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

★

Vol. 5 FEBRUARY-APRIL 1953 No. 2

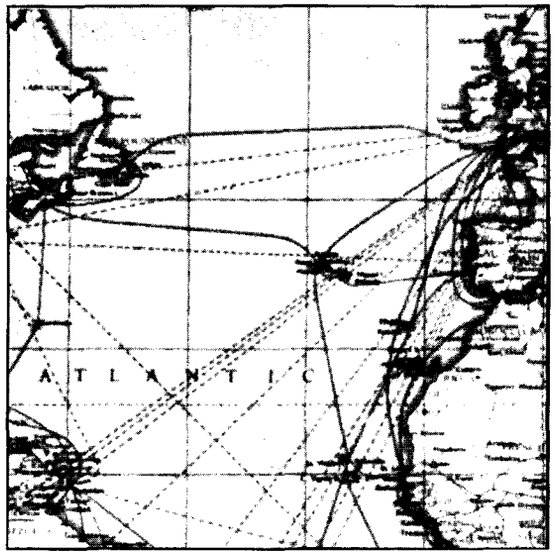
A New Chapter

WE PUBLISH IN THIS ISSUE A BRIEF OUTLINE OF the new External Telecommunications Executive created by the Post Office as a further step towards integrating the oversea telegraph services formerly operated in the United Kingdom by Cable and Wireless, Ltd., with the oversea telecommunication services—telegraph and telephone—operated by the Post Office.

The British oversea telegraph services have had a long and eventful history since the four companies which were ultimately amalgamated as the Eastern Telegraph Company opened the first direct cable service between Britain and India in 1870. The "Eastern", gradually expanding its own and associated operations until it became known as the Eastern and Associated Telegraph Companies Group, joined forces with Marconi's Wireless Telegraph Company in 1928 and both were merged in the following year with the Post Office Beam Services, the Imperial transatlantic cables, and the services of the Pacific Cable Board in a single company, though with many associated and subsidiary concerns. After eighteen years, the structure of these British-owned oversea telegraph services was again changed, and this recent change, which began in 1947, and subsequent developments, are outlined in the article about the new Executive that begins on page 47.

Readers of the *Journal* will wish the best of fortune to Mr. W. A. Wolverson, Director of the new Executive, and to his colleagues, in this latest step towards knitting the United Kingdom's services into an even more effective network than today.

Restoring the Transatlantic Cable, 1952



"Via Imperial"

TWELVE SUBMARINE TELEGRAPH CABLES RUN under the North Atlantic between the British Isles and Canada, but for nine years from October, 1943, there was no direct communication between Britain and the Dominion through a British-operated cable. American companies were working cables between England or Ireland and Newfoundland; Cable and Wireless, Ltd., maintained communications through their cable that runs from Porthcurno, Cornwall, by way of Fayal in the Azores, to Halifax, Nova Scotia, and, when necessary, through diversionary routes; the same Company, until April, 1950, and since then the United Kingdom Post Office, worked a radio beam circuit from London to Montreal; but the duplex cable from Porthcurno to Harbour Grace, Newfoundland, and thence to Halifax was interrupted and, owing to war and post-war difficulties, could not be restored. On 21st August, 1952, however, Captain J. P. Betson, Commander of H.M.T.S. *Monarch*, stepped ashore at Halifax after many weeks of work, to be welcomed by the Premier of Nova Scotia on the historic occasion of "the restoration of this long dormant communication".

The whole of the original cable from the United Kingdom to Canada, some 2,900 miles in length, was laid by C.S. *Faraday* in 1874 for the Direct United States Cable Company, formed in 1873. This cable was later taken over by the United Kingdom Post Office as the "Imperial" cable and became part of the "All-Red Route" between Britain and Australasia, Canadian landlines providing connection across the Dominion, the Pacific Cable Board's cable, laid in 1902, from Vancouver to Australia, completing the route. Since 1950, the Canadian terminal has been operated by the Canadian Government; Cable and Wireless, Ltd., however, retain control of the cable and of the terminal at Porthcurno, which is linked by landline with the Post Office Cable and Wireless Central Telegraph Station in London.

In 1951, the Company chartered H.M.T.S. *Renown* to survey, investigate and repair all breaks in the eastern half of the Atlantic cable and commissioned one of their own fleet, C.S. *Lady Denison-Pender*, to carry out similar operations on the western half as well as the whole of the Halifax-Harbour Grace section.

On completion of these operations, *Monarch* sealed and slipped a good end towards Porthcurno some 1,130 nauts from Porthcurno, while *Lady Denison-Pender* found a good end towards Harbour Grace some 220 nauts from Harbour Grace, thus leaving a gap of 800 nauts to be filled. It was also proved that 400 nauts of cable would be required to renew the Halifax-Harbour Grace section.

The cost of the whole operation was estimated at £1,900,000.

Meanwhile, the requisite cable was being manufactured by Submarine Cables, Ltd.; but whereas the original cable was insulated with gutta-percha in accordance with the practice of the day, the new cable was insulated with Telcothene, which is the manufacturer's brand of polythene, the recently developed thermoplastic polymer of ethylene which is lighter than gutta-percha, is more impervious to damage—and has equal insulating properties and better transmission characteristics.

On 21st June, 1952, *Monarch* moored off the works at Greenwich and began to load some 1,300 nautical miles of cable to undertake final repairs. Three weeks later, on 14th July, she left the Thames for mid-Atlantic.

"The weather", records an officer of the ship, "was fine and clear for the next few days. Cable hands were busy preparing the cable gear, and entries in the log were 'light south-west wind, slight sea, fine and clear, speed 12½ knots . . .'. Positions by sun and stars were taken by the navigating officers at every opportunity and the familiar phrase as they relieved each other was 'Can we hold this fine clear weather and be able to pin-point the cable position?'—the position where that very small line of cable about an inch in diameter lay streamed on the bottom of the ocean a mile and three-quarters deep.

"But this was not to be, for, 36 hours before we were due to arrive at the required position, fog, the curse of all seafarers, had enveloped the ship".

The fog persisted throughout the run. Nevertheless Captain Betson knew that the only way to get a good dead-reckoning position for dropping the mark buoy was to maintain course and speed. The strictest lookouts were kept. The Captain and the officer of the watch kept their eyes glued to the radar, which, regardless of the degree of visibility, can give pictures of objects within a radius of 25 miles. Frequently an officer had to dash into the chart room to ascertain the soundings given by the echo sounder from the sea bottom. Throughout, in accordance with international regulations, the ship's whistle blasted her whereabouts every two minutes—monotonous to all, wearisome to officers and men trying to snatch a little sleep between watches.

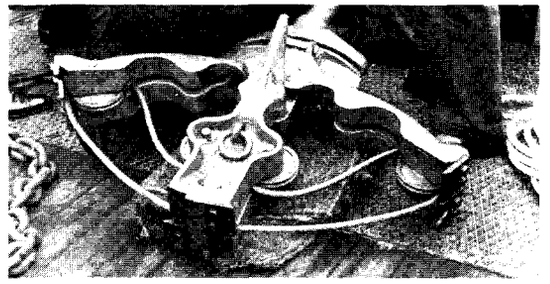
When the log, which records the actual speed of the ship and the number of miles she has steamed, showed that *Monarch* was within five miles of the estimated position of the streamed Porthcurno end, all preparations were made for dropping the mark buoy.

When the estimated position was reached on 5th August, the echo sounder was recording a depth of one and three-quarter miles. The ship was stopped and the Cable Officer in the bows ordered to pay out the buoy moorings and slip the buoy.

On the following morning banks of fog were still drifting across the ship, sometimes completely obscuring the foredeck. There was no sign of clearing and the Captain decided to grapple, positioning the ship by radar from the mark buoy. Meanwhile the cable station at Porthcurno had been asked to maintain continuous watch from 0700 hours for the ship's call on the cable.

The course was set at right angles to the line of cable, as the best possible angle for hooking. The grapnel was lowered forward on the end of two and a half miles of rope passing under the dynamometer, and the ship's speed was set at one knot. The officer in the bows sat on the cable rope, feeling with his stern—the most sensitive part of the body for the purpose—every movement of the grapnel as it slowly dragged along the sea-bed.

If the grapnel fouls on the sea-bed, the officer feels a sudden pull and the dynamometer rises



Deep-sea grab, open

sharply; if the cable is hooked, the officer feels twinges and the dynamometer shows a slightly rising weight.

For five hours *Monarch* moved slowly over the estimated position in the dense fog. At about 1515 hours Captain Betson noted that the dynamometer was creeping up the scale. The officer stood up from the rope and went to the bridge telephone to report that the cable was hooked. A wireless message was sent to Porthcurno: "MON now recovering your end". Slowly the cable, with a weight of 150 cwt. showing on the dynamometer, was heaved up to the bows. Porthcurno was asked, by way of Harbour Grace and Montreal, to insulate her end.

The cable hands stoppered the cable and put on leads to test towards Porthcurno. The tests succeeded, thus proving that the cable was good. With the paying back of the cable to the ocean bed, moored to a buoy with two miles of rope, the first part of the operation was completed—a fine piece of work in so short a time in a dense fog.

Monarch then began to plough her way 800 miles westward, taking soundings all the way, her whistle blaring through the fog every two minutes. The position of the streamed Harbour Grace end was on the Grand Banks off Newfoundland and in the iceberg area.

Wireless messages reported bergs to the north-west, but radar cannot be depended upon to pick up icebergs. Nevertheless, in a morning watch, a big blob appeared on the radar screen bearing green 0 20°; the sea temperature dropped and the sea became a flat calm, and half an hour later a large mass appeared on the radar passing down the starboard side of the ship. As daylight broke it was proved to have been an iceberg, for on the starboard side the seamen could see the ice blink—a shining whiteness about the horizon produced by reflection from a distant mass of ice. *Monarch* duly wirelessed a warning to all other shipping in the vicinity.

The ship was now approaching the estimated position. Weather reports from Halifax promised a break—fog thinning and clearing by the afternoon on which *Monarch* expected to reach the position. Overnight the skies cleared, making navigation possible by the stars. Next morning *Monarch*, driving in a south-easterly direction across the cable, quickly grappled; the cable was raised and tested with Harbour Grace, and the end was jointed and spliced to the new cable in the tanks.

Now began the laying operation back over the eight hundred miles towards the buoy left to mark the buoyed end, 1,130 nautical miles from Porthcurno. *Monarch* steamed at seven knots with the cable running over the stern sheaves. Soundings on the westward trip had shown a fairly even sea-bed with frequent depths of 2,000 to 2,040 fathoms. The Engineer Officers in the drum room controlled the percentage of slack, which had previously been calculated at 7 per cent. over the 800-mile lay, to allow for irregularities over the bed and to facilitate recovery should the cable need repair at some future date.

Finding a cable buoy in mid-ocean needs skilful navigation and good weather. For several days the good weather held, but it began to deteriorate when only about 100 miles of cable were left to pay out. Doubts arose about finding the buoy, when C.S. *Lord Kelvin*, a Western Union cable-ship, steaming east on a parallel course at 12 knots, signalled asking whether she could help. Captain Betson replied with thanks, adding that if *Lord Kelvin* should sight the buoy *Monarch* had left two weeks earlier, he would be grateful if she would report whether the light, left on it two weeks earlier, was still burning. At 2000 hours *Lord Kelvin* reported the light. At midnight *Monarch's* bridge watch was relieved and the search for the buoy began with binoculars and radar. Soon a lookout on the starboard bow reported the buoy, just as it had been left. *Monarch* had achieved perfect navigation and a perfect lay. The buoyed end was lifted, spliced on to the new cable, tests were made, and at 1900 hours on 6th August connection was at last restored over a direct cable between the United Kingdom and Canada. By 27th August the 400-mile length on the Harbour Grace-Halifax section was renewed and, after a few days in harbour, *Monarch* sailed for other commitments, having completed one of her largest cable repair operations.

The dynamometer rises as the grapnel takes the weight

External Telecommunications Executive

A new Post Office Headquarters department

NEARLY THREE YEARS HAVE PASSED SINCE the Post Office assumed, in 1950, responsibility for operating in the United Kingdom the overseas telegraph services previously operated by Cable and Wireless, Ltd. During 1952 the organisation for the administration and control of all the overseas telegraph and telephone services of the United Kingdom was reviewed, with the result that, except for the ship-shore radio services, they have been transferred to a new headquarters department of the Post Office, the External Telecommunications Executive. Before describing the new organisation, it may be as well to recapitulate briefly the developments* which led to the changes of 1950, and so, ultimately, to the formation of the Executive.

Acquisition by Governments

Between 1947 and 1950 the Company's assets in the United Kingdom, Canada, Australia, New Zealand, South Africa, India and Southern Rhodesia were acquired by the Governments of those countries; Ceylon followed suit in 1951. The various Governments either set up special organisations to operate the services or integrated them with the local Post Office services.

Cable and Wireless, Ltd., remained in being as a Company, with its own Court of Directors, operating the Central Telegraph Station in Electra House, London, the Cable Station at Porthcurno in Cornwall, the 150,000-mile submarine cable network, five wireless stations in the United Kingdom and 40 United Kingdom branch offices in London, the provinces, Scotland and Northern Ireland, for the collection and delivery of telegrams.

The existing Commonwealth Communications Council was transformed into the Commonwealth Telecommunications Board, with the duty of co-ordinating the activities of the various organisations throughout the Commonwealth. The functions of this Board were described in the August, 1952, issue of this Journal.

On 1st April, 1950, the operations of Cable and Wireless, Ltd., in the United Kingdom, except for the Cable Station at Porthcurno, were transferred to Post Office control, leaving the Company's overseas operations as since 1947.

The new External Telecommunications Executive now controls the whole of the British-operated overseas telecommunications services in the United Kingdom, except ship-shore radio services; a few foreign-owned companies continue to operate overseas telegraph services under licence from the Postmaster-General.

Field Units

The Executive's field units are: London Station, formerly the Company's Central Telegraph Station, with which the five outlying wireless stations are connected by landline, and which has direct landline links with the Company's Cable Station at Porthcurno; the Cable Room of the Central Telegraph Office, operational headquarters of the Post Office continental cable and radio telegraph services, which is linked with the British terminals of the cross-Channel cables; the International Radio Exchange in Wood Street, London, and the Continental Telephone Exchange in Faraday Building. The Wood Street and Faraday Building exchanges constitute the British terminals of all the overseas cable and radio telephone services.

The Director of the Executive keeps in close touch with the Company. He represents the Government on the Commonwealth Telecommunications Board. Within the Post Office he is responsible to the General Directorate.

The Executive came into being on 1st October, 1952. The accompanying chart shows the broad layout. The Director is supported by two Deputy Directors, who are supported by two Controllers, a Planning Engineer, a Financial Adviser and two Principals. One Controller is responsible for

* See the Journal for May, 1950.

