POST OFFICE

tele communications

JOURNAL

ONE SHILLING AND SIXPENCE

WINTER 1959

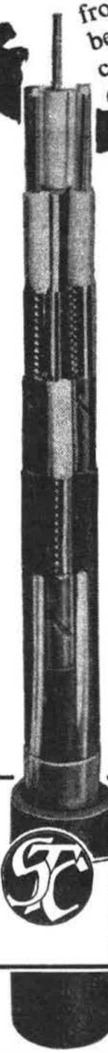
Over 2,000 conversations on one cable

59. Development of the coaxial cable made a large reduction in the cost of long distance telephone conversations. In modern coaxial cables up to 960 simultaneous conversations can be transmitted over a pair of coaxial tubes, of which there may be several in each cable. But engineering development is now being pushed a stage further. By reducing the spacing between repeater stations from 6 to 3 miles the capacity of existing cables between some main centres will be increased so that the same pair of tubes will cater for about 2,400 simultaneous conversations or 1,000 conversations plus a two-way television channel.

Microwave radio systems providing simultaneously for telephony and ... have been developed and brought into service.

60. ... ineers in ... Post Offic

extract from the Post Office Report and Commercial Accounts 1957-58.



S.T.C. were the first in Europe to manufacture Coaxial Cables in 1935 and have pioneered all subsequent developments.

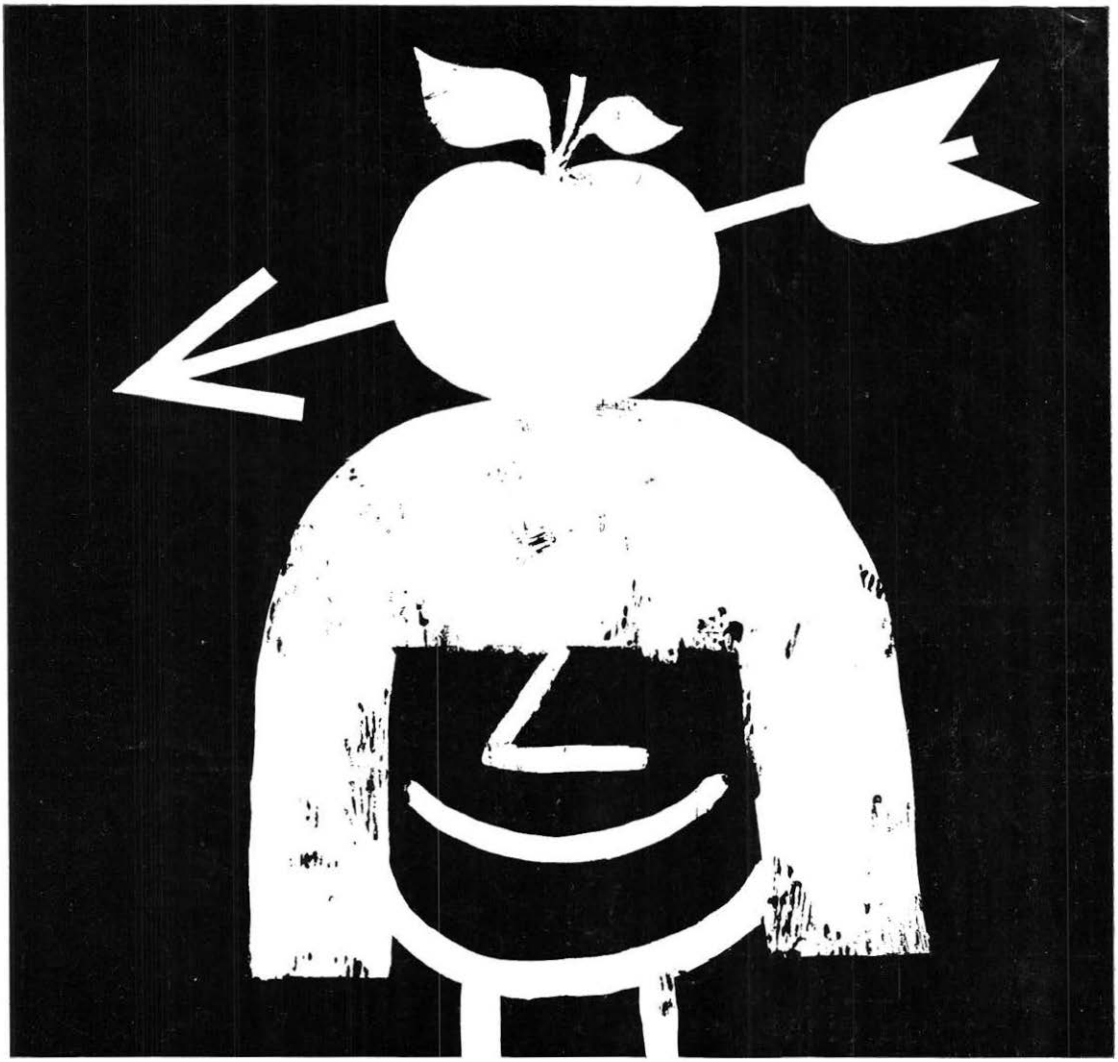
S.T.C. have installed or have on order over 10,000 route miles of Coaxial Cable incorporating 36,000 miles of Coaxial tube.

STC CABLE AND WIRE GROUP

Standard Telephones and Cables Limited

Registered Office · Connaught House, Aldwych, London, W.C.2

TELEPHONE CABLE DIVISION: NORTH WOOLWICH LONDON E.16



Post Office Telecommunications Journal

Published by the Post Office of the United Kingdom to promote and extend knowledge of the operation and management of telecommunications

Contents

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Vol. 12 *Winter,* 1959 *No.* 1

Electronic Exchange

ON NOVEMBER 10, THE POST OFFICE AND THE equipment manufacturers concerned demonstrated at Dollis Hill a working model of the all-electronic telephone exchange which is to be put into service at Highgate Wood, London.

The all-electronic exchange, which we hope to describe in our next issue, is probably the biggest step forward in telephone technique since the automatic exchange was introduced from 1912 onwards. There have been major developments in subscribers' service, the latest example being Subscriber Trunk Dialling, but the electro-mechanical automatic exchange has held the field in basic exchange equipment for nearly fifty years.

The all-electronic exchange has been the subject of research for several years, because engineers have seen the possibilities of smaller, lighter and cheaper equipment which, having no moving parts to wear out, should have a longer life and be more reliable. These possibilities came a step nearer with the model exchange now announced and which is to be followed by an exchange in public service at Highgate Wood. There are still many hurdles to clear, however, before the goal of the electronic exchange fully competitive in price with existing types has been reached.

The design is a product of close co-operation between the Post Office and private enterprise in the Joint Electronic Research Committee—JERC—which has been working on the project for some three years.

Although when opened for service this new type of exchange will still in a sense be experimental—only daily operation on live traffic can prove the efficiency and durability of its many components—it is clear that the Post Office and the manufacturers have set out on a radical departure that may well revolutionize public exchange technique.

The Post Office Telecommunications Advice Service

R. M. Watson

IN THE PARLIAMENTARY PAPER *Telephone Service and the Customer* published last February the Postmaster General said that "the aim and purpose of the telephone service is not only to serve, but to please the customer. Everything must be subordinated and surrendered to that end".

The Postmaster General was, of course, restating one of the fundamental principles of Post Office policy. In telecommunications the aim has always been, within available resources, to please customers and indeed, to go to great lengths to advise all customers and potential customers about their communication problems. The free help and advice the Post Office gives to telephone customers through the Headquarters Telecommunication Advice Service, Regional Headquarters and the Telephone Area Sales staff has been publicized among the Federation of British Industries, the Institute of Directors and the Office Management Association. Telephone Managers have also been asked to bring this service to the attention of the larger subscribers in their areas.

ADVICE ORGANIZATION

The Post Office has a national organization for advising on telecommunications services. Its cost is amply repaid in general goodwill, and in public recognition of a desire to be of service.

In every Telephone Manager's Area concerned with providing, altering or removing telecommunications facilities, the Telephone Manager's Sales Division offers a consultancy service. Most of the day-to-day work of visiting, advising and negotiating with customers in the Area is done by Sales Representatives who have been selected and trained to see that the telecommunications services meet customers' requirements in the most efficient and economical way.

There are 850 Sales Representatives of whom 670 are on visiting work. The remainder are largely employed on sales development work on which detailed planning of the future expansion of the service is based. All have been specially recruited for the work of advising and negotiating with customers and they must have a pleasant personality and an ability to explain Post Office services in non-technical language to a mainly non-technical public.

The Post Office gives them a series of detailed training courses at the Headquarters Sales Training School in London, alternated with periods of practical Sales experience in the Telephone Areas in which eventually they will work.

The Sales School has every facility for providing modern training and has a fully equipped telephone demonstration room which includes all types of customers' telephone apparatus, ranging from a PABX to a magneto telephone. There is also a well equipped telegraph demonstration room designed to demonstrate the telex and private telegraph services. These demonstration rooms are used not only for training but also by Sales Representatives in London to demonstrate telephone and telegraph facilities to a large number of customers who are brought to the School during negotiations.

In addition to basic training, instruction on a large number of specialized communication facilities is also given to Sales Representatives and to their Supervising Officers. These include provision of telephone; telex and telegraph private wire services; civil and military defence communication needs; police and fire communication systems.

Advice in the Area

In the Telephone Manager's Area in which he works, the Sales Representative is allotted a "territory" within which he is responsible for giving advice as well as for accepting orders for the provision, alteration and removal of telecommunication facilities.

The public generally know the simpler features of telephone service, but there are many features, even with modest installations, on which the Sales Representative can usefully advise the customer.

Such is the variety of the Sales Representative's work that he can be called on at one moment to advise on a simple installation with one or two telephones, and then on a complex installation such as a large PMBX or PABX to serve an important commercial or business undertaking, and involving the connexion of large numbers of exchange lines and extensions.

Within the Telephone Manager's office there are Traffic and Engineering specialists whom the Sales Representative frequently consults and who, indeed, often accompany him to advise on special aspects of the service. When a problem is complicated the customers' interests are fully safeguarded because, not only does the Sales Representative bring the Traffic and Engineering Divisions into consultation as necessary, but he is ensured of support and guidance from his Sales Superintendent who from his wider experience of dealing with communication problems is able to give help and guidance.

Advice in the Regions

The Regional Telecommunications branches are closely concerned with advice on communications given to customers. The staffing of the Telephone Manager's Sales Division, general oversight of all their work and, more particularly, the control and co-ordination that must be exercised between Areas on communication problems which are not limited to one Area in the Region, are all the responsibility of the Regional Telecommunications Branch.

Regional officers give help and guidance to the Area Sales Divisions in the more involved advisory work that Sales Representatives may be handling, and they often participate in the more detailed national investigations undertaken by Headquarters Telecommunications Advice Service Group.

Now that the Post Office is bringing the advice service to the attention of larger telephone customers, Regional officers will undoubtedly be called on to undertake wider responsibility in advice matters. Although much of the increased advice work that will arise will fall on Area Sales Divisions, there will be increased pressure on the Telecommunications branches, not only to guide and co-ordinate this work but also to give help to Areas on complex installations and assistance to Headquarters in all phases of Telecommunications Advice work.

London Telecommunications Region, with its eight very compact Telephone Areas, and exceptionally dense concentration of big business establishments, has for long recognized the importance of giving an advice service. In addition to the Sales Organization at Regional Headquarters there is a specialist Sales Advisory Team, whose function is to examine and advise on the telephone arrangements in the many Government Department offices in London. This team makes a very real contribution to the efficiency of these Government offices, and no little contribution to the national economy by the improvements made in their telephone arrangements.

Headquarters Telecommunications Advice Service

Government Departments, nationalized industries and other large organizations with factories, branches and establishments spread throughout the country, often have specialized or national communication problems. These problems are often beyond the range of a single Area or Regional organization to deal with, and can best be handled by a centralized group of Sales Investigation staff who can more easily and efficiently co-ordinate the examination of the customer's national requirements, and who have rather easier direct access to engineering and traffic specialists when particular facilities and systems have to be developed, or new procedures and services introduced. Such a centralized group, called the Telecommunications Advice Service (TAS), exists in the Subscribers' Services Branch at Post Office Headquarters.

In essence, the responsibilities of the TAS Group are broadly similar to those of the Sales Representative in an Area; indeed, many members of this group served part of their "apprenticeship" as Area Sales Representatives before going to Headquarters. Their work involves deciding what facilities a customer really needs and how existing communications of all kinds should be organized to give maximum efficiency with greatest economy.

The Group seeks constantly to develop new ways for customers to use communication services and new methods to meet their needs. Many of the tasks they are asked to undertake for large firms call for long and continuous study of a firm's organization and functions, its business methods and more particularly its communication methods, both internal and external. The problem is studied and analysed and recommendations are made to the firm, usually in the form of a report.

While complex and unusual problems are not beyond the scope of the Regional and Area organization the TAS Group are often asked to deal with them because they involve detailed development work and have policy implications.

The following example illustrates the kind of advisory service given by TAS. Although this was done by the Headquarters Group, it is true to say that very similar work is regularly undertaken in the Regions and the Telephone Managers' Areas.

COMMUNICATIONS FOR THE ROOTES GROUP

The Rootes Group of companies, which are private and commercial vehicle manufacturers, distributors and exporters, have their headquarters at Devonshire House, Piccadilly, London. The organization is divided into two broad divisions: Manufacturing and Distribution. The Manufacturing Division has two main centres: Coventry for private cars and Luton for commercial vehicles, with establishments at other points in the Midlands and southern England. The main centres of the Distribution Division are at London, Birmingham, Canterbury, Maidstone and Manchester, with depots at a number of other places in the country.

A particular communication problem for Rootes arose during the early stages of the expansion of Post Office telex service in 1956. The Group quickly recognized that telex would be an excellent means of communicating with dealers in all parts of the country, and overseas, about sales, service and car parts. So convinced were they of the value of telex service that they were anxious not only to install a number of stations throughout the organization but were also prepared to persuade their dealers to install and use the system. Their immediate communication problem arose because of the danger of telex overlapping and not integrating with their existing private teleprinter network, which might have made their system unbalanced, inefficient and uneconomic.

After TAS had discussed the problem with Rootes' Management and the Group's Communications Officer and had examined the organization in detail, the task was divided into three broad phases. While each phase was treated as a separate problem, the ultimate aim was to design an integrated and efficient communication system for the whole organization.

The three phases were:—

(i) advance provision of sufficient telex facilities to enable service to be given to Rootes dealers and distributors throughout the country, with the ultimate absorption of these facilities into an overall communication system;

(ii) examination and redesign of the existing private telephone circuit network;

(iii) examination and redesign of the private telegraph network.

Phase 1: Telex Service

Rootes regarded telex as ideal for messages from and to dealers. The majority of messages related to car parts, which were stored mainly at Coventry and Luton. An estimate—based on examination of message traffic—put the initial needs for telex stations as three at Coventry (Ryton), one at Luton, and one at Birmingham, to assist in the opening of a new centralized Parts Department. Devonshire House already had telex.

Ad hoc traffic checks showed that a number of other depots and stores, could with advantage install telex. The immediate result, in addition to improving communications, was some reduction of dealers' trunk telephone costs—a factor of some importance in persuading them of the value of telex service.

With the introduction of three telex stations at Ryton, it became apparent that the collecting and distribution of messages to the Parts and Service departments would have to be improved. This was done by providing short-distance telegraph circuits from the telegraph switchroom direct to these two departments.

Such has been the success of the telex service, for communicating to and within the Rootes organization, that 40 of their dealers in this country and 19 overseas have now become telex subscribers. An interesting feature of the telex expansion is that Rootes' Communications Officer was largely responsible for persuading many of the dealers to rent telex installations.

Phase 2: Telephone Network

Calls over the existing telephone private circuit network (Fig. 1) particularly those to Coventry (Ryton) and Luton, were subject to considerable delay and much of the traffic had to go via the public system. Many of the original point-to-point circuits had been incorporated into the network which had apparently grown up piecemeal and was not now capable of carrying all the traffic originating from the stations connected to it, nor of providing overall a satisfactory quality of transmission. Arbitrary routing of calls by operators often added to difficulties.

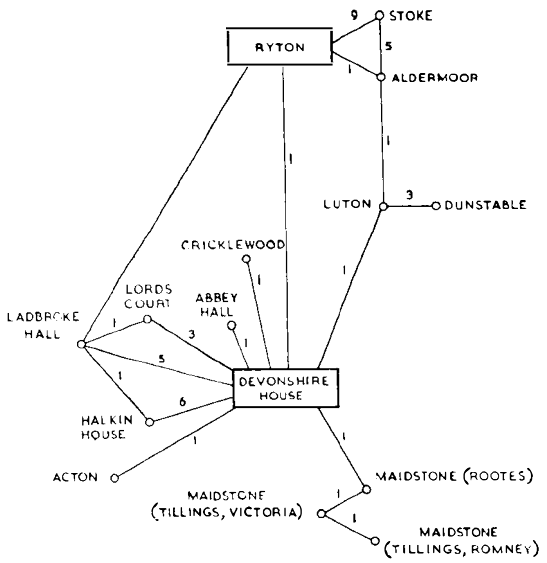


Fig. 1: Existing private telephone circuit network

A detailed traffic record was taken of calls passing over the network and of all inter-depot calls connected over the public system. From this record, and after visits and discussions with the Management and with Post Office Headquarters traffic experts, a new network was designed having a radically different pattern.

The pattern of the new network (Fig. 2) was based on one "backbone" route between the two main switching centres, namely, Coventry (Ryton) and Devonshire House, London, each centre having a number of dependent depots and stations capable of being connected to each other on a maximum of 3-link connexions.

In all, four new stations were connected to the rearranged Coventry switching centre, and five new stations to the Devonshire House switching centre. It was calculated that the new network would permit 35 per cent. of calls made within the busy hour to be connected on demand and 65 per cent. with less than six minutes delay. Outside the busy hour the percentage of calls connected on demand would, of course, be higher. This was a great improvement on the service possible with the old network.

Operating procedures for the new network were devised and recommended after consulting Post Office Headquarters traffic specialists. It was also recommended that all network operators should be given up-to-date detailed information about the location of all stations on the network, with the relative telephone numbers. Detailed routing instructions were also prepared.

Although the rental costs of the new network were substantially greater than those for the existing network, these additional costs have been more than offset by the saving in costs of the trunk calls previously overflowing on the public system. In periods of extreme pressure a few calls may still overflow to the public system, but the regular traffic checks recommended will enable this aspect to be kept under review.

Phase 3: Telegraph Network

The existing telegraph network (Fig. 3) including the new circuits needed for the introduction of telex at Coventry, had two main switching centres at Coventry and at Devonshire House, each with teleprinter switchboards linked by two long-distance simplex circuits. Connected to these switchboards were dependent stations. The telegraph network paralleled and was complementary to the private telephone network.

For a variety of reasons this network was not satisfactory. Delays in transmission were frequent and prolonged and rigid booking and queueing procedures were in operation. Stations without auto-transmitters blocked expensive main routes with manual transmission. To provide a priority service, circuits were being reserved at fixed times to transmit urgent operational messages but sometimes the messages were not ready when circuits were cleared and reserved for them. Multiple address messages were frequent, but the network was seldom free to permit their transmission and many stations preferred to repeat messages individually to each address, rather than try to broadcast them.

A careful analysis of the type and quality of messages being transmitted showed clearly that the main difficulties were caused, not by overloading but because the network was fundamentally unsuitable for the type of message traffic the firm was originating. Switching of circuits, with consequent blocking of routes for long periods, was inefficient and uneconomic and created delay and often confusion.

It was more efficient to relay messages from one station to another by separate transmissions, rather than to switch circuits together, and a perforated-tape relay system employing novel features and using the existing circuits was designed with the assistance of the Post Office Engineering Department Telegraph Branch.

The new telegraph network is shown diagrammatically in Fig. 4. The teleprinter switchboards and one simplex circuit were ceased, and the remaining long-distance simplex circuit was converted to duplex working and terminated at each end with a printing reperforator, producing a printed and perforated tape, and an automatic transmitter No. 5A. This arrangement enabled messages over the circuit to be sent and received simultaneously between each centre. The two centres were now regarded as relay centres.

Each of the dependent stations connected to the relay centres cannot now be switched to other stations in the organization; messages from the centres are received at these stations on page printing teleprinters, and messages are transmitted to the centres manually from the same teleprinter—automatic transmission at this stage had no appreciable advantage. All incoming messages to the centres are reproduced on printed and perforated tape at the centre.

At each centre all the circuits from dependent stations are terminated on a concentrator, to which two teleprinters are connected capable of producing printed and perforated tape, both having keyboards

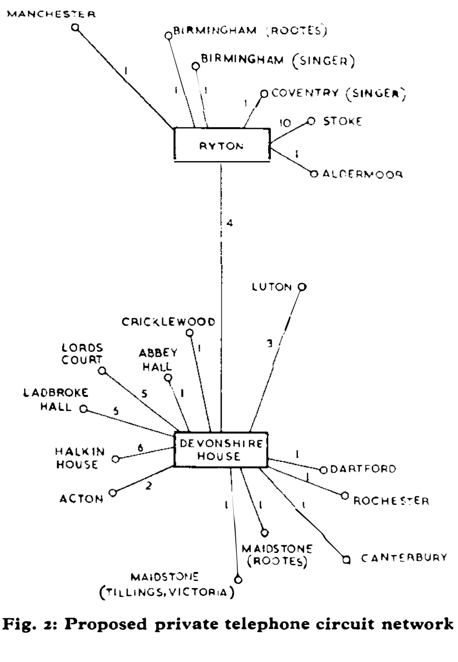


Fig. 2: Proposed private telephone circuit network

to permit manual transmission. Associated with each concentrator is a switching panel, to which are connected two auto-transmitters. Thus all incoming messages from the dependent stations are received on the two teleprinters, and the two auto-transmitters transmit all outgoing messages from the centre to the dependent stations.

This rather novel feature of the new network—which is very efficient—was recommended because the light volume of message traffic made it uneconomical to terminate each of the circuits from dependent stations on individual teleprinters. The only exception to this arrangement is a direct circuit from Luton (commercial vehicle factory), which was terminated in the Devonshire House relay centre on a p·inting reperforator.

Facilities had to be provided in each relay centre for converting perforated tape into page messages for delivery within the offices where the centres are located and for reversing the process for outgoing messages from these offices. This was achieved by connecting a teleprinter with perforating attachment (teleprinter No. 7BPK) to the switching panel at each centre.

Extension of telex working

With the re-design of the telegraph network integration of telex facilities into the Group communication system was now considered. There was evidence that the service would be useful at a number of stations already connected to the telegraph and telephone networks, in addition to those places where telex had already been installed.

After the overall loading of the new telegraph network had been carefully estimated it was decided to concentrate telex facilities at the two relay centres and then relay all telex messages over the telegraph network rather than provide individual telex facilities at the various separate stations. This reduced the number of individual telex installations, increased use of automatic equipment with consequent economy in reduction of call charges and operating time, gave better service to callers by grouping the telex installations and providing auxiliary working over the group, enabled callers to send messages for different points into the relay centres with one transmission, and made telex service available to all stations on the network whether or not they justified a separate installation.

