THE
National Telephone Journal

VOL. VI. OCTOBER, 1911. No. 67.

TELEPHONE MEN.

LXV.—BERTRAM SYDNEY COHEN.

BERTRAM SYDNEY COHEN was born on Oct. 26, 1876, and educated at Highbury New Park Grammar School and the City of London College. He subsequently attended the Polytechnic School of Engineering and the Finsbury Technical College.

In 1895 he entered the Electrical Company, Limited, as a pupil, and was engaged in arc lamp testing. He was with the General Electric Company for a short time in 1896 and thence went to the arc lamp department of Messrs. Peter Jackson & Company in Salford. Returning to London, he entered the Company's service in May, 1897, and was engaged in switchboard fitting under Mr. Hidden, at that time electrician for the City district. In the course of a month or so it was found necessary to overhaul and partly re-wire the old flat board and test board at Gerrard Street, and to instal a new power plant. A special staff, under Mr. Wormull, of the Engineer-in-Chief's Office, was formed for the purpose. This staff, to which Mr. Cohen was attached, worked entirely at night time all through the summer of 1897, and he has many amusing recollections of this strenuous time, when sometimes it was necessary to work continuously from a Saturday evening until Monday morning.

At the end of 1897 Mr. Cohen was transferred to the Engineer-in-Chief's staff at Oxford Court as assistant to Mr. W. Aitken, who was then in charge of the Switchboard Equipment Department. At that time the Company was passing through a transition period as regards telephone systems. The C.B. system had not yet been adopted, and attempts were being made to introduce a system which would combine some of the features of both the magneto and the C.B. Mr. Cohen was chiefly employed in designing circuits and drawing up specifications for new exchanges, with some occasional investigation and experimental work. He was also concerned in drawing up the specifications for some of the early C.B. exchanges installed in this country.

In 1900, in conjunction with Mr. P. H. Cole (now in Shanghai), Mr. Cohen took a leading part in the formation and continuation of the Company's Correspondence Class scheme. These classes have now grown from one course and about 900 members in 1900 to seven courses and about 3,000 members. From 1899 to 1905 he was Lecturer in Telephony and Telegraphy at the West Ham Technical School.

In 1904 Mr. Cohen was placed in charge of the newly formed Investigation Department in the Engineering Office. In this department hundreds of technical investigations of all kinds, but principally dealing with transmission, have been carried through to a conclusion. This department has, in addition, for some time been dealing with the standardisation of the transmission in the Company's areas, and, since the adoption of loading by the Company, has undertaken this work, over 2,000 circuit miles of cable having either been loaded or schemes prepared.

In 1907 Mr. Cohen, in conjunction with Mr. G. M. B. Shepherd, read a paper on "Transmission" before the Institute of Electrical Engineers, for which they received the Fahie premium. He has also read two papers before the Physical Society of London on "The Production of Alternating Currents for Telephonic Measurement" and "Telephone Currents in Loaded and Unloaded Lines." Several articles written by him have appeared in this JOURNAL. In addition, he has lectured about 35 times before the Company's various telephone societies, and has made quite a reputation as a lecturer able to make difficult matters easy. In fact, Mr. Cohen's research work is well known to the scientific world both in this country and in both continents.

Mr. Cohen has designed apparatus for telephonic transmission

purposes, of which a form of barretter and a vibrating wire interrupter for producing electric waves are probably familiar to readers of the JOURNAL.

The work done by the department under Mr. Cohen has been of great value to the Company and to the science and art of telephony as a whole. Perhaps the great steps telephone engineering has taken in recent years has been due to the replacing of generalities by more exact knowledge, and in this matter Mr. Cohen has borne an important share.

Among his many hobbies are reading and music, and he is very fond of swimming, boating and nature study.

THE COMPANY'S CORRESPONDENCE CLASSES, 1910-11.

WE give below a list showing the members who obtained the first five places in each of the various courses of these classes during the past session :—

	Name.	District.	Percentage.
"A" COURSE.			
1st place ..	Payne, E. T... ..	Newcastle.. ..	97·5
2nd ,, ..	Husband, S. J. ..	Head Office ..	96·5
3rd ,, ..	Jarrett, G.	Liverpool ..	94·0
,, ,, ..	Ponsonby, W. ..	Liverpool ..	94·0
,, ,, ..	Rankin, G.	Liverpool ..	94·0
"B" COURSE.			
1st place ..	Payne, E. T	Newcastle ..	93·8
2nd ,, ..	Broomhead, A. ..	Sheffield	92·8
3rd ,, ..	Carrier, G. H. ..	Birmingham ..	85·6
4th ,, ..	Morton, C.	Birmingham ..	81·0
5th ,, ..	Crispin, W.	Met. Engr.'s Dept.	75·8
"C" COURSE.			
1st place ..	Carter, A. O. ..	Exeter	95·8
2nd ,, ..	McGowan, G. ..	Manchester ..	90·4
3rd ,, ..	Impey, A. B. ..	Sheffield	89·0
4th ,, ..	Wright, J. W. ..	Sheffield	86·9
5th ,, ..	Thompson, E. J. ..	Luton	82·1
"D" COURSE.			
1st place ..	Carter, A. O. ..	Exeter	93·1
2nd ,, ..	Hyde, J.	Sheffield	79·5
,, ,, ..	Kneale, G.	Dublin	79·5
4th ,, ..	Morrish, H.	Met. Elec.'s Dept.	65·8
,, ,, ..	Sutter, A.	Glasgow	65·8
"E" COURSE.			
1st place ..	Baker, T. W. ..	Leeds	100·0
,, ,, ..	Booth, W.	Manchester ..	100·0
3rd ,, ..	Brown, F.	Leeds	99·1
,, ,, ..	Davidson, H. C. ..	Norwich	99·1
,, ,, ..	Goulden, W... ..	Head Office ..	99·1
,, ,, ..	Pinnock, A. E. ..	Hull	99·1
"M" COURSE.			
1st place ..	Ayers, R. J.	Norwich	99·6
,, ,, ..	Frisby, A. L. ..	Leicester	99·6
,, ,, ..	Pollard, R.	Norwich	99·6
,, ,, ..	Woods, T.	Norwich	99·6
5th place ..	Betts, E.	Norwich	98·8
,, ,, ..	Thirkell, E.	Met. Acct.'s Dept.	98·8
"N" COURSE.			
1st place ..	McEwan, A. . ..	Newcastle ..	99·2
2nd ,, ..	Peake, A. W. ..	Met. Engr.'s Dept.	97·8
,, ,, ..	Shaw, R.	Gloucester ..	97·8
4th ,, ..	Thompson, E. J. ..	Luton	96·4
5th ,, ..	Knight, E. W. ..	Southampton ..	96·0

NATIONAL TELEPHONE STAFF BENEVOLENT SOCIETY (LONDON).

Special Notice.—The committee wish to draw the attention of the collectors to the advisability of keeping the objects of the society under the notice of the staff during the next few months. So much of interest to all will be continually in the minds of the staff during this period that our society may be in danger of being overlooked at a time when its position, in view of the transfer, should be made as strong as possible.

Grants to the value of £12 3s. 6d. were made during the month of August, 1911.

Total number of grants made since formation of society 367, value £1,171 18s. 4d.

Amount of subscriptions receiving during August £7 2s. 1d.

Donations received, £11 9s. 11d.

FROM THALES TO NEWTON.

BY P. T. WOOD, *London.*

(*Concluded from page* 127.)

THE credit for the introduction of the decimal point is also due to Napier, though such a method of operating with fractions did not come into general use until the eighteenth century.

The period which saw the death of Napier and his contemporaries marks the commencement of a new era in the history of our subject—the modern era of applied mathematics. With few exceptions, the mathematicians of ancient and medieval times had devoted themselves to the theoretical rather than to the practical side of their subject, and indeed had rather scorned the idea of its application to commercial needs. But their work, though not in the cause of practical knowledge, was none the less useful to succeeding generations, and to-day the branch of geometry called conic sections, named by the Greeks "sublime geometry," has become the starting point for the consideration of hyperbolic functions as applied to electrical engineering. History repeats itself when Dr. Kenelly, at the Institution of Electrical Engineers, prefaces his lecture on this subject with a reference to the pleasure of speaking on such a "beautiful" subject.

At the commencement of the seventeenth century mathematical reasoning began to be applied to various physical sciences, and the first to derive benefit from this new ally was mechanics.

Practically nothing had been added to the theory of statics or hydrostatics since the time of Archimedes, but now it became usual to represent forces by straight lines, and to find their resultant stress by the application of the "triangle of forces."

This latter was the invention of Stevinus, a merchant's clerk in Holland, who also was the first to distinguish between stable and unstable equilibrium. The treatment of problems in statics was thus completely changed, and the first step taken towards vector working.

It is evident that Stevinus was somewhat impatient of contrary opinions, for he writes: "And those who cannot see this, may the Author of nature have pity upon their unfortunate eyes, for the fault is not in the thing, but in the sight which we are unable to give them." Mathematics is not usually a subject of controversy nowadays, but disputes were frequent and bitter in the seventeenth and eighteenth centuries, keen rivalry existing between the leading mathematicians of this time; in fact, it was the practice to keep discoveries secret in order to secure an advantage over rivals when challenging them to mathematical contests.

The invention of analytical geometry and the calculus gives us mathematics in its modern form. These two branches are by far the most important contributions that have been made to the expression of physical phenomena in mathematical terms.

Descartes, the inventor of analytical geometry, was by birth a Frenchman and by profession a soldier. Walking one day through the streets of a town in Holland he saw a placard in the Dutch language that excited his curiosity. He stopped a passer by and asked for a translation, and was told that the placard was a challenge to all the world to solve a certain geometrical problem. Descartes worked it out in a few hours. This proof of his mathematical abilities decided him to retire from the uncongenial life of the army and occupy his time in study. In the year 1638 he published his geometry, which contained the simple proposition that a point in a plane could be completely defined by giving its distances, say, x and y, from two fixed lines drawn at right angles to each other in that plane.

Such a proposition led to the important conclusions that though an equation might be satisfied with an infinite number of values of x and y, yet a few such values would enable a curve to be drawn expressive of the equation in which every point would be equally true to that equation. On the other hand, given the curve it would be possible to obtain an equation expressive of that curve from which any inherent property could be deduced by ordinary algebra.

By the use of squared paper, now universally employed for laboratory or, indeed, any investigation work, the full benefit of Descartes' discovery is gained. Any relationship between two co-ordinates can be readily ascertained and the cause of any variations in

that relationship investigated; in fact, there is hardly a limit to the benefit derived from this application of algebra to geometry.

Descartes was also responsible for the present system of indices, and was the first to employ the letters at the beginning of the alphabet to denote known quantities and those at the end of the alphabet to denote unknown quantities.

There remains one further branch of mathematics to consider. I shall risk the sneer that "fools rush in where angels fear to tread," and refer briefly to the calculus; my purpose being to interest those who desire no more than an intelligent appreciation of this subject, as well as to excite a desire to know more in the mind of those whose mathematical knowledge stops short of it.

To Newton belongs the honour of the discovery of the infinitesimal calculus, though that honour must be in part divided with Leibniz, who gave the calculus its existing form and introduced the names and signs employed to-day. It is said by one competent to judge that "Newton was not only the greatest genius that ever lived, but he was also the most fortunate, for as there is but one universe, it can happen but to one man in the world's history to be the interpreter of its laws."

Before the age of 25 he had invented the binomial theorem and the fluxional calculus, and had formulated his great theory of universal gravitation. There is, of course, a very intimate relation between the astronomical problems upon which he was engaged, and (1) the measurement of circular areas and curves, and (2) the calculation of the rate of change in a varying quantity. It was in connection with this work that Newton developed his calculus, and was enabled to obtain conclusions in many branches of research work, not otherwise possible.

As we have seen, the ancients knew no method of obtaining accurately the area of any figure with a curved boundary. Approximate results, however, were obtained by regarding the curved line as made up of a number of short straight lines, and the greater the number of the lines taken the nearer to accuracy was the result. Such a method was greatly improved at a later date by Kepler and others, absolute accuracy being obtained in the limit, *i.e.*, when an indefinite number of such lines were taken. This process of summation is called integration, and historically, as we have seen, such a method preceded that of the more fundamental (let it pass) principle of the differential calculus, or calculus of small differences. This latter was the invention of Newton, and is the process of finding the value of the ratio which an increase in y bears to an increase in x when an indefinitely small change is taking place.

Suppose, for example, a point on the circumference of a revolving wheel. At any instant this point is moving in the direction of the tangent of the curve of the wheel at that point. Not only is the point changing in direction and position but it is also changing at a definite rate. The measure of the velocity, change of direction and position of the point, it is the business of the differential calculus to find, and once more the problem resolves itself into "running to earth" the proportion which a tiny change of position or direction bears to an equally tiny change of time or distance.

Space will not allow a more detailed reference to this fascinating subject, nor to the law of organic growth underlying all its problems. It should be clear, however, from the little that has been said what really is the use of the calculus. Its importance lies in the fact that whenever a quantity changes—and most things in nature are in a constant state of change—the differential calculus enables the rate of increase or decrease to be measured. It is largely by this means that the laws governing physical quantities in a state of transition are investigated, *e.g.*, water cooling, energy dissipating, etc.

Newton died at the age of 85, and was buried in Westminster Abbey. It is said that the binomial theorem is inscribed on his monument, so great was its importance to mathematical investigation deemed, but this I have been unable to confirm. His extraordinary abilities enabled him to advance every branch of mathematical science then studied, and brought within the scope of mathematics the chief branches of physics. It was characteristic of the man that he could, a little before his death, make the well-known remark: "I do not know what I may appear to the world, but to myself I seem to have been only like a boy playing on the seashore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, while the great ocean of truth lay all undiscovered before me."

Since the time of Newton a number of great mathematicians have arisen in England and on the Continent, but more important perhaps than the attainments of the few has been the spread of mathematical knowledge among the many. Cocker (1631 to 1675), whose arithmetic ran into 112 editions, was the first of the many modern writers of text books on mathematics, and except that terms such as alligation, single and double fellowship, false position, etc., are used, his work differs little from elementary text books of to-day. Very curious, however, are the earliest books on arithmetic, and an example of the earliest known book on Indian mathematics will be of interest. It is called *Lilivati*, and is written in poetry, and based on a kind of romance (since made the foundation for one of Longfellow's prose writings).

One of the sums given is the following:—

"Pretty girl with tremulous eyes, if thou knowest the correct method of inversion, tell me what is the number which, multiplied by three and added to three-quarters of the product, and divided by seven, and reduced by subtraction of a third part of the quotient, and then multiplied into itself, and having fifty-two subtracted from the product, and the square root of the remainder extracted, and eight added, and the sum divided by ten, yields two." Which reminds one of the examination question set to a noble of the court of King Arthur:

"If A trade a barrel of onions to B, worth 2 pence the bushel, in exchange for a sheep worth 4 pence, and a dog worth a penny, and C kill the dog before delivery, because bitten by the same, who mistook him for D, what sum is still due to A from B, and which party pays for the dog, C or D, and who gets the money? If A, is the penny sufficient, or may he claim consequential damages in the form of additional money to represent the possible profit which might have inured from the dog, and classifiable as earned increment, that is to say, usufruct?" To which the bewildered student replies: "Verily, in the all-wise and unknowable providence of God, who moveth in mysterious ways His wonders to perform, have I never heard the fellow to this question for confusion of the mind and constipation of the ducts of thought. Wherefore I beseech you, let the dog and the onions and these people of the strange and godless names work out their several salvations from their piteous and wonderful difficulties without help of mine, for indeed their trouble is sufficient as it is, whereas an I tried to help I should but damage their cause the more, and yet, mayhap, not live myself to see the desolation wrought."

"THE AWARD OF PERSISTENCE."

BY THE CONTRACT MANAGER, *Brighton*.

HE dwelt in a thriving Sussex town, and since that first day, now so long ago, when the suave and courteous contract officer unfolded the oft-told tale of the telephone's advantages, he had hidden deep in his heart that "some day" in the dim and misty future he should possess this joy. But, alas, between him and It there loomed the stern visage of his would-be better half, who looked askance at Contract Officer A. on his regular calls. Finally, when she hurled at him the ultimatum that if a telephone came there she would go, even the best contract man could not induce a subscription under such conditions.

For seven long years she was wooed and lost, but Contract Officer A. reports last week that, three days after the lady had been called to another clime where contract officers cease to worry and most contract managers are at rest, he called on the bereaved and the order was fixed for a telephone.

Surely not more was Jacob's wait for Rachel, an equal seven long years and persistence now has its own reward. May the new love's help and companionship bring seven years' plenty—and the rental!

SOME OBSERVATIONS ON TELEPHONE TRANSMISSION.*

By J. L. McQUARRIE.

(*Concluded from page* 116.)

FOR a long time extensive use has been made of means permitting the simultaneous use of a line for telephony and telegraphy. If the two wires of a metallic telephone circuit are used for independent grounded telegraph circuits, we say the line is "composited"; but if the two wires of the telephone circuit are used in parallel as a telegraph circuit, we say the line is "simplexed." The compositing of a circuit does not limit the possibilities of also using it as one side of a phantom. The composited or simplexed circuits result in large savings, but whether the former or latter should be used depends upon a number of considerations. It may here be stated, however, that in general the use of the simplexed circuits presents fewest complications, so that where an adequate supply of telegraph circuits can be obtained by this method it is not usual to resort to composited circuits. This should not be misunderstood as implying that the use of composited circuits involves much complication, since, provided suitably designed equipment has been procured, the operation of composited circuits presents no difficulties. The transmission loss due to the addition of composited apparatus to the two ends of a circuit is just noticeable, being about 10 per cent. or one mile of standard cable. The loss due to simplexing depends upon the type of simplex employed whether "bridged retardation coil" or "repeating coil," and in each instance upon the type of apparatus used. In the case of small cheap repeating coils sometimes employed the loss may be serious, being perhaps 50 per cent. or six or seven miles of cable.

