POST OFFICE

telecommunications

JOURNAL

ONE SHILLING AND SIXPENCE

WINTER 1957

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TRANS-ATLANTIC telephone cable system

The transatlantic telephone cable system, an advance in telecommunications which will rank high among the century's major engineering achievements, provides, for the first time, direct cable-telephone communication between Europe and America.

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can supply

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Telecommunication Engineers

Connaught House, Aldwych, London, W.C.2

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Taming the Ether

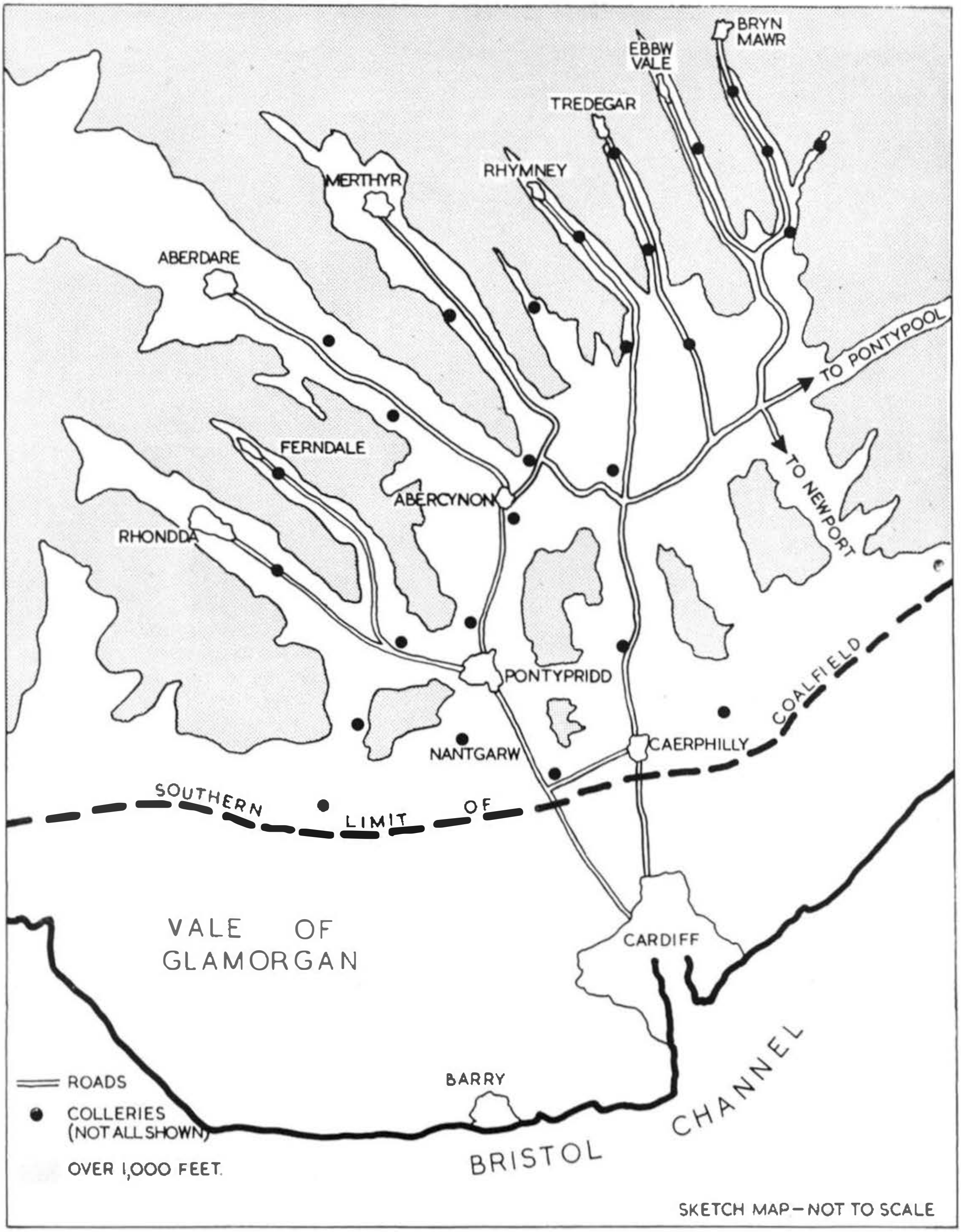
FIFTY YEARS AGO, ON DECEMBER 21, 1906, BROADcasting was born as an infant whose "squall"—actually a recording of Handel's *Largo*—was received in good voice at Plymouth, Massachusetts, ten miles away from the National Electric Signalling Company's aerial at Brant in the same state; Professor Aubrey Reginald Fessenden had invented the means by which, ultimately, Her Majesty the Queen's annual Christmas Day message to her people can be heard in every country of the Commonwealth.

But in the jubilee year of this event, and at the same time of the year—some authorities say the first broadcast was on Christmas Eve, which is certainly more picturesque—the technique of broadcasting, so intensively and extensively developed since that first successful attempt, took a further step forward; on Christmas Day the peoples of the Commonwealth were able to hear H.R.H. The Duke of Edinburgh broadcasting a message over a circuit of some 12,000 miles from the Royal yacht *Britannia* on the verge of the Antarctic.

Reception of the speech in Britain has been described as satisfactory, in spite of adverse radio conditions at the moment; indeed, through all the background noises 95 per cent. of the message was reasonably audible in this country. Moreover, immediately after the speech, when conditions improved, members of the Royal Party and the officers of the yacht were able to exchange Christmas greetings with home even more clearly.

The broadcast has been described as a major feat in telecommunications. As our description in this issue of the planning and carrying out of this feat shows, it was the result of more than six months' planning and experiment between the Post Office, Cable and Wireless and the B.B.C.

While we offer congratulations to all those concerned in the achievement of this feat, we remember also the pioneer work of Professor Fessenden and of all who have worked to tame the ether during the past half century.



Eastern side of South Wales coal-field

Study of the surface at Mardy Colliery in the Rhondda Valley, South Wales, where a £4,000,000 re-organization and development project is now nearing completion (Courtesy of South Western Division of N.C.B.)

Coal and Communications in South Wales

W. G. Scantlebury and W. L. Hall

THE SOUTH WALES COAL-FIELD EXTENDS ACROSS the northern half of Glamorganshire and reaches into the county of Monmouth; part of it is shown on the sketch map. Between the coal-field and the Bristol Channel, eight to ten miles away to the south, lies the Vale of Glamorgan, a fertile rolling countryside which gives no indication of the grim grey valleys to the north. A group of valleys comes to focal points at Pontypridd and Caerphilly and the coal-field was first developed in this area. The area is administered by the South-Western Division of the National Coal Board at Cardiff, and from its inception the Division planned to make great use of the telephone in its task of integrating a vast diversity of interests.

Before the industry was united under the Board in 1947, each colliery, which operated either as a self-contained unit or one of a group, had its own telephone connexion with the outside world. A direct exchange line or two, or maybe a small P.B.X. with possibly a private wire, were all that concerned the Post Office. Private contractors provided and maintained the switchboards and internal communications of the colliery itself, and most inter-communications between collieries in a group.

As late as 1950, private switchboards resembling genuine museum pieces were still in service and for obvious reasons could not be taken over by the Post Office. An extract from a policy statement issued in the Post Office Directorate of Wales and Border Counties at that time might be of interest:

". . . . . and approximately 300 collieries will eventually be connected within the network. In conjunction with the provision of circuits a large number of obsolete switchboards are being replaced by standard Post Office switchboards. The whole work is of considerable magnitude and is expected to take about three or four years to complete".

The external line plant serving remote parts of the collieries was more conventional in design, but the terrain gave rise to overhead routes as outlandish as the switchboard equipment. South Wales collieries are usually at the bottom of narrow valleys, with hills rising steeply from 600 to 1,000 feet on either side. Up these crags went the overhead telephone lines to serve extensions either on the top of the mountain or, in some places, over the mountain to a colliery in an adjacent valley.

The new telephone network was based on an organization "tree" supplied by the Coal Board, a simplified extract of which is shown in Fig. 1.

P.B.Xs are, of course, provided at all offices and collieries (there is a P.M.B.X.1A at Headquarters) each with the usual direct lines to a public exchange, and at first sight it appeared that a fairly conventional network of Post Office P.B.Xs in tandem (for example, Divisional Headquarters — Area — Sub-Area—Group) would do the job. Even then, the design would have required a lot of thought to meet essential signalling and transmission limits. But the Division wanted something better than this, and they stated their case in detail.

Among other things to be borne in mind was that in an emergency, direct exchange lines to a P.B.X. are almost certain to be blocked and alternative outlets must be readily available to enable priority calls to be disposed of at once. It has to be remembered, too, that coal and the railway wagons used to carry it are heavy, bulky and costly to move and handle. The commercial side of the undertaking has to ensure that the number of wagons on a particular day at any colliery is neither too many nor too few. This is ensured by close liaison between colliery and transport officers on the

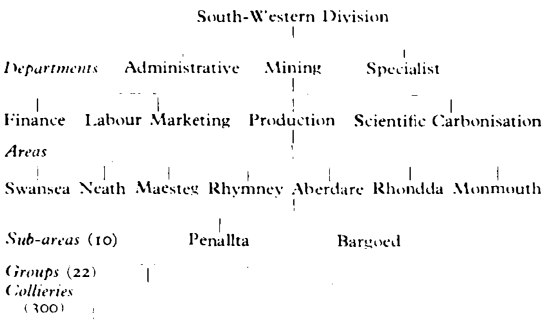


Fig. 1

telephone—a very efficient method, but it may use a lot of plant.

These considerations made it clear that simple tandem working would not do and that considerable inter-switchboard connexions between P.B.Xs would be required if unduly lavish provision of circuits on a straightforward "chain-of-command" basis was to be avoided.

From a design point of view this meant that a very careful check of routings had to be made, because what was a highly flexible system of great value to the Coal Board meant complexity to the Post Office planning engineer. Every effort was made, of course, to avoid the "brute-force" method of obtaining flexibility by installing all possible inter-connexions, but even so some pretty circuitous routings were unavoidable at times. What has emerged, however, is that no matter how busy the lines, the flexibility of the private wire network almost guarantees that a free route to any office can be found. The arrangements are constantly under review and there is the closest liaison between the Coal Board Divisional Telecommunications Officer and the Telephone Manager's staff.

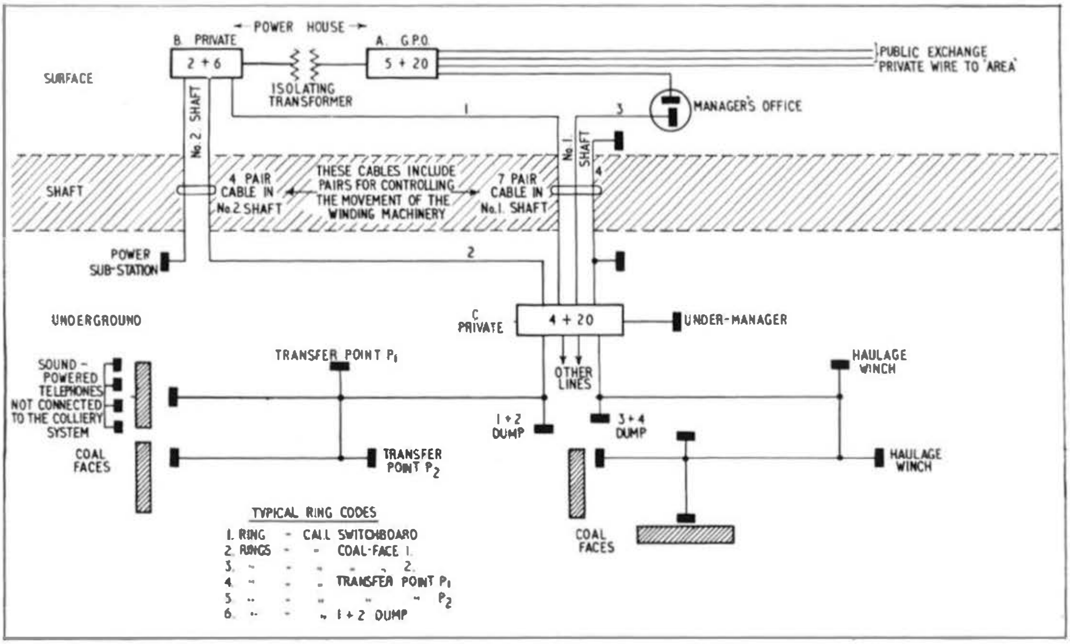
Apart then from the rather special inter-linking of P.B.Xs and some tricky overhead construction problems here and there the "surface" arrangements for providing telephone service are more or less conventional, and today as in the past the Post Office provides and maintains equipment only as far as the pit head.

The underground "operational" telephone plant is the responsibility of the Coal Board's technical staff. When this plant is connected to a Post Office switchboard the Post Office engineers have to see that the stringent safety precautions which have been laid down are observed.

The individual requirements of the collieries vary considerably and are not related solely to the size of the underground workings; underground operational telephones in use range from about 70 at a large to three at a small colliery. These telephones are connected to industrial-type switchboards of which there may be as many as four in the larger collieries. At least one such board will be connected to the Post Office P.B.X., but there are seldom more than two lines between a privately owned system and the Post Office equipment.

Before looking at a typical colliery telephone lay-out in detail it would be useful to know for what purpose the telephones are used. Calls on the colliery telephones can be divided into five classes:—

OUTLINE OF TYPICAL COLLIERY COMMUNICATIONS



Below: **Modern re-constructed underground roadway at Mardy Colliery, Rhondda Valley; this roadway, which must be close to the shaft bottom, is ver uncommon as most roadways are dark and very restricted**

(Courtesy of South Western Division of N.C.B.)

The P.B.X. switchboard at Divisional Headquarters

Haulage: Calls for passing instructions; for example, to an engine man or for passing information on the whereabouts or movement of "trams"—which are the small railway-like trucks still used in many collieries for moving the coal underground.

Supplies: Calls asking for engineering supplies such as pit props, machine parts and so on to be sent, or passing information about the progress of supplies.

Maintenance: Calls for a fitter or electrician.

Pit Control: Calls conveying management instructions on the running of the pit or for discussion between management officials, for example, between an overman and his under manager.

Information: Calls asking for information about how things are going: for example, whether coal is coming yet, why the conveyor belt has stopped, prospects of clearing any hold-up, the hourly score. (The "hourly score" relates primarily to progress with coal-getting but can also include information about cricket scores or the state of a Test match wicket. Such news from above ground is not without importance to men who may be working a long way from the pit shaft in conditions which have to be seen to be appreciated.)

It should be remembered that there are many miles of tunnels or "roads" in a normal pit and that the coal-face can be two miles or more from the shaft bottom. To get from one point to another usually means walking along a narrow, dark passage of very uneven surface and varying head room. In addition there are hazards such as jutting rocks, haulage machinery, and "journeys" of trams which come at speed through the darkness and which can be avoided only by darting into small recesses, cut for the purpose into the walls of the tunnel at intervals of ten yards. Where personal movement is so difficult telephone communication becomes very important.

The movement of conveyor belts, coal tubs and the pit shaft winding machinery is usually controlled by bell signals, not by telephone.

A telephone system in an underground working has to conform to certain technical requirements. First there must be no danger of causing a fire or explosion. Secondly, the equipment must be simple to operate, reliable and robust. Because of the exceptional maintenance difficulties, the amount of line plant used and the number of telephones must be kept to a minimum. It is worth stressing that maintenance is a real problem and only first-hand knowledge can give even a hazy idea of conditions which are unknown even to Post Office staffs or Army Signals. Imagine a place where the floor, walls and roof are slowly but continually being distorted and destroyed and where space is so costly to provide that it is barely sufficient for the mining staff; add a constantly moving stream of hundreds of tons of coal, and the plight of the telephone engineer, whose lines run precariously through this wilderness, can perhaps be appreciated.

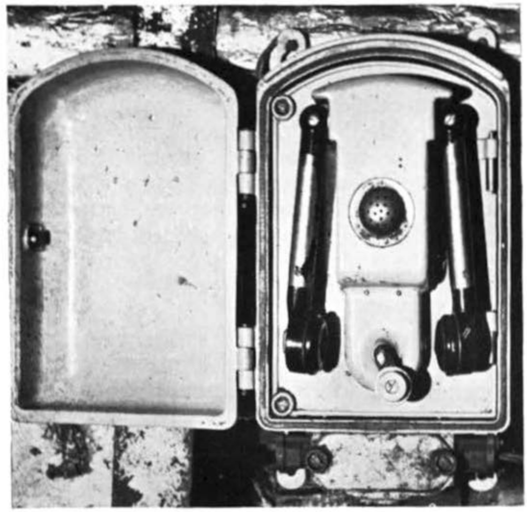
A telephone system best suited to meet these conditions is readily envisaged by the Post Office engineer. It will use hand-generators for signalling and local batteries for speaking. The equipment generally will be iron-clad and flame-proof. Switchboards will be of the "cordless" type and permit bunching of calls—that is, the connexion of several extensions together at the board. Telephones will be sited with great care to use as few as possible yet to serve as many people as possible, and will be usable in very noisy situations. Lines will be armoured and, to keep the total length of cabling to a minimum, several telephones will be connected to one line. "Isolating" transformers will be used on lines connected to the Post Office switchboard so that, for safety, there is no direct metallic connexion between the mine and the public network. And that is what was found generally when, by courtesy of the South Western Division of the Coal Board, the "Lady Windsor" and "Bargoed" mines in South Wales were visited.

The description which follows is a composite picture of a medium-sized colliery's communications, drawn from impressions made by short visits to those two mines, each of which produces rather more than 10,000 tons of coal a week. The diagram on page 51 will help the reader to follow the description.

At the surface there are two switchboards—one Post Office and one owned and maintained by the National Coal Board.

The Post Office switchboard (A) handles the general administrative extensions and technical and operational extensions and has one tie line to the privately owned switchboard (B). This tie line has an isolating transformer which breaks the metallic connexion between the Post Office and private systems. These switchboards are side by side and a member of the Power House staff operates both boards. Two lines run from switchboard (B) to the underground switchboard (C), one line running in each of the two pit shafts, and an extension is provided at the underground power sub-station.

Miner using underground telephone (Courtesy of South Western Division of N.C.B.)



Underground telephone (Courtesy of South Western Division of N.C.B.)

Switchboard (C) is near the bottom of the main shaft and provides the underground switching system. It has facilities for setting up a maximum of four calls simultaneously, but two or more of the possible 20 extensions may be bunched together for any call. As shown in the diagram, extensions 1 and 2 are the lines to the surface switchboard (B) and can be connected to the Post Office switchboard when necessary. No. 3 extension gives the manager direct access to all underground staff, while extension 4 is used for passing information about the movement of coal from the bottom of the shaft to the surface.

The other extensions serve the coal-faces and the intermediate points between such faces and the shaft. When coal is moved on conveyor belts a telephone is always provided at a "transfer point" where one belt ends and another starts. Some coal is hauled along rails in tubs, and a telephone is always provided at the haulage-winch and at places where the rail points have to be switched. The number of lines and the number of telephones on each varies, of course, with the individual requirements of each mine, but the description may be taken as typical.

Usually, more than one telephone is working on one line, and a system of code ringing is used which allows every telephone on an extension line to call any other on the same line without the help of the switchboard. Where a mechanical coal-cutter is used to hew the coal at the coal-face the machinery has a party line of its own built into it which is not connected with the colliery system. This line is for the men along the face to keep in touch with each other. There may be up to six telephones on the line. They are completely self-contained, using generators at each point for signalling and being what is known as "sound powered". This means that no batteries or outside electrical current is needed to facilitate speech, the sound of the voice generating its own current in the transmitter.