To obtain the full benefit from these arrangements it was also recommended that at each station connected to the networks someone should be

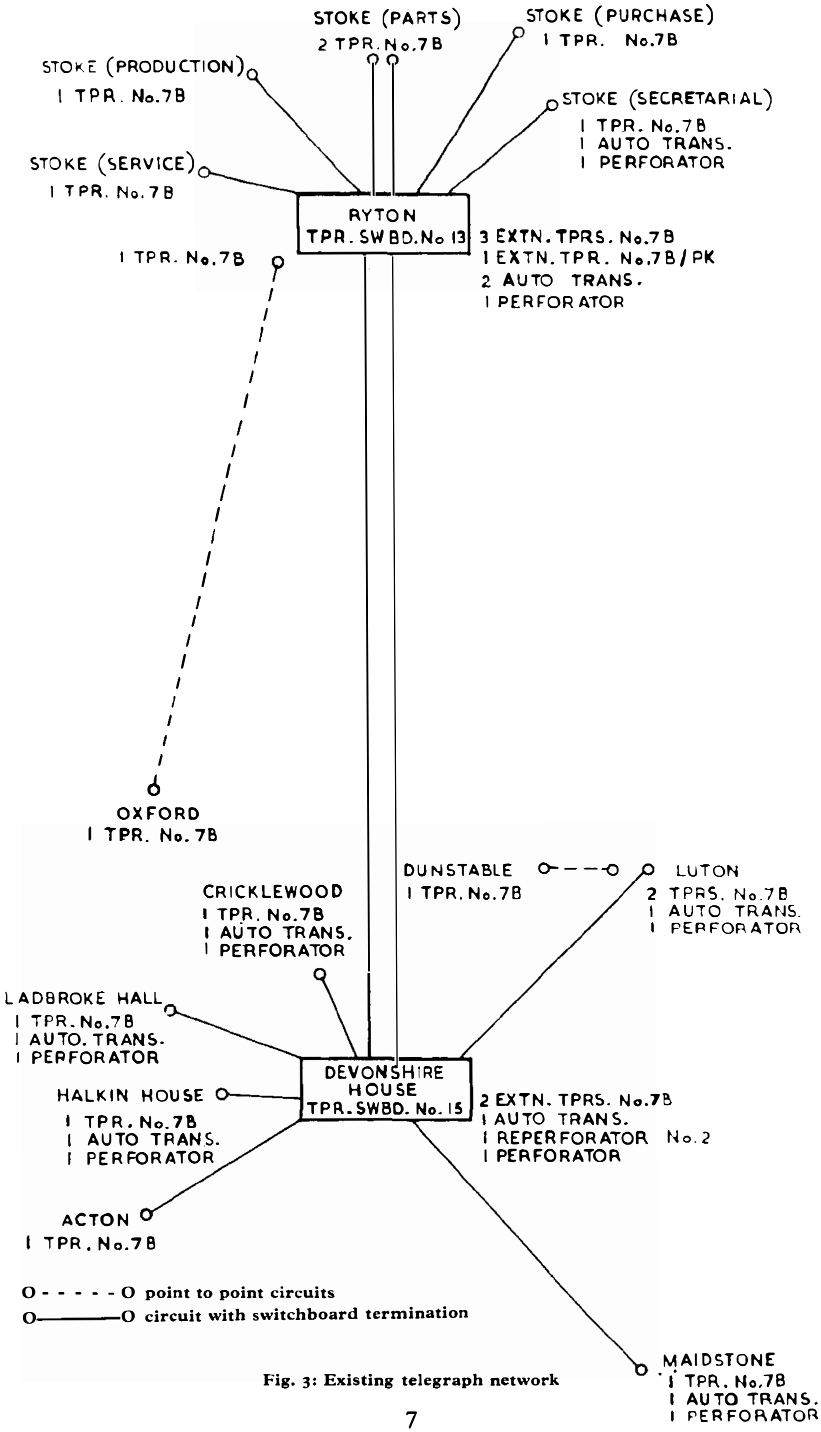


Fig. 3: Existing telegraph network

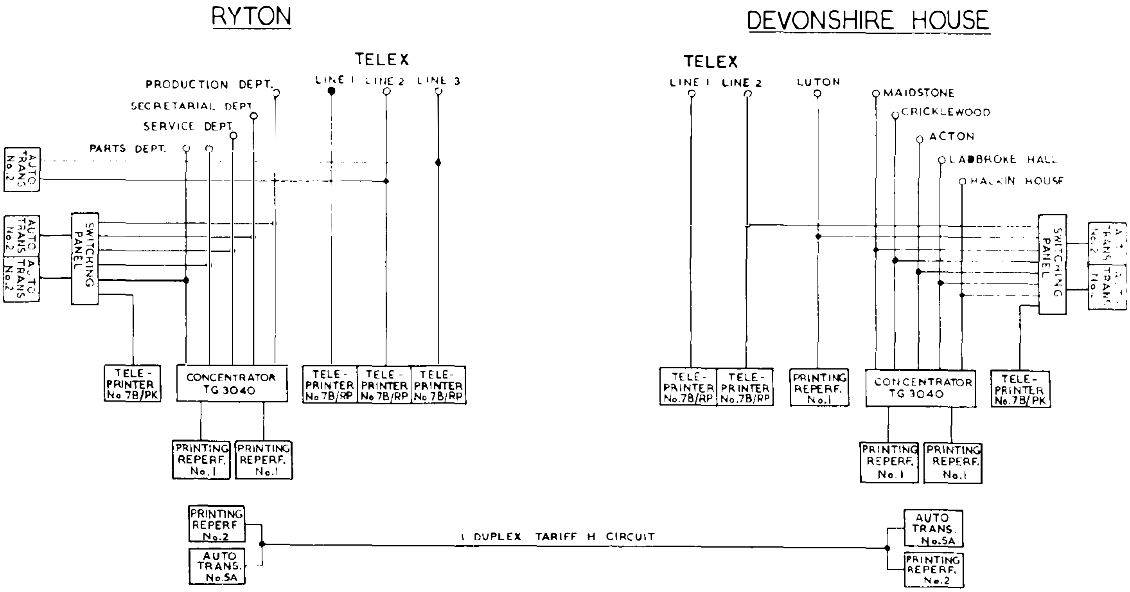


Fig. 4: Proposed telegraph system

responsible for ensuring that telex was used for communication with customers and suppliers who were telex subscribers.

Conclusion

A number of minor intercommunication requirements within the London area of the organization were examined and recommendations made, but these did not significantly affect the telegraph or telephone networks. TAS also advised that the whole field of Group telecommunications should be kept under regular review so that changes could be made where necessary to keep pace with changes in the organization.

Most of the measures recommended to Rootes were designed primarily to increase the efficiency of the firm's telecommunications, but it is satisfactory to report that, in addition, savings in the overall costs were also achieved—a happy combination.

The value of the telecommunications advice service cannot be wholly measured in concrete terms. Undoubtedly there is a good deal accruing to the Post Office on the "profit" side in general goodwill and improved customer relations, in prevention of complaints, in highlighting demands for new and additional communication facilities and finally, in helping national productivity.

Value to the Customer

The value to the customer is evident. He is given assistance and advice on his communication problems; he is sure of competent and courteous attention to his needs whether he has a simple installation or a large and complex communication system linking various parts of the country.

Finally, as the late Postmaster General rightly said: "We must never forget that we are a monopoly. We do not face the challenge of competition so we inherit special responsibilities to the community. We must not fail them. Let our purpose be to give the finest service in the world". The Telecommunications Advice Service is one example of the Post Office's acceptance of this special responsibility to the community.

Television News Films by TAT

R. H. Franklin, E.R.D., B.Sc.(Eng.), M.I.E.E.

The television news film of the Queen's departure for Canada last June 18, seen in Canada and the United States before Her Majesty arrived at St. John's, Newfoundland, and the corresponding films of the Royal party's arrival, were the first television pictures for public showing ever to be transmitted over the transatlantic telephone cable. In fact, the first public demonstration of a motion picture facsimile system developed for transmitting television news film over a programme circuit in the TAT was given to the Press at Alexandra Palace on the previous day.

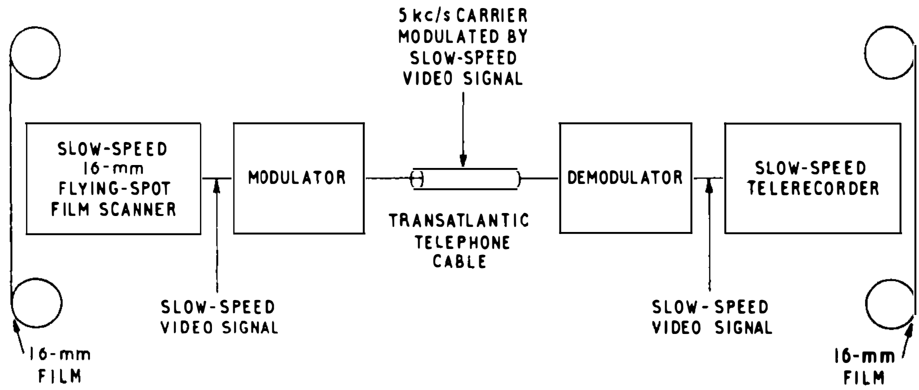
In this article Mr. Franklin shows how the system was developed.

TRANSMISSION OF THESE ROYAL NEWS films was the successful outcome of design and development by BBC engineers and followed a series of tests of the new system over a circuit between London and Montreal. The Post Office, the Canadian Overseas Telecommunications Corporation, and the American Telephone and Telegraph Company co-operated closely with the BBC for these test transmissions, the first two providing facilities for using the London-Montreal circuit. The BBC were greatly assisted by the co-operation of the Canadian Broadcasting Corporation in their Montreal Studios, where local telecinė and film facilities were provided.

The BBC made early tests in 1957, using normal picture transmission techniques. Batches of 384 frames of the film were transmitted as one picture over a normal transatlantic telephone circuit in about 30 minutes. In this way a 30-second film sequence could be transmitted in about an hour. The definition of the pictures obtained was inadequate, but the experience encouraged the BBC to produce a better method.

The new system uses a different technique and enables the frames to be transmitted, one by one, over a circuit normally used for the transmission of music programmes. For live television pictures, using the 405-line system used in the United Kingdom, a bandwidth of 3 Mc/s is required, which is much greater than the total 144 kc/s available on the transatlantic cable. Furthermore, only a small part of this bandwidth could be made available for television because it is normally fully occupied with traffic circuits, and any appreciable reduction in the number of circuits available would result in serious delays on the transatlantic telephone service.

Recognizing these problems, the new system has been designed to work over a narrow band-



width and with some reduction in picture quality. The need to economize in bandwidth means that live television pictures cannot be transmitted because the actual transmission over the cable takes appreciably longer than the film sequence as finally seen by television viewers.

The system uses 16 mm film at the transmitting and receiving ends. Only alternate frames of the originating film are transmitted and each frame sent is reproduced as two adjacent frames at the receiving terminal. Each frame consisting of 200 lines takes eight seconds to transmit, which is approximately 100 times the normal running speed, so that a half minute film sequence takes approximately 50 minutes to transmit over the cable. The received film can be shown on television as soon as it has been developed.

At the sending end, alternate frames of the film are scanned by a slow-speed flying-spot scanner to produce a "video" signal which is used to modulate a carrier frequency for transmitting the signals over the cable circuit—as shown in the diagram.

At the receiving end, the signals are demodulated and used to operate a slow-speed film telerecording equipment. Twin optical systems are used in the receiving equipment to record simultaneously on two adjacent film frames. The full 25 frames per second are thus restored on the received film, but from the point of view of movement, reproduction is 12½ per second. This results in satisfactory viewing except when the movement is rapid.

Arrangements are provided for transmitting every frame of the original film when necessary but this of course doubles the transmitting time.

Transmission over the transatlantic cable is on a channel normally used for sound broadcast transmissions. This channel has a nominal bandwidth of 6.4 kc/s and occupies the frequency spectra normally used for two ordinary telephone channels. To limit problems arising from delay distortion near the edges of the 6.4 kc/s band, the film transmission uses only about 5 kc/s of the available bandwidth. The vision signal is transmitted by the vestigial sideband method, the carrier frequency being 5 kc/s. To achieve a favourable signal to noise ratio the modulation is some 160 per cent. This over-modulation necessitates the use of synchronous detection at the receive end.

The length of the London-Montreal circuit is about 4,150 miles. From London to Oban it is routed on carrier and coaxial cables and then to Clarenville, Newfoundland and Sydney Mines, Nova Scotia, over the transatlantic cable. From Sydney Mines the circuit is routed to St. John over a microwave radio relay system and thence to Quebec on an open wire carrier system and on to Montreal in a carrier cable. Successful test pictures were transmitted over the circuit London-Montreal-London, a total length of over 8,300 miles.

The success of the new system is a tribute to the ingenuity of the engineers of the BBC in developing a system which makes effective use of a programme circuit for transmitting motion picture film. The present system is intended only for transmitting short news items of high interest value; it should prove a valuable aid to producers of television news until such time as a world-wide television network becomes a practical proposition.

Motorway Emergency Telephone System

The first section of the London–Yorkshire motorway was completed on October 31, and motorists can now travel non-stop from Watford to Rugby. The motorway will eventually form part of a system of international trunk roads, and to comply with international requirements the Ministry of Transport asked the Post Office to provide emergency telephones at one mile intervals along each side of the motorway.

In our next issue we hope to publish articles dealing with the general considerations surrounding the emergency telephone system, and the novel signalling equipment which the Post Office developed at short notice.

I.P.O.E.E. Essay Competition

The Institution of Post Office Electrical Engineers announces five prizes and five certificates of merit to be awarded for essays submitted for the year 1959–60. Technical accuracy is essential but a high technical content is not absolutely necessary for an award.

Closing date for entries is December 31 1959 and further information will be given by the Secretary (Mr. S. Welch), I.P.O.E.E., G.P.O. 2–12 Gresham Street, London, E.C.2.

Materials Testing in the Engineering Department

R. L. Bull, B.Sc., F.R.I.C.

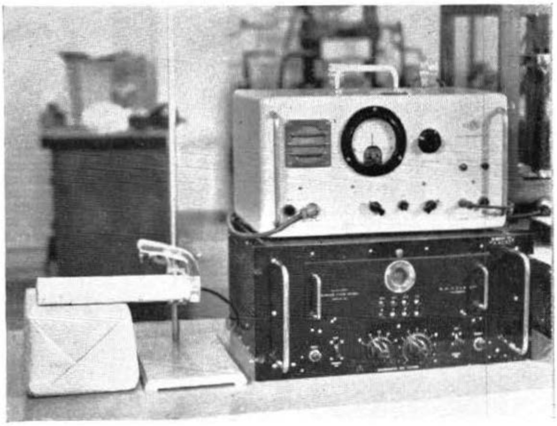
MATERIALS WORK IN THE ENGINEERING Department's Test and Inspection Branch may be said to date from 1901 when Mr. James Jupp, the first professional chemist employed by the Post Office, began work in the Testing Branch at Mount Pleasant. Until then the Government Laboratory had done some material testing for the Post Office but as the Post Office began to do more of its own chemical work the amount sent to the Government Laboratory decreased, not without protests from the Government Chemist.

At this time the Testing Branch (later the Test Section) was a part of the then Stores Department, but it was transferred to the Engineering Department about 1910, and in 1916 moved from Mount Pleasant to the new depôt at Studd Street. During the middle 1920s materials work was started at Birmingham also, and it grew until by the 1930s the numbers employed at London and Birmingham were about the same, as they are today.

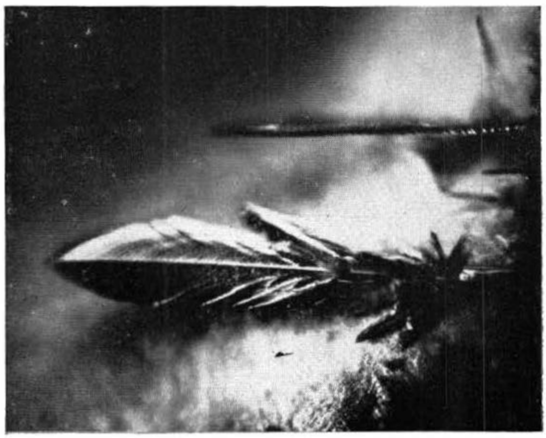
In 1937 the Chemical Sections at London and Birmingham were set up as separate units from the Test Sections and in 1956 were renamed Materials Sections. This is a better description as the work done is physical, metallurgical and microbiological, as well as chemical.

One of the Materials Sections' main functions, as may be gathered from the fact that they are parts of the Test and Inspection Branch, is to carry out acceptance testing of materials for engineering work bought by the Post Office. This covers a very wide field and involves dealing with such diverse materials as plastics, rubber, textiles, metals and alloys both ferrous and non-ferrous, paper, leather, plated and enamelled finishes, lubricants, paints, wood, insulating compounds, cement and solvents. Control is exercised by examining samples from deliveries of materials or apparatus. Where continuous production over a period is involved—cables for instance—samples are taken periodically and may include raw materials as well as the finished product.

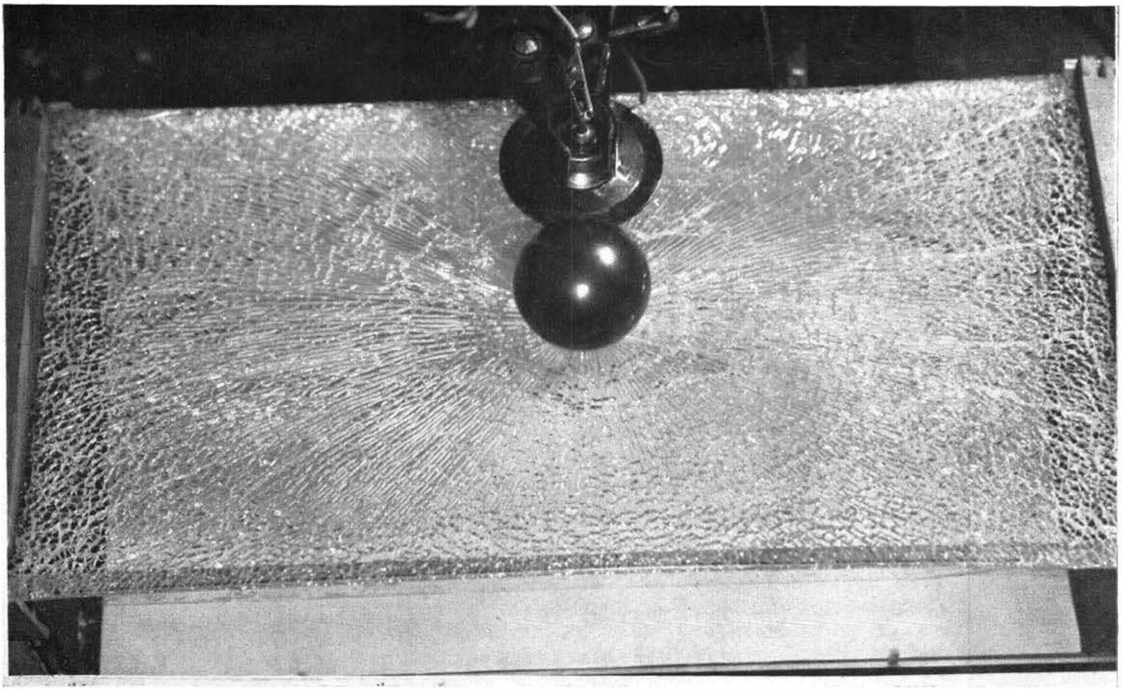
Complaints from the field are also investigated. They are welcomed because they may uncover a weak point in the inspection system which can be remedied or they may show that some material or article, although passing the current specification,



Apparatus for measuring radioactivity of parcels



Dendritic and tapered growths on sulphide coated silver contacts (magnified 200 times)



Toughened glass sheet at moment of fracture by dropping steel ball

is unsuitable in some way for the purpose required.

The Materials Sections also provide advice about materials to other branches of the Engineering Department, the Directorates, Regions and other Post Office departments. Problems arise which require a knowledge of the properties of materials and the organization concerned may submit these problems to the Materials Sections. Some enquiries can be answered directly from known facts, but others require experimental work before an answer can be given.

The work of the Sections requires not only knowledge of the properties of various materials, but also, since manufactured goods are frequently concerned, of manufacturing methods. Thus when dealing with metal items some knowledge of such production techniques as forging, casting, extrusion, and heat treatment of the formed article is necessary, while for plastics some detail of injection, compression and transfer moulding, extrusion, and manufacture of laminates.

For greater efficiency in using the comparatively small staff, the work is divided according to type between the London and Birmingham Sections so that Birmingham deals with metals, alloys, corrosion and inorganic work generally and London with organic materials and finishes.

Investigation may involve developing new methods of chemical or instrumental analysis, or evolving new tests to ensure the suitability of a material for conditions encountered in service. Quite often specifications in the Engineering Department M Series are issued either to control the quality of materials examined by the Test and Inspection Branch or for reference in documents issued by other branches and relating to apparatus.

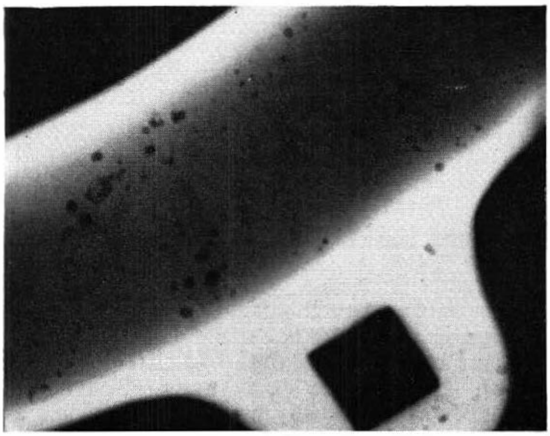
For many years the Postal Services Department has been advised about the risks from transmission by post of substances which might be corrosive, poisonous or flammable. Certain materials can be accepted if they are suitably packed; packing methods therefore often have to be considered.

Recently radioactive materials have been examined for the Postal Services Department; many industries are now using these in increasing quantities and the conditions under which they can be accepted for transmission by post have had to be defined. Considerable quantities of photographic film are posted for processing and exposure to quite low levels of radiation may fog it. Taking into account the length of time two parcels may remain near each other in a mailbag, it has been decided that to be acceptable the radiation, measured at any surface of the parcel, shall not exceed 10 millirads in 24 hours. Such a low level of radiation is harmless to staff and precautions in handling are not necessary. Apparatus for testing parcels has been assembled at Studd Street and efforts are being made to devise means of testing parcels at the office of posting.

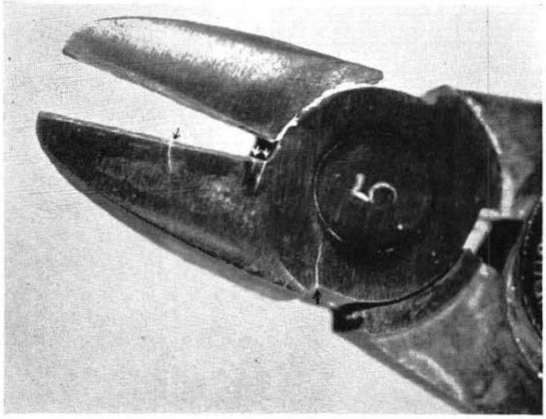
The following further examples of problems dealt with by the Materials Sections show the wide range of work covered.

When the new 700 type telephone was being developed, opportunity was taken to consider whether any advantages in price or performance could be obtained by using materials different from those previously used for the mouldings. The available materials were surveyed and an attempt made to assess their properties. It became evident that the choice lay between polymethyl methacrylate and high-impact polystyrene and eventually it was decided to use polymethyl methacrylate.

Corrosion frequently has to be investigated and many different causes have been found, such as aggressive soil waters, effluents, severe industrial and marine atmospheres, packaging materials, poor ventilation, bimetallic contacts, contact with chemicals, vapours from organic materials and microbiological decomposition of textiles. Apart



Radiograph of gasholes in cast iron



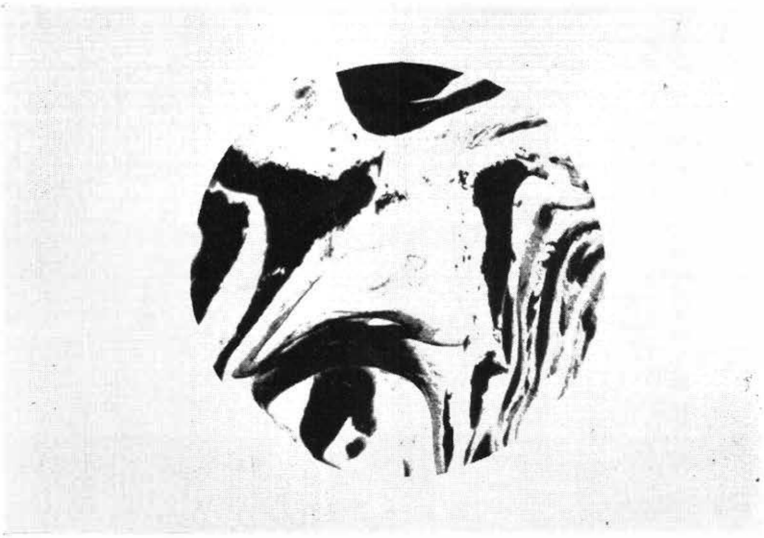
Diagonal cutting nippers showing cracks in jaws detected by magnetic method with fluorescence in ultra violet illumination (magnified 2½ times)

from general chemical attack and the development of pits from electrolytic action, troublesome film formation and growth may occur. Silver contacts and plating are prone to sulphide formation from atmospheric contamination and sometimes dendritic (branching) and tapered growths are found.