In the case of composite apparatus especially, it is important that it should be carefully designed so that the telephonic efficiency will be a maximum, and the chances of interference due to noise between the telegraph and telephone made a minimum.

STANDARDISING METHOD OF MEASURING TRANSMISSION.

In the successful practice of any art it is essential that means be provided for measuring the value of its elements, and a standard method of measuring the value of telephone transmission has been developed. In the earliest days of telephone practice it was customary, when comparing two instruments, or when comparing the transmission over two lines, to express the difference in transmission by the statement that one of them was a certain per cent. superior or inferior to the other. The objection to recording the results of tests in this way is that no two observers expressed a given difference in transmission efficiency by the same percentage. Each observer had a certain arbitrary standard by which he expressed the differences. Thus, for instance, an observer might note a difference which he could just distinguish as 5 per cent., a comparatively important difference by 15 per cent., and a very large difference by 50 per cent. Another observer might express a difference which he could just distinguish by 1 per cent., a comparatively important difference by 5 per cent., and a very large difference by 15 per cent., or 20 per cent. It therefore became necessary to choose some standard unit so that the results of different observers could be compared, even if one was a telephone engineer in the United States and the other a telephone engineer in a foreign country. The engineers of the American Bell Telephone Company selected as the basis for a standard of transmission a No. 19 B. & S. gauge paper-insulated cable, having a capacity of ·054 microfarad per mile. The transmission efficiency of a telephone circuit between two standard sub-stations could then be stated to be equivalent to a certain number of miles of standard cable. If this circuit was changed in some small degree, such as, for example, by the insertion of a bridged drop, the changed circuit was then noted to be equivalent to a slightly different length of standard cable. The difference between the two lengths of standard cable corresponding to the line with and without the bridged drop was said to be the transmission loss or gain, due to the insertion of the bridged drop; or, as another illustration, if with one type of transmitter it was possible to talk over a given length of No. 19 gauge cable, while with another transmitter the same volume was obtained over a different length of standard cable, the difference between the two lengths was said to measure the inferiority or superiority of one transmitter over the other. As it is not convenient to use actual No. 19 gauge cable circuit, artificial cables were designed in convenient form for transmission testing. Some of the earlier forms of these cables are described very fully in P. E. Erickson's article on page 676 of *Telephony*, June 12, 1909. It should be here pointed out that in the use of artificial lines, or, for that matter, in the use of actual No. 19 gauge cable, certain precautions must be taken to avoid false results. For instance, the insertion of one mile of No. 19 gauge cable in the middle or at the end of an aerial line does not increase the transmission loss over the circuit by the same amount as does the insertion of a short length of cable, such as one mile in a similar cable circuit. To illustrate: If open wire lines were being compared and they differed slightly, correct results would not be obtained if, in order to make the volume the same, a short length of cable, say, one or two miles, were added to the circuit having the better transmission. The length of cable added would not represent the difference in transmission efficiency. One method of measuring the transmission efficiency of the two circuits would be to determine the equivalent of each one in terms of standard cable, then to take the difference between the two noted results as representing the difference in efficiency of the two circuits.

OBTAINING CONSTRUCTION AT MINIMUM COST.

To one called upon to furnish telephone facilities the important problem is to determine in detail what construction should be employed in order to obtain the required result at a minimum cost. At the present time telephone sub-station apparatus has been fairly well standardised, and the difference in cost between the very best and the inferior instrument is so small that there should be no excuse from a financial point of view for the purchase of inferior transmitting or receiving apparatus. Compared with the cost of the lines, as will be illustrated later, the differences in the price between the very best telephone apparatus and the poorest is infinitesimal. The largest economies, therefore, which it is possible for one planning a telephone system to achieve are accomplished by savings in line construction and by the use of such methods of operation as will secure the maximum use of the facilities provided.

In dealing with this phase of the problem it is first necessary to establish a standard of transmission which it is desired to furnish. Preferably this standard of transmission should be expressed in miles of standard cable, although if it is so desired it can be expressed in terms of an open wire copper circuit of a given loop resistance or weight per conductor per mile. If different classes of lines are to be considered, it may be advisable to have two standards, one for a certain class of service, perhaps the bulk of that which is being considered; the other for a certain special class of service which represents but a small percentage of the total amount. For instance, it might be desirable to fix for certain classes of service a 20-mile standard, which for other classes of service a 30-mile standard might be considered satisfactory.

GENERAL SUGGESTIONS REGARDING CONSTRUCTION.

Having established the standard of transmission, I may point out certain general principles for guidance in determining the most suitable construction. If the circuits are to be wholly of open wire, the problem is comparatively simple. If copper wire is to be used, mechanical strength limits the engineer to the use of wire not below 160 or 175 lbs. in weight, although climatic conditions, such as sleet or high winds, must be taken into consideration. Very approximately, where copper is used, the length of line over which it is possible to give the desired standard of transmission is inversely proportional to the resistance of the circuit per loop mile. To illustrate, if transmission between two sub-stations of a standard type is satisfactory over a 400-mile line of 210-lb. copper wire having a loop resistance per mile of approximately 8·5 ohms, then an equal grade of transmission can be given over a circuit 200 miles in length by using copper wire weighing approximately 105 lbs. per mile and having a resistance of approximately 17 ohms per loop mile. However, as the latter size of wire under ordinary conditions does not possess

* Abstract of a paper presented at the Boston Convention of the Association of Railway Telegraph Superintendents.

satisfactory mechanical strength, it is necessary either to use larger copper wire or to use bi-metallic wire, selecting in this case a size and grade of wire which will provide mechanical strength with a resistance not in excess of that of the 105-lb. copper conductor, or 17 ohms per loop mile.

Two cautions may well be introduced here: First, that this proposal is only approximate and, since exact transmission efficiency involves the knowledge of an experienced telephone engineer, it is well, where the amount of construction is considerable, to obtain the advice of an expert, because the difference in cost between two sizes of wire may represent a very large sum of money. Second, for iron wire circuits no simple rule applying to different gauges of wire can be given, since their efficiency is not simply related to the weight or resistance, as well as for the reason that in the case of iron circuits there is a tendency for the joints to become of high resistance, causing an old iron circuit to have a much lower transmission efficiency than the same circuit when newly installed.

In the case of cables, the transmission efficiency varies inversely as the square root of the product of the loop resistance and the mutual capacity. Diverging for a moment, since in the past there has been some confusion in regard to the capacity of a cable as affecting transmission, it may be emphasized that it is the mutual capacity between wires of the pair and not the grounded capacity of a wire or conductor which influences the transmission. However, it can be added that for ordinary paper-insulated lead-covered cables the ratio of the mutual to the grounded capacity is nearly constant, being approximately two-thirds. Hence, if in one case the mutual capacity is known and in the other only the grounded is available, it is possible to compute the mutual capacity in the latter case and then compare the two cables.

To illustrate this rule governing the efficiency of cables, an example or two may be presented. Very approximately the capacity of paper-insulated lead-covered cables of different gauges may be taken as the same, since it is common practice so to construct them. Assuming No. 19 B. & S. gauge cable as the standard, a No. 16 B. & S. gauge cable which has approximately half as many pairs for the same size of lead sheath and for the same weight of copper, gives only 40 per cent. increase in transmission efficiency over the standard No. 19; or, in other words, 1·4 miles of such No. 16 gauge cable is equivalent to one mile of No. 19 gauge cable. In the same manner, two miles of No. 13 gauge cable gives the same transmission loss as one mile of No. 19 gauge cable of the same capacity; that is, in the case of non-loaded cables, of which I am now speaking exclusively, to double the transmission efficiency it is necessary to multiply the weight of the copper conductor by four, which obviously results in a very large increase in cost.

Regarding the capacity of cables, it may be pointed out that, in order to obtain a change in mutual capacity of, say, from ·070 to ·054 microfarad per mile, it is necessary to very greatly reduce the number of pairs in a cable having a given-sized sheath, the reduction in some cases being almost as great as 50 per cent. While it is not possible to formulate a rule applicable to all cases, it has in general been found to be economical to use cable having a reasonably high capacity, that is, a rather compact cable, and then where necessary to increase the transmission efficiency by increasing the size of the conductor and gauge rather than to attempt to secure the transmission gain by a low capacity. This is especially true when the price of copper is low.

As to Part Cable and Part Open Wire.

The above directions apply to cases where the transmission circuit is wholly a cable line or wholly an open wire line. If of necessity the circuit must be carried for part of the distance in cable and part of the distance in open wire, the problem is much more complicated, since in order to obtain a standard grade of transmission at a minimum cost it is necessary to so proportion the cost of the cable portion of the circuit and the cost of the open wire portion of the circuit as to produce a minimum cost for the whole line. In a paper of this nature it is hardly possible to present even general rules to cover the methods to be followed in so proportioning costs. I may, however, illustrate what is not good practice by an example: If it is desired to furnish transmission between points 400 miles apart, and if of this distance conditions require the use of a cable for ten miles, the remainder of the distance being open wire, it would obviously be uneconomical to use a large gauge conductor, such as a 420-lb. copper wire, for the open wire portion of the circuit, and for the cable portion of the circuit to use a No. 22 gauge cable. It would probably be more nearly correct proportion to use a 210-lb. copper conductor for the aerial portion of the circuit, and a No. 10 gauge conductor for the cable portion of the circuit. The actual details of construction, however, depend upon several factors, such as the number of circuits which it is desired to provide, whether the cable is to be underground or aerial, etc.

It will in most cases be necessary to equip the telephone line not only with apparatus directly concerned with the transmission of speech, such as the transmitter and receiver, but also for the purpose of signalling there will be required apparatus, such as bells, drops, relays or repeating coils, and these devices will have to be considered in calculating the line. A few general statements more or less in the way of caution may be in place with respect to the use of such appliances. First, referring to bridged apparatus, it being assumed that excepting for very special cases series apparatus is not to be employed, it should be pointed out that the effect of bridged apparatus on the transmission does not depend on its direct current resistance, but upon its impedance to currents of telephonic frequencies; that is, it is quite possible that a drop having a resistance of 200 ohms would not cause as great a transmission loss as another drop having a resistance of 500 ohms if the first drop mentioned had a higher impedance to telephonic currents. For a given style of drop, it is true that the higher the resistance the higher the impedance, but in considering transmission values it is not safe to compare drops of different design and construction on the basis of their direct current resistance.

Guarding against Transmission Losses.

In the case of other apparatus, such as phantom circuit repeating coils, no rule can be given for the transmission efficiency of the coil, since in the design of the repeating coil an attempt has been made to secure adequate ringing efficiency as well as high transmission efficiency. As a general rule, however, the cheaper coils on the market are inefficient from a transmission standpoint. In this connection a word may be said regarding the importance of guarding against transmission losses in the apparatus attached to the circuit. Illustrating by the case of phantom repeating coils, it may be said that the cheapest coil on the market costs perhaps $4, while the most expensive coil on the market costs approximately $15, a difference of $11. For the complete equipment of the phantom circuit the difference in cost of the four coils is, therefore, but $44. Considering the transmission loss at the two ends of the side circuits, the difference in transmission efficiency between the cheap coils and the high grade coils is perhaps four miles of No. 19 gauge cable. It is not a difficult problem in the case of any circuit to determine the cost of making up this transmission loss by the use of a larger gauge of copper conductor. In most cases it will be found that the cost of making up the loss introduced by the coils will be from ten to 100 times greater than the saving which results from the use of the cheaper coil. Therefore, in an efficiently designed plant the use of cheap apparatus involving a large transmission loss is not in general found to be economical. This, however, must not be taken to apply to special cases where a satisfactory grade of transmission can be given over circuits with an inefficient type of associated apparatus. Such cases arise where, for the purpose of mechanical strength rather than for the purpose of telephone transmission, it is necessary to use a certain type of construction. In this connection also it may be pointed out that a transmission test on a piece of apparatus, such as a drop, is not a sufficient indication that the drop should in every case be satisfactory from a transmission point of view. A loss of much less than one mile of standard cable cannot be readily determined even by experts in transmission. Since to make up a loss of a fraction of a mile of cable by increasing the size of the conductor means the expenditure of a large sum of money, the actual amount depending upon the circuit, even losses as small as one-tenth of a mile of cable cannot necessarily be neglected. A safe practice is to secure the best apparatus from reliable sources which can be depended upon to give accurate data regarding the behaviour of the apparatus and circuit.

As the satisfactory quality of telephone transmission depends

to a large extent on what is usually termed the maintenance of the telephone lines, it may be of interest to emphasise certain features involved in maintenance. Poor maintenance results in three defective conditions :

1. Decrease in actual telephonic efficiency; that is, the telephone currents themselves are not transmitted with full efficiency.

2. Noise due to leaks to ground or to adjacent lines, which may be either telegraph, power or lighting circuits.

3. Cross-talk or overhearing from adjacent circuits.

Even when the maintenance is not so poor as to cause an actual decrease in telephonic efficiency but merely to cause noise or cross-talk, the net result is a decrease in telephonic efficiency, since speech is rendered less distinct. As far as the electrical requirements are concerned, maintenance should care for the following points :—In order to prevent a reduction in actual transmission efficiency the maintenance should be of such character that under no condition of weather will the insulation between the two sides of the circuit fall below a certain permissible minimum. As a matter of fact, however, in the case of actual non-loaded circuits, the permissible minimum for the installation is rather low if it is uniformly distributed, and not much trouble in practice is encountered in securing a satisfactory value, especially as it is only in cases where insulators become soiled or where the lines come in contact with foliage that the insulation falls, even under the worst weather conditions, to a seriously low value.

Considering the matter of noise and cross-talk however, the electrical requirements are that the two conductors should themselves be electrically similar and similarly located electrically with reference to all other wires and the earth. By the two wires being electrically similar it is meant that they should be of the same size and of the same material, and that neither wire should contain high resistance joints. By stating that the wires should be similarly located electrically with reference to other wires and to the earth it is to be presumed that, under the usual conditions, the wires have been balanced by transpositions. If, however, one wire has a large leak to earth at a given point and the other wire is well insulated at this point, the balance secured by transposition is disturbed and the chances are that the line will become noisy or that there will be cross-talk. For this reason leakage to earth through poor insulation is very likely to cause noise.

PROBLEM NOT A SIMPLE ONE.

The problem of securing a satisfactory grade of telephone transmission at a minimum cost is not by any means a simple one. However, it is a problem which admits of exact engineering or of as exact an engineering solution as the corresponding problems in power distribution. One called upon to provide telephone transmission facilities as compared with one called upon to provide power transmission facilities, is confronted with two difficulties: First, the problems involved in the case of the telephone are more complex; secondly, the telephone apparatus of different manufacturers is not as classified in a standard manner with respect to performance, while power apparatus, such as generators, motors and transformers, is rated in definite units as to efficiency, consumption of energy, output, etc.

TELEPHONE RATES.

BY W. E. GAUNTLETT, *District Manager, Gloucester.*

IT must have struck all telephone men, more or less, that practically every telephone subscriber, no matter what he pays for a telephone service, whether much or little, invariably complains that it is too expensive. Tackle him and argue it out, and he often has to retract, or he equivocates. The fact appears to remain that the public have not been educated up to the sense of the value of the telephone service from its intrinsic side, and yet on the other hand no man who has once had a telephone service and can afford to continue paying for it cares to give it up, but will admit that its usefulness is inestimable. Why this anomaly? It would appear that his commercial training has only taught him to think in £ *s. d.* directly, and that he is unable to appreciate indirect benefits. Neither does he appear in many cases to calculate the value of a telephone message. For instance, a short time since a firm were approached to increase their facilities as it was found they were losing many calls through "line engaged." They already had a private branch exchange, and it only meant a question of one or two additional junctions and an outlay of a very few additional pounds a year. Figures were submitted to prove it. The reply was simply astounding in these, one would have thought, enlightened days. It was to the effect that it was found the congestion was due to many messages being sent by telephone which should have gone by letter, and that steps had been taken *to reduce* the telephone traffic. The telephone messages would not have cost a penny each, the letters may cost—who knows ? Certainly not less than 2*d.* to 2½*d.* is recognised as the cost price of a letter sent through the post, and if a reply is necessary then this is doubled. This is only one feature of the value of the telephone. What about the time saved? Is there no value in that ? We say time is money, aye, and very often life also. Where is a greater time-saver than the telephone? One can hardly imagine such retrogression, and yet that is a firm who no doubt pride themselves on their business acumen. However, *nil desperandum*—but it is hard work. As we know, the measured rate was introduced to bring the telephone within the reach of the small man, and to a certain extent it is succeeding, but slowly. The small man has not yet got to appreciate the value of the telephone. He wants to see a direct profit on his outlay. He must be educated up to seeing the indirect profit also. The introduction of this rate as an optional alternative to the flat or unlimited rate had the effect of lowering the average annual revenue per line below the cost of production, and naturally the option had to be withdrawn, and all users, great and small, put on a measured service. No one so far has been able to bring forward a single legitimate argument against it. It is the principle of all trading—a certain quantity for a certain sum. Where can you find a commodity sold where one gets an unlimited quantity for a fixed sum? No, the only argument brought against it is that the rates are too high, and here we are brought back to our first point, that the public either don't or won't put a fair value on it. Suppose one man's telephone does cost him £50 per annum against another man's £5, so long as he pays in proportion why should he grumble? He is having value for it; he must need it. Probably his establishment, his rent, rates, staff, etc., are in the same, or even greater, proportion. Does he grumble there? Probably not. but, on the other hand, congratulates himself that it is so. But the telephone--that is another matter. He has only a machine like anyone else in his office, and that appears to be the beginning and the end of his idea of the telephone service. He doesn't see enough for his money apparently. Yet again he doesn't grumble when he pays 6*d.* for a telegram and perhaps 6*d.* for a reply of twelve words, including address; but a telephone conversation and reply of perhaps 300 words he considers dear at 2*d.* or 3*d.* Why? It is a mystery which remains to be solved.

