up their crude and cumbersome home-made appliances for fear that the neater and more compact factory-produced apparatus would fail to give the results desired.

Such is usually the position of a new science before a great accumulation and classification of facts gives the theoretical worker the raw material from which to produce and check his formulæ. In the 20 years which have elapsed since the first commercial wireless apparatus was set before the world, a great host of workers have collected a vast store of important observations, and scientists have so sorted, checked, and compared them that we now see order, where formerly was disorder only, with the result that the science of radiotelegraphy is now firmly established upon a sound mathematical basis.

Such thoughts as these occur to us on opening the volume on *The Calculation and Measurement of Inductance and Capacity*, which the well-known radio worker, W. H. Nottage, B.Sc., has just written. It is the first book devoted entirely to this subject, and brings together for the first time many of those classified facts and formulæ to which we have alluded above. Wireless telegraphy being a science of oscillations, and oscillations depending for their production upon the proper arrangement of inductance and capacity, it needs no deep knowledge or wide reading to see how important such a book as this must necessarily be. Both professional and amateur wireless workers are almost daily called upon to make calculations such as those which are dealt with in the book before us, and it is a fact beyond dispute that much needless work and even more regrettable error has arisen from the ignorance of the correct formulæ to use, and the absence of such a book as this, where the special means of calculation for particular circumstances can be found.

As the author says in the preface, the object of this book is to present in a convenient form the more generally useful formulæ and methods of measurement of inductance and capacity. There have been considerable developments in recent years in the design of instruments intended for the calculation of inductance and capacity, and it is hoped that the descriptions in the book may prove of service to

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* *The Calculation and Measurement of Inductance and Capacity*, by W. H. Nottage, B.Sc. London Wireless Press, Limited. 2s. 6d. net.

those engaged in this work, especially as some of these instruments do not appear to have yet been noticed from the various text-books dealing with the subject. In Chapter I. we have the meaning of inductance explained, and the principles on which the calculations are based. The calculation of inductance of a straight wire and a coil are then treated from an elementary standpoint, and the difference between high-frequency and steady current values discussed. A number of important formulæ for the self-inductance of a straight wire and a straight tape next follow, after which we come to the treatment of mutual inductance of two wires for tapes. Then step by step we proceed to the considering of the inductance of circular wires, circular tapes, squares and rectangles, and other geometric forms. And next, what is very important from the standpoint of the wireless worker, the self-inductance of a single layer coil.

In the half-forgotten days of peace, when poles were erected in gardens, on roofs, against the walls of out-buildings, and in other places, when the thin wires of amateur aerials appeared almost as frequently as threads of gossamer upon the countryside, we were continually receiving in our letter basket questions such as :

"What is the inductance of a coil 6 inches long and 2½ inches in diameter ?"

"What wave-length can I receive with ½ lb. of enamelled wire wound on the former 7 in. by 3 in. ?"

"What size wire must I use on my tuner to receive Eiffel Tower ?"

And so on, depending on the knowledge and experience of the particular amateur. It seemed to make little difference when we pointed out from time to time that the inductance of the coil depended not only upon the diameter and length of the coil, but on the number of turns to the inch and the space between them. One fact, however, stood out above all others on going through our daily correspondence, most amateurs needed to have placed before them the main facts regarding tuning coils and their inductance. Here in Mr. Nottage's book we have just what the serious amateur has been waiting for for years. On page 18, for instance, speaking of coils without iron cores, the author gives Professor Nagaoka's formulæ, explaining its uses and also its limitations. This enables the investigator to calculate the inductance of a single layer coil of wire with a precision sufficiently great for most practical purposes. For making approximate calculations of the inductance of a coil, a table is given from which the inductance of coils ranging from four to ten centimetres in diameter and from one to thirty-four centimetres long have been worked out. Another highly useful table gives a number of turns per centimetre for coils wound with various covered wires.

After dealing with coils with iron cores, we come to the treatment of mutual inductance. There are a number of formulæ for the mutual inductance of single layer coils, the one to use depending, says the author, on whether the coils are concentric or at a distance apart, or whether the inner is higher than the outer, etc. These formulæ are mostly very complicated, and if, for example, the curve of the mutual inductance between two coils of various relative positions was required, the work involved would be very great. To overcome this difficulty Mr. Nottage has devised a simple graphic method by which results of fair accuracy can be obtained with a small amount of work, and it is very suitable for plotting a curve of the nature referred to.

Chapter II. deals with the calculation of capacity and the various forms of condensers, fixed and variable. As in the case of inductance, full descriptions are given of the various methods of calculation and the various factors which have to be taken into consideration in special cases. The important contribution to the science of radiotelegraphy made by Professor Howe in his papers for the British Association on "The Capacity of Radiotelegraphic Antennæ" are next treated, and we remark that the author is right up to date in dealing with Professor Howe's papers presented to Newcastle only a few months ago.

Chapter III. is devoted to the measurement of inductance, and explains the use of the Fleming-Anderson bridge, the Maxwell bridge, and the bridges of Butterworth, Owen and Hay. The Drysdale alternating current potentiometer is also considered. Other forms of apparatus dealt with in this chapter are Professor Lee's bridge, the Campbell inductometer, the Ballistic galvanometer, Grassot fluxmeter, and Drysdale's combined inductance and capacity testing bridge.

In Chapter IV. the calculation of capacity comes in for the same careful treatment, Wein's series resistance bridge, Fleming and Drysdale's bridge and other methods not being omitted, and by the time he reaches this portion of the book the reader will be truly unobservant if he fails to note the great care and thoroughness with which the subject has been treated.

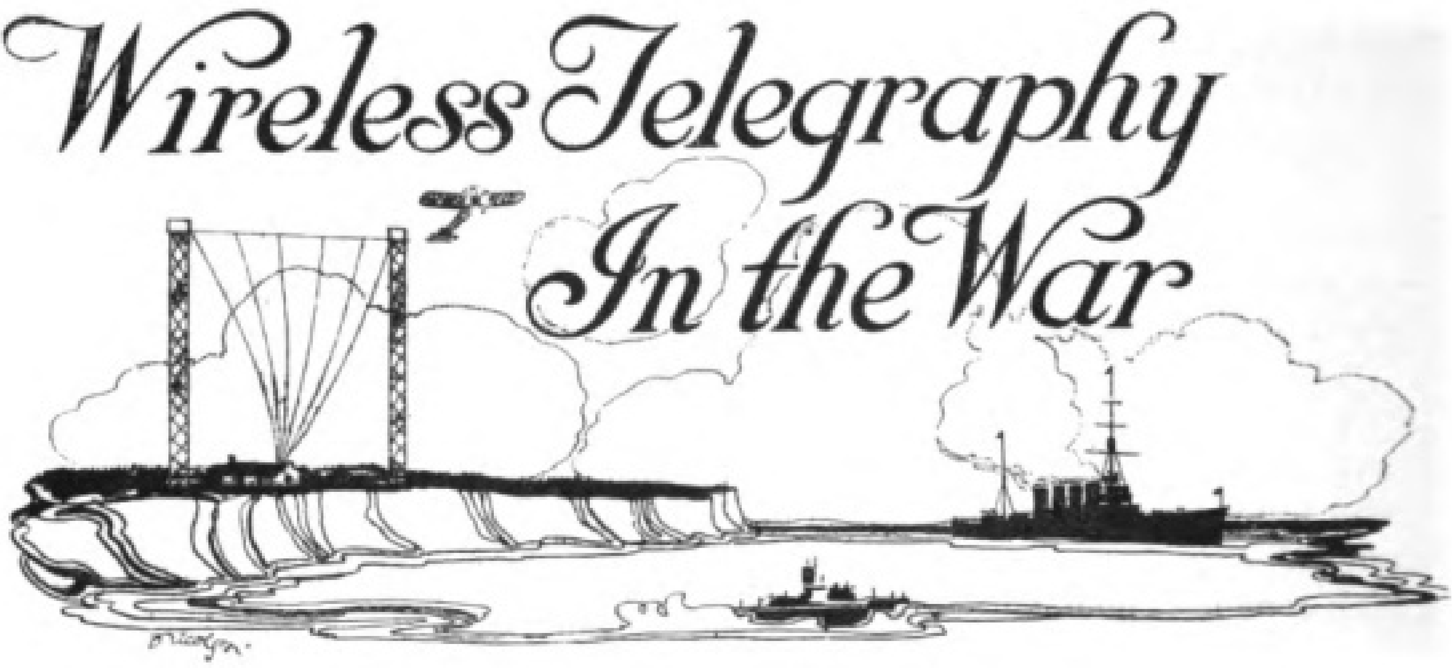
Chapter V. is devoted to high-frequency measurements, and Chapter VI. to appliances for use in measuring inductance or capacity, including the testing receiver, the vibration galvanometer and the Sumpner alternating current galvanometer, whilst in an appendix we find a number of useful tables. The print is clear, the diagrams well reproduced, and the binding and general make-up of the volume excellent. Many books have been said to be indispensable to the wireless worker, but this treatise above all is entitled to be so designated. We can strongly recommend the book to all workers, wireless or otherwise, who at any time need to undertake calculations relating to either inductance or capacity.

Administrative Note

ALASKA.

The Director of Naval Communication has announced that, effective October 1st, 1916, radio rates to conform as near as possible to the rates of the Washington-Alaska military cable and telegraph system effective that date, will be placed in effect *via* the naval communication service in Alaska. All traffic to or from ships at sea will be prefixed "Radio." Cable count will be used. Ten-word minimum will be required. Naval radio stations at St. Paul, St. George, Dutch Harbour, Kodiak, Cordova and Sitka will apply a 6-cent coast tax. Service between any point in Alaska reached by the naval communication service or the Washington-Alaska military cable and telegraph system and any of these stations will carry a rate of 5 cents. per word additional. This will also include North Head or Seattle for local delivery or for transfer to other systems to reach points beyond these systems. The traffic may be routed *via* either the naval communication service or cable service or both. This rate does not include other line charges, which should be added if it is necessary to employ other lines to reach destination.

Wireless Telegraphy In the War



War as a Teacher.

War is a great teacher of ethnology, geography and history. We wonder how many people before the recent happenings in Roumania realised that the territory of our Ally forms the *locale* of the old Roman colony of Dacia, or that the Roumanians themselves are not only descended from these Roman colonists, but actually speak a language of Latin origin. The piers of a bridge constructed by the Romans are still to be found in the neighbourhood of Orsova ; whilst Constantza, which recently underwent the sorry experience of German occupation, is the modern representative of Tomi, the Dacian town to which the Roman poet, Ovid, was exiled for his too successful practical exposition of the theories which form the theme of his famous poem "De Arte Amoris," *The Art of Love*. This port of Tomi (or Constantza) excited a good deal of interest amongst wireless operators and newspaper correspondents who found themselves in Turkish waters during the Balkan struggles of five years ago. At that time the Roumanian wireless station there located proved of considerable assistance to news-getters, who had to contend with a prohibitively rigid Turkish censorship. One resourceful correspondent managed to elude Ottoman supervision by boarding one of the Roumanian mail steamers lying off the Seraglio Point (Constantinople), and persuading the ship's operator to send his newspaper messages by wireless to Constantza, whence they travelled without hindrance to England.

It was mainly with the view of keeping in touch with these vessels, belonging to the Roumanian Royal Mail Line, that the land station was erected. The installation, in peace time, consisted of medium power machinery, working a system known as the Branly-Popp. We recently pointed out that the different radio stations not infrequently possess special "Notes" of their own, and this was very markedly the case in this particular instance. Its spark was of the peculiar variety aptly described by our French friends as *étincelle rare*. In fact the frequency was so low that the separate sparks could almost be counted, there being only three or four of them to the dot. The Roumanian vessels (one of which was named the *Dacia*) also carried apparatus of the same system, and the ship's operators appeared unable to communicate with any vessels other than those belonging to their own line and with the shore station at Constantza.

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A WIRELESS MAN CAMPAIGNING IN AFRICA.

Some of the most interesting items of news in connection with the various British Expeditionary Forces have been contributed, not by professional newspaper correspondents, but by private letter-writers. Every now and again the recipients of such correspondence have placed their epistles at the disposal of the Press and, in the case of war-zones, without some specific reason for so doing, the Press Bureau does not veto their appearance. Pioneer J. H. Rolison, who has for some time past been serving with a wireless signal-company in the East African campaign, has written home a number of interesting communications, describing the conditions under which the campaign has been conducted, and the following notes are mainly extracted from his letters.

On the latest maps of the districts wherein the Anglo-Africander forces have been operating, the country is marked *unexplored* and—says our campaigner—" speaking " truly I should think no man would ever want to explore it. It is absolutely " nothing but thick bush, forbidding enough by day, and at night reverberating with " one perpetual roar of lions and hyenas. Last night a big brute dashed by the " electrician on duty, passing within a few yards of him, and broke three of the

CONSTANTZA, THE ROUMANIAN PORT RECENTLY OCCUPIED BY THE ENEMY FORCES, AND THE MODERN REPRESENTATIVE OF THE ROMAN TOWN OF TOMI.

"*earths* connected with the station." Apart from the dangers incurred through the presence of these swarms of savage wild beasts, and apart from the heavy toil involved in cutting a way through thick and pathless vegetation, our wireless men have run constant risks through the manifold activities of the enemy. "During the course "of the most important fighting, the wireless station was shelled the whole day long "by one of the guns saved by the Germans from the wreck of the *Koenigsberg*." Fortunately, the range was not very accurately "spotted" by them, and practically no damage was done, although at times the telegraphists had some narrow escapes. Mr. Rolison instances one piece of shell, no less than 7 lb. in weight, which dropped in such unpleasantly close proximity to him that he is keeping this fragment as a souvenir of an almost miraculous escape.

At the time when the difficult task of clearing the country round Kilimanjaro and Meru was being conducted, the wireless section appears to have had an extremely hard three weeks' work. They rose to the occasion, and gave universal satisfaction by the way in which they accomplished their task, receiving in consequence official commendation for their strenuous exertions. Indeed our wireless friend records with easily comprehensible pride the fact that "The Headquarters "Staff complimented "us on several occasions, and even stated "that the fate of the "column depended "upon us." Such a statement might appear at first sight to be a little far-fetched; but, when we come to look into the conditions of this campaigning we can understand the justification for it. The Anglo-Africander forces have found that the only possible lines of advance lie through the uncleared thick bush, cutting their way as they went, because all the *made* roads had been mined by the enemy, who had also

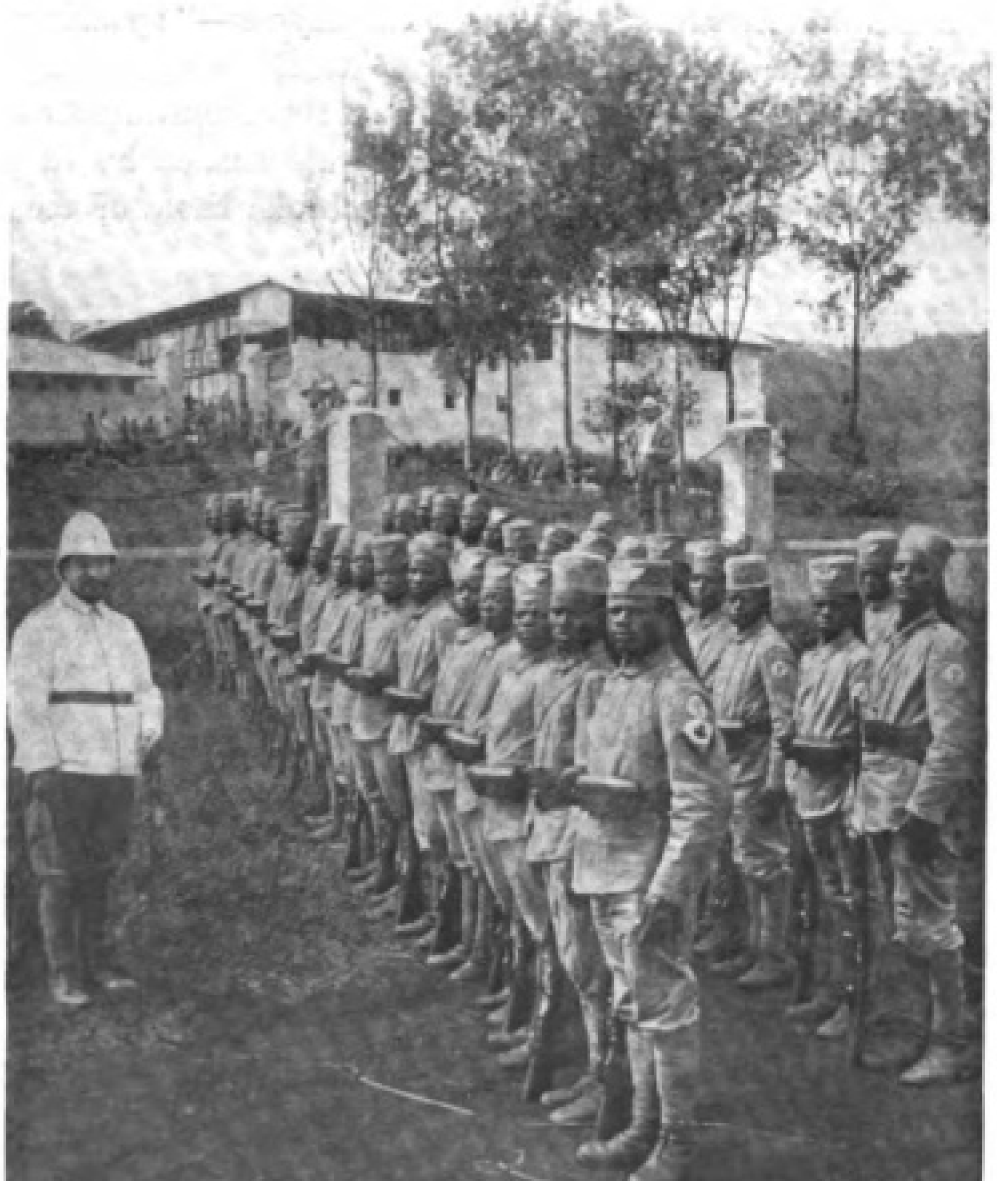

Photo [*Underwood.*

GERMAN "ASKARIS," THE NATIVE TROOPS WITH WHOM THE ANGLO-AFRICANDER FORCES UNDER GENERAL SMUTS HAVE HAD TO CONTEND.