The simple system described in general terms has served the requirements of a colliery reasonably efficiently, but it is understood that the Scientific Department of the National Coal Board has in mind the development of an automatic system. Code ringing is a big objection to the party-line system now used in underground workings because there is often so much noise around the telephones that the ringing is not clearly heard. This can lead to delay in getting an answer from the right telephone and, with the speeding up in colliery processes which mechanization is bringing about, such delays will become intolerable. Other developments which the Scientific Department is considering are better telephones for operating in very noisy situations, an improved alarm system for giving warning of danger, and improved cables having great mechanical strength coupled with fire-resistant properties.

"Reith" Lecturer Praises T.A.T. Men

How Sir Edward Appleton Discovered "Polar Blackouts"

BROADCASTING THE FIRST OF HIS REITH Lectures, 1956 ("Science and the Nation"), Sir Edward Appleton, Principal and Vice-Chancellor, Edinburgh University, spoke of the value of the "applied scientist", for whom, "certainly no less than for the pure scientist, his work can be an intellectual adventure . . . it is as a creative individual, who has found a happy medium between thought and action, that I would especially honour the applied scientist".

Sir Edward added that it must "have been an enviable and rewarding experience to have been associated in any way with the design of those two great engineering projects whose completion for service has been prominent domestic news of recent months. I refer to the transatlantic telephone cable . . . and the Calder Hall nuclear power station".

After a brief outline of the telephone cable, Sir Edward continued:—

"Yet you may wonder why it was necessary to go to such lengths as laying cables on the bed of the Atlantic when the world appears so easily bridged by radio.

"I can remember how, nearly a quarter of a century ago, I stumbled on the particular defect in long-distance communication which these new submarine cables have been designed completely to remove. This was during the second International Polar Year, when I was a member of a British expedition studying radio wave reflections from the ionosphere in north Norway. It happened to be my turn of all-night duty at the receiver one night in August, 1932. At first, reception conditions were normal, the ionospheric reflections being strong and distinct. Then suddenly, about ten o'clock at night, the reflections vanished and everything seemed to go dead. I was naturally greatly perturbed, feeling perhaps that my apparatus—or myself—was at fault. I tried the whole range of wavelengths available, but still found the ionosphere unresponsive; and it remained so throughout the night.

"The following morning a Norwegian assistant said to me: 'I think we should have seen the northern lights last night if it had been winter'; and he drew my attention to a magnetic record which I remember was still wet from the dark-room. This record showed that a magnetic storm had broken out at the time I had experienced the radio curtain of silence. Since that time the frequent incidence of these 'polar blackouts', as they are called, has been found to be characteristic of radio conditions in high latitudes and has rendered our radio communication with North America fitful and uncertain. That is why we need the translantic telephone cable".

(*Extracted from the* Listener, *November* 15, 1956)

Time in Telecommunications

F. I. Ray, C.B.E.

A talk given by Mr. Ray to the Post Office Inland Telecommunications Department on November 6, 1956

TWENTY-SIX YEARS AGO I ATTENDED A lecture by A. O. Gibbon on the electrical control of time services in the Post Office. The discussion languished and I was unexpectedly called on to speak. Knowing little of the subject of the lecture I tried to describe the importance of time in telecommunications but I do not think that the Astronomer Royal, who was present, was much impressed by my eloquence.

As we grow older we learn to appreciate the true value of time, but do we all realize how vitally time affects our job of providing telecommunications? To explain what I mean I will take a very simple example.

We all know that a dial has 10 holes in the finger plate because it is used to signal numbers, and numbers are arranged on the dinary or decimal system because the Arabs who originated the system counted on the fingers of both hands. We can, in fact, say that there are 10 holes in the dial because human beings have 10 fingers.

But why do we design dials to send impulses at the rate of 10 a second? To answer this question we must know what happens at the exchange when one dials.

Removal of the receiver connects the calling telephone to a disengaged selector and current flows through the *A* relay of that selector. When the dial is released this current is momentarily interrupted by the impulsing springs of the dial, the number of disconnexions being equal to the digit being dialled.

Each time the dial spring breaks the circuit the *A* relay releases and allows current to flow through the vertical magnet of the selector, thereby raising the wipers one step. Each time the dial springs "make", the current flows again and the *A* relay re-operates, disconnecting the vertical magnet which restores to normal to await the next impulse.

It is obvious from this description that the duration of the break part of the impulse must be sufficiently long to allow the magnet to lift the wipers, and the make period must be long enough to allow the magnet to return to normal. Because it has to lift the wipers, the magnet takes almost twice as long to operate as to release, and consequently the break period of the dial impulse is made twice as long as the make period. Also, the whole movement of operation and release takes about 50 milliseconds.

It would indeed be possible to use impulse speeds of up to 20 impulses per second if we could be sure that the impulse ratio—that is the proportion which the break period bears to the make period—was always two-to-one, but in practice the ratio is liable to be distorted and therefore a lower speed is required if we are to be sure that the magnet has enough time both to operate and to release. It is to provide this margin of safety that 10 impulses a second are used.

Formerly, the dials on operating positions were adjusted to 12 impulses per second to speed up the work, but with 2-VF dialling over long trunk lines the margin of safety is not sufficient for this higher speed and the practice has been discontinued.

Risk of low speeds

At speeds below 10 per second there is the risk of premature release of another relay—relay *C*; also, subscribers become impatient and force the dial back, which is bad for the dial and for the success of the call. The standard speed of 10 impulses a second, therefore, is not just "a nice round number" but is the speed best suited to the requirements of the electro-magnetic system of switching. It is the result of the influence of time in telecommunications.

When the train of impulse ends the selector wipers rotate to find a free outlet.

Here we meet another time factor, for the outlet must be found before the next train of impulses arrives. This means that the rotary hunting speed of the selector must be high, but there is a limit to the speed that can be achieved with an electro-magnetic ratchet driven mechanism and there is no doubt that subscribers would often beat the selectors, and calls would fail, were it not for the slipping cam, an ingenious lost motion device incorporated in the dial, which adds 200 milliseconds to the interval between successive impulse trains.

Another, and rather more complex, timing problem occurs at the end of a call. When the handset is replaced the calling loop to the *A* relay is disconnected and the selector is returned to normal. The selector must, however, be able to distinguish between the disconnexion which signifies that the call is ended and the momentary interruptions which occur during dialling. It does this through the agency of the slow-to-release *B* relay, which, when operated marks the switch as engaged and, when released, restores it to its normal position. This relay must be capable of remaining in the operated condition during impulsing, during which time its circuit may be broken ten times for periods of 66 milliseconds or more and be closed for periods of only 33 milliseconds, and to meet this condition its time to release on disconnexion would need to be about 250 milliseconds.

Relays of this sort can easily be designed, but the releasing time of a relay cannot readily be measured in maintenance and in any given exchange there will be considerable variation between the release times of the *B* relays of different selectors.

Junction ends must be guarded

Now the problem to which I would direct your attention occurs with calls between exchanges. Here it is a basic requirement that the outgoing end of the junction should be guarded—that is, marked as engaged—until the selectors at the distant exchange have started to release. For this to be done safely the selectors at the outgoing exchange must not release for, say, 350 milliseconds after disconnexion. Sometimes calls are made over two junctions in tandem and each must be guarded during release. This means that the originating exchange must not release for 500 milliseconds after the subscriber has hung up, and to achieve a minimum of 500 milliseconds some selectors will hold on for about 700 milliseconds.

But when a free line cannot be found, "busy" flash is connected to the line to recall the operator should the call come from a switchboard. The busy flash lasts for 750 milliseconds and during this period no current flows in the calling line; normal conditions are reapplied for 750 milliseconds and the flash is then repeated. During the flash the switches are prevented from releasing, as they would do when current ceases in the calling line, and therefore the switches have only the 750 milliseconds between flashes in which they can restore if the caller replaces his hand-set, and they can barely do this if they are to avoid unguarded intervals on calls over two junctions in tandem. To enable calls to be dialled over more than two junctions in tandem it has been necessary to abandon the busy flash facility.

Code dialling

The time requirements of an electro-mechanical system become increasingly troublesome when we try to extend the dialling range for, besides the problem of unguarded intervals to which I have referred and other technical problems, there is the question of the codes to be dialled to route calls to their destination. Code dialling is outside the scope of this talk and I will only say that the usual solution is to employ some kind of register, such as the director, to receive the dialled impulses and to take over the task of routing the call.

This solution has the disadvantage of introducing a time interval between the end of dialling and the receipt of ringing tone. Even within London this delay can be very aggravating, but with nation-wide dialling calls may have to pass through several registers in succession and this time delay may result in serious criticisms of the service. We shall therefore need more rapid systems of switching and dialling than those to which we are accustomed.

In this connexion I would mention the key-sending telephone which has already been used experimentally in one exchange in Sweden. Each telephone is fitted with 10 press buttons instead of a dial and the subscribers tap out the numbers they require in a second or less. The exchange is of the crossbar type, which works more rapidly than the Strowger type, and the speed with which calls are established is most striking. Press buttons also reduce subscribers' errors and will, I think, ultimately replace the dial.

So far I have referred to time only as a factor in equipment design, but of course time enters into our work in a much more direct fashion. Our job is, indeed, to sell conversation time and the method of measuring and charging for that commodity is very much our concern. Formerly machines called calculagraphs were used to print the time of starting and ending a call on the ticket, and this system is still in use in Amsterdam exchange. The calculagraph has the great merit of providing a record which can be shown to any subscriber who complains of overcharging, but the space occupied by the machine was a disadvantage and I do not suppose anyone would criticise the decision to replace it by chargeable time indicators and by chargeable time clocks (clocks 44).

But these modern timing devices need to be tested and this testing takes a surprisingly long time. Nearly half the work of routine testing by night operators is spent on timing devices, about 1,160,000 hours each year for the country as a whole.

This is, of course, only one of the costs we incur in providing subscribers with bills for their telephone service. Tickets have to be prepared, priced and brought to account and recent visits to continental administrations suggest that appreciable economies could be made by mechanizing some of these processes, but the cheapest way of charging for calls is to record them on the subscribers' meters. This can most easily be done on calls dialled by subscribers, but it is possible to design circuits which permit manually handled calls to be metered according to distance and duration.

French system

This system was adopted in France in 1943 because of the difficulty in getting paper for tickets and I have sometimes wondered whether it might not be worth while to introduce the idea into this country.

Our present policy, however, is to press on with subscriber trunk dialling and the question is how we should charge for line time with a fully automatic trunk service. In accordance with economic principles our price should be proportional to the cost and this is made up of two main elements, the cost of setting up the call and the cost of the line time used. Logically our charges should comprise a setting up charge and a duration charge but with a manually operated service this would be a very complicated tariff to administer. We have therefore compromised by charging for a minimum period of three minutes to ensure that, however short the call, we receive enough to pay the setting up costs, which are a large (and growing) proportion of the whole.

With a subscriber dialled call, however, the setting up charges are small, and can easily be covered by one or two meter operations at the beginning of the call. Thereafter the call charge can be registered either by several meter operations at, say, minute intervals or by single operations at more frequent intervals. Most of you will know that we are adopting the latter system in this country, but you may not be aware that the credit for devising it belongs to Dr. Karlson of the Helsinki Telephone Administration.

For my next example of the importance of time in telecommunications I would refer to the telegraph system. Efforts have long been directed at increasing the number of calls which can be made at the same time over a single circuit and at present we are able to send 12 or more messages simultaneously by dividing the speech band into frequency channels.

Early time division multiplex

But long before the design of electrical filters made this frequency channelling possible, teleprinter multiplex working was employed, using the Baudot system. Rotating brushes at each end of a line successively connected transmitters to receivers so that each pair of instruments in turn was given the sole use of the line for a fleeting moment. This was an early example of time division multiplex and I mention it as an introduction to the latest development in telecommunications—the use of electronic devices instead of the conventional electro-magnetic relays and switches.

Four years ago the first electronic switch to be used for public service was installed in Richmond (Surrey) Exchange and has given complete satisfaction. It was designed to perform the functions of a director and to be part of the existing exchange; but to obtain the most economic results from electronics it will be necessary to depart entirely from traditional circuit arrangements and to use principles which exploit the high speed of operation of which electronic equipment is capable.

One very promising line of development is the use of time division multiplex, but with electronic instead of mechanical switching. It is possible to connect a large number of subscribers to a single circuit through what are called gates.† These consist mainly of germanium diodes and permit current to flow only when a potential is applied to them. If potentials are applied simultaneously to two subscribers' gates, the subscribers can speak to each other, and by applying potentials to pairs of gates in sequence it is possible for a number of

† *This system is more fully discussed in the article on the "Electronic P.A.B.X. at the Post Office Research Station" on page 61.*

conversations to proceed simultaneously and without mutual interference.

It is surprising for how short a time the gates need to be opened to enable speech to be carried on, providing the openings are repeated with sufficient frequency. Very little speech distortion will occur providing the gates are opened for one micro-second repeated every 100 micro-seconds. In theory the frequency of repetition of the gate potential should be twice that of the highest frequency to be transmitted—which means that gates opened every 100 micro-seconds would allow 100 simultaneous conversations on the one circuit, each with a frequency range of up to 5 kcs.

Finally, I should like to refer to the latest task of telecommunications, the transfer of data to computers. These data-processing machines work at tremendous speeds and it is very difficult for any one administrative or executive unit to keep them employed. Only by feeding data from many points into a central machine can economic use be made of these expensive devices, but the rate at which data can be transmitted over a line depends on the frequency range of that line and it may well be that we shall have to supply music circuits or even coaxial links to transmit data at the required rate. I saw recently that someone had calculated that all the communications, oral and written, made by an average man in his life-time, could be transmitted over a coaxial line in 10 minutes by using data processing machines.

I am aware that in this talk I have barely touched the fringe of my subject, for time is the fourth dimension which enters into almost everything which we do. But in closing I should like to sum up my own experience.

Just as chemists have seen the molecule split into atoms and these in turn divided into protons and electrons, so we in telecommunications have seen time subdivided into smaller and smaller units. When I started in the Post Office we measured time in seconds, usually by stop watch. During my early service in the circuit laboratory we got used to talking and working in milliseconds. Now I have to think in terms of micro-seconds.

How times have changed!

Post Office Accounts Show Rise in Telephone Income

Financial Report for 1955-56

THE *Post Office Commercial Accounts* FOR 1955-56 show that the telephone service made a surplus of £4.9 millions, income being £138.1 millions against an expenditure of £133.2 millions. The surplus was higher by £0.6 millions than the surplus for 1954-55.

The trading results of the postal and telegraph services, however, showed deficits of £1.5 millions and £1.1 millions respectively, so that the net surplus realized on General Account (comprising all three services) was reduced to £2.3 millions. This compared with £5.2 millions for 1954-55.

Readers will remember Mr. E. W. Shepherd's definition of the Commercial Accounts in his article outlining Post Office finance in our Winter, 1956, issue: "they are fundamentally similar to the trading accounts which would be prepared by a trading concern not required—as the Post Office is—to conform to the specialized cash requirements of Parliamentary Accounts." Comprising income and expenditure accounts, depreciation accounts and balance sheets, their purpose is to show the trading results of Post Office operations for the year.

It should be noted that the provisions of the "White Paper" *Report on Post Office Finance and Development* of October, 1955—to which Mr. Shepherd referred in his article—did not affect the accounts for 1955-56; those provisions did not come into force until the beginning of the financial year 1956-57 last April.

Following is a summary of the year's working in the telecommunications services.

The table on page 60 compares the results of the telegraph and telephone services for 1955-56, with those for 1954-55.

TELEPHONE SERVICE: 1955-1956

	1954-55	1955-56
NUMBER OF LOCAL EXCHANGES AT END OF YEAR		
Automatic	4,576	4,662
Manual	1,351	1,282
Total	5,927	5,944
NUMBER OF AUTO-MANUAL AND SEPARATE TRUNK EXCHANGES AT END OF YEAR	261	272
	1954-55 '000	1955-56 '000
NUMBER OF EXCHANGE CONNEXIONS AT END OF YEAR		
On automatic exchanges	2,976	3,216
On manual exchanges	1,031	1,049
Total	4,007	4,265
ANALYSIS OF EXCHANGE CONNEXIONS UNDER RENTAL CATEGORIES, &C.		
Business Rate —exclusive service	1,547	1,587
shared service	143	152
Residence Rate—exclusive service	1,425	1,468
shared service	773	935
Post Office Service	53	55
Call Office	66	68
Total	4,007	4,265
NUMBER OF STATIONS AT END OF YEAR		
Exchange Service	6,436	6,830
Private Circuits (telephone and telegraph)	55	57
Total	6,491	6,887
NUMBER OF APPLICATIONS FOR EXCHANGE CONNEXIONS DURING THE YEAR	471	474
NUMBER OF APPLICATIONS FOR EXCHANGE CONNEXIONS OUTSTANDING AT END OF YEAR	372	344
TRAFFIC—NUMBER OF CALLS		
Inland:—		
Trunk	306,332	333,369
Local	3,615,000	3,865,000
Total	3,921,332	4,198,369
Overseas:—		
Continental cable services:—		
Outward	1,816	1,956
Inward	1,665	1,826
Transit	29	30
Radiotelephone services:—		
Outward	97	108
Inward	95	113
Transit	23	27
Short range calls with ships:—		
Outward	8	9
Inward	50	62
Total	3,783	4,131

	1954-55 £ m.	1955-56 £ m.	*Difference* £ m.
Telegraph Account—			
Income	16.2	17.7	1.5
Expenditure ...	18.7	18.8	0.1
Deficit	2.5	1.1	1.4
Telephone Account—			
Income	123.3	138.1	14.8
Expenditure ...	119.0	133.2	14.2
Surplus	4.3	4.9	0.6

Comparative results

Telegraph Services

Inland telegraph traffic again fell substantially and, in spite of the full year effect of the increased charges introduced on August 1, 1954, total income fell from £4.1 millions to £4.0 millions.

The revenue from private wires, at £4.3 millions, showed an increase of £0.6 million on the previous year. Income from international telegrams also rose by £0.6 million to £6.6 millions. The revenue from miscellaneous telegraph services rose by £0.4 million to £2.8 millions, of which £0.3 million was due to growth in the inland telex services.

The continuing process of adjusting staff numbers to falling traffic caused a net reduction of £0.6 million in telegraph staff costs, and accommodation costs fell by £0.7 million; but total expenditure rose by £0.1 million owing to pay awards which cost £0.8 million, including the effect on pension liability; £0.3 million of this increase represented the full year effect of increases made in 1954-55.

Inland telegram traffic, at 20,546,010 messages, was about 20 per cent. lower in 1955-56 than in the previous year; 56,000 fewer Government telegrams were sent, the total falling from 360,000 to 304,000.

On the other hand, oversea telegram traffic, including transit traffic, rose from 20,859,000 telegrams to 21,125,000. The increase included a rise of 30,000 in ship-shore radiotelegrams.

The number of oversea telex calls rose from 1,454,000 to 2,065,000

Telephone Services

Growth of business accounted for £9.9 millions of the increase of £14.8 millions in the income of the telephone service; revenue from trunk calls contributed £4 millions of the increase, from exchange rentals, £2.3 millions, from local calls, £2.1 millions, and from private wires, £0.7 millions. The tariff increases introduced on January 1, 1956, yielded £4.7 millions, and the remaining £0.2 million arose from increases in the rates charged for agency services to other Government Departments.