It may be, that with the acquisition by the Government of the telephone service of the country, there will be a revision of rates, but there must be one proportionate rate for all. The old obsolete tariffs must go and everyone put on the same basis. This may lead to a general reduction, but will without doubt not please everyone. The great factor is education—missionary work, if you will. The public must be taught the value of the telephone, not only from its useful side, but its intrinsic side; they must be got to view it as something which costs money to instal and maintain, to learn that the beginning and end of a telephone service is not simply the little piece of apparatus which they have fixed in their premises, but that this is a part of a vast system and organisation requiring first-class plant together with a highly skilled and technical staff to maintain it, who naturally require a fair return for their services. The telephone service of this country has got to pay its own way, and that will not be done by starving it either of men or money. The Government must not act hastily in the matter of rates. Efficiency must come first. This means the best of material and the best of labour. There must be sufficient inducement to attract the best class of man. The system must and will pay if run on proper commercial and technical lines, but those lines must be broad and expansive, offering a field to men and women of the best calibre, with sufficient inducement to instil ambition into them, that they may know that perseverance, energy and ability will receive their due reward.

TELEPHONE WOMEN.

CIII.—ANNIE TURNER.

MISS TURNER joined the Company's service at Wolverhampton in June, 1896. At that time there were only four operators in the Wolverhampton Exchange; but as this exchange grew, she was appointed Supervisor under Miss M. E. Wylde, the present Clerk-in-Charge, in August, 1908, and was the first Supervisor to be appointed in the district. From this position she was soon promoted, and in April, 1909, was appointed to her present position of Travelling Supervisor in the North Midland district.

She visits in the course of her duties the whole of the outside exchanges in the North Midland district numbering 32 in all, scattered over portions of the counties of Staffordshire, Worcestershire, Shropshire and Herefordshire.

Since her appointment, which in the first instance was experimental, as she was one of the earliest Travelling Supervisors so appointed in the country, excellent results have been achieved by her work and teaching.

ANNIE TURNER.

During her fourteen years' service Miss Turner has served under four district and five local managers.

She has no particular hobby, but admits that her chief interest has always been in her work and that some of her happiest times have been spent in the Company's service.

CIV.—FLORENCE WEST.

MISS WEST entered the Company's service in March, 1899, when there were only two 50-line switchboards with less than 100 lines, operated by hand micro-telephones only, at the Margate Exchange. She is Kentish by birth. Her eleven years' service in the same exchange has brought her into intimate acquaintance with the general conditions of operating and the characteristics of the subscribers, which is always of advantage to an operator and to the service generally.

Only four junctions (all to National exchanges) were then connected to the switchboard, and she has seen the exchange increase until it serves about 500 stations with an operating staff of six, whilst there are six Post Office junctions and fourteen National junctions terminating on the boards at the present time.

Appointed to the post of Chief Operator in May, 1901, Miss West has always had the appreciation of the staff under her, who feel that they have a helper in their sometimes difficult duties. Her

FLORENCE WEST.

aim in the switchroom is order and efficiency, combined with that human touch which makes for the happiness of the staff in their duties.

Although uneventful, her service under four district managers and four local managers has been a very happy one.

CAPITAL AND REVENUE.

BY J. M. ANDERSON, *Glasgow*.

(*Concluded from page* 121.)

GENERAL INSTRUMENT REPAIRS ORDER.

THIS order (Fig. 6) performs exactly the same office for the instrument and exchange plant as the last example does for outside plant. All inside plant, once it has been erected at the charge of capital account is kept up to its original good condition upon the "instrument repairs" branch of revenue expenditure, and these orders are the medium by which this is principally carried out. Instead of one works order being issued for the whole district, for local convenience a separate order is made for each of the seven electrical areas.

The work most commonly done under this head consists of

Clearing instrument faults.
Clearing switchboard faults.
Instrument inspections.
Instrument removals not paid for,
Etc., etc.

These three examples show jobs which are each chargeable to one account only. Such jobs present little difficulty with regard to

FIG. 6.

Date issued. *29/9/* 190 *9.* A/c. *J. R.* W.O. *14,119*
To Instrument Fitter — Centre
Please fix *"Royal" Inst. Repairs* instruments
in connection with — line
from *Month ending 28/10/09*
to
for
Commenced *Oct. 1,* 190 *9.* *A. B. R., p.* District Manager
Completed *Oct. 28,* 190 *9.* Local Manager or Electrician
Working 190 Date 190
Posted to Works Order Book by *Jas. McAllan.*
No.

(B 36.) DEBITS. W.O. No. *14,119.* A/C. *J. R.* CREDITS.

Date.	Slip No.	Wages.	Material.	Sundries.	Date.	Slip No.	Wages.	Material.	Sundries.
Total		58 9 9	17 2 11		*Total*			*1 16 6*	
			1 16 6						
			15 6 5						

their allocation. It is in cases where the work partly affects capital account and partly revenue that the finer shades of allocation come into play.

The simplest case of this kind which we have is the ceasement of a subscriber's connection.

FIG. 7.—"C" WORKS ORDER.

Date issued
Wages. *I. & L. R.* *C.*
11/10/ 190 *9* A/c. *Material.* *O. C.* W.O. *14,423*
To Instrument Fitter — Centre
Please fix *Cease O. R.* instruments
in connection with — line
from *D.O. 3,946*
to *Char. 221 Y 4*
for *W. Wilson & Co.,*
587, Garscube Rd.
Commenced *18/10/* 190 *9* *A. B. R., p.* District Manager
Completed *18/10/* 190 *9* Local Manager or Electrician
Working 190 Date 190
Posted to Works Order Book by *Geo. Sharp,* Fitter
Approved *A. R.,* Local Manager or Electrician
Date 190

This is the reversal of the process seen in the first sample—the removal of an established connection. The course of action in such cases is to

(1) Disconnect the line,
(2) Take down the instrument, and
(3) Bring the instrument into stock.

The wages, etc., spent under (1) and (2) are not perhaps strictly of the nature of maintaining the plant or running the service, but emphatically they are not capital expenditure. They are therefore a revenue charge and are allocated (1) to line repairs and (2) to instrument repairs.

No. (3) is the return to stock of a piece of plant which went out on capital. It is a reduction in the value of the plant erected and the value of the instrument is therefore credited to, or taken off capital expenditure.

These works orders are thus allocated to three different accounts; wages to instrument and line repairs, and material to ordinary construction.

Observe that no adjustment is made of capital in respect of the original expenditure on line plant. The line is not taken down and remains a charge against capital. The asset remains—useless for the nonce—but it may be used again. Reference has already been made to the "picking up of spares."

Finally, we come to re-construction work, *i.e.*, broadly, the removal of one piece of plant and its replacement by another. Such work may be undertaken for a variety of reasons. To take a few examples:—

(1) A route may have to be shifted because of wayleave withdrawal or because it is in the way of new building.

(2) An overhead route may be placed underground to modernise the plant and improve the service.

(3) A magneto exchange may be converted to common battery working for similar reasons, etc., etc.

What we have to keep before our minds in allocating such jobs is that capital account must be debited only with the nett increase in value and that all other expenditure must be charged to revenue.

FIG. 8.—SAMPLE OF ALLOCATION.

Gross expenditure ..	£500	0	0	Labour recovering	£20
Less recoveries ..	£60	0	0		
Nett expenditure ..	£440	0	0	Estimated original cost	£400

Nett cost new work £500 − £20 = £480.

Allocation.	Capital.	Revenue.
New work	£480	—
Labour recovering	—	£20
Old existing work	£400	£400
Recoveries	—	£60
	£80	£360

This is used as a general guide.

A piece of plant which originally cost £400 is being replaced. We spend in the process £500 and recover—of the old plant—material to the value of £60.

To charge this correctly we must divide it into four different portions.

(1) New work.—Of the £500 spent, it is found that £20 has gone in labour removing the old plant. The nett new work, £480, is a charge to capital.

(2) The £20 referred to is chargeable to revenue.

(3) Capital, having already borne £400 as the original cost, that sum (since it no longer represents an asset) must be credited to capital and debited to revenue.

FIG. 9.

No. W.O. No. *4,342* ALLOCATION ½ *ORD.* CONSTRUCTION ½ *LINE* REPAIRS.

DEBITS.						CREDITS.						ALLOCATION.				
Date.	Slip No.	Wages.	Material.	Sundries.	Total.	Date.	Slip No.	Wages.	Material.	Sundries.	Total.	Ordinary Constrctn.	Exchange Constrctn.	Junction Constrctn.	Line Repairs.	Inst. Repairs.
Total		*14 10 2*	*15 12 7*													
			4 1 3													
			11 11 4		*26 1 6*		*Total*		*4 1 3*			*13 0 9*			*13 0 9*	
Gross new			*30 2 9*													
Recovery and transfer			*5 10 0*													
Nett new				*24 12 9*												
Original value—																
Material			*5 16 2*													
Wages			*5 10 0*													
Sundries			*1 0 0*													
Total				*12 6 2*												
Nett increase				*12 6 7*												

Date issued to Local Manager. *22/12/* 190 *8.* A/c. ½ *O. C.* ½ *L. R.* W.O. *4,342*

To Line Foreman *T. Lavin.* Centre
Man-hours estimated *325,* spent *582.*
Please *Strengthen route between Busby and Thorntonhall.*
from
to
for
Commenced *22/2* 190 *8.* *R. F. G., p.* District Manager
Completed *9/1/* 190 *9.* Local Manager

(4) The value of the recovered material (£60) being a portion of this £400, is, as an off-set, credited to revenue.

The final result is that capital bears the nett increase in the value of the plant, and revenue bears the loss in value of the old plant plus the unremunerative expenditure in removing it.

Here (Fig. 9) we are spending £26 1s. 6d. nett on strengthening a route. The work consisted of removing some poles, replacing them by heavier poles, transferring the wires to these new poles, etc.

Leaving aside the value of recovered material, the money spent is £30 2s. 9d. Of this sum we find that £5 10s. is labour used in recovering displaced plant and in transferring the wires to their new positions. Subtracting this, we get £24 12s. 9d. as the actual value of the new plant in position. An estimate of the original cost of the displaced plant puts it at £12 6s. 2d. The nett increase in value of plant is therefore £12 6s. 7d., and that sum only is a proper capital charge. As this is approximately half of the total nett expenditure of £26 1s. 6d. the allocation is made "one-half 'ordinary construction' and one-half 'line repairs,'" and each item of expenditure as it comes through is divided equally between these accounts.

FIG. 10.

Date issued to Local Manager. 8/11/ 190 8. A/c. L. R. {Credit O. C. and Debit L. R. with £135 on completion. W.O. 4,295

To Line Foreman Centre

Man-hours estimated spent

Please *Shift two cables from temporary position to permanent position, on Caledonian Railway*

from

to *Ground, Crawford St.*

No. {Cr. "O. C" and Dr. "L. R." with £135 on completion.

(B 36.) DEBITS. W.O. No. 4,295. A/C. L.R. CREDITS.

Date.	Slip No.	Wages.	Material.	Sundries.	Date.	Slip No.	Wages.	Material.	Sundries.
Total		*31 1 7*	*71 4 9*					*23 17 4*	
			23 17 4						
			47 7 5		*Original value old plant*			.. ..	*228 0 0*
					Gross new			*102 0 0*	
					Transferring, etc. ..			*9 0 0*	
					Nett new			.. ..	*93 0 0*
					Decrease			..	*£135 0 0*

Here we have to alter the positions of two underground cables and the shift is accomplished by laying and joining up two new cables in the new positions, then cutting out and removing the old cables.

The gross expenditure is £102 odd, of which £9 odd is expended on the shifting, etc., leaving £93 as the value of the new plant in position.

The cables recovered in this case were in such a condition that they could not be used again. They had to be treated as scrap, and, together with the other sundries recovered, are only valued at £23 17s. 4d. These old cables were actually of greater capacity than the new, and an estimate of their original value in position places it at £228, or £135 greater than the new cables. Capital account carries, therefore, a debit greater by that amount than the value of the now existing asset. To rectify this (in addition to charging it with all the expenditure incurred on the present job) an additional debit of £135 goes against "line repairs" and comes off "ordinary construction."

Having devoted some time to the consideration of capital generally, and the Company's capital in particular, let us, in conclusion, consider for a moment a species which may be new to you. I call this species personal capital. I suggest that every man or woman who by his or her work can earn a regular pay, is a distinctly valuable asset and has a substantial capital value.

What is the capitalised value of a worker? Take a man who, throughout an active career of 50 years, earns an average of £100 per annum. He obtains the same return for his services as would the sum of £2,150 invested at 4 per cent. per annum. He may truly be said to possess, in his own proper person, capital to that extent.

This personal form of capital is really more stable in character than the other varieties. Bar sickness and accident, it is more constant than any gilt-edged security. A wealthy man may lose all he owns by rash speculation, by failure in business—in hundreds of ways—but his personal capital value survives all such disasters.

Personal capital is capable of expansion to a greater degree than any other kind. It is no unusual thing to hear of a man who, at the start of his career, seemed to have no prospect of making a greater average than £100 per annum, qualifying himself, by the acquisition of knowledge and in other ways, to earn £500. In such a case the personal capital value has increased, by wise investment, from £2,150 to over £10,000.

Take the case of a man who starts a small business with a capital—in cash—of one or two hundred pounds. By dint of dogged perseverance, he improves and increases his business, and finally makes it yield him a comfortable living—as comfortable a living as an idler has with, say £10,000 in Consols. How much of that return is due to the cash he originally invested and how much to the personality?

What is true of the small business is true of the huge concern with which we are connected. The Company can show in its accounts the millions subscribed by its shareholders, but it cannot show the enormous amount of personal capital invested by its staff—though this has been the more potent factor in securing the success of the business.

THE TELEPHONE FUTURE OF LONDON.

BY J. STIRLING.

IN the *Post Office Engineers' Journal* for July, 1911, there appeared three attractive articles on telephone subjects. The first—"Telephones in England and U.S.A.," by Mr. T. F. Purves—was commented upon in the NATIONAL TELEPHONE JOURNAL for August. The others were "Advertising the Telephone," by Mr. John Lee; and "The London Telephone System in 1920: A Forecast," by Mr. M. C. Pink. The articles are not only extremely interesting, but are noteworthy as indicating the close attention which is being given to telephone questions by responsible officers of the Department. Although the themes are somewhat different, one is struck by a remarkable coincidence in the tenor of the concluding paragraph in each case.

Mr. Purves winds up with "Employ high-grade men and there will be no friction."

Mr. Pink, after a plea for "a liberal view of the situation," concludes with, "It must not be the sad lot of some historian of the future to say that the Treasury or the Post Office, or both, failed to realise and provide for the potentialities of telephony in the United Kingdom."

Mr. Lee's conclusion is "It is no use advertising unless prompt connections can be given on the application of the public. Here I impinge upon engineering matters, and with courteous abruptness I must stop."

It is the note of doubt, struck, it may be, unintentionally, but struck at the same time, and by different hands not acting in concert, which compels attention. It suggests that some reference to one or two of the outstanding features in the Company's successful organisation in London, and the lines along which progress would have been likely to run had time for further expansion been at command, may not be out of place. The three passages quoted deal with the vital questions of men, money and plant. Regarding each there is implied, rather than stated, a feeling of pessimism, and one wonders whether the telephone future is likely to dispel or confirm that feeling.

Qui s'excuse s'accuse, and fortunately no excuses need to be made for our London staff. Differences of opinion there always will be—that is a healthy sign—but friction between departments is now happily unknown. Several causes have contributed to this; as to whether, when boiled down, they can be dished up in the phrase "high-grade men" the reader must judge. First I place friendly and harmonious relations between the heads of the departments, and

a prompt discouragement by them of methods and manners on the part of their staff which are likely to irritate those in other branches of the service. Encroachments on the functions and powers of another officer, even on trivial matters, must be avoided; but this also implies an obligation to immediate and combined action when more than one department is concerned. Indeed, it is admittedly one of the weaknesses of purely functional organisation that, unless the chiefs are closely and sympathetically in touch with each other, the machinery is apt to get out of gear. Periodical meetings of the chief officers for interchange of views and to discuss and decide questions of policy—which, of course, would include alterations in system, methods of carrying out work, improvements in organisation and the issue of service instructions to the staff—are of the utmost importance. These should be supplemented by similar meetings held by the chief of each department with his executive officers. There must necessarily be also an arbitrator, who shall have power to decide points of difference after hearing both sides of a case, and whose decision must be regarded as settling the matter at issue—an arbitrator who can metaphorically rap together the heads of any inclined to be quarrelsome, where that seems the best way of securing a settlement. Then there must be that loyalty to employers and to each other, which is so much more a question of spirit even than of act; it is a spirit which bullying and unsympathetic methods will do much to prevent, but which can be cultivated and brought to full flower by tactfulness, sympathy and thoughtfulness.