Alloys and finishes with improved resistance to corrosion are investigated. The nickel-chromium stainless steel notice frames in telephone kiosks are liable to pitting corrosion in industrial and marine atmospheres and molybdenum-bearing stainless steel is being investigated for this application. Hot dip "aluminizing" is being tested to determine its suitability for applying to line fittings.

Toughened glass was first used departmentally for the glass TELEPHONE signs (Glasses No. 47) at the top of kiosks. These were so much more robust than signs made of ordinary glass and lasted longer. The specification included a test for strength which consisted in dropping a steel ball on to a glass supported from beneath round the edges. Because of the good results obtained with Glasses No. 47 this material is now used for other purposes. The ball drop test was then adapted to other sizes and thicknesses of glass. Photographs were taken during the investigation, with the aid of Research Branch, and it was found that if a sheet of toughened glass does not stand up to the test the whole plate shatters within a millisecond of the impact of the ball.

Radiography is used in routine inspection, fault examination and design development. Samples may thus be examined internally without damage



Poor dispersion of carbon black in polythene (magnified 100 times)

and a permanent photographic record obtained.

An example of a fault found by radiography is the presence of gasholes in cast iron—cavities in the solid casting caused by gas evolved from the metal or from the mould. Fine cracks and laps are difficult and often impossible to find radiographically and a magnetic crack detection unit is used to find such defects.

Polythene—now used for cable sheaths—is subject to deterioration by ageing if exposed to strong sunlight and this may lead to cracking. It has been found that the addition of carbon black (2–3 per cent.) will prevent this. Not only must the correct amount be added, but the carbon must also be uniformly dispersed through the material; if it is unevenly dispersed parts of the sheath will be left without adequate protection and cracking may start at these points. In the early days of adding carbon black to polythene it was thought that mixing natural polythene with a master batch containing about 30 per cent. carbon in the extruder would ensure a suitable product. This process was found to give uneven dispersion and the use of a previously compounded material was necessary. Adequate carbon dispersion is tested by microscopic examination of a cross section about 1 mil. thick cut by a microtome. A properly compounded mix shows a uniform brownish colour by transmitted light, whereas improper mixing shows a varied pattern of black (high concentration of carbon), brown and white (natural polythene containing no carbon).

The Indicator Gas Leak No. 2 was introduced about 25 years ago for detecting very small quantities of coal gas or other gas containing carbon monoxide when present in underground structures. Carbon monoxide is detected by a change in colour of a spot of palladium chloride when exposed to gas. Originally this solution was one of palladium chloride in an acetone-water mixture containing some free hydrochloric acid. This was found unstable but stability was increased by using sodium chloride instead of hydrochloric acid as the stabilizing agent. A later development was the use of the double salt sodium chlorpalladite in acetone-water and this solution has been used for 10 years. All solution is now made and bottled by the Birmingham Materials Section, some 110,000 phials having been issued to date. Palladium from returned phials is recovered for further use.

In recent years advice has been given on the preservation of poles. One example is the examination of a fractured pole after an accident. The broken pieces are photographed to obtain a permanent record of the fracture and a section of pole away from the break is examined to determine the amount of residual preservative and to detect any areas of untreated sapwood. The broken ends are examined to find the type and extent of decay and an opinion is formed about the probable length of time since decay began. The results obtained may eventually have to be presented as evidence in a court of law.

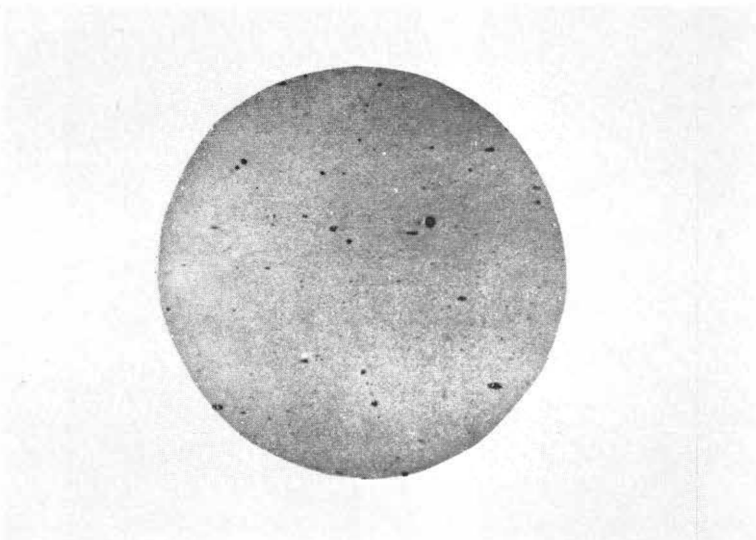
Samples taken from poles purchased for field trial—for example of new preservatives—are also examined both before and during the trial. This chiefly involves chemical assay of the quantity and distribution of the preservative used. The main difficulty lies in methods of sampling. Irregular absorption of preservative by the timber can easily cause the sampling error to exceed the errors involved in the chemical determinations. Poles which have been subjected to remedial treatments in the field are also examined. Because a standing pole cannot be pressure impregnated, re-impregnation usually means applying water-soluble preservatives which migrate into the timber by diffusion. Complete examination of such specimens involves sectioning at regular intervals followed by spraying with chemical reagents to detect the diffused preservative, photographing the stained sections to produce a permanent record, chemical estimation of the preservative in selected portions of the pole and checking the elimination of any decay originally present by culturing suitable pieces of pole on nutrient agar. This work involves techniques acquired from the study of chemistry, physics, timber technology, botany and microbiology.

Advice is also given in connexion with excavation and building. Examples are examinations of waters, effluents, soils, rocks, aggregates and cements. Trouble is sometimes caused by naturally occurring sulphates in soils—for example, the London Clay sub-soil. Sulphates may cause attack and disintegration of concrete. In high-sulphate areas high-alumina and sulphate-resisting cements are used but attack may still occur if they are not laid under proper conditions. A characteristic of sulphate attack is the formation of calcium sulphoaluminate which crystallizes with 31 molecules of water.

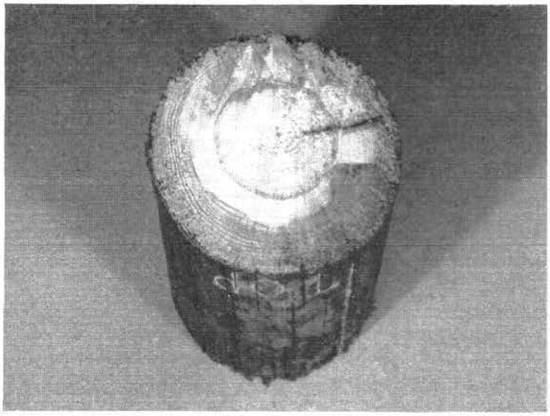
The Post Office uses various inks in addition to writing ink supplied by the Stationery Office. When ball-point pens came into common use, some inks faded when exposed to light and some spread so badly that the writing became indecipherable. For many Post Office purposes scripts have to be permanent; also, for security reasons, they should resist solvent action. In conjunction with a manufacturer, an ink was evolved which had the same order of resistance to light and solvents and spread as ordinary writing ink; this was approved for Post Office use.

Until 1950 proprietary inks were bought for use on various recording instruments. These were all glycerine-water-dye mixtures containing 15–30 per cent. glycerine. Some were not very satisfactory in performance and in 1952 Specification M 511—ink containing 7 per cent. glycerine—was issued for general use in recording instruments.

In 1956 a capillary type pen was introduced on certain decibelmeters and it was found that ink to this specification was not entirely suitable for use with the new pens as it had only a limited trough life. As a result of experimental work a new ink was introduced which contained ethylene glycol instead of glycerine. This gave satisfactory per-



Good dispersion of carbon black in polythene (magnified 100 times)



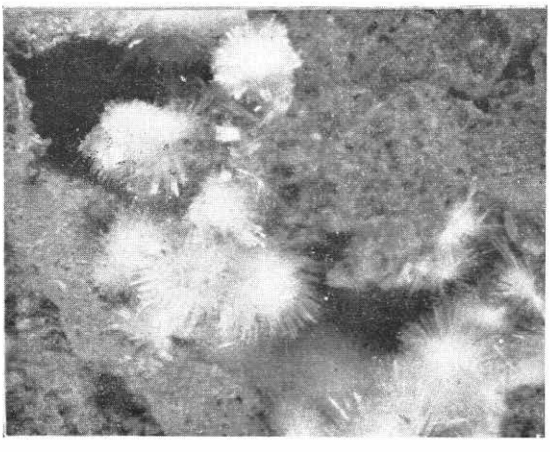
Pole section after chemical treatment to determine pattern of preservative penetration

Inner ring	Heartwood
Intermediate light area	Untreated sapwood
Outer dark area	Treated sapwood

formance in the new pens and the Post Office has taken out a patent for it.

Specifications have also been provided for use by the Supplies Department for stamp cancelling inks both for use with metal stamps (oil based) and with rubber stamps (glycerine based), and also for white ink for use with stencils.

This list of examples could be continued but enough perhaps has been said to indicate the wide range of the Materials Sections' work in their endeavours to apply the knowledge of materials to help the work of the Post Office.



Crystals of calcium sulphoaluminate in concrete after sulphate attack (magnified five times)

P.O. Telephone and Telegraph Society Programme 1959-1960

The Post Office Telephone and Telegraph Society of London opened its winter session on November 4 with an address on "Radio Astronomy" by Professor Ryle of the Cavendish Laboratory, Cambridge.

On November 30 Mr. L. G. Semple, C.B.E., Director, South Western Region will speak on "STD in Practice". On December 21 Mr. C. Powell, Decca Navigation Co. Ltd., will talk on the "Decca Navigator System". Mr. W. G. Busbridge of the Harwell Atomic Energy Establishment will speak about "Fission, Fusion and the Future", on January 26, and on February 29, Mr. J. K. Horsefield, Director of Finance and Accounts, will talk on "P.O. Financial Methods and Aims".

On March 22, after the Annual General Meeting, Col. D. McMillan, C.B., O.B.E., Director, External Telecommunications Executive, will close the session with an address on "International Telex".

All talks will be given in the Lecture Theatre of the Institution of Electrical Engineers, Savoy Place, W.C.2, beginning at 5.15 p.m.

Road Weather Service Resumed

The Road Weather Telephone Service reopened on October 1 until April 30.

Bulletins, compiled by the Automobile Association from regular reports sent in by their patrols when roads are affected by snow, fog, ice or flood, give road conditions in an area of about 50 miles from the centre of London, Birmingham, Leeds, Cardiff, Edinburgh and Glasgow, or about 50 miles around Manchester and north of Liverpool.

Last year 273,652 telephone calls were made to the eight centres.

The Post Office stand at the Radio Show included an enlarged model of a mould used to give the internal shape to a special waveguide element capable of changing a particular configuration of electromagnetic wave in a rectangular guide into a different shape in a circular guide.

Such a device is a small but essential part of research equipment with which investigations are being made into the possibility of transmitting vast numbers of communication channels through hollow metallic pipes.

Charging for STD Calls

H. A. Longley

The rendering of telephone bills to Bristol Central Exchange subscribers last March, the first to be rendered since Subscriber Trunk Dialling equipment was installed in December 1958, *marked a new epoch in the telephone history of the United Kingdom. Group charging (described in the Winter* 1958 Journal) *and the STD tariff, "The Twopenny Telephone", have brought about a complete revolution in telephone call charging, comparable in importance with "Penny Post" in* 1840 *and pregnant with as far-reaching consequences.*

In this—the sixth article in our STD series—Mr. Longley tells the story of the development of the call-charging methods for the new system.

When all trunk calls are connected by operators and recorded separately on tickets the assessment of the charge for each call is a clerical process. This gives the planner of a trunk call tariff for a manual system a good deal of freedom. But when trunk calls are dialled the choice of a tariff can have important effects on the design of the equipment and the economics of the system.

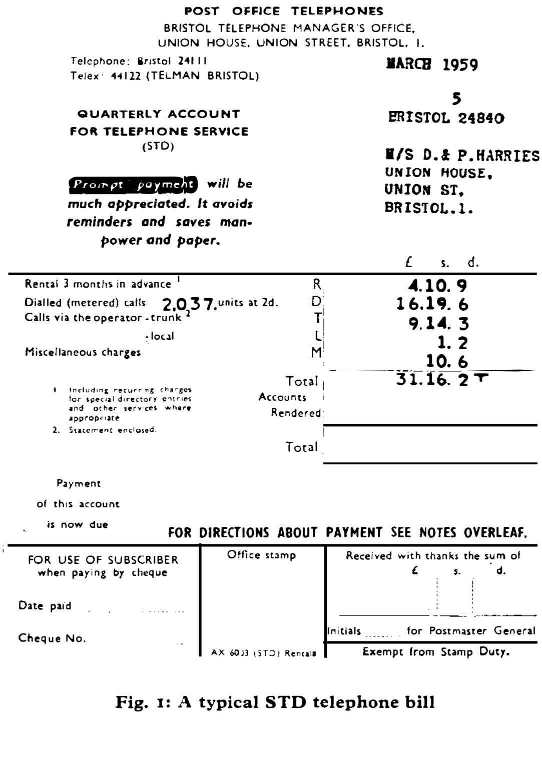
Automatic machines which produce a detailed documentary record of each dialled call are possible, but they are complicated and expensive. Moreover, their use has the disadvantage to the subscriber that the need to recover the cost of the machines and bring the individual calls to account tends to perpetuation of a tariff similar to that of the manual system with its three-minute minimum charge. For these reasons the Post Office decided that in the STD system of the United Kingdom the charges for dialled trunk calls should be recorded on the meters used hitherto for local calls.

Bulk Billing

The bills sent to the Bristol Central subscribers this year were the first in this country to include charges for long distance calls in terms of metered units, without their being listed, as hitherto, on a statement showing the date and charge for each call. This was a big step forward, continuing a process which began many years ago.

Before 1921 all calls of more than five miles chargeable distance were trunk calls; they were therefore timed and itemized on the subscribers' bills. In 1921 calls of 5–7½ miles chargeable distance were recorded as 2-unit calls and bulked with the one-unit local calls; they were of course untimed. The next step was in 1934 when, for automatic multi-metering, calls up to 15 miles were similarly treated, being recorded as 3- and 4-unit calls. A further step was taken in January 1958 when group charging was introduced and the local call area was extended to an average of 17½ miles radius at the same time as a single-unit charge of 3d. was adopted for all local calls. The Bristol bills were thus the culmination of a long process moving towards bulk billing of inland call charges.

The next major step will undoubtedly be to bring some continental call charges into the same


POST OFFICE TELEPHONES
BRISTOL TELEPHONE MANAGER'S OFFICE,
UNION HOUSE, UNION STREET, BRISTOL, I.

Telephone: Bristol 24111
Telex: 44122 (TELMAN BRISTOL)

MARCH 1959

5
BRISTOL 24840

QUARTERLY ACCOUNT
FOR TELEPHONE SERVICE
(STD)

M/S D.& P.HARRIES,
UNION HOUSE,
UNION ST,
BRISTOL.1.

***Prompt payment* will be much appreciated. It avoids reminders and saves man-power and paper.**

		£ s. d.
Rental 3 months in advance [1]	R	4.10. 9
Dialled (metered) calls 2,037 units at 2d.	D	16.19. 6
Calls via the operator - trunk [2]	T	9.14. 3
- local	L	1. 2
Miscellaneous charges	M	10. 6
Total		31.16. 2 T
Accounts Rendered		
Total		

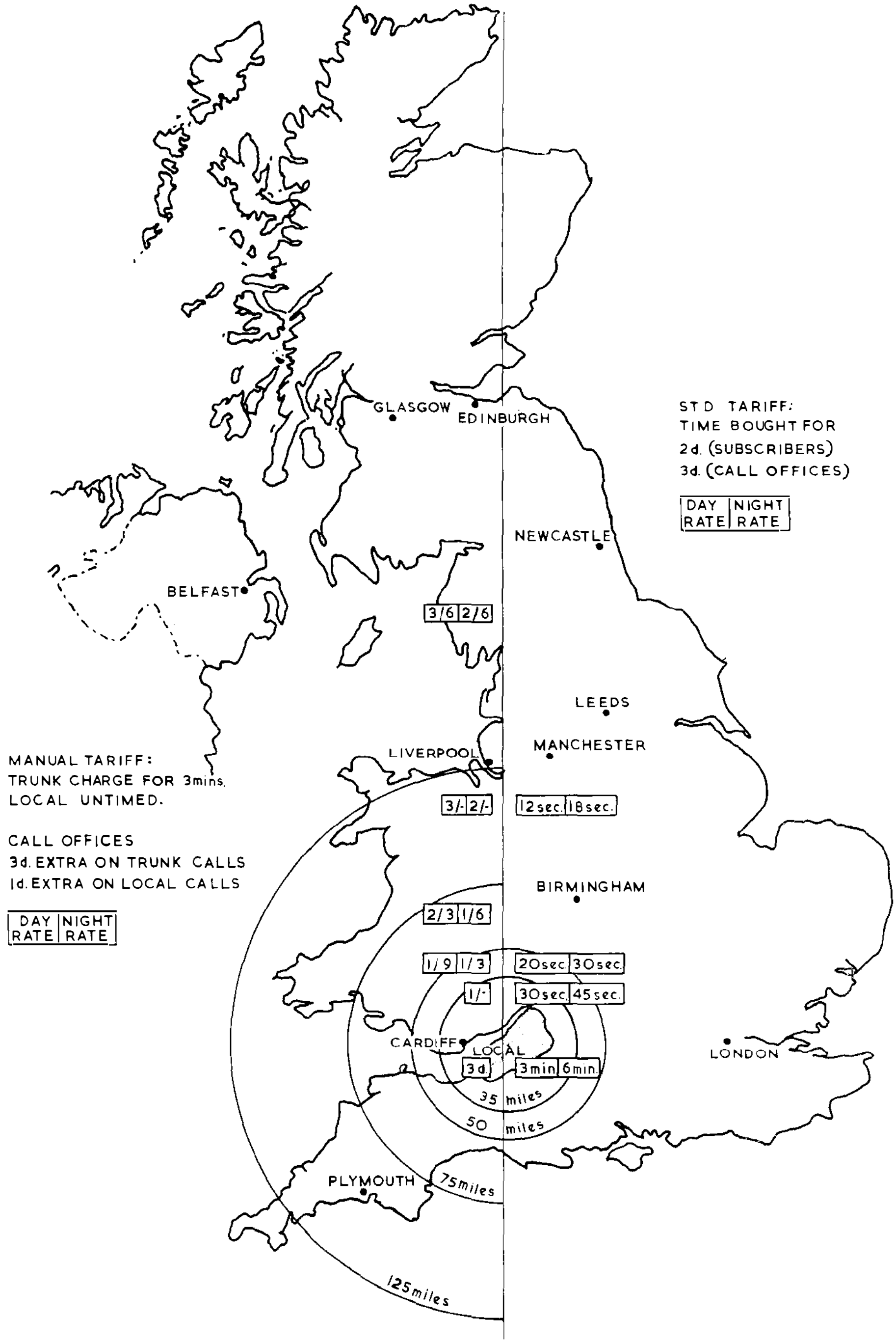
1. Including recurring charges for special directory entries and other services where appropriate
2. Statement enclosed.

Payment of this account is now due

FOR DIRECTIONS ABOUT PAYMENT SEE NOTES OVERLEAF.

FOR USE OF SUBSCRIBER when paying by cheque	Office stamp	Received with thanks the sum of £ s. d.
Date paid		Initials ...... for Postmaster General
Cheque No.	AX 6033 (STD) Rentals	Exempt from Stamp Duty.

Fig. 1: A typical STD telephone bill


GLASGOW
EDINBURGH
NEWCASTLE
BELFAST
LEEDS
LIVERPOOL
MANCHESTER
BIRMINGHAM
CARDIFF
LOCAL
LONDON
PLYMOUTH
STD TARIFF:
TIME BOUGHT FOR
2d. (SUBSCRIBERS)
3d. (CALL OFFICES)
DAY RATE | NIGHT RATE
MANUAL TARIFF:
TRUNK CHARGE FOR 3mins.
LOCAL UNTIMED.
CALL OFFICES
3d. EXTRA ON TRUNK CALLS
1d. EXTRA ON LOCAL CALLS
DAY RATE | NIGHT RATE
3/6 | 2/6
3/- | 2/-
12sec. | 18sec.
2/3 | 1/6
1/9 | 1/3
20sec. | 30sec.
1/-
30sec. | 45sec.
3d.
3min | 6min.
35 miles
50 miles
75miles
125miles

scheme, and meter them with inland charges. There is as yet no saying where the process will end.

Timing of Local Calls

The Bristol bills were the first ever to include charges for local calls on a "time-unit" instead of a "call-unit" basis. It is interesting that in 1934, when a high-level committee recommended metering of three and four-unit calls, they also said that untiming had probably gone far enough, and suggested that on the next major revision of call charges the question of timing all calls, including local calls, might well arise. The White Paper of May 1958, *Telephone Policy—The Next Steps*, announced that "in STD areas all calls will be timed whether dialled by the subscriber or connected by the operator." Economically this system is fair and sound because the cost of dialled calls is proportionate to their duration. Those who habitually make short duration calls have really been paying more for their local calls because others—who make long calls—have been getting them at the same price. Long telephone conversations also lead to wasted effort by callers on ineffective calls to engaged lines, and to queues outside call offices. The extension of the local call area to its present size made it especially desirable and urgent to reintroduce charging on a time basis, and an exhaustive examination of the problem showed that the fairest, cheapest and soundest method of achieving this was to time all, including local, calls.

Three other important advantages that flow from the timing of local calls are:

(*a*) The unit charge is reduced from 3d. to 2d. A subscriber who can keep his conversations to three minutes or shorter can thus reduce his bill for local calls by 33 per cent.; alternatively, he can have 50 per cent. more local calls for the same outlay as before. Under similar conditions the revenue from the charge of 2d. for three minutes is the same as the revenue from 3d. untimed, so that overall, the cost to the public of local calls should not increase under the new system. A charge of 2½d. for five minutes would have produced about the same revenue but was considered less attractive on balance than the charge adopted.

(*b*) A cheap evening and night rate is, for the first time in history, applied to local calls by increasing from three minutes to six minutes the time allowed for 2d. after 6 p.m. (2 p.m. on Sundays). This should be a valuable concession to residential subscribers (who make about a quarter of their local calls in the evening), affording them a further opportunity to reduce their bills. It also achieves, for the first time, the economic advantage that an inducement is offered to subscribers to avoid making local calls in the busy hours of the day when almost all the costs of automatic telephone service are incurred. If subscribers respond by transferring some of their local calls to the evening, an important saving in local telephone service costs may be realized.

(*c*) The unit charge of 2d. can remain fixed, virtually for all time, because any adjustment of tariff can in future be made by lengthening or shortening the time unit according to whether less or more revenue is required. This has a special importance in relation to trunk calls and to coin-box working, as will be seen later.