Photo by] [Photo Press.

ANGLO-AFRICANDER FORCES BIVOUACKING. THESE ARE THE WHITE TROOPS (WITH NATIVE BEARERS) WHO HAVE BEEN SO LONG CONTENDING WITH THE NATIVE ASKARIS UNDER GERMAN LEADERS. (*See opposite page.*)

completely demolished all the bridges. Think what this means! Picture to yourselves the small parties of axemen and others making a path where none was before, often separated from one another in such a way as to be completely out of touch save through intercourse by wireless, relying upon this medium not only for maintaining their communications with their brother-pioneers, but with the General in command. A prime necessity for forces operating in such districts is a regular supply of water, and it is the duty of those who discover such supplies to advise their Commanding officers without delay, for the enemy, reverting to the savage methods of Bushmen and American Indians, systematically tampered with all the known water supplies.

Our article in the November issue, under the title of "Wireless in Jungleland," explains some of the reasons why radiotelegraphy possesses such a marked superiority over wired telegraphy in these bush-infested tropical regions, so that it is hardly an exaggeration to take the view that wireless alone has enabled the Anglo-Africander advance to be made in many parts of German East Africa without the expenditure of an immensely larger force than has been available and without the consuming of a much longer period of time for the campaign.

War Notes

THE recent occasion when a Norwegian Torpedo Boat Commander took drastic action against a German vessel, which attempted to ignore his orders, is typical of the sturdy spirit of his race. It will be remembered that, in defiance of Norwegian Wireless Regulations, the Teutonic Commander not only held on his course with aerials in full working order, but went so far as to ignore two warning shots fired across his bows. The Scandinavian Captain sent a boarding party and summarily dismantled the apparatus. The indomitable independence of the Norwegians has seldom been better exemplified than by their recent conduct under most difficult circumstances.

Indomitable Norway.

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We recently came across a rather amusing description of military aviators in Russia, and some of our readers may be interested to learn of the influence exerted by wireless telegraphy upon the fierce spirits of these Muscovite aviators. The pilots, we read, are real "Devils of the Air," whose lives are all of them "filled with unprecedented and terrible adventures." *They*, it will be noted, have nothing to do with wireless telegraphy ; but the "scouts" are painted as men not only differing in *rôle*, but in character. Their business is to watch the effect and direction of the guns, report results, and give directions by wireless. Though apparently drawn from the same "raw material," they are described as "much calmer in temperament." As far as we can see, the only cause which can create this relative calm is that of a prolonged study of the applied science to which the world owes so much. So that, if we want to tame the wild and fiery spirit of an unruly young man, the suitable prescription appears to be—*teach him wireless.*

Wireless as a Tranquilising Influence.

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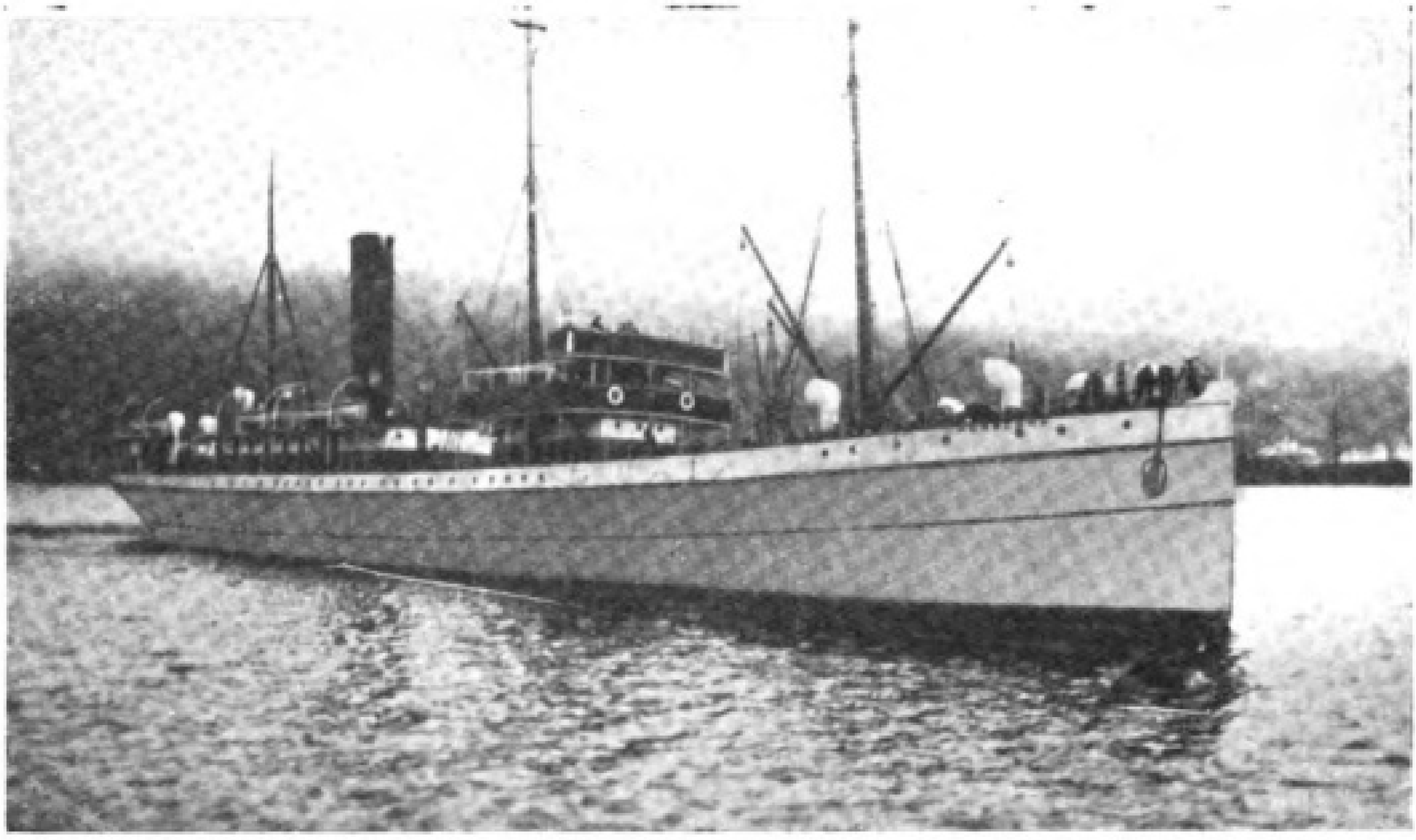
An interesting little point, in connection with the lies told by German wireless, came up recently when the Egyptian pilgrims to Mecca were returning to their homes. These annual pilgrimages, during which Mohammedans from all quarters of the globe meet together in common pursuance of their religious duties, constitute occasions when the various races compare notes with regard to what is going on in their respective countries. It must be remembered that these peoples, a large proportion of whom never learn to read, do not possess the universal sources of information available through the medium of the Press in Western lands. A prominent Egyptian Mohammedan recently stated that he and his fellow-Moslems were much impressed with the fact that at Jeddah, one of the historic seaports of Palestine, they saw with their own eyes a British man-of-war reported by the German wireless to have been sunk in the Battle of Jutland.

Ocular Demonstration.



THE S.S. "MORWENNA"

From an Operator's Note Book

A Trip to Cuba

By DOUGLAS R. P. COATS

SHE was a trim little steamer, the *Morwenna* ; small, it is true, but comfortably found and when not butting into a heavy head sea as steady a packet as an eight hundred and fifty-six tonner could be. She introduced me to many things, including Cape Hatteras hurricanes and a German submarine,* and took me to places which but for her I might never have visited.

We had run down from St. John's, Newfoundland, and Halifax, and were lying at our wharf in Brooklyn when orders came for us to proceed to Havana. To me, as to all cigar-smokers, the name of the city was as familiar as Newcastle to an English coal merchant. It recalled the *Maine* incident with its tragic sequel, when someone was tactless enough to blow up an American warship at a time when Uncle Sam was in a scrapping mood. Somewhere, on fans probably, I had seen pictures of bull-rings in Havana, and somewhere else I had read of cock-fights. Señorita has certainly clapped her hands and flashed dusky, hero-worshipping eyes at these bloody encounters in the past, and may, for aught I know, do so to-day.

I was fired with a desire to investigate these matters and hoped to return with a story worth telling, but imagine my chagrin on our arrival at Havana when a string of code flags fluttering over the crumbling walls of Morro Castle told us to proceed immediately to Caibarien. It was most humiliating to be thus deprived

* See account of loss of s.s. *Morwenna* in Vol. III., p. 234

of the pleasure of describing life in a city so bristling with romance as I believed Havana to be, but wireless orders confirmed and amplified the code flags' message, so there was nothing for it but to leave, finding what consolation we could in the thought that maybe the grapes were not so sweet after all, that written descriptions of the city might very possibly have been exaggerated.

To Caibarien, then, we went, and once again I must disappoint the reader who expects a picture of the town, for here the sea, generally such a rich indigo in West Indian regions, showed bottom through a light clear green, and shoaling far out from shore compelled us to anchor among some islands almost beyond sight of Caibarien itself.

The gentleman who boarded us for the purpose of examining the ship's papers was a Spaniard, attired in winter costume—a sort of flimsy pyjama suit and a black overcoat. We on the *Morwenna* were in white ducks and a state of perspiration at that, but this was winter in Cuba, and probably our visitor was cold, though I strongly suspect the overcoat was worn to create an impression, an effort in which the Spaniard was at any rate remarkably successful—if we did find it difficult to subdue our mirth! He spoke a smattering of English, all the time gesticulating with a pair of bony hands which Nature might have specially bestowed on a garrotter.

Mañana, we learned, was to see the arrival of our first sugar-laden schooners from Caibarien. Mañana means "to-morrow," a time said never to come, especially in these parts. The Cuban will start loading to-morrow; he will positively finish No. 1 hatch to-morrow; to-morrow he will do anything you please, but to-day—"Señor, it is impossible!"—and he flourishes those scraggy fingers of his. To-morrow came in this case, however, and brought with it three or four schooners high-piled with bags of sugar upon which reclined in various listless attitudes a number of the biggest niggers I have ever seen.

THE MORRO CASTLE, HAVANA

The black man in these climes affects neither the airs nor the dress of his Europeanised brother of the north. The liberty, equality and fraternity idea does not appear to have penetrated so deeply beneath that thick skull of his, and mates can let themselves go with something of their old-time freedom of address to inferiors, though perhaps the white-toothed smile of the nigger may be accounted for by his poor understanding of vituperative English! He wears a two-piece suit comprising a pair of cotton unmentionables and an upper garment which is often a sugar-bag with holes cut for his head and arms. When working in the stifling atmosphere of the ship's hold he removes, not his coat, but the nether half of his wardrobe!

ABOVE: TOBACCO PLANTS IN THE FIELDS. BELOW: MAKING HAVANA CIGARS

Photos] *[Underwood & Underwood.*

His labouring capacities are indeed wonderful. For hour after hour he will toil, staggering under giant bags of sugar, which he carries on his hip, his dark hide polished with perspiration and sugary stickiness. Sugar cane appears to be his staple diet, mealtime finding him squatting about the deck chewing assiduously at a three-foot piece of cane held flute fashion.

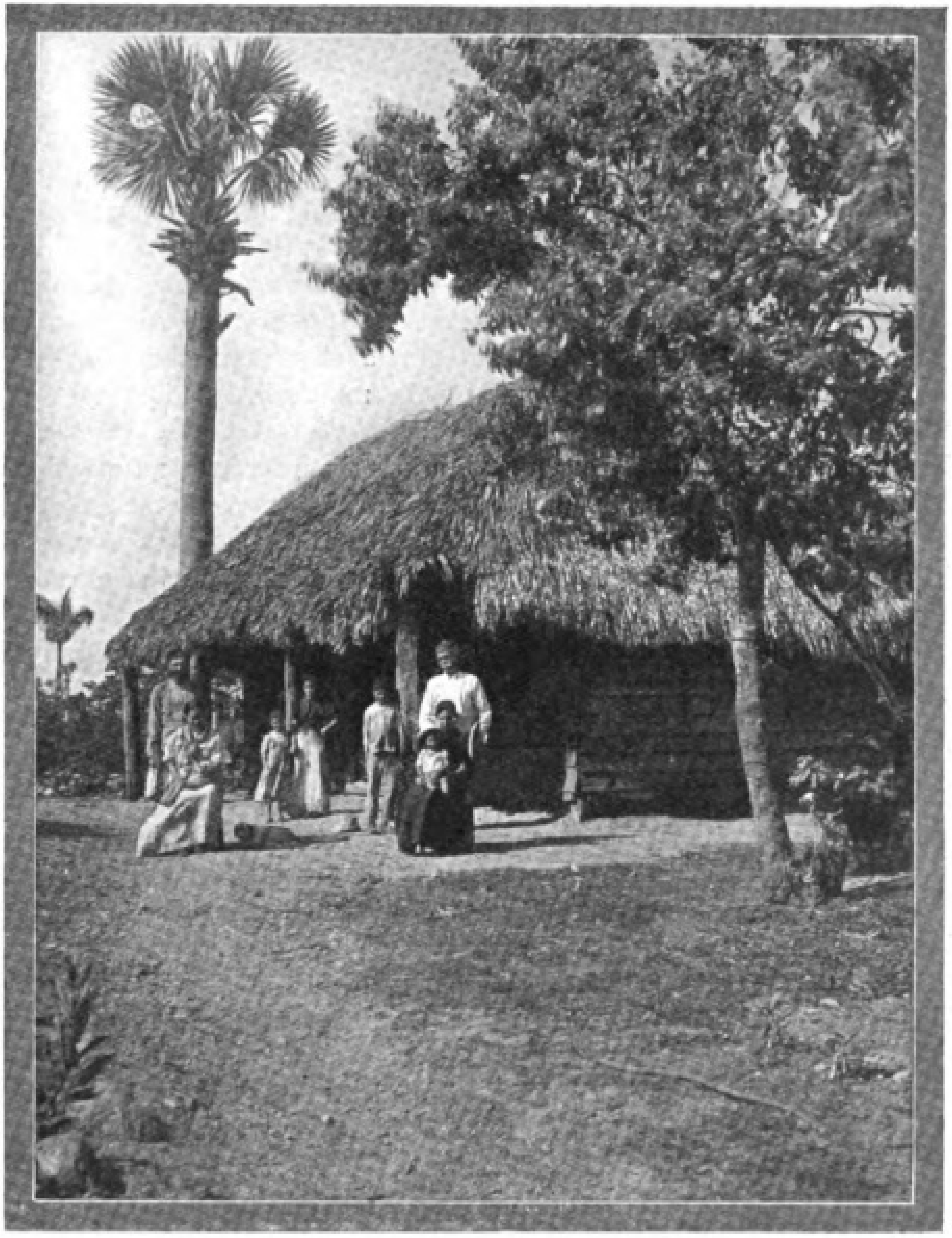
To the obviously Spanish descended crowd who came out also on the schooners were assigned the less laborious tasks of checking cargo and running the winches. Hatred of work seems to be an instinct with the tan man in Cuba. He prefers, since he must do something, a job requiring the least possible exertion, one which will allow him to lean against some supporting wall or rail. He carries constantly a chocolate-coloured cigarette in his mouth and a small armoury in his belt. A brace of forty-five revolvers and a twelve-inch knife is not considered by him an excessive armament, the idea presumably being to command a certain respect which the decent stranger might otherwise be disinclined to give. I was not afforded an opportunity of witnessing his dexterity with the "shooting-iron," but if it approaches to his skill in handling a knife I imagine it to be pretty good.

Photo] *[Underwoo & Underwood.*

ON A SUGAR PLANTATION, CUBA

We had been shark fishing with some success, inasmuch as a nine-foot bite lay dead upon our deck. Curiosity demanded an examination of the internal works of our catch, so the ship's cook was called upon to "open her up," an operation which he immediately attempted by jabbing at the white belly with his knife. The hide was tough, however, and repeated trials having failed to result in piercing it, one of our Spaniards smilingly took the knife from cookie and in a moment the shark's interior was open to view. It was wonderful, that lightning twist of the wrist, and I made a mental note always to be polite in my dealings with these amiable folk and to avoid any suicidal breach of etiquette.

Fishing in these regions is, to quote our American friends, a "cinch." If one wants muscular exercise, a game of tug-of-war and the excitement of dodging the gentleman's many rows of teeth, the accommodating shark is ready to oblige. The engine-room staff can manufacture the hook from half-inch iron rod; the deck department provides the line and a float consisting of one or two life-belt corks; while the cook hunts up a pound or so of meat. The bait is arranged to hang a couple of feet below the surface, the sharks flock round to make inquiries—you can



Photo] [*Underwood & Underwood*.

A FARM HOUSE IN THE PROVINCE OF PINAR DEL RIO, CUBA see their dorsal fins cutting the water—comes a snatch, a floundering and splashing, and then look out! He is away with bait, hook, float and all. If your line is mere signal halyard it parts when the big pull comes or frays on the keel as the shark dives under the ship and somewhere in the ocean there is a shark attached, in a manner which must be most interesting to his submarine acquaintances, to an iron hook, several pieces of cork, and twenty feet or more of line.

Heavier stuff will secure him, however, and when the monster is hauled partly out of the water a rifle-shot well placed will save all kinds of trouble in bringing him aboard. The specimen we caught was accommodating in more ways than one, for his stomach was a veritable museum of odds and ends thrown overboard during the week. It was amusing for a while to watch our stewards searching and to hear their exclamations as something fresh turned up, but the tropical sun soon made us anxious to be rid of Mr. Shark, and the work of removing his backbone for the purpose of making walking-sticks was hastened by the mate's instructions to "pitch the lavender over the side."