It would be difficult to over-estimate the good results which have been experienced in London through our weekly meeting of chief officers. They keep us in touch with each other and with each other's work in a manner which would be impossible in any other way; the minute books supply countless examples of important subjects thoroughly threshed out in discussion—probably after examination and report by a small committee—decided upon, and the decision embodied in a circular instruction to the staff. Indeed, one feels that such a gathering has now become a *sine qua non* of telephone administration in London, and ought to be an integral part of any organisation laid down for future operations. Given your high-grade men, you must still have a proper system, flexible yet reliable and capable of adaptation to changing needs, if the men are to be given a fair chance of producing the best work.

Further, when men have been appointed to positions of authority, that authority should be real. More and more, as the telephone business has grown, has the Company extended the principle of delegating responsibility to its officers on the spot. This has been notably the case in London, and if economy, combined with efficiency in working, be any test, the policy has been justified by results. There are, of course, certain questions of general policy, the lines of which must be very clearly and precisely laid down, and regarding which no plenary powers could be allowed to administrative officers, but outside of such there are numberless matters which can and ought to be settled on the spot in the interests of the service and the subscribers. In the interpretation of the Head Office Service Instructions, also, the tendency in London has been to apply the spirit rather than the letter, and so allow intelligence and common sense an active, in place of a passive, share in arriving at decisions; this undoubtedly leads to prompt settlements and avoids piles of arrears, both results not to be lightly regarded in the ever-growing work of a great city. In that respect, also, the freedom allowed by the Company has proved to be wise. One other point on the question of staff, and here again I merely iterate the Company's practice, of recent years at least. That is, when far-reaching changes are about to be introduced, give those who will have executive control in carrying them out an opportunity of considering and discussing them before they become effective. How much more smoothly the machinery becomes adapted to a new order of things when there has been a little preparatory confidence reposed in those who run it, instead of suddenly confronting them with an arbitrary and probably cast-iron set of new regulations to be brought into force immediately.

We have also of recent years succeeded in divesting our procedure of the "circumlocution" methods which prevailed in early days. It is so much easier to allow a bad practice to grow up than allow ourselves to grow out of it. Direct dealing between the officer who requires and the one who can supply information has everything to commend it; it is rational, economical and effective. No supervising officer should allow his office to become a clearing house, nor should he allow himself to be swamped by a mass of detail which his subordinates could deal with. How to leave things alone is often as important as how to do things well.

If the telephoning of a great city like London, with its diverse conditions, is to be done on sound commercial lines, that "wide measure of discretion to local officers" which the Postmaster-General emphasised in his speech at the staff dinner will become increasingly necessary. The variety of matters which arise daily is surprising, and it is certain that the day will never come when new problems of telephone administration will be exhausted and stereotyped replies take the place of considered decisions.

The questions of money and adequate plant are inseparably connected. Now that the "Telephone Transfer Act" is an accomplished fact, there will presumably be no lack of the former. The provision of the latter on sound lines is a much more complicated problem. One has seen so much money wasted on the provision of inadequate plant. It is an easy thing to spend money, a more difficult thing to spend it wisely. In telephone work we have now learnt the lesson that haphazard plans do not pay either directly or indirectly.

The special competitive conditions in London must have led to a great deal of direct waste; while the necessity, thrown upon the Company, of making provision up to the end of its license only, has meant indirect waste, the consequences of which will unfortunately become only too apparent in the future. When the whole Metropolitan system comes under *one* control, there will be an opportunity for planning on better lines, because the artificial conditions which have hitherto prevented that will be removed. The first step will probably be to make a new development study for the whole of the Metropolitan area. It will have to be done thoroughly and carefully by officers who know the localities; it will also have to be done promptly; but until it is done, Engineering, Traffic and Contract staffs are largely working in the dark and cannot fully appreciate the needs for which they have to provide. New exchange buildings, cable routes and lay-out, switchboard capacity, all must be planned many months before they are actually needed if subscribers are not to be kept waiting, and when, as has too often happened, the provision is not ready for, or equal to, the demand, temporary arrangements involving unremunerative expenditure have to be made. Of course, the arguments which can be adduced in favour of complete and systematic development studies are rudimentary, but the waste which the lack of them leads to, and the saving which their existence secures, are sufficient excuse for emphasising their necessity. If, as is prophesied by Mr. Pink, the number of telephone stations in London will be increased within the next nine years from 200,000 to nearly 700,000, the opportunities for prodigality in capital expenditure will be endless; the temptation to become prodigal will be irresistible, unless prompt, adequate and well-considered provision for this immense but not over-stated development can be obtained.

There have been, during the last two or three years, some well-marked tendencies, both in the Company's and the Post Office service, which give one a clue to a few of the developments which are likely to take place in the near future. *Present* circumstances have compelled the Company to "ca' canny" in these respects; *future* circumstances have hitherto laid a like necessity upon the Department.

First I place the abolition of the present Metropolitan tariffs, and the introduction of a measured rate, pure and simple. Every year, as the calling rate per direct line mounts up, the iniquities of the flat rate tariff increase, and vex the souls of all who have occasion to study traffic questions. The waste of valuable plant which an abnormal load per line renders unuseable, the dislocation of traffic with its consequent irritation and expense due to blocking the lines with unnecessary calls, the lament of the small user who is called upon to make good the losses caused by his richer brother, are some of the many evils which are ripe for the application of the only remedy. With the abolition of the flat rate, exchanges will be run on sound and sane lines, and a reasonable ratio between work done and revenue obtained be fixed.

Greater facilities will probably be afforded in future to selected

officers for the study of the telephone art in other countries. America, of course, is the land of promise to which all eyes in the telephone world are at times turned with longing; indeed, it is doubtful whether any other country in the world has now much to teach us. With American thought and practice we are fairly familiar through the agency of their excellent journals and the lectures given at our telephone societies, but the United States have mastered the telephoning of great cities in a manner which we are told must be seen to be believed, and therefore many are full of desire to see. For the young men in particular, a pilgrimage to the States may be, in the future, a part of the curriculum through which they must pass to qualify them for responsible positions in telephone work. When that time comes, London will have no cause to fear comparison with New York.

Akin to obtaining the best that other countries have to give us, is the necessity for utilising to the full the resources we already have. In the training of operators, who would now dream of reverting to the old happy-go-lucky method of dropping a girl down at a position in the exchange, and leaving her to acquire by observation and the stimulating lash of a subscriber's tongue a knowledge of operating methods; the operating school has proved itself in. Systematic training is bound to be extended; it ought to be applied to all branches of the service; and it ought to be done during business hours. Surely it is as important to teach an inspector how to look for and clear a fault properly, a fitter how to fit an instrument quickly and neatly, a contract officer how to secure users of telephone service, as it is to train our operators how to operate. All departments are so dovetailed into each other that inefficiency in one reacts on all the others; bad maintenance gives operating trouble; sloppy contract work misleads a subscriber, and his service therefore does not get a fair chance; the curt letter of a clerk creates wayleave difficulties for the engineer, and so on in a vicious circle. A proper system of training will not prevent troubles, but it will reduce them, and it will sift out the capabilities of those trained so that the round man will not be squeezed into the square hole; it ought further to teach the telephone servant his duty to the public, the difficult task of putting himself in the other man's place, and give him a larger perspective of his work and its relation to the work of other people. It will also help to abolish the watertight compartments which are gradually built up in a large business—another weakness, by the way, of functional organisation. Such a system would doubtless have the effect of encouraging private study, and would also increase the interest in telephone societies, which have now undoubtedly justified their existence, and have helped considerably to weld together the various ranks and departments of the service. In London particularly, controlling as it does 30 per cent. of the telephones in the United Kingdom, is there a splendid field for a comprehensive system of training.

If there is one subject more than another regarding which controlling officers are inclined to become impatient, it is criticism of their working costs. Why this should be so is a mystery of human nature, for nothing is more necessary in a business concern, provided the criticism be helpful and not carping. We have not by any means reached rock-bottom in our investigation of costs, particularly as to the cause of the differences between large towns under such heads as line and instrument repairs. Nor have we even approached finality in arriving at unit costs of construction and economy of time and material in carrying out new work. There is here a vast field for the investigator, and if recent American experience counts for anything, a profitable field. Even a year or two ago the large amount of office work involved in keeping detailed records of costs might have deterred an administration from embarking on such an enterprise, but up-to-date mechanical aids have deprived the work of many of its terrors, and rendered practicable what had previously been dismissed with the phrase "the game's not worth the candle." The Hollerith tabulating machine, installed by the American Telephone and Telegraph Company in its offices, and to a demonstration of which the writer recently accompanied the Company's Metropolitan Superintendent, is an excellent example. Such scientific aids will render possible much that has not hitherto been attempted, and in the near future it should be possible to have available statistics of costs much farther down the line than has yet been thought practicable; thus providing facts on matters which have up to now been largely left to chance.

Following on this there will doubtless result more frequent meetings between responsible officers in large centres, in order to discuss costs and kindred topics. To discover the cause of differences goes half-way to remove them. If the cost of, say, instrument repairs in six of our largest towns varies appreciably, and that cost can be analysed into common factors, the chief maintenance officers meeting together with the figures before them ought soon to discover the real causes, and apply the remedy. If the local conditions are such as to justify the difference, a value can be placed on those conditions and applied to future comparisons. Here again one feels that much can be profitably done.

Then—and I make this my last point, although there are others, such as a central enquiry bureau, improved distribution of stores, the abolition of local areas, etc., one would fain have touched upon—it seems likely that for the first time "in our island story" a Government Department is to be out asking for business on a large scale. It is not only going to sell telephone service, but is to show members of the business community that the telephone is as much a necessity to them as their premises and their stock. It is the abandonment of the old *laissez faire* idea that if people wanted a thing they would come and ask for it; they are now to be educated up to wanting it. Contract Departments, especially in the large centres of population, are likely to become not only selling forces, but educational forces, on a scale which could not previously be attempted. When one thinks of the many streets and squares of London where every house ought to have an installation, and where the great majority have not even an exchange line, the possibilities of the future can scarcely be overstated by the most sanguine.

In most of these matters the Company has already done much, and would undoubtedly have done more had it possessed a free hand and unlimited tenure. The State will have both these, and I have no doubt that the advantage which they give will be used to the full, and that the Postmaster-General's evident determination to run the system on business lines will be given effect to. I revert to the three articles in the *Post Office Engineers' Journal*, and as a concluding word would say that friction is as often caused by enforced conditions as by lack of the right men, but if you give the men reasonable control over their own conditions, causes of friction are reduced. Engineers, if they are to complete orders quickly, and it must be granted that advertising and canvassing are largely nullified if that cannot be done, must not be unduly hampered in carrying out the proposals which they deem necessary to attain that end; delays in passing plans for extension of plant, building of new premises, ordering of material, are often outside the engineer's purview, and again illustrate the necessity for close and sympathetic working between the Engineering and Commercial Departments. Much money will be needed immediately for urgent work; after all that has been said in and out of Parliament, it will surely be forthcoming; but the spending wisely is more important than the spending only, and to delay spending is not necessarily more economical than spending at once.

One of those epigrammatic paragraphs which are nowadays so prominent in commercial journals says, "One of the difficulties of life is to successfully put together the little things, and make big ones of them." It might be amplified by "Having made big things, be always trying to make them better." Unless the deduction of pessimism in the three Post Office articles is mistaken, then it is to be hoped that the extra energy which will be introduced into the Department's service as a result of American visits, will, with the assistance of the Company's staff, be instrumental in having the requisite works pushed on, and not blocked either by the Treasury or any of the other influences which the Department's officers seem to fear.

INVENTORY OF PLANT.

The following additions have been made to previous lists:—

TRAVELLING STAFF.

Rendell, E. J.	Exchange Inspector	Leicester
King, W. H.	Swbd. Fitter	Manchester

HEADQUARTERS.—*Nil.*

Deletions.

Kennedy, J. W. M.	Clerk	Glasgow
Head, F. J.	Sub-Engineer	Bristol
Kenworthy, H. M.	Asst. Electrician	Dublin
Searle, W...	Foreman	Metropolitan

The National Telephone Journal.

"BY THE STAFF FOR THE STAFF."

Published Monthly at
TELEPHONE HOUSE, VICTORIA EMBANKMENT, LONDON, E.C.

NOTICES.

All communications to be addressed—The Editing Committee, "NATIONAL TELEPHONE JOURNAL," *41, Telephone House, Victoria Embankment, London, E.C.*

The Editor will not undertake to be responsible for any rejected MS. All photographs will be returned if the sender desires.

Subscription: To the general public, 4s. per annum, including postage to Great Britain or abroad.

To the Staff, 2s. 6d. per annum, with free delivery to the Offices of the Company. Single copies may be obtained, 3d. each, or 4½d. post free.

For rates for the insertion of Advertisements apply to H. SELL, 167-168, *Fleet Street, E.C.*

VOL. VI.] OCTOBER, 1911. [No. 67.

THE FUTURE OF LONDON.

THOSE of us who have at heart the attainment of the fullest telephonic development by this country in the coming years will read with special attention Mr. STIRLING'S article on "The Telephone Future of London," as they will have no doubt read with interest Mr. PINK'S article in the *Post Office Electrical Engineers' Journal* on "The London Telephone System in 1920," to which our contributor refers. The fact that London and its aggregation of suburbs employs nearly one-third of the telephones in use in the British Isles is sufficient to indicate the important part which the future development of the Metropolis will play in the development of the whole country. The present population of the London telephone area may be computed at 7,184,000 inhabitants, that is to say, considerably more than that of Scotland and Wales put together. The present number of telephones in London is roughly 210,000, whilst the total number of telephones in Scotland, Ireland and Wales does not greatly exceed 120,000. But, even with its considerably higher ratio of telephones to population than the rest of the country, London is especially the field where the telephone statistician expects to reap an abundant harvest in the next ten years, for when its 200,000 telephones are compared with the 400,000 of New York, a city greatly its inferior in size, the opportunities which it presents for development are strikingly obvious. Mr. PINK'S diagrams point to a standard of 700,000 in 1920, if circumstances and the Treasury smile on the endeavours of our future administrators. Assuming that the population of the London area is roughly 8,000,000 in that year, this would mean a telephone to every 11·3 inhabitants, an ideal by no means impracticable and one reached at the present day by many American cities, but, nevertheless, only attainable here by a progressive growth which without the most businesslike management, the greatest technical foresight and a generous expenditure of money will not be secured. To those who put their trust in curves no doubt this figure has an air of pleasing inevitableness. The snowball grows as it rolls, but the more it grows the greater is the effort required to roll it—and the telephonic development of London is no downhill work. To change the metaphor, the field is doubtless there, but it will require some scientific husbandry to make it fully productive. Mr. LEE in his article on "Advertising the Telephone" has realised this. From 200,000 to 700,000 is a huge step in ten years, and although the latter figure will still leave London behind New York, that enormous number of orders will require some ingenious methods on the part of contract officers to obtain, and some expert prevision of telephone engineers to complete.

We are unfeignedly glad to see writers in the *Post Office Journal* so keenly alive to the task before them. The opportunities in telephonic work are so vast that we can well understand the fascination the subject has for those who are to control its destinies in these islands. We hope that a new enthusiasm, augmented by the new blood it will receive, will continue to animate the Department charged with the task of developing more fully this greatest and quickest means of public communication.

What will London be in ten years' time? We cannot emulate such writers as Mr. H. G. WELLS in their glimpses into futurity, but by comparing the last two or three censuses we can observe that in one decade the innermost boroughs stand still or even decrease in population, and that in the last decade even that of the County Council area was stationary. It may be that by the year of the next census the boroughs of outer London will have almost ceased to grow, and the residential population, aided by improved transit, have gone deeper still into the home counties. But even in the stationary central districts we learn that there are "many streets and squares where every house ought to have an installation and where the great majority have not even an exchange line" and there are, no less certainly, distant yet populous suburbs with well-to-do residents to the majority of whom a telephone connection is in most instances undreamt of. Time will change all that; and what the spirit of the times leaves undone the persuasive voice of the contract officer will do. Even without any increase in its population, therefore, London offers new worlds for the telephonic Alexander to conquer. And what applies to London applies in greater degree to the provinces. A few more years' education, a few more years' progress and, given the necessary flow of capital, wonderful developments should be seen. We can then imagine our statisticians rejoicing in curves of quite voluptuous rotundity!

NERVES—AND RATES.