Operations and Planning, and the other for Staff and Buildings. One Principal is responsible for Services and Tariffs and one for Overseas Relations.

In the main, the staff of the new Executive has been provided from existing Post Office establishments. In the paragraphs which follow, a brief description is given of the functions of the individual Branches of the Executive.

Operations and Planning Branch

This Branch is responsible for defining the traffic requirements of all the field units and for the operational control of the International Radio and Continental Telephone Exchanges and the Central Telegraph Office Cable Room. In Electra House, however, immediate control is vested in the Telegraph Manager, but the Controller of the Operations and Planning Branch is responsible for liaison with Cable and Wireless, Ltd., in respect of all traffic handled in the Station. The Telegraph Manager remains in immediate control of the "Post Office Cable and Wireless" branch offices and agencies in London.

Engineering Branch

The Planning Engineer is responsible for formulating the long-term engineering requirements in respect of additional overseas circuits, including the broad lines of technical development. He presents these requirements to the Post Office Engineering Department and, in consultation with the appropriate Branch in that Department, agrees how they are to be met. The Engineering Department, because of its centralised research and experimental establishments, undertakes the design of specialised equipment and is responsible for its supply.

Staff and Buildings Branch

On the staff side, the functions of the Staff and Buildings Branch include supervising the general conditions under which the staff work, and such matters as staff consultation, sick and other leave, pensions, discipline, recruitment, training, welfare, promotion, organisation and grading. The Buildings side of the Branch is concerned with housing the staff and equipping the field units.

Finance Branch

The Finance Branch deals with the work arising from the field units and is completing the adaptation of the Electra House accounting and other financial processes to the Post Office system.

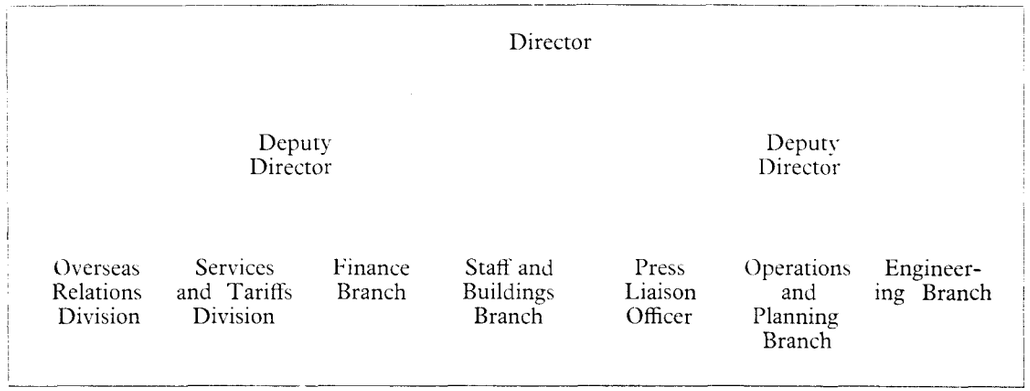
Services and Tariffs Division

This Division deals with the provision of new overseas telephone and telegraph services, with the extension of existing services and with rates and tariffs for overseas services.

Overseas Relations Division

This Division is concerned with relations with the Commonwealth and External Telecommunications Boards; general questions on relationship between the Post Office and Cable and Wireless, Ltd., and between the Post Office and foreign telegraph companies operating from this country.

Organisation of External Telecommunications Executive



Some comments on the future of the European international telephone service

A. H. Mowatt

P.O. Headquarters, Scotland; formerly Overseas Telecommunications Department

THE INTERNATIONAL OPERATOR WILL SOON be able to select telephone numbers in foreign countries without the aid of another operator. Indeed, the feat has already been accomplished in field trials of new signalling equipment designed for the purpose. This advance is called on the Continent "semi-automatic" working and is the immediate objective of the European telephone administrations, including the British Post Office, co-ordinated by the International Telephone Consultative Committee (C.C.I.F.).

The problems which have been met and are being overcome in the attainment of semi-automatic working are scarcely concerned with distance: longer distances have to be traversed in the U.S.A., where it is much farther from New York to San Francisco than between opposite corners of Europe. The problems in our continent arise rather from the differences of language; from the variety of telephone systems to be interconnected; and from the need to relate each call and its duration to the chain of connection used, in order that the telephone administration of each country through which the call passes may be given its due quota of the revenue collected. (To an intermediate country such traffic brings in revenue from abroad and is therefore an "export".)

The Language Problem

The scope for mechanical aids in the European international service might be limited by language differences. The *sine qua non* of semi-automatic working is that an operator in the country of destination does not have to intervene: automatic equipment will make this intervention technically unnecessary, but if the international operator setting up the call had to speak at any length to the person answering the called number, and were frequently to get into difficulty because of the language difference, the equipment might not be worth providing, since it would not save calling in an operator in the called country to assist.

International operators have language qualifications, but they cannot be expected to speak more than one or two foreign languages. Calls to the international exchange could be intercepted and then directed to a controlling operator speaking the language of the country wanted, but this system would have many drawbacks. At least one operator for every European language would have to be available every hour of every day, which would make staffing extravagant and inflexible; the extra link on calls to the international exchange would delay the call, lower the quality of transmission, make supervision of the call difficult and perhaps inconvenience the caller. The field trials will test various procedures, but it seems likely that the present use of a few operating languages will be continued. In London, for example, French is used in operating to France, Belgium, Switzerland and Italy, and English to the Netherlands, Germany and Scandinavia. The aim is that ultimately every operator in the London Continental Exchange will be able to speak French as well as English, and the choice will depend upon which is used by a distant international operator who may intervene. Conversation with the distant subscriber will be avoided as far as possible, to avoid the risk of language difficulty.

Call Practice

On ordinary calls the caller is prepared to speak to anyone who answers the called number, and the operator will let the conversation begin naturally and will rely on the caller's appealing to her if there should be difficulty. In this way the language problem will be avoided on ordinary calls. On personal calls, which make up about 40 per cent. of all calls between the United Kingdom and Continental countries, the operator may have to obtain information from the person answering the called number about when or where the desired person may be available. The solution of this problem will probably be a compromise. The controlling operator will attempt to get the necessary information and is expected to succeed more often than not; but she will be able to send a special signal if necessary to call in an assistance operator in the country of destination. This facility will be essential as a standby, but on many routes it may seldom be used: in the Netherlands and the Scandinavian countries, for instance, a great many people speak English. Moreover, the preponderance of international calls are made by and to a small number of firms and people engaged in foreign trade. (This is signified by the fact that nearly nine-tenths of the calls from the United Kingdom to the Continent originate in the London area.) The field trials have already given encouragement for the view that language difficulty will be seldom encountered, and therefore the use of automatic equipment, even on personal calls, will be justified. Closer social intercourse between nations may one day result in a wider, less specialised use of the international telephone service, and the language difficulty might then be more frequent on some routes; but in the last resort some circuits could be set aside for personal calls on those routes and connected directly to assistance operators, by-passing the automatic equipment: the chance of this being necessary is small.

In sending the inward assistance (or, officially, "forward transfer") signal, the controlling operator will have to indicate in what language or languages she can speak to the assistance operator. This indication might not be necessary on circuits used only for direct traffic between the terminal countries, but it would still be convenient, since the circuits may pass through common terminal equipment; moreover, a switching network is envisaged. On a call from, say, London to Vienna, switched through an automatic exchange at Frankfurt on to a Frankfurt-Vienna circuit used also for terminal traffic, it will be essential to indicate to Vienna that an operator answering a call for assistance must be able to speak either English or French. Thus, a list of codes will have to be agreed on internationally, each code probably being a single digit that can be sent automatically in advance. The list may conveniently include not only all the international operating languages but also various combinations; "English or French" might be the choice signalled on all calls from the United Kingdom, so that assistance could be sought from a wider field of operators in certain international exchanges.

Trunk Routing in Foreign Countries

When the controlling operator has obtained the automatic trunk exchange at which the international circuits terminate in the distant country, either directly or by dialling a code through a tandem exchange in an intermediate country, she will be faced in a semi-automatic service with the task of routing the call over the trunk network of that country. At first, she will be expected to reach only those national group centres which are accessible by direct dialling or key sending, and

then only the automatic exchanges at those centres. Even with this restriction, the routing information to be provided in each international exchange will be very large, since it will comprise a list of every exchange on which numbers can be remotely selected in every other European country. (The absence of an exchange from the list will indicate that the call must be set up by a distant international operator.) Only a small part of this information need be available at the operator's position, since international traffic is mainly between the largest European cities, but it will be very desirable that the routing procedure be as simple and uniform as possible.

Step-by-Step or Single-Code Routing

There are two alternative systems of trunk routing. In the United Kingdom it has been decided to adopt step-by-step routing for the initial trunk mechanisation. With this system, which is to some extent similar to the non-director system in a local network, the code used to obtain a particular group will vary according to the point of origin and to the route followed. With single-code routing, which is akin to the local director system, each trunk group is given a unique number which is used by a trunk operator in any other part of the country; at each switching point this code is translated automatically into the code appropriate at that centre for switching the call.

Step-by-step routing is straightforward, but its capacity and flexibility, like those of the local non-director system, are limited by the mutual dependence of codes and routing.

Single-code routing has two advantages. It permits automatic alternative routing of calls so as to secure a higher utilisation of circuits, and thus economy in line plant, for a given grade of service. Furthermore, the trunk codes can be published in the directory and subscribers encouraged to print them on their notepaper so that callers will use them in booking trunk calls, thereby saving operating time. It is, moreover, the only system suitable for the dialling of long-distance trunk calls by the subscribers themselves. On the other hand, the initial cost may be high and the design of the system is necessarily a complex business.

Single-code routing using a national numbering plan is generally regarded as simpler for international operating and for this reason it has been recommended to national administrations by the International Telephone Consultative Committee (C.C.I.F.). Since, however, the United Kingdom will have only one switching centre (in London) for incoming international calls, the trunk codes dialled by foreign international operators to obtain exchanges in this country will be uniform under either system, although changes in routing codes may be more frequent with the step-by-step system as it develops.

International Switching Scheme

Whichever routing system may be adopted nationally, the C.C.I.F. has recommended that for the international switching scheme each country should be identified by numerical codes, probably of two digits. A country may have two or more codes, one for each international exchange.

Since the number of international exchanges in Europe is fairly small (about thirty), it would be possible to connect every pair by direct circuits; and indeed a good many are already so connected, but the traffic between some centres is quite small, justifying scarcely more than one or two circuits, and consequently it has been thought wise to assume that some economy will be gained by the use of an automatic switching system.

The value of a switching system depends on how much saving in circuit costs can be achieved after taking into account the cost of the switching equipment. The European plan at one time envisaged a ring of high-frequency cables—coaxial or carrier—around the periphery of the continent, with spurs to countries not on the ring. The ring was suggested because it offered a safeguard against breakdown; some circuits on major routes could be permanently routed in each direction round the ring, or they could be re-routed round the longer arc when an interruption occurred on the shorter arc. The ring conception has become somewhat tenuous; alternative routing along parallel cable routes will probably give as good or better safeguards more cheaply, but at least a horseshoe if not a ring is developing (Figure 1) and all the international circuits will tend to be concentrated on it.

This disposition of circuits will make it convenient to adopt a scheme using switching centres at appropriate points on the horseshoe. Rather than provide, say, five circuits between London and Budapest, we may decide to switch calls at Zurich; and the same grade of service may be given by adding perhaps only two circuits to each link to carry this traffic if the links are already fairly large groups of circuits carrying other traffic. The decision will depend on an economic formula which will show whether it is cheaper to put in the

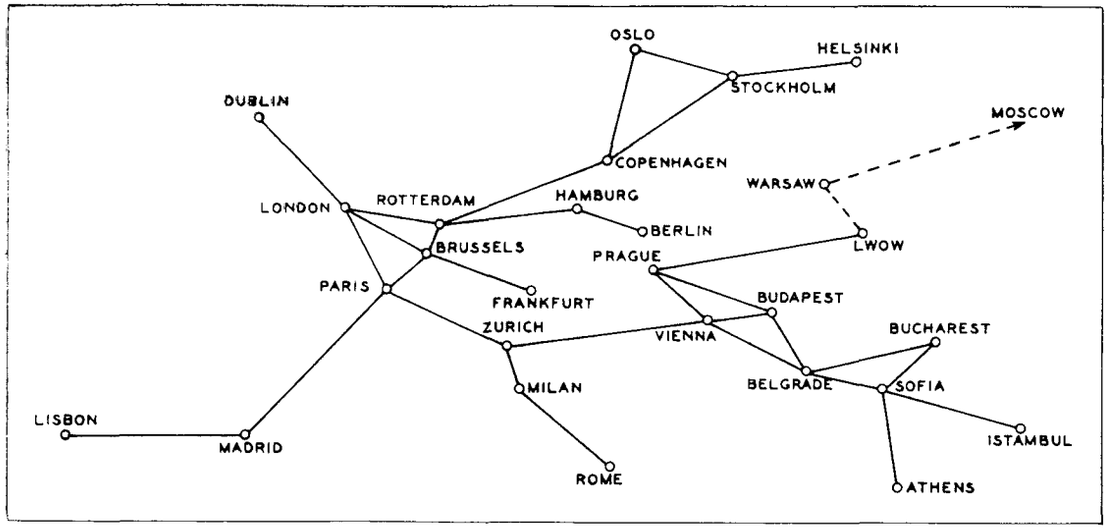


Fig. 1. Coaxial and carrier cables. C.C.I.F. trunk switching plan

five direct circuits or to add the two circuits on each tandem link and the switching equipment for connecting them.

Alternative Routing

Alternative routing is a compromise between, on the one hand, routing all traffic on direct circuits and, on the other hand, switching it all over two tandem links. Alternative routing by operators has its limitations, especially in the capacity of the operators to memorise the routes. If the alternatives are connected to switching equipment so that calls overflowing from the direct circuits are automatically connected over a tandem route, this difficulty is removed: and the system may yield useful economy in long, costly international circuits.

The number of direct circuits may be deliberately limited to those that can be heavily and thus economically loaded: the grade of service is safeguarded by the overflow route. The cost of a direct circuit will always be less than that of a through connection over the tandem route, because terminal equipment for transmission and signalling, as well as switching equipment, is necessary at the tandem exchange. If the number of direct circuits is increased, however, a point will be reached where the load carried by the last circuit is so much less than the average loading on the tandem circuits that the lower circuit cost is outweighed by the smaller load carried: the cost of handling a unit of traffic on the last direct circuit is then higher than the corresponding cost on the tandem route and so this last direct circuit is not justified.

The optimum load division is such that the cost of handling a unit of traffic on the last direct circuit is just less than the cost on the tandem route. This optimum point is found from a formula which (if the system is adopted) will have to be agreed internationally: it will indicate the minimum load on the last direct circuit and hence the number of direct circuits to be provided.