Some people who have the habit of long telephone conversations will not welcome local call timing. However, a questionnaire sent to Bristol Central subscribers after their bills had been despatched revealed that about 75 per cent. either welcome local call timing or accept it on the whole having regard to the reduction in the unit from 3d. to 2d. This is a remarkably satisfactory verdict for the early days of such an innovation. Nearly 80 per cent. of Bristol STD subscribers' local calls are going through at 2d. The questionnaire revealed some impatience among STD subscribers at delays in completing their calls to extensions at PBXs and this subject is going to receive much special attention in future.

Lower Trunk Call Charges

The bills sent to Bristol STD subscribers in March must surely be unique since the war in reflecting a substantial reduction in the prices charged for a public service. This reduction was made possible by the savings in operating costs when subscribers dial their own calls. It was effected in two ways:

(*a*) The overall level of charges was lowered so that the charge for a three-minute call was reduced on most trunk calls as follows:

Fig. 2 (*opposite*): **Telephone call tariffs**

	Day rate		Night rate	
	Proportion of calls	Change in charge	Proportion of calls	Change in charge
Trunk calls up to 35 miles	48%	Nil	31%	−33%
,, ,, 35– 50 miles	13%	−15%	13%	−20%
,, ,, 50– 75 miles	11%	+11%	14%	−11%
,, ,, 75–125 miles	13%	−17%	17%	−17%
,, ,, over 125 miles	14%	−30%	25%	−33%

The increase in the 3-minute charge for a 50–75 mile call was a consequence of combining the last three steps of the manual tariff to reduce the STD charge steps to three; because of the effect of periodic metering, however, the higher charge applies only to calls that happen to terminate in the last 12 seconds of a 3-minute period, calls of any other duration being cheaper, or no dearer.

(*b*) The 3-minute minimum charge was withdrawn by the introduction of periodic metering for trunk calls; this represents a saving to the subscriber, which is additional to that shown in the table and which varies with the time unit and the distribution of durations in each charge step; the average saving to the subscriber from periodic metering on trunk calls is estimated to be 13 per cent.

The combined effect of the lower level of charges and periodic metering represents an average reduction of about 25 per cent. on the standard charges for manual trunk service.

At the same time as the charges are reduced by the STD service, the quality of service is improved; 90 per cent. of the Bristol subscribers who answered the questionnaire preferred the new system to the old, and—even more surprisingly—25 per cent. implied that the quicker service given by STD was more important to them than a reduction in charges. This can be no reflection, however, on the manual service which STD replaces, and which by any standard is as good as its kind anywhere in the world.

The Twopenny Call

The most striking feature of the new charging system is that a call of any distance can be made for 2d., the time allowed varying with the distance and time of day. In conjunction with local call timing it turns the telephone system into a unified whole in which, so far as charging is concerned, the difference between local and trunk calls virtually disappears.

This feature of the tariff will, it is to be hoped, act as a stimulus to telephone traffic. Meter readings and service observations show the tendency of Bristol subscribers to make more calls than before and to have shorter conversations, and this is reflected in their bills. The early trend has continued as regards numbers of calls, but there are now signs that conversations are tending to become longer; the bills for the first three quarters show that the effect on revenue of the reduction in charges has been more than offset by increased use.

The STD bill shows the price of the unit, and the number of metered units made in the quarter; both these features were innovations. Each call contributes one or more units to the total according to its duration, distance and time of day; a 6-minute local call at night would contribute one unit whereas a long distance call of the same duration in the day would contribute 30 units (see Fig. 3). Obviously the number of metered units on a bill can range from being equal to, or many times, the number of calls made, according to the subscriber's calling habits. To cope with the great increase in metered units for heavy trunk users a 5-digit exchange meter, with ten times the capacity of the existing meter, was provided on the busier lines.

Periodic Metering System

Many different methods of periodic metering were examined before the present system was adopted. The choice depended on engineering possibilities, their relative costs, and the degree of precision that was regarded as tolerable. Present automatic apparatus is designed to cause a meter operation when the called party answers. A timing device could have been associated with each call which could ensure subsequent periodic meter operations with any degree of precision that might be desired, but this would have been unduly expensive.

The alternative is to depend for periodic meter operations on taking electrical pulses from a common pulse-generating machine after the start of the call. If meter pulses subsequent to that on answer are taken direct from the pulse generating machine, a second meter operation may occur immediately after the first or at any time during the first pulse interval. On a local call, if this method were adopted, it would be fortuitous whether the charge for a call of up to nearly three minutes was two units or one. This system of periodic metering is the cheapest to provide, but with such a system it would be necessary that the advertised tariff should specify that the charge is two units for the initial pulse interval and one for subsequent intervals.

A minimum charge of one unit is obviously specially attractive to the telephone using public, and various ways of catering for this are available. For example, the initial periodic pulse may be suppressed—that is, prevented from reaching the meter—or the pulses may be generated at a rate several times that required and a counting device may be inserted that allows only one-in-so-many pulses to reach the meter. These two methods are exemplified in the system used in two other countries, Sweden and Germany, that have adopted periodic metering. In the system used in Sweden the first periodic pulse only is suppressed; in Germany, the counting device allows every sixth pulse to operate the caller's meter. The Swedish arrangement favours the subscriber, who may get a call lasting twice the advertised period for one unit; the German system may result in a 2-unit charge for a call that is short of the advertised minimum period.

The Post Office decided that its own system should admit of no infringement of the time a caller would reasonably expect from the advertised tariff, and, on the other hand, that it should have as high a degree of precision as could be provided without great expense. Precision was thought important in view of the supply of meters to subscribers.

The method adopted is slightly different for local calls and trunk calls. For local calls pulses are generated 10 times as fast as required for meter operation (at 18-second intervals in the day and 36-second intervals in the night period). A counting device then allows every eleventh pulse after the pulse-on-answer to operate the meter (see Fig. 4(A)). In the daytime, therefore, the first periodic

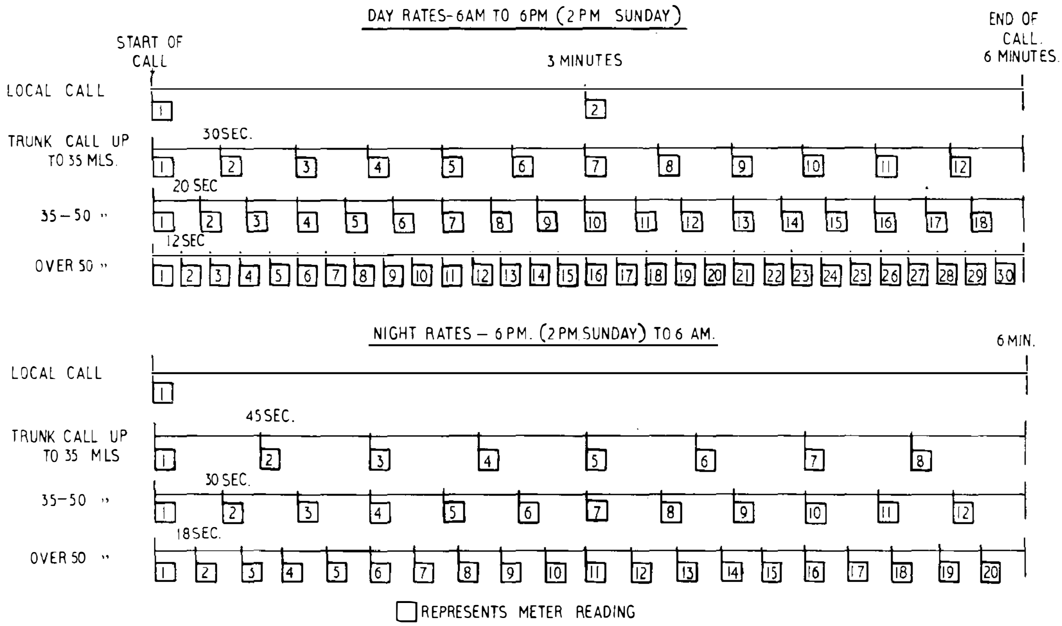


Fig. 3: Periodic metering rates for 6 minute calls

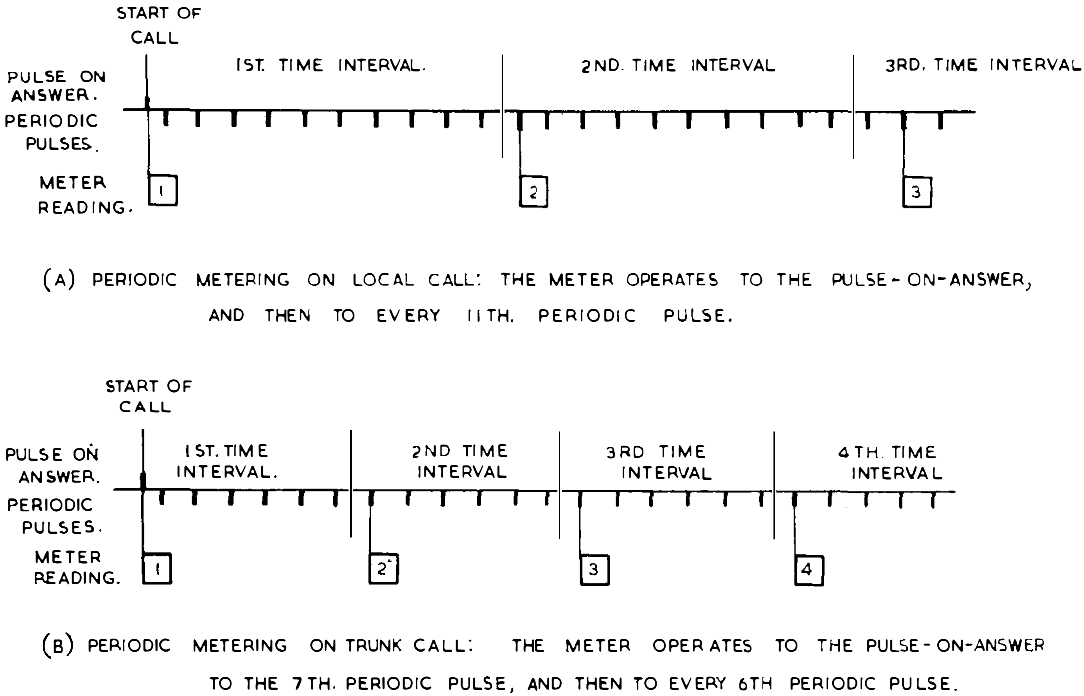


Fig. 4: The two periodic metering methods

meter operation occurs from 180 to 198 seconds after the start of the call and subsequent operations at 198 second intervals. There is thus no encroachment on the time that should be allowed for the first unit and, in fact, the meter operates slightly later for every subsequent three minutes (or six minutes) of a conversation. A daytime local call of 30 minutes costs therefore, not 1s. 8d. as might be expected from the advertised tariff, but 1s. 6d. This feature is introduced in the interests of economy, as equipment for timing local calls (over 90 per cent. of the total) must be installed at every exchange and would be appreciably more expensive if more precise, but the proportion of long duration calls is too small to justify the additional outlay to secure greater precision on their timing.

For trunk calls pulses are generated at six times the rate required for meter operation and the counting device used allows the seventh periodic pulse after the start of the call to operate the meter and thereafter every sixth pulse operates the meter. Thus, though the interval allowed for the first unit may be up to 17 per cent. more than the advertised period, subsequent intervals are exact (see Fig. 4(B)). The more precise and therefore more expensive timing equipment for trunk calls is installed only at group switching centres—perhaps 7 per cent. of the exchanges in the country; it is justified by the shorter pulse intervals on trunk calls, any inherent lengthening of which would give rise to significant undercharging. Hence on a daytime call of over 50 miles the first charge unit will buy 12 to 14 seconds but subsequent units will buy exactly 12 seconds; on a trunk call under 35 miles at night the first unit will buy 45 to $52\frac{1}{2}$ seconds, subsequent units buying exactly 45 seconds.

The four methods of periodic metering discussed above are compared diagrammatically in Fig. 5.

Local calls made by dialling the national code will be timed in accordance with the trunk-call system of metering; the first interval between meter operations in the daytime will therefore be from 180 to 210 seconds, subsequent intervals being 180 seconds.

Under the manual system call charges can be changed literally by a stroke of the pen. When call charges are recorded automatically however the degree of flexibility that may be needed for future adjustments of the tariff must be built into the apparatus.

Cheap Night Rates

There seems always to have been a cheap evening or night rate for trunk calls, but the Bristol STD bills were the first to reflect a cheap night rate for the whole range of call charges. The cheap rate for local calls allows double the time for each unit while that for trunk calls allows 50 per cent. more than the day rate The object of cheap rates being to attract traffic to slacker periods and so use plant that would otherwise be idle, the inducement must obviously be proportionately greater the smaller the charge involved, but should not be so large as to create a cheap rate peak necessitating provision of additional plant. Hence, though the day and night pulse intervals for STD trunk calls are now all in the ratio 2:3, this ratio will not necessarily be permanent; it may not always be the same for all steps in the tariff. To give the degree of flexibility needed, and to provide for any other tariff adjustments in the future, the arrangements provide for day and night rates to be independent selections from a range of pulse rates provided from a pulse-generating machine. Provision is also made for a third, intermediate, rate if this should be required. The pulse-generating machine is arranged to provide 20 different pulse intervals, so chosen that the advertised time allowed for a unit charge can always be a round or fairly common number.

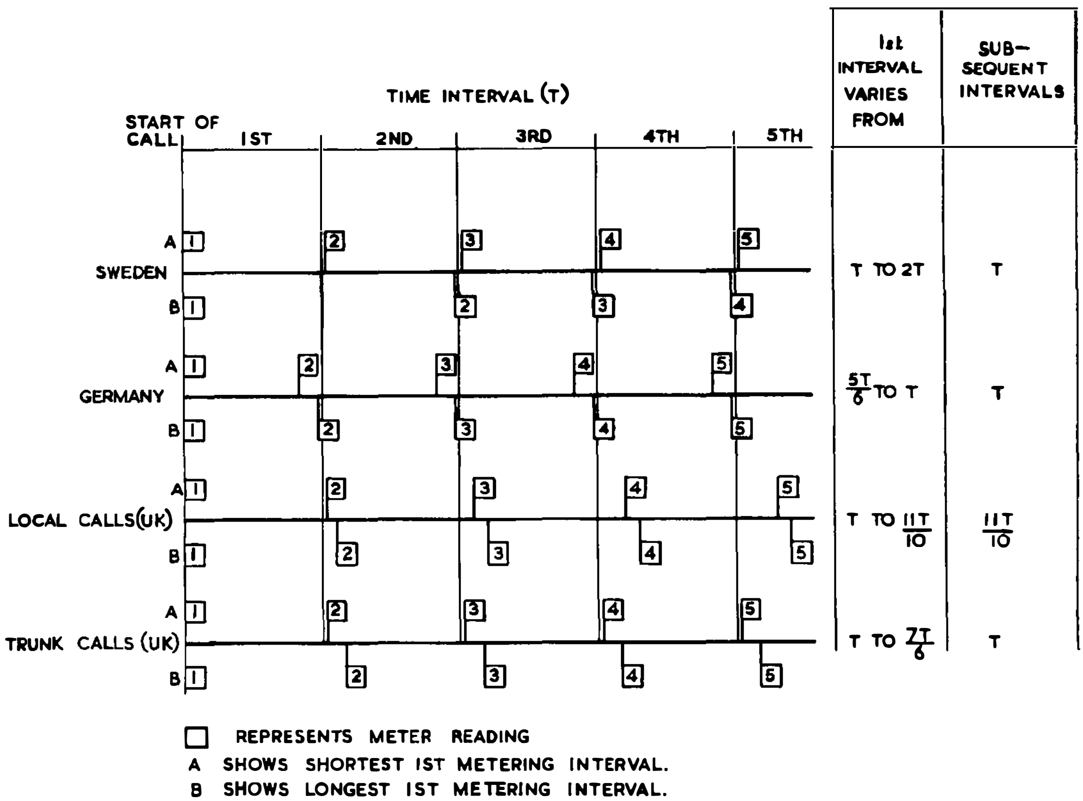


Fig. 5: Range of variation of different periodic metering systems

Under the manual system a call is charged for its whole duration at the rate that applies when it is connected; a 5-minute call set up at 5.58 p.m. on a week-day will be charged at the full rate although it extends into the cheap rate period. The reverse applies when the charge reverts from the cheap to the full rate at 6 a.m. With periodic metering the arrangements are different; such a call would be charged at the full rate for the first two minutes and at the cheap rate for the last three minutes. Safeguards incorporated in the equipment against over-charge at the change-over have the effect of slightly advancing the application of cheaper rates and slightly deferring the application of higher rates. Devices are incorporated that continuously check the pulse supply; means are also provided whereby engineers and operators can readily check the correctness of the meter-pulse rates.

The Bristol bills were the first since the war to include cheap rate charges over the Christmas holiday. With the extension of STD cheap rates might be given on public holidays without giving rise to staffing problems. A degree of flexibility to enable tariff changeover times to be altered when required has therefore been incorporated in the exchange apparatus.

Subscribers' Private Meters

STD has brought with it the novelty that subscribers may rent meters to be fitted at their premises. Their main purpose is to replace the "advise duration and charge service", which enables hoteliers and others to collect charges from customers. For this purpose the meter gives the number of units consumed on a given call, but it also gives the total recorded units because some subscribers need this information for internal accounting purposes—for example, allocating costs between subsidiary companies. Hence, for the first time, some subscribers at Bristol have a reliable means of checking their bills if they wish to do so, but since STD started the proportion of queries from Bristol Central subscribers about metered call charges has so far been appreciably lower than previously.

In all telephone bills (other than STD) an aggregated total charge for metered calls and manually-handled local calls is shown; if this were done on the STD bills, subscribers with meters would find the total shown on the bill consistently higher than the total recorded on their own meter, and they would be led to question the charges. A new item has therefore been added to STD bills so that charges for local calls through the operator can be shown separately from those for metered calls.

Calls Through the Operator

At present Bristol Central subscribers must continue to obtain about 40 per cent. of their trunk calls through the operator; this will be reduced to 20 per cent. early next year and the remaining calls will become diallable as automation proceeds. In addition to calls which STD subscribers cannot dial either because dialling access is not yet provided or because the terminal or intermediate exchanges are still manual, there are some types of call which may always need manual connexion:

(*a*) Personal calls and transferred charge calls. (There may always be a demand for these types of call but the STD system greatly reduces the need because a subscriber can for a few pence make a call to find if the person he wants is available or arrange for him to ring back, and this is likely to be appreciably cheaper than the normal personal or transferred charge call service.)

(*b*) Special services additional to (*a*), for example, the Freefone service.

(*c*) Calls on which the subscriber wishes to have a record of the charges.

(*d*) Calls on which difficulty has already been experienced in dialling and which are required urgently.

(*e*) Continental and overseas calls.

For all these calls the standard manual charges are still made; they are itemized on the subscriber's trunk statement, with further details of destination and duration (at a small additional charge) if the subscriber wishes. It is, of course, an innovation to have different charges for calls over the same distance according to whether they are dialled or manually handled. The policy in this matter is:

(*i*) to pass to the subscribers who dial their trunk calls the monetary savings thereby effected;

(*ii*) to continue at economic rates all the manual board services now available; in fact to improve these services whenever possible, as for example, with the recent "Friendly Telephone Campaign" and the credit-card system shortly to be introduced.

The popularity of this policy is shown by the fact that Bristol subscribers are dialling 97 per cent. of the calls to exchanges that can be dialled. The

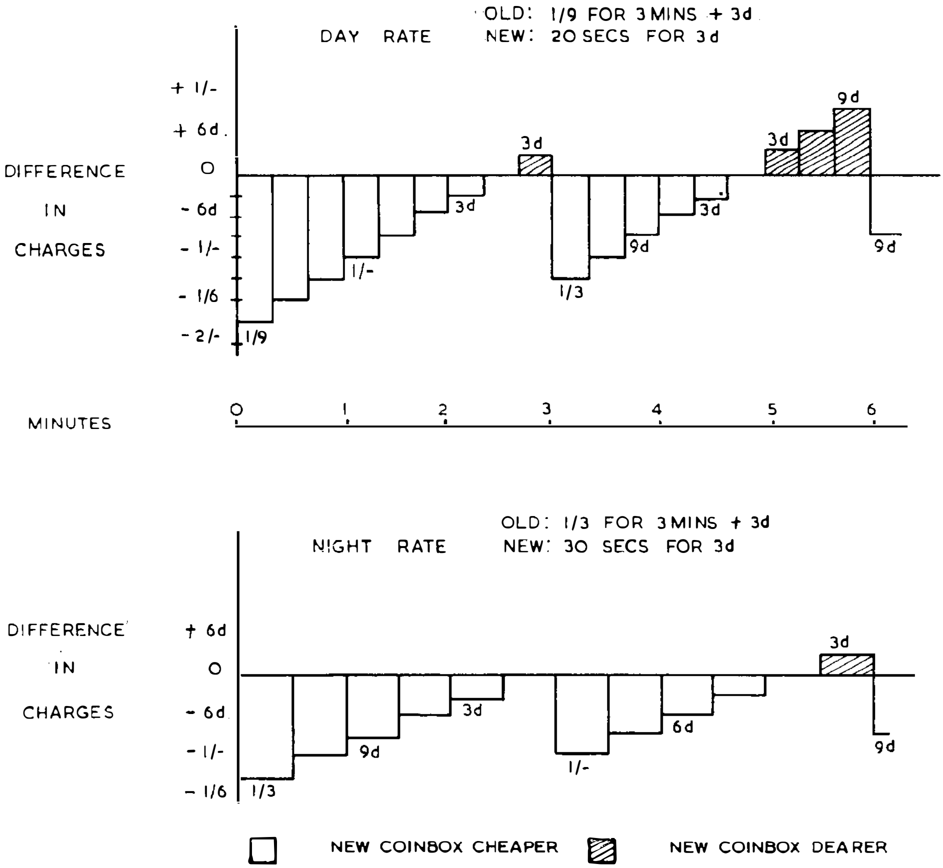


Fig. 6: New coin-box charges compared with the old for calls up to 6 minutes in 30-50 mile charge step

number of their calls manually-handled and itemized on their trunk statements is therefore practically at the minimum possible in present circumstances.

Local calls through the operator are not charged at the standard manual tariff but at the new STD rates. This was imperative, otherwise a subscriber could choose to dial his short calls at 2d. each, while making his long duration calls through the operator at 3d.

Timing Signals

On calls through the operator subscribers will continue to hear the time-signal "pips" at 3-minute intervals, but on dialled calls in STD areas there are no time signals. Years ago when trunk lines were few and delay working was common, calls were charged in 3-minute periods, and it was the practice at the end of each 3-minute period to offer the caller an extension. At that time a 400-mile call cost 8s. 6d., equivalent to perhaps 25s. at present prices. Extensions of time in one-minute steps were introduced in 1929, and when demand working came in the early '30s, the practice was changed and the operator entered circuit merely to announce that three minutes had elapsed. As a further improvement the operator's announcement was replaced in 1936 by the now familiar "pip" signals, which are applied a few seconds before the 3-minute period ends.

Only the United Kingdom has used these pip signals. Their purpose is to warn a subscriber to finish his conversation if he wishes to avoid an extra charge, but this need would not be met by arranging for pips in time with the meter operation; moreover such an arrangement would be costly to provide and would be irritating to subscribers particularly on long-distance calls. The most important point is that as only a 2d. charge is added for each interval of conversation the subscriber does not have to decide whether what he has left to say is worth a substantial further sum. The additional expense of providing pips on STD calls was not therefore incurred.

STD Coin-Box Charges

The new "pay-on-answer" coin-box now in use in the Bristol Central Exchange Area will be standard for public call offices and coin-box subscribers in STD areas. Mr. Leaver described this coin-box in the Autumn *Journal.*

All calls from the new coin-box are timed. In place of the present charge of 4d. (untimed) for a local call, callers pay 3d. for three minutes in the daytime and 3d. for six minutes at night and on Sunday afternoon. A threepenny bit, a sixpenny or a shilling piece may be used to make a local or trunk call, the time allowed being adjusted automatically. For trunk calls also the same time intervals apply as for ordinary STD subscribers' calls, the unit charge being 3d. instead of 2d.