As with the other Post Office services, pay awards were the main cause of increased expenditure on the telephone service during the year. They cost £5 millions, of which £2.2 millions represented the full year effect of increases made in the previous year. Other increases in operating, administrative and maintenance staff costs amounted to £3 millions. An extra £2.2 millions was allocated for depreciation, bringing the total to over £28.4 millions, and £1.9 millions more were allocated to interest charges on the capital invested in telephone plant.

Statistics of telephone traffic and development are given in the table on page 59.

The figures show that local call telephone traffic rose by 7 per cent. in 1955-56 over 1954-55, and inland trunk calls by 9 per cent. Traffic over the Continental cables increased by 9 per cent. and on the radiotelephone services by 17 per cent.

The number of inland trunk speech channels over 25 miles in length, in use on March 31, 1956, was 21,543, an increase of 428 during the year.

I.R.A. Damage to Plant.—Post Office and B.B.C. telecommunications plant were among property damaged in the armed raids on Northern Ireland in mid-December.

Near Toomebridge, five yards of Post Office duct were blown up and the 122-pair cable it contained was put out of action. The damage was done in the middle of the night and repairs could not be started until daylight as the area was cordoned off by the police. By five o'clock that evening, however, repair work was completed and all circuits had been restored.

Near Londonderry, an aerial cable was cut through with a hacksaw, and in the south of County Down all the wires were cut on three overhead routes carrying junction and subscribers' circuits. All services were restored on the same day.

Some damage to overhead plant was done during the attacks on police stations in Fermanagh two days later, but this was repaired next day.

The B.B.C. transmitter at Londonderry was seriously damaged and put out of action by a bomb thrown through the window, but there was very little damage to Post Office plant.

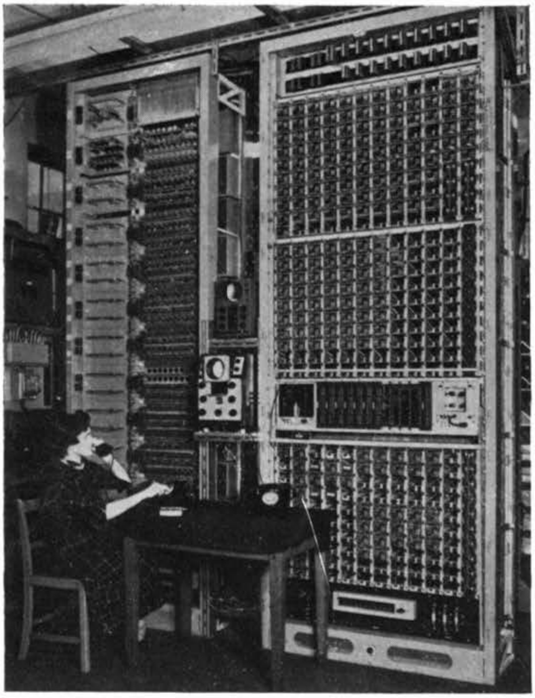


Fig. 1: The electronic P.A.B.X. at Dollis Hill

Electronic P.A.B.X. at the Post Office Research Station

W. T. Duerdoth, B.Sc., A.M.I.E.E.

THE POST OFFICE RESEARCH BRANCH HAS designed and constructed a small electronic Private Automatic Branch Exchange (P.A.B.X.) which has been in service at its Research Station at Dollis Hill, London, for about a year. The exchange is entirely electronic and has no mechanical parts. It serves about 50 extensions and through a manual board (a P.M.B.X.IA) gives access to other non-automatic extensions and to the public telephone system. Part of the exchange is shown in Figure 1.

The objective of research on exchange switching is not at present to provide small P.A.B.Xs but to develop towards electronic exchanges inter-working on a nation-wide basis under the control of subscriber dialling. It is therefore not surprising to find that the electronic P.A.B.X. was not designed as a small unit but was assembled by methods applicable to a full-sized public exchange. The project was undertaken to gain experience in the construction, operation and maintenance of the equipment rather than to give a local service, which at this stage could undoubtedly have been obtained more economically with orthodox equipment.

One of the main advantages of electronic equipment is the extreme speed at which it operates. This allows design on principles very different from those used in mechanical exchanges. Many switching methods are possible only with electronic equipment but I propose to describe only those employed in the P.A.B.X.; however, a more technical description of a similar but earlier exchange is to be found in the reference.*

Register-marker Principle

The equipment of an electronic exchange must perform all the switching functions of a mechanical exchange but without the use of moving parts. A subscriber must give instructions to the exchange to enable connexion with the subscriber he wants, and these are produced by way of the caller's switch-hook and dial, which are on his premises and are used to produce changes of potential at the exchange. These changes of potential must contain the necessary controlling instructions to the exchange.

The mechanical system in this country uses a step-by-step method in which each train of pulses dialled by a subscriber advances the call a further stage. But with electronic equipment the speed of

** A more technical description of a similar but earlier exchange was given by F. Scowen in "A Small Experimental Electronic Automatic Exchange", Post Office Electrical Engineers' Journal, Vol. 47, parts 1–3, 1954.*

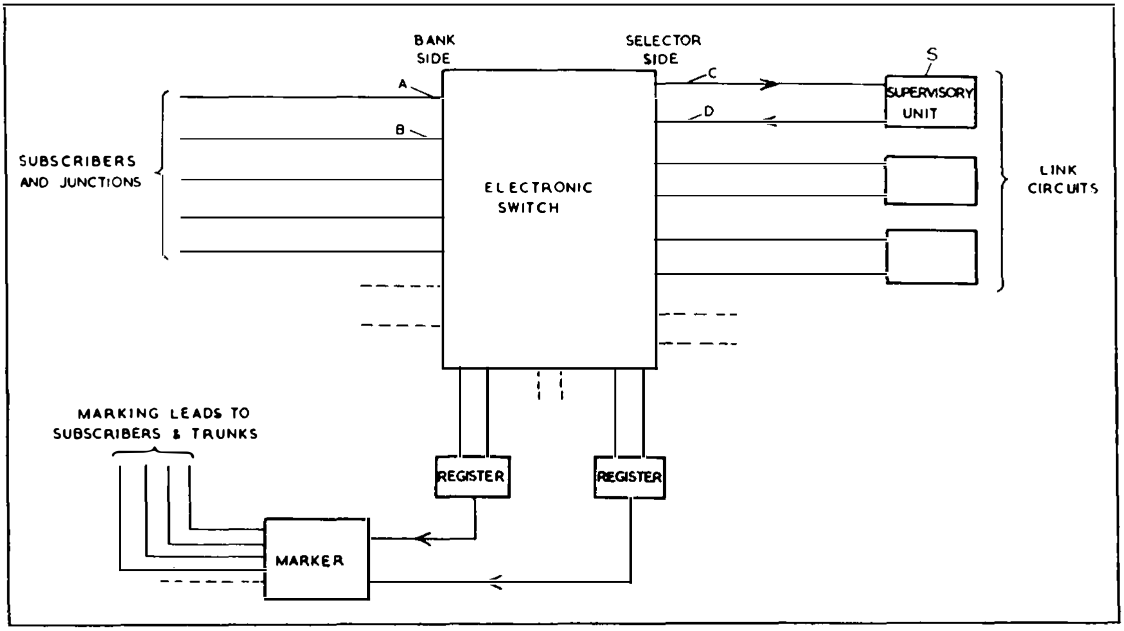


Fig. 2: Electronic P.A.B.X. trunking diagram

operation makes it economical to connect the subscriber first to a storing circuit called a register, which receives all the dialled information, and the call need not be further advanced until this information is completed. When it is complete, the register becomes connected to equipment called the marker, which controls the setting up of the call. Only one marker is necessary and only one call can be in the process of being set up at a time, but since it takes only 10 milliseconds to set up this is no disadvantage, even with the largest exchange. This register-marker principle has advantage in that it reduces the amount of equipment required in the exchange, as all possible paths through the exchange can be examined before one is selected for a call. This principle is used in the P.A.B.X.

Trunking

The trunking of the exchange is illustrated in Fig. 2. A subscriber or junction is connected to the electronic switch, which is capable of making connexions to any of the link circuits or registers. Many connexions can exist at one time.

A calling subscriber or junction is first connected to a register, and after the dialled information is complete the marker controls the connexion to another subscriber or junction through a link circuit. The link circuit controls such functions as ringing, metering and releasing a call. When a call is set up the speech from subscriber A will pass through the switch and around the link circuit from C to D and thus again through the switch to another subscriber B. Before explaining the operation any further the electronic switch must be described.

Time-Division-Multiplex Principle

The electronic switch is designed as a time-division-multiplex system. In this system a permanent physical connexion exists between each subscriber and a common pair called a "highway". Between the subscriber's line and the highway is equipment consisting mainly of germanium crystal diodes which permits speech currents to pass between the subscriber and the highway only when a potential is applied to the diodes. This equipment is known as the subscriber's "gate", as it controls the subscriber's connexion. If potentials are applied simultaneously to the gates of two subscribers they are then able to speak to each other.

An exchange has to cope with more than one conversation at a time, but if potentials were applied to additional subscribers' gates all the subscribers would be interconnected. This difficulty can be overcome by rhythmically opening the gates of the first pair of subscribers and then the second and so forth so that more than two gates are never open at once. Thus, the speech between a pair of subscribers will come through in regularly spaced bursts, and is suppressed while the other conversations are in progress. It might be expected that this chopping of the speech would cause considerable deterioration, but provided that the interconnexion occurs regularly and not less frequently than every 100 microseconds (μs) the speakers will not detect any deterioration.

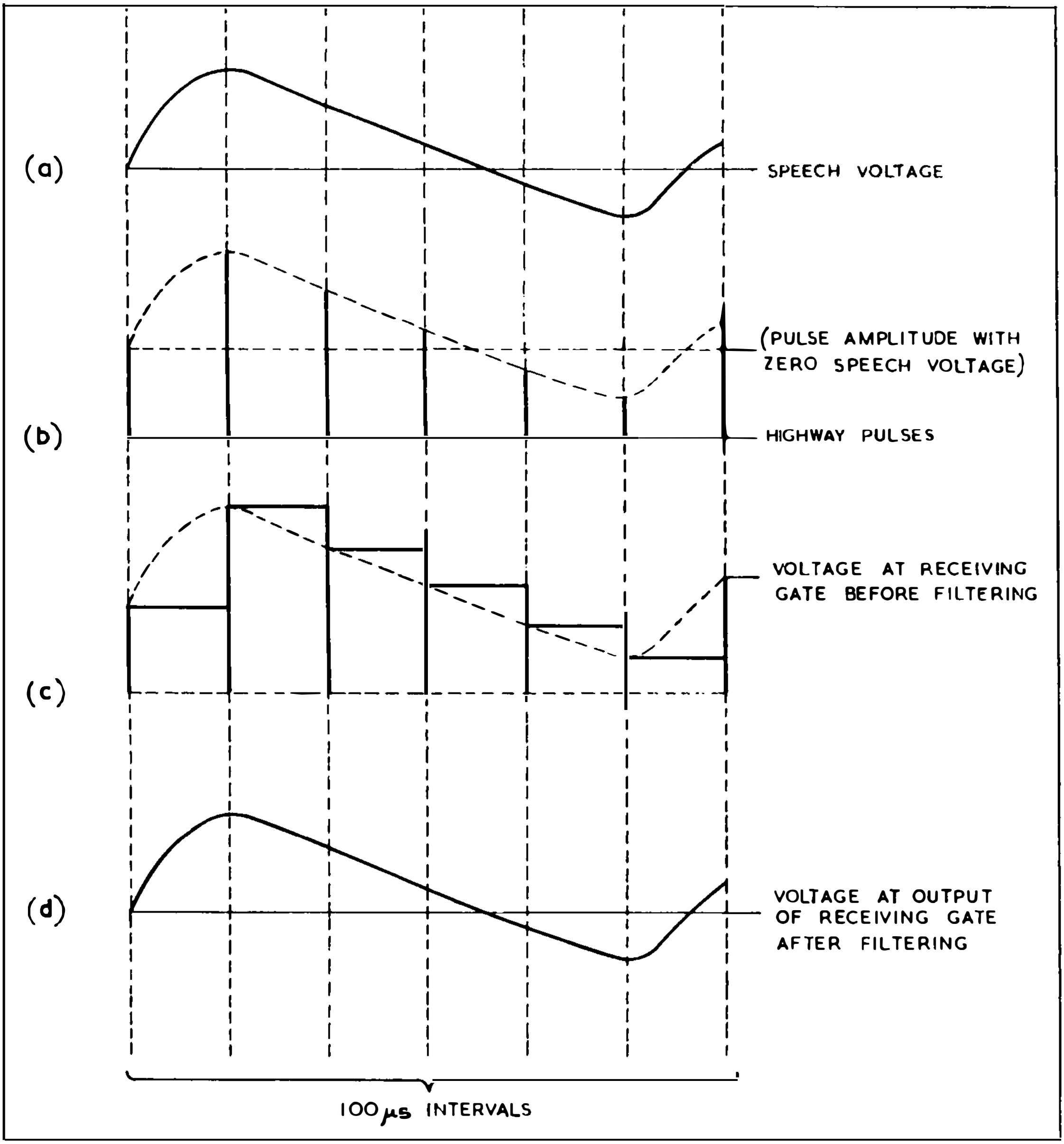


Fig. 3: Time division multiplex principle

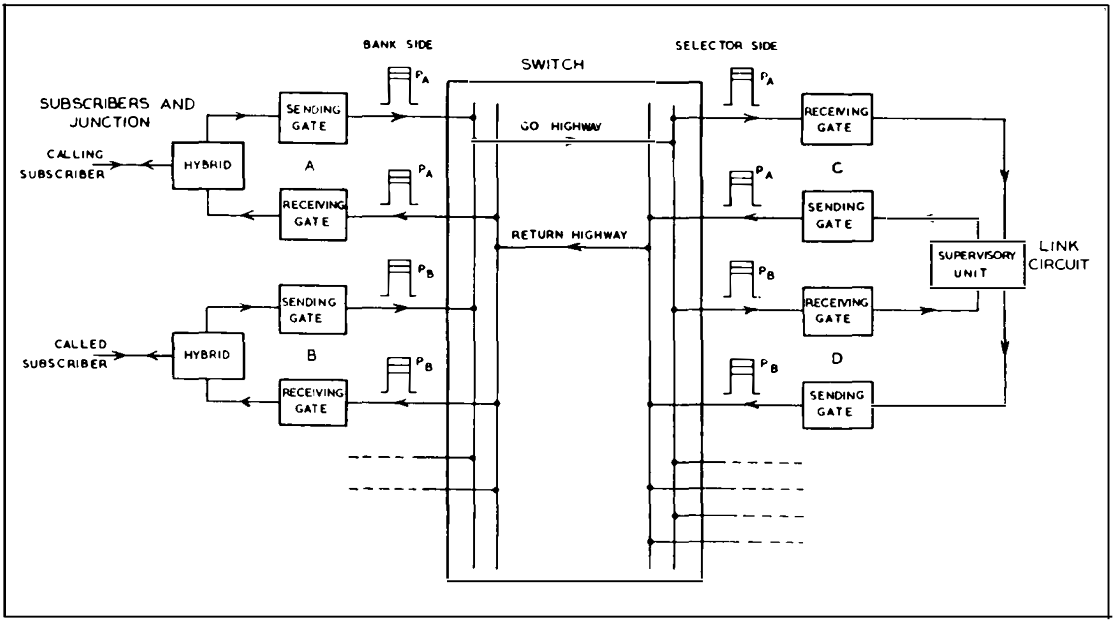


Fig. 4: Connexions through switch

Voltages produced in an electric circuit by speech waves change slowly compared with such a small time as 100 μs; this is illustrated in Fig. 3 (*a*), where the speech voltage is shown divided into 100 μs intervals. Speech transmission is possible by making rapid measurements of this voltage every 100 μs so that a sequence of almost instantaneous measurements is obtained, as in (*b*). These measurements have to be made and passed over the highway to the "receiving gate". This can be achieved in 1 μs. Thus, the "sending gate" must measure the speech voltage every 100 μs and transmit its value to the receiving gate, 1 μs being allowed for this process. The receiving gate notes the value of the voltage and produces and *maintains* a corresponding output for the remainder of the 100 μs, when a new value will be received—see (*c*). This output is passed through a filter circuit, when it again becomes speech voltages, see (*d*), suitable for transmission to a subscriber.

Thus the gates of two subscribers which are to be connected must be open for the same 1 μs every 100 μs and during this 1 μs a pulse whose amplitude is a measure of the speech voltage must pass from the sending gate to the receiving gate, but during the remaining 99 μs the highway must be free to transit pulses associated with other conversations.

The potential which opens the subscribers' gates must be a pulse train consisting of a 1 μs pulse every 100 μs and if 100 such pulse trains, each having its pulse staggered 1 μs later than that of the previous pulse train are made available, a hundred conversations are possible at once on a single highway without mutual interference, any two subscribers being interconnected by applying the same pulse train to both their gates.

The P.A.B.X., while using this principle, is a little more complex, since its sending and receiving gates are different and two highways, one for each direction, are used.

Each of the possible 99* subscribers' lines has a pulse permanently allocated to it and this becomes connected to its sending gate as soon as the subscriber lifts his receiver. Fig. 4 gives a more detailed illustration of the switch. It will be seen that a complete connexion uses the pulses P_A and P_B of both subscribers and that connexion is made from the calling subscriber A to the link circuit using pulse P_A and from the link circuit to the called subscriber B using pulse P_B.

The subscribers are connected to the "bank

* 99, *not* 100, *pulse trains are provided, as these are more economical to produce.*

side" of the switch where all the pulses are fixed, that is, the same pulse is always connected to any particular gate. The links are connected to the "selector side" of the switch where any of the 99 pulses may be required at any gate. One of the problems in setting up a call is to select the necessary pulses and connect them to the gates of the link circuit to be used.

Pulse Storage

The P.A.B.X. is equipped with 10 link circuits so that only 10 calls can be in progress at once; this is adequate for the number of subscribers served. Each link circuit has two connexions to the selector side of the switch so that there are 20 points to which pulses have to be connected. The actual pulse which must be connected is not known until the calling subscriber has dialled the number he requires.

When the register has received the dialled information it must first select one of the 10 links which is not in use, and must then connect to one end the pulse of the caller and to the other the pulse of the called subscriber. Once connected, the pulses must remain for the rest of the call even after the register has been released. Thus a pulse storage device is necessary which will release when the calling subscriber clears.

A complete set of 99 pulses is available at each of the 20 points on the selector side of the switch, and any one of these pulses can be connected to the gates of the link circuits by striking an appropriate cold cathode tube. These tubes once struck continue to glow and apply the pulse until the power supply is removed at the end of the call.

The simple application of this principle would necessitate 99 cold cathode tubes at each of the 20 points, but by employing a coincidence system of pulse trains of 9 μs and 11 μs spacing, used on a vernier principle, the number of cold cathode tubes can be reduced to 20 at each point on the selector side of the switch.

When a call is established the pulses on the bank side of the switch are maintained by the loop condition from the subscribers, and those on the selector side are produced by its pulse stores.

Sequence of Operation

This description of the exchange is much simplified and incomplete but it should be sufficient to enable an abridged sequence of operation to be followed.