For those with weak hearts or jumpy nerves I can recommend catching pencil-fish. These are peculiar little fellows varying in size from a few inches in length to sometimes a foot and a half and have been given their name on account of their pencil-like noses. They reminded me of small swordfish with the serrated sword transformed to the perhaps mightier but certainly less dangerous "pencil." To the successful pencil-fisher four things are requisite—some strong thread, anything in the least resembling bait, a bent pin, and the faculty of being easily amused. The fourth is as necessary as the other three, for of all the dreary pastimes devised for keeping man out of mischief pencil-fishing is the tamest. The water is clear to the bottom and the fish are as thick as gold-fish in a small aquarium and about as easy to remove from their native element. The bait has only to be dropped by the creature's nose and held there long enough to be recognised as something to eat. The fish does the rest, and, provided he does not succeed in wriggling off the pin during the delicate process of hauling in, may be regarded as "caught" from the time he first notices the bait. His flesh is white and good eating, in spite of his innumerable hair-like bones, but the difficulty of picking him to pieces more than offsets the ease with which he is captured.

From Caibarien we proceeded, deeply loaded, to Philadelphia, and from thence the *Morwenna* returned to West Indian waters, this time to the much more interesting island of Hayti, or, as it is generally called to-day, San Domingo. I have far more to tell of our visit to the island of the unhappy black republic, but, as Kipling would say, "that is another story."

Maritime Wireless Telegraphy

Two "U" Boat Crimes.

THERE is no difference in the matter of principle between the two cases of German frightfulness which took place in the Mediterranean towards the end of November, when the *Britannic* and the *Braemar Castle* were both sent to the bottom. The sinking of the former, however, by virtue of her size, looms larger on our mental horizon. Originally designed for a White Star liner, it was the intention of her owners not only to fit her with a wireless installation of 5 kw. (plus ½ kw. emergency), but also to equip two of her lifeboats with complete radio sets. As matters turned out, however, she only left the shipyard after the beginning of war, and never entered at all upon her intended career as a liner. With a tonnage of 47,500 gross, she was constructed in such a way as to exemplify the "latest word" in mercantile marine shipbuilding, and her destruction doubtless furnished a *bonne bouche* to our chivalrous foes. German wireless attempted to add insult to injury by a paragraph insinuating that the large number of the *Britannic* complement, which consisted of 1,200 souls, indicated that she was being used for purposes other than that of a hospital ship. This attempt was not only characteristically mean, but also absurdly inept, in view of the fact that the German boat *Imperator*, of approximately the same tonnage, used to carry a ship's company numbering 100 more than that of the *Britannic*.

The *Braemar Castle* was one of the oldest of the Union Castle steamers now afloat, and, in sharp contrast to the *Britannic*, could look back with pride upon a career of sixteen years' service as a liner in the South African trade. Her tonnage was 6,280 gross, and her wireless equipment consisted of the usual 1½ kw. set.

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A Gallant Attempt at Rescue.

Despite all that has been done to enable man to cope with the dangers involved in the navigation of the high seas, every now and again some dramatic incident brings home to us the fact that the forces of nature are as yet far from being within our control. A short while ago a message was received at Lloyd's from Falmouth to the effect that the Dutch steamer *Rijndam*, belonging to the Holland-Amerika line, reported that she had on a Sunday afternoon in November received the following SOS signal, in latitude 47 north, longitude 14 west, from the American four-masted ship *Manga Reva* : " Come as quickly as possible. Am drifting before the wind with no boats." The *Rijndam* answered the signal with " Coming full speed."

Not content with herself hastening to the rescue of the distressed American, the Dutch vessel sent a wireless message to the American steamer *Rockingham* (formerly the *Nebraskan*, and now owned by the Garland Steamship Corporation), asking her to proceed to the *Manga Reva*, as *she* was nearer to the locality of the distressed sailer than herself. The *Rockingham* accordingly steamed at full speed direct to the spot indicated, which she was timed to reach at 2 p.m. on the following Monday. However, despite these gallant attempts to go to the assistance of the crippled American sailing ship, the rescuers appear to have arrived too late, for the *Rijndam's* report to Lloyd's states that later on she received a message from the *Rockingham* announcing that she could find no trace of the *Manga Reva*, so that both Dutchman and American had no resource but to proceed each on her own course.

Here we have an occasion where Science has done her best, and where men have strained every nerve to deliver their fellow-creatures from the perils of the deep, but without success. But for every instance of such failure there are so many in which wireless has enabled the warnings to be effectual that such instances only serve to indicate that the risk of failure, though minimised, has not been altogether eliminated. Moreover, this incident in itself forms an admirable illustration of the way in which wireless at sea enables vessels to maintain touch, not only with the shore but with each other, in such a manner as enormously to decrease the chances that any ship may vanish from human ken and—as the greatest of dramatists puts it —" leave not a wrack behind."

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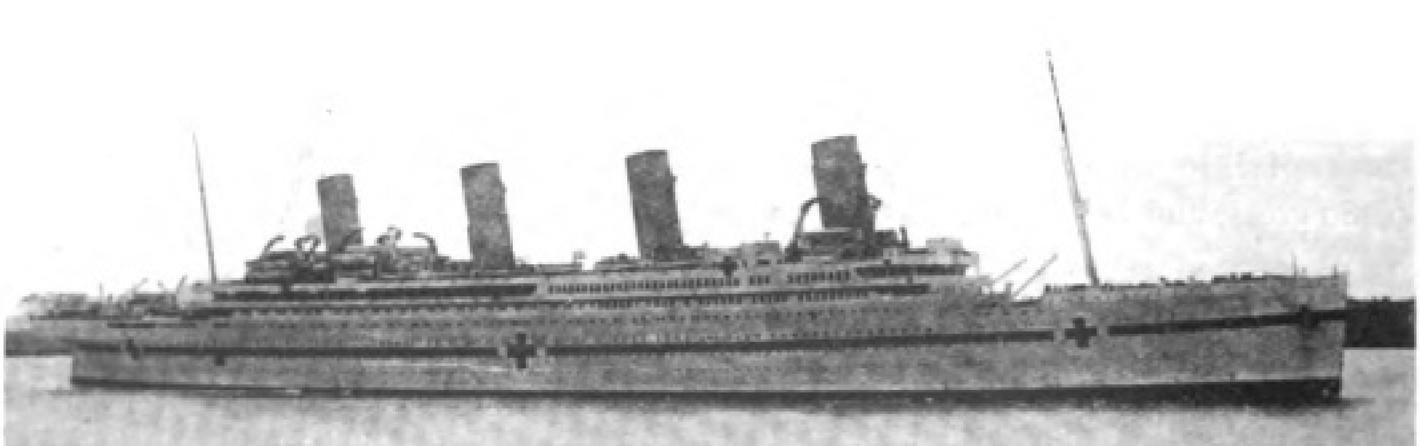
ADVENTURES " NEVER COME SINGLY."

The *Rijndam*, whose attempt to rescue an American ship we chronicle above, was more successful on another occasion. Two days out from St. John, answering



Photo] [*Central News*.

H.M.H.S. BRITANNIC.

Photo] [Exclusive News Agency.

IN THE MARKET QUARTERS, SEMARANG.

a wireless SOS signal, she came across the *Vigilant,* a little American tug, belonging to New York and bound from Newfoundland to Cardiff. She proceeded to her assistance and took off the captain and twelve of the tug's crew. Three of the men refused to leave, and, taking control of the ship, actually succeeded in bringing her within sight of the Irish coast, where a British patrol vessel picked them up. The terrible weather encountered *en route* had smashed several parts of their little craft, and so tied them to their places that they remained for fifty hours without food, water or sleep. However, by sheer pluck they " won through." The *Rijndam* seems to tumble very rapidly out of one adventure into another, for, on her arrival at Las Palmas at the beginning of last December, she reported that she was a witness to the shelling and torpedoing of the Dutch cargo steamer *Kediri,* whilst she herself was being overhauled by another and somewhat smaller German submarine.

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An interesting little story has reached us in a letter from one of the Marconi operators on the Rotterdamsche Lloyd steamer *Wilis.* The incident occurred one day towards the close of September last when our correspondent's steamer was lying at anchor at Semarang, in Dutch Borneo. There were a number of other ships in the roadstead, amongst them, as a matter of course, several British vessels. The climate in this part of the world is warm, to say the least of it, so that on this September evening the wireless operator was glad to take his ease, book in hand as he reclined in a deck chair near the wireless cabin. The crew and stevedores were hard at work loading cargo, under the rays of a thousand-candle-power lamp, suspended near the bridge. Suddenly the eyes of the telegraphist were caught by light-signals, which were being flashed by the Morse lamp of a vessel not far away in persistent attempts to arrest the attention of the officer in charge of the *Wilis*. Our correspondent accounts for the fact that no one else had previously observed it by the fact that the mates were all extremely hard at work superintending the loading. On account of the strong electric " flare " suspended from the bridge it was not possible to utilise the *Wilis'* own Morse light. For a while he hesitated what to do, but at length was inspired with the brilliant idea of trying whether he could answer the call with his pocket electric lamp. Success crowned his efforts : by means of his " little portable apparatus " he managed to establish communication with the signaller on the British s.s. *Orestes*. " Wireless telegraphed me," says our Hollander friend, " that they were in urgent need of a doctor, one of the crew being in a state of collapse through sunstroke, whilst other members of the sea staff were ill." With this information the ingenious Dutchman went to the doctor of his own ship, and, as the latter expressed his willingness to undertake the duty himself, the " pocket wireless " was set to work once more, and announced the welcome intelligence to the *Orestes* that a boat would immediately put out in order to bring the much-needed medical assistance.

Our readers will, doubtless, have read descriptions of various forms of apparatus which claim to be pocket wireless sets, but we doubt whether any of them would have been capable of meeting the emergency detailed above by our correspondent. Scientific apparatus is useful ; but far more useful still is alertness of mind and ingenuity in meeting a critical situation.

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GOOD RESCUE WORK ACCOMPLISHED.

Congratulations to the Union Castle Line. The days have long gone by since niggardly owners grudged the expense of delay involved by their vessels having stood by a sister in distress, and nothing better pleases the public-spirited shipowners of to-day than to find their captains able to record good rescue work accomplished. The Union Castle Line have in recent days strikingly maintained their excellent record in this respect. Our readers will perhaps remember that the 302 survivors of H.M. transport *Franconia* were rescued and taken to Malta by the *Dover Castle*, under the command of Captain J. N. Culverwell. A further rescue of victims of enemy submarine attack was recently effected by another vessel belonging to the same line—the *Glenart Castle*, commanded by Captain E. W. Day. The latter's rescue roll consisted of the captain, officers and crew of the torpedoed Newcastle steamer *Welsh Prince*, comprising 40 men in all. Both the South African liners were employed on Government service as hospital ships at the time when they came to the relief of the vessels in distress, and in each case wireless telegraphy played its usual honourable rôle of providing the medium through which the need of aid was communicated, and that by which the saving operations were rendered possible. Captain Day, of the *Glenart Castle*, appears to be quite specialising in such rescue work, for on two previous occasions he has received honourable recognition at the hands of the British and the Dutch Governments for saving shipwrecked crews under trying conditions during heavy weather at sea.

Notes of the Month

Wireless Loyalty.

Various questions have recently been asked in the House of Commons concerning the loyalty of wireless operators on board British vessels, both mercantile and naval. With regard to the latter the answer is obvious: operators in the Navy are all necessarily British subjects. With regard to the former the greatest possible care has all along been taken, both by the Marconi Company, which supplies by far the greater proportion of such operators, and by the British Postmaster-General. It is not possible, in the national interests, to detail exactly what steps have been taken, but Britons, both at home and abroad, may rest assured that there is very little need for apprehension with regard to this matter of loyalty.

Wireless and the Occult.

People sometimes talk as though the study of science must necessarily involve a curtailing of the imagination and of the forces which act through it. Such is very far from being the case. Indeed, the more truly scientific we become the more do we exercise that side of the brain which is affected by what we may call the emotional influences of imagination. A short while ago we came across an account in our contemporary *Light*, a journal devoted to psychical, occult, and mystical research, wherein a young man who is now engaged on active service as wireless telegraphist at sea narrates how he came to take up the study. It appears that on the occasion of a séance he received a number of communications from the spiritual world through the medium of Mrs. Clara Irwin. Amongst the extraordinarily accurate descriptions then communicated there were certain items which affected his future career, and amongst these was a recommendation to take up radio-telegraphy. He followed the advice of his psychical mentor, pursued his studies with great success, gained his certificates, and is now actively pursuing his career. We wonder whether any of our wireless readers have been subjected to any similar " influence " !

Some Reflections of Sir Oliver Lodge.

The writings of the veteran scientist Sir Oliver Lodge are always well worthy of close perusal and thought, and we hope that Wireless World readers have not missed some contributions from his pen which have been recently appearing in our contemporary the *Daily Chronicle*. Sir Oliver has, *inter alia*, been pointing out the fact that wave undulation is far more generally common in nature than it is usually known to be by " the man in the street." After emphasising the wonderful way in which the everyday production of speech is brought about, through a series of "aerial pulsations," and recalling to his readers the wonderful way in which the hearing organs of the human body " tune out " the sounds that they do not wish to receive, whilst they " take in " and transmit to " auditory centres in the brain " the waves which they desire to take cognisance of, Sir Oliver lays it down that " wireless telegraphy " is not an iota more marvellous, but has, through its unfamiliarity, succeeded in arousing a sense of wonder.

We do not purpose attempting to give even the briefest résumé of this veteran scientist's papers, but the following sentence will indicate to our readers the general trend of his discourse. After pointing out that matter is an indirect medium of communication between one mind and another, he goes on to say : " That direct " telepathic intercourse should be able to occur between mind and mind, without " all that intermediate physical mechanism, is therefore not really surprising."

German Cut Rates for Wireless.

Information recently reached us through Geneva of a determined effort on the part of Germany to foster the interchange of wireless telegrams between themselves and America. The rate actually in force is 1 mark 50 per word ; but in future each word is not to cost more than 35 pfennigs. This rebate of 115 pfennigs per word implies a reduction in charges amounting to over 76 per cent., and indicates not merely a desire to increase German propaganda news in the New World but also an attempt to cheapen communication and thereby stimulate trade between the two countries as soon as trade becomes possible.

A New Wireless School.

We note with interest that at a recent meeting of the Newcastle Education Committee a recommendation was adopted for the establishment of a class for Wireless Telegraphy at Rutherford College. It was stated at the meeting that permission had been granted by the Postmaster-General and the proper authorities for the college to acquire and utilise the equipment. The Lord Mayor looks with great favour on the proposal and a small committee has been appointed, including that gentleman and five colleagues, to meet representatives of the shipowners on the Quayside with reference to the best way of carrying out the project.

Aeroplanes across the Atlantic.

One of the effects of the present war has been to stimulate aviation to an extraordinary degree, and there is little doubt that as soon as peace supervenes the long-talked-of crossing from America to England by aeroplane will be accomplished. Indeed, it is openly alleged that there will be quite a race between rival experts as to who shall be the first to accomplish the feat. One of our Yorkshire contemporaries recently published an interview on the subject with the well-known aviator Mr. Rowland Ding, who is at present employed as a civilian test pilot of Government machines. He expressed the opinion that an important factor towards accomplishing the journey consists of the possibility of the newer aeroplanes being equipped with a complete wireless outfit, capable of keeping them in touch with transatlantic shipping as they proceed on their way. In this opinion he differs from the late Mons. Gustave Hamel, who looked forward to an occasion when he would be able to " rush " the journey on a light single-seated machine as bare of equipment as possible. Mr. Ding, on the contrary, prefers " a big, steady machine of enormous engine power " and dual control for two pilots."

Operating in the Merchant Service

How to Join the Wireless Service of the Mercantile Marine

SOME eighteen months ago there appeared in these columns an article entitled "How to Become a Wireless Operator," in which we endeavoured to explain just what a young man had to do if he wished to take up this interesting profession. As the particular number of THE WIRELESS WORLD in which this article appeared is now out of print, and as the conditions since that time have somewhat altered, we have decided to set forth once more the salient facts which were previously given, modifying information where necessary and amplifying it where our experience has shown this to be required.

In two previous articles (October and November, 1916) we have explained fully how to join the wireless services of His Majesty's Forces, and we wish to make it clear at the outset that everything we say in this article applies solely to the wireless service on board ships flying the British flag. The conditions of service on board vessels of other nations differ considerably and cannot be stated in general terms.

The wireless telegraphic apparatus on board ship is under the sole control of the commander, and the shipping company to whom the vessel belongs, in the great majority of cases, hires the apparatus from the Marconi Company, who provide the necessary operator or operators. In such cases the Marconi Company pays the operator's salary and arranges with the shipping company to advance on account of salary a certain sum per week through the captain, in order that the operator may have enough money at all times to satisfy his immediate needs. The balance of salary is then drawn on arrival in port. The operator receives all his instructions of a technical nature from the Marconi Company, but he is, of course, required to carry out any orders which the commander or his authorised assistants may give him.

In some cases—very few in number—the shipping company employs its own operator, and in such cases conditions of service may differ from those we set forth here. It should be remembered, however, that an operator entering the service of a particular shipping company will not have much variety in his life, and will probably remain on one vessel or one ocean route for a very long time.

Assuming that our would-be operator wishes to enter the service of the Marconi Company, he must first see whether he can comply with that Company's requirements. All wireless telegraphists operating installations on board British ships must not only be British subjects, but both parents must also be British-born. For this reason a man, one of whose parents is of foreign birth (although naturalised in this country), is disqualified. All applicants must be of good character and must produce suitable references, either from previous employers, or, in the event of their never having been employed previously, from some responsible people who are personally well acquainted with them. Thorough physical fitness is also essential, and before acceptance every applicant is thoroughly examined by the Company's doctor, in order to discover whether he is constitutionally sound. It should be noted here that lameness, however slight, will bar an applicant from acceptance, although weak sight, if suitably corrected by glasses, will not necessarily act as a bar. It should be unnecessary to say that perfect hearing is absolutely essential.

With regard to the limitations of age, in normal times no man is accepted who is under 18 years of age or over 25. At the present time men slightly younger than 18 may be taken, provided they are otherwise suitable, but the limit of 25 is strictly adhered to. It is quite useless for a man who is over this age to commence training in the hope that an exception may be made in his case.