Coin-box charges are inherently tied to the coinage, and it was especially important—following the decision to adopt the threepenny bit as the lowest valued coin that can be inserted in the box—to have a means of adjusting the tariff without altering the unit charge. Local call timing also met the public demand for some restraint on long duration calls from call offices. Common pulse rates for ordinary and coin-box lines imply, of course, that if it should be necessary at some future time to raise additional call revenue, more frequent insertion of coins—or the more frequent use of larger value coins—would result from the shorter pulse intervals that would be used. The public reaction to this would no doubt depend on the circumstances: if, for example, the need to raise charges was part of an inflationary trend, other articles or services which now cost 3d. would cost more, and the public would doubtless appreciate the maintenance of the minimum local call charge at 3d., even if the time allowed were shorter.

The new coin-box is more expensive to produce than the old one, and it needs additional equipment at the exchange. The extra costs tend to offset the operating savings and it has therefore not been possible to reduce the overall level of charges for dialled trunk calls from coin-boxes as for ordinary subscribers' STD calls. The new scale of charges is in fact calculated to produce approximately the same revenue as the manual tariff from call office calls of the same average duration. The need to insert coins at intervals is however likely to affect the duration of calls, while the advantage of being able to make cheap, short duration calls over any distance may stimulate new traffic. The overall effect on revenue remains to be seen.

A casual comparison of the charges for a three-minute call from the new and old coin-boxes may give the impression that the new tariff is generally higher, but this overlooks the effect of charging in small units of time which shows considerable saving on short duration calls or calls extending just beyond a multiple of three minutes. This effect is illustrated in Fig. 6.

The table below shows for calls up to five minutes in all charge steps how the new charges are often lower (—), sometimes the same and sometimes higher (+) than the old charges.

On 80 per cent. of the charges shown in the table the new coin-box charge is the same as the old or cheaper. The tendency is however for longer duration calls in the daytime to be dearer. Calls in the cheap rate period are almost invariably cheaper with the new box, and one-third of all trunk calls

Duration	Day rate 1 min.	2 min.	3 min.	4 min.	5 min.	Night rate 1 min.	2 min.	3 min.	4 min.	5 min.
Local	−1d.	−1d.	+1d.	+2d.	+2d.	−1d.	−1d.	−1d.	−1d.	−1d.
Trunk—35 miles	−9d.	−3d.	+3d.	−3d.	−3d.	−9d.	−6d.	−3d.	−9d.	−6d.
,, 35– 50 miles	−1/3	−6d.	+3d.	−9d.	same	−1/-	−6d.	same	−9d.	−3d.
,, 50– 75 miles	−1/3	same	+1/3	+3d.	+1/6	−9d.	same	+9d.	+3d.	−1/-
,, 75–125 miles	−2/-	−9d.	+6d.	−1/3	same	−1/3	−6d.	−3d.	−9d.	same
,, over 125 miles	−2/6	−1/3	same	−2/3	−1/-	−1/9	−1/-	−3d.	−1/9	−1/-

Preparing the first STD accounts at Bristol Telephone Manager's Office

from coin-box telephones are made in the cheap-rate period.

The coin-box telephone caller is, however, less interested in the charge for three minutes, and the time allowed for the unit charge, than in the amount of time allowed for different numbers and kinds of coins. The charges are therefore to be presented to coin-box users in the following style:

	Minutes for					
	3d.	6d.	1s.	2s.	3s.	5s.
Up to 35 miles ...	$\frac{1}{2}$	1	2	4	6	10
35 to 50 miles ...	$\frac{1}{3}$	$\frac{2}{3}$	$1\frac{1}{3}$	$2\frac{2}{3}$	4	$6\frac{2}{3}$
Over 50 miles ...	$\frac{1}{5}$	$\frac{2}{5}$	$\frac{4}{5}$	$1\frac{3}{5}$	$2\frac{2}{5}$	4

Timing starts when the initial period of pay-tone ends on the insertion of a coin, and conversation can then begin. Conversation may be continued during any subsequent 3-second interval of pay-tone, indicating that the time paid for has run out. During the insertion of each coin there is, however, a short interruption of speech, and the coin-box system is designed to allow a credit of one second for each coin insertion after the first, this time being added to the total time allowed. The coin-box charges (and the above comparisons of charges) take no account of the 12 seconds extra time allowed after the time paid for has expired, to enable the conversation to be finished; this time is free of charge.

About half the coin-boxes in this country are fitted in subscribers' premises. The subscribers pay a special rate for the calls and keep the difference between this charge and the money inserted as a set off for the rental of the box. The difference between the charge to the coin-box subscriber and that to the coin-box user has varied considerably over the years. With the old coin-box it stands at present at $\frac{1}{2}$d. on each local call ($12\frac{1}{2}$ per cent. of the money inserted in the box); there is also a rebate of 1d. on trunk calls (perhaps 3 per cent. of the trunk charges). Subscribers with the new coin-box will be charged 2¾d. a unit, which means that the subscriber will retain 8 per cent. of the money in the box; this is estimated to produce, at current traffic levels, about the same average return to the coin-box subscribers as the old charges. Apart from this, coin-box subscribers will be billed in the same way as ordinary subscribers.

Quarterly Staggered Billing

Since 1939 telephone bills have been rendered half-yearly, and in spite of public demand we have been unable to revert to the pre-war quarterly system because of the extra staff and accommodation that would be needed. The reduction in ticket handling work resulting from the metering of trunk calls has reduced the work of preparing Bristol subscribers' bills and provided the necessary margin for a changeover to quarterly billing. These bills were thus the first to be rendered quarterly for twenty years. All subscribers will now have the benefit of quarterly bills from the time they get Subscriber Trunk Dialling.

Telephone bills have hitherto been rendered in January, April, June and October, after the meter readings on or about quarter-day, but all dispatches will shortly be staggered in preparation for mechanical accounting. The Bristol STD bills rendered in March covered the three months ending in February, and were in fact the first staggered telephone bills to be rendered in this country.

The Bristol Central subscribers have now received and paid three quarterly bills under STD conditions. They are making 45 per cent. more calls to places that can be dialled and, rather surprisingly, 30 per cent. more to places that cannot be dialled. Despite this only 18 per cent. of them said, in reply to the questionnaire, that the bills were more than they expected; 53 per cent. said they were about what they expected and 12 per cent. less than they expected. Surely a rare comment in these days!

The indications are that the STD charging system which was the end product of several years of study by Post Office telecommunications staff of all ranks in many departments has made a good start in this country.

How Rompin went on the Telephone

A MINE IS BRINGING PROSPERITY TO THE little known village of Rompin in the State of Pahang, Malaya, and to help this happy state of affairs along, British, Australian and Gurkha soldiers have brought Rompin into telephonic communication with the "outside world".

Until two months ago, many of the villagers had little or no idea what a telephone looked like. If they wanted to use one, they had to travel 17 miles to Endau, Johore, and cross two rivers on the way.

Now Rompin has its own exchange, a small automatic type with 25 lines linked with the Endau exchange.

Providing this link was quite a problem for the Telecommunications Department of the Federation of Malaya, and they appealed to the Commonwealth Forces for help. The civilian concern had money and materials—but not men.

On the practical side of the project, there were many obstacles: some large, others small. The larger ones, in the shape of the rivers Endau and Pontian, were the cause of "brain-racking" moments, but the Army decided that, despite all difficulties, the job was a good one to tackle.

There was an opportunity to help the civilians; an appealing chance of providing the soldiers with invaluable and out-of-the-ordinary training; and a means of testing the ability of the different types of soldiers to work together.

Overseas Commonwealth Land Forces Signal Squadron (Royal Signals), 28 Commonwealth Brigade Group Signal Squadron (Royal Signals and Royal Australian Signals), and the Gurkhas from 17 Gurkha Division Signal Regiment took on the job. Two officers and 40 men began the operation with the British, Australian and Gurkha contingent camping under canvas at Endau. The 20-strong Gurkha party later moved to Rompin. "Signals Detachment, Endau"—as the group was named—was led by Captain R. Plant, Royal Signals, aided by Lt. P. R. Buchanan, Royal Signals, from 17 Gurkha Division Signal Regiment.

The Technical Assistant Tele-Communications, Mersing, Lodz bin Ahmed supervised the civilian side and was in constant liaison with the Army officers. About six linemen and labourers, who assisted the soldiers, were camped near the Gurkhas.

Above: A Gurkha lineman

The two biggest problems were tackled last. The first, the River Endau, was overcome by laying submarine cable, and the second, the Pontian, was crossed with the aid of two massive 60-foot "H" poles. These poles had to be transported from Mersing to Pontian by sea; there was no means of hauling them overland.

The most difficult stretch of land was a 10-mile route between Endau and Pontian, where the men had to erect poles in swamp land. As fast as they dug a hole, it would fill up with water and cave in. While erecting the first few miles of poles, the men killed three cobras, and at one particular period were constantly attacked by wasps and ants. In camp an Australian one night killed a snake with a knife—and 17 young snakes emerged!

The Pontian having been reached, digging on the other side was easier, the ground being firm, but there were still problems. When it came to lifting the poles, they were invariably so hot that burned shoulders were the rule rather than the exception.

Altogether, the soldiers erected 520 poles to carry 112,640 yards of pure copper wire.

Below: British, Australian and Gurkha troops, with civilians heaving an "H" pole into position

Inland Telecommunications Department

THE INLAND TELECOMMUNICATIONS DEPARTMENT is the Department at Post Office Headquarters which formulates policy for the telephone and telegraph services in the United Kingdom and plans their general development. It advises the ministers on these services and issues instructions for the guidance of Regional and Area staffs on their operation.

Under the Director of Inland Telecommunications there are four Branches, each in charge of an Assistant Secretary, dealing respectively with subscribers' services, planning, operations and telephone mechanisation.

The Subscribers' Services Branch is concerned with the facilities provided for the public, the conditions of service, the rentals charged, and the legal enactments which give the Postmaster General his powers and obligations in telephone matters. It keeps abreast of the public's changing needs and sponsors the development and introduction of modern equipment such as the new kiosk, the new coin-box and new telephone instruments. It is responsible for telephone and telex sales policy and procedures, and co-ordinates the telephone needs of the Fighting Services and other Government Departments.

The Planning Branch is mainly concerned with programmes for the development of the telephone and telegraph systems and is responsible for compiling and presenting the annual capital investment programme for consideration by the Treasury. In collaboration with the Engineering Department and the Accountant General's Department it controls the allocation of funds between various classes of work and between the Regions to ensure a balanced and orderly development. It has a particular responsibility for the exchange equipment and trunk lines programmes and for telex development.

The Operations and Organization Branch has general responsibility for the quality of service given by the telephone system. In particular, it prescribes operating methods and procedures designed to meet the customers' needs in a pleasing manner, and determines staffing standards, management techniques and training methods on the basis of providing an efficient service. The Branch exercises similar responsibilities in respect of the telegraph service and, in addition, formulates policy on telegraph tariffs and facilities. The Branch has an Organization and Methods Unit which serves the Inland Telecommunications Department as a whole.

The Telephone Mechanization Branch was set up two years ago to bring together under one control all matters connected with the mechanization of the telephone service. It co-ordinates the plans for introducing subscriber trunk dialling and for educating the public in the use of this service. Because the method of charging for calls is bound up with the design of a mechanized system, this Branch also deals with telephone call tariffs and telephone accounts questions, including the mechanization of telephone billing.

Underlying the activities of all the Branches is the common objective of giving the customer the kind of service he wants at the lowest possible cost.

(left to right): Mr. K. H. CADBURY, M.C., Assistant Secretary, Planning Branch; Mr. J. T. BALDRY, Assistant Secretary, Operations and Organization Branch; Mr. F. I. RAY, C.B., C.B.E., Director; Mr. A. KEMP, C.B.E., Assistant Secretary, Telephone Mechanization Branch; Mr. D. E. KNAPMAN, Assistant Secretary, Subscribers' Services Branch.

Data Transmission

E. H. Truslove, B.Sc.(Eng.), A.M.I.E.E., A.M.I.Mech.E.

THE TERM "DATA TRANSMISSION" HAS NOT been with us long. In common with terms like "electronics" and "computers" it produces visions of an era of automation that lies ahead: an era when all kinds of laborious processes will be replaced by the silent and efficient operation of machines working at prodigious speeds. But, like electronics and computers, data transmission is not new; it is merely entering a phase of fresh developments so that its form will be suitable for new and possibly novel applications.

What is data transmission? It would be difficult to improve on the colourful description—"machine-to-machine talk". If you try to decide whether data transmission is telegraphy or whether telegraphy is data transmission you find that it doesn't really matter. Data transmission is generally aimed at avoiding the intervention of an operator so that one machine can "talk" direct to another machine. It can eliminate telephone conversations, teleprinters and letters according to circumstances. It is the transmission over lines or radio links of information in digital (that is coded) form and normally the method of storage before and after transmission is a medium (such as punched paper tape, punched cards or magnetic tape) that can be fed into a machine.

Business and industry are just beginning to understand and to use automatic data processing. The variety of business machines that can handle data is becoming greater at an increasing rate. They can read (from punched tape etc. and nowadays from certain printed characters, but not yet from manuscript!) write, find information in a data store, and of course the really clever ones known as electronic computers* can discriminate, calculate, accept instructions and do almost anything from directing a rocket to answering an 11-plus paper—or so we might be inclined to imagine.

But they all have the same weakness; they have to be spoon-fed; the data they handle must be in exactly the right form and this form varies from one make of machine to another. Almost without exception in current business machines it is a digital form and each character is represented by a code in which each digit is a two-way choice similar to the "mark" and "space" of telegraphy. Hence the term "binary digit" which is abbreviated to "bit".

Data handling installations do not necessarily include an electronic computer. But they can all be broken down into three parts (not necessarily separate units) with the functions input, processing and output. The input may be, say, a punched card reader and the output, say, a high-speed printer. If the processing is at a different rate—and it often is at a much higher rate—than the input, there is generally a store (perhaps magnetic tape) between input and processing and between processing and output.

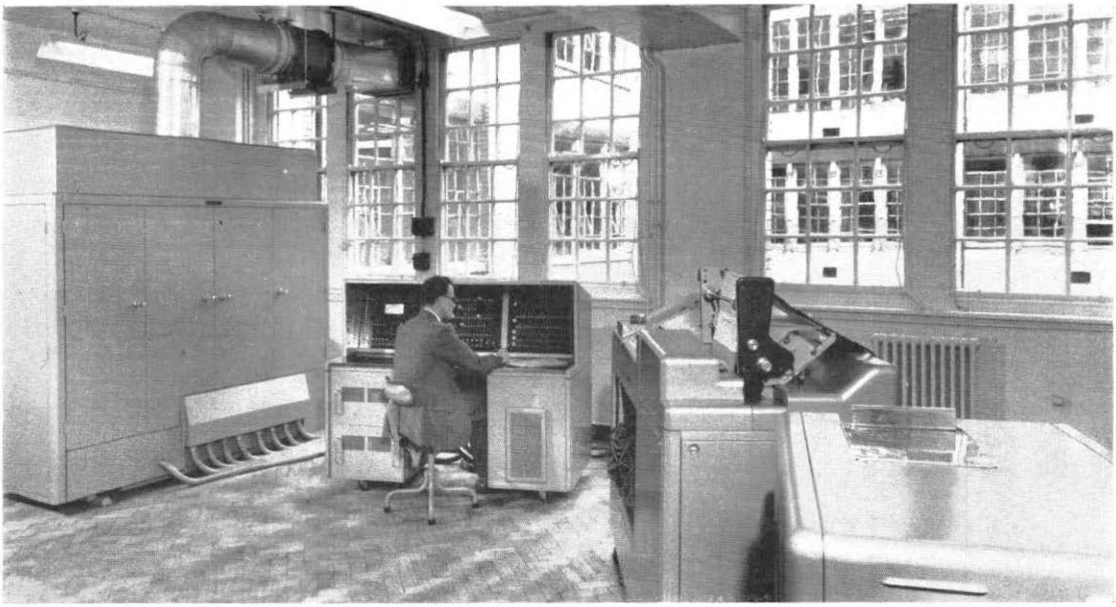
Relatively few data handling installations are yet linked with remote equipment by data transmission, although many are fed with information received from outstations—for instance, our London payroll system, LEAPS. This is often achieved at present by sending the information by post, teleprinters or telephone.

When the possibility of employing data transmission is considered three important factors come to mind; the rate of transmission, the introduction of errors, and the cost.

Signalling Rate

The first of these, the rate of transmission, is best referred to as the signalling rate to distinguish it from the propagation time. The propagation time (the time taken for a character to reach the distant end) is never greater than about 50 milliseconds even for the longest circuits and is seldom of interest to the equipment user although it may be of importance to the equipment designer. The signalling rate, on the other hand, determines the capacity of a circuit to handle data; it is expressed in bits a second (one bit a second is equivalent to a telegraph speed of one baud). The teleprinter signalling rate of 50 bits a second over telegraph circuits is familiar. It is roughly equivalent to 400 characters a minute in telegraph working but in

*See "Electronic Computers in the Office", Spring 1958 issue.



Part of a Post Office automatic data processing installation—the Hollerith 1201 computer used by Supplies Department at Studd Street, London, primarily to control engineering stores

other cases the character rate would obviously depend on the number of digits transmitted for each character. Data transmission over telegraph circuits—for example, tape-to-tape transmission—has already played a useful part and the use of machines to convert tape to cards and vice-versa has opened up further possibilities.

If the quantity of data to be transmitted in a given time cannot conveniently be carried by one or more telegraph circuits, a circuit with a higher signalling rate will be required. A number of computer users are expecting to need such circuits in the next few years and attention is focused on the use of speech-bandwidth circuits.

Over speech circuits the maximum signalling rate without appreciable errors is influenced by the electrical characteristics of the line; for example, the frequency band which can be transmitted without undue attenuation and the delay characteristic-variations in propagation time at frequencies within the transmitted band. A signalling rate of 800 or more bits per second is expected to be practicable; this is 16 times the rate for a standard telegraph circuit. Much basic research has been done on digital systems using a modulated tone or tones, not only with data transmission in mind, but because research people are also looking at digital (pulse modulation) systems for the transmission of speech. But data transmission equipment for use with speech-bandwidth circuits has not yet reached the manufacturing stage in this country.

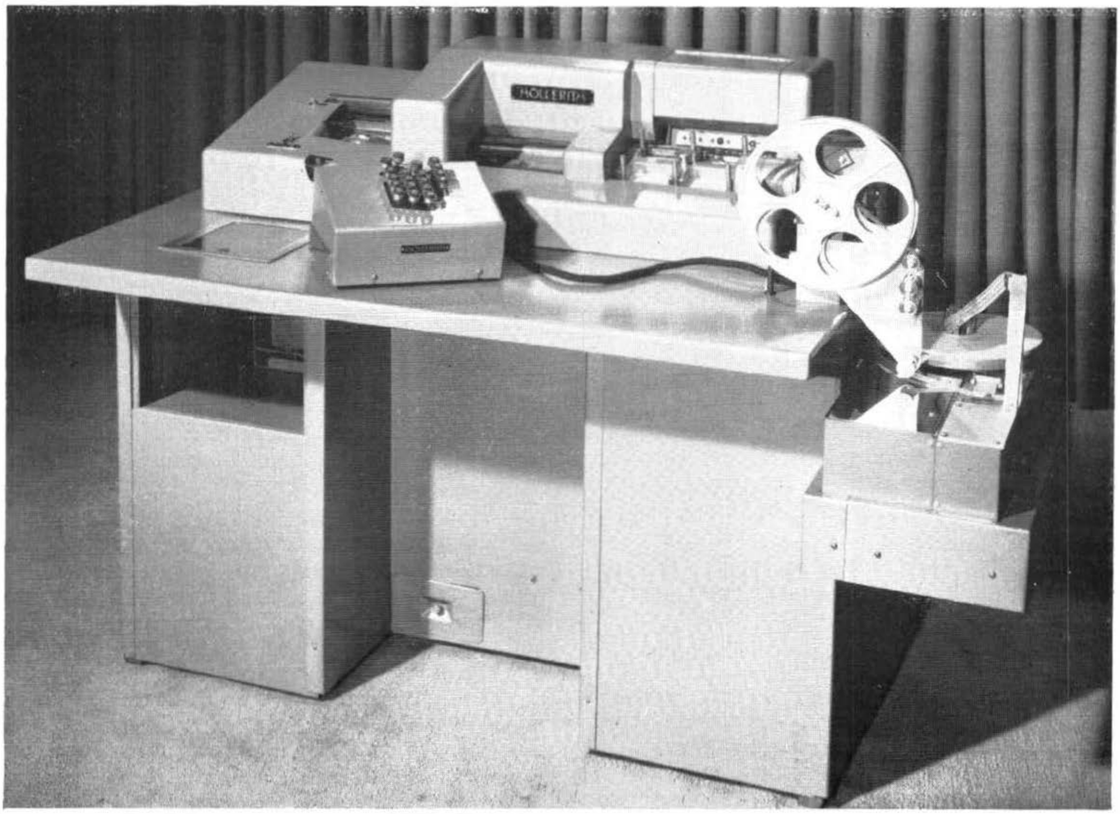
Typical of the limited equipment at present available is the data-transceiver marketed by International Business Machines (IBM) which, in association with other IBM units, reproduces punched cards by data transmission over a speech circuit; the speech band is split into four channels and each channel is capable of reproducing about 600 punched cards per hour.

Suggestions have been made that data transmission for computers will require very much higher signalling rates than this. Some computers function at the rate of about 100,000 bits a second, or higher. However, enquiries made of a number of computer users suggest that speech-bandwidth circuits will have adequate capacity for handling data transmission for most commercial purposes, at least for a number of years. It is unlikely that business computers will in general be connected directly to data circuits; an intermediate store will be used and this will allow the transmission rate to be lower than the input rate to the computer.

No transmission system is perfect and data transmission will inevitably introduce some errors into the data. Data transmission is subject to errors which tend to increase if the signalling rate is raised due to the effects of very short duration interruptions or bursts of "noise" which would be unnoticed by a telephone caller. Research is aimed at producing a method of transmitting digital signals that will be substantially free of error but will nevertheless have a high signalling rate. Reliable figures are not yet available for speech-bandwidth circuits but for telegraph circuits error rates better than one in 40,000 characters are frequently achieved.

An error rate of this order is much superior to that of the average keyboard operator and will be adequate for many purposes. Data transmission over telegraph circuits is giving satisfactory results without special error-detecting arrangements. But for some purposes even this low error rate may be intolerable and some form of error detection will be needed. Inside some data-handling equipment the data is checked before and after each transfer; the method most widely used is the application of redundancy in the code and this could be applied to data transmission.

Very simply, there are more digits in the code than are necessary to produce a separate code combination for each different character or "word". The spare digits are used as "parity bits" and are redundant as far as the code is concerned but make the total number of "mark" digits or of "space" digits an odd or even number. If an error occurs the total digits (in a character or a "word" of several characters) stand a good chance of becoming non-uniform and the check rejects it. In



Hollerith tape-to-card converter *(Courtesy, I.C.T. Ltd.)*

The I.B.M. data transceiver which allows direct card-to-card transmission
(Courtesy, I.B.M. United Kingdom Ltd.)

another form of redundancy system an eight-digit code, say, can be arranged so that each character sent has four "marks" and four "spaces" and the check would reject any character not having this feature. These types of detection are not foolproof but can detect a high percentage of errors. If data transmission introduced, say, one error in 10,000 characters, and the error detection system found 99 errors out of every hundred, the resulting error rate would be only one in 1,000,000.

When an error has been detected it can be corrected either manually or automatically. For manual correction the equipment could, say, stop the transmission and light a lamp to call the operator's attention; the doubtful characters could then be retransmitted. If this is to be done automatically the equipment must not only detect and retransmit but must also prevent the detected erroneous information from being recorded at the receiving end. The equipment to do this will be expensive but may prove economical if the need for the attention of operators is completely eliminated.