Overflow will always be on to a larger group of circuits and ultimately on to the major "backbone" routes, which must be kept supplied with a sufficient number of circuits to give the standard grade of service without further alternative routing.

Automatic alternative routing gives the greatest saving on long routes and on small routes—two extremes which tend to go together and are common in the European international network.

Circuits, Routing and Charging

The switching will be done on a four-wire basis and up to three international circuits may be connected in tandem. The network will be planned on the basis that three alternatives may be allowed

No.	Signal	Direction	Purpose
1a *1b*	***Terminal seizing*** ***International transit seizing***	→	To cause the appropriate equipment to be seized at the distant end. This signal is sent when keying is complete.
2a *2b*	***Terminal proceed to send*** ***International transit proceed to send*** (There is no distinction between these signals on the IVF system)	←	To indicate to the automatic sender that the equipment is ready to receive impulses.
3a	***Impulsing*** (16 combinations)	→	To convey the numerical information : Codes 1-10 : Digits 1-0. Also to provide certain special signals :— Code 11 : to route the call to an incoming operator. Code 12 · a numerical code : to route the call to a particular operating position, or group of positions. Code 15 : See signal No. 4.
3b	***Digit acknowledge*** (2VF system only)	←	To confirm the correct receipt of each digit (including Codes 11, 12 and 15).
4	***End of impulsing*** (using the impulsing combination Code 15)	→	To indicate to the distant register that no more digits will be sent.
5 *6*	***Ringing tone*** ***Busy flash***	←	To operate visual signals at the controlling operator's position : to be used when practicable.
7	***End of selection*** (2VF system only)	←	Used when it is not practicable to send signals 5 or 6.
8	***Answer***	←	To operate the controlling operator's supervisory signal when the called party answers. On the IVF system this signal must be preceded by the ringing tone signal (5).
9	***Backward clear***	←	To operate the controlling operator's supervisory signal when the called party replaces his receiver.
10	***Re-answer*** (2VF system only)	←	To operate the controlling operator's supervisory signal. (On the IVF System the backward clear signal is continuous and hence its cessation could imply re-answer conditions, but incorrect supervisory conditions which may sometimes be encountered in the called country would lead to speech being necessary but impossible under backward clearing conditions when the line was in use for signalling.)
11	***Forward clear***	→	To release the distant switches at the end of the call when the controlling operator releases the international circuit.
12	***Release guard***	←	To indicate that the incoming equipment has been released and the circuit can now be freed for use again : or to release the circuit after it has been engaged by a blocking signal.
13	***Blocking***	←	To engage a circuit withdrawn from service at the inward end.
14	***Forward transfer*** (inward assistance)	→	To call in an assistance operator at the inward international exchange on a call which has been set up by remote mechanical selection.

Signals Nos. 1a, 3a, 8, 9, 11 and 13 correspond in purpose to signals used in the British national two-frequency system (S.S.A.C. No. 1).

Fig. 2. List of signals adopted by the C.C.I.F. for the international field trials of semi-automatic working

for the first link (including the direct route where justified). The operator will be given a lamp indication of which outlet has been selected by the equipment and whether one or two international switching points (or none) have been negotiated. This information will be recorded as a numerical code on the call ticket and will enable the exact routing to be determined for the international accounts.

Signalling Systems

Although switching may be valuable for small quantities of traffic between distant countries, the most important need in introducing semi-automatic working is a long-distance signalling system for direct dialling or keysending over large and important routes between European cities. A system such as the British national two-frequency system (S.S.A.C. No. 1) might do for most purposes if it could be standardised, and if the inward assistance signal were provided, but work is proceeding in a different direction.

Two alternative systems are being developed and they both employ current pulses of voice frequency transmitted over the speech channel. One system (described in the *Post Office Electrical Engineers' Journal*, volume 45, parts 3 and 4) employs two frequencies of 2,040 and 2,400 cycles per second. (The design differs considerably from the standard British national system.) Short and long pulses of each frequency separately and also of the two frequencies transmitted simultaneously are used for supervisory signals; for dialling or keysending, shorter pulses of each of the two frequencies are sent in groups of four. Each decimal number is converted into a four-digit binary number, of which each digit (1 or 0) is signified by one of the two frequencies. As there are 16 possible combinations and only 10 are necessary for the 10 decimal figures, there are 6 spare combinations, which may be used for other purposes. With this system about 5 digits could be sent per second.

The other system (also described in the article already quoted) uses a single frequency of 2,280 cycles per second. Pulses of short and long duration (about one-tenth and one-half of a second) are used, and the receiving equipment also has to distinguish for the supervisory signals between short and long spaces between pulses. Impulsing is done by a telegraphic start-stop four-unit code: each digit begins with a start tone and ends with a space of the same length, and in between come four similar periods of either tone or space, according to the particular four-element combination chosen for a digit. The six elements of the code each last one-twentieth of a second, so that about three digits could be sent per second.

Field trials are being carried out under the ægis of the C.C.I.F. to gain technical and operating experience of semi-automatic working and to obtain information about the relative merits of the two signalling systems. Experience with the two-frequency system has been very encouraging; the trials of the other system are not so far advanced. Both systems may prove equally satisfactory and so long as only one international link is involved and a common operating procedure is practicable, there would be no reason for using only one system, except that it is obviously desirable to avoid uneconomic diversity of equipment. For switching purposes it is essential to have a single standard.

International List of Signals

The international list of signals adopted by the C.C.I.F. for the field trials of semi-automatic working is given in Figure 2. A feature which has emerged from the development of signalling systems to provide these facilities is that it may be impossible to translate the foreign ringing and engaged tones into those the operator is accustomed to hearing in her own country. This might be a serious drawback in operating, since there is a wide variety of tones used in Europe and little prospect of uniformity. However, the inward assistance signal will enable operators to find out the significance of tones they cannot interpret, and as they gain experience the need for this assistance will decline. A further help may be the fact that the ringing tone of most countries has a gap of at least two seconds between successive pulses, whereas the engaged tone is repeated at intervals of less than one second.

Letters and Figures on Foreign Dials

For the actual process of remote selection, keysending rather than dialling will be employed. There is, however, a serious operating drag to be overcome. The association of letters with figures on the dial differs from one country to another, and international operators will have to be supplied with correlating lists. It may be of interest to remark that in Sweden the dial is arranged from 0 to 9 instead of from 1 to 0: dialling 0 transmits one impulse, 1 sends out two impulses and so on, 9 transmitting 10 impulses. (The reader may care to guess the reason and judge whether it yields an advantage worth having.) Conversion will be necessary before numbers in that country can be correctly keyed by international operators, but fortunately the translation can be arranged to take place at the international exchange in Sweden. It is because the letters are associated with numerical digits that the letter variation will not yield to similar treatment.

Conclusion

This survey of the immediate future of the European international telephone service shows that as a result of close co-operation among all the administrations technical progress will soon enable us to have a faster and more convenient telephone communication with other countries. This can only be a benefit to trade and society and lead to closer contact between the peoples of all nations.

Acknowledgment

The author acknowledges with thanks the help and technical advice received from Mr. L. E. Magnusson and Mr. D. C. Smith, of the Post Office Engineering Department (Telephone Development and Maintenance Branch), but the opinions expressed, and any errors, are his sole responsibility.

Is it Cricket?

It was recently necessary to consider a name for the new director exchange to relieve Cunningham (London). An obvious choice was "Abercorn", after Abercorn Place, St. John's Wood, which gave its name to an earlier exchange in the neighbourhood; but subscribers on the old Abercorn exchange had a lot of trouble, when the Abbey exchange opened, with callers for "Abbey" numbers who spelt it "Abey".

The next choice was "Lords", after the famous cricket ground, which took its name from the Mr. Lord who founded it. At the same time one or two variants on "Lords" were considered; for example, "Lordsground" and "Lordsgrove". It was decided, however, that "Lords" was so hallowed in the tradition of our national sport that it might arouse resentment to embody it in a composite name. In the meantime a number of arbitrary names were considered and an attempt was made to find some connection between the neighbourhood and the name "Kipling", after the late Rudyard Kipling. This was thought to be a good general name in the traditions of Byron, Gladstone and Wordsworth. No such connection could be established, however; in fact, Kipling seems to have spent very little time in London, much of his later life being spent in Sussex.

Tests made with "Lords" were so satisfactory that the use of that name has been decided upon.

Few people realise that so many factors have to be considered when naming a new exchange. The factor of tradition is not merely a matter of sentiment, but may also, as in "Lords", be one of familiarity.

The Post-Hole Borer

A Ferguson tractor with a post-hole boring attachment, which is driven by a shaft connected directly to the gear-box of the tractor and lifted and lowered by means of the hydraulic lifting gear, has been used extensively in the Lincoln Area during the last two years. With the use of an extension piece to extend the length of the auger, holes up to a depth of 4 ft. are being bored. While this depth is sufficient only for light rural lines, quite a considerable saving in manual labour and time is being effected.

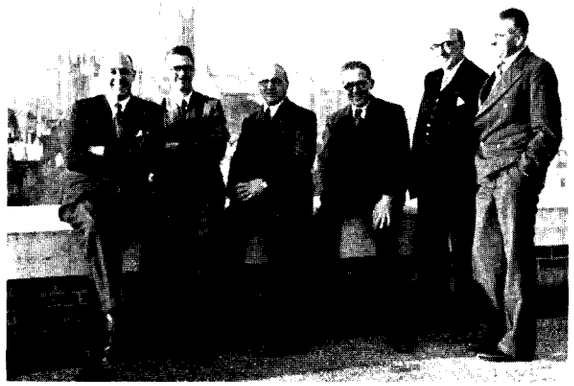
The machine is used mostly in rural area for "farmers' lines" and wherever possible travels under its own power from one job to another.

All working parties have one member who has been given tuition in the operation of the machine, which can also be used for trenching and stay holes.

As the auger has no downward pressure except its own weight, it is difficult to get the borer to "bite" in the stone and heavy clay areas.

The use of explosives in conjunction with the borer in these areas can be very successful.

CANTERBURY TELEPHONE AREA



Left to right: C. W. A. KENT, Chief Traffic Superintendent; F. C. HALIBURTON, A.M.I.E.E., Area Engineer; W. H. SCARBOROUGH, A.M.I.E.E., Telephone Manager; G. H. GREENWOOD, Chief Clerk; A. BROUGH, Senior Sales Superintendent; A. G. ROBINS, A.M.I.E.E., Area Engineer.

Canterbury—the Mother City of the English-speaking world—has recently made discoveries in Castle Street which establish beyond doubt the fact that an early settlement existed in Canterbury about 250-200 B.C.

The Canterbury Telephone Manager's Area covers 1,310 square miles in the "Garden of England" and has seven group centre exchanges. There are 106 telephone exchanges serving 47,581 direct exchange lines and 82,593 telephone stations. The total Area staff excluding operating personnel numbers 1,197.

The Kent coalfield is near Canterbury, and in the southern half of the Area there are large fruit growing and packing industries. Big commercial interests and industrial areas are established in and around Maidstone and Chatham. Maidstone, the county town, is the centre of a thriving agricultural industry, which includes some of the famous Kentish hop-fields. Ashford is another agricultural and sheep farming centre. South of this is the Romney Marsh, which gives its name to a world-famous breed of sheep. Two large paper mills exist in the Medway area, and beyond the Chatham Dockyard, on the Isle of Grain, is the new £40,000,000 Anglo-Iranian Oil Refinery, which will soon be producing aviation and motor spirit, with other by-products. In addition there is a long belt of seaside resorts, which includes such places as Margate, Ramsgate and Folkestone, with Dover as the "Gateway to the Continent."

GLOUCESTER TELEPHONE AREA

The ancient City of Gloucester is the headquarters of a Telephone Area of about 1,420 square miles, mainly in Gloucestershire and Wiltshire. Although predominantly agricultural, a variety of important light industries are carried on in Gloucester and some of the smaller towns. Many are connected with aircraft construction. Fighter planes prominent in the Battle of Britain, notably the Hurricane, were first manufactured in Gloucester. The world's first successful gas turbine jet-propelled aircraft, the Gloster Whittle E 28/39, completed its initial flight trial here in 1941. This was followed by the Gloster Meteor and more recently the GA5 (now named the Javelin).

Besides Gloucester's magnificent Cathedral, the surrounding district will recall to many the Cotswolds and the Wiltshire Downs, each with their particular type of scenic beauty—Arlington Row at Bibury, Painswick Beacon, Symonds Yat and Savernake Forest.

Left to right: V. C. L. HOLLAND, Senior Sales Superintendent; E. H. JEYNES, A.M.I.E.E., Area Engineer; W. MOSELEY, M.B.E., Telephone Manager; E. P. RUMING, Senior Traffic Superintendent; F. D. KILBY, Chief Clerk.

The fashionable Promenade, the squares and terraces of Regency houses of which Cheltenham Spa is so proud are well known, as are also, for a different reason, the extensive railway works at Swindon. Cirencester, sometimes called "Ciceter", Stroud, the home of West of England Cloth, and Marlborough, whose interests centre round its famous school, are among the other towns of the Area.

The Severn Bore, the Druids' Stones at Avebury, the Severn Wild Fowl Trust—these are but a few of the many notable features of an Area rich in natural and historic interests.

Of the 108 exchanges serving some 32,000 subscribers (53,250 stations), 88 are automatic. The waiting list has been halved in the last three years and now stands at 1,550. The total staff on the Telephone Manager's establishment is 933.

Graham Bell's telephone of 1877 (*Devon Commercial Photos*

The First Telephone in Britain?

C. T. M. Farmer

Inland Telecommunications Department

ALEXANDER GRAHAM BELL left his native city of Edinburgh in 1870, when he accompanied his father to Ontario, Canada. He did not return to Great Britain until he brought his nearly perfected telephone across, seven years later. Four years of intensive work, combined with a fortunate accident in the form of a faulty connection on his Harmonic Telegraph apparatus, had led to the invention, in 1876, of the first really effective telephone receiver.

At first the receiver was used for transmission, for which it was reasonably satisfactory. It was not until later that the carbon microphone was developed.

Patent rights were secured in this country in December, 1876.

In July, 1877, Sir William Preece brought the first pair of practical telephones to England. He was followed shortly by Bell himself and in the following month (August) they both addressed a meeting of the British Association at Plymouth and demonstrated the instruments. During the next few months, Bell delivered lectures and gave many demonstrations. His London agent offered telephone instruments to the Government at reduced rates, but the offer was refused. Nevertheless the telephone "caught on" immediately and in June, 1878, "The Telephone Company" was formed, with offices at 36, Coleman Street, London, where the first telephone exchange was opened the following year.

The first private installation of which we have hitherto had record was fitted in 1878 for Mr. Thiarks, of Chislehurst, between his house and his stables.