Before being appointed to a vessel, the applicant must obtain a certificate of proficiency granted after thorough examination by the Postmaster-General. This examination, of which full particulars are given in the *Handbook for Wireless Telegraph Operators Working Installations Licensed by His Majesty's Postmaster-General* (published by the Government and obtainable from the Wireless Press, Ltd., price 3d., post free 5d.) comprises tests in sending and receiving, knowledge of the theory of wireless telegraphy and knowledge of the practical working of the apparatus, including the tracing and clearing of faults. A course of training for the examination can be undertaken at one of the many wireless telegraph training colleges advertised in THE WIRELESS WORLD, and any of these institutions will be pleased to forward particulars regarding fees, etc., to readers who apply for them. There are also a number of correspondence courses which go a long way in teaching wireless telegraphy, but it should be clearly understood that no correspondence course can give complete training for the examination, as actual practical experience of a wireless installation is absolutely essential before the student is competent to enter.

Some of the schools running correspondence courses can arrange for a short time personal attendance at the school, so that the training can be completed.

Three classes of certificate are now granted by the Postmaster-General—*i.e.*, first class, second class, and temporary. In order to obtain the first class certificate the candidate must be able to send and receive accurately at least 20 words per minute for several minutes without error, and is required to show a thorough knowledge of the theory of wireless, the construction and manipulation of various instruments and the tracing and clearing of all faults which are likely to occur in actual work. He must also have a good knowledge of the regulations laid down by the Postmaster-General for the proper handling of wireless telegraph traffic and the general working between stations. To obtain a second class certificate just as much theoretical and practical knowledge is required, but the speed need not be higher than 12 words per minute. The temporary certificate, which has only come into existence recently and will probably be abolished when war is over and when the present abnormal demand for operators has subsided, requires a speed of at least 12 words per minute and some amount of technical and practical knowledge. It is always endorsed to show just what degree of knowledge is possessed by the candidate, and in this way the certificates vary to some extent. It should not be overlooked that no matter how clever an applicant may be in sending and receiving, in handling the apparatus and in acquaintance with the theory, he may quite conceivably fail to pass the Postmaster-General's examination through bad handwriting. It is not sufficient to be able to write clearly and legibly at a low speed; good plain handwriting at 20 words per minute is what the examiner looks for.

Having obtained the certificate, the newly-fledged operator should write to the Traffic Manager, Marconi International Marine Communication Co., Ltd., Marconi House, Strand, W.C., stating his qualifications and asking for conditions of employment and form of application. On receiving these he should study them carefully and return the application form, together with the papers he is asked to provide. This will include his birth certificate and a signed, unmounted photograph. The birth certificate will be returned to him later, but the photograph will be retained.

Many applicants seem to imagine that the mere possession of a Postmaster-General's certificate entitles them by right to immediate employment by the Marconi Company. This is, of course, quite wrong. The Marconi Company can only offer employment to a man when it has a vacancy and when the man is found to be suitable for employment in its service. At the present time there is a very great demand for operators, and, providing the man is suitable, it is highly probable that he will be accepted immediately.

If, after perusal of the application papers, the Marconi Company decides to consider his application favourably, the budding operator will receive a letter inviting him to call at Marconi House for the purpose of receiving a test. Upon receiving such a letter the applicant should lose no time in proceeding to London, and, of course, the expenses in this connection will have to come out of his own pocket. For the benefit of those readers who are not quite sure of the location of Marconi House, we would mention that it is situated in the Strand, opposite Somerset House and about five minutes' walk from Charing Cross Station. Applicants arriving at Paddington should take the tube for Trafalgar Square, when a short walk will bring them to the office; those arriving at Euston should take the tube to the Strand; from King's Cross or St. Pancras, by Piccadilly tube to Aldwych (about one minute from Marconi House); from Marylebone by tube to Trafalgar Square; from Waterloo by bus to Wellington Street (half a minute from Marconi House); from Liverpool Street by bus to Somerset House; from London Bridge, buses 13, 13a or 13b to Somerset House; and from Victoria by District Railway to Temple.

On reaching the offices the applicant should state his business to the doorkeeper and will be taken by lift to the fifth floor, where he will be interviewed by a representative of the Traffic Manager at the first opportunity. Applicants who are required to wait some little time before being interviewed should not become impatient, but should remember that, especially with the war on, there is a great deal of much more important business than theirs to be attended to.

Provided the applicant is approved by the Traffic Manager, he will be required to proceed to the Company's doctor for medical examination, and, should he pass this test satisfactorily, he will be given a day on which to report for duty in the London school. The time he will be required to stay in the school depends upon his knowledge, and if he possesses a first-class certificate he will not remain there long. Some men who possess a first-class certificate are surprised that they are required to attend even a few days at school, but it must be remembered that the P.M.G. certificate is not a certificate for proficiency in the *Marconi Company's methods*, but only in general radiotelegraphy. On appointment to the staff a Marconi operator commences with a salary of £1 a week, and, of course, whilst he is on board ship he receives his board and lodging free. If he should be appointed in charge of a ship's installation when his salary is under 30s. a week he will be given an additional 5s. per week so long as he is in charge of the installation. Provided the operator's conduct is satisfactory, annual increases of pay of 2s. 6d. per week are given, until 30s. per week is reached, after which annual increases are given at the rate of 5s. per week up to a maximum of £2 15s.

In the event of the operator being employed on shore for a considerable period an additional allowance will be made to cover the additional living expenses, and if he should be appointed to any special duties additional remuneration may also be given.

With regard to uniform, with which the operators are required to furnish themselves, there are a number of tailors advertising in this magazine who specialise in Marconi uniforms and will be able to advise the new operator exactly what he requires. It is always advisable to go to a tailor who has experience in making Marconi uniforms, otherwise the operator may be gravely misled. He will be perfectly safe in dealing with any of the firms whose advertisements he finds in this magazine.

We are frequently asked whether it is not possible to join the Marconi Company's London School without having obtained one of the Postmaster-General's Certificates. To this the answer is: the Marconi Company from time to time is in a position to take suitable young men who are keen to become wireless operators and place them in the London School for full training. Applications should be addressed to the Traffic Manager, Marconi International Marine Communication Co. Ld., Marconi House, Strand, W.C. Such men are given a thorough training for the Postmaster-General's Certificate and will be required to pass the examination within a reasonable period. No fee is charged for such instruction—on the contrary, if the man's conduct and general progress are satisfactory, he will be paid a small salary after he has made some progress, and this may be increased towards the end of the course, provided his advancement continues to be good. Students who come into the school with a good knowledge of telegraphy will naturally be paid at a higher rate than those who enter with no knowledge whatever.

Before accepting any position which the Marconi Company may offer, the applicant should carefully peruse the conditions of service. He should understand, for example, that he will be required to take duty on any ship sailing to any part of the world, and that he must be prepared to take the rough with the smooth, serving either on a cargo vessel or liner as the Company may require. The progress he makes in the Company will depend entirely upon his own ability, and, other things being equal, the best men will be appointed to the best ships. Lastly, he should not forget that the "Questions and Answers" column of this magazine is always open to him for the solution of any difficulties which may arise in his consideration of the new career.

Interned in Germany

British Wireless Operators at Ruhleben

MANY of our readers will be interested in the photogragh below, which shows two of the Marconi Company's operators, Messrs. B. O. Baxter and R. J. Henry, who have been interned since the outbreak of war at the Ruhleben Camp. Mr. Baxter was the operator on the s.s *San Wilfredo* and Mr. Henry on the s.s *Nicoya*. Both of these vessels were in the Elbe on the outbreak of hostilities, the *San Wilfredo* being sunk by a mine. We understand that the crews of both these ships are all at Ruhleben.

Conjecture has been rife amongst the various associations which have for so long contributed towards the comfort of our interned prisoners as to their position owing to the establishment of the new Central Prisoners of War Committee, which has been recently formed for the purpose of ensuring that all British prisoners of war in enemy

A PHOTOGRAPH TAKEN IN THE INTERNMENT CAMP AT RUHLEBEN. ON THE LEFT, STANDING, OPERATOR B. O. BAXTER. ON THE RIGHT, STANDING, OPERATOR R. J. HENRY.

countries shall receive an adequate supply of foodstuffs and to prevent all possibility of overlapping in the future.

The Mercantile Marine Service Association, in particular, which has for so long been despatching food, clothing and tobacco to the British merchant seamen of all ranks interned in Germany, Austria, Turkey, was much concerned by the new arrangements. An impression seemed to exist amongst the general public that this new Committee was being financed by the Government and would include all ranks and all classes of men.

The Secretary of the Mercantile Marine Service Association accordingly approached the Central Prisoners of War Committee making inquiries as to its scope, and a reply has now been received in which statements are made to the following effect: (*a*) The Central Prisoners of War Committee is in no way financed by the Government, being entirely dependent for the success of its work on the generosity of associations and individuals; (*b*) officers of the Mercantile Marine (viz., masters, mates, including chief officers, engineer officers, pursers, doctors, wireless operators and apprentices, skippers and second hands of fishing vessels) are all exempt under the new regulations. In view of these facts, the Committee express the hope that public bodies would still continue their kind contributions towards the support of the merchant service prisoners of war. In these circumstances the Council of the Mercantile Marine Service Association, with the generous support of its many friends, is continuing its efforts to ease the sad lot of our merchant seamen who have the misfortune to be in the enemy's hands.

Correspondence

We hasten to print the following letter which has just come to hand, and fully apologise to all those Australian readers whom we may have unwittingly offended!—EDITOR.

DEAR SIR,—All the 700,001 inhabitants who dwell near the sides of the "Beautiful Harbour of Sydney" are after you with the selfsame inhabitants' family carving knife and hatchet thirsting for your blood.

By an error, no doubt, you have mortally offended all Sydneyites, who are inordinately proud of their harbour, "a jewel to which no other can compare."

On page 383 of the present volume you show a view purporting to be "A General View of the Beautiful Harbour of Sydney," which in reality is one of Devonport, Northern Tasmania. As you state in letterpress, one of the two first Marconi stations in Australasia was at Devonport, and the view, the credit of which you would give to Sydney, is one of this pretty Tasmanian watering-place and the River Mersey, taken about 1½ miles south of the wireless station.

I might add the station has long since been dismantled.

On your future visits to Australia, Mr. Editor, you are advised to avoid Sydney, but you may be sure of a warm welcome from Devonians who appreciate the Tasmanian coastal town.

Best wishes,

"PMACS."

Amateur Mechanics Wanted for the Royal Engineers

We have pleasure in directing our readers' attention to the following letter :—

Dear Sir,—A number of the amateurs who have been enlisted at this depot have turned out to be very suitable men, and it has occurred to me that perhaps you would let it be known, through the medium of your paper, that there are further vacancies in this centre.

At the moment we are particularly in need of men who possess some skill in working ebonite and brass, as instrument makers.

I attach particulars of the conditions of service, and should be pleased to give you any further particulars you may require.

Yours faithfully,
A. Handley (Major R.E.)
O.C. Wireless Training Centre, R.E.

Wireless Training Centre,
Royal Engineers,
St. Martin's Gate, Worcester.

Vacancies exist in the Wireless Section, Corps of Royal Engineers, for the following tradesmen :—

Electricians,
Instrument repairers,
Engine drivers,
Fitters,
Wireless operators.

Qualifications.

The following qualifications are necessary for enlistment :—

Electricians.

Essential.—Thorough knowledge of ordinary electrical work (including dynamos, motors, accumulators and telephones, bells and electric lighting). Thorough knowledge of all soldering work.

Desirable.—Knowledge of internal wiring of transformers, dynamos and motors ; ability to re-wind and repair same ; ability to use lathe (trueing up commutators, etc.) ; knowledge of wireless ; knowledge of bell and telephone wiring, switchboard experience.

Instrument Repairers.

Essential.—Ability to use treadle lathe and do plain turning ; experience in small scientific instruments (making and repairing) ; knowledge of use of taps and dies, and soldering.

Desirable.—Knowledge of electricity ; knowledge of wireless ; knowledge of telephone repairing, and ability to wind small coils, etc. ; ability to do screw-cutting on lathe. (Watchmakers generally of little use.) Also knowledge of milling.

ENGINE DRIVERS.

Essential.—Able to drive small internal combustion engines and do ordinary repairs. Able to ride twin motor cycles up to 8 h.-p. and carry out repairs.

Desirable.—Able to drive heavy lorries or cars up to 30 h.-p. and carry out ordinary repairs ; knowledge of draughtsman's work.

FITTERS.

Essential.—Knowledge and experience of small or motor cycle internal combustion engines up to 8 h.-p. ; able to do all repairs to above ; knowledge of ordinary fitter's work and soldering.

Desirable.—Knowledge of turning and screw-cutting ; knowledge and experience of heavy car and lorry engines up to 30 h.-p. ; knowledge of electricity, also brazing and welding ; able to drive car or lorry.

WIRELESS OPERATORS.

Essential.—Ability to send and receive at not less than twenty words a minute on sounder or buzzer.

Desirable.—Knowledge of wireless telegraphy.

TERMS OF SERVICE.

Men are enlisted for the duration of the War.

Electricians, instrument repairers, engine drivers and fitters enlist as Sappers ; wireless operators as Pioneers. If found suitable at the conclusion of training in the Signal School, Pioneer Operators are re-mustered Sappers.

Recruits are given a course of training in the workshops and Signal School of the Wireless Training Centre and on completion of this course are drafted to the Expeditionary Forces.

PROMOTION.

Prospects of promotion to N.C.O. rank are good for men of high technical qualifications possessing ability to command men.

Vacancies arise at intervals for military mechanist staff-sergeants, and men from the ranks having special knowledge and experience of technical apparatus are chosen to fill these positions.

Frequently openings occur in the commissioned ranks for the Royal Engineers. Since the formation of the Wireless Training Centre eighteen commissions have been taken up by N.C.O.'s and Sappers, while at the present time a good number of Cadets chosen from the ranks are undergoing a course preparatory to taking up commissions.

PAY.

The following are the rates of pay in the Wireless Section R.E. :—

Rank.	*Regimental Pay.*	*Engineer Pay.*
Pioneer	1s. 2d. day	6d. day.
Sapper	1s. 2d. ,,	1s., 1s. 4d., 1s. 8d., or 2s. day. (according to qualifications).
Lance-Corporal	1s. 6d. ,,	,,
2nd-Corporal	2s. 2d. ,,	,,
Corporal	2s. 6d. ,,	,,
Sergeant	3s. 3d. ,,	,,

Military Mechanist Staff-Sergeant: Consolidated pay at the rate of 5s. 3d. a day.

The usual Separation and Dependants' Allowances are given in addition to the above.

For the first twenty-eight days only, during which the recruit is undergoing a course in squad and manual drill, use of arms, musketry, etc., Engineer pay is reduced by 6d. a day.

APPLICATIONS FOR ENLISTMENT.

Applicants for enlistment should apply at least a fortnight before they become liable for military service.

This will allow sufficient time to enable War Office approval or otherwise to be given for special enlistment in a technical unit.

Applications should contain full particulars as to qualifications, and, if possible, medical classification.

Merchant Service Uniform

The several organisations of shipmasters and officers, ably seconded by that of the marine engineers, which exist for the purpose of safeguarding the interests of the certificated members of the merchant service, have lately been actively pressing for a distinctive uniform for the mercantile marine. Our seamen have done excellent work for the country during the present war and they desire, and ought to have, a suitable and distinctive uniform, established and recognised by the Government, defined by rules and regulations which would entirely abolish the present haphazard system whereby fourth officers of one steamship line wear the same uniform as the masters of another.

On Monday, November 6th, a conference upon this subject took place at the Admiralty between representatives of the various shipmasters' and officers' societies and the officials of the Department, headed by Commodore Cecil F. Lambert, R.N., Fourth Sea Lord, the object being to place the Admiralty in possession of the views of the officers of the mercantile marine on the question.

On Tuesday last an important and very influential deputation was received by Mr. C. Hipwood, Assistant Secretary to the Marine Department of the Board of Trade, with a view to a further consideration of the proposals. Mr. Basil Peto, M.P. introduced the deputation.

Amongst those present were Commander A. Houghton, R.N.R. (President), and Captain J. R. Coverley (Member of the Executive Council), of the Mercantile Marine Service Association, Captain J. W. Grace (Chairman), Captain A. B. Toms (Vice-Chairman) and Lieutenant T. W. Moore (Secretary), of the Imperial Merchant Service Guild, and Mr. Todd (President) and Mr. D. Bramah (Secretary), of the Marine Engineers' Association. The various members of the deputation all expressed their own views and were accorded a most courteous and patient hearing from Mr. Hipwood. No definite decision was arrived at, but the members of the deputation express themselves well pleased with their reception and the evident desire of the Board of Trade to meet, as far as possible, the views of the masters and officers of the mercantile marine.

The Calculation of the Inductance of Single-Layer Air-Core Solenoids

By PHILIP R. COURSEY, B.Sc. (Eng.).

As Lieut. Hoyle has pointed out in his articles dealing with this subject, there are a large number of formulæ available for the calculation of the inductance of air-core solenoids, each applicable to a different shape or type of coil, so that some confusion may often arise as to the best formula to employ in any particular instance. More especially is this the case when one is using them at somewhat infrequent intervals for the calculation of odd coils, and much valuable time may in consequence be lost through an incorrect choice. Moreover, many of the formulæ are very complicated, and consequently rather unsuited for practical work. Any simplification or limitation of the available formulæ is therefore always welcome, as conducive to greater speed and accuracy in calculating results. Lieut. Hoyle's article should be useful in this respect.

If a word of friendly criticism will not be taken amiss, it may be pointed out that a little confusion might possibly have been avoided had *both* the Tables of Q and of X in his article been given for values of $2a/b$ (=diameter/length), *or* of a/b (=radius/length), instead of one table with each function. There would then be less liability of errors arising through failing to notice this difference when passing from one table to the other.