THERE is no obvious connection between the twin subjects of this article; the connecting link is the telephone. We sometimes think that if we could lead two diligent and hardened newspaper readers into a secluded examination room and impose on them the task of writing a general essay on "Telephones," one would dilate at length on the "restless age we live in," "the worry and tear of modern life," "the shrill ringing of bells, the tooting of motor horns perpetually in our ears," and observe that "thanks to the telephone, the taxicab and the tabloid we endeavour to crowd ten times as much into a day as our

forefathers did," and so forth. The other would infallibly discourse of cheap rates, and having uttered the magic passwords "Stockholm" or "Switzerland," he would give some good advice as to the rates to be charged by the Government, demonstrating with sweet logic that, other things being unequal, what is applicable to A is necessarily applicable to B. Perhaps he would proceed to explain that America is ahead of this country because the American takes to telephoning as a duck to water, while the Briton has to be thrown in like an unwilling terrier; that the Swiss telephone is cheap because the Swiss uses it little; that the American service is dear because the American uses it much; and that, therefore, the Englishman who wants to use it much should be charged little like the Swiss. Then he might endeavour to explain that the American service was not really dear because the purchasing power of money was less and the cost of labour higher in the United States than in England, but that the telephone in Stockholm was really cheap although in Sweden the value of money was greater and the cost of labour and other charges less. And, having reached this point, he might well be excused if his nerves were in the condition which the other writer had so picturesquely described as the result of the strain of modern life and the tyranny of the telephone.

If we may believe a German-American writer, Professor MÜNSTERBERG, the alleged modern nerve strain is largely imaginary and self-induced; but he considers that the constant suggestion of the disease in newspapers and by publicists, scientific and otherwise, may induce the reality. As regards the other telephone question, which is apparently supposed to be nearest the public heart—viz., rates—we observe that a conference is being called by the City Corporation at which this is one of the subjects to be discussed. We are certain that the principle of the measured rate has only to be properly expounded before any body of impartial men to secure approval, whether in the present or in a revised form.

TRUNK LINE STATISTICS.

AN article by Herr VON HELLRIGL in a recent number of *Electrotechnik und Maschinenbau*, on "Telegraph Statistics in 1909," gives some tables of mileage and traffic, which include figures for telephone trunk lines. The first impression that strikes one on looking at these tables is the immense disparity in the trunk development of the different countries of Europe; and further consideration of them suggests at once how useless comparisons are when no common basis for comparison exists. For instance, the principal European States (from a telephonic point of view) figure as follows:—

	Trunk calls.	Mileage of trunk wire.
Germany ...	279,716,178	340,000
Denmark ...	29,314,172	45,600
Great Britain ..	26,638,398	113,200
France	21,947,412	256,500
Sweden	16,751,450	75,000
Austria	3,432,763	31,500

The more these figures are looked into the stranger they appear. Germany is a country of considerably greater extent than Great Britain and no doubt has a more extensive trunk system, but can it be believed that more than ten times as many calls are made in that country as this? France, with a mileage more than three-fourths that of Germany makes less than a tenth of the number of calls; and so on with the other places. It should be mentioned that England is shown in the tables as making 50,989,158 trunk calls, but this figure is obtained by adding the trunk calls made by National subscribers to the total calls made on the Post Office trunk lines.

If we bring in the United States we get no aid to the solution of the problem.

	Toll connections daily.	Mileage of toll wire.
United States (Bell system only) ...	517,341	1,804,552
	(say, 155,000,000 annually)	

It will be observed that "toll wires" takes the place of trunk lines, and this perhaps does throw some light on the subject They include, of course, everything which is not a local call. In fact, the determination of what is a trunk call is chiefly a matter of terminology. Who shall say how many of these 279,000,000 trunk calls of Germany would not be so classed in another country. It may well be that in some countries a call from a city to its outlying suburbs ranks as a trunk call and in others not. The elasticity of the term "junction call" in England is especially wide, and there is little doubt that if what are practically long distance calls of this denomination were added to the figures given above, a truer idea of the trunk line traffic of the British Isles would be afforded. It may be doubted whether in any other country in Europe such calls as from London to Tilbury Dock, London to Reigate, Richmond to Enfield, Christchurch to Poole, Leeds to Otley, Jedburgh to Galashiels, Belfast to Larne, Kilmarnock to Ayr, Glasgow to Kilsyth, and over thousands of similar junction routes, varying from under 5 to over 30 miles, would not rank as trunk calls.

A comparative statement of the total number of true long distance calls would be instructive and interesting; but it is feared that this is practically unobtainable.

HIC ET UBIQUE.

A CORRESPONDENT writes to the effect that a Bedford subscriber, whose works are close to the Midland Railway, from which of late everyone had been on the look-out for aeroplanes, one day left his hand micro-telephone off the rest. Thereupon the exchange tried to get the subscriber's attention by means of the Howler, with the result that the men in the works turned out *en masse* to see the aeroplane which they thought they heard overhead—much to the astonishment of the neighbourhood. Their disgust on finding the cause of the buzzing may be imagined.

WE received from our Plymouth correspondent as a matter of interest for illustration a wilted-looking vulcanite mouthpiece which was alleged to have become thus distorted as the effect of the sun's rays, reflected on the switch-hook by a piece of glass in the door. Experiment was made on a similar mouthpiece at Head Office, but the most terrific temperatures were endured by the vulcanite with impassive calm. The effect of prolonged boiling, however, was to reduce the mouthpiece to a state comparable with that of its dilapidated western brother. The question now is: How came it in its shrivelled condition? Whether the subscriber or his servant dropped it in the stock pot, lost it in the bath, or merely boiled it as a hygenic precaution is one of those perplexing and fascinating mysteries which we fear will never be solved.

VECTORS, VELOCITY AND ACCELERATION.

BY E. T. PAYNE, *Chief Clerk, Newcastle-on-Tyne.*

AN understanding of these items when once obtained is well worth the trouble taken, and practical applications are numerous in scientific work.

In the case of vectors, *those having* any knowledge of the subject will recognise the term as applied to diagrams called "parallelograms of force" and in "curve" work. They are used largely in mechanics as well as in electricity and magnetism, and are the mathematical expressions for various forces.

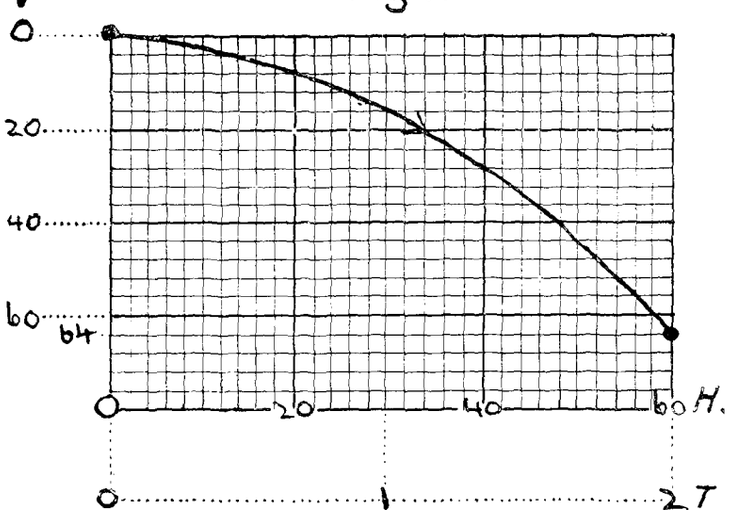
A casual reference to the N. T. Co.'s "D" Course (Paper No. 8 *re* Transmission, etc.) will give an idea of some of the advanced practical applications.

Without attempting to treat either of above subjects scientifically I will give a few examples of problems that have some bearing on them:

(*a*) A ball is fixed at the masthead of a vessel travelling at the rate of 30 feet per second (about twenty miles per hour). The mast is 64 feet high and at a given instant the ball is released, taking two seconds to reach the level of the boat. Where does it fall?

Ans. Although while falling the boat moves forward by 60 feet the ball still drops at the foot of mast (its actual path being as shown by the curved line on diagram, Fig. 1).

Fig 1.



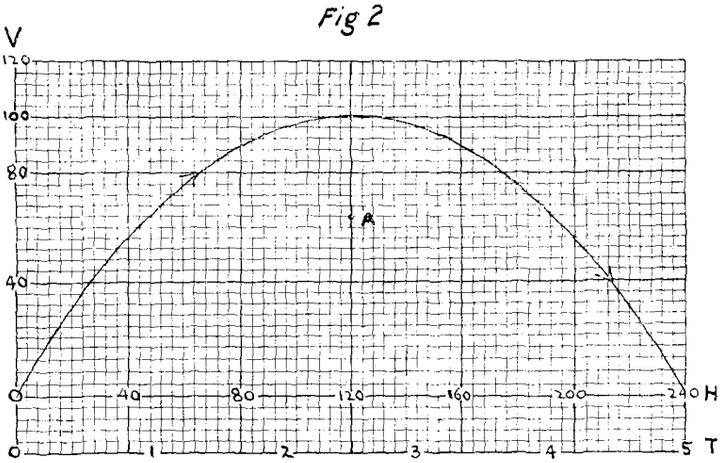
If there was no such thing as gravity the path would be a line parallel to the earth's surface and the ball would reach neither the deck of the boat or the sea, that is, the air would in time stop its horizontal motion, and it would remain in mid-air for the rest of its existence.

The diagram also gives the distance fallen in every second or portion of a second. It will be noticed that this is not equal for each period of time. The ball, however, follows a regular law, which will be referred to in the following example:—

(*b*) A railway porter while standing at the back of a goods truck travelling at the rate of 48 feet per second (about 33 miles per hour) throws a small stone directly into the air above him, the stone reaching a height of 100 feet. It takes for its journey up and down a total time of five seconds and in the meanwhile the train has moved forward a distance of 240 feet. Where does the stone fall?

This little problem leads to a wonderful variety of theories on the part of the uninitiated, very few at first, except by pure guesswork, coming to the correct conclusion, which is that the stone falls into the truck itself.

Fig 2



As this and similar items have interesting mathematical points I will explain at length, using a diagram (Fig. 2), but omitting such unnecessary details as the railway lines, truck, etc. In both figures the letters V, H and T represent vertical distance in feet, horizontal distance in feet, and time in seconds respectively.

In the first place the stone's movement is a compound of four forces:

1. Vertical velocity with which it leaves the man's hand.
2. Horizontal velocity of train.
3. Downward pull of gravity.
4. Resistance of air.

A small stone being slightly different in its nature from a balloon and meeting with very little resistance from the air, during its period of five seconds, item No. 4 can be neglected without appreciably affecting the result. We have now to calculate the effect of three forces, and by the aid of formulæ and squared paper this is easily done. The conditions must of course all fit in with each other, that is, if the height the stone is to reach is changed, other conditions must be changed to correspond or the stone will *not* fall as desired, although in the latter case we can still calculate exactly where it *will* fall.

In making up the figure, the given conditions are first taken and noted, that is, the values up to 100 vertically for height, and values up to 240 horizontally for horizontal distances. Time intervals are also shown with the latter as the two vary directly with each other.

The curve can then be plotted in a variety of ways, one of which is to "graph" the equation $H = \pm 12 \sqrt{(100 - V)} + 120$. An algebraic equation can be obtained for all parabolas (which is the name of this type of curve), although in accordance with mathematical custom the values are usually put in a different way to that above.

A common form of the equation is $Y^2 = 4 A X$, and if this is used on squared paper with a value of 36 for A an identical curve will be obtained except that its position on the paper will be varied.

The main thing that varies for each parabola is the position of a point called the focus. This is shown in the present case at A, and can be found in several ways, as simple a method as any being to run down the centre or axis of the curve until a point is reached where the distance to vertex or top is exactly half the shortest distance to either side. Only *one* point will be found to answer this condition for each curve, and its value is an important one, amongst its other uses being the fact that when given (36 in the present case) we can at any time construct an identical parabola with the greatest ease, although the curve's exact position on the squared paper and the way it runs will, of course, depend on the form of the equation.

Parabolas figure prominently in mathematics, as all calculations on squared paper that combine the downward pull of gravity with a horizontal force or velocity produce this particular form of curve.

The effects of gravity, as most people are aware, are universal, and there are, therefore, very few branches of science that are unaffected by the same in one way or another.

As an instance, although we should not naturally connect stones thrown from railway trucks with astronomy and comets, yet many of the latter follow exactly the same law as the stone in the example given, that is, their paths can be accurately described by an algebraic equation representing a parabola, although the focus differs as regards its relative position to its curve for each case.

Other comets, Halley's is one, describe ellipses for which there are also standard equations or formulæ.

Roughly the comets that describe ellipses are those that come and go periodically, and those that describe parabolas are comets seen once but never again.

It may be of interest to mention that the velocity of comets is governed by the fact that a straight line from the comet to its focus, the sun, sweeps out equal areas in equal times.

All curves have in conjunction with squared paper important applications, as, if we fix a unit and measure up our lines accordingly, we get by the use of squared paper practical working values without the tedious calculations otherwise necessary.

To apply this remark to the present example, we can see at a glance from the curve the exact horizontal distance or height of the stone *at any second or fraction of a second* from its time of starting. This applies for the whole of its journey, and although such information may not be of much use here, the general fact is of great importance in curve work and one of the chief advantages thereof. We can also, by methods which it has been necessary to exclude from this paper, obtain the actual velocity of the stone at any instant, together with its acceleration, etc.

Many of these remarks should really come under a separate heading for "curves" or "graphs." These, however, are closely connected with "vectors"; in fact, it is somewhat difficult to find any two branches of mathematics that are not related to each other in *some* way. Curves generally are a fascinating study, but contain quite enough material for a paper of their own. In the present case a curve, $V = \frac{1}{2} g t^2$ (where g = acceleration due to gravity = $\pm$ 32·2), is amalgamated with an ordinary vector of which the vertical and horizontal components are:

1. The velocity with which the stone is thrown upwards; and
2. The velocity of the train.

The combination of the three is also referred to under the details of the problem itself.

Probably few people are aware that under proper conditions the practice of stone throwing may be of assistance in determining the height of buildings, etc., difficult of access. Possibly an idea of this nature runs in the minds of some of those youths who amuse themselves by throwing stones at the Company's insulators.

To carry the method out we must know the starting velocity (a graduated catapult might be useful), the angle fired at, and the time in seconds for the rise to maximum height. The height itself is then merely a matter for calculation, although the practice cannot be recommended to the Inventory staff as a means of measuring telephone poles, especially in thickly populated neighbourhoods.

The principle is, I believe, sometimes practically applied on battleships by means of guns in which the shot leaves the muzzle at a known velocity and angle.

In all such cases, except where the aim is directly vertical or perpendicular to the ground, the shots, etc., describe parabolas—that is, you cannot, for example, throw a stone that will describe a semi-circle or any other curve than a parabola.

As regards "velocity," the usual definition of this is the "rate of change in position," and "the rate of change in velocity" itself represents the well-known term "acceleration." Mathematically these terms are applied whether the rates are fast or slow, plus or minus, although in ordinary life this is not so. Velocity for instance, is generally associated with *fast* motion, reminding one of a school-boy's definition which was "what people drop a hot plate with." In the same way as regards acceleration, we generally associate the term with an *increase* in motion, whereas, mathematically, if (say) a train is travelling uniformly at 60 miles per hour and then slows down to 40 it has been "accelerated" although in a negative way.

For calculations this is obviously the simplest way, as otherwise we should need a double set of definitions in many cases.

Fairly simple examples of velocity and acceleration can be obtained from railway time tables, more especially to those who have the opportunity of timing points intermediate to the actual stations. Illustrations would take up far more space than allowable here, although one could deal with this partly by returning to Fig. 2, but with this important difference that as the stone travels upwards as well as horizontally, whereas the railway train travels horizontally only, the actual velocity at any instant in the former case is slightly more complicated than in the latter, that is, the curve in Fig. 2 represents not the path of the luggage truck but a totally different thing, that is, the path of the stone.

To deal with a train mathematically, a short distance only would be taken and the time intervals would be arranged, say, in very short sections when the diagram could be accurately drawn, forming a satisfactory "curve" showing the velocity, acceleration, distance, maximum speed, etc., with their relationship to each other, that is, all the details required in a mathematical study of the subject.

As already pointed out our general ideas of velocity differ considerably from the mathematical view, the latter being far more comprehensive. For instance, in everyday life, if a train takes an hour to go from one station to another 60 miles distant we are satisfied with its average velocity of 60 miles per hour without taking into account various accidental stops, time lost in starting, slowing down, etc. This is not quite good enough for the mathematical view of the subject, which also differs in other respects.

Scientifically a snail in motion possesses velocity equally with an express train, although the former only covers about ·005 feet per second. For comparison I give a few approximate examples of various rates of motion which may be of interest and give some idea of the extremes:

Growth of heliotrope	·0000005	Feet per second.
Movement of a snail	·005	
Express train (say, 60 miles per hour)	88	
Sound...	1,090	
Shot from Armstrong gun	1,180	
Hydrogen molecules in air	5,280	
Light and electricity...	188,000 × 5,280	

It will be noticed, for instance, that the snail's progress compared to that of an express train is far more rapid than the velocity of latter is compared to that of light.

Our general ideas of what motion *is* are frequently incorrect, or at any rate incomplete, and an examination of the subject leads to interesting information. For instance, things that we think of and call absolutely still are sometimes in incessant motion, apart of course from the movement with the earth itself.

The apparent stillness in most cases arises from our limited eyesight. In the first item above, for instance, we can see motion in one sense but not in another, although it is just as real as that of an express train.

There are also cases where very rapid motion not only gives an appearance of stillness (as with the above case of slow motion) but also turns a very soft material to a very hard one. It has been proved, for instance, that if a column of water an inch or so in diameter is poured continuously under proper conditions from a height of about half a mile it cannot be broken into at foot by a

heavy hammer, that is, the effect of its velocity when approaching the ground is to create a pillar as solid or more solid than a brick wall.