There is little doubt that the talk to the British Association at Plymouth was Bell's first formal address in this country. He must have given it within ten days of his landing from the United States. It was therefore with considerable interest that, in searching for old pieces of equipment for the museum that we are trying to set up, we came across a cutting from the *Western Morning News* referring, among other things, to a "telephone relic" at the Plymouth Museum, described as an instrument that had been installed in 1877 and kept in regular use for many years.

There is no doubt that since the "switchboard museum" project* was first mooted at Headquarters, our sense of smell for things historic has

* P.O.T.J., February, 1952—"A Museum of Telephone Switchboards".

developed acutely. Old photographs are scanned eagerly for any trace of telephone history, old text books are read carefully from cover to cover and the files of press cuttings that circulate round the office from time to time are awaited with avidity. This particular cutting was far too good to miss and we promptly sought and received the willing co-operation of the local Telephone Manager, Mr. H. C. O. Stanbury.

It appeared that these instruments—there are three of them, all identical—were presented to the Plymouth Museum in 1923 by Miss Mary Bayly, who told the Curator that they had been installed in 1877 by Bell himself.

We knew that Bell had stayed in Plymouth shortly after his arrival in this country in August that year. It looked as if we were "on to something". With the acquiescence of the Curator, arrangements were made for a local studio to photograph the exhibits—one of the photographs accompanies this article—and Mr. Stanbury sought an interview with Miss Bayly.

Miss Bayly is now 82 and her memory stretches back far beyond the present century. She told Mr. Stanbury that she could clearly remember Bell's visit to Plymouth, because he stayed at her father's house, Torr Grove, throughout his visit. From a diary written at the time, she copied the following extract for us:—

"He stayed at Torr and let us children listen to a fly—in a pill box—walking. It sounded, as one of them said, like a man with hobnail boots walking across a floor".

At her father's request, Bell had installed these telephone instruments between the house and the gardener's cottage. Initially only one instrument had been fitted at each end of the line, but her mother had found difficulty in using the same instrument for both speaking and listening, so a second, identical, receiver had been added at the house end.

The installation remained in use for many years and was not finally recovered until she moved from Torr Grove on the death of her father in 1923, when she presented it to the Museum.

It looks, therefore, as if we have located not only the details but the actual instruments of the first effective telephone installation in Great Britain. It would not be right to say so categorically, but so little time elapsed between Bell's arrival here and his visit to Plymouth that it is extremely unlikely that he had either the time or the opportunity to establish any other permanent equipment in this country.

Our gratitude is due to Miss Bayly for her kind co-operation and to the Curator of the Plymouth Museum, who was most helpful.

Inland Telecommunication Statistics

In the six months ending 30th September, 1952, there were 159,000 new demands for telephone service (compared with 192,000 in the corresponding period of the previous year) and 155,000 new subscribers' exchange connections were installed. The number of shared-service connections at the 30th September was 526,000, compared with 463,000 at the 31st March.

The number of telephones in service at the end of the period was 5,814,000, a nett increase during the six months of 98,000 (including some 1,000 public call offices). The number of outstanding applications was 448,000, representing a decline in the period of some 34,000.

133,247,000 inland trunk calls were made, of which 34,310,000 (26 per cent.) were at the cheap rate. In the corresponding period of the previous year, the figures were 133,107,000 and 32,815,000 (25 per cent.) respectively.

The number of inland telegrams (excluding Railway and Press) amounted to 19,004,000, including 3,195,000 (17 per cent.) greetings telegrams. The figures for the corresponding period of the previous year were 20,623,000 and 2,817,000 (14 per cent.).

At the end of September, 1952, there were 48,361 telephonists, 9,630 telegraphists and 54,459 engineering workmen employed. The corresponding figures for September, 1951, were 47,653, 10,009 and 53,883.

To help new subscribers and others to complete their sets of the Journal, *the Business Manager will be pleased to supply copies of issues during the first two years (November, 1948, to August, 1950, inclusive) at the reduced price of 6d. a copy, plus 1½d. postage.*

The full price remains chargeable for later issues.

The Telephone System of the United States

Wm. H. J. McIntyre

Telecommunications Attaché to the U.S. Embassy, London

TELEPHONE SERVICE IN the United States is provided by the American Telephone and Telegraph Company and its associated operating companies, 22 in number, and by some 5,000 connecting companies. All are interconnected into one telephone "system", so that the person making the call ordinarily does not know whether the party he is calling is served by the same company or a different one. The bill he receives for the service does not indicate that more than one company may have entered into furnishing the service.

The A.T. & T. Company is both a holding and an operating company. With three exceptions, it holds mostly all of the common stock of all of the 22 associated operating companies and of the other necessary associates such as Bell Telephone Laboratories, a scientific organisation, and Western Electric Company, the system's supply and manufacturing organisation. By virtue of its influence, A.T. & T. is enabled to promote those engineering and operating standards which assure the universality of good service over all of the United States and Canada, which is quite a large and populous area indeed. In addition to its holding activity, A.T. & T. also operates what are called "long lines". These are the long-distance circuits that spread across these countries.

The 22 associated Bell operating companies furnish local and toll service within their respective territories. In general, the associated companies are knit together by the long lines of A.T. & T.

The term "connecting companies" is used to designate those 5,000, more or less, companies which are an integral part of the unified telephone system but which are not financially controlled, either directly or ultimately, by A.T. & T. An illustrative comparison, not too exact however, would be the situations in Hull and the Channel Islands, in their relation to the General Post Office. Connecting companies vary in size from as small as 50 or less stations, up to large financially strong operating companies, such as one in California with 500,000 stations. Some of these connecting operating companies are grouped together under holding companies; one of such aggregates 1,500,000 stations. Thus you will appreciate that A.T. & T. is not by any means the sole organisation concerned with furnishing telephone service to the public. This great responsibility is well extended. The various connecting companies receive from A.T. & T.'s 22 associated companies detailed engineering and operating counsel. Thus uniformity of operating practice and engineering standards, an absolute essential of good universal service, is attained.

We have therefore the 22 associated Bell operating companies and the 5,000 connecting companies, all operating within well-defined territories, non-competitive with each other, knit together by A.T. & T.'s long lines and so co-ordinated as to furnish a unified service to the public. The aggregate of their operations is enormous.

This article is based on a paper read by the author before the Post Office Telephone and Telegraph Society of London. A further article by Mr. McIntyre on trunk service and other developments in the United States, will appear in a subsequent issue.

Expressed in sterling, in the United States there is a total investment approximating £4,550,000,000, serving some 47,000,000 stations, with annual operating revenues totalling about £775,000,000. This will help convey to you the magnitude of the business and the tremendous responsibility of stewardship of the employees', the investors' and the rate-payers' interests imposed upon the men and women in it. That they have measured up, that these men and women have served their public conscientiously and well, may be realised from the fact that of A.T. & T.'s 1,100,000 stockholders—and A.T. & T. is not the only telephone pebble on the beach—the preponderance are ordinary people of modest incomes, who, over many decades, have invested their savings in a business in whose integrity with good reason they have faith and confidence.

Associated Companies

Telephone companies in the United States are organised quite differently from the Post Office. You may therefore be interested in hearing how we are set up to perform our job. I am going to take, as reasonably typical, The Bell Telephone Company of Pennsylvania (Fig. 1), which is one of the 22 associated companies. At its head, there is the President. Associated around him are the Comptroller, and the Vice-Presidents of Personnel, of Public Relations, of legal matters, of fiscal matters and of operations. They may be considered as the Company's Headquarters.

It is in the functions of the Vice-President of Operations that I think your primary interest will lie. He ranks next to the President and he is responsible for all of the operations performance in Pennsylvania. He is assisted in the company headquarters by an advisory staff headed by a Vice-President, Staff. The operations function for the entire State is divided into three subordinate areas—Eastern, Central and Western. At the head of each Area is a Vice-President and General Manager, each responsible directly to the Vice-President of Operations for the operations in his Area. Of the three Areas, I will describe the Eastern in order to develop my theme.

Area Organisation

In the Eastern Area of Pennsylvania (Fig. 2), reporting to its Vice-President and General Manager, there are a Chief Engineer, a General Commercial Manager, a General Traffic Manager and a General Plant Manager. Each heads a Department and each has an advisory staff.

The Engineering Department is responsible for the detailed design and the construction of buildings and central office equipment and for the general (but not specific) layouts of outside plant. It is unique in that it is all grouped together and located in the Area Headquarters, although, of course, its men have to travel over the territory. The other three Departments are different, in that they not only include an Area Headquarters staff, but also are spread out into the territory. The Chief Engineer has reporting to him an Engineer of Buildings, an Engineer of Equipment, an Engineer of Outside Plant, an Engineer of Transmission and Protection, an Engineer of Plant Extension, and an Engineering Personnel Supervisor.

The Engineers of Buildings and of Equipment and their subordinate groups are responsible for the detailed design of the buildings and equipment in them, and the Engineers of Transmission and Outside Plant are responsible for the general design of the outside plant. The Engineer of Plant Extension is responsible for the planning of additions to plant and the allocation of the material available to the immediate and prospective needs for it. Obviously, he must co-ordinate very closely with the other four. The Engineering Personnel Supervisor is responsible for obtaining subordinate personnel, evaluating jobs, assisting in rotating personnel, preparing for expected vacancies and the like.

Commercial Department

The United States' telephone usage of the word "commercial" is quite different from British. In America, the Commercial Department deals with the public. The General Commercial Manager is surrounded by a technical staff consisting of a General Commercial Engineer, a General Commercial Supervisor, a General Sales Manager, and a General Directory Manager. The General Commercial Engineer with his group of technicians is responsible for such studies as estimating the future needs for service and where exchange boundaries should be drawn, and the rates required to meet the Area's revenue requirements. The General Commercial Supervisor is responsible for studying results, devising more efficient methods, and for training personnel.

The General Sales Manager is responsible for the selling of service, but he is, in a sense, a service engineer, since primarily his job is to ensure that industrial and commercial customers have the right kind of special facilities, that is private

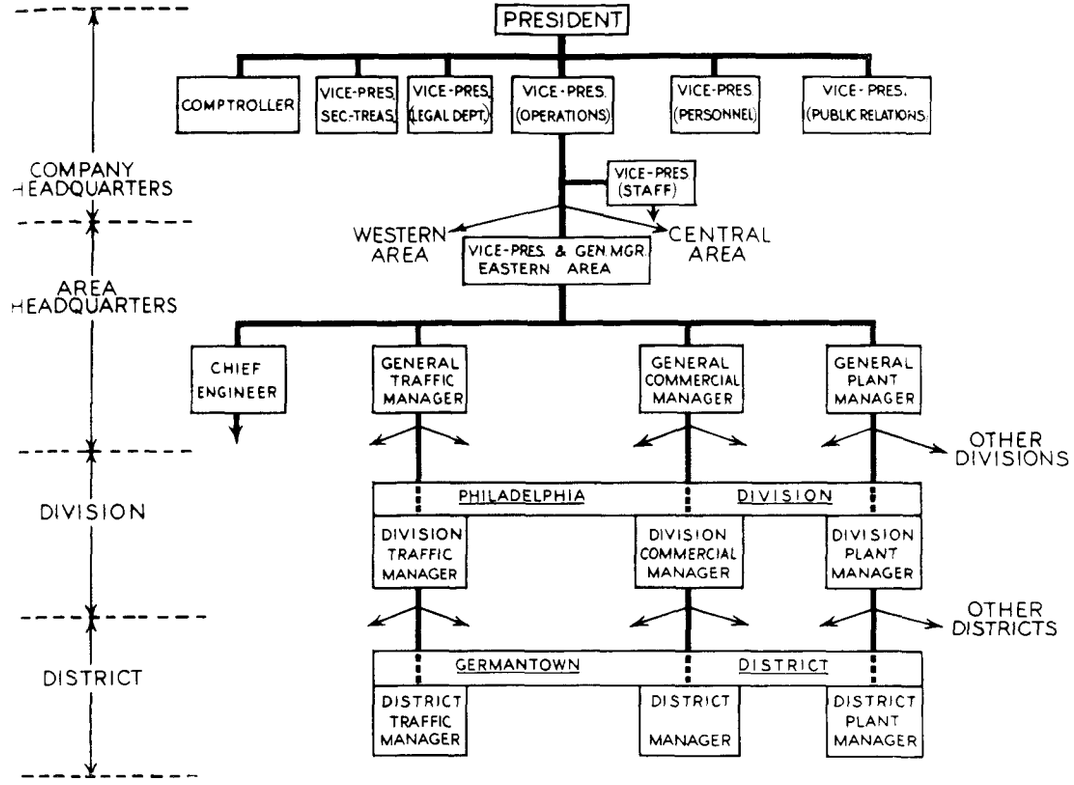


Fig. 1. General organisation of the Bell Telephone Company of Pennsylvania

branch exchanges, special wiring plans, off-premises extensions, etc., that are suited to their peculiar needs.

The General Directory Manager is responsible for getting out all the directories in the Area. That involves compiling and having printed accurate lists of the subscribers and their call numbers, determining which exchanges have enough calling from one to the other to warrant their being included in the one book and also supervising the obtaining of the advertising that is put in the directory. I may add that in the Bell of Pennsylvania the job of soliciting the advertisements is let out on contract to a company specialising in such work, which lightens the work of the telephone company, although obviously the telephone company is responsible to the customers and therefore must supervise the work done.

Traffic Department

The Traffic Department is primarily concerned with the flow of traffic from the calling to the called station, which would include the operation of manual switchboards and the design and adequacy of automatic equipment. The General Traffic Manager's staff consists of a General Traffic Engineer, who is expected to foresee and plan for developing needs; a General Traffic Supervisor, who is responsible for quality of service, efficiency of operation and development of better methods; and a General Traffic Personnel Supervisor, who is responsible for employment, working conditions, training of personnel and morale.

Plant Department

The Plant Department is responsible for the detailed design and construction of outside plant structures, for the installation of P.B.X.s and all subscribers' station equipment and for the maintenance of all plant—right of way, land, buildings, exchange equipment, subscribers' equipment, overhead pole, cable and wire lines, underground conduit and cables, buried cables and

submarine cables. The General Plant Manager has a General Buildings and Supplies Superintendent, who is responsible for the adequacy of supplies and the maintenance of buildings, motor vehicles, etc., a General Plant Supervisor, who deals with installations, construction of outside plant, transmission, repairs, etc., and a General Plant Personnel Supervisor, who is responsible for obtaining and training plant people, working conditions and such matters. There is also in the Plant Department a Special Agent, who is responsible for investigating illegal use of service, thefts of company property and similar matters, and a General Right of Way Superintendent, who is responsible for obtaining rights of way, rights to use poles jointly with other companies and similar contract matters and also for the investigation of accident claims.

The Vice-President and General Manager of the Area and his four Department heads for Engineering, Commercial, Traffic and Plant, with their staffs, are a consolidated autonomous operating entity. They are "Area Headquarters".