When a subscriber lifts his receiver the loop circuit is completed and a change of potential occurs at the exchange; this causes the subscriber's pulse to be connected to his gate on the bank side of the switch, see Fig. 2. The pulse also serves to indicate to the registers that one is required. Four registers are provided, and several subscribers may call at once. Yet it is necessary to ensure that only one register is connected to only one subscriber. This is achieved by using the subscriber's pulses. Although several subscribers may be calling at once their pulses occur at different times, being staggered over the 100 μs period. Electronic equipment is fast enough to detect this difference in timing and deals with each call at its pulse time; thus, the subscribers appear to be calling one after the other. The choice of one out of the four registers is achieved by similar methods, an independent pulse system being used to offer the registers in time sequence.

The subscriber becomes connected to the register by way of the electronic switch, and dial tone is heard. On completion of dialling the register uses the marker to apply the called subscriber pulse to the bank side gate, and the marker is released.

A free link must now be chosen; this again is achieved by a pulse selection method. Once the link is selected, and the calling and called subscribers' pulses put into the pulse stores the register is released and the supervisory unit in the link circuit controls the ringing of the called subscriber, the metering and the final clear down of the call.

Future Systems

This brief description of a small exchange represents an early stage in the development of electronic telephone exchanges and the system described is rapidly being outdated by the development of simpler and less expensive systems. For example, the P.A.B.X. has two highways in the switch, equivalent to four-wire transmission, but it is now possible to make a switch with a single highway capable of bothway transmission. This gives a considerable saving in the number and complexity of the gates and avoids the use of two-wire four-wire hybrid coils. Many of the controlling functions in an exchange can be made very fast with electronic equipment so that they can deal with fast-calling rates. Thus the numbers of units used can be reduced and can often be used to perform several functions. Work on these and associated developments continues and much more economical systems may be expected in the future.

Telegraph Hand Delivery

H. S. Holmes

UNTIL AFTER THE FIRST WORLD WAR TELEgrams were delivered either on foot or by pedal cycle messenger. The motor cycle was introduced between the wars, and the practice of delivering telegrams by telephone was considerably extended. There has been a very great increase in the number of motor cycles used for telegraph delivery, the number in service having grown from about 400 in 1947 to about 1,600 at present, although, during the same period, the number of inland telegrams a year has fallen from some 46 millions to about 20 millions.

These changes, with the difficulty in obtaining casual messengers and changes in the methods of transmission, have led to a reduction in the number of telegraph delivery offices and, therefore, to an increase in the size of the hand delivery areas of the remaining offices. The larger offices often deliver by hand up to seven or eight miles away, and sometimes, even further. Figure 1 shows three typical delivery areas.

This revolution in the telegraph service has served to emphasise the basic hand delivery problem which, in its simplest terms, may be stated as that of delivering on the same delivery run as many telegrams as possible without involving unacceptable delay in delivering individual telegrams. This is illustrated by figure 2, which shows the mileage required to deliver five telegrams individually, compared with the mileage if they were delivered on the same run. The diagram is based on an actual delivery area.

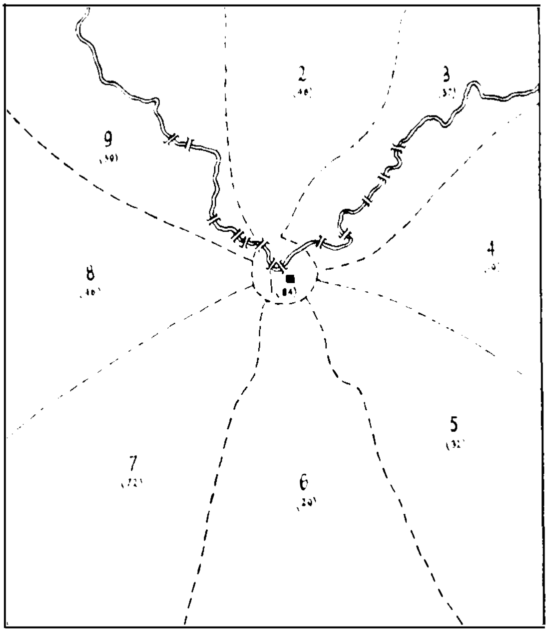
It will be seen that if each of these telegrams were delivered individually a total of 15.2 miles would be travelled, compared with 6.2 miles if they were delivered in the same batch. Assuming a rate of travel of 15 miles per hour and 1.5 minutes spent in handing the telegram over to the recipient, the comparative average times to deliver would be 7.5

Modern motor cycle messenger and pre-1914 messenger

and 15.5 minutes, respectively; the worst delivery services would be 11.5 minutes and 27.5 minutes respectively. The problem is, however, complicated by the fact that if telegrams are taken out singly the later ones may have to wait for the return of the messenger, whereas if they are batched the earlier ones have to be held up until a batch has accumulated.

This basic problem has been well understood for many years now; as long ago as 1923 instructions on the organization of telegraph delivery laid down that delivery areas should be split into "walks" and that delivery to the walks should be made at specified intervals. It was suggested in the instructions that normally there should be about 100 telegrams per walk per day. However, these instructions were issued at a time when telegrams were preponderantly business messages and most of them were delivered on foot to addresses near the office.

After the last war the cost of hand delivery increased rapidly, mainly as a result of the abolition of the Boy Messenger class and higher rates of pay generally. In 1935, when the average revenue from a telegram was 1s. 3d., the average cost of delivery



Above 1 (a) and below 1 (b)

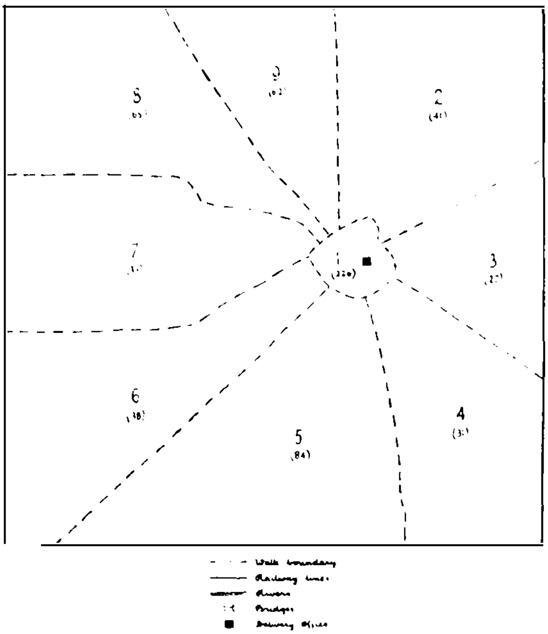
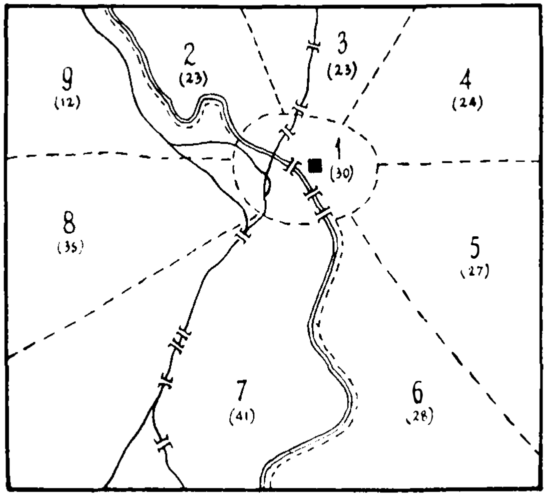


Fig. 1 : Three typical delivery areas showing walk patterns

Bracketed figures are numbers of telegrams per day
Total daily traffic :—
Fig. 1 (a)—406 ; Fig. 1 (b)—607 ; Fig. 1 (c)—243



1 (c)

was $5\frac{1}{2}$d. In 1954 55 the average hand delivery cost was about 2s. 6d. and it is now probably about 2s. 9d. The present average revenue from a telegram is 4s. $3\frac{1}{2}$d. That is to say, average revenue is about three times as high and average delivery cost six times as high as twenty years ago.

A completely fresh review of all the factors affecting telegraph delivery service and costs was therefore undertaken to determine whether the great changes in them warranted any modifications to the methods of organizing telegraph delivery areas and controlling the telegraph delivery process. Initial work was concentrated on designing a method of measuring all the factors involved and, after partial investigation at about twenty offices, what was considered to be a satisfactory technique was evolved. This technique was later applied in full at six offices and, at the same time, fuller records of two of the key factors were obtained from twenty other offices. From this work information was obtained on the following points:—

Time for a telegram to be transmitted from the office of acceptance to the delivery office (that is, until the telegram is gummed or written down).

Time for a telegram to travel from the gumming or writing down point to the delivery room.

Time a telegram waited in the delivery room until despatch.

Number of telegrams delivered on the same delivery run (batch size).

Length of delivery run.

Rates of travel on pedal and motor cycles.

Messengers' time spent on the road, that is, delivering telegrams.

Proportion of telegrams delivered by pedal cycle, motor cycle and foot messengers.

Number of delivery walks into which the delivery area was officially divided and the extent and nature of the walk linkage resorted to by despatching officers to keep batch size up.

Geographical distribution of telegrams delivered.

Time distribution of telegrams delivered.

From these data it was possible not only to assess in great detail how existing arrangements worked in a particular office but also to make paper studies of the probable effect on delivery results of changes in the lay-out of the area or in despatching intervals. At the same time an effort was made to find whether the empirical results so obtained lined up with those gained from a purely theoretical study based on the application of mathematical techniques to a hypothetical delivery area.

These studies served to establish that there was, for the practical range of batch sizes, fairly precise relationship (which could be expressed graphically by a straight line), between the number of messages in the batch and the length of the delivery run. A number of such straight lines are illustrated in figure 3.

Other information derived from the studies was that the average motor cycle speed generally realized in practice was about 15 miles an hour; that with the then existing walk patterns the average batch size was bound to be small unless despatching officers linked walks very freely; that the method of controlling delivery was likely to lead to wide variation in the times that telegrams were held before despatch; and that there was a tendency to regard motor cycles as an auxiliary means of delivery and thus to use pedal cycles to travel quite long distances.

An attempt was therefore made in the paper schemes referred to above to see whether a combination of regular despatching at fixed intervals, greater use of motor cycles and larger walks would lead to a reduction in the number of messenger minutes spent actually delivering telegrams without seriously affecting the service. The considerations which led to the thought that experiment on these lines would be profitable were as follows.

For normal rates of travel it is cheaper to use a motor cycle than a pedal cycle, even though a motor cycle costs 3d. per mile to run. It is, of course, quicker.

If a satisfactory system of controlling despatches could be devised, a fixed despatching interval would avoid the risk of a telegram waiting too long in the delivery room.

Establishment of the approximate straight line relationship between batch size and duration of journey had also shown that increase in batch size reduced the number of minutes per telegram, but by a decreasing amount as batch size grew.

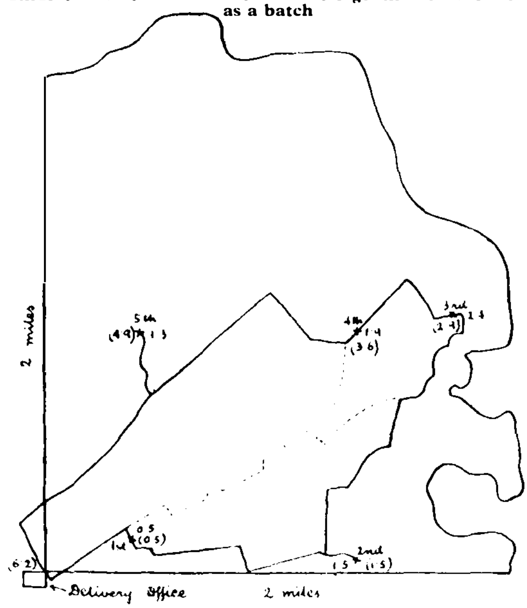
On both theoretical and practical grounds it appeared likely that the return from increasing average batch size beyond five would be slight.

It was therefore concluded that the aim should be to obtain, if possible, an average batch size of between four and five, which meant aiming at targets of about 100 telegrams per walk per day with half hourly sending out, or 200 with quarter hourly sending out. Examination of the sort of distributions and traffic densities of the delivery areas examined showed that, for motor cycle walks, at any rate, the first alternative was the only practicable one. This conclusion envisaged using motor cycles to the fullest possible extent.

Using the paper study technique, each of the delivery offices for which data had been collected was laid out to secure this objective and theoretical runs based on actual traffic distribution and incidence and the average speeds of travel obtained

Fig. 2 : Five telegrams delivered separately and in a batch

Note.—The unbracketed number against each address is the distance to it (in miles) by the route followed when the telegram is taken out alone. The bracketed number is the cumulative distance when the five telegrams are delivered as a batch



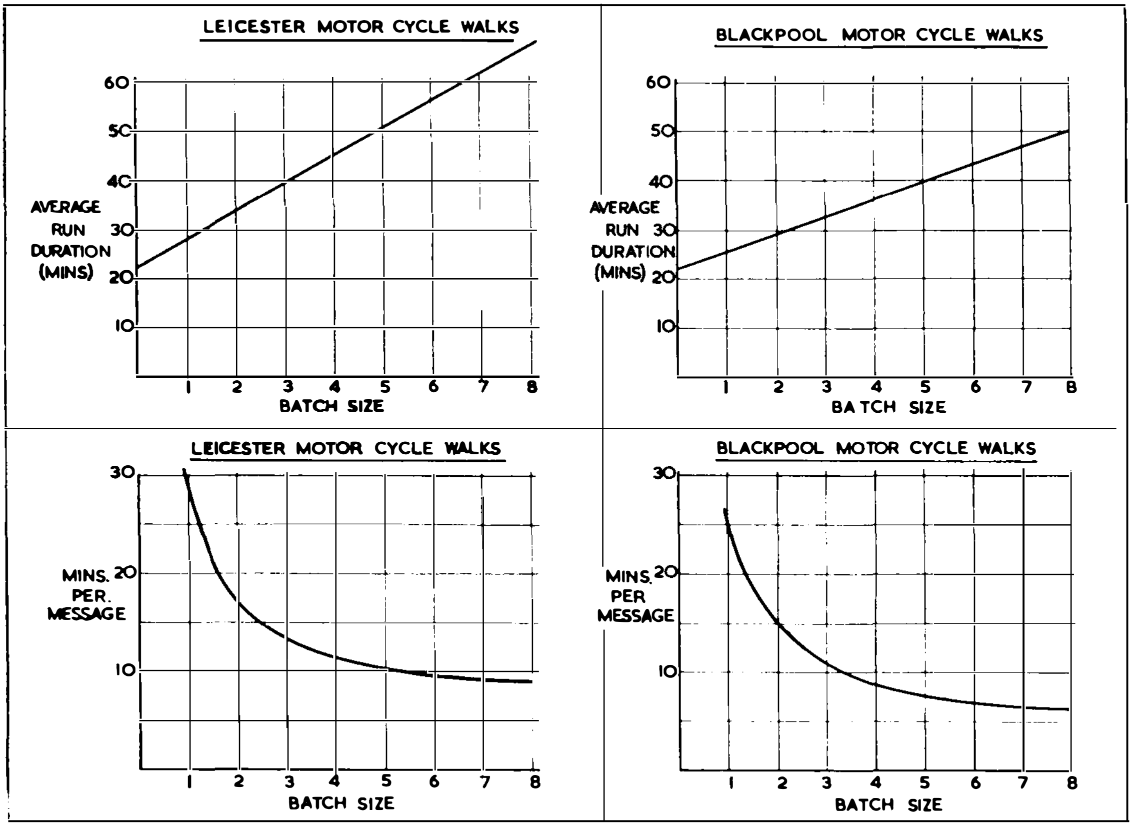


Fig. 3: Relationship between batch size and run duration; and batch size and minutes per message

in practice were undertaken. At the same time, the mathematical studies of the hypothetical delivery area, based on theoretical traffic volumes, incidence and distribution were also made. Both these methods gave roughly the same kind of results. Indeed, the degree of agreement was far greater than had been expected. They suggested that fixed batching intervals would greatly reduce the spread of delivery delays, that greater use of the motor cycle would in large degree neutralize the effect on the service of larger walks and batches, and that, in summary, the methods would lead to a substantial reduction in occupied minutes per message without seriously affecting the service.

There were, of course, snags. These were, first, that the method adopted assumed a constant average of performance in which the best possible routes of delivery had been chosen; and, secondly, it had been assumed that the proportion of motor cyclists to total delivery duties could be increased to the extent demanded by the scheme adopted. In fact, there may be serious limitations on the use of motor cycles because the normal age range for delivery staff is from 15 to 18 and it appeared likely that, for this and other reasons, not many more than half the total delivery force could be employed on motor cycle duties.

However, it is not uncommon for messengers to be employed on other than telegraph delivery work and it was hoped that by reserving auxiliary duties for boys under 16, it would be possible to employ more than half the telegraph delivery force on motor cycles.

Taking all the relevant factors into account it was considered that the results were sufficiently favourable to warrant a practical trial. Accordingly, a system of recording traffic according to walks so as to ensure regular despatches and so that results could be critically examined as regards performance was devised.

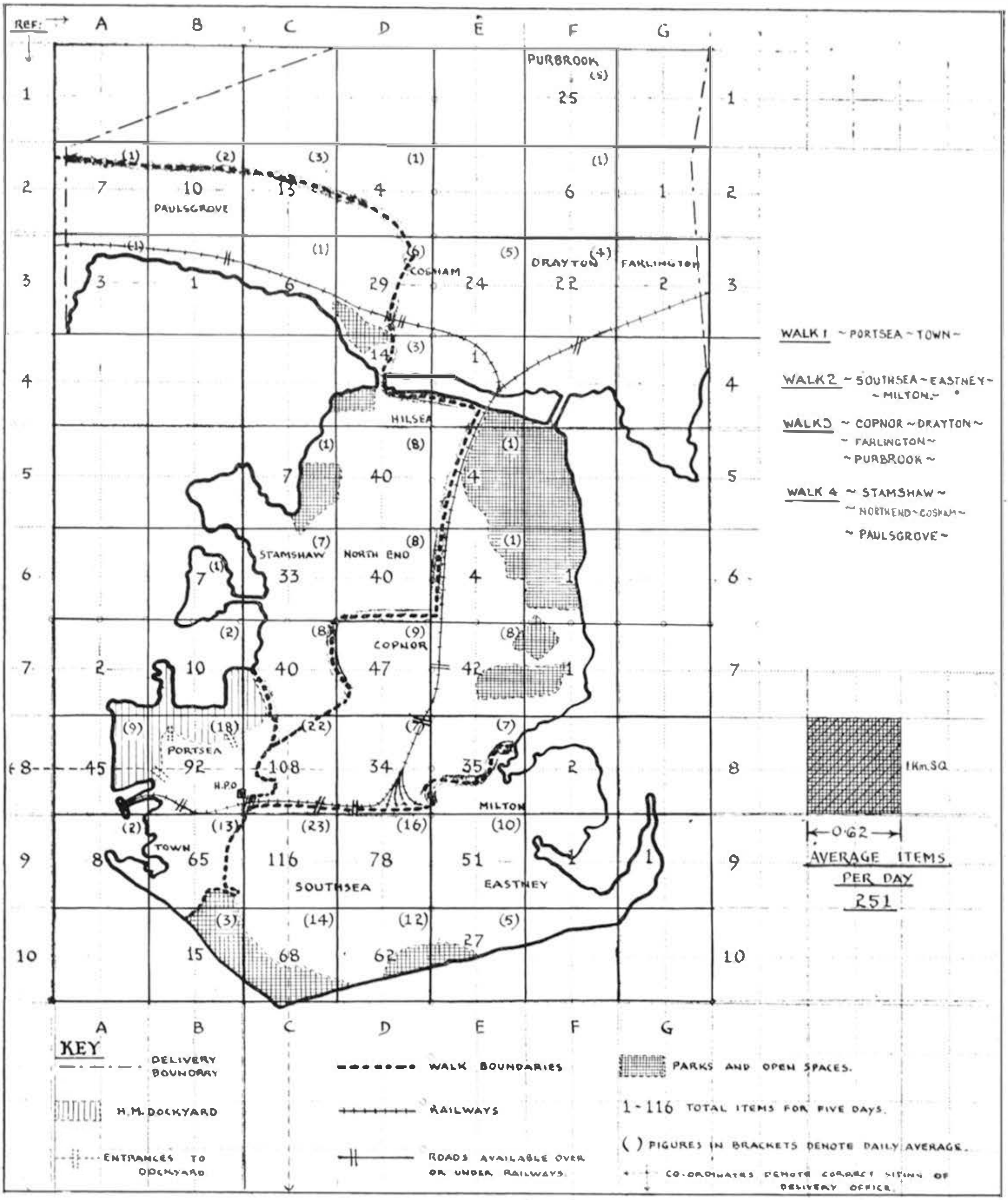


Fig. 4 : Portsmouth delivery area—distribution of telegraph traffic

With the agreement of the Staff Associations experimental delivery schemes, based on the results of the paper studies and using the recording technique devised, were introduced at seven offices during the Spring and Summer of 1956. They have now been in operation for some months.