It has also been proved that many of the things we call hard solids are merely composed of soft material, in rapid motion the apparent solidity arising owing to the range of movement being exceedingly small.

Under a theory arising from this, it is supposed that even the chairs we sit on are made up of small whirling systems of motion, and also that anything not already in motion on its own can be made, as regards its molecules, to move.

To conclude, the following few examples of problems *re* vectors, forces, etc., met with from time to time may be of interest, although rather mixed:—

(1) A rope hangs over a smooth easy-running pulley; to one end is fastened a weight of 10 stone and to the other a sailor also of 10-stone weight, both hanging in mid-air. The sailor starts to climb up his end of rope. Will the weight move, and if so will it rise or fall?

(2) A bee flies without resting around the inside of a railway carriage travelling at 60 miles per hour. Does it expend more energy in doing this than it would if the train were at a standstill?

(3) A P.O. official in a P.O. railway sorting van throws a parcel from one end to the other. Does he use the same force in doing this when van is at rest as

(*a*) When travelling at 60 miles per hour in *opposite* direction to that parcel is thrown;

(*b*) When travelling at same speed but in same direction.

(4) Does the top part of a carriage when in motion move farther or at a greater rate than bottom portion, or, to put it in another way, of two exactly opposite points on the circumference (of which A is on ground and B at highest point), does B when the wheel starts move during any portion of a revolution further or faster than the A?

(In abridging this paper, apart from the omission of various problems, it has been necessary to cut out some branches of the subject, including for instance trigonometry altogether, although, as pointed out in Mr. Payne's original paper, each of such branches possesses its own interesting properties.

Doubtless sufficient has been given to show that a study of mathematics has its pleasures as well as its duties.)

CORRESPONDENCE.

ROYAL AGRICULTURAL SOCIETY'S EXHIBITION.

TO THE EDITOR OF THE NATIONAL TELEPHONE JOURNAL.

WITH reference to Mr. O. W. Stevens' article, and to Mr. Elliott's letter in the September issue, I beg to say that the Company had an exchange on the *show ground at Derby in 1906*. The installation was C.B., the switchboard being of similar type and capacity to that used at Norwich.

Nottingham, Sept. 6. M. B. OLDBURY.

NATIONAL TELEPHONE CHESS CLUB, LONDON.

THE committee begs to announce to past, present and intending new members of this club that the coming season opens on Tuesday, Oct. 3, at "Ye Mecca," 140, Cheapside, E.C., at 6 p.m. The committee hope that chess players in all parts of London will make a special effort to join and make the season a complete success, and to those members who took a leading part in forming the club, announce with pleasure that the services of Mr. R. P. Lowe, who is at present on the Inventory staff at Hamilton House, Temple Avenue, have again been obtained as hon. secretary, and he will be pleased to answer any enquiry relating to the club's affairs. An attractive list of matches in connection with the Civil Service and Municipal Chess League has been drawn up, and it is confidently expected that greater success will be met with than during last season when the services of some of the best players could not, for various reasons, be obtained. To new members joining on or before the opening night, the entrance fee is 1s. (thereafter 2s. 6d.). The annual subscription is 2s. 6d. There are a few members of the club who are also enthusiasts at draughts, and members of the staff wishing to play this game alone are cordially invited to come along. Members of the Inventory staff at present in London will be specially welcomed.

LOADING COILS IN UNDERGROUND AND AERIAL CABLES.

BY E. L. PRESTON, *Engineer, Bristol.*

No doubt many of the staff have read with interest the papers of Messrs. Cohen and Shepherd on "Telephone Transmission." I do not, however, remember having seen any articles dealing with the practical application thereof to the Company's plant. A few

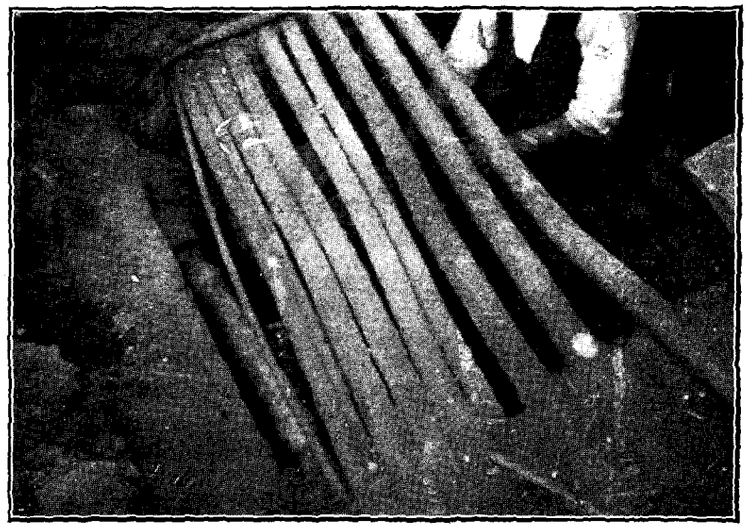


FIG. 1.—Showing Electric Light Cables and Gas Mains, making Work Difficult during the Fitting of Coil at the Split.

particulars therefore of the recent installation of loading coils in some of the junction circuits in the Bristol area may prove of interest.

In the first place, to enable the Engineer-in-Chief's Department to determine the locations and types of coils, the composition of the

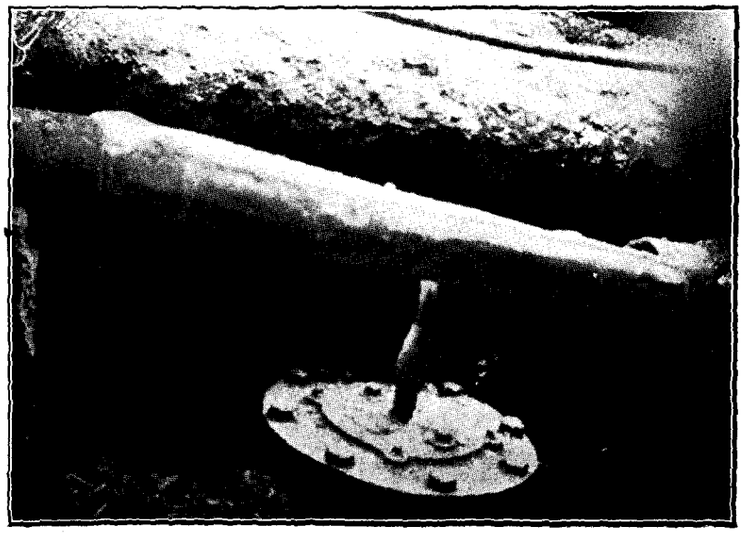


FIG. 2.—Coil Fitted ready for the Building of Brick Chamber.

junctions must be ascertained, it being necessary not only to give the *total composition* but the relative positions of each type of conductor for each route affected.

A plan is then received, together with instructions giving what might be termed the "theoretical" locations of the coils, and, so far as is practicable, these "locations" should be worked to. As,

FIG. 3.—Coil Fitted, and Jointers Testing for Junctions to be Loaded.

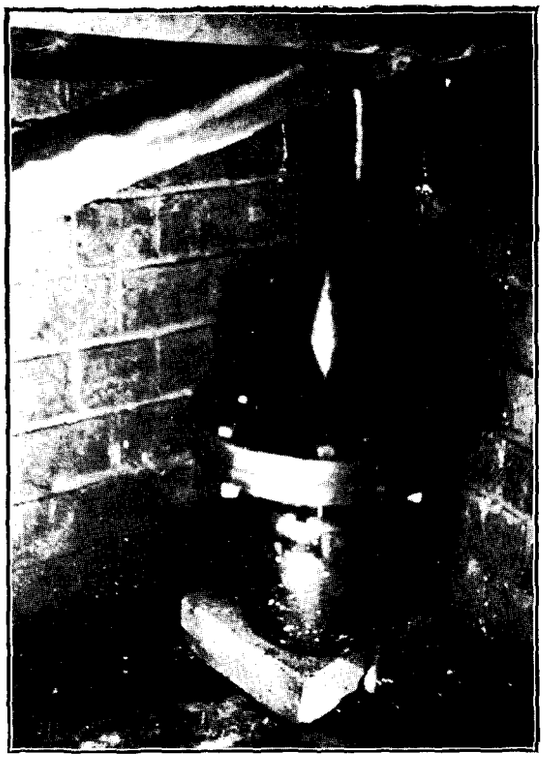


FIG. 5.—View of Coil Pot on Floor of Manhole before Iron Band was Fitted.

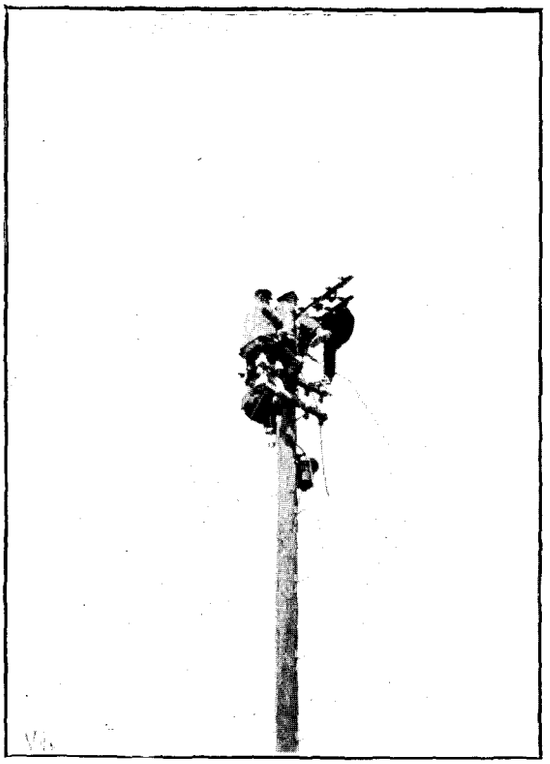


FIG. 4.—Testing of Circuit, and Plumbing after Coil Jointed in.

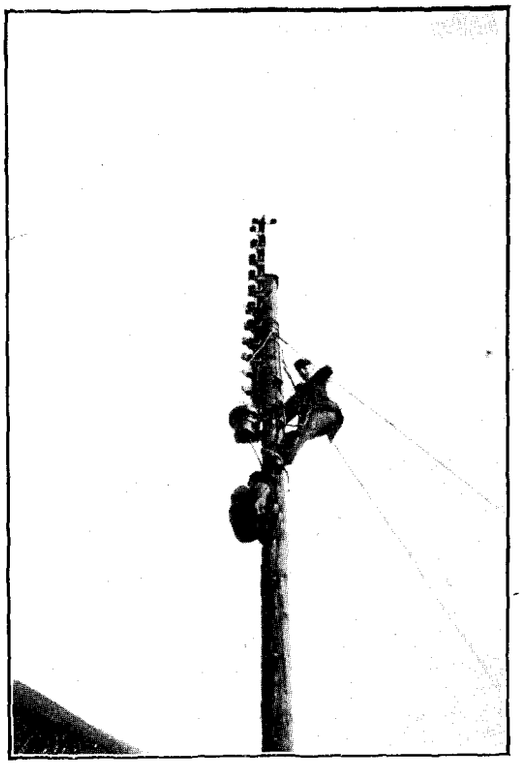


FIG. 6.—Preparing to Fit Cover on Coil.

however, the "theoretical" location may not be at a joint, and for various reasons, such as obstacles preventing the building of a brick chamber, inability to extend manhole or unsuitability of pole, it is allowable to vary slightly the location, such variation having to be sanctioned by the Engineer-in-Chief's Department.

In manholes the pot can be stood on the floor and clipped to wall by an iron band (Fig. 5); where more convenient, supported by a bracket and clipped to wall, as shown in Fig. 7. In a brick chamber the pot merely rests on the floor at a split (Figs. 1 and 2). A suitable brick chamber must be built as close to the joint as possible. At a pole the pot may either be in a brick chamber at the foot of pole, with a dry-core lead-covered cable leading up the pole to the cable to be loaded, or it may be supported on the pole as shown in Figs. 3, 4 and 6.

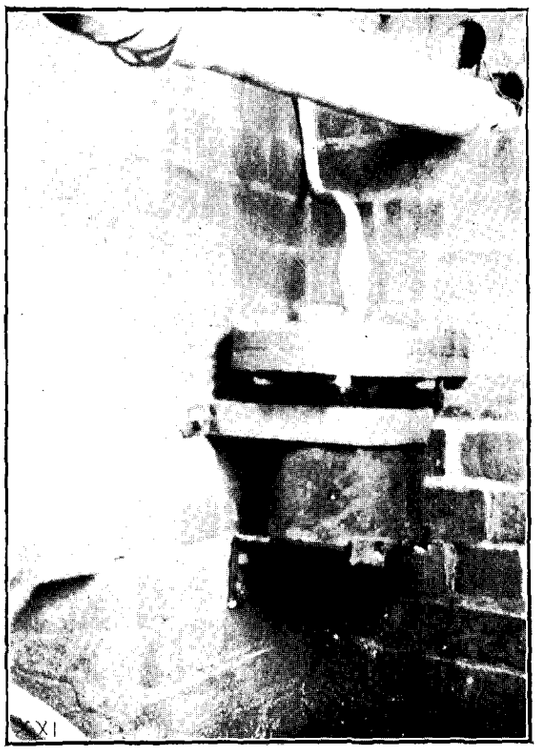


FIG. 7.—Showing Pot Fixed on Bracket, and Clipped to Wall in Manhole.

If fitted on poles, the pot is protected from stone-throwing by a sheet-iron guard, as shown in the photographs. The required cable pair having been identified in joint, the pair is cut and jointed into the tail of the pot so that each coil is in series with the circuit, as the circuits to be loaded are usually the long circuits and therefore in the core of the cable, necessitating the piecing of all through pairs in the cable. This should not be lost sight of when estimating, as it is a considerable item in large cables. It is as well to piece any other pair that may be loaded subsequently, and bring it to the outside of the joint, in order to save expense of piecing the joint a second time.

To prevent damage to the coils by excessive current, special testing arrangements have to be made and the loaded circuits specially marked in each test room. The loaded circuits are also marked on the switchboard to inform the operator that the circuit in question should be used for certain routings.

The photographs are the work of Assistant-Engineer B. C. H. Rumley and Draughtsman J. C. Pike, who are certainly to be congratulated on the results obtained, seeing that the conditions under which they worked were far from ideal.

TWO RURAL ULSTER EXCHANGES.

HOLYWOOD, BELFAST AREA.

RATHFARNHAM, BALLYBODEN.

AN IMAGINARY CONVERSATION BETWEEN TWO TELEPHONES (A KIOSK AND A MEASURED RATE TELEPHONE).*

BY NELLIE B. HUNT, *Operator, Bristol.*

"AT last the opportunity has arrived, for which I have so often wished," said the kiosk. "The operator has apparently left us connected after a conversation has been finished, so let us, in the meantime, become better acquainted with one another. You are, I know, what they call a 'limited' or 'measured rate,' but I should like to understand a little more about you; as to your circumstances, and what sort of a life you live, and so on."

"I shall only be too delighted," replied the other, "to give you any information I can, but like the rate of telephone to which I belong, I am afraid my knowledge is also 'limited.' I live in a private residence, and am well looked after in the way of being kept clean, and also in the way I am handled or used. I'm just the ordinary type of telephone, but I don't make queer noises as you do, every time I am used, and quibble over a penny before I work. I don't understand you at all, so I wish you would tell me about yourself, as I guess you must have a very wide experience of the world and its ways, too."

"Right you are," said the "penny in the slot" machine, "I'll fire away. I live in a little house made purposely for me, all by myself, with no master and no mistress, and do not get the little attentions you do. I am, I think, what people call a public facility, being situated at a prominent place in a busy corner or street of the town, where anyone and everyone may use me at will, always providing that they put a penny in. This fee, which has to be paid by every caller, is the means by which I am kept going, and as the Company have placed me here, they naturally have the takings. The queer noise you refer to is the result of the penny being dropped and a handle being turned. It is called the 'buzzer' and enables the operator to know whether the fee has been paid or not. Sometimes a caller will come in who does not understand how this works, the result being that the penny becomes jammed, and then there is an awful bother. Your guess at my wide experience is quite correct, for I am used for as many different purposes as any telephone can be. There is the man who regularly uses me for ordering a great many things he requires in his business, but does not care to have the telephone fitted up at his house (perhaps, inconsistently enough, he privately votes it a nuisance, as many others do). Then there are the usual callers who want to book for the theatre or empire of varieties, or to ring up the rink, picture palace or other places of amusement. I don't know what people would do without me now who want half a crown placed on the 'favourite,' or to know the result of the races; whether the City won the match, what time the aeroplanes are on show, or when they will fly, etc., *ad infinitum*. One thing which annoys me very much is that naughty children, who deserve to be punished, come

* Prize paper read at competitive night of the Bristol Operators' Society.

in, disfigure the walls of my little wooden hut by scribbling or drawing, handle and pull me about with anything but gentleness, and annoy the operator at the exchange by whispering, giggling and general misbehaviour. She puts on the 'howler' to try to frighten them (but this racks my poor bones and joints all to pieces). Then, finally, they go away and leave me hanging, until someone comes along and puts me right again. Yes, I have always an endless stream of callers, and I've come to the conclusion that I am like the brook which sings:

"Men may come, and men may go,
But I go on for ever."