Field Structure

The field structure, naturally, lies under Area Headquarters. The Eastern Area is sub-divided into Divisions and the Divisions are further subdivided into Districts. In addition to their staff heads which I have already mentioned, the General Commercial Manager has Division Commercial Managers, the General Plant Manager has Division Plant Managers, and the General Traffic Manager has Division Traffic Managers, reporting to him. Under each of these Division heads are several District heads. In other words, the Area is eventually divided geographically into a number of Districts, the heads of which report their accomplishments and problems to their Division head and get their instructions from him; he, in turn, carries as much of it as is necessary to his Department head.

Thus, in each of these geographical Areas designated as a District, there is a District Plant Superintendent, a District Traffic Superintendent and, you will note, a District Manager, not a District Commercial Manager. The last-named is actually the Commercial Department's man in the District, but, since he must speak to the public in the name of the company as a whole, he is given a title which furthers his public relations but which does not mean that his actual internal authority extends to more than to his own Department.

I recall that quite some time ago some one in London asked me about advertisements in United States telephone magazines. From the great variety of equipment and plant items offered for sale, he had gained the impression that more standardisation would perhaps be better. A complete exposition of the condition is not warranted here; in short, however, there is in fact a very high degree of standardisation.

There is a dual aspect to the answer: the one concerns the associated companies of A. T. & T. and the other the independent connecting companies.

Concerning the former, since standardisation too readily becomes an absolute freezing of design, the Bell companies do not attempt to halt progress. There is a continual search for new and better ways of providing communications. To test these ways in the laboratory of practical operation causes new types to be introduced into the network. Once introduced, they are usually retained for the duration of their useful lives. Additionally, when a Bell System company may have obtained by merger a telephone property with other than Western Electric switchboard equipment, in some cases it has absorbed growth by switchboard extensions of the same make as the installation acquired. In the case of the independent connecting companies, many of them do purchase a great variety of items not manufactured by the Western Electric Company. However, when it comes down to switchboard equipment capable of interconnection with the nation-wide toll and long-distance network, the "independent" manufacturers provide all features essential to permit of interconnection.

Finding the Managers

Because of the rapid growth of telephone service and because of its highly technical nature, the A.T. & T. Co. and its associated companies each year make a determined effort to secure a great number of graduates from the numerous universities. A young man, so entering the Bell service, is given a student course, which I suppose does not differ greatly from that which the Post Office affords. For some months, during which he does no real work, he observes and learns and gains an appreciation of all of the numerous activities in the four main Departments. At the end of his training period, he signifies what he would like to do at the start of his career. The Company makes every effort to locate the desired niche for him.

It is during this formative period that he first has ground into him a lesson he is never permitted to forget—that it is the public to be served; first last and always! Once assigned his niche in the organisation, his day-to-day duties usually require consideration of the problems of the other Departments. From the very beginning, teamwork is stressed; for the success of the business it is essential to have close co-ordination between Departments. There is also a considerable interchange of personnel between Departments. This is well recognised as one means of broadening a man's experience and fitting him for greater responsibilities. Some—but not all—of the men at vice-presidential level and above have had experience in more than one Department.

By no means all top executives in the Bell System have had the benefit of university education. Some, because of their native ability and of having made the most of their experience, have risen to the top without a university educational background.

You will have observed that I said that our numerous telephone companies each operate within well defined territories and are non-competitive with each other. They are, in fact, monopolies. Now in the United States, "monopoly" is a dread word. At first blush it conjures up all sorts of horrible things—particularly that of high cost to the purchaser, who can buy at one place only, or else do without. How then, apparently flying in the very teeth of free competition, man to man, do we calmly accept the philosophy of monopoly?

The reason is that there are a number of businesses that many economists call "natural monopolies"; the electricity and gas supply industries are two excellent examples; but there is a better one—the telephone business. Consumers of electricity and gas are not consciously concerned whether their neighbours or aunts or uncles also have such services; but it is of direct and immediate interest to a telephone subscriber to have certain other subscribers to converse with. However, when competition exists, a person either has to secure service from all of the competing companies, or else forgo the ability to talk with any desired persons. Thus, of all "natural monopolies", telephone service is the most natural. It was only after much hard and very costly practical experience that it became obvious that the public can be better and more cheaply served when these "natural

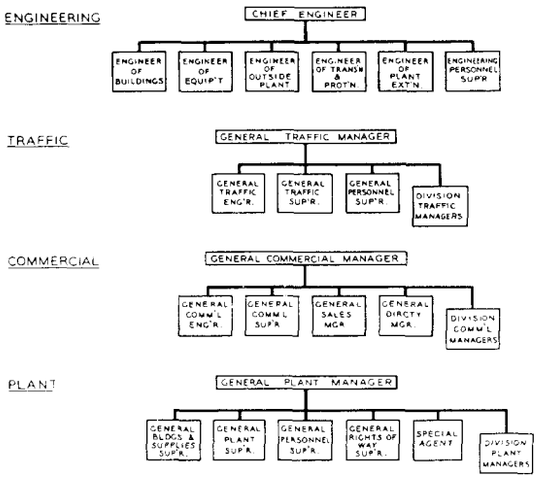


Fig. 2. Area Headquarters of Bell Telephone Company

monopolies" furnish their services non-competitively.

Since these companies are privately owned, however, with their managements selected by the owners, there has to be some method of control by the public, by the body politic. This is attained by what are known as regulatory commissions. Forty-six of our 48 States have their own regulatory commissions which have jurisdiction over most of the numerous natural monopolies operating within them; when the question goes beyond the boundaries of a State, the United States Government becomes interested. Thus, on telephone service between two States, the Federal Communication Commission has jurisdiction.

The regulatory commission in my home State is called the Pennsylvania Public Utilities Commission. All of the telephone companies doing business in Pennsylvania—about 150 in number—must file with this Commission a statement of their rates and the rules and regulations under which they furnish service. Such a statement is known as a company's tariff.

You will recall that about a year ago the Post Office was enabled to do away with its former method of re-writing individual contracts to effect a rate change. The former method was too cumbersome and time-consuming to be practical in a business as extensive as is yours. In the United States we too avoid this cumbersome complication.

In Pennsylvania, for example, a company desiring to effect a change in its rates files its new

schedules with the Public Utilities Commission, together with data purporting to justify them. A notice period follows—60 days for most types of utility services, including telephone—in which the Commission may institute a formal investigation or any subscriber may enter his objection. If the Commission chooses, it may in its discretion suspend the new rates for a maximum of nine months. In any event, the new rates, or such part of them as the Commission has allowed, become effective either on the proposed effective date or at the end of the proceeding. I should add that the Commission's action is reviewable in the courts.

Tariffs

As a somewhat sweeping generality, the charges made for local service—as distinct from toll and long-distance—vary from place to place, and usually reflect the number of subscribers available to the caller without incurring a toll or long-distance charge. In flat rate service, an unlimited number of local calls may be made. In measured or message-rate service, a certain number of local calls is included in the basic monthly rate, after which a charge is made for each additional call. The message allowance is usually of the order of 50 to 100 messages a month, and is designed to cover the average needs of residence or small business users. There is also a division between business and residence usage. A further development is party-line service. This is an old established institution. Individual line, two-party line and four-party line service is offered in communities down to as small as a few hundred families. In sheer farming territory, multi-party line service, usually with a maximum of eight subscribers per line, is a normal service.

In small and medium-sized exchanges, telephone service is mostly on a flat-rate basis. In most large cities, for example in Philadelphia, Pittsburgh, Cleveland, Detroit and Los Angeles, all business service is provided on a measured or message-rate basis, while residence subscribers have their choice of either flat or message rates. However, in Chicago, most of New York, and downtown Boston, all service, both business and residence, is on a measured basis. Most of the large metropolitan areas have rate plans designed to meet individual requirements. These usually include primary calling areas in which flat-rate or one-unit message-rate charges apply, message-unit charges on calls beyond these areas varying broadly with distance and length of conversation. In a few cases the customer has a choice between a larger or smaller primary calling area, but in most cases this area is fixed on the basis of average needs.

In my home city of Philadelphia, residence customers have a choice of individual or two-party lines, on either a flat or a message rate basis. Four-party service is not offered. Flat rates are the equivalent of £2 4s. 7d. a month for an individual line and £1 17s. 7d. a month for two-party service, and include (a) unlimited calling to any point within the city, which approximates 140 square miles, and (b) unlimited calling from central office districts lying within the city but on the "city-line" to suburban exchanges on the other side of the "city-line". Message rates are the equivalent of £1 12s.2d. a month for an individual line (including 75 units), and £1 3s. 4d. for two-party service (including 50 units). One unit is charged for each call within the calling area of flat-rate customers.

Calls to suburban exchanges outside the flat-rate calling area are charged for on a message-rate basis at about 4½d. a unit and, for message-rate customers, are applied to the monthly allowance. Business service is offered on an individual line basis only, the monthly rate being the equivalent of £2 13s. 7d. and including 85 units. Calling privileges are the same as those for residence message-rate customers.

In a small rural village—one having a local service area up to 1,000 telephones—the form of the rate structure would be like this:

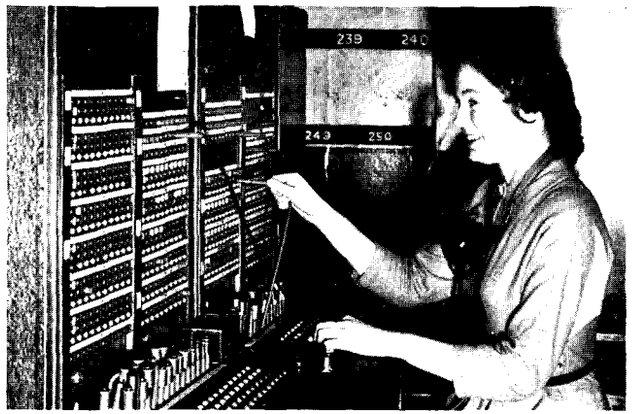
	Per month within the base-rate area	
	Business	*Residence*
	£ s. d.	£ s. d.
Individual line ...	2 3 0	1 5 0
2-party line ...	1 15 8	1 1 5
4-party line ...	—	0 19 7

Outside of the base-rate area, individual, two-party and four-party services are furnished only upon payment of mileage charges of 3s. 7d., 2s. 1d. and 1s. 6d. a quarter-mile respectively; and multi-party service is offered to business and residence stations at £1 10s. 4d. and 19s. 7d. a month respectively.

At the end of 1940, in Pennsylvania about 36 per cent. of the total station development was individual lines, 45 per cent. was two-party lines and 19 per cent. was four-party lines; but owing to the post-war facility shortage, the individual line proportion has dropped from 36 to 28 per cent., and the two-party from 45 to 42 per cent., while the four-party has risen from 19 to 30 per cent.

Liverpool Telegraphs

Half a Century of Development



Phonogram concentration switchboard, 1942-52

A. C. Arkinstall
Superintendent, Telegraph Branch, Liverpool

VIVID RECOLLECTIONS OF THE BLITZ DAYS were recalled on Sunday, July 6th, 1952, when the Telegraph Branch of the Liverpool Head Post Office was transferred to new premises. The official opening ceremony was performed the following day by the Lord Mayor, Alderman A. Morrow, who was accompanied by the Lady Mayoress.

Before the ceremony, guests were introduced to the Lord Mayor and Lady Mayoress and were told how in May, 1941, the Head Post Office had been severely damaged by enemy action. The Telegraph Room, which occupied the top floor of the building, had been entirely gutted and for the past eleven years the telegraphs had operated from a temporary instrument room in requisitioned premises.

The move to Telegraph House opened a new chapter in the long and eventful story of the Liverpool Telegraph Office. To some extent it is the story of the telegraph service itself, but the Liverpool office has had more than its share of changes.

Its first home, in the 19th century, was in the old Head Post Office in the Liverpool Customs House and in October, 1899, it was transferred to the new Head Post Office in Victoria Street, the foundation stone of which was laid in 1894. The office, which is still in use, covers nearly two acres of ground.

The top floor of the Head Post Office accommodated telegraphs and trunk telephones, with their staff retiring rooms. The instrument room was a lofty rectangular room, with an area of 13,900 square feet (compared with 7,300 square feet at the Customs House), and, being the top floor, was well lighted from all sides and from skylights. As an instrument room it ranked second to none.

Morse telegraphy, with the Wheatstone system as its high-speed complement for Press work, was in its heyday at the time. Operators used an assorted array of pencils and had to contend with four pads, one for delivery messages, for which carbon copies were prepared, one for transmitted messages, one for foreign messages and one for service messages. Good handwriting, of that clear style known as the Civil Service hand, was essential for a good telegraphist. In considering outputs on modern telegraph instruments, we should remember that 15 telegrams per operator per quarter hour, send or receive, was a normal total; anything less frequently called for a written explanation.

Liverpool has always owed much to cotton and the cotton trade influenced its telegraph traffic. As far back as 1889, Liverpool had direct communication by the Hughes telegraph system with Hamburg and Le Havre, and the growth of the cotton market led to further enterprises by direct

routes to Paris (1901), Bremen (1903), Antwerp (1907) and Rotterdam (1927).

The need for further telegraphic expansion at Liverpool was felt towards 1905 and the difficulty was overcome by terminating many circuits on a concentrator switchboard. The distant station attracted visual attention by causing a small needle on the concentrator to oscillate; it was then connected to a Morse circuit by means of a plug and cord.

From then onwards hardly a year passed but some new phase of telegraphy was introduced and Morse began to decline. The face of the instrument room altered almost month by month, as machine telegraphy developed.

Creed working, using perforated Morse slips capable of reproduction in roman characters, had been limited to the news wires, but in 1914 it was tried experimentally for commercial traffic between Liverpool and Glasgow and extended in the following year to Liverpool-Dublin.

The first serious break from the Morse code was also in 1914, when the Siemens Halske system was introduced between Liverpool and London. Perforated slips, using the five-symbol code, were prepared by typewriter keyboard and fed into a transmitting machine, the received characters being printed letters produced by an electric spark photographing the required letter through a revolving stencil wheel on to sensitised paper. After passing through developing and fixing baths situated in the receiving cabinet, the slip was ready to be gummed to ordinary forms.

After extended trials, this machine gave way the same year to the Siemens system, which had a faster machine, the receiving side of which operated by electro-magnets in place of the photographic principle. Very high speeds were attained, but the necessary contact brushes were a German monopoly and war put an end to the supply and the experiment.

A further mechanical type instrument, the Baudot, was also introduced to us in 1914. This had already proved its worth and been adopted by the Post Office as standard equipment for main circuits. It operated on the principle of a five-key keyboard, similar to five white piano keys, and by various combinations of the keys all letters of the alphabet, figures, and marks of punctuation were reproduced on a printed tape.