The method adopted was to take a control record to obtain traffic distribution and quality of service details and on the basis of this evidence, to prepare a fresh walk pattern allowing for the fullest practicable use of motor cycles, and a regular despatching schedule designed to ensure that optimum batch sizes would be obtained. Figure 4 shows the distribution of traffic and the walk lay-out decided on for Portsmouth, the first of the schemes to be introduced.

It was not to be expected that all would go smoothly from the start but, thanks in particular to the fullest possible co-operation from all ranks concerned in the experiments, early difficulties have been sorted out.

Neither was it to be expected that all schemes would operate with the same degree of success, partly because variations between paper and real life schemes were naturally likely and partly because the difficulties in planning walks to obtain a satisfactory balance between the size of a walk in terms of geography and traffic terminating there were bound to lead to some faults of lay-out.

However, the schemes have worked well on the whole and have clearly demonstrated the practice value of overhauling telegraph delivery arrangements on the lines indicated by the theoretical studies.

Not for the first time, a new approach to what is essentially an old problem has led us to the same conclusions as our predecessors. To end this article I cannot do better than quote from an address given by Mr. W. Fraser to a conference of Telegraph Superintendents in October, 1935:—

"*The sortation of telegrams for delivery into walks and their despatch at regular intervals is a sound arrangement. At some offices, however, the number of walks appears to be excessive, and perhaps a general revision of the walk system at all offices would be worth while from the point of increasing the number of items delivered per messenger journey and effecting a reduction in messenger force*".

Transatlantic Success

Telephone calls to and from Canada up from 530 to 1,330 a week; calls to and from the United States up from 2,320 to 3,870 a week—nearly 100 per cent. increase in total calls with North America since the Transatlantic Telephone Cable came into service on September 25, 1956 !

Moreover, the average paid duration of each call has also increased considerably, so that the total paid minutes of traffic have increased by nearly 125 per cent. in that time.

That is a measure of the success of the cable, which, little over three years ago, was still a designer's dream.

But a much wider audience in Great Britain than those who, in increasing numbers, use the transatlantic telephone, is appreciating the stability and remarkable clarity of communication over the cable. "Live" broadcasts from reporters in the United States are now regularly carried over the cable to be broadcast by the B.B.C. and reach the listener as though "the speaker were sitting in Broadcasting House."

And, as this note is written, telex service has just been opened through the cable between Canada on the one hand and Great Britain and the European Continent on the other. Although the Canadian inland telex system is still in its infancy, 133 calls a week are already being connected and a heavy traffic build-up is confidently expected.

These early results confirm that telecommunications users are not slow to appreciate the benefits of trans-ocean cable operation and leave no doubt that the Transatlantic Telephone Cable is the fore-runner of great events in the development of intercontinental telecommunications.

* * *

" We get a look occasionally at the British side of this vastly important undertaking through the *Telecommunications Journal* . . . and there we found recently an attitude which we consider pleasantly British . . . so confident, so serene as almost to imply ' what's all the shoutin' for ? ' " comments the August *Bell Telephone Magazine*, quoting the final paragraph of J. F. Bampton's article on the Oban Terminal in our Spring, 1956, issue. Mr. Bampton wrote:—

"Even now the gashes torn in the countryside at Oban are beginning to heal, grass is growing again over the disturbed ground, a new road leads up to a neat granite-faced building at the entrance to one of the adits and gradually the other signs of the minor invasion will fade. In fact, those concerned with the provision of these highly reliable communication systems feel that after the exciting events of the current year are over, transatlantic cable telephony will be so uneventful that some of the lost serenity will return to the mountains which shelter "Transatlantic Terminal Oban ".

The Post Office in Wales and Border Counties

The Directorate: left to right: Mr. J. T. Smith, Public Relations Officer; Mr. A. M. D. Donovan, Finance Officer; Mr. H. F. Rodgers, Staff and Buildings Controller (now Deputy Regional Director, North Eastern Region); Mr. C. A. Blackmore, Postal Controller and Deputy Director; Mr. F. E. A. Manning, C.B.E., M.C., T.D., Director; Mr. C. E. Clifton, Secretary to the Regional Board; Mr. C. E. Moffatt, Chief Engineer; Mr. H. R. Jones, Telecommunications Controller.

Some months ago, having covered the whole country in our feature "Telephone areas" we planned to publish a series of descriptions of Post Office directorates and regions with photographs of their boards. The opening of the series this quarter with Wales and Border Counties is particularly appropriate since work in the Directorate is so prominent in this issue, with an article on "Coal and Communications in South Wales" describing communications in a Welsh colliery, and a description of "Trunk Mechanization in Wales and Border Counties" which was inaugurated in Swansea on January 5.

Wild mountains, placid valleys; ancient towns dating back to pre-Roman times, ultra-modern towns planned and built in the last few years; sparsely inhabited rural districts and densely populated industrial areas; all of these and, indeed, practically any feature to be found elsewhere in Britain has its counterpart in the 10,000-odd square miles that constitute the Post Office Directorate for Wales and Border Counties. Although coal-mining is still a principal industry—Welsh steam coal is world famous—it has been reinforced by the introduction of light industries of many sorts, and trading estates are now a feature of many parts of the Directorate.

Among Wales' other claims to fame are the highest mountain in England and Wales, the largest steel strip mill in Europe and probably the most famous Rugby Football ground—Cardiff Arms Park—in the world. The International Eisteddfod held annually at Llangollen attracts competitors and visitors from all over the world. The British Empire and Commonwealth Games are to be staged in the Directorate in 1958.

With a language and a literature of their own the Welsh are a distinct nationality and there is often a Welsh slant on telephone problems arising in the Principality that has very much to be taken into account. In some telephone exchanges Welsh is the normal language used to transact business and in a considerable area of the Directorate call office notices are printed in Welsh and English.

Among features of telecommunications business in the Directorate are the proportion of business demand for, and supply of, telephones, and the financial amount allotted for the supply of rural allocation kiosks, which are greater than in any other Directorate or Region. The supply of telephone service to farmers is a major problem, particularly because, on average, a farmer's line is "worth" 12 ordinary subscribers' lines in terms of work; counting heads is not necessarily an indication of size of effort.

Post Office Headquarters is in Cardiff, the capital city of Wales, where close touch is easily maintained with other Government offices in Wales and with Welsh interests in general. Although all Headquarters staff do not claim to speak Welsh, at Rugby Internationals the Welsh fervour uncovers hidden linguistic talents and English, Irish and Scottish colleagues join enthusiastically in the swelling chorus of "Hen Wladfy Nhadau" (Land of my Fathers).

The common complaint that Wales is run from England can be reversed in regard to Post Office affairs, for the Director in Wales rules part of England. The "Border Counties" in his full title includes all Herefordshire and Monmouthshire, most of Shropshire, the southern part of Cheshire and a little of Worcestershire. The Post Office affairs of Chester—originally a Roman fort built to keep the Welsh in order—are today managed from Cardiff. The Director in Wales would see that Housman's "Shropshire Lad" had plenty of postal, telegraphic and telephonic facilities at his disposal. Hereford and Leominster, Shrewsbury and Wellington are among towns which prove that, as far as the Post Office is concerned, England truly "marches" with Wales today.

The Directorate serves about 3,174,000 people through more than 2,400 post offices and four telephone areas—Cardiff, Swansea, Chester and Shrewsbury—with 641 exchanges (475 of which are automatic) and about 175,000 telephone connexions.

Shell-Mex instal private T.A.S.—The new Postmaster General, Mr. Ernest Marples, M.P., performed his first official task on the day he succeeded Dr. Charles Hill (now Chancellor of the Duchy of Lancaster) by inaugurating the new private teleprinter automatic switching system which the Post Office has installed for Shell-Mex and B.P. Ltd. at Shell-Mex House, London, with centres at Bristol, Manchester and Glasgow respectively. During the ceremony Mr. Marples exchanged teleprinted messages with the civic heads of the three cities.

Mr. Vignoles, Managing Director of Shell-Mex and B.P., said that the new system—on which we hope to publish an article shortly—had greatly improved transit times and was saving the Company £15,000 a year.

Olympic Games Traffic

More than 2¼ million words of Press telegraph traffic—about 75 per cent. of the total Games traffic—were received in London from Australia during the Melbourne Olympic Games. A feature of the special arrangements was the introduction of teleprinter working on the Australia-United Kingdom cable and radio routes. Urgent "results" messages were routed over a through circuit using the "Teleprinter-on-Cable" (TOC) system on the trans-Pacific-trans-Canada-transatlantic telegraph cables and were delivered simultaneously to the major news agencies in London within, on average, three minutes of being handed in at the special office in the Main Stadium.

Four teleprinter circuits using the "Teleprinter Error Detection" (TED) error correction system were provided over the direct Sydney-London radio route and two other TED circuits between Sydney and Vancouver were extended across Canada and thence to London on voice frequency channels in the transatlantic cable. This was the first time that either the "TOC" or "TED" systems had been used under heavy traffic conditions and they were consistently reliable.

Traffic incoming to Electra House over 5-unit circuits, and which had been prepared for page printing, was received on typed reperforator slip and translated, via an auto switching unit, to the appropriate disposal point where, whenever possible, it was again tape translated to addressees over private wires or telex. This proved most expeditious, as the many expressions of appreciation received from the Press testify.

In addition to the public service facilities, ten private circuits from Australia were provided for agencies and newspapers and some of the circuits were extended to customers' offices in Düsseldorf, Malmö, Paris and Stockholm.

During the Games almost 1,000 radio-phototelegrams were received in Electra House from Melbourne at a time when the Picture Room was particularly busy because of the Suez crisis and the events in Hungary.

In a full description of the work, the Commonwealth Press Union comments that the successful achievement of the Overseas Telecommunications Corporation of Australia was naturally dependent to a large extent on the co-operation of other bodies, notably Cable & Wireless Ltd. (who provided cable circuits and wireless relays and developed equipment) "and the British Post Office."

Trunk Mechanization in Wales and the Border Counties

J. E. Dawkins

READERS OF THE *Journal* WILL REMEMBER the article on trunk mechanization by Mr. Beastall in the November-January, 1955-56 issue. To the Wales and Border Counties Directorate fell the honour of having the first provincial trunk mechanization unit. This was opened at Swansea in January. Since then another unit has been opened at Chester.

Both schemes are small in comparison with the two trunk automatic units opened two years ago at Kingsway and Faraday in London, but they make an important contribution to the mechanization programme. Swansea is a sub-zone centre and affords only a limited addition to the through dialling network of the country; Chester, however, a group centre at present, became a zone centre when its new trunk automatic unit opened adding appreciably to through dialling facilities.

In Fig. 1 the areas included in the Swansea and Chester schemes are shaded and the various group centres affected can be seen. The opening of the Chester zone has appreciably diminished the size of the Liverpool zone, although in fact the amount of trunk traffic controlled at Liverpool is still considerable (see later reference).

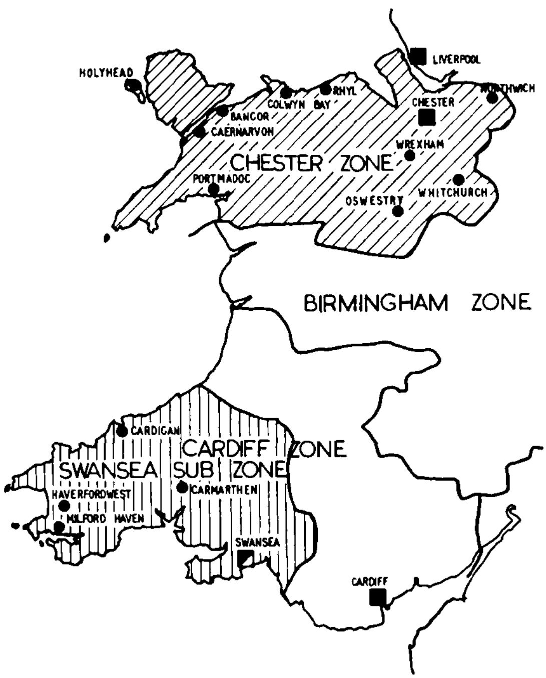
Mechanized units in the provinces will become quite commonplace during the next five years as more and more schemes mature in the Post Office's closely co-ordinated programme. While they are still novel in the provinces, it is worth while dwelling for a moment on what the changes mean to the operating staffs concerned.

As a preliminary to the introduction of the trunk automatic unit at Swansea a few weeks later, the Siemens No. 16 type local automatic exchange, which has been in use for 32 years, was replaced by standard equipment with multi metering and a fair-sized junction tandem unit. The extension of dialling facilities thus obtained resulted in a staff saving of 16 full-time and 10 part-time telephonists, and three assistant supervisors, whereas the reduction from the introduction of through switching of trunk traffic was only three full-time and six part-time posts. These references relate to Swansea alone, and it should be realized that the trunk mechanization unit will produce additional but indeterminate savings at trunk switchboards throughout the country.

Care was taken to keep the Swansea exchange staff in touch with developments and a booklet was issued to all members describing the main changes resulting from the introduction of multi-metering and the junction and trunk tandems. This served to put the alterations in procedure and the reduction in establishment in the right perspective from the staff's viewpoint—and to allay any fears that the new automatic trunk unit would virtually eliminate the need for operators.

Swansea's new trunk unit will affect operators' work considerably. There is a certain satisfaction in being able to set up calls oneself without the

Fig. 1 showing the areas (shaded) included in the Swansea and Chester schemes



need for intermediate and distant operators and the opportunity to do this, of course, has been extended greatly through the introduction of the new unit. Not only Swansea staff, but operators at Cardigan, Carmarthen, Haverfordwest and Milford Haven, which are group centre exchanges in the Swansea sub-zone, have automatic access by code dialling through the trunk unit to Chester, London (Faraday and Kingsway), Manchester, Newport and Plymouth; access will be extended to Birmingham about September this year. As an example, a Carmarthen operator setting up a call to, say, Burnley, before the opening of the trunk unit, needed the assistance of operators at Swansea and Manchester. Now the Carmarthen operator merely dials 927.391 and the subscriber's number over a trunk circuit to Swansea. Dialling the first three digits of the code gives access from Swansea to Manchester, while the second three extend the connexion from Manchester to Burnley.

Sense of loss

Perhaps controlling operators at Swansea may feel a sense of loss for a little while in being unable to seize a particular circuit to Manchester, for example—as they did in pre-mechanization days. Maybe there was something positive in picking up a circuit the number of which was clearly apparent in the outgoing multiple. Now Swansea operators have to dial codes over a group of circuits to the trunk unit and receive no indication of the circuit seized.

A notable exception, however, is the route to Cardiff, only 40 miles distant radially, which is still available from the auto-manual switchboard. The reason for this is that as all the group centre exchanges in the Swansea sub-zone have routes to Cardiff, their home zone, the amount of traffic passing through Swansea to Cardiff is very small. Nothing was to be gained, therefore, in routing through the trunk unit the large number of calls to Cardiff originating from the Swansea group, and Cardiff numbers are still dialled direct over individual circuits.

Information in Visible Index Files now in use at the group centre exchanges previously mentioned presents a very different picture from that obtained from the files of pre-mechanization days. Many dialling entries consist of digits and symbols only, although for the time being letter codes are still needed on calls to the Liverpool and Manchester director areas. Dialling codes such as that for Biggleswade—95.335.871—plus a four or five figure number, are not uncommon. One wonders whether the satisfaction from dialling this imposing array of digits, and then the subscriber's number, is not tempered by the mental effort involved in turning the printed code into dialled digits.

At group centre exchanges in the new Chester zone, operators will occasionally have even longer codes to dial. For example, the code to reach Saundersfoot, near Tenby in West Wales from, say, Portmadoc is 425.97.819.136 and there is a four figure subscriber's number to be dialled after this. The code 425 routes the call through the Chester unit to Swansea, 97 through Swansea to Carmarthen, 819 from Carmarthen to Tenby and 136 picks up the last link from Tenby to Saundersfoot.

Fortunately this type of call should be rare, as the bulk of traffic is, of course, between the larger centres for which dialling codes are designedly simpler. While a controlling operator will at least have the routing information in front of her, complications are introduced if she is unable to dial the calls herself but has to pass the routing information orally to an operator at another exchange for completion of dialling. This has to be done at some of the North Wales group centres (referred to later) which, for the time being, cannot dial through the Chester equipment and have to pass calls orally to the "Chester" incoming operators, who are not provided with routing information. Where it is necessary to pass forward the code, the controlling operator will have to speak very clearly to the Chester operator, who, in turn, will have to note down a long code rather than run the risk of dialling error by attempting to memorize the code as she hears it.

Disadvantage of long codes

The disadvantage of having long codes to be dialled or passed forward will certainly be compensated for in other directions. For example, the pressure on certain zone centres arising from violent fluctuations in the level of traffic during the reduced rate period should be eliminated and this will be of particular importance to night operators. During the height of the summer season and at other peak periods the aggregation of peaks of traffic from various group centres when concentrated on zone centres can create difficult service problems. Under trunk mechanization, however, the automatic switches provided for day conditions should be ample in all but a very few instances to deal with the peaks of evening traffic.

At Swansea the only types of incoming trunk traffic left to be dealt with at the manual board are: (1) assistance calls, and (2) re-booked calls arising from a "no lines" or delay advice in dialling through the trunk unit. Congestion and delay announcing equipment is fitted, but controlling operators in the Swansea and sub-zone should rarely hear any of the announcements on live calls.

At Chester the introduction of trunk mechanization was combined with upgrading to give status. Chester thus became the first mechanized provincial zone centre. The decision to establish another zone centre so close to Liverpool arose from the need to relieve the Liverpool zone centre exchange of some of its traffic load.

Transfers to new zone

All the group centre exchanges in North Wales—Bangor, Caernarvon, Colwyn Bay, Holyhead, Portmadoc, Rhyl and Wrexham—as well as Oswestry and Whitchurch, both in Shropshire, and Northwich in Cheshire, are being transferred to the new zone. These exchanges are at present in the Liverpool zone except Northwich, which is dependent on Manchester for its zone outlet. Northwich is the only group centre exchange in the new zone which is not within the Wales and Border Counties Directorate. The residual Liverpool zone will consist of the Liverpool, Douglas, Isle of Man and Southport groups.