"Your experiences are very varied indeed," said the measured rate, "but do you ever have anything funny happen? For instance, the other day my mistress wanted to speak to her husband at the office, and as 'hubby' generally answers the telephone she asked, 'is that you, dearie?' but a very gruff voice replied 'No—who do you want?—we are J. C. Wall & Co.' Another time when ringing up to order a pound of bacon, she found herself speaking to the doctor at the hospital."

"Well," said the slot machine, "someone ringing up Mr. Wise, the butcher, the other day, asked as usual 'are you Wise?' 'No,' came back the answer 'I wish I were.' Occasionally a caller will come in and start talking some rubbish about 'chests' or something like that, and then ——"

"*Trunks*, you mean," interrupted the other, "that is when a person wants to speak to another town, and that reminds me, I want to know your opinion on the change which is soon to take place when we shall all be under Post Office Government."

"Well," said the kiosk, "I hear a good deal about it, one says this and another that, but the most sensible thing for us to do, I think is to wait and ——" (click).

Just then the operator without ceremony disconnected them and the further remarks of the garrulous kiosk were left to waste their sweetness in his lonely wooden hut.

SOUTH AFRICAN TELEPHONES.

WE learn from an American consular report that, according to the *Cape Times* of Feb. 7, 1911, the Government has decided that the message rate shall be introduced as soon as the necessary changes in the telephone system can be brought about.

There is now under construction a new switchboard on the central battery principle. Payment will be made on the basis of the number of calls, all calls being registered by meters.

The introduction of the system into the Cape means the installation of an entirely new switchroom equipment and a different class of telephone in every subscriber's office. This is a work of considerable magnitude, which will take many months to complete and will also cost a large sum of money. The conversion of the system, even in Johannesburg, is not absolutely complete, although the work has been in progress for two or three years, and in Cape Town the change will also take place gradually.

At first glance, says the *Cape Times*, it does not seem that the business man who makes considerable use of the telephone will benefit much by an installation charge of £10 with 900 free calls, three a day, as against the present tariff of the same rate for an unlimited service. On the other hand, the small charge in the Transvaal for private residences, about £4, with 600 calls a year, or two a day, if applied in the Cape Peninsula, would mean a considerable advantage to the small user of the telephone. It is, therefore, confidently anticipated that the number of subscribers will be increased.

In the Rand the area is divided into circles, and the charges are as follows, according to the *Times*:—

Within a five-mile circle, 1*d.* a call; between five and ten miles, 2*d.*; over ten and under twenty-five miles, 3*d.*

In Cape Town in all probability a similar system will be adopted and a radius will be made embracing the suburbs and practically all the outlying places of any importance. The change, however, will not take place until the Central Exchange equipment is in position. At the same time all expedition is being used with a view to as early a change as possible.

GLASGOW NOTES.

THE 1911-12 syllabus for the telephone society (Glasgow and West of Scotland districts) has now been issued, and energetic steps are being taken by the committee to make this a record year. The committee have been successful in getting Mr. Eustace Hare, Mr. W. Aitken, of the British Insulated and Helsby Cables, Limited, and Professor Magnus Maclean, of the Technical College, to deliver lectures. There are also several other interesting items in the syllabus.

A SMOKING concert was held on Tuesday, Sept. 26, in Messrs. Ferguson & Forrester's Restaurant, West Nile Street, under the auspices of the Inventory and district staffs. There was a good attendance, and with song and story a pleasant evening was passed.

OUR popular and genial Cashier, Mr. J. W. McDonald, has done exceedingly well in reaching the final of the championship of the Queen's Park Bowling Club. He was the winner of a prize value £2 2s.

MR. JAMES F. SCOTT, Cashier, has been promoted to be Chief Clerk at Kilmarnock. Mr. Cullen has been appointed head of a sub-department and Mr. J. W. M. Kennedy has been recalled from the Inventory staff.

ON the occasion of his marriage on Sept. 8, Mr. John Grierson, Outstandings Department, was presented by the members of the clerical staff with a handsome clock and silver cruet. Mr. Anderson, Chief Clerk, in making the presentation, wished Mr. Grierson every happiness in the future.

UNDER the auspices of the Bell Golf Club the September Medal Competition was held at Carntyne on Saturday, Sept. 2, with the following result:—W. Stewart (previous winner) 87 − 5 = 85, Mr. D. B. Hebenton (winner) 87 − 4 = 83. The hole-and-hole competition has now been completed, Mr. J. F. Murray (13) being the winner. In the final he beat Mr. H. Thomson (6) by 4 up and 2 to play after a tie.

MISS H. BURNSIDE has left the service to get married. As a wedding gift she received an *epergne* and butter knives.

THE Scottish Exhibition (1911) is now commencing its sixth and last month. This ranks as one of the most successful of Glasgow's successful exhibitions. Several items of interest to electrical men have been added recently to the Kelvin Hall, and these will bear inspection. The Post Office Telephone Exchange, which can be seen in full operation, is also proving of interest.

LONDON NOTES.

THE brilliant summer of 1911 has proved no exception to the rule covering matrimony during the holiday months. Three weddings, accompanied by presentations from the staff, have to be recorded as taking place recently. Mr. W. C. Inman, Cash Book Clerk, Salisbury House, was presented with an onyx stone clock; to Mr. F. W. Whitford, Metropolitan Stores Office, the gift of his colleagues was a hammered copper fire screen, curb and fittings; while Miss Elsie Price, Typist, Paddington, was the recipient of a teapot and rose bowl. The Paddington staff seem to have been reluctant to part with Miss Price, for they have broken out into the following "poetic" quotation over her departure:—

"His house she enters, there to be a light,
Shining within, when all without is night;
A guardian angel o'er his life presiding,
Doubling his pleasure, and his cares dividing."

THE results of the Board of Education and City and Guilds Examination for the 1910-1911 session have been announced. The Metropolitan staff have done excellently. In the former, 60 passes have been obtained in the electrical subjects, as against twelve last year, although unfortunately in the various grades of mathematics there are only sixteen passes, as compared with nineteen last year. The City and Guilds results are equally gratifying, the total passes being 145 in all subjects, as against 80 in the previous year. The number of entrants was of course greater in 1910-1911, but the percentage of passes shows a corresponding increase. It is profoundly to be hoped that, whether the Department continue the "encouragement" policy of the Company or not, the new session which opens this month will see no diminution in the number of students.

THE staff contributions to the Hospital Saturday Fund have created a new record, the amount for the June quarter having been £206, as compared with £184 in 1910. This is doubtless the result of a special Coronation appeal issued by the fund, asking each contributor to give one penny additional during Coronation week. Considering the numerous charitable appeals, the fidelity of the staff to this fund is in every way admirable.

PADDINGTON operating and maintenance staffs took advantage of the continued good weather to hold a second outing. On Sept. 16 therefore they journeyed to Windsor, where the Castle, the aerial post and the river formed irresistible attractions. Tea at the "White Hart" Hotel in the afternoon, with an impromptu concert and dance at the same place in the evening, were not the least delightful features of an enjoyable day. A double saloon was reserved for the party by the Great Western Company, so that the journey was made most comfortably. Miss Steele and her committee are to be congratulated on their successful arrangements.

THE City and Western Fitting Departments, inspired also no doubt by the good weather, disported themselves at cricket on Sept. 2. Whetstone was the venue of the match, and like so many of the villages on the outskirts of Greater London, proved itself admirably adapted for both cricket and a country outing. The scores were City 49 and Western 34. Humphreys, Foster and Hawkins were top scorers for the former, while the Western heroes were Dixon and Snare. In bowling Cornish for the Western and Foster for the City did most of the damage. A meat tea at the "Black Bull" and an open-air smoking concert, presided over by Mr. Greening, rewarded the exertions of the cricketers. So successful was the event that a football match between the two districts is now talked of.

THE London Telephone Society will hold its inaugural meeting for the new session on Monday, Oct. 9, when Mr. Greenham, the president, will give his address. Between 6 p.m. and 7 p.m. the models that were specially prepared in connection with the arbitration proceedings between the Postmaster-General and the Company, will be on view. The meeting will be held in the Chandos Hall, 21a, Maiden Lane, Strand. This is a very central and easily accessible position, and the hall has seating accommodation for 200. The bills, which have just been issued, announcing the programme for the session, should be carefully scanned by everyone, as it is certain that few will be able to resist adding their names to the list of members after having read particulars of the fare to be provided. It is also to be hoped that a large gathering will grace the opening meeting.

THE long expected visit of the Inventory staff is now *un fait accompli*, or nearly so. Mr. Waite has a number of his officers actively engaged in the North-Eastern district. Advance guards are busy in other districts. Owing to the size of the Metropolitan area, and to so many of the details and methods of working being different from those in vogue in other parts of the country, special methods of dealing with stores slips, works orders, etc., have had to be devised. To ensure that uniform methods should, as far as possible, be adopted in all divisions, and that overlapping should be avoided, a special meeting of Inventory divisional officers and London senior officers was held recently in London, under the chairmanship of Mr. Watts; many preliminary questions were thus settled, and some of the rough places smoothed over in advance. When it is mentioned that 140,000 stations have to be dealt with, many of them being connected to large and complicated private branch exchanges, and that in the City and West End the plant is necessarily of a somewhat congested nature, the magnitude of the task will be indicated. There are, of course, difficulties, but they will be easily overcome, and the Inventory officers may certainly rely on the willing co-operation of the local staff.

A VERY successful dinner given by the Metropolitan staff to the executive of the Staff Transfer Association was held at the Holborn Restaurant on Sept. 18. It was thought that some such gathering would fittingly mark the appreciation of the London staff for the work done by the executive in connection with the Telephone Transfer Act, and the result justified the expectation. The evening was an unqualified success. The attendance numbered 220; Mr. H. G. Corner, chairman of the Metropolitan local committee, proved an admirable chairman; Mr. Valentine, Mr. Bold and Mr. Lowe made excellent speeches; Mr. Edmonds also spoke well in proposing the toast of the "Local Committee"; the dinner was good and expeditiously served; the presence of ladies added a grace and charm to the gathering; and a much appreciated high-class musical programme delighted the audience. Mr. Alsop's regretted absence through illness was the one disappointment. Mr. Carter, the secretary, and Mr. Ryall, the registrar of the local committee, deserve a word of praise for the work they did to ensure the success of the evening.

Two deaths of old servants of the Company have occurred recently—Mr. C. Petterson, a Painter, who had been over fifteen years in the service, and Mr. W. C. Beddoes, who had served thirteen years. Both are deeply regretted by their colleagues.

THE friends of Mr. Clarke, Local Engineer, Woolwich, will be glad to hear that he has now been discharged from the hospital of which he has been an inmate for two months, as the result of a serious bicycle accident. He is progressing satisfactorily, and it is hoped that he will be able to proceed to a convalescent home in a week or two.

NEW PATENTS.

THIS list is specially compiled for THE NATIONAL TELEPHONE JOURNAL by Messrs. Rayner & Co., registered patent agents, of 37, Chancery Lane, London, from whom all information relating to patents, designs, trade marks, etc., can be obtained gratuitously.

LATEST PATENT APPLICATIONS.

18,586 Bronislaw Gwozdz. Telephones. Aug. 17.
18,648 Western Electric Co., Ltd. Automatic telephone exchange systems. Aug. 18.
18,649 Western Electric Co., Ltd. Telephone exchange circuits. Aug. 18.
18,680 Bullers, Ltd., and Edward Haward Chambers. Attachment of insulator-carrying arms to telegraph and like poles. Aug. 19.
18,785 William M. English, Louis E. Boukofsky and Solomon M. Lichtenstein, Antiseptic telephone mouthpieces. Aug. 21.
19,011 Bronislaw Gwozdz. Telephones. Aug. 24.
19,186 Siemens & Halske Akt.-Ges. Circuit arrangement for automatic telephone systems. Aug. 26.
19,187 Siemens & Halske Akt.-Ges. Circuit arrangement for automatic telephone systems. Aug. 26.
19,230 Siemens & Halske Akt.-Ges. Circuit arrangement for automatic telephone systems. Aug. 28.
19,252 Charles George Redfern. Telephone station. Aug. 28.
19,456 Siemens & Halske Akt.-Ges. Circuit arrangement for automatic or semi-automatic telephone exchanges. Aug. 31.
19,753 Siemens & Halske Akt.-Ges. Arrangements for automatic telephone systems. Sept. 2.
19,645 Siemens & Halske Akt.-Ges. Circuit arrangements for automatic telephone systems. Sept. 4.
19,829 Arthur de Courcy Bower. Receiving apparatus for use in radio telegraphy and telephony. Sept. 6.
20,032 William Kennedy-Laurie Dickson. Portable telephones and electric batteries therefor. Sept. 8.

SPECIFICATIONS PUBLISHED THIS MONTH.

27,857 Born. Conversations-counter for telephones without crank handles.
11,239 Bellini. Transmitters and receivers for wireless telegraphic and telephonic apparatus.
12,200 Bennett. Telephone mouth-pieces.
28,368 Boult. Telephone call recorders.
3,730 Ellison & Thorroegood. Single-wire telephone systems.

Printed copies can be obtained from Messrs. Rayner & Co., at the published price of 8*d*.

LOCAL TELEPHONE SOCIETIES.

Plymouth.—A general meeting took place on Sept. 1, when prizes were awarded for papers given last session as follows:—First prize, Mr. F. Knight, for a paper entitled "The Telephone Inspector and His Relation to Commerce." Second prize, Mr. W. C. Harris, for paper entitled "Principles of Single and Double Current Duplex Telegraphy." Third prize, Mr. S. G. Tregillus, paper entitled "Storekeeping." Special prize, Miss E. D. Davy, paper entitled "Some Phases of Operating and Supervision." The secretary's report for the past session was read, the officers for the forthcoming session were elected, and general arrangements made for continuing the society.

Southern London.—The annual general meeting of this society took place at the Hop Exchange. The proceedings opened by the Chairman (Mr. Inman) calling upon the secretary for his report and balance sheet. These were adopted by the meeting without dissent. Then followed the election of officers for the coming session. Mr. F. Woollard was unanimously elected president, with Messrs. T. M. Inman and J. Johnson as his vice-presidents, while Messrs. Baxter, Hayes and Morphen were re-elected on committee, with the addition of Messrs. Buer, Scott and Yewen. Last year's secretary (Mr. Grant) was re-elected. At the conclusion of the meeting Mr. F. M. Ward read a short paper on "Accumulators," which was full of instruction and interest, and gave rise to considerable discussion. The evening concluded with a very hearty vote of thanks to Mr. Ward proposed by the Chairman in the unavoidable absence of the president.

THE above photograph shows the members of the staff who took part in the golf match, East of Scotland *v.* West of Scotland, at Lanark, reported in the July JOURNAL.

PRESENTATION TO MR. AND MRS. A. L. E. DRUMMOND.

IN the the district office, Newcastle-on-Tyne, on Sept. 2, an opportunity was taken to present Mr. Drummond, the District Manager, and Mrs. Drummond with a handsome silver bowl and trinket box on the occasion of their silver wedding. The acting District Engineer, Mr. W. T. Douglas, in a few suitable remarks made the presentation, and congratulated Mr. and Mrs. Drummond on the attainment of the twenty-fifth anniversary of their wedding. Mr. Drummond, in accepting the gift on behalf of himself and Mrs. Drummond, thanked the staff for their kindness, and deeply appreciated the sentiment associated with the gifts. In referring to his 25 years of married life he also reviewed his service with the Company and stated that in November next he would have completed 30 years' service, of which he also felt very proud.

NEWS OF THE STAFF.

Mr. ARCHER W. SMITH, District Manager, Wolverhampton, has been appointed Furniture Inventory Officer, stationed at Head Office.

Mr. J. HAYWARD, Chief of the Instrument Fitting Department, Manchester, has, for the third time, been appointed Lecturer in Elementary Telephony at the Manchester Municipal School of Technology.

Miss LEONORA STRAW, Operator, Sheffield, was promoted on Sept. 1 to be Supervisor.

Miss HILDA L. STEELE, Operator, Southampton, has been appointed Traffic Clerk.

Mr. R. MOGG, Junior Clerk, Weymouth, has been appointed Local Office Clerk at Salisbury.

Mr. W. WALSH, Faultsman, Winchester, has been appointed Linesman Inspector for the Basingstoke area.

Miss MARGARET ELIZABETH EVANS, Clerk-in-Charge, Penarth, has been transferred to Barry Dock, vice Miss Richards resigned.

Miss MARY LOYN, Supervisor, Cardiff, has been promoted to be Clerk-in-Charge, Penarth, vice Miss Evans transferred.

Miss LILY WHELER, Operator, Cardiff, has been promoted to Supervisor, Cardiff, vice Miss Loyn transferred.

Foreman LONGHORN, who had been in the York centre for about eleven years, was, on the occasion of his transfer to Middlesbrough, presented by the York staff with a portmanteau.

Mr. W. E. BABIDGE has been appointed Chief Inspector, Bristol. Mr. Babidge entered the Company's service in 1895, and has filled successively the offices of Inspector, Test Clerk, Exchange Inspector, Chief Switchboard Fitter and Acting Electrician. He also carried out the duties of Clerk of Works on the recent Bristol switchboard extension.

Mr. F. F. BEAL, Inspector, Bristol, who has been promoted to the position of Chief Inspector, Cheltenham, was presented by his colleagues and other members of the Bristol staff with a travelling bag as a mark of esteem. Mr. W. E. Babidge (Chief Inspector, Bristol) made the presentation.