Use of Public Services

Where speed is not essential, data, in the form of tapes or pages of characters, is likely to continue to be sent by post or rail from office to office. But uses of data processing are expected to arise which will demand the speed which only data transmission can supply. For some purposes private circuits (full-time or part-time) will meet the need. For others, perhaps those that include occasionally interrogating a central record, it will be more economical for the user to be able to buy transmission time, and there is growing interest in the data carrying possibilities of telex and telephone calls.

Data is already being carried over telex by the use of standard telex equipment. Many enquiries have been received about the use of data codes different from the standard teleprinter alphabet. These codes usually have some effect on the functional teleprinter signals such as "who are you", "carriage return" and "line feed", and the problem is to find a way of preventing false operation of the telex equipment. It is proposed to meet subscribers' needs as far as it is possible to do so and substantial use of the telex service for data transmission in the fairly near future is visualised. The method of connecting subscribers' own data equipment to the Post Office station set is being studied.

As normally used the 5-unit code has no inherent redundancy. Redundancy can, however, be achieved for the purpose of data transmission by means of group parity checks or by including special totals to enable the receiving equipment to decide if errors are present.

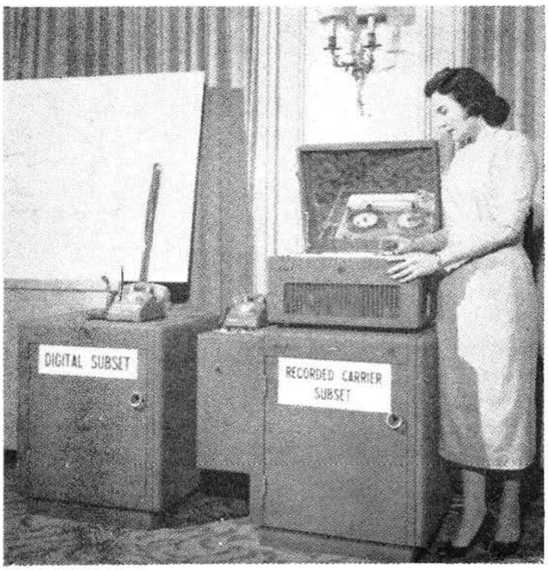
The use of telephone calls presents a number of problems, such as interference with telephone signalling equipment, and no decision has yet been reached about their use for data transmission. But the transmission path in the majority of calls is expected to be adequate, if suitable equipment is developed, despite the wide variation of performance. The average error liability of a large number of calls has yet to be determined; error detection might be essential. The most suitable signalling rate (which will be a compromise with error liability) is not yet known.

In the United States the use of public telephone calls for data transmission is now on trial. The service—called "Dataphone"—uses special devices (digital subsets) which can handle various types of business machine codes. The subsets interpret and transmit data read from punched cards, magnetic and paper tape and other media. They can also transmit text. The signalling rate is up to 600 bits a second. The subset is essentially a frequency modulator/demodulator; it converts bits into tones at the transmitting end and vice-versa at the receiving end. Each subset is capable of transmitting and receiving but is not arranged to do both simultaneously.

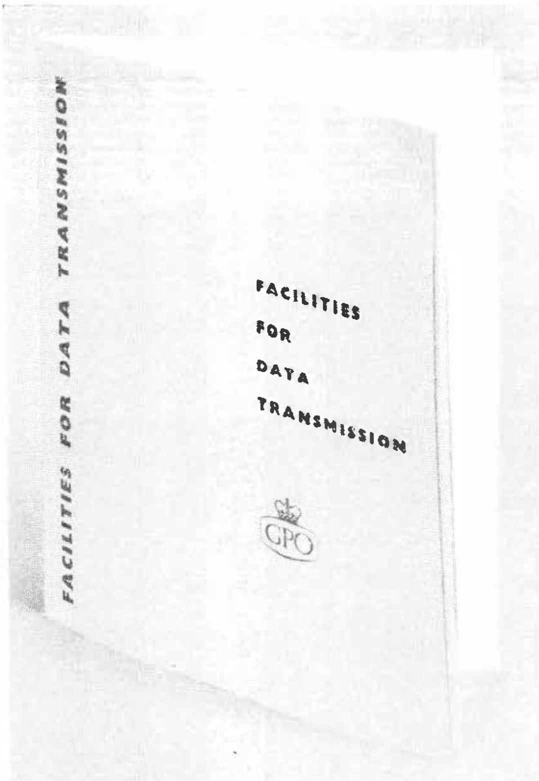
An optional feature is the "recorded carrier subset" which allows information to be stored for transmission later, for example during the cheap rate period. Pulses are accepted from the machines at a relatively slow rate and recorded on a magnetic tape; subsequently the taped information is transmitted to another subset over a telephone call at a rate (about 600 bits a second) eight times faster than the recording rate. Thus 24 minutes of recording can be compressed into a three-minute call. At the receiving end the procedure is reversed; the information is first recorded and then "played back" to business machines.

If equipment to serve a similar purpose is developed for use in this country it must either, as in the American trial, handle a variety of codes or separate models must be designed to suit each of the codes used by data equipment. Although some standardization of codes is being considered by the many interested bodies, this is likely to remain one of the major design problems. A "subset" would, of course, have to be compatible with all the other subsets to which it would be connected.

What will the future of data transmission be? That there is a future seems certain; just how quickly the demand for it will grow cannot readily be judged, but it is a fascinating thought that in years to come the Post Office might be called on to carry more data transmission than telephone traffic!



The American digital subset and recorded carrier subset



The Post Office booklet on data transmission

There are now more than 200 computers in use in this country but many have not been installed long enough to pass the initial breaking-in period; the expensive installation has perhaps been applied to a limited task possibly involving considerable reorganization of procedures, and the business concerned finds itself preoccupied with this major step. When the initial task has been satisfactorily transferred to the computer, these firms are likely to look for other work for the data installation. That may be the time when outstations will come more fully into the picture and when data transmission will be needed.

Not all data transmission will necessarily be helping to feed the monsters of the computer world. Much more modest data systems could be developed to serve a host of miscellaneous purposes. Seat reservation systems for airways, theatres and so on are expected to be one future innovation. The girl behind the desk at a booking agency may have equipment which will transmit data to interrogate, and up-date a central record.

One novel application of data transmission that has been investigated is known as "Hotac"; this would allow hotels to have displayed at airports and railway stations the state of room reservations. The indicator would be kept up-to-date by setting up an ordinary telephone call between the hotel and the special equipment at, say, a railway station and, by a device attached to the hotel exchange line, slow speed impulses would be sent over the call.

The Post Office is keeping in touch with all the various possible uses of data transmission as they emerge. Customers are being helped to work out ways in which they can use data transmissions most effectively and at the same time information is being collected about new types of service likely to be required. The Engineering Department is investigating new techniques and deciding how existing services can be adapted. A booklet *Facilities for Data Transmission* has been supplied to guide customers and equipment manufacturers and to stimulate enquiries.

But, for the present, trying to forecast the way in which data transmission will develop is rather like trying to predict the pages of history. Factors such as technical developments, economics, standardization, and error detection techniques, will all play a part. One thing is clear: the Post Office will have a major role in this new field, and is anxious to play its full part.

Telecommunications Statistics

	Quarter ended 30 June, 1959	*Quarter ended 31 March, 1959*	*Quarter ended 30 June, 1958*
Telegraph Service			
Inland telegrams (excluding Press and Railway) ...	3,194,000	2,944,000	3,349,000
Oversea telegrams:			
Originating U.K. messages	1,198,124	1,130,898	1,149,169
Terminating U.K. messages	1,208,828	1,180,705	1,164,121
Transit messages	1,352,719	1,320,693	1,403,869
Greetings telegrams	740,000	720,000	752,000
Telephone Service			
Inland			
Gross demand	111,551	106,859	88,753
Connexions supplied	100,668	93,286	83,820
Outstanding applications	140,757	145,036	160,216
Total working connexions	4,643,206	4,606,091	4,516,285
Shared service connexions	1,135,847	1,140,760	1,147,296
Total inland trunk calls	93,116,000	84,054,000	82,319,000
Cheap rate trunk calls	21,203,000	18,797,000	18,739,000
Oversea			
European: Outward	682,037	626,015	601,321
Inward	642,650	595,887	574,603
Transit	not available	not available	4,469
Extra-European: Outward	62,190	56,603	52,424
Inward	66,725	65,510	55,673
Transit	17,142	17,187	14,655
Telex Service			
Inland			
Total working lines	5,226	5,027	4,448
Calls from manual exchanges	704,000	656,000	*
Calls from automatic exchanges	217,000	184,000	*
Metered units from automatic exchanges ...	937,000	790,000	*
Oversea			
Originating (U.K. and Irish Republic) ...	554,174	521,258	447,010
Terminating (U.K. and Irish Republic) ...	529,598	507,815	427,036
Transit	6,135	5,841	4,440

* No comparable figures

Gas Pressurization to keep Water out of Cables

R. J. Griffiths, B.Sc. (Eng.) A.M.I.E.E. and H. P. Brooks

ALTHOUGH REGULAR INSULATION RESISTANCE tests are made on pairs in trunk and junction cables, it is well known that most cable sheath defects come to notice only when water enters the cable, causing circuits to be reported faulty (usually by operators) for noise, signalling difficulties or, exceptionally, poor transmission. With the introduction of Subscriber Trunk Dialling, there will be fewer operators to report faults in the early stages of a cable failure or to handle any significant amount of delayed traffic caused by cable breakdowns. It is desirable, therefore, that with cables carrying a large number of circuits, some means of preventing water entering the cables should be employed. This is achieved by making the air pressure inside the cable sheath greater than the pressure of the atmosphere. This process is known generally as "gas pressurization". Gas pressurization will not only minimize interruptions to service through reducing the possibilities of water entering the cables but will also avoid the chance of subsequent interruptions when piecing out wires where the paper insulation has been contaminated by the water.

Gas pressurization is not a recent development. The first dry-core cables, laid in 1834 for railway signalling, were pressurized; subsequently (1900—1910) a number of London junction cables were pressurized, but the pressurization was discontinued probably because of difficulties in finding the "leaks". Also, as gas pressure detects all sheath failures, while insulation testing detects only those failures which are under water or in very damp places, faults appear to be more numerous on pressurized cables, and this has led to a belief that gas pressure causes sheath failures. We have, however, seen many failures which might have been attributable to "gas pressure" but have always found that the failures have been caused by a manufacturing defect, or inadequate preparation of a sleeve or sheath by the jointer. Probably, with the vibration which most cables have to withstand, all these defects would have come to notice eventually by failure of circuits.

In the United States, the systematic pressurization of all long toll (trunk) cables was started in 1924; practically all the underground and most of the aerial cables were under pressure by 1942. A reduction by some 90 per cent. in circuit failures (due to cable faults) is attributed to the pressurization. In Australia, all the inter-exchange cables are under gas pressure and in most other countries, coaxial cables have been pressurized.

In this country, field trials of gas pressurization were started in 1949 and were so encouraging that in 1953 it was decided to gas pressurize all future coaxial and balanced pair cables. A number of

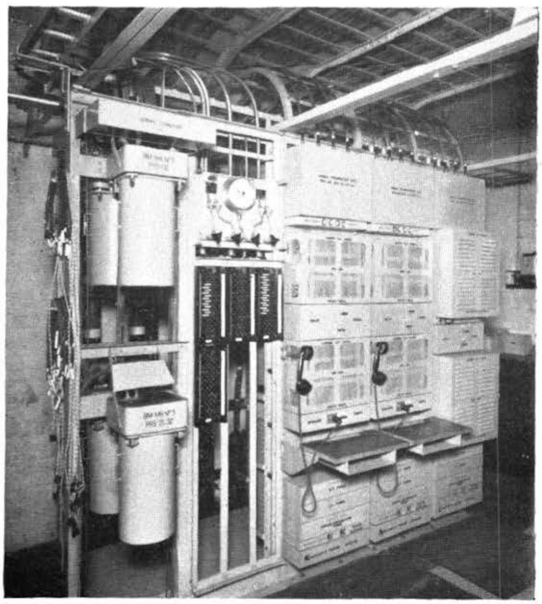


Fig. 1: Intermediate repeater station installation

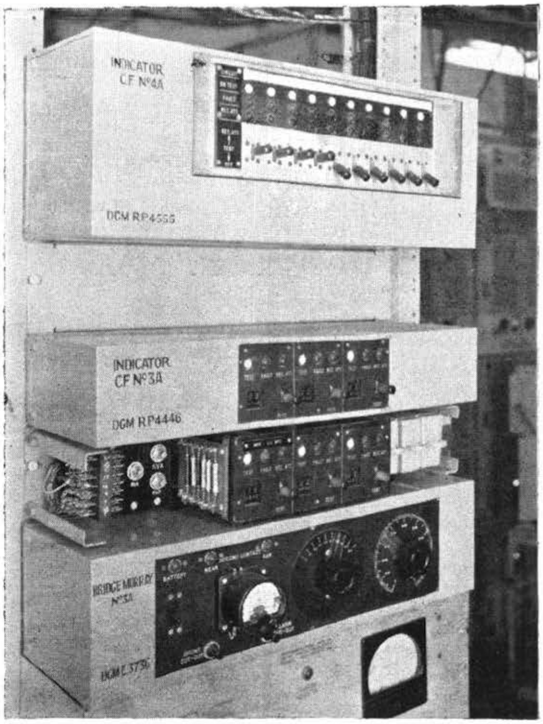


Fig. 2 : Alarm equipment

existing coaxial and audio cables have also been pressurized where the former fault rate combined with the importance of the cable has made this course desirable. At present some 900 miles of coaxial and 150 miles of other trunk and junction cables are under gas pressure.

To give maximum protection against water entry, cables should be kept under as high a pressure as possible but the pressure should not be such as to result in expansion of the lead sheath or sleeves, or the failure of properly constructed joints. The maximum pressure which satisfies these requirements for the larger cables in the Post Office network is 10 lb. per square inch. Experience in other countries indicates that this pressure will not cause joint failures, and as it is desirable to have standard pressure throughout the network the Post Office has decided that cables shall be maintained at a pressure of 9 ± 1 lb. per square inch.

Small leaks on cables can be detected by regular checks of the gas pressure but arrangements have to be made for alarms to be given when large leaks occur. For this—in cables pressurized between 1949-1956—pneumatically operated switches, known as "contactors" were inserted in joints at regular intervals along the cable: 500 yards for audio cables and 1,000 yards for coaxial cables. Contactors of several types were used in the early trials but a type similar to that used in refrigerators appeared to be the most suitable.

It consisted of a partially evacuated cylindrical bellows and a micro-switch whose contacts were placed across an "alarm" pair in the cable. The contactors were adjusted so that the contacts closed when the surrounding pressure fell to about 6 lb. per square inch and reopened when the pressure was raised to about 8 lb. per square inch. Equipment was provided so that when a pair of contacts closed, an alarm was given, and the site of the contactor located. The elapsed time for the closing of the second, third and other pairs of contacts was noted by the equipment as it was thought that this would facilitate fault location. Owing to a lack of stability in the contactors, however, this last facility has not been of much value, but the trials have shown that it could have been of value if the stability of the contactors had been satisfactory.

As time went on, the contactors fitted to cables were found to be becoming less reliable and further development of the contactor was shown to be required. This work was put in hand, but at the same time a trial was started of an alarm system for a pressurized coaxial cable using "contact-gauges" in the repeater stations in place of "contactors" in the cable. These "contact-gauges" were standard pressure gauges with the addition of a contact on the indicator arm and a spring loaded manually adjusted arm carrying a further contact. The gauges

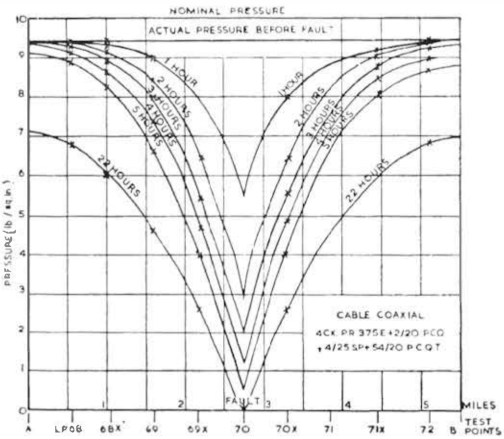


Fig. 3 : Large leak—coaxial cable

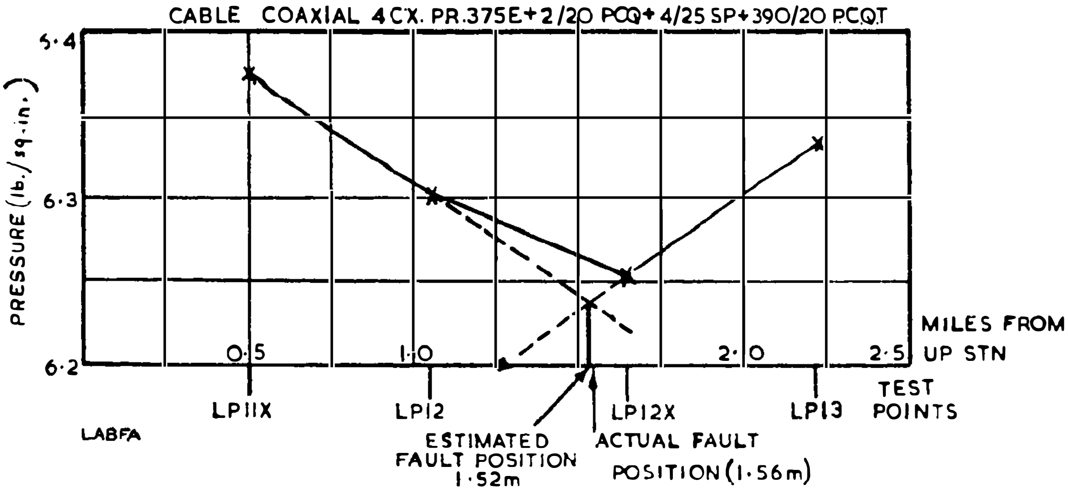


Fig. 4 : Leak caused by crack at wipe

were connected to the cable and the contacts to an alarm pair in the cable. The adjustable arm was set so that the contacts close and an alarm is given when the pressure in the cable at the station falls to 7 lb. per square inch. This was 1 lb. higher than in the contactor system and was to compensate for the greater distance between alarm contacts.

The use of these "contact-gauges" in conjunction with a pressurized coaxial cable proved satisfactory and they have been used for all coaxial cable pressurization schemes initiated since 1956. "Contact-gauges" are also used for audio schemes where the exchanges and repeater stations are suitably spaced. A typical intermediate repeater station installation is shown in Fig. 1. This figure shows the racks being used as follows:—

Rack 1 (left) - Audio pair terminations rack for an unpressurized coaxial cable.
Rack 2 - Contact-gauge panel and audio termination rack for two pressurized coaxial cables.
Racks 3, 4 & 5 Coaxial system equipment racks.

It will be noticed that provision is made for the Up and Down cables of two coaxial systems to be inter-connected on each contact-gauge panel. This reduces the cost of provision and maintenance, and also facilitates fault location.

Alarm equipment is provided in the principal repeater stations on each route, a typical installation being shown in Fig. 2. Cable-fault indicators, No. 3A are used in conjunction with a Murray Bridge, No. 3A for giving an alarm and providing a location of closed contacts on long cables where a number of contacts are "teed" across one cable pair. Cable-fault Indicators No. 4A are used for short cables where a separate pair is used for each contact. The indicators also give an alarm if a disconnection is made anywhere in the test circuit. Leakages from the cables are normally made good from compressed air cylinders, but at large staffed stations electrically driven air compressors have been provided. Nitrogen is not used, as leakages from nitrogen filled cables could cause oxygen deficiency in manholes.

In other countries contactor systems are still being used for long cables but some of these countries are now adopting *excessive* gas flow as the sign of a gas leak and are using either the *rate* or current of gas flow for preliminary location. The station equipment for gas flow systems is more expensive than for "contactor" or "contact-gauge" systems and, if it is to be used for preliminary fault location, precludes any change of cable size between the points at which the equipment is fitted. In other countries the "contactor" and "flow" systems are probably necessary for maintaining gas pressurized cables, as cables are buried and joints not readily available for fault location. In this country, however, the "contact-gauge" system should be adequate for most cables, since joints are readily available in surface boxes. The contact-gauge alarm system, however, would not be suitable for a cable in the remoter parts of the country because the exchanges it joins would be too far apart. The gas flow system would also be unsuitable, and it would be necessary to provide these cables with contactors.

The introduction of gas pressure has brought new techniques in the localization of sheath defects. With unpressurized cables a sheath defect only becomes noticeable when the insulation resistance of the wires in a cable deteriorates; location is then made, using the Varley and Murray tests so well known to transmission engineers. With pressurized cables, however, the insulation resistance does not deteriorate when a sheath defect occurs and the defect must be located by determining the pressure variation or the flow, along the cable.

When a defect occurs in a cable sheath the pressure at that point falls to a value just above atmospheric. The distribution of pressure in the remainder of the cable depends upon several factors; the leak size, the pneumatic resistance of the cable and the time elapsed from the occurrence of the fault. The pneumatic resistance varies with the air space in a cable, being high for small paper-core cables and low for coaxial cables, and it can be affected by the constrictions produced by insulating gaps and anti-creepage devices. The pressure distribution in the middle of a faulty repeater section of coaxial cable after 1-22 hours is shown in Fig. 3.

When a large leak occurs, sufficient to cause an alarm, an approximate location can be made from a knowledge of the contactor operations or pressure gauge reading at the ends of the section. Pressures are then measured at points in the vicinity of the approximate location and pressure/distance gradients are drawn from which the site of the leak can be determined fairly accurately.

For a small leak, which has been noticed by routine inspection of pressure gauges, it is necessary to measure the pressures at 1,000-yard intervals along the affected section and to plot these pressures to give an approximate leak point. Further measurements are made in the vicinity of this point, and from the pressure/distance gradients obtained (see Fig. 4) the leak point can be determined more accurately. The accuracy of localization will depend greatly on the care and speed with which the measurements were made but can be affected by constrictions in the cable or through replacement lengths not having the same pneumatic resistance as the original cable.

For very small leaks a localization cannot always be obtained by pressure/distance graphs and it may be necessary to use a differential manometer to determine the direction of gas flow at joints.

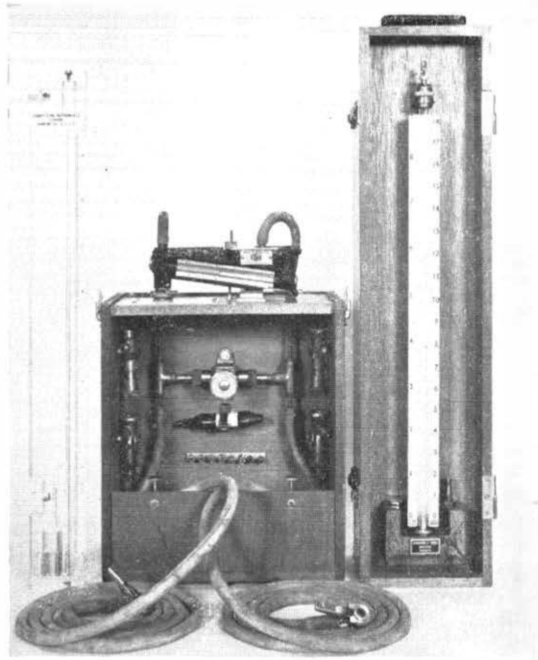


Fig. 5 : Manometers for measuring pressures

The equipment used for measuring pressures in the cable is shown in Fig. 5. On the left and right of the photograph are mercury-in-perspex and mercury-in-glass manometers and in the centre is the differential manometer, with its associated equipment. These manometers are developments of the simple U-tube manometer containing mercury or water, in which the pressure to be measured is applied to one arm of the U-tube, whilst atmospheric pressure is applied to the other arm. The pressure difference results in the liquid flowing from one arm to the other and can be calculated from the difference in height of the liquid in the two arms. The pipes and valves directly associated with the differential manometer are provided for by-passing the manometer while the instrument is being connected to the cable. The other items are valve assemblies which can be connected to a pressurized cable without the loss of gas. In addition to this equipment, pocket barometers and charts giving altitude correction factors are required so that the measured pressures can be adjusted to take account of level and atmospheric changes along a track.