Despite the provision of a trunk unit at Chester, there will be no immediate reduction in operating staff there. In fact there may be a small increase, because at first, as mentioned earlier, some of the through traffic previously handled at Liverpool will still be dealt with manually at the new zone centre, and the staff savings resulting from mechanization will occur at Liverpool, which has been relieved of through traffic.

Full advantage of the new facilities cannot be taken throughout the Chester zone at first because dialling is not possible over circuits from certain of the group centre exchanges to the new unit until modern equipment is provided at the centres concerned. The first of these exchanges where the necessary dialling equipment will be provided is Bangor, which is to be converted in the autumn of this year; the Caernarvon group will be closed and its exchanges added to the Bangor group when Caernarvon is replaced by a remote non-director exchange in the spring of 1958. Holyhead will have dialling facilities when automanual equipment is provided in the summer of 1958. The building for the new exchange at Colwyn has been started.

The trunk auto unit at Chester follows the Swansea pattern but is on a larger scale. With the exception of the Belfast route, for which line plant will not be available until 1959, the unit has direct routes to all other zone centres. The range of dialling access and consequently of the type of routing codes used is thus much greater than at Swansea and, as shown in the example already quoted, the codes can be quite complex. There are the same verbal announcements of congestion and delay; but unlike Swansea, where special arrangements had to be made because the trunk unit is not in the same building as the automanual switchboard, the announcements are controlled from a panel in the switchroom.

From now on trunk mechanization will be provided fairly rapidly at other centres and it might help those who have yet to experience the new system to know how it appears to those who are now operating it in Wales and the Border Counties. The columns of the *Journal* are open to correspondence—and I hope that this article on trunk mechanization will encourage members of the staffs at Chester, Swansea and the group centres concerned to send their views to the Editor.

World Ploughing Contest.—A communications problem was presented by the three-day contest held by the British Ploughing Association and the World Ploughing Organization last Autumn.

The site of the contest and of the associated display of agricultural equipment, about 300 acres in all, was in the area served by the Warborough, Oxfordshire, exchange. This is a single-position C.B.S.2 exchange with about 180 subscribers. A full-sized agricultural show, more than 100 competitors and thousands of visitors, with Press and B.B.C. interest in the proceedings and results, seemed highly likely to create chaotic conditions at such a small exchange, and an alternative method was considered well before the event.

The scheme decided on was to tap in to the Oxford–Reading main underground cable, which passes within 150 yards of the site, and to provide service by trunk subscriber equipment on Oxford exchange. Enough spare pairs were available to allow service for some 30 show-ground subscribers. Ultimately, 15 exhibitors desired service, and these, with five Press telephones, and installations in the mobile post office and the mobile kiosk (a grand total of 25) left an ample margin in the cable.

Changing the Coin-Boxes

G. Turner

and

A. E. J. Sims

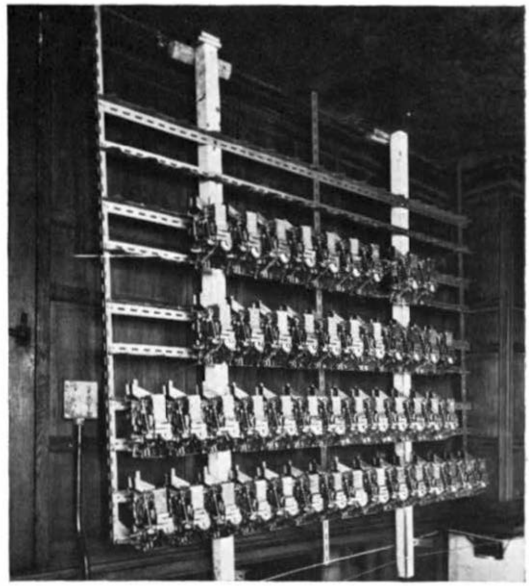


Fig. 1: Centre Area storage rack for modified equipments

THE LAST OF THE INCREASES IN TELEPHONE charges announced last Spring took effect on January 1, when the call office local fee was raised from 3d. to 4d. Although apparently a simple repetition of the changes made in 1951, when the charge was raised from 2d. to 3d., this latest change involved much more engineering work and our purpose in this article is to describe something of the effort entailed.

When the present prepayment coin-box was introduced 30 years ago the mechanism was designed to check the presence of two pennies by a weighing operation. New pennies weigh roughly 9.5 grams but well-worn ones may be as light as 8 grams. The difference between 9.5 grams, representing the maximum weight of a single penny, and 16 grams, representing the minimum weight of two pennies, therefore had to be detected. The 6.5 gram difference between these weights represented a margin of safety, enough to permit the use of a relatively simple weighing device. Friction between the coins and the sides of the swinging container which serves to keep the pennies in position on the balance arm, is liable to reduce the effective weight of the coins and this had to be allowed for in considering the adequacy of the safety margin.

When the fee was increased to 3d., the maximum weight of two pennies (19 gm.) and the minimum weight of three (24 gm.) had to be differentiated; consequently the safety margin was reduced to 5 grams. The conversion was made by suitably increasing the balance arm weight and the reduced factor of safety was accepted.

If the increase to 4d. had been achieved by increasing the balance arm weight once more, the difference between the maximum weight of three pennies (28.5 gm.) and the minimum weight of four (32 gm.) would have had to be detected, and the safety margin would have fallen to 3.5 grams. The risk inherent in accepting so small a safety factor could not be tolerated and other methods had to be sought.

The main alternative to weighing as a means of checking the number of coins would be the use of a mechanical counter which could be arranged so that the number of coins to be counted could be further increased if need be, but this method was not adopted as the modifications would have been too extensive. Economic reasons also prevented the adoption of devices that would have enabled a 3d. piece and 1d. to be used as an alternative to four pennies.

The method finally chosen was first devised by Hall Telephone Accessories Ltd. (now Associated Automation, Ltd.), and was virtually a combination of the two basic methods. The idea is first to check three pennies by weighing and then to wait for the insertion of a fourth before allowing the call. The chief merit of this design over all other practicable designs was that it required the smallest amount of additional equipment and this could be readily fitted. A limitation was that it could not be easily adapted for an increase beyond 4d. but as plans were already being worked out for a completely new coin-box, this limitation could be accepted.

Apart from the question of cost it was also important to be able to make the change from 3d. to 4d. working on the 120,000 coin-box installations throughout the country in as short a time as possible. To this end a conversion kit was designed to include an easily removable counterweight (equivalent to the weight of 1d.) which would cause the mechanism to weigh only two pennies and then wait for one more—thus making it temporarily give 3d. working. In this way the work could be divided into two distinct stages, the first or preparatory stage involving the bulk of the work but capable of being spread over perhaps six months, while the second stage, involving the minimum of work, would enable the actual change of fee to be made in as short a time as possible.

Field trial

Before embarking on full production of the conversion kits it was considered prudent to conduct a field trial and early in 1955 a hundred kits were obtained and fitted into call offices working to Non-Director, Central Battery, and Unit Automatic exchanges in the Peterborough Area, and to a Director exchange in London. A review of the trial six months later revealed that although the basic principle was sound there were some mechanical weaknesses and the Engineering Department considerably improved the kit design before contracts for bulk supplies were placed.

The work involved for the first stage was such that it was undesirable to carry it out in the confined space of a kiosk or cabinet. Consequently, a pool of spare coin-box mechanisms had to be made available so that the main work could be done at central conversion centres and the work on site be reduced to the relatively simple replacement of the mechanism. It was known also that early types of mechanism were in service which were unsuitable for conversion and others which contained old type components which would have to be changed. A sample of one thousand mechanisms in the field was examined to estimate the quantities of these auxiliary items.

The main items that had to be provided were 155,000 conversion kits, 15,000 coin box mechanisms, 20,000 penny gong units, and 15,000 coin transmitters. Contracts for all these items were placed early in 1956 and first deliveries were promised by mid-June with completion by the end of November. Owing to initial production difficulties, however, it was not until late August that the kits became available in the Telephone Areas in quantity, though a limited quantity were distributed in June for training purposes. Completion promises, however, were met in general, so the first stage of the conversion work had to be concentrated into four months.

Regional and Area planning began when the Engineering Department issued a works specification in May. The detailed requirements of densely populated urban areas were expected to be different from those of sparsely populated rural areas. In addition, Regions and Areas differ from one another in other ways, both geographically and operationally. Consequently we shall describe subsequent work in one Region only.

In London, two distinct organizations were adopted for the conversion work, one for the two inner Areas (City and Centre) where distances were short but the distribution of call offices was dense, and the other for the outer Areas where distances were greater and the call offices more widely dispersed.

Benches and storage racking

One centre, a selected installation workshop, was used in each of the two inner areas. Figures 1 and 2 show the benches and storage racking set up in the Centre Area. The racking, constructed from "Handy Angle", a pre-drilled angle section, accommodated the mechanisms awaiting conversion or re-installation.

In contrast the outer Areas generally established more than one centre to avoid the disadvantage of long journeys; in some places, when the conversion had been completed in one district of three or four exchange areas, the Centre was transferred to another district for further work.

The centres were set up in June when the initial supply of training kits was received. It was unfortunate that the bulk supplies were not received early in July as originally promised, as the delay necessitated the disbanding of some of the trained staff until full supplies were available. Later even more staff had to be trained so that the arrears of work could be overtaken. As the programme proved to be rather tight and as there was some doubt whether completion by the end of the year was possible, coin-boxes rented by subscribers were given priority in accordance with an Inland Telecommunications Department direc-

Fig. 2 : Centre Area workshop showing benches

tive. In London, rather surprisingly, there are more of these than public coin-boxes.

In addition to ample bench space, the centres were provided with spare coin-box containers in which the converted mechanisms could be tested, and with a test line for checking the gong tones.

Throughout the operation we had to ensure that unmodified mechanisms held in section stocks were not issued for new installations or for maintenance replacements. All stocks were therefore forwarded to the conversion centres to supplement the conversion pools and all demands by maintenance and installation staffs for mechanisms were met by the issue of modified mechanisms from the centres.

After the mechanisms were converted in the workshops they were generally transported in the special travelling crates which had held the initial pool received from the Supplies Department. In the London Centre Area, however, one van was equipped with temporary racking. This vehicle carried 70 mechanisms and was extremely useful in the London railway stations, where there is a high concentration of call offices. At Victoria Station 80 call offices were fitted with converted mechanisms on one Sunday.

After the converted mechanisms had been installed and a box locked up ready for service, a complete test call was made, including the pressing of button A to deposit the coins in the cash container. Each centre had therefore to keep a supply of pennies for the staff engaged on this work. This supply was obtained from a local imprest account, and its use recorded.

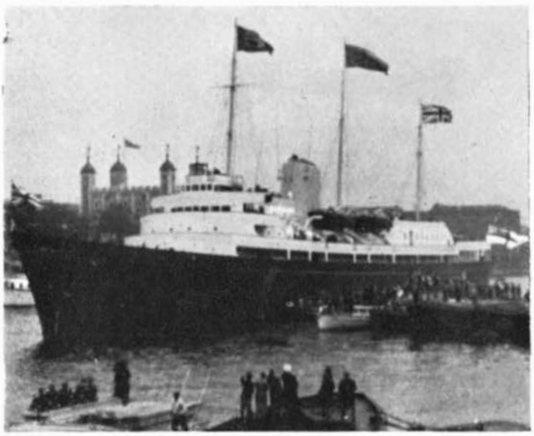
The operation provided an opportunity for changing or cleaning many mechanisms needing maintenance. Also, to avoid duplicating labour, opportunity was taken to equip some installations with special mechanism designed to reject American one cent pieces. The Traffic Divisions had specified these installations some time previously, but the equipment was not available until late in the summer.

In London, 13,000 public call offices and 22,000 subscribers' installations had to be converted and this engaged an average of 90 men at a time between September and the end of the year. Areas kept a very accurate record of the progress of their conversions by using a procedure similar to that employed for telephone exchange conversion work. One continuing difficulty was the problem of "no access" to private renters' premises in spite of previous written notice.

The final stage of removing the counterweights and fitting new notices was started on January 1, and had to be completed in a maximum of five days. To streamline the work as much as possible the mechanism was checked by inserting four pennies, which were then recovered by pressing button B. Also, it was decided that meters need not be read as each box was converted, but in batches when the exchange area was completed or at the end of the day if an exchange area was unfinished. It was important that the coin-boxes should not be converted to 4d. working in advance of the changing of the notices and although the Engineering Department do not normally change notices they changed them concurrently with their other work on this occasion.

In many places the limited availability of keys for the mechanism compartments determined the maximum number of men that could be employed on this work.

The way in which the work was organized and the speed with which it was carried out reflected much credit on engineering staffs in the field.



Her Majesty's Yacht "Britannia" called from the Antarctic

Lt. Col. D. T. Gibbs, M.V.O., O.B.E., T.D.

CHRISTMAS SEEMED A VERY LONG WAY OFF when members of the Post Office External Telecommunications Executive and Cable and Wireless Ltd. met representatives of the Flag Officer, Royal Yachts, in London on May 25 last year to discuss the communication requirements for the Duke of Edinburgh's world tour.

Soon, the possibility of providing a live Christmas Day broadcast from His Royal Highness on board H.M.Y. *Britannia* was being discussed, even although she would then be sailing in the extreme southern portion of the Pacific Ocean, not far from the Antarctic Circle. The chance of obtaining a direct telephone circuit to London was remote but we felt that by harnessing together the various radio stations and telephone networks of the Commonwealth there were reasonably good prospects of establishing a satisfactory broadcast circuit back to London. The yacht, however, would be operating at maximum range and the conditions would be critical.

Study of the problem suggested that the following eight possible routes should be considered:—

(1) Direct radio circuit, yacht–London
(2) Relayed radio circuit *via* Ascension
(3) " " " " Barbados
(4) " " " " Sydney
(5) " " " " Perth
(6) " " " " Wellington
(7) Direct radio circuit, yacht–Vancouver, thence extended over trans-Canadian land lines and the new transatlantic telephone cable to London

(8) Direct radio circuit, yacht–Sydney, thence extended over trans-Australian land lines to Perth and then by radio to London.

Just before *Britannia* sailed from Portsmouth at the end of August, officials of the E.T.E. and the B.B.C. met on board to complete arrangements. The B.B.C. provided high-quality microphones with associated apparatus for the Duke's use during the broadcast.

We decided later, in view of more up-to-date predictions available, the absence of a suitable aerial at Vancouver, and the fact that *Britannia* would be using only one transmitter, of low power, to concentrate mainly on one of two relay circuits—Barbados or Sydney. There had been little practical experience on communications in the region of Antarctica, so tests were scheduled for the three days before Christmas, between 1400 and 1515 hours, to ascertain which routing offered the best prospects for the time of the broadcast. These included the first five possibilities listed above.

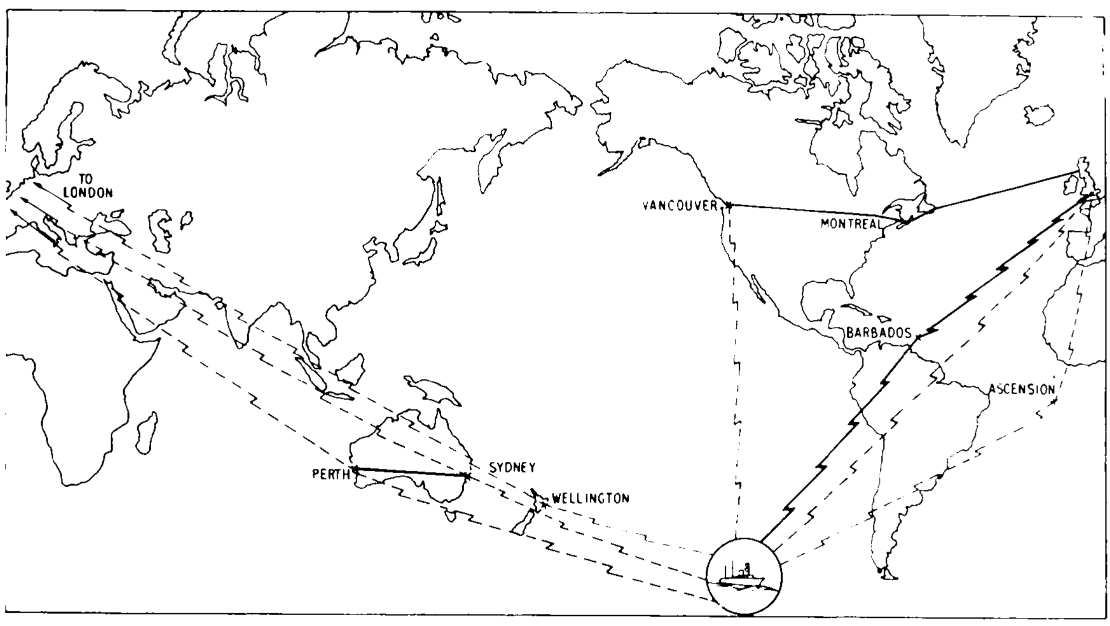
The results of these tests varied considerably; Ascension and Perth receptions were always very poor, direct reception in London was fair on December 24 only, and Barbados and Sydney alternated between very poor and fairly good.

Since predictions favoured Barbados and as the frequency in the 22 megacycle band—suitable for Barbados—might also be received direct in London, we decided that the Barbados route should be the primary one for the Christmas Day broadcast. Sydney was asked to monitor, however, if in the event they should receive a good signal. Had Sydney been used as the primary route, a 16 megacycle frequency would have been necessary and this would have ruled out any available alternative routings as a stand-by.

On Christmas Day, Barbados proved to be the only possible route for the actual broadcast. Unfortunately radio conditions were not good, and not to be compared with those experienced on the tests. However, a fairly intelligible two-way circuit through Barbados, covering a distance of over 12,000 miles, was established a few minutes before zero hour. The broadcast was received at Baldock and Bearley and extended via Brent Radio Telephone Terminal to the B.B.C. Having regard to the poor radio conditions prevailing, the high noise level, various forms of interference and the inability of the yacht to operate on a higher radio frequency, the results were satisfactory.

So culminated, in three minutes, the labour of over six months planning.

The broken zig-zag lines indicate the radio circuits considered and the unbroken heavy zig-zag lines indicates radio circuit used for Christmas broadcast



Regional Representatives of the Journal

Left to Right: Mr. S. J. GIFFEN, Northern Ireland; Mr. J. E. D. STARK, Midland Region; Mr. R. F. BRADBURN, Wales and Border Counties; Mr. K. RIDEHALGH, B.Sc., Home Counties Region; Mr. E. G. CONLEY, North Western Region; Mr. R. W. C. ALFORD, North Eastern Region; Mr. J. EVANS (deputizing for the Editor), Miss K. F. A. McMINN and Mr. H. A. SIMMONS, Public Relations Department; Mr. W. F. WESTAWAY, South Western Region; Mr. C. R. LANE, London Telecommunications Region (Mr. E. W. SANSOM, who also represents the L.T.R., was unable to be present); Mr. H. SCARBOROUGH, Scotland; Mr. N. V. KNIGHT, Engineering Department

DIRECTORATE AND REGIONAL REPRESENTAtives of the *Journal* have been functioning ever since the first publication in November, 1948. They were, and remain, senior officials on the Telecommunications Controllers' staffs, having special aptitude for the work.

They were known originally as correspondents, which seems to suggest that they were intended merely to send articles and news to the Editor. They still do this work, collecting local news items, persuading their colleagues to write articles, sometimes themselves writing articles.