Mr. WILLIAM BURNETT resigned his position as Inspector on Sept. 16, after eighteen years' service, in order to go out to Brisbane, Australia. On the eve of his departure he was presented with a kit bag and dressing case subscribed for by all grades of the Sheffield staff. He takes with him the best wishes of the staff for all possible success in his new venture.

Miss ELIZA MILLER, Clerk-in-Charge, Royal Exchange, Glasgow, has been transferred to Argyle Exchange in the same capacity. The staff in the Royal Exchange presented her with a gold bangle.

Miss LOUISA MORTIMER, Clerk-in-Charge, Douglas Exchange, Glasgow, has been transferred to Royal Exchange as Clerk-in-Charge. She was presented with a writing case by the Douglas Exchange staff.

Miss GEORGINA SMITH, Clerk-in-Charge, Argyle Exchange, Glasgow, has been transferred to New Douglas Exchange as Clerk-in-Charge. The staff in the Argyle Exchange presented her with a pendant and chain, also a brooch.

Mr. J. R. CRAIG, Exchange Manager, Hillhead Exchange, has been transferred to New Douglas Exchange as Exchange Manager.

Inspector V. ROBINS was presented with a silver-plated teapot on the occasion of his leaving the Company's service to go to Australia. Mr. F. Bennett, Acting Electrician, made the presentation.

Mr. H. HATTON, Chief Inspector, Brighton, has been appointed Lecturer in Telephony at the Brighton Municipal Technical College for the second year.

METROPOLITAN STAFF CHANGES.

Mr. J. R. DAVIES, Clerk, from Correspondence Department, Salisbury House, to Western Engineer's Office.

Mr. J. BLYTHE, Stores Labourer, East, appointed Storekeeper, Bromley.

Miss HELEN M. HERRICK, Operator, Avenue, appointed Clerk in Rentals Department, Salisbury House.

Traffic Department.

Miss EMMA GOODWAY, Travelling Senior Supervisor, N.E. district, promoted to be Clerk-in-Charge, Hammersmith.

Miss EDITH TRINGHAM, Senior Supervisor-in-Charge, Hammersmith, transferred as Travelling Senior Supervisor to N.E. district.

Miss MARGARET WELLS, Senior Supervisor, London Wall, transferred as Senior Supervisor to Kensington.

Miss FLORA PRESS, Supervisor, Westminster, promoted to be Travelling Senior Supervisor, South district.

Miss ADA BRIDGES, Supervisor, Croydon, transferred as Supervisor to Hop.

Miss LILIAN CLEAVE, Supervisor, Hop, transfered as Supervisor to Avenue.

Miss CLARA CLARKE, Supervisor, Avenue, transferred as Supervisor to Croydon.

Miss LILIAN TYRRELL, Operator, Gerrard, promoted to be Supervisor, Avenue.

Miss EMILY ORPIN, Operator, Kensington, promoted to be Supervisor, Avenue.

Miss FLORENCE M. JOHNSON, Operator, Avenue, promoted to be Supervisor, London Wall.

Miss ELLEN MINCHIN, Operator, Holborn, promoted to be Supervisor, Gerrard.

Miss KATHERINE MULVANEY, Operator, Holborn, promoted to be Supervisor, Westminster.

Miss EDITH MORGAN, on her promotion from Paddington to be Senior-Supervisor-in-Charge, Hampstead, was presented by the Paddington staff with a handsome pearl and peridot pendant.

Miss ALICE L. WILLIAMS, Operator, East, on resigning from the service, was presented by the staff with a handbag and a brooch.

MARRIAGES.

Miss EVELINE ANNIE RICHARDS, Clerk-in-Charge, Barry Dock, left the Company's service on Aug. 24, and was married on Sept. 2. Miss Richards joined the service in March, 1900, at Cardiff Exchange, became Senior Operator in July, 1902, and was finally promoted to the position of Clerk-in-Charge, Barry, in March, 1904. The operating staff in the Cardiff centre presented her with an electro-plated cake basket and cake knife as a mark of respect and esteem, and with their best wishes for her future happiness.

Mr. W. F. RATHBONE, of Tunbridge Wells, but now officiating as Chief Inspector, Norwich, during Inventory operations, was presented by the Norwich staff with a case of fish carvers also a case of fish knives and forks and other articles on the occasion of his recent marriage. During his stay at Norwich Mr. Rathbone has won the esteem of a wide circle of friends, and the District Manager (Mr. O. W. Stevens), who made the presentation, happily expressed the congratulations and good wishes of the staff.

Inspector C. H. DOE was on the occasion of his marriage the recipient of a useful present from the whole of the Ramsgate staff, viz., a brass kerb rail and coal vase. The presentation was made by the Local Manager, who voiced the very best wishes of all the staff for Mr. Doe's happiness.

Mr. J. P. MELVILLE, Collector, Edinburgh, was on the occasion of his marriage presented with a marble timepiece. The presentation was made in the district office by Mr. Wilson, Chief Clerk.

Mr. DAVID STEWART, Faultsman, Rochdale, on the occasion of his marriage (which took place at the Old Parish Church on Sept. 16) was presented with a tea service and a pipe, subscribed for by the staff.

Miss FLORENCE M. ADAMS, Ramsgate, who has been in the Company's service about thirteen years, the greater part of the time as Chief Operator, was presented on Sept. 1 with a hold-all and a hat box, subscribed for by the Ramsgate and Broadstairs staff. Mr. Rhodes, the Local Manager, made the presentation, and wished Miss Adams a safe voyage and every happiness and success in a new country. Miss Adams is sailing for Montreal, Canada, and will shortly be married there to Mr. F. BRIGG, the late Chief Inspector of Ramsgate.

Mr. D. H. RASTALL, Sub-Engineer, Nottingham, was married on Sept. 19 to Miss Sarah Hilda Loverseed. He was presented with a handsome marble clock by Mr. C. H. Sibley, the District Manager, on behalf of the staff, who expressed his own and the staff's good wishes for Mr. Rastall's future happiness.

Miss GRACE COOK, Central Exchange, Birmingham, left on Aug. 24 to be married. She had been in the service since April, 1904. The operating staff at Central Exchange presented her with a case of cutlery and an electro butter dish. Miss Cook also was the recipient of many other gifts from her particular colleagues.

Miss A. GREEN, Typist and Message Rate Clerk, resigned her position in the district office, Sheffield, on Sept. 16, after about fourteen years' service, in view of her approaching marriage. She was the recipient of a handsome pair of bronzes from the staff, together with numerous other gifts from individual lady members of the staff. She left with all good wishes for her future interests and welfare.

Miss MABEL ORRELL, Supervisor, Sheffield, left the Company's service on Aug. 31 to be married. She was presented by the operating staff with an electro-plated flower vase. She was also the recipient of several other presents from individual members of the staff.

Miss ALICE MAUDE HARRIS, Operator at Hove Exchange, Brighton, has resigned to be married, and has been presented by the staff with a tea service.

Miss IDA NEUMAN, Senior Operator at Battersea, on resigning to be married was presented by the staff with a tea service, and in addition received eight other gifts, principally art needlework, from personal friends in the exchange.

Miss LIZZIE WALKER, Operator, London Wall, was the recipient of a dinner service, which was presented by the staff on the occasion of her resignation on Aug. 31 on account of her approaching marriage.

Miss BEATRICE WHITE, Operator, London Wall, was also presented with a dinner service on her leaving the service on Sept. 14 to be married.

OBITUARY.

It is with much regret that we have to record the death (which took place on Aug. 28) of Mr. F. A. LUKE, of the district office staff, Dover. Mr. Luke, who was only nineteen years of age, had been in the Company's service since May, 1908. Death ensued after a very short illness, the deceased being on duty on Friday morning and dying on the Monday following. He was a promising young clerk, a conscientious worker and a favourite with every member of the staff. A wreath was sent by the District Manager (Mr. C F. Ashby) and another by the deceased's colleagues. Messrs. J. Law (Chief Clerk), J. U. Wood and E. T. French represented the staff at the funeral.

CORRECTION.

Miss E. CLOSE, Operator Sheffield, described in last month's issue as leaving the Company's service to be "married," left for other private reasons.

Mr. H. JAMES, Assistant Exchange Inspector, Sheffield, was married on Aug. 12, not July 12, as stated last month.

STAFF GATHERINGS AND SPORTS.

Dundee.—The telephone society commenced the session on Friday, Sept. 15, in Lamb's Hotel, with a whist drive, in which members of the Post Office and Company's Inventory staff participated, and a most enjoyable evening was spent. The arrangements for the session are well in hand and an interesting course is anticipated.

Edinburgh.—A ramble, attended by a party of about 50 of the Edinburgh staff was held on Saturday, Sept. 9. Train was taken to Colinton (a distance of three and a half miles) from Edinburgh, and from thence the party walked to Balerno, five miles farther on. Going by Torduff and Clubbiedean Reservoirs, "Poet's Glen" and Lymphoy estate, the route lay along the north-west slopes of the far-famed Pentland Hills, so dear to the heart of Robert Louis Stevenson, and passed through a district of great beauty and old-time interest. On reaching Balerno tea was served, after which dancing was indulged in. The larger number elected to walk back to town, the route varying slightly to that taken on the outward journey. Beautiful weather favoured the outing and a most enjoyable afternoon was spent. Great praise is due to the organisers for the able manner in which the arrangements were made.

Bath.—A pleasant outing to Castle Combe was enjoyed by the Bath staff on Sept. 16. The outward journey was not without adventure, one of the brake horses "coming a cropper," and, later, a lady member of the cyclist detachment colliding with another, happily without serious results in either case. The ancient church and ruins were explored and tea partaken of, the return journey to Bath being completed by 9.30 p.m.

Maidstone.—At the Maidstone Swimming Baths on Wednesday, Aug. 30, a team of four (viz., F. Oliver, L. Wilson, C. W. Fisher and S. G. Waghorn, representing the Maidstone staff of the National Telephone Company) was successful in winning its way into the second round of the "Flying Squadron Team Race" for the silver cup presented by the *South Eastern Gazette*. The team conceded to their opponents—the Loyal Providence Lodge of Oddfellows—a start of three seconds in four lengths (120 yards).

Eastbourne.—The return cricket match between the combined staffs of Eastbourne and Hastings and the Tunbridge Wells staff took place at Eastbourne on Saturday, Aug. 26, the local team again proving successful. The Tunbridge Wells teams batted first, and were dismissed for 46, the Eastbourne and Hastings men replying with 155. Mr. E. B. Jempson again topped the scoring with a fine innings of 75. After the match tea was partaken of on the ground, a pleasant day being concluded by all (including the operators and visitors) joining in a hearty game of rounders.

Oldham.—The members of the Savings Club, Oldham, held their annual meeting at the Café Monico on Sept. 5. The chair was occupied by Mr. W. B. Cheetham. The society was formed twelve months ago (on the model of the Cardiff Society) and had a membership of 38. £161 had been paid in during the year. The secretary and treasurer's reports were adopted and a code of new rules for the ensuing year were passed. The meeting then proceeded to the election of officers, resulting as follows:—President, A. Pugh; secretary, E. Higson; treasurer, G. Broome; committee, Misses F. Mills, G. M. Turner and Messrs. F. A. Wade, M. Pinder, A. Blackburn and R. H. Woodford; collectors, Miss F. Wilson, Mr. P. Wilson and Mr. T. Earnshaw. A vote of thanks was accorded to the officers and committee for service during the past, and it was decided to hold a whist drive with part of the profits.

Brighton.—On Sept. 2 the Brighton staff had a very enjoyable little outing to Glynde. The party went by train to Lewes, and thence walked over the hills to the destination, where tea was provided at the "Trevor Arms." After tea the majority indulged in sports in the recreation ground, while the minority tested the rural joys of inspecting pigs and gardens. One section of the party returned by the eight o'clock train to Brighton, the remainder staying behind for some music and dancing, after which they walked to Lewes and caught a late train home.

On Sept. 16 another outing was arranged, when 27 journeyed by brake to Fulking *via* Shoreham and Beeding. At Fulking they were met by a walking contingent, who proceeded by way of the Devil's Dyke. Forty-two took tea at "The Shepherd and Dog," and before and after this sports and walks were the order of the day. The brake party returned to Brighton *via* Patcham, while the pedestrians went on to Hassocks, thence taking train for home. Both outings were extremely enjoyable, and were arranged by Mr. E. J. Clarke, secretary of the A.S.T.E., assisted by Miss Trott (the Brighton Clerk-in-Charge), Miss Gigg, Mr. E. A. Dyer and Mr. W. Davis. Amongst those taking part, besides the above, were Mr. C. F. Moorhouse (District Manager) and Mrs. Moorhouse, Mr. L. Parsons (Chief Clerk) and Mrs. Parsons, Mr. R. Curling (Eastbourne Manager), Mr. H. Hatton (Electrician) and Mrs. Hatton, Messrs. Hill, Wrey, Adames, Roberts and Roach (of the Inventory staff), and a number of visitors. Mr. H. Gaston kindly supervised the brake arrangements.

EXAMINATION SUCCESSES.

THE following successes have recently been gained by members of the Engineer-in-Chief's staff in the examinations held by the City and Guilds of London Institute:—

Telegraphy.—J. W. Wheeler, first class, honours, silver medal and first prize of £3.
,, F. W. Friday, ,, ,, ordinary.
,, ,, second ,, honours.
,, E. Strong, first ,, ordinary.
,, ,, ,, ,, honours.

The following have passed the examinations instituted by the Board of Education:—
R. Burke, magnetism and electricity.
A. W. Spooner, ,, ,,
,, practical mathematics.

Chatham.—*City and Guilds Examinations.*
Inspector H. H. Bell, ordinary, first class.
,, ,, electrical engineering, ordinary, passed.
Board of Education Examinations.
Inspector H. H. Bell, magneto and electrical, section 1, first class.
,, L. W. Jezard ,, ,, ,, ,, ,, ,,

Norwich.—*Board of Education Examinations.*
H. M. Cowles, Chief Inspector, Great Yarmouth, a first class certificate, magnetism and electricity.

Preston.—*Board of Education Examinations.*
Chas. E. Mills, District Office Clerk, Preston, first class, practical mathematics, stage 1; first class, applied mechanics, stage 1; second class, magnetism and electricity, stage 1.
C. W. Arthur, Inspector, Preston, second class, magnetism and electricity, stage 1.

Bristol.—*City and Guilds Examinations.*
Inspector V. G. Critchlow, Bath, first class certificate, telephony, ordinary grade.

Plymouth.—*City and Guilds Examination.*
W. C. Galloway, Inspector, Plymouth, gained third place in all England in telephony (ordinary grade) and has obtained the City and Guilds bronze medal.
The following members also gained certificates:—
F. J. Knight, first class, magnetism and electricity, first stage; first class, telegraphy, ordinary; second class, telephony, ordinary.
W. C. Harris, first class, telephony, honours grade.

Exeter.—*City and Guilds.*
A. O. Carter, Night Operator, Exeter Exchange, first class certificate, telegraphy, ordinary, and telephony, ordinary.

Portsmouth.—*City and Guilds Examinations.*
F. S. Wainscot (Inspector), electrical engineering (continuous current), ordinary, pass; (alternate current), ordinary, pass; electric wireman's work, final, second.
T. Collins (Exchange Inspector), electrical engineering (continuous current), ordinary, pass.
F. Luckham (Assistant Test Clerk), telephony, ordinary, second; telephony, honours, second.
N. Jarrett (Fitter), telephony, ordinary, second.
H. C. Lewis (Inspector), telephony, ordinary, first; telegraphy, ordinary, first; mathematics (practical), stage 1, first.
G. Goodall (Inspector), magnetism and electricity, stage 1, second.
L. V. Lees (Acting Chief Inspector), magnetism and electricity, stage 1, second,

Brighton.—*City and Guilds of London Examinations.*
Junior Inspector Edgar Parsons, second class ordinary in telephony.
Board of Education Examinations.
Inspector Harold Leney, first stage, second class, in magnetism and electricity.

Nottingham.—
V. E. Lane, Instrument Fitter, Nottingham, has passed an examination in magnetism and electricity, thereby gaining a scholarship at the Science Evening Classes at the University College, Nottingham.
Board of Education Examinations.
A. W. Barnsdale, Instrument Inspector, Nottingham, has obtained a first class certificate in magnetism and electricity, stage 1.

Sheffield.—*Board of Education Examinations.*
A. Burgess, C. Marsden, R. Gillett and J. W. Wright (magnetism and electricity) stage 1, first class.
H. Addy, B. Glenn, B. Marsden and D. Thomson, second class.
Sheffield University Examinations.
F. G. Bishop, pure mathematics, stage 1, section "B," first class

London.—*Holborn Exchange.*
A. W. Trickett, second class, telephony, honours.
H. A. Temple, ,, ,, ,,
A. W. Trickett, ,, ,, ordinary.
P. Joncke, ,, ,, ,,
H. Marks, ,, ,, ,,
F. L. Glass, ,, telegraphy, ,,
H. A. Temple, ,, ,, ,,
P. Joncke, ,, ,, ,,
T. Chater, first class, telegraphy, ordinary.
F. L. Glass, first stage, first class, magnetism and electricity.
A. W. Trickett, ,, ,, ,, ,,
J. Joncke, second stage, second class, ,, ,,
H. A. Temple, ,, ,, ,, ,,