It may be as well also to point out that in the great majority of the cases that occur amongst the coils used for wireless apparatus it is quite unnecessary to evaluate the correction ΔL for the insulation and number of turns on the coil, since in practically every case its value is less than 1 per cent. of the actual inductance of the coil, and only in very extreme cases does it reach about 2 per cent. of that value. The correction might be worth considering were it possible to predetermine the inductance of a "wireless" coil with such accuracy, but in general practice it is neither necessary nor even possible to do so. The reason is to be found in the fact that the inductances as calculated by these formulæ (even when the above correction is included) are still low frequency values, whereas the coils are to be used for high-frequency currents. The change from low to high frequency brings about a change in the effective inductance of the coil—generally in the direction of a decrease of the inductance—which, although not very large, is yet usually sufficient to mask any such corrections as the above and to render them rather unnecessary. The result is also modified by such phenomena as the "self-capacity" of the coil, a quantity which is of great importance at high frequencies. Further, it is a very rare occurrence that a circuit has to be made up to possess a certain natural oscillation frequency or wave-length without means being provided for the adjustment either of the capacity or of the inductance of the circuit. In these circumstances, therefore, it is not necessary to calculate (or measure) the inductance to a very high degree of accuracy, and in the vast majority of cases met with in general experimental work a 5 per cent. accuracy is ample. Hence it is usually unnecessary to work out the values to a "four figure accuracy," and a slide rule will generally yield all the results that are required.

When this is the case it is possible to simplify matters still further than has been done by Lieut. Hoyle by the use of only one formula for any of the cases that are likely to arise. The formula referred to was first given by Prof. Nagaoka,* and may be written in either of the following forms :—

$$L = \pi^2 D^2 n^2 l k \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

$$\text{or,} \quad L = \frac{W^2}{l} k \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

where, L = Inductance of coil in centimetres.

D = Mean diameter of coil (to centre line of turns) in centimetres.

l = Length of coil in centimetres.

n = Number of turns per centimetre length of coil $= N/l$, where

N = Total number of turns on the coil,

k = A "correction factor" which is a function of the dimension ratio l/D of the coil.

W = Total length of wire on the coil, in centimetres.

(NOTE.—It is evident that $W^2 = (\pi D)^2 \times N^2 = (\pi D)^2 \times (nl)^2$, so that the two forms are really equivalent to one another.)

Values for k are tabulated in the *Bulletin of the Bureau of Standards*, Washington, Vol. 8, page 224 (1912). The figures there given do not, however, meet quite all the cases of coils used for wireless work, so that the writer has calculated some further values to meet these cases. These were published in the form of curves in the *Electrician* for September 10th, 1915, Vol. 75, page 841. By the use of these curves of k, the inductance of any given coil may be quickly determined, especially if a slide rule is employed, without any chance of confusion in selecting a formula. The curves may be used for any shape of coil, from a single turn upwards ; and also for "flat" (or "pancake") coils, as well as for solenoids, if it is remembered that the inductance of a flat coil of mean diameter $= D$, and radial depth $= l$, is to a first approximation the same as that of an ordinary solenoid coil of the same mean diameter, and of axial length $= l$. In the paper above referred to additional curves are also given to facilitate the design of a coil to have any given inductance, by a further application of the same general formula.

As a comparison of the two methods, the inductances of the coils taken as examples in Lieut. Hoyle's article are worked out below, using the above formula and curves :—

(1) The first example, for which $D = 50$ cms., $l = 1$ cm., and $n = 10$ turns, we have $l/D = 1/50 = 0{\cdot}02$, and from the curves the corresponding value of $k = 0{\cdot}061$.

Therefore we have

$$L = \pi^2 \times 50^2 \times 10^2 \times 1 \times 0{\cdot}061$$
$$= 150{,}000 \text{ cms.}$$

The value given by Lieut. Hoyle is $47385\pi = 148{,}800$ cms.

The difference $= 1{,}200$ cms. $= 0{\cdot}806$ per cent.

* *Journal* College Science, Tokyo, Vol. xxvii, 1909.

(2) In his second example,

$$D=25 \text{ cms.}, \ l=10 \text{ cms.}, \ N=100,$$
$$\therefore \ n=N/l=10,$$
$$\text{and } l/D=10/25=0{\cdot}40,$$
$$\therefore \ k \text{ (from curve)}=0{\cdot}471,$$
$$\text{Therefore } \ L=\pi^2\times25^2\times10^2\times10\times0{\cdot}471.$$
$$=2{,}905{,}000 \text{ cms.}$$

The value given by Lieut. Hoyle is 2,902,000 cms.
The difference = 3,000 cms. = 0·103 per cent.

Both the above were worked out by the help of a slide rule and give results differing by less than 1 per cent. from his calculated value, so that from the practical point of view there is little to choose between the two methods on the score of accuracy, while the use of a single formula for any and every form of practical (single layer) coil should be a distinct advantage in all ordinary work.

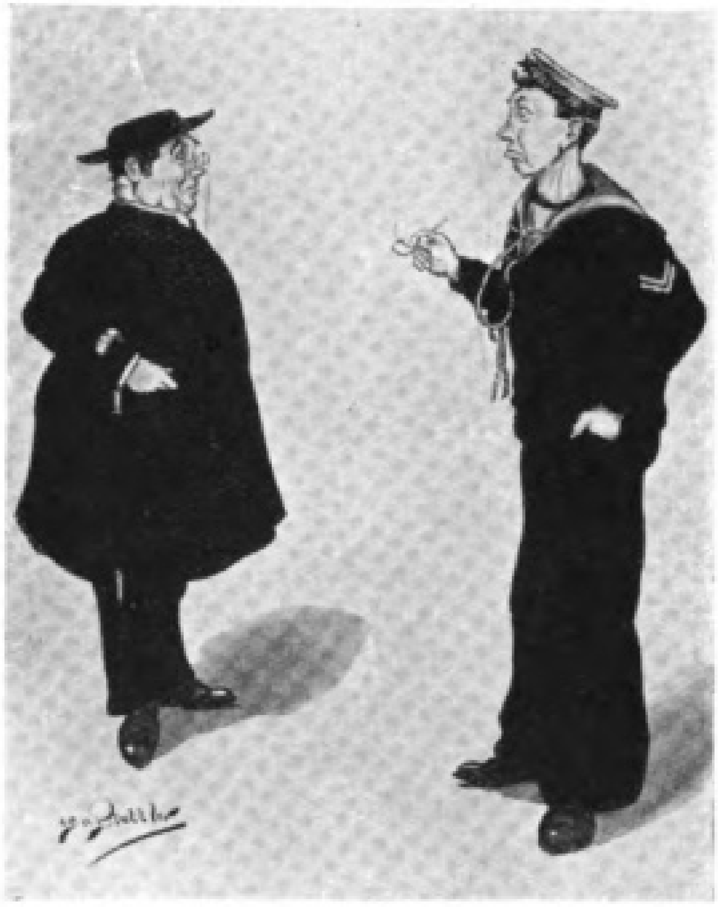
The "Naval Bairnsfather"

READERS of THE WIRELESS WORLD are familiar with the name of Beuttler. It figures upon a number of cartoons, which appeared month after month in our earlier volumes, and which only the exigencies of war-conditions compelled us to discontinue. The same deft hand is still frequently to be found in our pages, and the "Sparkington-Gapp" series owes a great deal to the artistic humour of Lieut. Beuttler's illustrations.

LIEUT. E. G. O. BEUTTLER, R.N.V.R.

Under the title of the "Merry Mariners" a series of the gallant seaman's drawings have recently appeared in book form (*United Newspapers, Ltd., price* 1s.). We can conscientiously recommend every reader of THE WIRELESS WORLD to purchase a copy; one does not have the chance every day of securing so good an investment for the "nimble shilling." One of the best drawings, in the series under review, represents a British aeroplane fishing for "U" boats. They have tried all sorts of bait without success, but finally bring the German shark to the surface by the lure of a dummy baby. The thirst for destruction of the weak and helpless displayed by these literal "Enemies of the Human Race" is admirably indicated. It can be felt in the spirit of the drawing. This cartoon fulfils a fundamental canon of the Art; that, to wit, which demands a seriously satirical side to the humour. The Dutchman, M. Louis Raemaekers, possesses this quality in an eminent degree, and largely owes to it his superlative position.

We are glad to notice, in the little collection of drawings before us, fresh indications of that improvement in technique which also forms a marked feature of the Beuttler sketches that have appeared in our recent numbers. Moreover, the artist is to be congratulated on having largely given up the overcrowding of his pictures with figures, a tendency which detracted from the artistic value of his earlier work. In order to point our remark we print on this page (by kind permission of Lieutenant Beuttler and the *Daily Chronicle*) a reproduction in miniature of one of the cartoons where the figures are but two in number, a restriction which adds considerably to the strength of the effect. Feeling, moreover, that our readers will be interested to see the lineaments of one who has contributed so much to their amusement we here present them with his portrait, for which again we are indebted to the courtesy of our daily contemporary.



CURATE: "MY MAN, HOW YOU MUST *love* THE SEA!"

BLUE-JACKET: "BEGGIN' PARDON, YOUR REVERENCE; FISHES WERE MADE FOR THE SEA AND HUMANS FOR THE BEACH. NOW, DO I LOOK LIKE A HADDOCK?"

(From "Merry Mariners," by Lieut. E. G. O. Beuttler, R.N.V.R.)

In our December issue we published—as one of our "Pastimes for Operators" series—an article on sketching. We believe that the hints there given by our contributor will be found inspiring by many young operators, and we should like to add the further recommendation that any aspirants after artistic attainments should study the work of those who have already made their mark; not in order to imitate them, but in order to learn the secret of their success. Amongst such subjects for artistic study we would include the drawings of Lieut. E. G. O. Beuttler, R.N.V.R.

One of the hall-marks of success, which is generally looked upon in the artistic world as a mark of "one who has arrived," is the acceptance and publication of a drawing in the pages of *Punch*. Our readers are doubtless aware of the fact that, on more than one occasion, specimens of our old friend's artistic work have appeared in the pages of the *London Charivari*.

Among the Operators

THE HOSPITAL SHIP "BRITANNIC."

OPERATOR F. N. CALVER.

THE terrible outrage on the hospital ship *Britannic* is referred to on another page. This vessel carried two operators, F. N. Calver, sen., and S. E. Cleverley, jun.

Frank Norman Calver was born at Balham in November, 1891, and received his education at that place. He trained for wireless telegraphy and received his P.M.G. Certificate at the British School of Telegraphy, Clapham Road, and joined the Marconi Company's London School in April, 1912. Before joining the *Britannic* he had served on a number of large vessels, including the *Aquitania*, *Mauretania*, and *Caronia*. We are very pleased to be able to announce that Mr. Calver was among those saved from the wreck, being rescued without injury.

OPERATOR S. E. CLEVERLEY.

The junior operator, Mr. Stephen Ernest Cleverley, who was also saved, uninjured, is a native of Devonshire, and is but a few months younger than Mr. Calver. He was educated at Plymouth and received his preliminary wireless training at the school of Mr. Jerritt, of Bedford Park, Plymouth. Joining the London School in February, 1913, he soon completed his training, and served on the s.s. *Pardo*, *Amazon* (several trips), *Canning*, *Anglo-Saxon*, *Reventazan*, and *Canada* before being appointed to the *Britannic*. We heartily congratulate both these men on their fortunate escape.

OPERATOR THOMAS RHODES.

* * * * *

ANOTHER HOSPITAL SHIP.

The *Braemar Castle*, another hospital ship which has fallen a victim to Germany's

OPERATOR A. POWER.

methods of warfare, carried as operators Messrs. Thomas Rhodes and Arnold Power. Mr. Rhodes, who hails from Hull, is 24 years old, and was educated at Leeds. He received his preliminary wireless training at the British School of Telegraphy, and joined the Marconi House School in May, 1912, and shortly afterwards was appointed to the s.s. *Tunisian*. He afterwards served on the s.s. *Royal George, Minneapolis,* and a number of other ships, receiving his appointment to the *Braemar Castle* two years ago. We are glad to say that Mr. Rhodes is reported as safe and sound.

The junior operator, Mr. Arnold Power, is of Irish birth, his home being in Kilkenny. On leaving school he became interested in wireless telegraphy, and took a course of training at the Atlantic Wireless College, Caherciveen, where he received his first-class certificate. He joined the Marconi Company as recently as September last, the *Braemar Castle* being his first ship. Mr. Power was also rescued uninjured, and is, we believe, none the worse for his experience.

* * * * * *

S.S. "CITY OF BIRMINGHAM."

The *City of Birmingham,* which was recently sunk, carried one operator, Mr. Bernard Hamilton Montgomery, of Sheffield. Mr. Montgomery, who is 29 years of age, was employed as a telegraphist in the Post Office before joining the Marconi Company. He joined the London School in February, 1911, and has served on a large number of vessels. We are glad to say that he was saved from the wreck and is uninjured.

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S.S. "RAPPAHANNOCK."

The loss of this ship and all her crew has already been reported in the daily Press. The wireless operator, Mr. William Jasper Jane, whose sad death we must here chronicle, was a native of Plymouth, and 22 years of age. He was educated at Plymouth Public School and the grammar school in that town, and on leaving entered a business career, and later joined the National Telephone Company, Taking an interest in wireless telegraphy, he received a preliminary training at Mr. Jerritt's school,

OPERATOR B. H. MONTGOMERY.

THE LATE OPERATOR W. J. JANE.

joining the Marconi House School in March, 1915. On the completion of his training he was appointed to the s.s. *Mennon*, later transferring to the s.s. *Bornu*, and thence to the *Cambrian*. He had already sailed for two trips on the s.s. *Rappahannock* before she was sunk. Deep sympathy is felt with the late operator's parents in their bereavement.

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OPERATOR T. MOYLAN.

We regret to announce the death in Canada of Operator Thomas Moylan, who was 23 years of age, was born at Liverpool, and educated at Seaforth. After leaving school he obtained a position in the telegraph department of the *Liverpool Daily Post*, and joined the London School in November, 1915. On appointment to the staff he took duty on the s.s. *Theseus*, but he had not long been on this vessel when he was removed to hospital in Montreal. Very deep sympathy is felt for the late Mr. Moylan's mother, as his father died a short time ago, and we believe a brother was killed earlier in the year.

THE LATE OPERATOR MOYLAN.

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LONG DISTANCE BY AMERICAN OPERATOR.

Operator A. J. Costigan, of the s.s. *Floridian*, has reported a new long-distance record.

The *Floridian* left San Francisco for Sydney, Australia, on July 12th; from that date, up to and including July 31st, the vessel's position was transmitted to San Francisco. With a single exception, these position reports were received directly at the Marconi Hillcrest Station, near San Francisco, up to a distance of 5,227 miles.

The *Floridian* is equipped with the standard Marconi 2 k.w. 500 cycle panel set. The current consumption at the transformer did not exceed 1,600 watts up to 2,600 miles, and at 5,200 miles the power consumed was 2,600 watts. Costigan says the San Francisco signals were audible up to some 3,000 miles.

An important patent suit is being litigated this month in the United States District Court, where his Honour Judge Mayer, you will recall, recently handed down a decision in the Fleming Valve case, and before whom was also tried the National Electric Signalling Company's high-frequency patent suit. The present contest is between the Atlantic Communication Co. (Telefunken System), defendant, and the National Electric Signalling Co., plaintiff. Patents involved are those covering continuous wave transmission and Heteroddne system of reception, Fessenden claiming invention of both methods. Prominent among those engaged in this suit are Professor Zenneck and Mr. John Stone, Stone for the Atlantic Communication Co., and Mr. John L. Hogan, jun., who is testifying as expert for the National Electric Signalling Co. While the case is only about half finished at this time, there have already been on the stand Mr. Nikola Tesla, Professor Pupin, Mr. Alexanderson, the designer of the General Electric high-frequency alternator, and other prominent personalities in the radio world.

The United States Senate recently passed a resolution providing for the investigation of matters relating to Interstate Commerce, as well as the advisability of Government ownership of telephone, telegraph, and wireless communication systems. The committee consists of the following gentlemen, and is known as the Newlands Committee :

Senator Newlands, Nevada (Chairman).
Senator Underwood, Alabama.
Senator Robinson, Arkansas (Secretary).
Senator Brandegee, Connecticut.
Senator Cummins, Iowa.
Senator Cullop, Indiana.
Representative Adamson, Georgia (Vice-Chairman).
Representative Simms, Tennessee.
Representative Esch, Wisconsin.
Representative Hamilton, Michigan.

This Committee is empowered to make an exhaustive investigation of the subjects mentioned, and also to call such witnesses from the various industries as in the Committee's opinion may be necessary. I have just learned that the Joint Committee will begin its investigation of the radio subject on November 20th, 1916, in the Senate Office Building at Washington, D.C. In this connection I should mention that certain people in Washington, and in particular some of the executive and administrative officers now connected with the Government branch of radio communication, hold the opinion that existing commercial radio coast stations in the United States should be taken over and operated by the Government. To this end a bill is being drafted, and I understand it is proposed to introduce this bill at the next session of Congress. The exact provisions of this bill are not yet definitely known. In commercial as well as in scientific circles I have heard nothing but strenuous opposition to such a move, and it is expected that before any bill of this character is presented to Congress commercial and other interests will be given an opportunity to present their side of the case. The importance of this vital subject accounts for the great interest expressed by all those actively connected with the art of radio communication.

A novel experiment is to be tried with amateur radio equipments during the coming Presidential election. Members of the National Amateur Wireless Association are to take the lead in a nation-wide preparedness test. Under the leadership of W. H. Kirwan (9XE), of Rock Island, Ill., who has been appointed National Chief of Relay Communications of the N.A.W.A., the amateurs will be organised into a relay chain to broadcast throughout the country messages from President Wilson. The great organisation of licensed amateur stations under N.A.W.A. control will be placed at the disposal of the National Chief of Relay Communications, and selections will be made from the list to establish relay points. The entire country will be divided into circles whose diameter will be the sending radius of the stations officially appointed, the circles overlapping and connecting up all strategic points. The messages will be received in each city and town, whereupon each operator will file a copy of the message with the postmaster, and receive a receipt, which will insure him credit for the work.