When the leak point has been localized, the leak itself is located either aurally or by a soap-suds or "Lensodel A" solution. Where it cannot be found by these means, air containing a small amount of Arcton 6 (diflourodichloromethane) is injected into the cable in the vicinity of the leak and the point at which this mixture emerges is found by an electronic device which detects the halogen ions present in Arcton.

Up to the time of writing, sheath defects have not caused any failures of service of circuits in gas pressurized cables, and the method used can therefore be regarded as satisfactory. It would appear, however, that the cost of pressurization will not always be covered by savings in cable replacements and repairs; if, however, the excess cost is small, an extension of pressurization could well be the best means of improving the reliability of the trunk and junction network.

Catering for Election Traffic

POSTMEN HAD TO DELIVER SOME 120 MILLION General Election addresses during the three weeks before October 8 but their telecommunication colleagues were also under pressure throughout the period to provide lines for candidates and their agents, circuits for the Press and broadcasting to communicate election news right up to and beyond election day. The following brief "election round-up" is compiled from reports received from *Telecommunications Journal* representatives in the Post Office.

Every agent needs telephones for the period and must be given priority without partiality. The heaviest demands were in the London Telecommunications and Home Counties regions, each of which had to provide 240 lines. The Post Office in Scotland had to provide 234; North Eastern Region, 203; South West, 202; North Western, 193; Midland Region, 156; and Wales and Border Counties, 153.

A little tact was called for where shared service was necessary. For example, the Midland Sales Representative who visited Arley in Meriden constituency found only two subscribers likely to sympathize with the Labour candidate—and one, despite its name, was by constitution non-political. Fortunately the other allowed a Plan 7 extension.

Press Demands

Sound radio and television (states our North Western reporter) took a lot of enquiry traffic that used to "bob up" on election night but at Manchester the average number of Press fixed time and picture calls doubled to 27 on the day after the election, mainly during the early hours of the morning.

The Press Association used Nottingham as a collecting centre for the East Midlands; most of the traffic passed over the P.A. teleprinter network but on election night a contract call, Birmingham-Nottingham, was booked from 9.15 p.m. to 3 a.m. and on the following day from 9.15 a.m. to 5 p.m.; the P.A. also booked Nottingham-Sheffield from 1 p.m. to 5 p.m. on the day after the election. The national newspapers' rented networks handled most of the Press traffic in London; newspapers called for only 20 extra internal extensions and the Exchange Telegraph Company asked for six extra. The *New York Herald Tribune* augmented their transatlantic telegraph services by using a Perforating Attachment No. 45 in connexion with their existing facilities.

In Scotland the Press asked for 24 temporary exchange lines at Glasgow and one at Ayr.

Press agencies asked for about 25 per cent. increase in transmission times for their oversea broadcasts.

Broadcasting Needs

From about 10 o'clock on election night every result was announced on television through the Post Office T.V. Control. Throughout the night four or five men were on duty and Mr. W. L. Newman, Executive Engineer in charge, himself stayed on duty all night and (say L.T.R.) "the success of both B.B.C. and I.T.V. transmissions was due in no small part to his careful planning and supervision."

At London Trunk Control six additional staff remained on duty throughout election night to cope with the increased traffic. During the election period special circuits for the BBC (and the Press) were set up to provide for 350 separate "broadcasts". At TV Control switching work can be pre-set for "automatic operation" but these temporary broadcasting circuits had to be set up manually, "piecing cords" being used—the process of linking one circuit with another to provide a continuous line is called "piecing". LTR pay tribute to Mr. R. F. Holliday, Area Engineer, for the planning and foresight that made this plan such a success.

Outside Broadcasts

London has 24 Outside Broadcasting "sites" through which transmissions over temporary OB lines can be fed back to the BBC and ITV. Under the direction of Mr. B. H. Moore at Headquarters plans were organized over 200 circuits for outside broadcasts from 14 different localities. Transmission tests were started at mid-day on October 8 and transmissions continued until 4 a.m. on October 9, when the engineers got two hours' respite, after which the results were transmitted until most of them had been declared. Control at the various locations was in the hands of 25 specially qualified Post Office technical staff but the setting up and supervision involved many other Post Office men in every London Telecommunications area.

In Leeds nine circuits were provided to the Town Hall for BBC TV and five for Granada. Before polling day Granada TV ran an "Election Marathon" in which candidates appeared in question and answer programmes; six local ends and four temporary exchange lines were provided to the Granada office, with a temporary private circuit between the offices and the local Metro-Goldwyn-Mayer studio. In Newcastle upon Tyne, four control circuits were provided for the BBC to Lime Grove (London), to Manchester (2) and to Carlisle; one local circuit was provided for "The Hustings" between Newcastle and Sunderland. The Post Office also provided three control circuits for Tyne Tees TV to ABC Birmingham, Granada Manchester, and Associated Rediffusion London.

Coaxials for Computer

Independent Television had an elaborate installation at the English Electric works, Stafford, for using the computer to provide second-by-second information culled from the "electric brain". This involved coaxial cables and called for a high degree of engineering work.

In Scotland several Outside Broadcast facilities were set up for the BBC and ITV for October 8 and 9; the broadcasting authorities rented four temporary exchange lines and 25 local ends.

This "election round-up" is by no means complete. Throughout the United Kingdom Post Office telecommunications staff had three weeks of increasing activity. The clerical staffs shared the extra work; election agents must closely watch their expenditure and had to be given specific details of rental and call charges throughout the period. And, since they must by law pay all their election bills within two weeks of polling day, all meters had to be read, all temporary equipment recovered, and all accounts rendered well within the fortnight.

City reports showed that Stock Exchange transactions reached record totals of more than 25,000 a day round about October 8.—As a result, Stock Exchange telecommunications traffic rose by 16 per cent. above normal during the two previous days and by 29 per cent. on October 9.

Car Radiophone Started

The new Postmaster General, Mr. John Reginald Bevins, M.P. for Toxteth, Liverpool, who succeeded Mr. Ernest Marples (now Minister of Transport) after the election, performed his first public ceremony by making the inaugural call on October 28 on the new South Lancashire Car Radiophone Service.

The service enables any car in South Lancashire, fitted with the equipment, to telephone to any normal subscriber on the United Kingdom network. Mr. Bevins talked with Lord Rootes in his London Office. It is operated through Peterloo Exchange Manchester, with base stations at Winter Hill, near Horwich, and Lancaster House, Liverpool. An auxiliary station at Manchester improves reception in the city area.

Frequency-modulated equipment on five 2-frequency channels is used; one channel is for calling, as the link between the car and the exchange. The car equipment includes a loud speaker.

The radio licence fee will be £7 10s. a quarter and calls within the area will be charged at the rate of 2s. 6d. for three minutes. Calls outside the area will be charged at ordinary trunk rates plus 2s. 0d. radio charge for a three-minute call.

The Post Office believes there will be no greater road safety risks than those affecting the 20,000 private VHF radiophones already in use.

Telecommunications in Malta

A. Attard, M.B.E., A.M.I.E.E.

MALTA IS THE LARGEST OF A GROUP OF islands in a sub-tropical latitude in the centre of the Mediterranean Sea about 60 miles from Sicily and 180 miles from the nearest point on the North African coast. The group consists of Malta, Gozo and Comino, and two small uninhabited islands. The areas of Malta, Gozo and Comino are about 95, 26 and 1.1 square miles respectively; their population is approximately 290,000, 30,000 and 100 respectively.

Telephones

The history of the telephone dates back to about 1882 when Chevalier Rosenbuch of the Societé Internationale des Téléphones opened the first exchange in Valletta, capital city of Malta; three years later, this Society merged with another company and became the Melita Telephone Company.

The first telephone exchange was of the magneto type. On the termination of the contract for running the system in Malta, the Government decided to take over the administration, and placed a contract with Siemens of London to supply and install an 800-line C.B. manual exchange with ultimate capacity for 2,000 lines, which was called Valletta Exchange, and an external plant to cover a three-mile radius from that exchange.

The Government Telephone System was inaugurated on January 8, 1933, with 544 working exchange lines and 939 telephones. The telephones outside the three-mile radius were still working on the old system, although they were connected to Valletta Exchange on a switchboard position with circuits designed for this purpose. The sister island of Gozo was served until 1936 by a small magneto switchboard with a single junction line to Valletta Exchange. By the end of 1937 all telephones in Malta and Gozo were converted to the C.B. manual system.

Applications for telephones were received at a high rate and Valletta Exchange was increased in 1934 to a capacity of 1,200 lines, and in 1936 to its full capacity of 2,000 lines. During the years 1936–1938 four C.B. manual exchanges were installed at St. Paul's Bay, Rabat, Sliema and Gozo, and a 14-pair submarine telephone cable was laid between Malta and Gozo with a similar cable between Comino and Gozo; these two cables were connected by a 14-pair land cable along Comino. One pair was used to provide two telephone lines at Comino; one line terminated at St. Paul's Exchange in Malta and the other was connected on the Gozo Exchange.

Before the Second World War a magneto exchange, Valletta Emergency, was installed in a bomb-proof chamber; its main function was to keep all essential telephone lines working in air raids and to give air raid warning signals to all Siren Stations, Police Stations, and other points. The air-raid warning lines were grouped by sets of 10 keys with their handles fixed to a wooden strip. A set of 10 keys was fixed on the face of each switchboard position. The air-raid warning and the "raiders passed" messages were thus passed to 10 stations simultaneously. The air-raid warning telephones were reserved solely for this purpose.

War Damage

During the War there was a big decrease in service because of the evacuation of people from Valletta and the Dockyard area to other districts. Moreover, it soon became evident that the telephone exchange at Valletta was in great danger of being destroyed. A 200-line C.B. manual exchange which was being installed in the Dockyard Area was dismantled, transferred to a bomb-proof shelter and named Central Exchange. Parts of the switchboard and other equipment of the exchanges at Valletta and Sliema which could be spared were added to the Central Exchange, bringing its capacity up to 1,440 lines. Valletta Exchange was completely destroyed in April, 1942.

In 1955 an order for supplying and installing an automatic telephone exchange with an initial capacity for 4,300 lines and an ultimate capacity of 7,000, was placed with Standard Telephones & Cables of England, after a call for tenders. This

Malta—entrance to Grand Harbour, Valletta

exchange, which is of the British Post Office step-by-step type using 100 point two-motion selectors of the G.E.C. S.E. 50 type, was inaugurated in 1957. It is now being extended for another 1,700 lines, and an order was placed in October, 1958 for a further extension of 1,000 lines. This exchange was installed in a new surface building at Marsa and replaced Central manual.

A 600-line extension to Sliema Exchange was installed in 1958 using part of the equipment of the old Central Exchange. The Sliema Exchange building is being enlarged to install a 5,000–7,000 line automatic telephone exchange in replacement of the manual exchange. Work is also in progress to replace all manual by automatic exchanges and to install additional cables to meet the demand for telephones.

A 50-100-line satellite exchange was installed in 1957 at the Civil Air Terminal, Luqa.

On March 31 this year, 12,441 telephones were in service; there were 8,271 exchange connexions and 1,822 orders in hand for exchange connexions.

The main cable plant consists mainly of armoured cables laid in trenches on pavements about 30 inches deep. The cables are covered by concrete slabs 24 inches wide and two inches thick, the width varying with the number of cables laid in the trench; the minimum width is eight inches. These slabs serve as a warning when excavations are carried out close to the cables. The largest size of cable used is 600-pair.

The cables purchased during recent years are paper core, unit twin, local type, antimonial lead sheathed, single-wire armoured to B.S.S. 480 and in accordance with British Post Office specifications for cables varying from 30 to 600-pairs and 10- and 15-pair cables.

Cast-iron joint boxes are fitted on all joints and are buried in the ground, the letters "T.D." being engraved on the walls close to the joints to indicate where they are. The joint boxes are not filled in with compound.

In built-up areas, block terminals P.O. No. 17 fixed on the external walls of buildings are used for distribution. Cable terminals with fuses and electrodes fitted on iron-poles are used as distribution points when open-wire distribution is required. Plastic cable, 10 lb. per mile, insulated with polythene and P.V.C. sheathed according to the Preece, Cardew & Rider specification, is normally used from the block terminals to the telephone instruments. Cadmium-copper wire 40 lb. or 70 lb. a mile on wooden creosoted poles or brackets is used from the pole cable terminals to subscribers' premises. Plastic cable suspended on wooden poles is used in open country when the number of pairs required is from 10 to 25.

The kiosks in Malta and Gozo are all of the British Post Office No. 6 pattern with prepayment coin-box telephones and a hand-set resting on a hook fitted on the left hand side of the coin-box.

Party lines are not used, but external extensions, Plan 7A, are installed when two persons have to share the same line; the subscriber of the main telephone pays rent for the exchange line, while the extension subscriber pays rent for the extension. All calls are charged to the main line subscriber and the two parties arrange to share charges.

All P.B.X. switchboards of a greater capacity than $\frac{5+20}{25}$ are of the lamp signalling type.

The department's staff excavates trenches, lays and joints cables, and does all other installation work, but the suppliers install the exchange. A Clerk of Works was seconded from the British Post Office for the installation of the Central Automatic Exchange and a Standard Telephones engineer was responsible for maintaining this exchange for 12 months after the cut-over.

The Installing Engineer trained the maintenance staff during the installation and, a few years ago, all engineers were sent to the British Post Office for some months training and instruction. In 1931, three engineers of this department took a 4½ months course in theory and practice in telephony with the British Post Office and Siemens Bros. of Woolwich.

The bulk of the telephone equipment is purchased either through the Crown Agents for Oversea Governments and Administrations, or by a call for tenders locally and abroad. Inspection, when necessary, is carried out by the Crown Agents or by the consulting engineers, Preece, Cardew & Rider. All articles have to be of the latest British Post Office standards and in tropical finish in accordance with the latest Preece, Cardew & Rider specifications or their equivalents.

A call for tenders was recently made for the supply and installation of a 24-channel, S.H.F. radiotelephony system between Malta and Gozo.

Tariffs

Connexion fees for direct exchange lines and external extensions are 18s. 0d. and for internal extensions, 6s. 0d. When a subscriber changes his residence or office premises and the instrument has to be moved from one building to another, or when a new subscriber takes possession of premises where a telephone is already installed, these fees are also chargeable.

An additional charge of £1 is made for installing a coloured telephone instrument.

The annual rental of a direct exchange line in premises (including clubs) occupied wholly or partly for commercial purposes is from £4 16s. to £6, and in premises occupied as private residence or for the exercise of a profession, from £3 12s. to £4 16s. An extra charge at the rate of £1 1s. a year is made for each furlong or part of a furlong beyond 300 yards for direct exchange lines, where the instrument is more than 300 yards from the main cable termination.

Subscribers who have two or more lines in different buildings in the same town or village, and are connected to the same exchange, are allowed 15 per cent. reduction on the annual rentals in respect of the second and any other additional line of the same classification.

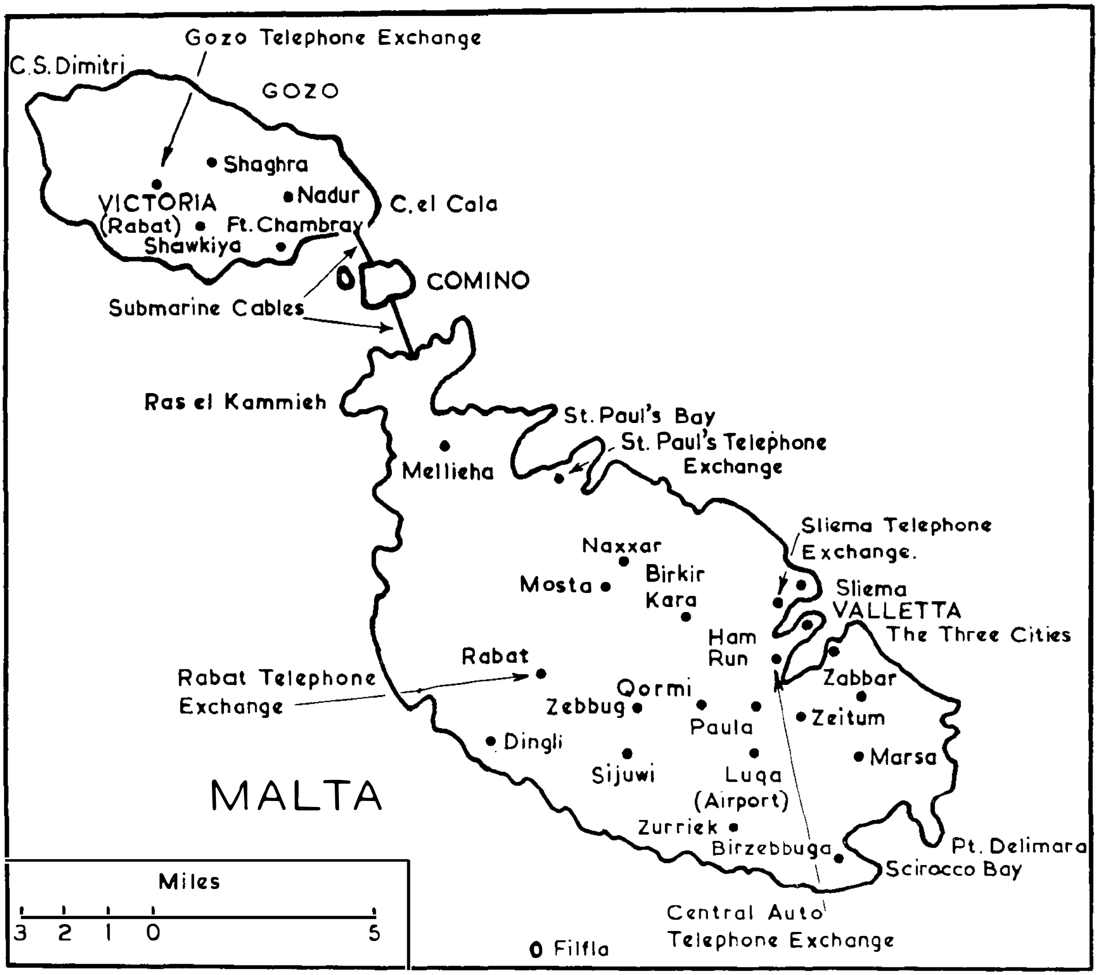
Subscribers who have more than one line in the same building are allowed a 25 per cent. reduction.

A fee of 1.2d. is charged for each local call from ordinary telephones and of 3d. for each call made from public kiosks.

Applications for a telephone have to be accompanied by the appropriate connexion charge and a deposit of £1 as a security for the settlement of the subscriber's account. The Postmaster General may, at his discretion, require a higher deposit, to bring it on to a level with the quarterly average in advance.

The Telephone Branch is run on commercial lines. Revenue and expenditure during the financial year 1956–57 were £88,572 and £86,330 respectively. The interest at 3½ per cent. a year on the Treasury Loan for the capital expenditure of the undertaking and depreciation during this year amounted to £34,948 and there was a net loss of £32,706 caused by the increase in salaries and wages and the higher costs of telephone materials.

Malta has no inland telegraph service but telephone messages for delivery to non-subscribers in



Malta and Gozo are accepted from telephones on the Malta Government System. There are eight deliveries of telephone messages daily. Messages are received in offices at the parent telephone exchange in Malta, and at Gozo exchange. The number of telephone messages delivered in Malta and Gozo during the financial year 1957–58 was 48,363 and 9,077 respectively. At night urgent messages only are acceptable; the police deliver these.

The charge for a single message is 6d. during the day and 1s. 0d. at night; for a reply-paid message the charge is 9d. during the day and 1s. 6d. at night.

Cable and Wireless Ltd. provide the oversea telegraph service.

Oversea radiotelephone service is provided via London for three hours a day, except Sundays, with most of the countries in Europe, and with the United States, Canada, Australia, North Africa and Newfoundland; via Rome one hour a day, except Sundays, with Italy and Sicily, and to Benghazi and Tripoli, half an hour a day, except Sundays.

Oversea telephone service by cable is provided 24 hours a day, including Sundays, via Rome, with the United Kingdom, most of Europe and North Africa, and the Lebanon. The Post and Telephones Department runs the service in conjunction with Cable and Wireless Ltd. The department maintains the oversea telephone exchange and inland lines, including booking of calls, and the Company wireless and other equipment of oversea links.

Oversea calls from non-subscribers are also accepted and are made from telephones specially installed for this purpose. They may be booked at the General Post Office, are accepted only on a fixed duration basis and must be paid for in advance. If the caller does not fully use the time for which he has asked—for example, if he books a six-minute call but terminates the call at four minutes—he will be charged only for the effective time, subject to a minimum of three minutes. Oversea calls from public kiosks are not accepted.

The Postmaster General is head of the Posts and Telephones Department. The major staff of the department consists of one chief engineer one chief clerk, one accountant and two senior engineers. The Chief Engineer is responsible for the Traffic and Engineering Sections, including the Stores Section. The Sales Section is under the charge of the Accountant.

One of the Senior Engineers is in charge of the exchanges and workshop; he is assisted by two engineers and three foremen. The other Senior Engineer is in charge of the whole outside plant and is assisted by two engineers, two inspectors and three foremen.

Broadcasting

A local broadcast relay system for Malta and Gozo was established in Malta in 1935 and is operated by Rediffusion (Malta) Ltd. The number of homes served by Rediffusion programmes has increased from 4,000 in 1945 to more than 46,000 in 1958. In addition, the Rediffusion service is installed in many restaurants, hotels, hospitals, bars and cafeterias. Rediffusion covers 95 per cent. of the population.

The Station broadcasts two separately channelled programmes relayed direct to each receiving set, each of which has a two-way switch for programme selection. The "A" switch is almost entirely a relay of the General Overseas Service of the B.B.C. The "B" switch programme is locally produced and is almost entirely in the Maltese language. The "A" programme begins at 7.00 a.m. and continues without interruption until midnight, and the "B" programme begins at 6.00 a.m. and closes at 11.00 p.m.

I wish to place on record the great assistance which the department receives from time to time from the British Post Office, Messrs. Preece, Cardew & Rider, and British manufacturers of telephone equipment.

OUR CONTRIBUTORS

A. ATTARD ("Telecommunications in Malta") is Chief Engineer of the Post and Telephones Department, Malta.

H. P. BROOKS (joint author, "Gas Pressurization to keep Water out of Cables") is an Assistant Engineer in the Main Lines Development and Maintenance Branch of the Engineering Department. He entered the Post Office in 1941 as a Youth-in-Training in Cambridge Telephone Area, and was transferred to the Regional Training School at Cambridge in 1950. He went to London Telecommunications Region in 1953 on promotion, and after field training was transferred to his present duties in 1954.