But as the years have gone by more work has been thrust on them. The 155 sales organisers throughout the kingdom work directly under their Head Postmasters or Telephone Managers but the representatives keep a fatherly eye on them and do all they can to help them to stimulate sales, especially among newcomers to the Post Office and men returning to telecommunications branches from the Forces.

The representatives come to London about twice a year for a conference with the Editor, when they report local progress and local opinion of the *Journal;* suggest what could be done to improve it and what kind of article would widen the readership and discuss new ideas for articles.

One important aspect of their work is keeping Headquarters in touch with opinion outside London and so helping to prevent the *Journal* from becoming a mere Headquarters, or metropolitan, publication.

As senior officers on controllers' staffs they are all busily at work in the field, developing the services but they find time to help the *Journal* along and to ensure that it is taken and read by as many as possible of the people for whom it is published.

Radio Anniversary.—The 60th anniversary of Marconi's demonstration of wireless at Toynbee Hall was on December 12. The then Engineer-in-Chief of the Post Office, Mr. W. H. Preece—later Sir William Preece—arranged the meeting; Post Office experts had had a demonstration but Mr. Preece wanted a public audience to see it.

Speaking at Toynbee Hall, Mr. Preece said, prophetically, that the discovery "would be of inestimable value to our ships". One of the first trials was from Penarth to an island in the Channel.

The Telephone Assistant Supervisors' Training Course Reviewed

J. P. Wreford and N. A. H. Parks

MR. R. W. C. ALFORD'S ARTICLE IN THE Autumn, 1955, *Journal* described the Training Course for Telephone Assistant Supervisors then being piloted in the North Eastern and South Western regions of the Post Office, and gave some first impressions of running these courses. By June, 1956, more than 350 men and women Assistant Supervisors in the South Western Region had been trained and the first series of courses came to an end. The purpose of this article is to consider further impressions gained from the experience of running the courses and to examine critically the possible achievements to date. The opinions expressed are our own and not necessarily those of the Post Office.

When this training was first evolved, the broad aim was "to help Assistant Supervisors to see more clearly their duties and responsibilities and the part they can play in improving the quality of the telephone service". Such an aim presupposes that a greater appreciation of telephone supervision techniques is needed, that Assistant Supervisors can influence the quality of telephone service, and that a training course can help.

Needs of the course

Mr. Alford said that the needs of the course were to pass on the conviction that the role of the section supervisor is as vital as ever to the telephone service. The narrower aims can therefore be stated as improving or expanding "work" knowledge; widening "background" knowledge and awakening interest in background information; and training in human relations and the appropriate social techniques.

Particular aspects of the needs of the course can be considered in the light of the apparent shortcomings which Assistant Supervisors themselves admit or for which their subordinates or seniors probably too readily criticize them. We can thereby break down the needs as follows:—

(i) **Knowledge of the work**
- (*a*) Appreciation of requirements of providing telephone service.
- (*b*) Development of operating procedure.
- (*c*) The telephonist's job.
- (*d*) The requirements of supervision: the physical "tools of the trade".

(ii) **Background**
- (*a*) Appreciation of the Assistant Supervisor's place in the organization.
- (*b*) Interest in growth and development of the telephone service.
- (*c*) Knowledge of interrelated jobs in the Post Office.

(iii) **Human Relations and Social Techniques**
- (*a*) Understanding other people in particular relation to their work in a telephone exchange.
- (*b*) Developing an awareness of the relationships between supervisor and supervised, and discussing methods of handling them.
- (*c*) Satisfaction in job.
- (*d*) The importance of communicating ideas between management and supervisors.

This list is not exhaustive, but we have deliberately re-stated some of the points covered in the earlier article to emphasize their diversity and breadth of coverage, because we suggest later that there may be a conflict of ideas which cannot be easily resolved.

In most books and articles about supervisory training there is usually a discussion on attitude or behaviour. Social trends in this country over the past two decades have moved far from an autocratic form of control, whether benevolent or not, to more democratic forms of leadership. In addition, and probably forming part of this trend, the post-war national policy of full employment and social security has undoubtedly removed the "stick" of autocratic disciplinary sanctions. It has therefore become both socially desirable and economically essential to find and adopt better methods of securing personal efficiency and co-operative effort. Proper training in human relations should therefore contribute towards encouraging appropriate attitudes and behaviour, and we hope that the Assistant Supervisors' Course has been able to do this.

The sessions in the course will be familiar to many readers. Our purpose is to give our main impressions of some of the various methods used, which have included:—

(*a*) General group discussion.

(*b*) Syndicate work.

(*c*) Case study by group discussion or syndicate, with or without acting of typical situations (Role-play).

(*d*) Lecture or talk followed by questions, and the use of films, slides, recordings and large-scale diagrams as training aids.

Group Discussion

From an early stage in running these courses it was obvious that the Group should be integrated as quickly as possible to achieve the best results from the training. If the course were fully residential this object would have been achieved earlier. It has been amply demonstrated that where, for example, all students have been booked at one or two hotels and where, in the town in which the courses have been held, opportunities for individual recreation have been limited, the group very quickly develops its own "personality". In our opinion it is vital that the instructors become members of this group without any special status; they should be socially acceptable and adaptable to the varying needs of every group.

In a residential atmosphere the ordinary social barriers are very quickly broken down. This undoubtedly helps the instructors enormously, but their own role cannot be ignored. Unless they can maintain an atmosphere of freedom during sessions and unless the supervisors are convinced of their sincerity and trust them, the human relations training can do more harm than good.

We found with many groups that, after three or four days, the individuals became apprehensive that they might be talking too much. This is probably because they were unfamiliar with the position in which they were placed in a discussion group, and had a preconceived notion that because they were attending a training course they were going to be talked to most of the time. Sympathetic encouragement from the instructor can quickly dispel such apprehensions.

We think there is a risk of overdoing the syndicate method for supervisors. The novelty soon wears off and on occasions there were indications that the method was boring the students. An impression of frustration can also arise because the student feels that he or she is doing all the work and hasn't been "told" very much. Of course, everyone does not feel like this, but the fact that such feelings were noticed at all indicates that the syndicate method might have been used excessively. Obviously, much rests on the instructor's skill, but as long as the risk is there the value of the training must be reduced.

"Role-play"

"Role-play"—acting of typical situations—has undoubtedly, in our opinion, been overplayed and we have found among the Assistant Supervisors an instinctive reaction against it, a considerable misunderstanding of the method and its value, and individual resistance. This may reflect the widely varying circumstances of Assistant Supervisors—their ages and their experience for example. Such factors produce differences in appreciation of problems and feelings of weakness in certain directions. Students will be reluctant to expose their particular shortcomings when they feel that because of accidentally differing circumstances their colleagues are not similarly deficient. If a student becomes embarrassed she immediately becomes biased and may orally and mentally justify and substantiate a point of view whether it be right or wrong. Role-play can be really valuable only if it can be introduced spontaneously and unobtrusively. The instructor has to exercise a great deal of tact and skill.

Recordings help—even the indifferent ones provided with the material for the course. The case studies offer possibilities but we recommend that if one or two longer studies could be provided they would be a useful addition to the material. Such studies should include more background information so that a more definite scene is set from which several problems affecting the same characters can be elicited.

Lectures

It has become fashionable in training to belittle the straightforward lecture or talk, and to try to avoid it, but we feel that some subjects can be best handled by lecturing in the course for first line supervisors which attempts to combine work and human relations. The students expect it and most of them are prepared to listen. But, although lectures will help the *converted*, lecturing stands less chance of *converting* compared with discussion and argument in which the student comes to his own conclusions. This suggests that lectures embellishing a theme can be useful after initial discussion and the group has accepted the theme.

When lectures are given, the most important points to consider, apart from the subject, are the speaker's personality and ability. If the group are impressed by his command of his subject, his manner and his sincerity, and if they are persuaded of his conviction in the ideas and ideals presented to them throughout the whole course, the lecture will succeed. We would stress that the utmost care be exercised in the choice of speakers, and of the instructors. Only the best will be good enough; irreparable harm can be done by a wrong choice.

General

We feel it important to add two general conclusions which we have reached. To argue the case for them is beyond our scope in this article, but we hope that by stating them we shall throw some light on the problems which still exist in this type of training.

First, from our experience we think that the proper balance between the work and human relations aspects of the telephone supervisor's job has not been fully achieved on the course. The attempt to combine vocational and general training for supervisors has prevented the smooth development of both, with a consequent tendency to confusion of particular issues.

No one seriously engaged in training would pretend to have produced or conducted a perfect course, but we consider that while the fundamental concepts are good much of the material at present used needs to be revised. It is worth considering whether it would be better to shorten the course and limit it to training in human relations.

Second, in human relations—which is at the same time the most important and most difficult aspect—we are not satisfied that the course has succeeded where it is most required. There are four basic requirements for improving skill in human relations:

(i) A sincere personal desire to improve, coupled with a willingness to admit deficiencies in the supervising system or in one's personal approach.

(ii) A "free" atmosphere avoiding censure when weaknesses are self-exposed.

(iii) Instructors who can be trusted, and who are both interested and capable.

(iv) Direct experience in working with other people.

The fourth requirement is met by training only those supervisors who have been appointed for a prescribed time—six months or longer. The Post Office has tried to meet the second and third requirements by selecting instructors carefully.

We are concerned particularly, however, with the first requirement, because too often supervisors lack a sincere personal desire to improve and are consequently unwilling to face their own deficiencies. It is known that a minority of Assistant Supervisors have been reluctant to attend these courses. The reasons given vary widely, but they often imply resistance to the whole concept of supervisory training. (This may of course, mean that they should not have been appointed to the job.) If a student is antagonistic to the concept, we are by no means sure that however skilful the instructor, the course is effective.

This question of whether the scheme has succeeded is undoubtedly the most difficult to answer. The ultimate aim of the training has been to improve the telephone service, but we have conducted a course which deals with work and human relations. Where can we find standards by which the success or failure can be judged? We suggest tests which might be considered, although we cannot too strongly emphasize the dangers of using any of these alone, without reference to other conditions.

Two basic classifications appeal to us; loosely they may be called objective and subjective:

Objectively, a number of criteria might be used. The danger, of course, lies in taking any or all of them as absolute evidence of the effect of the course. There are so many other factors which can otherwise affect any one of them. We suggest:

(*a*) *Service observations.* It is interesting that in the South Western Region the results of service observation have improved steadily since the first quarter of 1955, when this training began. Without overrating the value of the course it is tempting to attribute some of this improvement to the training.

(*b*) *Discipline*—the number of cases reported to higher supervisors in a selected period.

(c) *Absence from duty*—in any analysis the external causes which can affect the figures would have to be noted, but a cursory examination shows that there have been possible measurable effects.

(d) *Wastage rates*, particularly under the "dissatisfied with job" heading. Existing statistics do not enable such a study to be easily made, but the possibilities are obvious.

(e) *Measurement of individual or group output:* this technique, which is widely practised outside the Post Office in connexion with, *inter alia*, rate fixing, remuneration and costing, is not readily available, and even if it were it would not indicate the effectiveness of the supervision, since there are so many other factors. In providing a telephone service quality is as important as output which, in any event, is fixed by staffing standards.

Subjectively we can take the opinions of the students themselves at particular stages: for example, just before attending the course, at the end of it, and later, after, say, six months. This is a specialized technique used quite generally in industry and, to a limited extent, by the National Institute of Industrial Psychology in "validating" this course for the Post Office. Preparing a questionnaire and analysing the results are both sophisticated techniques which require expert handling. We feel there is room for further experiment in this direction but we would stress the importance of defining the problem clearly and in careful and skilled interpretation of the results.

On the other hand we can take the opinions of the senior supervisors. This method has been little used. The supervisors themselves must have been appropriately trained and in general be in sympathy with the aims and content of the courses. If they are not so disposed the possibility of development or, indeed, the chance of success of the whole training is small.

We can take the opinions of the students' subordinates. This type of survey has been used industrially in both the United Kingdom and the United States. This, again, requires specialist handling and delicate staff negotiation. The possibility of using it in this work of the Post Office appears to us to be remote.

Finally, we consider that some degree of success can be assessed from the expression of purely intuitive reactions which of themselves are not easily measured. We have heard such remarks as "the atmosphere in . . . . exchange has improved", "the Assistant Supervisors look as though they are enjoying their work", "the telephonists say they are much happier", and "we now know what is going on". Such spontaneous expressions of opinion are at least an indication of the right effects which the training appears to have achieved.

We cannot close this section, however, without saying that, in our opinion, it is wrong to expect spectacular results from this kind of training. The enthusiasm and willingness to do a good job which has been demonstrated, and the knowledge which has been acquired, must produce early effects if followed immediately in the right way. The more profound results will, however, be evident only over a long period of time and will materialize only if the spirit is fostered by example and encouragement at all levels of supervision and management.

We make no excuse for re-stating a principle which has often been emphasized and which, in the August, 1956, *Ministry of Labour Gazette*, was again stressed in an article on the Training of Supervisors. This is, that even when general management has accepted the main responsibility for training supervisors, its effectiveness depends on management interest and support. Managers must be aware of and in agreement with the aims and general content of the training.

As a corollary to this it follows that good communications must exist between the various levels of management. This sounds almost platitudinous, but experience in running these courses and in discussing them with telephone managers, head postmasters, traffic staff and others has shown weak links in the communication chain. We now know that any training of first line supervisors is wasted and can even have a negative effect unless it is evident to the student that sincerity of purpose is present at all levels. Example in applying human relations skills is of the utmost importance.

It was for these reasons that, in conducting the courses, we endeavoured to keep managers and supervisors informed of what was being done.

We decided at the conclusion of the Assistant Supervisor courses in the South Western Region to hold meetings of telephone exchange officers-in-charge at which topics of interest raised by their subordinates were discussed. The agenda included controversial items which affected the job of section supervision, and officers-in-charge were invited to give their opinions on them. The Regional Director, Staff Controller and Telecommunications

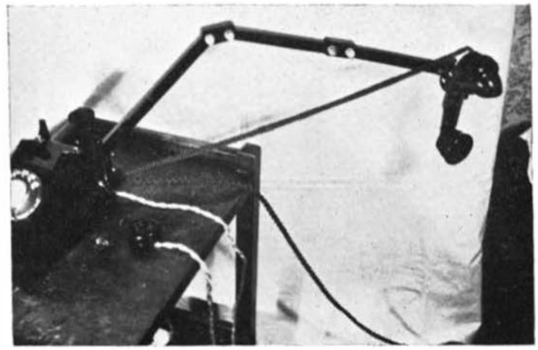
Controller were present and a representative telephone manager, head postmaster and chief telecommunications superintendent were invited. The officers-in-charge were interested and surprised to hear some of the opinions expressed on the courses and eager to discuss the problems among themselves. They were impressed by the interest shown in them and in this training by the senior officers.

We took the opportunity of stressing the need for following this training at all levels of management, and reviewed possible methods of doing this. As a first step a copy of the report of the meetings was circulated to each telephone manager, head postmaster and chief telecommunications superintendent in the Region as well as to every person attending. To keep the need for follow-up in mind, another similar series of meetings to review progress is planned for next June.

We feel sure that it is only by active co-operation among supervisors at all levels that the principles of the training can be maintained. Supervisory training cannot remain static; it must progress as social attitude and behaviour change. Its principles must also be completely integrated and observed. It is unrealistic to suppose that because all assistant supervisors and even all telephone managers and head postmasters have attended a training course the telephone service will automatically improve. We have already stressed with local managers and supervisors the need for sustaining the training in everyday experience and discussed possible methods of follow-up which we feel are so necessary. We hope that a review of these methods and an assessment of their success will form the subject of a further article.

Bradford Adapts Telephone for Disabled Subscriber

Telephone Managers receive many and varied requests for special services but one received recently by Mr. B. R. Bailey of Bradford aroused



his special interest and sympathy. It was from a subscriber who, as a result of war injuries, is completely blind and paralysed. His wife has to go out to work, so he is left alone for long periods.

He cannot hold a telephone instrument or dial; his only possible movement is a very slight movement of the fingers. He lies flat on a special invalid chair with his legs raised to about 60°, and cannot move his head, so some device had to be designed which would hold the hand-set close to his mouth and ear yet would enable the hand-set to be easily removed for use by a normal person.

A light industrial type of bench lamp was bought. The shade and lampholder were removed and replaced by a tennis racquet holder designed to be clipped to a bicycle frame. The clip was modified to fit in place of the shade and lampholder and hold the hand-micro-telephone. The base of the stand was bolted to a bedside table and the fitting made adjustable to any angle.

As the invalid cannot dial the engineers decided, after consulting the Traffic Division, to use Trunk Subscriber calling equipment, but it was also desirable that incoming calls should be obtained via the final selector multiple. They, therefore, modified the instrument by disconnecting the switch-hook springs and substituting a very light action double pole switch, extended from the instrument by means of a flexible cord to allow the switch to rest on the invalid's chest. Outlet No. 1 of the uniselector was disconnected from the normal trunking and connected via the intermediate distribution frame to the trunk subscriber relay set, which was also modified to give holding conditions to the subscriber's calling equipment. The manual board answering jacks are labelled with the subscriber's number.

The accompanying photographs give a general view of the modified equipment and how it is used. The stores bought locally cost £2 13s. 0d. Owing to the combined work of the Telephone Manager, the Traffic Division and the Engineering Division the subscriber now has an outlet to the world around him.

C. A. Thurlow

Our Contributors

J. E. DAWKINS ("Trunk Mechanization in Wales and the Border Counties") is an Assistant Telecommunications Controller, Class II, in the Headquarters of the Wales and Border Counties Directorate. He entered the old London Telephone Service in 1934 as a Clerical Officer, and became an Assistant Traffic Superintendent in 1938, serving in the Brighton, Bournemouth and Leeds telephone areas. Promoted Assistant Inspector (old style) at Headquarters in May, 1948, he was transferred to Cardiff in November, 1949.

W. T. DUERDOTH ("An all Electronic P.A.B.X. at the Post Office Research Station") is a Senior Executive Engineer at Research Branch of the Engineering Department. He was educated at Faraday House Electrical Engineering College where he was awarded the College's Gold Medal and obtained a B.Sc.(Hons.) degree in engineering. Most of his eighteen years in the Research Branch have been spent on long lines transmission problems and was concerned with work on submarine repeaters and the coaxial cable transmission network for telephony and television. Some three years ago he transferred to a group dealing with switching problems and is now involved in the design of electronic telephone exchanges.

D. T. GIBBS ("*H.M.Y. Britannia* Called from the Antarctic") entered the Post Office in 1929 as an Assistant Traffic Superintendent in the Southampton Telephone District. In 1933 he joined Post Office Headquarters as an Assistant Inspector, in the Service and Equipment Divisions. Being an officer in the Territorial Army, Royal Signals, he was mobilised in August, 1939, and finally served as a Lieutenant-Colonel in the British Second Army. On demobilization in 1945, he joined Midland Telephone Regional Headquarters. After further service on overseas telegraph duties at Post Office Headquarters from 1947 to 1952, he was seconded to the Commonwealth Telecommunications Board as traffic adviser. In 1953, he was appointed to his present post as Assistant Controller in the Operations and Planning Branch of the External Telecommunications Executive, where he has been responsible for the overseas telephone services. He was made a Member of the Victorian Order for services during Her Majesty's World Tour of 1953-54.