The next meeting of the Institute of Radio Engineers will be held on Wednesday evening, November 1st, at the Engineering Societies Building, New York. A paper by Messrs. Bowden Washington and T. H. Boyster on "A Determination of the Energy Losses in a Radio-Telegraph Transmitter" will be presented. An interesting new method of determining heat losses in transmitters will be described.

DAVID SARNOFF.

High-Frequency Resistance Calculation

By SAMUEL LOWEY

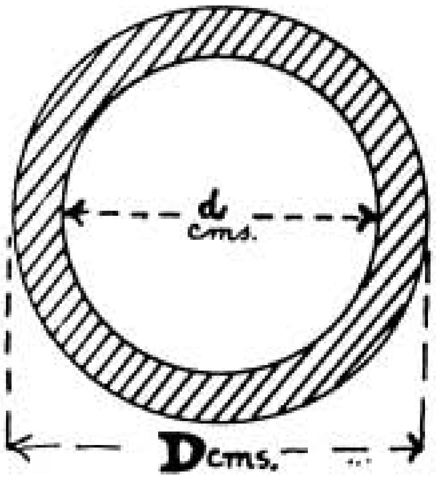


Fig. 1

The area of the shaded portion or ring (Fig. 1) $= \frac{\pi}{4} (D^2 - d^2)$ sq. cms.

If the thickness, ϵ, of the ring is given, $d = D - 2\epsilon$, so that the area of the ring (Fig. 2) will be

$$\frac{\pi}{4} \{D^2 - (D - 2\epsilon)^2\} = \pi\epsilon\ (D - \epsilon) \text{ sq. cms.}$$

If Fig. 2 is now considered as representing the cross-section of a conductor, the ring portion being the effective depth penetrated by a given high-frequency current, the resistance (per cm. length of conductor) to this current will be

(i) $$\frac{\rho}{\pi\epsilon(D - \epsilon)}, \text{ when } \rho = \text{resistivity.}$$

The resistance of equal length of the conductor to a steady current will be

(ii) $$\frac{\rho}{D^2 \frac{\pi}{4}}$$

The ratio $$\frac{\text{High-Frequency Resistance (i.)}}{\text{"Steady Current" Resistance (ii.)}}$$

$$= \frac{\frac{\rho}{\pi\epsilon\ (D - \epsilon)}}{\frac{\rho}{D^2 \frac{\pi}{4}}} = \frac{D^2}{4\epsilon\ (D - \epsilon)}.$$

This equals $\frac{1}{4x\ (1 - x)}$, if x is taken as the ratio of $\frac{\text{penetration}}{\text{diameter}}$ or $\frac{\epsilon}{D}$.

By substituting different values for x, a table may be made so as to show opposite to readings of $\frac{\epsilon}{D}$ the corresponding values of $\frac{\text{High-Frequency Resistance}}{\text{Steady Current Resistance}}$.

These are given in the scale Fig. 4. If $\frac{\epsilon}{D} = \cdot 001$ the high-frequency resistance is 250 times the steady current resistance, while only three times if $\frac{\epsilon}{D} = \cdot 092$.

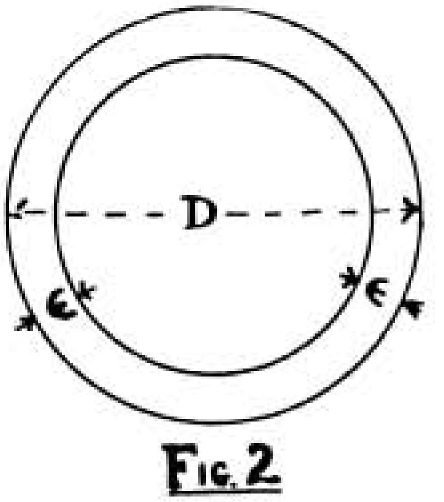


Fig. 2

The depth of penetration (ϵ) may be obtained from the formula * $\epsilon = \frac{1}{\sqrt{2\pi u C w}}$, which (by substituting $2\pi n$ for w and ρ (the resistivity) for $\frac{1}{C}$) becomes $\epsilon = \sqrt{\frac{\rho}{4\pi^2 un}} = \frac{1}{2\pi}\sqrt{\frac{\rho}{un}}$ or, if the material be assumed to be non-magnetic, $\epsilon = \frac{1}{2\pi}\sqrt{\frac{\rho}{n}}$.

This would be rather tedious to apply to a number of cases ; so, in order that the operation may be simplified, the diagram (Fig. 4) has been made.

From this diagram, by following out the instructions given thereon, the value of ϵ for any conductor (not magnetic) at any frequency may be obtained.

If necessary, the "frequency" scale may be *multiplied* by 100, 10,000, etc., providing that the result be *divided* by 10, 100, etc.

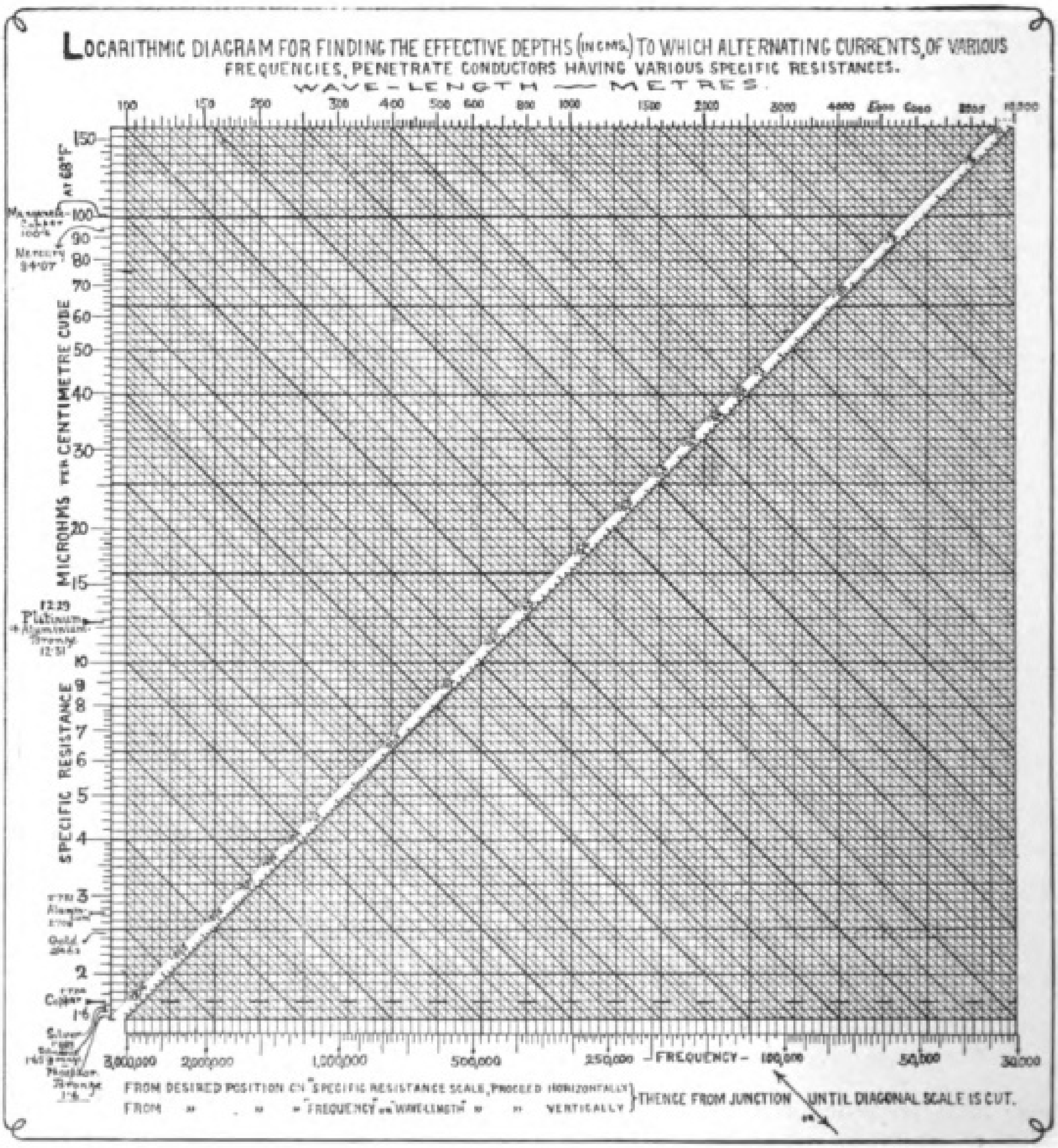


FIG. 3.

* Mr. Baillie's Article, p. 515, WIRELESS WORLD, October 1916 (q.v.).

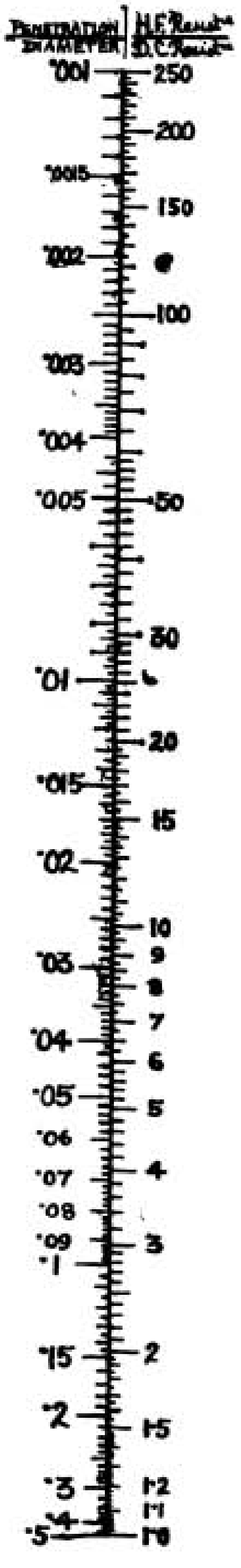


Fig. 4

To take a few examples.

Required: the resistance per cm. length of the following conductors compared with their resistance to direct-current.

—	Fig. 3 ϵ	$\frac{\epsilon}{D}$	Fig. 4 $\frac{\text{H.F. Res.}}{\text{D.C. Res.}}$
14 S.W.G. Copper, at $n=$ 3,000,000 ·203 cm. diam....	·00381	·018	14·2
Aluminium - bronze, 14 S.W.G., $n=300{,}000$ ·203 cm. diam.	·032	·158	1·7
40 S.W.G. Copper at $n=$ 3×10^{10} ·0122 cm. diam. ...	·0000381	·0031	80

For conductors of rectangular section, providing that ϵ does not exceed half the thickness of conductor, the high-frequency resistance per cm. length equals $\frac{\rho}{\epsilon\,(\text{perimeter}-4\epsilon)}$.

United States Government and the Wireless Direction Finder

Recognition of Great Invention

The Hydrographic Office of the Marine Department of the United States of America points out to the International Bureau of the Telegraphic Union at Berne the fact that the direction indicator of radio-telegraph signals having been perfected, and having become of the utmost importance to navigation, it is necessary to show on marine charts not only the geographical position of coast stations and fixed stations, but also the altitude of the top of the pylons of these stations in comparison with the level of the sea and the height of these pylons above the ground. These two latter pieces of information not being in the possession of the Hydrographic Office, the latter would be very much obliged to Administrations who would give one or both.

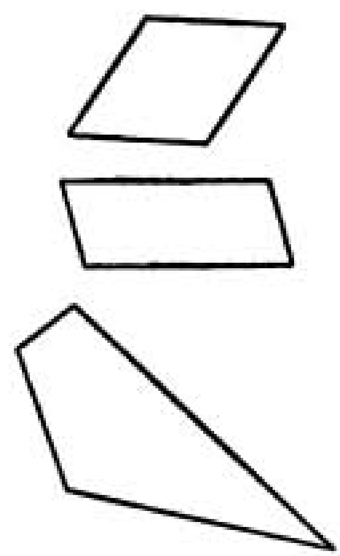
Instructional Article

NEW SERIES (No. 17).

The following series, of which the article below forms the seventeenth 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.

QUADRILATERALS.

106. The term quadrilateral includes all plane figures which are completely enclosed by four straight lines. Special forms are:



1. *Parallelogram.*—Opposite sides are parallel.

2. *Rectangle.*—All angles are right-angles. (This is a special form of parallelogram.)

3. *Square.*—All angles are right-angles, and all sides are equal. (A special form of rectangle.)

4. *Rhombus.*—A parallelogram with all the sides equal, but angles not right angles.

5. *Rhomboid.*—A parallelogram with opposite sides only equal and angles *not* right-angles.

6. *Trapezium.*—Any other form of quadrilateral.

POLYGONS.

In the term polygon we include any plane figure with more than four sides or angles. If its angles and its sides are all equal it is a *regular polygon.*

The most important types of polygons are the regular polygons with:

(*a*) Five sides, called *pentagons,*
(*b*) Six sides, called *hexagons,*
and (*c*) Eight sides, called *octagons.*

107. In Fig. 95 we have the construction for drawing a regular polygon of any number of sides in a given circle. We first of all draw a diameter, *AB*, and divide it into as many equal parts as there are to be sides in the polygon; in this case nine.

With *A* and *B* as centres, and radius equal to *AB*, draw two arcs cutting at *C*. Join *C* to the second point of division (from either *A* or *B*) and produce this line to cut the circumference of the circle at *D*. Then *AD* will be the first side of the required polygon, and can be marked off round the circumference as shown.

This method, though very convenient, is not as exact as that shown in Fig. 96. This shows the construction of a seven-sided figure (a septagon) in the given circle.

First draw a radius, *AB*, and then draw a tangent *DBC*; this tangent must necessarily be at right-angles to the radius *AB*. With centre *B* and any convenient radius draw a semi-circle *CED*, and mark it off into the seven equal parts.

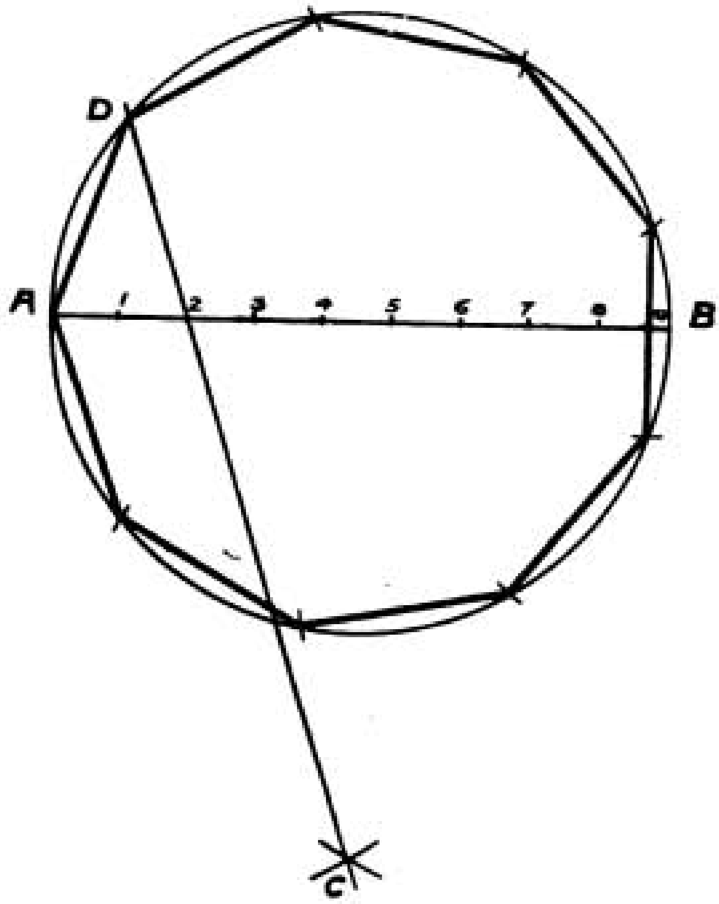


FIG. 95.

Straight lines drawn from *B* through each of these points of division will, when produced, cut the circumference of the circle at the points required for the polygon.

It will be seen that the method of Fig. 95 is much more convenient than this of Fig. 96, in that the former requires the division of a *straight line* into equal parts and the latter the similar division of a *semicircle*. Indeed, as this latter division would most probably be carried out by trial, it would be quicker to divide the circumference of the given circle straightaway into the required number of equal parts.

108. In Fig. 97 a regular polygon (a pentagon) is drawn *on the given base, AB.*

On *BA* produced, is drawn a semicircle, *BDC*, with centre, *A*, and radius, *AB*. This semicircle is divided into as many equal parts as the polygon is to have sides; in this case five. The straight line, *A*2, joining *A* to the second point of division from *C*, will be the second side of the pentagon.

Bisecting *AB* and *A*2 at right-angles we obtain, where these two bisectors cut, the point, *E*. A circle, drawn with centre, *E*, and radius, *EA* (or *EB* or *E*2) will be the bounding circle or *circumcircle* of the pentagon, so the remaining sides can be marked off round its circumference.

109. (*a*) To inscribe a circle in a given triangle, *ABC* (Fig. 98). Bisect any two of the angles of the triangle—say, angles *B* and *C*—with lines which cut one another at *D*. From *D* drop a perpendicular, *DE*, on to *any* side—say, *BC*—and with centre, *D*, and radius, *DE*, draw the required circle.

(*b*) To describe a circle about a given triangle, *ABC* (Fig. 99). Bisect any two sides—say, *AC* and *CB*—at right angles. Let the bisecting lines cut one another at *D*.

With centre, *D*, and radius equal to *DA* (or *DB* or *DC*) draw the required circle.