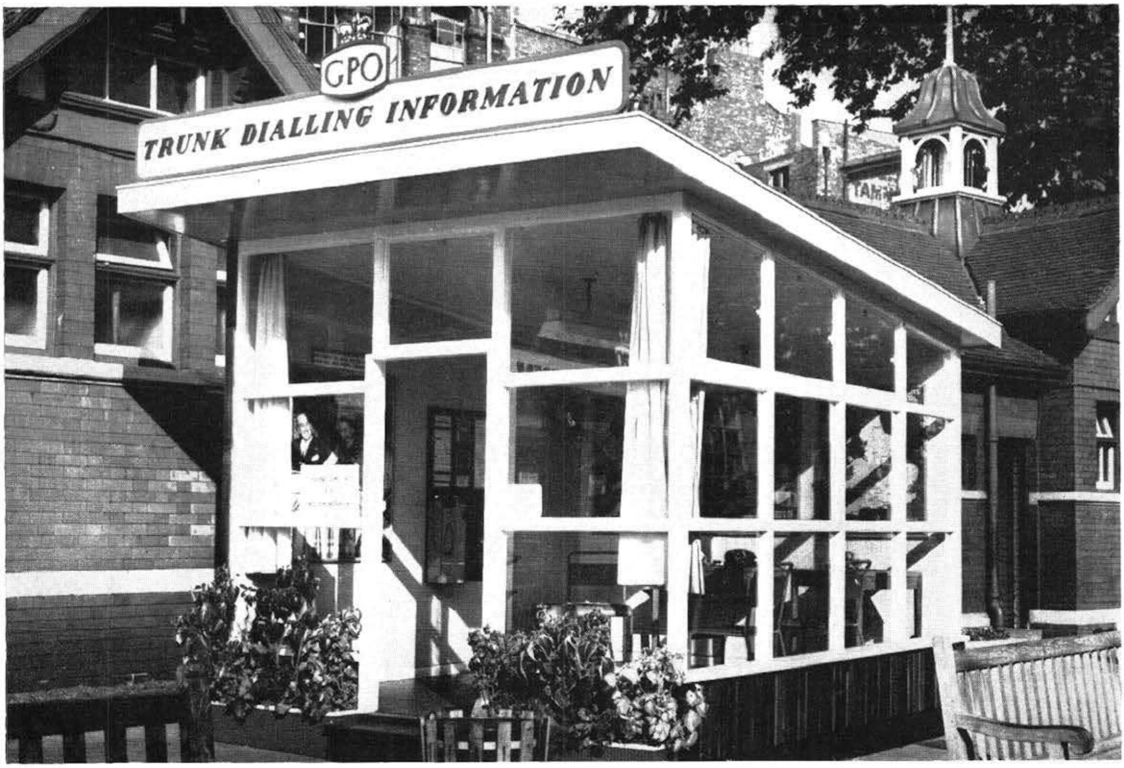
R. L. BULL ("Materials Testing in the Engineering Department") has always worked on chemical work in the Post Office since he joined the Engineering Department at Studd Street in 1927 as a Skilled Workman—there were no separate scientific ranks before 1937. In 1929 he was promoted Inspector and in 1937 regraded as Chemist. He transferred to Research Branch in 1939 and in 1946 became Senior Scientific Officer when the Scientific Civil Service was re-organized. Promoted to Principal Scientific Officer in 1949, he returned to Test and Inspection Branch where he is in charge of the London Materials Section.

R. H. FRANKLIN ("Television News Films by TAT") is Staff Engineer in charge of the Main Lines Development and Maintenance Branch of the Engineering Department. He entered the Post Office in 1924 as a Probationary Inspector and became a Probationary Assistant Engineer in 1928. After service in several branches he was promoted Executive Engineer in Lines Branch in 1936, where he was responsible for work on submarine cable telephone systems. During the war he served with Royal Signals in Egypt and Burma and returned to Lines Branch as Assistant Staff Engineer. He attended the Imperial Defence College in 1950 and following a period as Deputy Director of Signals at the Air Ministry, returned to the Post Office as Staff Engineer of the Transmission and Main Lines Branch.

R. J. GRIFFITHS (joint author, "Gas Pressurization to keep Water out of Cables") is a Senior Executive Engineer in the Main Lines Development and Maintenance Branch of the Engineering Department. He entered the Post Office in 1938 from the Department of Scientific and Industrial Research and joined the Engineering Department in 1940. He has been employed on the planning and provision of MU and CJ cables, the maintenance of audio, carrier and coaxial systems and, for the last nine years, on the maintenance of the MU and CJ cable network.

E. H. TRUSLOVE ("Data Transmission"), a Principal in the Subscribers' Services Branch of the ITD, joined the Post Office as a Probationary Inspector in 1938 and spent three years in London Telecommunications Region. In 1942 he passed the Probationary Assistant Engineers' competition and transferred to the Engineer-in-Chief's Office, Lines Branch. In 1943 he joined the Royal Naval Volunteer Reserve and was concerned with communications in Ceylon and India. After the War he spent several years in the Test and Inspection Branch of

(Continued on p. 50)



Trunk Dialling from Pay-on-Answer Coin Boxes

FIELD trial of the new pay-on-answer coin-box started at Bristol on September 5 when 23 existing kiosks in the City Centre were converted to the new system. This was inaugurated at a civic ceremony by the Deputy Lord Mayor of Bristol who made the first call from a pay-on-answer coin-box to the Lord Mayor of London.

After a preliminary trial of about a month work started on the replacement of the coin-boxes on the remaining kiosk and subscribers' coin-box lines on Bristol Central Exchange, a total of about 300.

To help callers to use the new type coin-box and, for the first time, to dial their own trunk calls, a demonstration bureau was installed for the first month near the largest suite of kiosks in the Centre. Telephonists staffed the bureau and patrolled the kiosks to give help and instruction. They were prepared also to give change, including the necessary threepenny pieces. The Royal Mint specially made available additional supplies of this coin to Bristol.

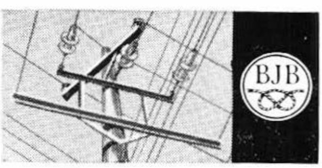
From the start of the trial public reaction has been favourable. Callers are becoming accustomed to "pay-tone" and to the timing of their local and trunk calls, and have been quick to take advantage of the opportunity to make short duration trunk calls Subscribers in other parts of the country are learning to recognize the new tone.

Celebration of the Golden Jubilee (September 29) of the Post Office Coast Radio services, deferred by the General Election, was held at the Baltic Exchange on November 3. The Postmaster General spoke with the Canadian Pacific *Empress of England*, which was off the St. Lawrence Seaway. He also replaced a ships' Radio Officer's proficiency certificate for Mr. R. Ferguson, Managing Director, Marconi International Marine Communication Company (who lost the original in a World War II shipwreck), and presented a certificate to the most recently qualified Radio Officer.

The PMG also sent congratulatory telegrams to all station officers and British ships' radio officers. Two of the original Marconi station officers were present.

Medico, the BBC documentary on the coast medical service, has won the International Italia prize contest.

The smallest things are often the most important—especially when they're wanted in a hurry. The BJB items shown here, for instance, are only a small part of the Electrical Transmission Line Equipment made by BJB—*and most of them can be delivered from stock*. BJB make practically everything you can think of for high and low tension distribution networks—from bracing gear to detachable pole steps. Write for the BJB catalogue.



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Notes and News

The Editorial Board of the *Journal* regret that Mr. H. T. W. Millar, Deputy Director of the London Telecommunications Region, has resigned from the Board so soon after succeeding Mr. Horn last April. He will be leaving London at the end of the year to become Director of the Post Office in Northern Ireland.

Mr. Millar's place on the Board will be taken by Mr. H. M. Turner, also a Deputy Director, L.T.R.

Other directorate changes in the Post Office announced recently are: Mr. L. G. Semple, hitherto Director of the South Western Region, is to succeed Col. H. B. Somerville as Director of the London Telecommunications Region. His place will be taken in the South West by Mr. L. J. Taylor, whom Mr. Millar succeeds in Northern Ireland. Col. Somerville retires on December 31.

Mr. G. H. Farnes, who has been Telecommunications Controller in the South West, is to become Deputy Regional Director.

Mr. L. Hill, Staff Controller in London Telecommunications Region, will succeed Mr. Millar as Deputy Director.

Mr. A. G. Robertson, Director in Scotland, will retire next March 24 and will be succeeded by Mr. W. H. Penny, Deputy Director in the South West.

OUR CONTRIBUTORS (*continued from page 47*)
Engineering Department until promoted to Senior Factories Executive Engineer in 1950. During six years in Factories Department he dealt with services and equipment needed in the new factories and planned the introduction of new factory processes. He returned to the Engineering Department in 1956 before joining ITD.

R. M. WATSON ("Post Office Telecommunications Advice Service") has been Assistant Controller of Sales in the Subscribers' Services Branch of ITD since 1958. He joined the Engineering Department in Liverpool in 1936 as a Skilled Workman after completing an apprenticeship as an electrical engineer with the Mersey Railway Company. From 1936 to 1939 he was engaged on exchange maintenance work. During the War he served in R.A.O.C. and R.E.M.E. in Air Defence Workshops, returning to Liverpool in 1945 as a Skilled Workman Class I. From 1946 he worked on exchange maintenance as Leading Technical Officer until appointed Assistant Sales Investigation Officer in 1949. From 1951 as Sales Investigation Officer he was engaged mainly on Telecommunications Advice work, Sales Office procedures and the Telex sales campaign until 1958.

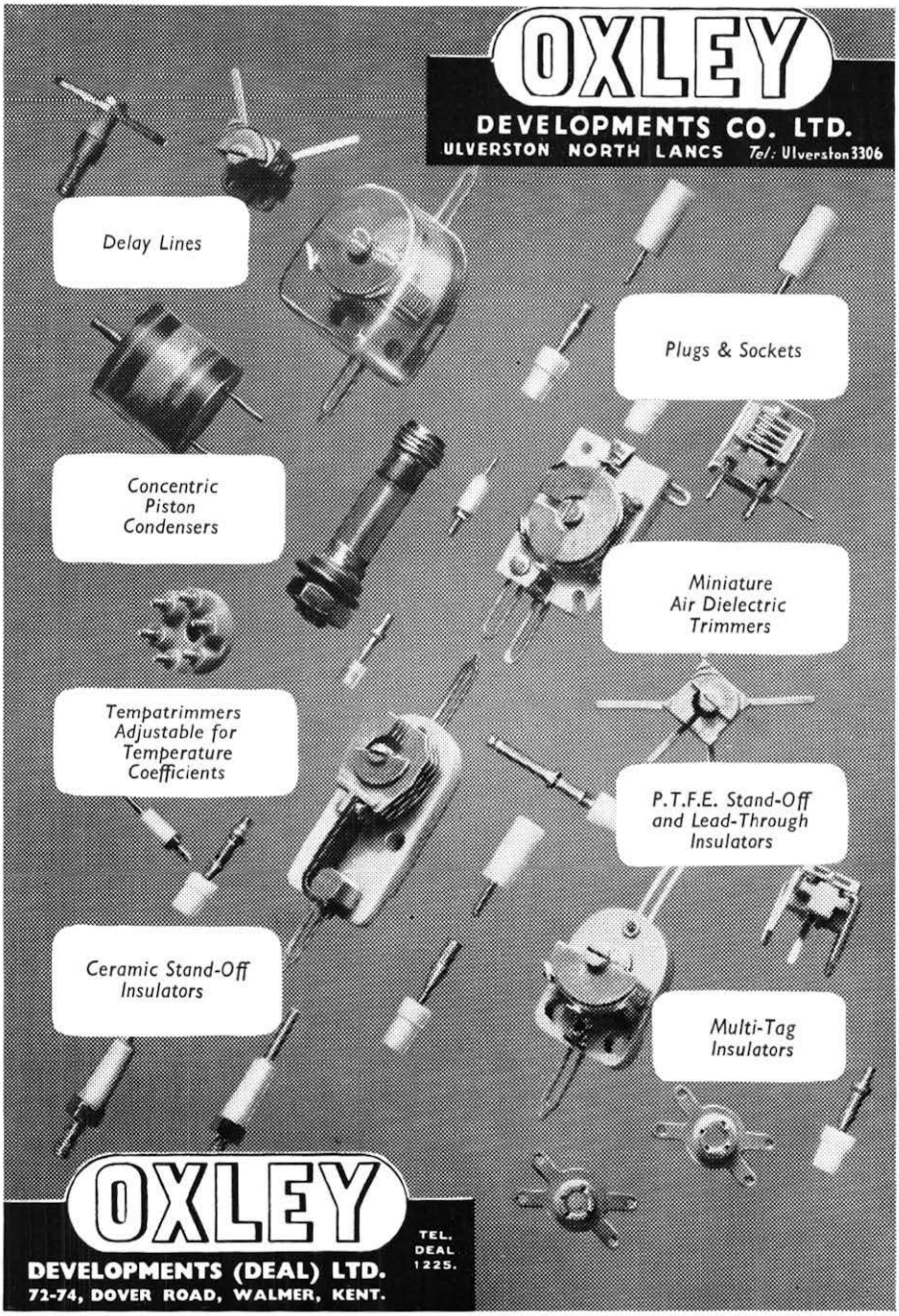
Charging for STD Calls: A. H. Longley's career was outlined in our Winter, 1958 issue

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

Contributions. The Editorial Board will be glad to consider articles of general interest within the telecommunications 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."

GPO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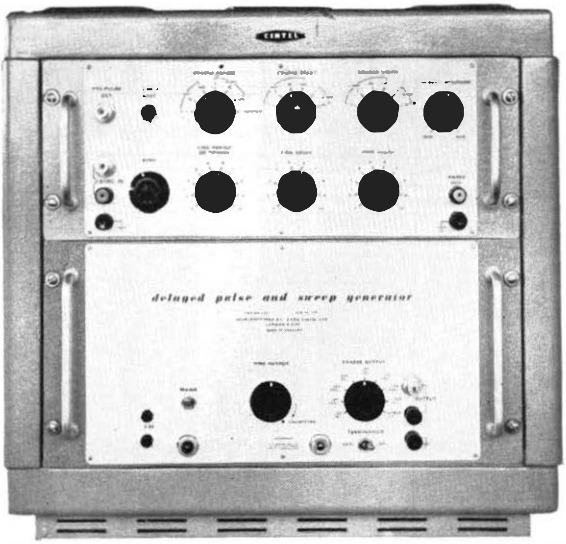

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Pre-pulse

40mμsec. 8V peak in 75Ω, positive going.

Main pulse

Width:	Variable from 0·09μsec to 105msec ±5%.
Amplitude:	Control gives 4:1 attenuation of each of four maximum outputs as follows:
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	10V max in 150Ω rise time <20mμsec
	25V max in 600Ω rise time <40mμsec
	50V max in 1000Ω rise time 50mμsec
Polarity:	Positive or negative going.
Accuracy:	±2%.

Delay

Conclusion of pre-pulse to advent of main pulse, delay variable from 0·09μsec to 105msec. Accuracy ±5%.

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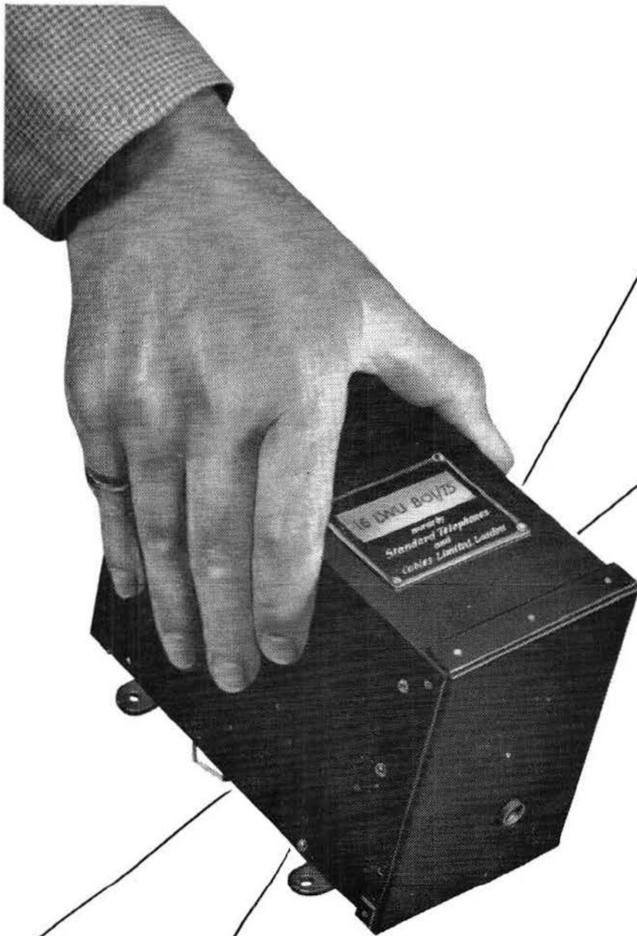


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Typical of the latest type of 'cordless' telephone switchboards are these operating positions installed by Siemens Edison Swan in one of the British Post Office Trunk Exchanges where operator controlled long distance calls are handled.

These switchboards are noteworthy for their use of remote-controlled automatic selectors in place of outmoded cords and plugs, and for such other advances as automatic call queueing and digit key sending. Calls can be established quickly and without effort, and for the subscriber this means an end to irritating delays.

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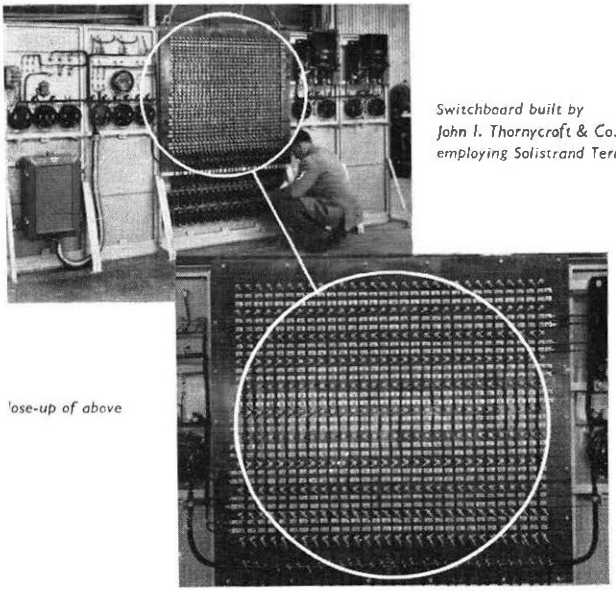

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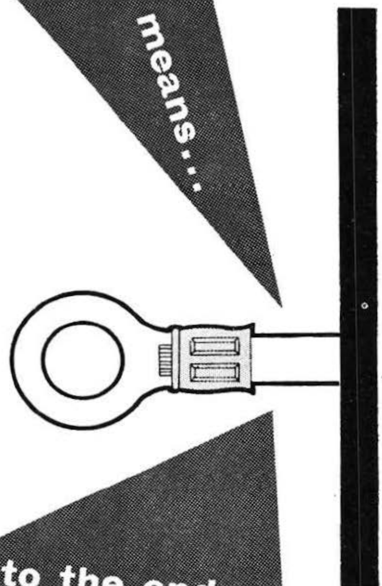

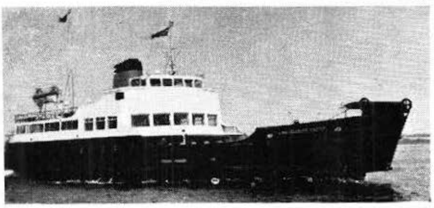

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The switching equipment is the type 32A Mark II Selector. 2 v.f dialling equipment and motor uniselector junction hunting equipment has been supplied by A.T.& E.Co. Ltd.

The new Oxford telephone exchange, replacing an older one nearby which gave service for many years.

Another A.T.E. exchange

One of the most modern exchanges in Great Britain has recently been put into service at Oxford. Catering initially for 7000 lines there is provision for early inclusion in the subscriber national trunk dialling network already operational in the Bristol area. The exchange switching, v.f. signalling and automatic trunk selection equipment was supplied and installed by A. T. & E. Co. Ltd. who also installed the Bristol trunk exchange and are at present supplying equipment of Strowger type for subscriber trunk dialling networks in Portugal, South Africa, etc.

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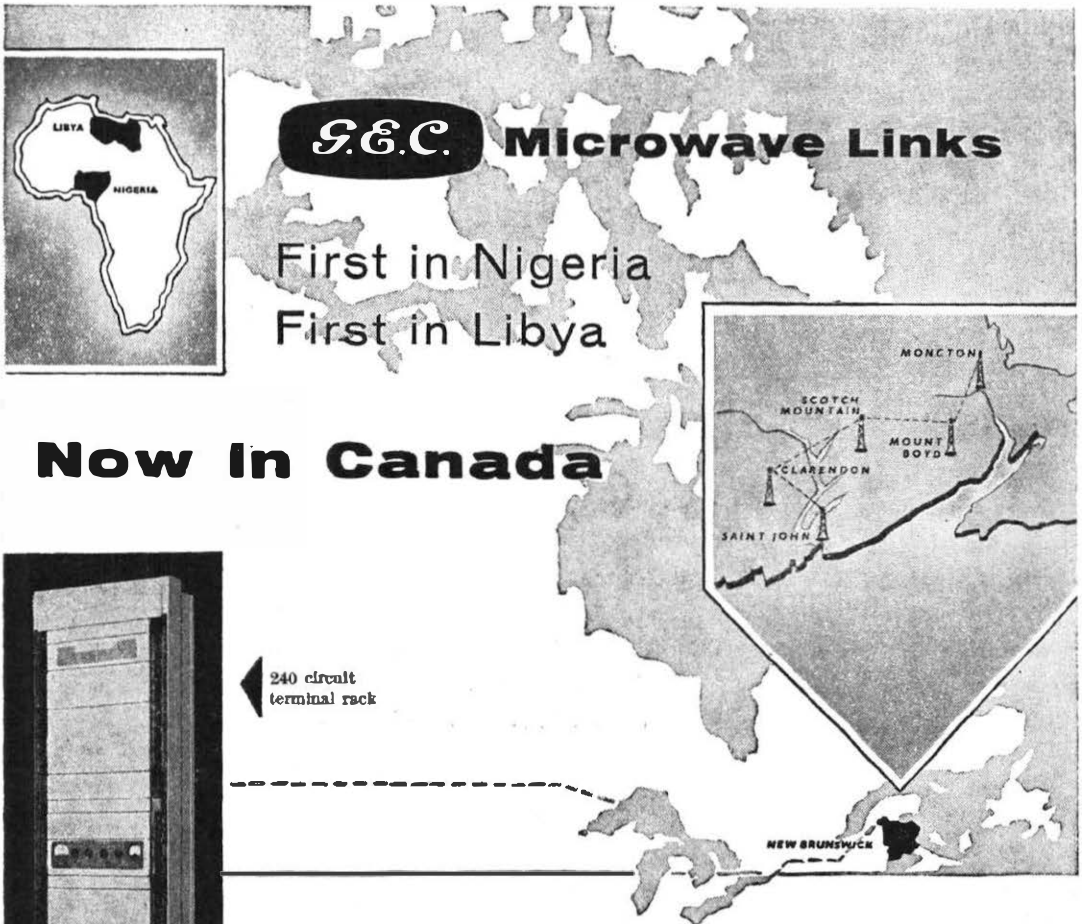

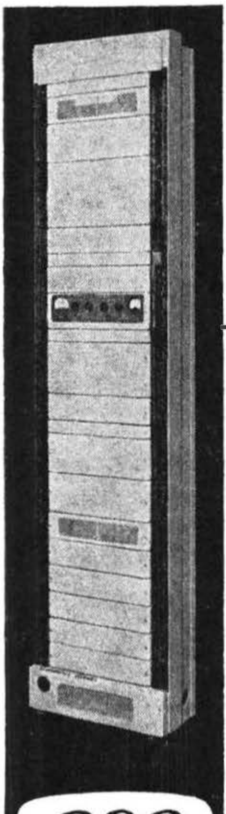

240 circuit terminal rack

The General Electric Co. Ltd. of England has received a contract from The Canadian General Electric Co. Ltd. to supply a multi-circuit microwave radio system between Saint John and Moncton, for The New Brunswick Telephone Company, Limited. G.E.C. 240-circuit 2000 Mc/s radio equipment will be employed, equipped initially for 60 speech circuits. The equipment will convey television signals instead of telephony circuits, if required. Three intermediate stations will be provided at Clarendon, Scotch Mountain, and Mount Boyd. A standby link will be supplied with automatic changeover in the event of failure or degradation of the main signal. Further 240-circuit systems can be added as required using the same standby link as a protection channel. For information on the radio and multiplexing equipment, please write for Standard Specifications SPO.5501 and SPO.1370

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Photograph by courtesy of the Director of the Jodrell Bank Experimental Station

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