H. S. HOLMES ("Telegraph Hand Delivery") was appointed Senior Inspector, Inland Telecommunications Department, in 1954, since when he has been concerned with studies of telegraph delivery and telegraph instrument room organization. He entered the service as an Assistant Traffic Superintendent at Glasgow in 1935 and transferred to Post Office Headquarters, Scotland, in 1941. From 1943 to 1947 he was an Assistant Inspector in the Telephone Branch at Headquarters, and from 1947 to 1954 an Assistant Controller II in the North Eastern Region Telecommunications Branch.

N. A. H. PARKS ("The Telephone Assistant Supervisors' Training Course Reviewed") is a T.T.S. in the Bournemouth Area. He entered the Post Office as a youth-in-training in 1940 in Bournemouth, worked with the American and British Forces on Salisbury Plain during the war, was appointed A.T.S. in 1950, and has since been employed on Staff and Service duties. Selected to run the pilot series of courses for Assistant Supervisors in the South West Region at Taunton from November, 1954, to June, 1956.

F. I. RAY ("Time in Telecommunications") is Chairman of the Editorial Board of the *Journal*. He is a B.Sc. (Eng.) and a Member of the Institute of Electrical Engineers. His Post Office service started in the Research Section in 1922 and he was in charge of the Circuit Laboratory during his earlier years. After serving as Sectional Engineer, he was one of the first group of Telephone Managers, was the first Telecommunications Controller at Manchester, and subsequently was Controller of Telephones, London Telecommunications Region. After serving as Assistant Secretary in the Inland Telecommunications Department for four years he was appointed Regional Director, L.T.R., in 1948. He became Director of Inland Telecommunications in 1956.

W. G. SCANTLEBURY ("Coal and Communications in South Wales") is an Assistant Engineer in the Cardiff Telephone Manager's Office. He entered the Post Office in the then Gloucester Section in 1935, and until 1939 was engaged in exchange construction, serving as an U.S.W. and later as an S.W.1. He served in the Royal Corps of Signals during the war and was promoted to the rank of Inspector in his absence. Since 1945 he has been employed on Local Line Planning duties in the Cardiff Area. (W. L. HALL, joint author, contributed an article to the Autumn, 1956, issue of the *Journal* on "Some Problems of Shared Service"; his career was outlined in that issue.)

A. E. J. SIMS, A.M.I.E.E. ("Changing the Coin-Boxes"), an Executive Engineer in the London Telecommunications Region Engineering Branch was formerly in the Engineering Department (Telegraph Branch) and the External Telecommunications Executive. During the war and after he spent six years with Royal Signals. Since 1954 he has been dealing with telephone non-standard facilities for Government departments and subscribers' services.

G. TURNER ("Changing the Coin-Boxes") is an Executive Engineer in charge of the group in the Engineering Department's Subscribers' and Service Branch dealing with the design of telephone coin collecting boxes, kiosks, cabinets and similar equipment. After four years in the Post Office as a youth-in-training in Glasgow Telephone Area, he transferred to the Engineer-in-Chief's Training Section in 1937. From 1939 to 1946 he lectured on automatic telephony and was closely concerned with the development of telex. He became an Executive Engineer in 1955.

J. P. WREFORD "(The Telephone Assistant Supervisors' Training Course Reviewed") is an A.C. II in the Telecommunications Branch at South West Region Headquarters responsible for telephone training. He served with the Royal Signals in the Middle East, Europe and India during the war, and has since been in the Bristol Telephone Area and R.H.Q. He is an associate of the British Institute of Management.

Notes and News

Mr. R. J. Halsey, Assistant Engineer-in-Chief

Captain J. P. F. Betson, Commander, *H.M.T.S. Monarch*

"T.A.T." Men Honoured.—The successful achievement of the first transatlantic cable in 1956 was recognized in the New Year Honours list. Mr. R. J. Halsey, Assistant Engineer-in-Chief of the Post Office, became a C.M.G., Captain J. P. F. Betson, Commander of H.M.T.S. *Monarch*, and Lieut.-Colonel F. A. Hough, M.B.E., Chief Regional Engineer of the London Postal Region, received the O.B.E. The British Empire Medal was awarded for their work in Newfoundland to Mr. R. A. W. Pantenay of the Engineer-in-Chief's Office, and to Mr. E. V. T. Perrins of the Research Station.

Other honours for Post Office telecommunications staff included the M.B.E. for Mr. V. W. N. Bowles, Chief Telecommunications Superintendent, London Telecommunications Region, and Mr. J. E. Day, Assistant Engineer of the Research Station; the British Empire Medal for Mr. C. W. J. Almond, Overseer, External Telecommunications Executive (Electra House), Miss D. M. Carder, Supervisor (Telephones), Bath, Mr. W. J. Cutts, Inspector (Engineering), Centre Area, London Telecommunications Region, Mr. R. Keech, Technician Class 1, North Area, L.T.R., and Mr. F. Spearey, Inspector (Engineering), Cardiff.

Captain T. A. Vickers, Commander of the C.S. *Mirror* (Cable & Wireless Ltd.), received the O.B.E. and Mr. F. G. T. Wilson, of the Company's head office, the M.B.E.

★ ★ ★

British Empire and Commonwealth Games.—A committee of experts drawn mainly from the Post Office has already been considering for some time the communications arrangements for the biggest sporting event ever to be held in Wales—the VIth British Empire and Commonwealth Games at Cardiff in 1958. Apart from the ordinary land-line network, a special teleprinter "round robin" will be needed for collecting and disseminating results, while mobile radio walkie-talkie sets will be essential for some of the sports. At least 400 Press representatives from various parts of the Commonwealth are expected, and elaborate Press facilities are being planned. Most of the events will be held in or near Cardiff, but rowing will take place at Llanberis, near Snowdon, about 160 miles away from the main headquarters.

★ ★ ★

Supervisor Training.—Arrangements are now being made for Post Office Telegraph Supervising Officers to attend a two-week training course on the lines of that given to Telephone Supervising Officers. The pilot course will be held at Leeds in the North Eastern Region very shortly. The Leeds centre will subsequently take officers from Scotland and the north of England and two other centres will be opened to cover the remainder of the country.

★ ★ ★

Tolerance!—Country subscribers tend—in general—to be more tolerant of defects in the telephone service than their urban cousins. Even allowing for this, however, there was some consternation in the Traffic Division of the Lancaster Telephone Manager's Office when a letter was received from a Windermere subscriber complaining that an extension line to his garage had been out of order for 25 years! A check of the rental card revealed that we were in fact charging for an extension, and the local assistant engineer hurried round to investigate. Happily the faulty extension was a private circuit not maintained by the Post Office. The subscriber was induced to rent a further extension and tranquillity was restored to troubled waters.

★ ★ ★

Transatlantic papers.—A symposium on the transatlantic telephone cable between London, Montreal and New York was carried over the cable itself on January 24. The occasion was a joint meeting between the Institution of Electrical Engineers, the American Institute of Electrical Engineers and the Engineering Institute of Canada. Sir Gordon Radley, Director General, British Post Office, and Dr. Mervin J. Kelly, Bell Telephone Laboratories, presented papers.

★ ★ ★

No dials for purdah.—"At the end of September", says the Board of Trade Export Services Information Branch, "work on the Siemens Halske telecommunications project which provides radio-telephone links between Jedda, Riyadh and Dammam and between Jedda and the capitals of Europe and the Arab countries was all but complete, and the formal opening was imminent.

"The automatic exchange installed by a British firm in Jedda last year would have been in operation by now, had it not been realized at a late stage that dial telephone would permit free conversation between women in purdah and any men who telephoned to them from without. After some discussion it was decided that automatic telephones might be installed in Government and commercial offices and in foreign embassies but not in private houses. It is hoped that the necessary connexions will be made within the next one or two months."

★ ★ ★

Help for the Relief Fund.—About 4.30 p.m. the Controller of the Central Telegraph Office was advised from the Mansion House that the Lord Mayor, Sir Cullum Welch, wished to send telegrams to all the Lord Mayors, Lord Provosts, Mayors and Provosts, and Chairmen of Urban and Rural District Councils of Great Britain in connexion with the launching of his appeal for the Hungarian Relief Fund.

The task involved a study of reference books and records to ascertain the correct personal names of the officials, but an hour later, when 1,700 telegrams were handed in, special staff had been earmarked and were ready for the work. Not only were the telegrams transmitted and delivered to all parts of Great Britain within a very short time, but during the same evening the Lord Mayor received most of the replies and the remainder arrived next morning.

Inauguration of the Fund produced a large

Inland Telecommunications Statistics

	Quarter ended 30th Sept., 1956	*Quarter ended 30th June, 1956*	*Quarter ended 30th Sept., 1955*
Telephone Service			
Gross demand	89,711	94,703	128,810
Connexions supplied	92,029	100,560	105,195
Outstanding applications	296,711	317,626	383,949
Total working connexions	4,357,610	4,313,170	4,141,393
Shared service connexions	1,135,390	1,113,542	1,009,213
Traffic			
Total inland trunk calls	82,733,000	*82,673,000	87,313,000
Cheap rate	21,460,000	*21,402,000	24,052,000
Inland telegrams (excluding Press and Railway)	4,630,000	4,092,000	5,653,000
Greetings telegrams	1,011,000	887,000	1,179,000
Staff			
Number of telephonists	48,523	49,495	48,195
Number of telegraphists	6,363	6,559	7,104
Number of engineering workmen	63,779	63,235	60,793

* Amended figures.

number of telephone enquiries and to meet the flood of calls additional telephones were quickly installed in an emergency office at the Mansion House. All this happened on Lord Mayor's Day—always an exceptionally busy time for communications at the Mansion House.

In a personal letter to the Postmaster-General, Sir Cullum Welch expressed his appreciation and warm thanks to all the staff concerned for what he described as "remarkably fine work displaying a high level of efficiency".

★ ★ ★

Telegraph Developments.—An experiment has been made in streamlining the movement of telegrams in the Post Office Newcastle telegraph office. The phonogram and teleprinter operators have been brought together on opposite sides of a suite of positions and telegrams are passed directly from one to the other. Circulation time and effort are thereby reduced. A similar experiment, in which one telegraphist performs both functions, is in progress at Aldershot.

★ ★ ★

Great Overseas link.—"For half of my voyage radio relays provided by your stations can keep me in constant touch with home", said the Duke of Edinburgh in a radio facsimile message from H.M.Y. *Britannia*, steaming eastward through the Malay Straits, to *Zodiac*, staff magazine of Cable & Wireless, Ltd.

H.R.H. added that one of the interesting aspects of his voyage was that he was having "a practical demonstration of the daily work of your great overseas link and can appreciate to the full the help of the relays at Nairobi, Colombo, Singapore, Sydney, Perth, Ascension and Barbados."

★ ★ ★

Telex Expansion.—The number of users more than doubled during 1956, ending the year at 3,354. Nearly five million calls were recorded.

★ ★ ★

Change of Staff.—Miss K. F. A. McMinn, who has been Assistant Editor of the *Journal* for nearly four years, has left to take up another post, on promotion, in Post Office Headquarters. She goes with our best wishes and our thanks for her devotion to the *Journal* since the Spring of 1953. Miss K. Davis is now Assistant Editor.

Publication and Price. This *Journal* is published in November, February, May and August. Price 1/6. The annual postal subscription rate is 6/6 post free to any address at home or overseas.

Contributions. The Editorial Board will be glad to consider articles of general interest within the telecommunication field. No guarantee of publication can be given. The ideal length of such articles would be 750, 1,500 or 2,000 words. The views of contributors are not necessarily those of the Board or of the Department.

Communications. Communications should be addressed to the Editor, Post Office Telecommunications Journal, Public Relations Department, Headquarters G.P.O., London, E.C.1. Telephone: HEAdquarters 4345. Remittances should be made payable to "The Postmaster General" and should be crossed "& Co."

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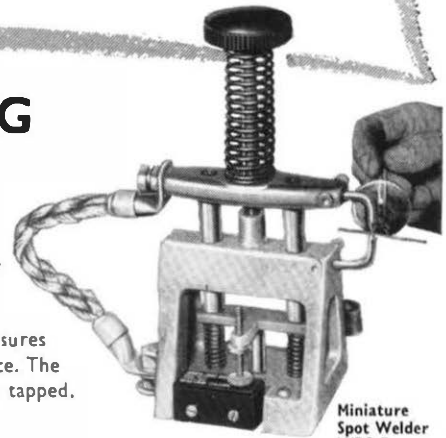

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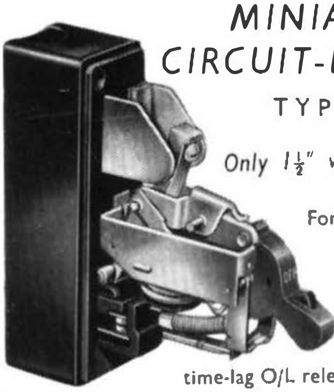

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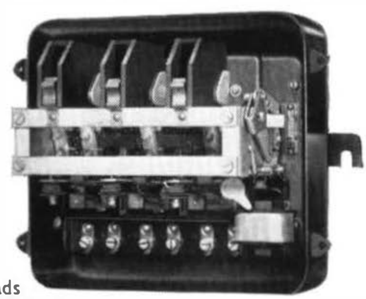

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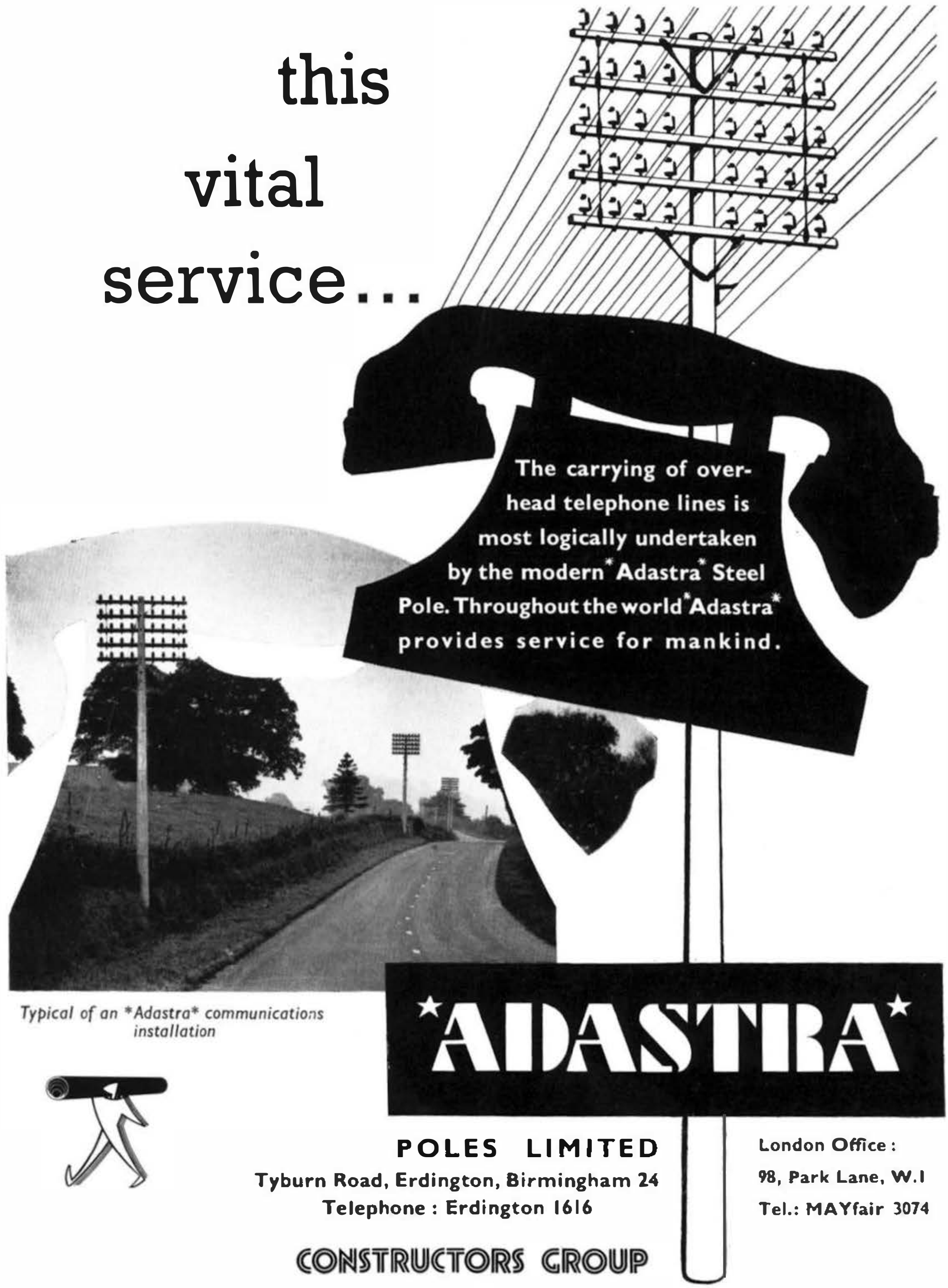

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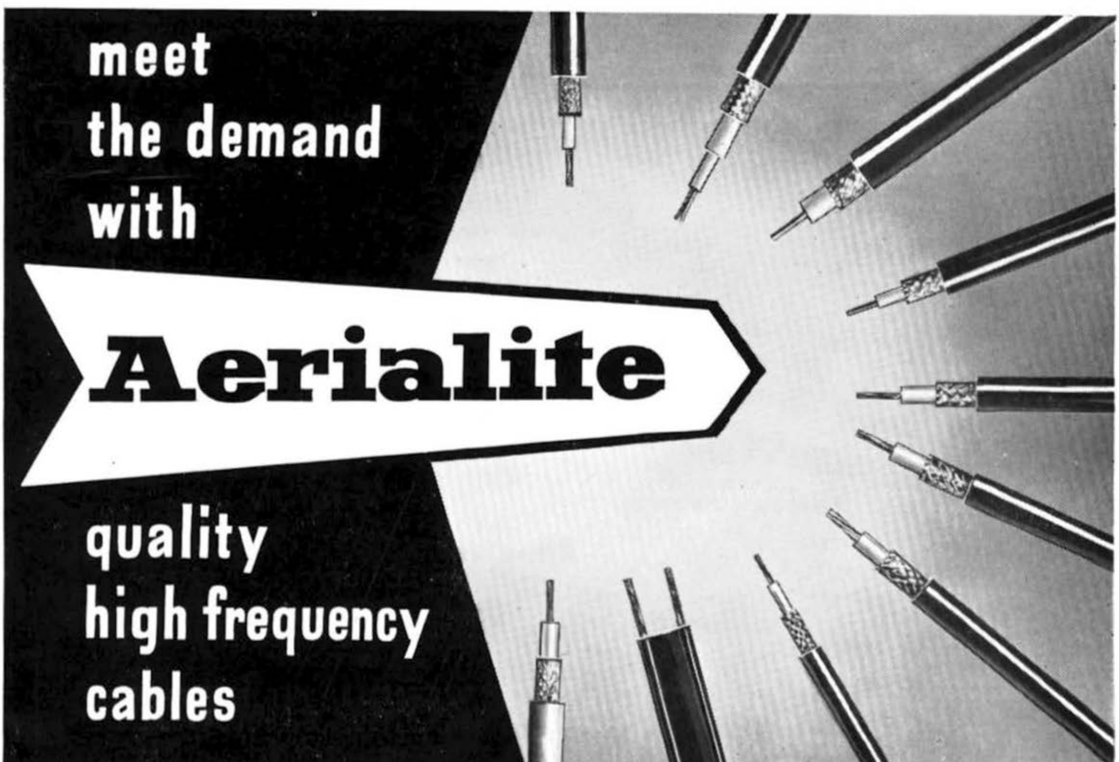

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