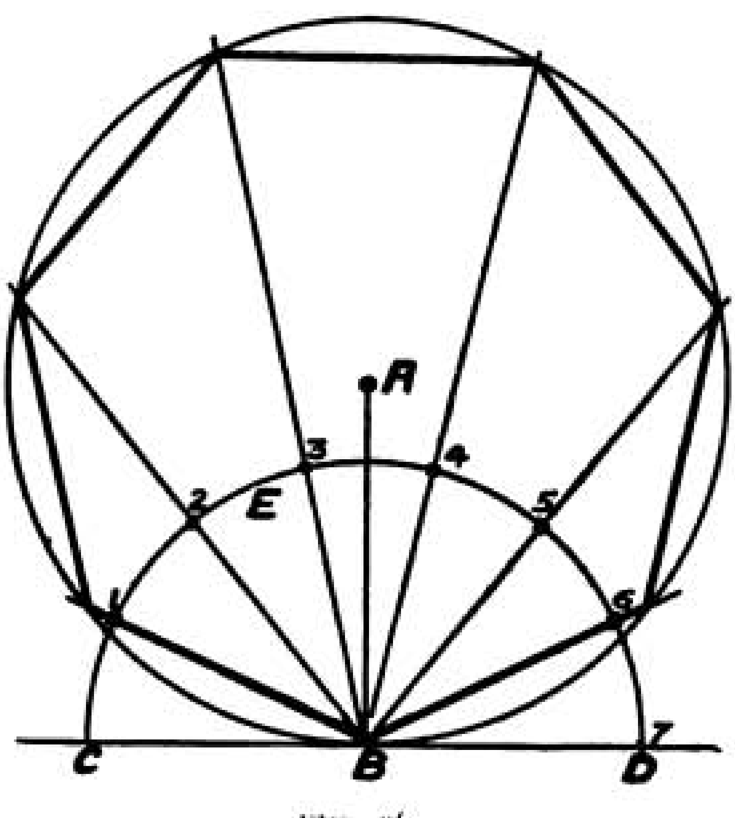


FIG. 96.

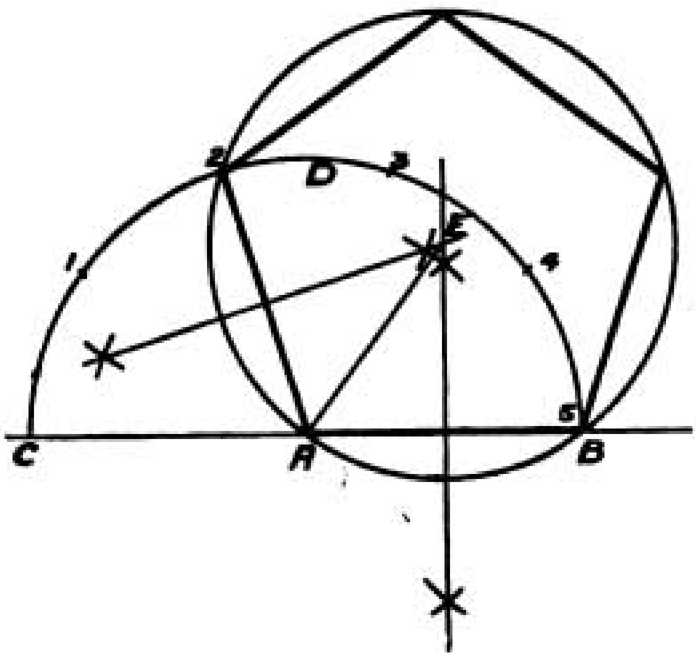


FIG. 97.

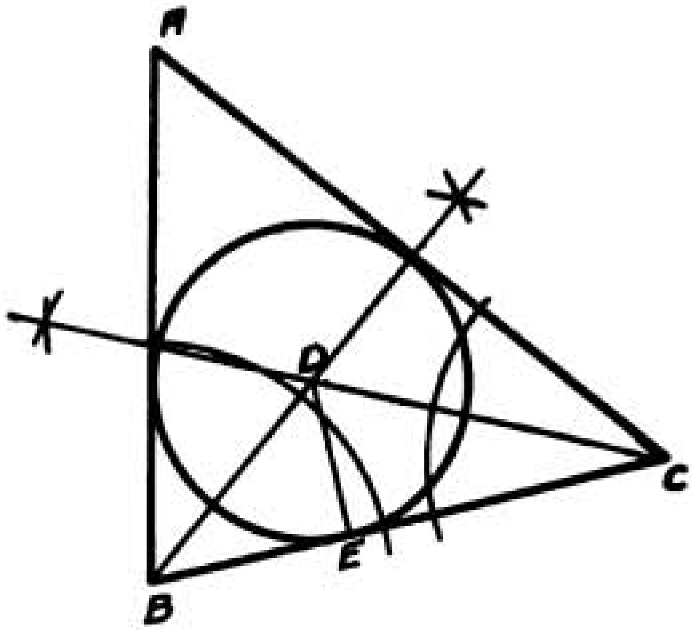


FIG. 98.

Solutions to Examples in Article XVI.

23. Prove $\cos(60^\circ+A)+\cos(60^\circ-A)=\cos A$.

$$\cos(60^\circ+A)=\cos 60^\circ \cos A-\sin 60^\circ \sin A.$$
$$\cos(60^\circ-A)=\cos 60^\circ \cos A+\sin 60^\circ \sin A.$$

Adding $\cos(60^\circ+A)+\cos(60^\circ-A)=2\cos 60^\circ \cos A$

$$=2\times\tfrac{1}{2}\times\cos A \quad (\text{because } \cos 60^\circ=\tfrac{1}{2})$$
$$=\cos A.$$

24. Prove $$\frac{\sin 2\theta-\sin\theta}{\cos\theta-\cos 2\theta}=\cot\frac{3\theta}{2}$$

$$\sin 2\theta-\sin\theta=2\cos\tfrac{1}{2}(2\theta+\theta)\sin\tfrac{1}{2}(2\theta-\theta)$$
$$=2\cos\frac{3\theta}{2}\sin\frac{\theta}{2}$$
$$\cos\theta-\cos 2\theta=2\sin\tfrac{1}{2}(2\theta+\theta)\sin\tfrac{1}{2}(2\theta-\theta)$$
$$=2\sin\frac{3\theta}{2}\sin\frac{\theta}{2}$$

Therefore $$\frac{\sin 2\theta-\sin\theta}{\cos\theta-\cos 2\theta}=\frac{2\cos\frac{3\theta}{2}\sin\frac{\theta}{2}}{2\sin\frac{3\theta}{2}\sin\frac{\theta}{2}}$$

$$=\frac{\cos\frac{3\theta}{2}}{\sin\frac{3\theta}{2}}=\cot\frac{3\theta}{2}$$

25. Prove $2\operatorname{cosec} 2A=\sec A\operatorname{cosec} A$.

$$2\operatorname{cosec} 2A=\frac{2}{\sin 2A}=\frac{2}{2\sin A\cos A}$$
$$=\frac{1}{\sin A\cos A}=\frac{1}{\sin A}\cdot\frac{1}{\cos A}$$
$$=\operatorname{cosec} A\,.\,\sec A.$$

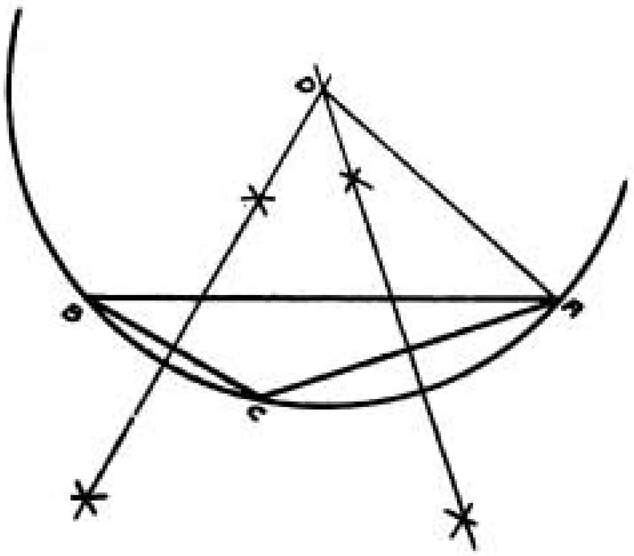


FIG. 99.

26. Prove

$$\frac{\cot^2 B+1}{\cot^2 B-1}=\sec 2B$$

$$\cot^2 B+1=\frac{\cos^2 B}{\sin^2 B}+1=\frac{\cos^2 B+\sin^2 B}{\sin^2 B}=\frac{1}{\sin^2 B}$$

$$\cot^2 B-1=\frac{\cos^2 B}{\sin^2 B}-1=\frac{\cos^2 B-\sin^2 B}{\sin^2 B}=\frac{\cos 2B}{\sin^2 B}$$

Therefore

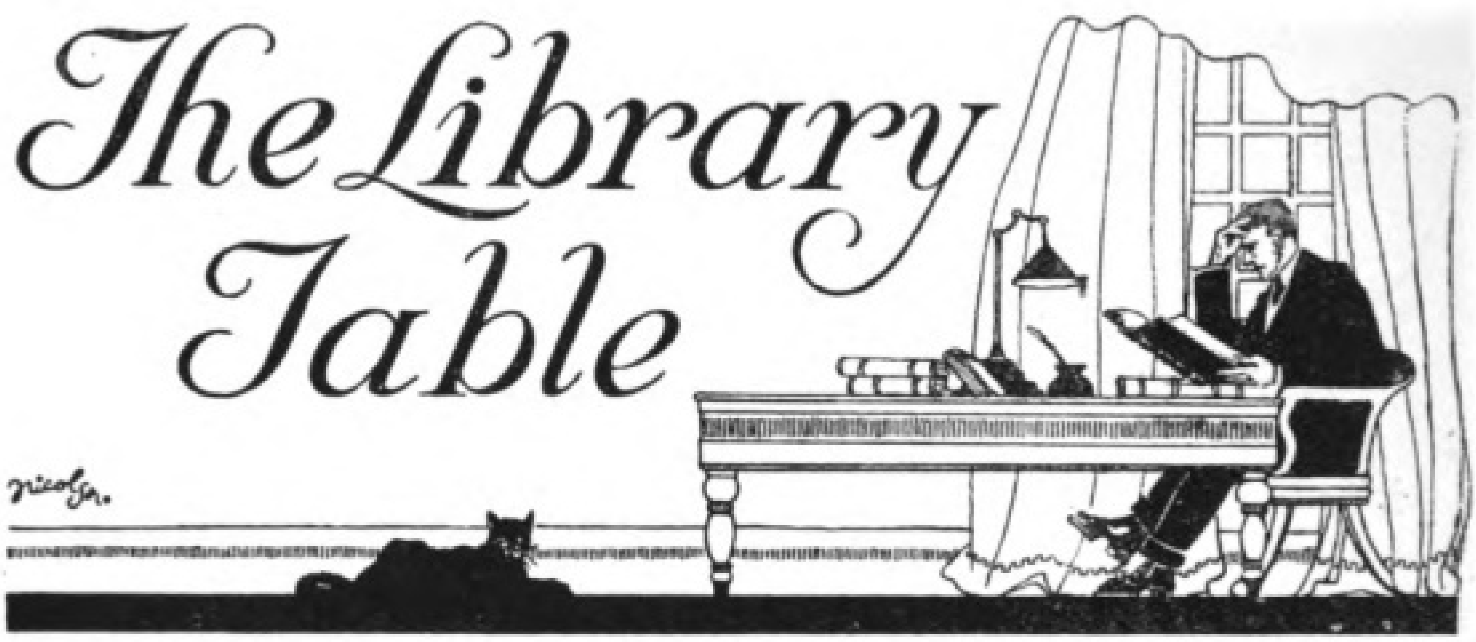
$$\frac{\cot^2 B+1}{\cot^2 B-1}=\frac{\frac{1}{\sin^2 B}}{\frac{\cos 2B}{\sin^2 B}}=\frac{1}{\sin^2 B}\times\frac{\sin^2 B}{\cos 2B}$$

$$=\frac{1}{\cos 2B}=\sec 2B.$$

Wireless Custom for Shops and Hotels

The American Press recently recorded an interesting little incident in connection with the wife of the Columbian Minister of the U.S.A. She was travelling from South America on one of the fruit liners *en route* to New York when " rude Boreas " carried off her hat and made a present of it to Father Neptune. The consequence was that the lady, having lost her favourite headgear, was much distressed at the idea of arriving at New York with " nothing to wear " ! What was she to do ? In this case, as in so many others, wireless telegraphy came to the rescue. The lady went shopping by Marconigram and ordered a hat in New York. Simultaneously with her wireless order she informed her husband of her plight through the same beneficent agency, and requested him to see that the hat was delivered to her as soon as communication between the ship and shore was established. All went well, husband and hat duly presented themselves at the earliest possible moment, and both doubtless received the warm welcome which was their due.

Of course, such " shopping by wireless " is still in its infancy and has not yet reached the systematised stage to which, in course of time, it will doubtless attain. It has, however, become no uncommon occurrence for passengers to order their hotel accommodation through the medium of the wireless aerials of the vessels on which they travel ; and, after all, general shopping would only be an extension of such a procedure. As matters stand at present the ship's newspapers, published on board with the news of the day as received by wireless, contain a number of hotel advertisements inserted for the express purpose of doing business in this way. No doubt in the course of time other business houses will follow suit and make arrangements for soliciting and executing orders borne by the ether waves. One of the leading French fashionable costumiers not long ago utilised the medium of the ocean newspaper for making an important communication to American buyers on their way to Europe, radiating their business announcement by wireless and arranging for it to be printed on board. We understand that the results were satisfactory, and a number of orders secured in consequence.



"How to Make Low-Pressure Transformers." Third Edition, with Additions. By Professor F. E. Austin. Published by the Author at Hanover, New Hampshire. 40 cents. London: E. and F. N. Spon, Limited.

This excellent little book, previous editions of which have been reviewed in our pages, is one of a series of small manuals which Professor F. E. Austin has put out within the last few years. All these books are eminently practical, and in this particular case the instructions for making efficient low-pressure transformers are all that could be desired. We note several improvements and additions in the present edition, notably a new and simple form of core construction described on page 14, and the special type of transformer for those who desire to experiment with different coil windings on page 16. How practical are the author's instructions and hints may be gauged from the fact that on page 20 Professor Austin describes how discarded condensed milk tins, varnish tins, and tin pails may be utilised to provide the material for transformer cores. These tins are really made of thin rolled steel coated over with a thin layer of metal tin, and if they are put in a hot fire, the solder and tin coating will melt off, leaving a thin metal, which can be annealed and softened by very slow cooling. The oxide which has formed on the metal in the fire is not removed, as this forms a useful insulating layer.

* * * * * * *

"Final Digest for Marconi Students." By J. Henstock. Published by the Author at Wallasey, Cheshire.

This book consists of a large number of questions and answers regarding Marconi ship wireless apparatus and claims to provide students with useful instructions and directions when preparing for the Government examination. Some of the questions and answers are good, and some are fair, but a number are so hopelessly inaccurate and misleading that we should hesitate before placing the book in the hands of any student whom we wished to pass the examination successfully.

In order that we may not be thought to be biassed or prejudiced, we think it best to deal in some detail with the volume, and will first of all point out two conflicting statements which appear in Part I. We would mention straight away that the object of the book seems to be not the proper instruction of the student, but the deliberate cramming of his mind with sets of questions to which he is supposed to give parrot answers. We cannot but regard with disfavour the method of giving a question, followed immediately by the answer. Questions should be quite separate from the answers, in order that the student may test his knowledge. This he cannot do if the answer is given immediately under the query.

But to come back to our criticism of Part I. On page 11 we find the following: "It is not likely any serious fault will be found with either the potential transformer "or the main condenser, because it would take too long to remedy it, and time is "limited in an examination. A candidate, therefore, need not trouble himself much "about these parts of the apparatus. . . ."

On the next page we find: "as regards the emergency set, the most common "fault in the battery or accumulators is sulphating. It may be easily detected "because the specific gravity of the acid at the end of the charge will be less than it "was at the end of the first charge. The remedy for this is an extra charge." Now, if time is limited in the examination, surely there is not enough time to see about charging or discharging the accumulator. We will say nothing about the folly of teaching a student to ignore faults which cannot be conveniently brought within the limits of an examination.

In Part II, where we have a long series of questions and answers, we find, as the first specimen, the following illuminating information :—

Q. Describe the difference between high and low potential.

A. High potential has greater voltage than low potential.

Lower down we find :—

Q. What is a wave train ?

A. A group of oscillations of one spark, fifty sparks equals one dot.

A reply such as this would be sufficient to fail a man in any examination. Still on the first page we find again :—

Q. What is a Bradfield insulator for ?

A. To provide insulation and water-proof lead-in for aerial, and also to *protect it from lightning*. (The italics are ours.)

On page 11 we read :—

Q. What is meant by amplitude ?

A. Height of wave above its centre maximum of half a swing.

This is unintelligible, but not so surprising as the next question but one, *i.e.* :—

Q. Does it matter what number of volts and ampères are used in a 1½ k.w. set ?

A. No, so long as they do not exceed 1,000 volts.

By this time we have begun to see Wireless in a new light, and when in the middle of page 15 we find :—

Q. What is the alteration of the spark gap ?

A. 120.

it seems that the whole of Wireless is altered. Page 16 affords the following :—

Q. Why is alternating current used in a 1½ k.w. set ?

A. Because it is faster and needs no attention like a hammer break.

Q. Are the starter and field regulator the same ?

A. Practically so, with slight modifications.

On page 19 we are told that the guard lamps are connected one in shunt to the armature and the other to the field of the converter—quite an interesting piece of news to those like ourselves, who thought they were connected across the D.C. and A.C. sides of the machine respectively. Other questions and answers which need no comment are :—

Q. What happens if six of the plates in the condenser are broken ?

A. It would shorten the wave length.

Q. What is meant by the word oscillation ?

A. Current surging backwards and forwards, many thousands of times per second, and gradually dying out.

Q. What is the purpose of the earth arrester terminal ?

A. It saves using a change-over switch ; prevents operator ***hearing his own signals***, and allows him to be interrupted in the middle of a message. (The italics are ours.)

Q. What are the condensers in the multiple tuner for ?

A. To tune to the wave-length of the transmitting station. These condensers in certain cases might be dispensed with, but it depends on the size and length of the aerial.