A feature of the instrument was that operators used the line-time a fraction of a second only for each character, this being obtained by a metallic cadence on the keyboard giving the operator an indication when to depress the keys. The cadence ran at about 45 beats per minute per operator and it was sometimes amusing to watch colleagues practising, even during meal reliefs and in retiring rooms, their heads nodding in rhythm to their fingers and an imaginary cadence. Installation of the Baudot system for the major circuits required drastic reconstruction in the layout of the instrument room. Morse tables disappeared overnight, but on the whole there was a general improvement.

Telewriter installed

During the 1914-18 war the room was staffed by women. There were few major changes during the war and for a period telegraphs remained static. Some innovations occurred, however, and in 1915 the first girl messengers were employed. About the same time a novelty instrument, the Telewriter, was installed, enabling local subscribers to transcribe their telegrams direct into the instrument room. The transmitter consisted of a pencil carried at the joint of two rods; movement of the rods varied the current to line and therefore to the receiving pen, which reproduced the lines drawn by the transmitting pencil. The paper was moved forward when required by pressing the pencil on a small contact and this action had a corresponding effect at the receiving tablet and at the same time dipped the receiving pen into the inkwell.

The serial check of sent and received telegrams was introduced in 1916 and during the same year authority was given for temporary counter clerks to insert clock time for the time of handing-in in place of letter codes. Until stencils were introduced in 1924, all envelopes were addressed in longhand.

It was not until 1928 that there was a further upheaval in the Liverpool instrument room. The teleprinter began to appear and slowly but surely displaced the Baudot system. Teleprinter working was also adopted by the provincial newspapers and news agencies, and this, combined with their private-wire systems, resulted in an appreciable decline in press traffic handled by the Post Office, until, in 1931, the famous YG press wires disappeared. The loss of the press work and the introduction of part-time telephone night operators resulted in a big reduction of the male telegraphist establishment. Previously, for press requirements, 12 to 15 men attended from 5.15 p.m. to 12.36 a.m. and between 20 to 30 attended from 6.20 p.m. to 1.33 a.m. Practically the whole of the period was occupied in transcribing Morse slips for the morning papers, which went to press at 3.0 a.m. The duty of preparing press for transmission and despatching received press to the newspapers was performed by a supervising officer. In addition to telegraphy, the men performed trunk operating duties from 8.0 p.m. to 8.0 a.m. Transport ceased at midnight in those days and there was many a long tramp home in every sort of weather; parties left the office bound in different directions and gradually thinned out, some officers having to walk five or six miles.

A further decline in the amount of handled traffic was apparent as the Post Office deconcentrated from zone centres and Liverpool lost direct telegraph communication with offices to which it had had direct points over a great number of years. The few remaining Morse keys disappeared with the transfer of minor offices to telephone-telegram working in 1932 and to cover this class of work telegraphists took up duty in the phonogram room, then part of the trunk exchange. A few months later, early in 1933, all phonogram traffic was transferred to the telegraph branch for both operating and supervising.

Towards the end of 1932, the Testing and Maintenance Officers scheme was formed and, as teleprinters gained ground, preparations went ahead for a further completely new layout. Approximately an eighth of the instrument room

Telegraph instrument room, before destruction in 1941

was released as an extension to the trunk exchange and one-third of the remainder was partitioned off as a new phonogram room containing four double-sided tables with single-tier ancillary equipment. The tube-table, which had always been situated in the centre of the room, was placed at the west end, Baudot tables were removed, the whole floor taken up and relaid, new tables for teleprinters installed and a complete conveyor system was erected for distribution and collection of traffic between instrument tables, circulation, segregation, delivery and phonogram room, but through all this upheaval uninterrupted communications were maintained.

New telegraph instrument room, opened in 1952

A notable feature of the teleprinter layout was the improvement at the operators' positions, the Post Office having devised the method of confining ancillary table equipment, such as condensers, relays and rheostats, on panels in the test bay. Operating time was speeded up by the use of electrically controlled Blick timing machines at the busier circuits. The teleprinter layout was completed in June, 1933.

Our next point of interest was the introduction of the greetings telegram in 1935, with a change in telegram charges to nine words for 6d. The engineers were not slow to improve the teleprinter system and in 1936 ancillary equipment was installed, whereby a series of offices were terminated on small concentrators at each operator's position, connection to the required station again being by plug and cord.

Destruction by Bombs

The stage appeared to be set for a long period of settled conditions, but disaster overtook Liverpool Telegraphs during World War II. Incidentally, one of the first buildings in Liverpool to be destroyed by enemy action was the Customs House, our old home of the 19th century. Like other important centres, Liverpool had prepared emergency instrument rooms, one in the basement of the Head Post Office and another in the basement of Lancaster House, the new Joint Trunk Exchange. On the night of March 12th-13th, 1941, incendiaries fired part of the roof of the Head Post Office, the instrument room and telephone exchange being damaged by water. All teleprinters and typewriters were saved by the staff on duty at the time, but the basement was flooded to such an extent that the emergency apparatus was unusable and for a day or two all traffic had to be handled on the few circuits at Lancaster House. However, the Head Post Office basement was soon made serviceable and communications were maintained.

Worse was soon to follow. During the night of May 3rd-4th, 1941, Head Office received another shower of incendiaries which completely gutted the top floor of the building and put the whole office out of action for several months.

The raids on Liverpool put accommodation at a premium and the various Post Office departments had to be dispersed over a wide area. Both telegraph and telephone communications in the city area were badly disrupted. Telegraph circuits to the largest towns were maintained from the Lancaster House emergency room, the telegraphists using the cable chamber as a retiring room, dining room and cloak room. When it is recalled that this particular emergency room measured 24 feet by 20 feet, had but one door and no windows and accommodated 21 teleprinter circuits working night and day throughout the following eight months, it requires little imagination to picture the unenviable conditions under which the staff worked; for days on end the temperature never dropped below 80 degrees.

Phonogram work was temporarily abandoned, but a few telephones were installed in a small adjacent room for the reception of traffic from a few offices. Traffic for branch offices was despatched by motor van and motor cycle and the branch offices in their turn collected messages by hand from smaller offices in their areas.

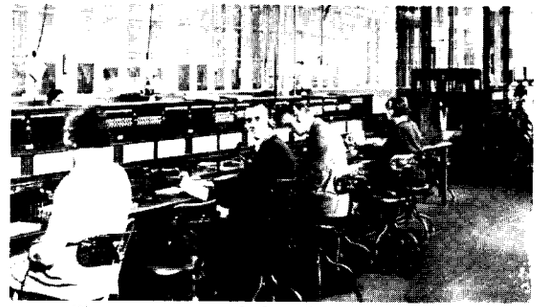
The engineering staff did a magnificent job to restore the city's communications. A phonogram and telephone-telegram suite, although of an elementary type, was installed at Eagle House, Dale Street, within a few weeks and several teleprinter circuits were brought into use at the same premises. Eagle House was a recently constructed modern building with more than the usual allotted space for windows. The accommodation was fairly good, but it could not be regarded as safe from blast and in the circumstances the circuits closed down at 8 o'clock each evening, traffic being disposed of via the circuits at Lancaster House. The Delivery Section and Message Clearing Section were housed in Zerneys Buildings, well over a mile from the instruments rooms, the messages for delivery being conveyed there by courier. Office drag was heavy but unavoidable.

It was of the utmost importance to gather the telegraph sections together under one roof and towards the end of 1941 the premises of Littlewood's Buildings were requisitioned to accommodate the telegraphs and the Telephone Manager's staff, who incidentally had also been bombed out of their own home. Littlewood's building was far from ideal as a telegraph office—it had originally been built as a leather warehouse—but it did enable the administrative and operating sections of the telegraph branch to function smoothly again. From December, 1941, to December, 1942, the instrument room occupied a part of the basement, the teleprinters were on trestle tables strapped together and traffic was conveyed by hand from one point to another.

Meanwhile, the Office of Works had got on with the job of making standard tables fitted with V belts on site and by the further efforts of the engineers the ground floor was transformed into a reasonably satisfactory instrument room. A phonogram room, operated on the manual concentrator principle, was also made available on the ground floor, the two rooms being separated by a glass partition. Unfortunately the writing room had to remain in the basement for the next 10 years.

Perhaps at this point it should be related that the Wireless Records Section, which had been outhoused from the Head Post Office as a precautionary measure, received a bomb on the night of May 7th-8th, 1941, and approximately 200,000 counterparts disappeared. By great diligence the complete record was rebuilt from the stubs collected from the counters. This section also found room in Littlewood's Building and in addition a Regional Telegraph Training Centre was set up and operated very successfully. Under these conditions it was possible to close the emergency room at Lancaster House and happily it was not required again.

Before the Head Post Office instrument room was destroyed, all the city branch offices and three railway acceptance offices forwarded their telegraph traffic to Head Office by pneumatic tubes. In September, 1942, the tube-heads were recovered



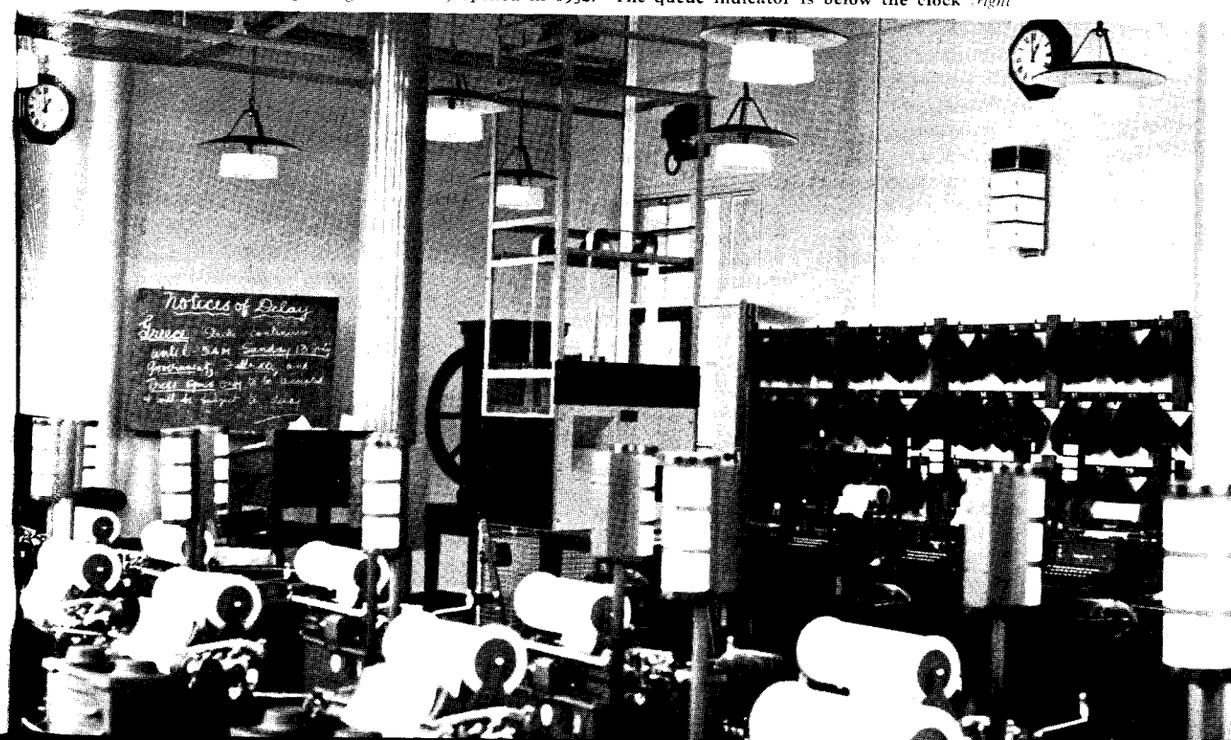
Phonogram room, before destruction in 1941

from the destroyed instrument room and re-erected in the Head Office basement, which was used as a transfer point, the carriers being re-tubed to the Cotton Exchange and the messages then conveyed some 500 yards by courier to Littlewood's Building—a good arrangement in the circumstances, but hardly good enough for a tablet return.

It was only natural that the war held up further development in methods of telegraphy and it was not until March, 1944, that the Post Office was able to break new ground and introduce teleprinter manual switching.

Manual switching was but a temporary forerunner to teleprinter automatic switching, the

New phonogram room, opened in 1952. The queue indicator is below the clock *right*



first stage of which was brought into service in October, 1950.

Records show that as early as November, 1943, the question of a permanent home was being considered. Plans were laid for the entire reconstruction of the Head Post Office, involving the outhousing of all sections in a new building to be erected on a bombed site previously occupied by a government building. This plan had to be shelved when the other department concerned notified its intention to re-occupy the site.

Various schemes were considered and in 1944 a decision was made to transfer the telegraphs to the old Bank Central Telephone Exchange—a building badly damaged by fire in the 1941 air raids but the main portion of which had been sufficiently restored to accommodate a fair amount of telephone equipment, the top two floors being merely weatherproofed.

Progress was deferred until November, 1946, when a Study Group was set up to consider ways and means of establishing the telegraphs in this building, which of itself could provide just sufficient floor space for the telegraphs and its auxiliary services but where it was not desired to retain a relief telephone exchange. This building is worthy of special mention, as it stands isolated in the centre of a large bombed area. As some of the steelwork of an adjoining building (Colgans) remained *in situ*, the possibility of restoring the two buildings with internal access from one to the other was examined and agreed upon. Approval of the scheme was obtained, plans were prepared and authority to proceed was given.

A hitch arose immediately. Previously Colgans building had been supported on three sides by other buildings and its foundations were insufficient in width for an independent structure. It was necessary to purchase surrounding ground for the foundations to be widened and strengthened. When it is considered that reconstruction and installation proceeded simultaneously, remarkable progress was made. As the building plans matured, the Regional Director decided that the combined structure should be known in future as Telegraph House.

The Post Office took full advantage of this wonderful opportunity to complete not only a modern but a model office. New standard instrument tables for 74 circuits were manufactured and fully equipped in readiness for teleprinter automatic switching. These tables were fitted with the latest tape-type Creed teleprinters. The phonogram suite of 55 positions is equipped with the up-to-date phonogram automatic distribution system, embodying improvements gained from the field trial at Newcastle-on-Tyne. The number of waiting calls at any moment is displayed prominently on each of three walls of the rooms and in the instrument room situated on the floor above. A full conveyor system operates throughout the instrument room and to and from the phonogram room. The engineers were able to divert from the street into the building a tube which had been unused for several years.

At Telegraph House, staff welfare has not been overlooked. The retiring rooms are spacious and commodious and the dining room is a work of art. It does really seem that the Post Office was prepared to do what it could to make amends for the discomfort of the war period.

New telegraph instrument room. Circulation and segregation tables

London: an International Phototelegraph Centre

London is becoming the hub of phototelegraph services between Europe and the rest of the world. Standard rates for "through" pictures have been agreed by the British Post Office with several European countries on the one hand and with the British Commonwealth and the American continent on the other. The Post Office hopes to extend the arrangements to include all European and extra-European countries to which there is direct access by wire or wireless.

Phototelegraph service is now available from London by cable to ten European countries and by radio to five European and fifteen extra-European countries. The service can be used for facsimile transmission of pictures, photographs, drawings, plans, documents, etc. For European countries the maximum size is approximately 7 by 5 inches and for other countries approximately 10 by 9 inches. Items larger than these dimensions can be divided to make several items.

Telecommunication Services in British East Africa

R. E. German
Postmaster General, Kenya

KENYA, UGANDA AND TANGANYIKA HAVE separate governments, but, since 1948, common services in these territories have been administered by the East Africa High Commission. Postal, telegraph and telephone communications, however, have been centrally controlled since 1933 by the East African Posts and Telecommunications Administration. The total area of the three territories is approximately 750,000 square miles and the population at the last census included 44,000 Europeans, 222,000 Asiatics and 17,500,000 Africans. The P. and T. Administration has headquarters at Nairobi and there are regional organisations in each of the three territories. The telegraph system consists of 379 offices, including 44 served by wireless only, and there are at the moment 168 telephone exchanges serving a total of 12,000 subscribers.

Before describing the services in detail, it will be as well to mention some of the particular problems that arise in providing telecommunications facilities in these vast and largely undeveloped territories.

Climatic conditions vary considerably and in those areas in which rainfall is heavy considerable difficulty is experienced in keeping undergrowth in control. The rate at which some of the creeping vines grow has to be seen to be believed. Termites exist over wide areas and, if steel poles cannot be obtained, wooden poles have to be specially protected against them. There are still areas in which game of all descriptions is present in considerable numbers. It is not so long ago that lions seriously interfered with the work of construction parties and stories are still told of African linemen having to spend a night at the top of a pole because lions had established themselves at the base. Telephone poles seem to have a peculiar attraction for elephants and the lines along the coastal area of Tanganyika and Kenya are frequently interrupted at certain times of the year, when elephants are on the move. In the plains of Kenya and Tanganyika, where giraffe are present, particularly high poles are used to ensure adequate clearance.

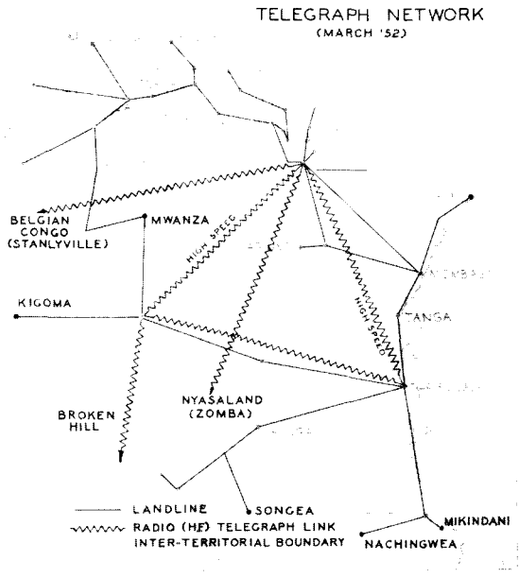
The telecommunication system extends into areas far beyond railways and far beyond what might be regarded as the main road system. There are as yet only relatively few miles of roads capable of carrying heavy traffic at all times of the year. Most of the all-weather roads have only loose gravel surfaces. During the rainy season, therefore, moving supplies in the outlying areas is a major problem.

Although special problems arise from the climatic and other features of the three territories, many of the difficulties confronting the East African P. and T. administration are exactly the same as those which are being experienced by telecommunications administrations the world over. The greatest of these is to meet the rapidly growing public demand for a service which requires very considerable material and financial resources for its modernisation and expansion.

Inland Services

Telegraphs. The telegraph service plays an important part in the communications system; some 2,000,000 telegrams are sent in the course of a year, which is about the same as the number of telephone trunk calls; moreover, the telegraph traffic, unlike that in many other parts of the world, has shown a steady progressive increase in recent years.

There are teleprinter circuits between the main offices and high-speed radio circuits between the territorial capitals, Nairobi, Kampala and Dar-es-



Salaam. The complete network for the 379 offices is shown in the diagram above.

Except for the high-speed radio circuits and teleprinter circuits, the whole of the telegraph traffic is on a hand-speed Morse basis. Practically the whole of the operating is performed by Africans.

The wireless stations operate in groups working on common frequencies and to strictly controlled schedules. The equipment provided is of various types from 10 to 750 watts output.

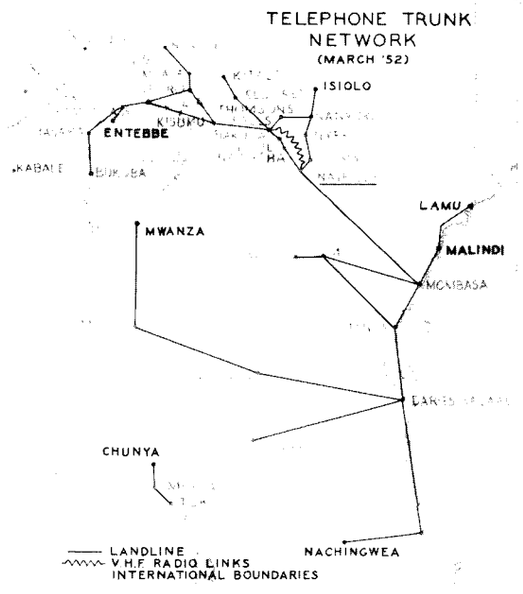
Telephones. Twenty-three of the 168 exchanges are automatic and of Strowger pre-2,000 type, having been supplied by either the Automatic Telephone & Electric Company or the General Electric Company. The total number of telephone subscribers connected to automatic exchanges is 7,200. The automatic exchanges vary in size from country satellite exchanges serving 10 subscribers to the exchange in Nairobi, which, with a small number of satellite exchanges, provides service for 3,084 subscribers. The remainder of the exchanges are all magneto, varying in size from a 10-line wall type switchboard to multiple type switchboards, the largest of which is at Nakuru, serving 277 subscribers. The telephone system handles about 25,000,000 local calls and 2,000,000 trunk calls in a year.

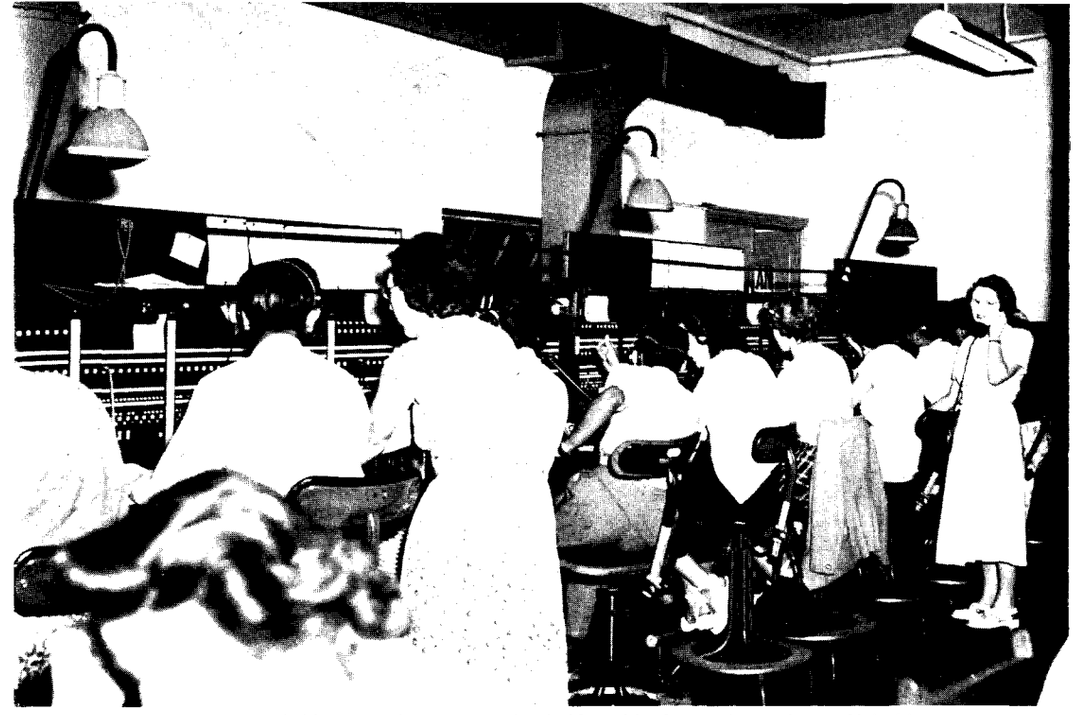
The total number of telephone operators employed is 338, of whom 52 are Europeans, 47 Asiatics and 239 Africans. With the exception of two areas, Mbeya in Tanganyika and Kabale in Uganda, all exchanges are connected to the main trunk network.

Subscribers' Distribution. In all the smaller places, subscribers' distribution is entirely by overhead line, but in the larger towns, the great majority of the underground cable distribution is by armoured cable in trenches about 30 inches deep. New cables are being placed in earthenware ducts. In the rural areas, particularly in those areas of Kenya and Tanganyika that have been developed by European farmers, the general policy is to provide service on a party-line basis.

Long-Distance Communication. The existing trunk telephone network is shown in the diagram below.

The whole of the long-distance communications, with the exception of that operated over an underground cable between Entebbe and Kampala, is by overhead routes. Most main-line routes utilise steel poles and arms and carry 200-lb. copper wire conductors. In the main, these routes follow the railway and were constructed without regard to the possibility of carrier working. Voice-frequency telephone repeaters were introduced in 1934 and





Ten-position bridge control auto-manual switchboard in the existing exchange, Nairobi

the first single-channel carrier system was fitted in 1936. Owing to the demand for long-distance communication during the war, additional carrier-systems were installed.

In 1950 the first 12-channel system was installed to work over an experimental V.H.F. radio system provided by the Marconi Company and installed between Nairobi and Nakuru, a distance of 100 miles. Two radio repeater stations are provided. Since then three other 12-channel systems have been installed on open-wire routes between Nairobi and Mombasa, Dar-es-Salaam and Tanga, and Kampala and Jinja.

International Services

Telegraphs. Cable and Wireless, Ltd., maintain stations at Nairobi, Mombasa and Dar-es-Salaam. At Dar-es-Salaam the company maintains a public office and delivers international telegrams. With the exception of a few circuits to contiguous countries, which carry terminal traffic only, the whole of the international telegraph traffic, which is handed in at Post Offices throughout East Africa, is handed over to Cable and Wireless for onward transmission. The company has direct radio-telegraph circuits from Nairobi to the United Kingdom. The stations at Mombasa and Dar-es-Salaam are connected by submarine cable to Zanzibar and thence to the general Commonwealth and foreign cable network. All incoming telegraph traffic to East Africa, with the exception of that addressed to Dar-es-Salaam, is handed over by Cable and Wireless to the Post Office for onward transmission and delivery.

Telephone Circuits. Cable and Wireless, Ltd., operate radio-telephone circuits from Nairobi to the United Kingdom, Aden, Nyasaland and South Africa. The International Service is available to all telephone subscribers in East Africa except those served by the few exchanges that are as yet not connected to the trunk network.

Plans for the Future

Telegraphs. Teleprinter circuits will be introduced on an increasing scale wherever the volume of traffic justifies this, but in view of the low traffic from some of the outlying offices and of the great distances involved, it is only to be expected that hand-operated Morse circuits will remain for many years to come over an extensive part of East Africa. It is unlikely that traffic density will warrant any extension of the high-speed radio-telegraph network, particularly as the provision of telegraph channels over the carrier systems increases. The Administration is extremely interested in the development of a facsimile telegraph system, which

New telephone exchange building, Nairobi

would have considerable appeal in East Africa if it could be operated satisfactorily over long lines.

Telephone Services. There has been, since the war, very considerable commercial and industrial development in the three territories and there is at present a waiting list of over 10,000 applications for telephone service. Exchange capacity is exhausted at many of the larger exchanges and the replacement of exchanges in Nairobi, Kampala, Mombasa and Dar-es-Salaam is already under way. The new Nairobi system will probably have been cut-over by the time this article appears. It consists of a central exchange catering initially for 4,000 subscribers, with seven satellite exchanges serving from 500 to 700 lines each. The equipment has been manufactured by the Automatic Telephone & Electric Company, Ltd., of Liverpool, and is of the 2,000 type, utilising subscribers' uni-selectors. The company is supplying calling-line identification equipment which will display the calling subscriber's number by electronic means on a panel inserted in the keyboard shelf of the manual position. The building accommodating the central exchange is shown in the accompanying photograph.

The installation of a new automatic exchange at Kampala with an initial capacity of 2,600 lines started in October. The equipment for this exchange is being supplied by the Automatic Telephone & Electric Company.

A new automatic exchange for Mombasa with an initial capacity of 4,000 lines has been ordered from Ericsson Telephones, Ltd., and installation is expected to begin in the second half of 1953. The exchange is scheduled to be brought into service towards the end of 1954.

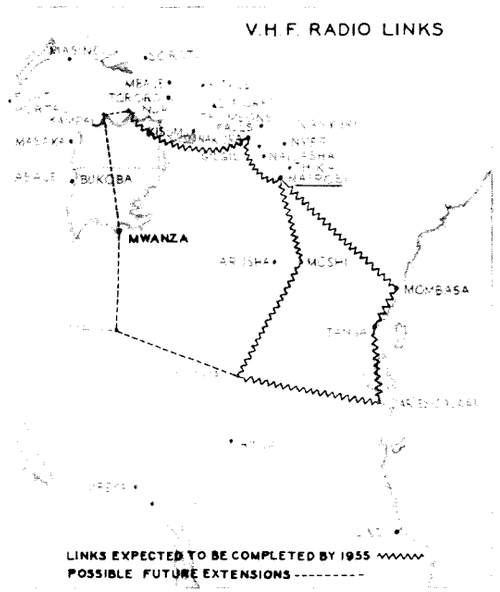
It is expected that a new automatic exchange for Dar-es-Salaam will be ordered early in 1953 and brought into service early in 1956.

It is essential in present-day circumstances to have in the larger towns an underground cable network providing the maximum flexibility. For this reason, it is now the practice to place new underground cables in these towns in earthenware ducts similar to those used by the British Post Office and cabinets and pillars are being used to improve flexibility.

The provision of telephone service in the rural areas presents rather special problems in view of the great distances involved. In many areas there are no recognised centres that would be suitable for the installation of automatic exchanges and it seems necessary, therefore, to visualise the continuance of party-line service on a fairly extensive scale for many years to come. Discussions are proceeding with the telephone manufacturing

ompanies to see whether it is possible to design system that will provide selective ringing on ulti-party lines, because it is thought that this ould remove one of the biggest objections to arty-line working. It is the intention to provide utomatic exchanges wherever possible and radually to replace magneto exchanges, which are ill such a feature in these territories. In the meanme, the capacity of many magneto exchanges is eing increased.