Q. How do you test the receiving apparatus ?

A. With a buzzer on a tapping iron band.

Last of all, we think the following piece of information will doubtless create a revolution in the scientific world :—

Q. Would an alternating current dynamo do ? (For charging accumulators.)

A. No.

Q. Why not ?

A. Because alternating current rapidly changes its direction and polarity many thousands of times per second (Some alternator [!]—ED.), and therefore would charge and discharge the cells all the time and would ruin them.

Part III. consists of questions and answers on the P.M.G. Handbook, and Part IV. gives information regarding the form of application for attending the Postmaster-General's examination.

The fact that this is a second edition of this book makes the inclusion of such errors as we have pointed out unpardonable.

Radiotelephony in Argentina.

A laboratory is being fitted up at the Radiographic station at the Darsena Norte, for the purpose of making experiments in radiotelephony. It is hoped to be able to effect communication over a distance of 200 miles.—*The Electrician*.

Personal Notes

We learn with regret from the *South London Press* that Gunner T. G. Gayner, R.G.A., of Roseberry Road, Brixton, was killed in action on November 1st. Gunner Gayner was a wireless operator, and was killed by the bursting of a shell. Prior to the war he was engaged as a salesman at a wholesale toy merchant's in Clerkenwell, and leaves a widow and child four years of age. His officer, communicating the sad tidings to his father, said he was very much liked by all his battery for his courage and helpful nature.

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Percy Bootham, of Bradford, a wireless operator in the R.N.V.R., is officially reported lost at sea on November 5th. He was 21 years of age.

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We learn from the *Bath Herald* that Sapper Telegraphist Charles Black, R.E., is back in Bath on leave, after seeing service since the beginning of the war. He was for seven years in the choir at St. Luke's, and while there was taught wireless telegraphy by the late Rev. G. E. Doudney, who had his own installation, which was described some time ago in the WIRELESS WORLD. Upon enlisting, Sapper Charles Black first joined the Royal Marines, taking duty on board a wireless experimental ship. He then served in the ranks with the Royal Marines, taking his full share of the infantry work of the Royal Naval Division. He was in the famous fighting at Antwerp, at the Dardanelles, Egypt, and Salonica, and a few months ago passed his examination in wireless telegraphy and was transferred to the Royal Engineers in France as a Sapper Telegraphist. He is now a wireless operator, and has been wounded twice, once at Gallipoli and once at Salonica.

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Mr. Samuel S. Taylor, a solicitor of Derby, and one of the county coroners, has joined the wireless telegraph section of the Royal Navy, and has been given warrant rank. Many of our readers will remember Mr. Taylor as President of the Derby Wireless Club in pre-war days.

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Congratulations to Lieut. F. C. Cross, R.N.R., on his promotion to Lieut-Commander, R.N.R. Lieut. Cross is the headmaster of the White Star Training Ship *Mersey* and the author of "Wireless Explained."

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Best wishes to Mr. Horace R. Neate on his marriage to Miss Dorothy

OPERATOR S. J. TAYLOR.

Claire Wall, of Cheltenham. Mr. Neate has seen service as a wireless operator at Suvla Bay on H.M.S. *Morea*, but since his discharge from the Naval Service has joined as a private in the Army. Mrs. Neate was a Red Cross nurse at Boddington V.A.D. Hospital.

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Hearty congratulations to Mr. A. Pink, chief operator at the Towyn wireless station, who was married on November 11th to Miss Meir Iona Roberts. The ceremony was conducted at the English Calvinistic Methodist Capel, at Aberdovey, Merionethshire, and the honeymoon was spent at Barmouth.

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We have more than once referred in our columns to the special attention paid to the welfare of the messenger service of Marconi's Wireless Telegraph Co., Ltd. As many of our readers are aware, facilities are given to these young men to study wireless telegraphy in the Marconi House School, and the latest to obtain his certificate is Mr. Samuel John Taylor, who successfully obtained a first-class certificate at the beginning of December. Mr. Taylor has now been appointed to the Marine Operating Staff, and by the time this magazine appears will be on the high seas, carrying out those duties which are of such great importance at the present time. We congratulate him upon the good progress he has made.

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We are able to publish this month a photograph of the late Mr. Hodgson, whose sad death in an aeroplane accident we recorded in our last issue.

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Friends of Mr. E. A. Planterose, who was for some time on the Marine Operating Staff of the Marconi Company, will be interested to hear that he has obtained a commission as Sub-Lieut. in the R.N.V.R., and is at present training for Observer in the Royal Naval Air Service. Mr. Planterose joined the Marconi Company in April, 1911, and served on a number of vessels, including the ill-fated P. & O. liner, *Arabia*. In 1914, he resigned to take up an appointment as Traffic Instructor in the Chilian Navy, and served in the wireless stations at Llanguihue, Talcahuano, and Valparaiso. In September of this year he patriotically resigned his contract and came to England to take up the commission to which we have above referred.

THE LATE PETTY OFFICER W. H. HODGSON.

SUB.-LIEUT. E. A. PLANTEROSE.

We wish him every success in his new appointment.

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It is with sincere regret that we have to record the death of 2nd Lieut. Percy J. Gibbons, who was killed in action on October 17th in France, when temporarily attached to the Royal West Kent Regiment. His commanding officer wrote as follows :—" He had been attached to the battalion under my command for a few weeks before his death. He was killed leading his platoon in an attack on the German lines. The battalion had been holding some front-line trenches, under very trying circumstances, for some few days before attacking. I happened to see a good deal of Lieut. Gibbons during these days, and was much impressed with his good work ; he was cheerful and did much to encourage his men, and by his death the Service has lost a very promising young officer. I think he was killed instantaneously on the battlefield, together with many others of my officers."

Lieut. Gibbons was a member of the accountant's department at Marconi House, and enlisted in the Royal Fusiliers shortly after the outbreak of war, together with several other members of the office staff. He only obtained his commission just recently, and he was much liked by those who knew him. Great sympathy will be felt with his mother, as he was her only child.

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Among the recently announced awards was that of the D.S.O., presented by the King to Flight Sub-Lieutenant Pulling, of the Royal Naval Air Service, for his brave and courageous work in the destruction of a Zeppelin off the East Coast of England. Sub-Lieutenant Pulling was a member of the Post Office Wireless Staff before taking his commission, and will probably be known to many of our readers. Not only wireless men, but the whole of the British nation are proud of this young officer in the work he has done in destroying a cowardly raider of the air.

Photo] [*Farringdon Photo Co.*

FLIGHT SUB-LIEUT. PULLING, D.S.O.

Patent Record

9335. July 3rd. F. Murgatroyd. Continuous wave dynamo electric machines.

9537. July 6th. Marconi's Wireless Telegraph Co., Ltd., and I. Shoenberg. Frequency measuring instrument for electric currents.

9649. July 8th. G. Constantinescu and W. Haddon. Transmission of energy by wave motion.

9766. July 11th. British Thomson-Houston. Regulators for polyphase transmission.

9812. July 12th. British Thomson-Houston. Systems of polyphase transmission.

9833. July 12th. Indo-European Telegraph Co. and A. H. Morse and H. Rivers-Moore. Electric oscillating or wireless systems and apparatus.

9927. July 14th. British Westinghouse Electrical Manufacturing Co. Production of asymmetric potential waves. (Convention date, U.S.A., July 15th, 1915. Patent No. 100,893. *Open to inspection.*)

9937. July 14th. M. Breslauer. Dynamo electric power transmission apparatus of unipolar type. (Convention date, Germany, July 10th, 1914. *Accepted.* Patent No. 100,894.)

9938. July 14th. British Thomson-Houston Co., Ltd. Protection of electric transmission systems.

10096. July 17th. I. Chortik. Method of producing high frequency oscillations.

10103. July 18th. I. Chortik. Generation of high frequency currents.

10096. July 18th. J. Bethenod and E. Girardeau. Spark gaps for Wireless Telegraphy. (Convention date, France, July 21st, 1915. Patent No. 100,957. *Open to inspection.*)

10122. July 18th. Lee de Forest. Oscillating audions. (Convention date, U.S.A., July 22nd, 1915. Patent No. 100,959. *Open to inspection.*)

10176. July 19th. Marconi's Wireless Telegraph Co., Ltd., and R. H. White. Means for opening and closing electrical circuits.

10205. July 20th. J. Pederson. Power generating and transmitting devices.

10227. July 20th. A. E. McColl. Protective device for alternating current electric systems.

10558. July 26th. G. O. Squier and L. Cohen. System of electrical signalling.

10576. July 26th. J. Bethenod and E. Girardeau. Wireless Telegraphy and Telephony. (Convention date, France, August 10th, 1915. Patent No. 101,148. *Open to inspection.*)

10627. July 27th. H. K. Harriss. Transmitting apparatus.

10713. July 28th. E. R. Clarke, S. R. Mullard and Ediswan Electric Light Co. Valves for receiving or producing wireless current.

10722. July 28th. I. Chortik. Means for producing high frequency oscillations.

10850. August 1st. British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.) Electron discharge apparatus.

10905. August 2nd. British Thomson-Houston Co., Ltd., and R. C. Clinker. Wireless transmitting system.

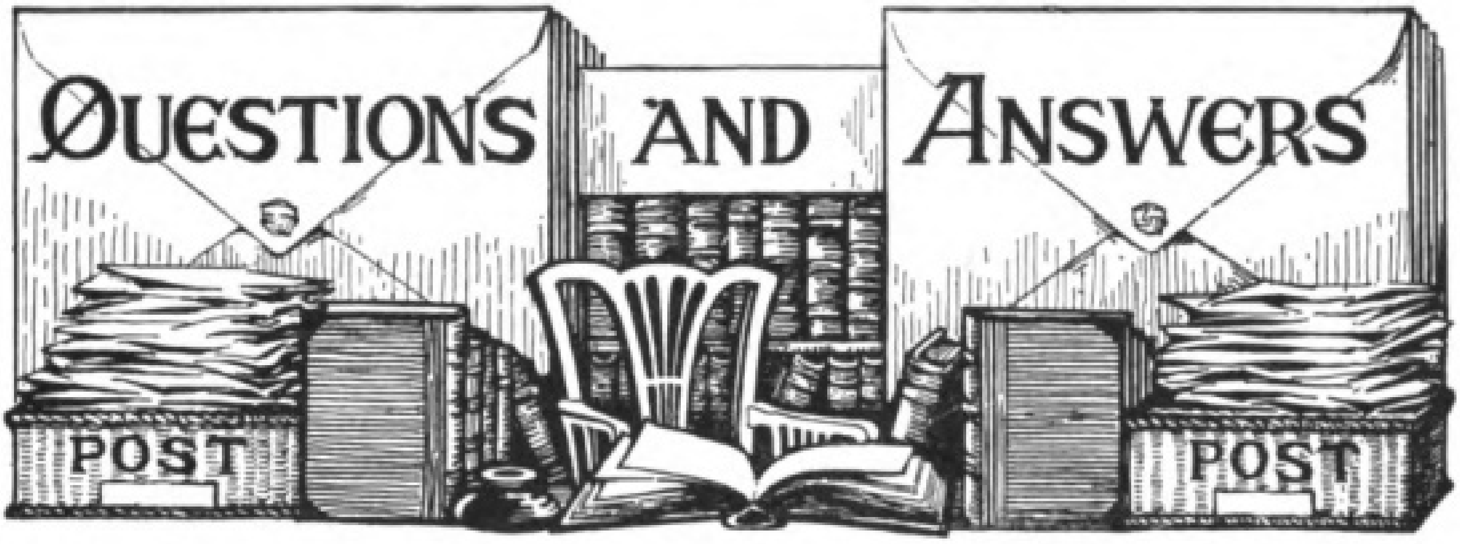
10999. August 3rd. W. Cross. (*Svenska Akt. Gas accumulator.*) Detectors for Wireless Telegraphy.

10958. August 3rd. R. A. Fessenden. Apparatus for transmitting and receiving sound waves through the ground. (Convention date, U.S.A., October 7th, 1915. Patent No. 101,968 *Open to inspection.*)

Share Market Report

LONDON, *December 11th*, 1916.

Business in the Share Market has been very quiet during the past month. The closing prices as we go to press are: Marconi Ordinary, £2 15s.; Marconi Preference, £2 6s. 3d.; Marconi International Marine, £1 17s. 6d.; American Marconi, 15s.; Canadian Marconi, 9s. 6d.; Spanish and General Wireless Trust, 10s.



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.

POSITIVELY NO QUESTIONS ANSWERED BY POST.

NOTE.—*In view of the large number of questions which now reach us from readers, we regret that we cannot undertake always to answer queries in the next issue following the receipt of letters. Every endeavour will be made to publish answers expeditiously.*

K MacB. (Cricklewood).—An article on "Operating in the Merchant Service" appears in this issue.

C. L. C. (Willesden).—The design for a wireless telephone transmitter given in the sketch attached to your letter is interesting, but it would not work owing to the fact that the selenium would not vary its resistance rapidly enough to enable it to be used in such a connection. Selenium takes quite an appreciable time to vary its resistance when a beam of light falls upon it.

D. M. J. (Plumstead).—Officer-in-Charge, Royal Naval Air Service, Wireless Section, Wormwood Scrubbs.

M. G. (Bradford).—(1) The age limit for any applicant for the Marine Service of the Marconi Company is 25, and this limit has not been relaxed during the war. (2) A few shipping companies employ their own operators, but we have no information regarding their conditions of employment. In any case a man of 34, with no sea experience would probably find difficulty in obtaining such employment. (3) Yes, there are occasional openings for English operators in the Colonial Mercantile Marine; but here, again, we come to the question of age.

J. S. (Cardiff).—See the article entitled "Naval and Military Wireless Telegraphists, Their Status and Conditions of Training," in our October issue.

J. W. (Blackpool).—See an article on "Operating in the Merchant Service," in this issue.

L. A. W. (Thirsk).—(1) You will find full details of the Marconi uniform and some useful hints on outfit in the *Wireless Diary and Note Book* just published. This is a very useful pocket-book and diary and the information contained therein should prove very valuable to you. (2) With regard to etiquette on board ship and the conduct towards the captain and other officers, there is nothing much to be said beyond that the operator is required to bear himself in a gentlemanly manner. The commander should be saluted, and it is considered courteous to salute the bridge when one's business takes one there. It is wise to respect little personal peculiarities of the commander, and a quiet chat with one of the officers on joining should make the way quite smooth. If an operator wants to make himself thoroughly unpopular he has only to "give himself airs," and if a new man will use his common sense and tact he is not likely to go wrong.

PRIVATE T. (H.M.S. ——).—If you carefully study the books you mention in your letter you should be in a position to pass the examination after a short finishing course. We do not think, however, that a week would be sufficient; a month would probably be the shortest time in which you could get the necessary practical training. P.M.G. Examinations are held at regular intervals and just as frequently as there is need for them. A postal course should be of great assistance to you as by answering the various questions which would be put to you and having your answers criticised, you should be able to learn your weak points. The value of a correspondence course is not so much in the text-books with which one is provided, but in the criticisms of one's work which are given.

E. J. G. (Upper Holloway).—See an article on "Operating in the Merchant Service" in this issue.

K. C. (Denmark).—Most of the crystals used in wireless telegraphy are rather complex bodies. Molybdenite is a bisulphide of the metal molybdenum, bornite is a copper ore, galena a lead ore consisting mostly of the sulphide of lead, iron pyrites is sulphide of iron, silicon and tellurium are elements, and plumbago is a form of carbon, chalcopyrite is complex copper ore consisting largely of copper sulphide and also containing iron. Zincite is an ore of zinc. Perhaps one of our readers who is a student of geology would like to contribute an article on crystal detectors from this point of view; we are sure it would be welcomed. With regard to your last question, wireless telegraphists in the British Mercantile Marine are required to be British subjects. The Société Anonyme Internationale de Télégraphie Sans Fil, Marconi House, Strand, W.C., which controls the wireless service on a large number of foreign vessels, would, however, give consideration to your application when you are free.

SAPPER L. B. W. (Epping).—There are vacancies at the present time for electricians with wireless knowledge in the wireless section of the Royal Engineers. See announcement on another page.

A. B. C. (Gosport).—See Post Office Circular, November 21st, 1916, No. 2323.

SPARK GAP (Tralee).—(1) The questions at the P.M.G. Examinations are oral and are not published. (2) *The Handbook of Technical Instruction for Wireless Telegraphists*, by J. C. Hawkhead and H. M. Dowsett, 3s. 6d., post free, 3s. 10d., from the Wireless Press, Limited. (3) and (4) Yes, the apparatus you mention is very good. The same firm supply, we believe, some cheaper sets, and you should write to them for particulars. (5) See advertising pages of this issue.

P. S. (Westcliff-on-Sea).—An article on the wireless service of the Navy appeared in our October issue. If this does not contain the information you require please write to us again.

P. J. L.—To explain clearly the working of vacuum valves would take more space than we can give in these columns. We hope, however, to publish an article shortly in which the working of all forms of vacuum valves will be thoroughly dealt with.

R. B. P. (Essex).—THE WIRELESS WORLD examinations have been suspended during the war.

S. G. (Tocra).—Thank you for your letter and kind wishes. In reply to your first question, the best arrangement for radiation is always that in which you get the best spark, and if you vary the fixed electrodes until such an adjustment is obtained, you may be sure you are getting the best radiation. We understand from your second question that you are increasing the wave length of your detector circuit by placing a variable condenser in parallel with the condenser of the tuner. This is quite a good arrangement, and is, in fact, similar to that adopted in the multiple tuner, where the capacity of the condensers is augmented by three fixed condensers attached to the studs controlled by the tuning switch. In reply to your third question, we regret we cannot publish any information regarding wave lengths of particular wireless stations, neither can we state which station sends out any particular programme of press. (4) Only British subjects can be employed in the wireless service of the British Mercantile Marine. The Marconi International Marine Communication Co., Ltd., Via del Collegio Romana 15, Rome, controls the wireless installations on Italian vessels, and you should make application to them after the war if you wish to enter such a service. We are very glad to hear that THE WIRELESS WORLD is so useful to you.

SPECIAL NOTICE.

Readers will considerably facilitate the work of our Expert if they write their questions on one side of the paper only, and make their queries as clear and full as possible. Questions should be numbered for reference and should not exceed four.