The problem of increasing the number of longstance circuits as the number of subscribers creases is a difficult one. There are few overhead utes on which it is possible to install additional rrier equipment. The clear alternatives, therere, are either to make use of V.H.F. radio mmunication or to rebuild the overhead routes er very long distances to an entirely different andard. The V.H.F. radio system between airobi and Nakuru has proved so satisfactory in actice that it has been decided to go ahead with n extensive programme of V.H.F. development. uring 1953 and 1954, V.H.F. radio systems will e installed between Dar-es-Salaam and Tanga, anga and Mombasa, Mombasa and Nairobi, akuru and Jinja, Dar-es-Salaam and Dodoma, odoma and Moshi, and Moshi and Nairobi. This will provide a long-distance network something on the lines of the diagram on this page.



East Africa is in many ways very suitable for V.H.F. radio working, but the siting of intermediate relay stations presents considerable difficulty, in that the most suitable site is often very inaccessible. It is necessary at all intermediate relay stations to provide independent power supplies and often to build many miles of access roads. The alternative of completely reconstructing overhead routes would have involved much more additional capital expenditure, however, and could not possibly have been done so quickly.

General

To prevent damage by termites, it used to be the practice to use steel poles for all overhead construction work; not only were these immune from attack by termites, but they were easily transportable and the construction of telephone lines in rural areas was very much facilitated.

Steel poles are now difficult to obtain and are extremely expensive, and it has therefore been decided recently to use wooden poles. Suitable eucalyptus gum poles are available in the forests of Kenya and the P. and T. Administration has installed an open-bath creosoting plant capable of treating 80,000 poles a year. It is hoped to instal a vacuum-pressure plant in 1953. While it is expected that the wooden poles, properly treated, will have a long life even in termite-infested areas, the transport of heavy wooden poles long distances by lorry is expensive and at times difficult.

Many types of insects build nests in the spaces under the insulators and are a source of serious difficulty. Clear glass insulators seem to be proof against this trouble and are now being introduced.

It has long been the policy in East Africa to encourage the local population to take an increasing part in telecommunications work. As yet it has not been possible to find a sufficient number of local Asiatics or Africans capable of maintaining the more complicated telecommunications apparatus and it is therefore necessary to employ Europeans to a larger extent than is perhaps likely in the future. Considerable attention is now being directed to technical education and it is hoped that as time passes it will be possible for Asiatics and Africans to take a fuller share in the maintenance of this essential system.

Easing the Burden

R. E. Rimes, B.Sc., A.M.I.E.E., Bradford Telephone Area

MECHANISATION CAN HAVE TWO important advantages, among others. It can enable a given amount of work to be done by fewer men and can lead to increased production by reducing fatigue.

With these principles in mind, experiments have been made in Bradford Telephone Area with a mobile crane, to facilitate the transfer of poles from railway trucks to pole stacks and to assist in the recovery of stout poles on derelict trunk routes, thus reducing to a minimum the number of men withdrawn from advice-note work.

Initial stage in recovering a 50-foot stout pole
Photo, F. K. Bottomley

During the trials, further uses were found for the crane, notably for shifting large cable drums at the Regional Cable Splicing Depot, erecting assembled kiosks in situations unsuitable for handling with the specially designed trailer and installing loading coils in manholes. The need for a crane lorry has been obvious for a long time, but the difficulty was to find a model fulfilling the following requirements:

> High manœuvrability; hydraulic jib, giving a lift of not less than 16 feet, easily adjustable to any position between a minimum of 4 ft. 6 in. and a maximum of 20 ft. 6 in. from the ground; adjustable lifting power in the range 1½-2 tons; crane to be mounted directly on vehicle chassis and powered from motor engine.

A mobile crane with these desirable features was obtained. It is mounted on a Morris chassis with four-wheel drive, giving a road speed of 30 m.p.h. The jib can be critically controlled from the driver's seat. Perhaps the crane shows to best advantage in the recovery of poles: 36-foot stout poles (unblocked) have been withdrawn from the ground and placed on a lorry in an average of nine minutes, the whole operation being carried out with the minimum of manual effort. Digging a pole out of wet, soggy clay is no easy matter and those men who do this work have shown very clear appreciation on first seeing such a task performed by the crane in a matter of minutes. The standard estimated time to recover a 36-foot stout pole is 14.3 hours, which includes stripping off step fittings and filling in the hole. Under reasonably favourable conditions, these operations can be carried out, using the crane lorry, in 1¼ hours.

The photograph shows the crane in action on a 50-foot stout pole, in position against the boundary wall of a busy thoroughfare and flanked on one side by a river. It was impossible to recover the pole safely by normal manual methods, since a pole should be stayed on all sides to ensure perfect control while being lowered. Owing to the difficult situation, the precaution was taken of cutting 10 feet off the top. The pole was then safely recovered and lowered on to the lorry in 30 minutes.

The staff reaction to the introduction of the crane is interesting. There are many demands from foremen for assistance, the chief attraction being the elimination of fatigue. At the same time, the staff seems to have recognised the Department's desire to play its part in the effort to increase production.

Restricted Telephone Service

D. H. Simpson
Oxford Telephone Area

IN NORMAL TIMES FUTURE TELEPHONE requirements can be forecast with reasonable accuracy and so it is possible to arrange in advance for annual programmes of cable construction and exchange installation work to ensure that plant is available to meet the demand as and when it occurs. Similarly, the need for renewal and replacement of deteriorated or obsolete plant can also be foreseen and provided for on an annual basis.

During the war years this procedure virtually ceased. In addition, the plant already existing suffered serious damage in many areas through enemy action. Consequently, when the war ended, there was a lag more or less equivalent to five years of normal progress to be overtaken and a considerable amount of work to be done to restore even the pre-war level of resources.

Thus there were obvious difficulties in the way of meeting fully the post-war demand for telephone service. This demand reached an unprecedented high level almost immediately and, moreover, its character and distribution differed in many places very widely from those of pre-war days and from pre-war expectancies. War-time evacuations of population and business concerns, new popular habits and modes of living, the increased importance of agriculture and altered importances of other industries in the national recovery effort, were among the contributory causes of this shift of telephone potential. A situation already difficult was made even more difficult.

The great efforts made to meet the demand resulted in exceptional inroads being made on the capacities of existing cables, overhead wires and telephone exchanges. Early exhaustion was inevitable in many places and in many others it was certain to occur long before adequate relief could be provided. A large expansion programme was an urgent need. There were even more urgent demands on national resources, however, particularly on those of steel, building materials, labour and capital investment for such things as housing, re-construction of bombed cities and increasing exports. In the circumstances, only a relatively small proportion of the needs of the telephone service could possibly be met and it became essential to develop expedients to increase the use of the available plant and labour. That essential need has persisted. It accounts for the post-war policy of line-sharing by two subscribers and, more recently, for the introduction of a restricted form of telephone service.

The real significance of those two features lies in the fact that they are radical departures from previously accepted standard principles of telephone service design and practice.

Design and Use of Plant

Basically, all telephone plant is designed on the principles that each subscriber will be connected to his exchange by a pair of wires reserved for his exclusive use and that he will be given a means of making and receiving calls which is as efficient and speedy in the busiest hour of the day as in the slackest.

Undoubtedly this is an ideal, but it is uneconomical and wasteful in terms of usage of resources—particularly with residential lines and traffic. It means that each pair of wires is in use for an aggregate of about 15 minutes or so each day—because on the average it is used for only about five or six calls—and that operating positions and automatic switching equipment are fully occupied for only an hour or two a day. It means, too, that whether national conditions are prosperous or not, we should as a business concern encourage subscribers to use their telephones more and especially to do so in the slacker hours of the day. Hence the post-war conditions did not create the problem; they emphasised the need to examine an old one, for in these two directions there was obviously scope for economies.

As far as line plant is concerned, the possible solution was soon acknowledged and the principle of exclusive line service, at least for residential subscribers, was abandoned. Shared service was introduced to enable each pair of wires to be used

to connect two subscribers to the exchange instead of one as before and it was applied to all new and removing residential subscribers. Theoretically, therefore, it could in time result in doubling the capacity of the line plant serving residential areas.

For call switching, however, no similar expedient had been adopted generally, until comparatively recently. The difficulty was to devise a means by which the connection of additional lines to an exchange did not result, as normally, in an increase in the number of calls to be handled in the busy hour. The question was whether or not subscribers would be content with a service that was not fully available for the whole of the day. It need be curtailed for only an hour or two, it need not involve complete disconnection at any time and it would, of course, be the alternative to no service at all. It was felt, therefore, that there was a reasonable chance of favourable public reaction if a workable arrangement could be devised.

New Scheme

A scheme involving the use of switching keys to disconnect the outgoing service only on certain subscribers' lines in the busy hour was introduced early in 1948 in the Sloane Exchange (London). It was also tried out without using switching keys at one or two small manual exchanges in Northern Ireland. Since then, and until recent developments took place, it had been extended only to a few automatic exchanges in London where there was a shortage of switching equipment. Now, some six months after the official extension of the service to the provinces, it is being used in over 100 exchanges, and telephones have been provided for several hundred people who would otherwise still be waiting for them.

Thus the second of the two fundamentals of design and use of telephone plant has been discounted and the question arises whether or not either or both should ever again be given their old significance. The case for the sharing of lines has already been discussed widely; the one for restricted service demands the same attention. If it is not acceptable as a normal feature for all future planning, it is at least a practical contingency which might be provided for to guard against the possibility of recurrence of our present difficulties or the occurrence of something similar.

Restricted service involves the provision of full normal telephone facilities but limits their use by means of disconnecting keys, or through the voluntary co-operation of the subscribers, during the busiest few hours of the day. Latitude in the duration of the restricted period is necessary because the busiest hour does not occur at the same time each day. Fundamentally, therefore, it is a simple, comparatively non-technical means of limiting the growth in busy-hour telephone traffic without limiting the growth in subscribers' exchange lines. It is applicable in one form or another at both manual and automatic exchanges and is provided on the condition that the line will not be used for originating calls during certain hours of the day, although it will be available for receiving calls at all times.

The embargo on originating calls may be complete or may refer only to those which involve the attention of operators. So long as this condition is fulfilled, a reduction in the growth of busy-hour traffic is bound to follow. Growth will not be eliminated because incoming service is not barred to the Restricted Service lines, because full-facility lines for business and essential subscribers will continue to be connected, and also because some increase always occurs through natural causes. There is, for example, the normally increasing use made by business concerns of existing full-facility lines—up to their maximum traffic-carrying capacity.

Thus Restricted Service, as at present provided, is a limited palliative. Moreover, it may be introduced only after all other relief measures have been attempted, and at a late stage in the life of an exchange. Its real value is in consequence somewhat obscured. On the other hand it has obvious possibilities which are interesting enough to suggest that it might be developed into a standard specific.

At least two questions must be answered satisfactorily before the merit of the scheme can be examined in its proper perspective.

The first is whether or not the subscribers concerned will remember the periods when they may not make calls. In manual areas this does not arise, because service can actually be barred by using keys or by other means, and disconnection by means of keys is also possible in main automatic exchanges. In those automatic areas where it is necessary to leave the purely automatic service undisturbed, however, the answer lies mainly with the subscribers.

The second question is whether or not this form of service is acceptable to the general public.

From experience in the Oxford Area, where the need for Restricted Service was particularly urgent and drastic, the answer to each of these questions is a definite affirmative.

Very few manually controlled calls have been made, during the prohibited periods, in an automatic area where a full check on all tickets has been maintained experimentally in order to have as complete a check as possible on the way in which the subscribers concerned have observed their obligation. Similarly, few attempts have been made to originate calls at a large manual exchange. In every case the reason for the irregularity has been forgetfulness on the part of the subscriber or ignorance of the condition on the part of a visitor in his house. Suitable notices on or near the telephones will no doubt overcome these difficulties.

All residential applicants who have been approached and many small business concerns have readily accepted the offer of Restricted Service. From some of the comments made, there is evidence of an actual demand for it—if it is available at a reduced rental. In any case, however, the condition is regarded as of little importance compared with the fact that it is the alternative to no service at all. The modern tendency for husbands and wives both to pursue business careers means that many households are virtually unoccupied during the morning hours and this no doubt is the explanation for the suggested demand for Restricted Service and, partially, for the ready acceptance of it.

Typical Examples

As far as immediate results are concerned, the following examples can be regarded as typical.

At a manual exchange where there were over 500 waiting applicants, none of whom could have been given service for about a year owing to busy-hour overload conditions, it has been possible to connect over 100 already and the total will certainly reach 150 before normal relief can be provided. In addition, a number of applicants on dependent exchanges will also get service a year sooner than could otherwise have been expected. In a non-director area also there are over 100 additional lines, a year or more in advance of completion of a major relief scheme, and still more will be connected soon. Some 20 dependent exchanges have been removed from the list of exchanges exhausted on grounds of load capacity of the parent manual board. It is reasonable to assume that should similarly difficult conditions arise elsewhere equal success could be achieved.

Future Possibilities

A superficial examination of future possibilities is sufficient to justify the opinion that shortages of exchange equipment are inevitable for many years to come and that they will probably occur in almost every Telephone Area. The serious discrepancies this year and next between the exchange building requirements and the material and labour allocations make it certain that delays will be of the order of several years in completion of relief schemes and that they will be fairly widespread.

Departure from present policy seems unavoidable in these circumstances or we shall be faced in due time with the alternatives of either refusing to connect new lines or accepting a seriously degraded standard of service in the busy hour. As a business concern we must be opposed to the former course and equally we cannot afford the latter. To discourage the use of our service by the business community through a lowering of our standard of efficiency is clearly a retrograde step. Busy-hour load-shedding by denial of service to lines that do not really need it is an obvious answer. It is already practised by other public utilities and has always been done in one way or another by almost every business concern either large or small.

Technical solutions, though not immediately apparent, may possibly be forthcoming, but they will take time to develop and labour to provide. Restricted Service, on the other hand, involves none of this. It is in fact a necessity, should a national emergency arise. It is straightforward and simple and costs practically nothing to provide and operate.

Clearly, then, a strong case can be made out for its use, if it is done on a sufficiently comprehensive scale to produce tangible results.

Objections to the scheme as a short-term expedient lie mainly in the fact that it is applicable particularly to residential lines and possibly to small business users. In other words, it applies to the lines that produce a relatively small proportion of the total busy-hour load, and as such it cannot possibly provide material relief in a single year. That may be regarded, however, as some justification for using Restricted Service on a long-term basis.

In an automatic area this is particularly appropriate to the trunk and toll calls made from residential lines. These form a small part of the total load that has to be handled by operators, and the extra number of them that would be made as a result of one year's growth in normal residential lines would be only a very small proportion of the total traffic increase. The amount would certainly be less than 1 per cent. out of a general total of, say, 4 per cent. and would therefore correspond only to the usual day-to-day fluctuations in the total peak load. The use for one year of the form of Restricted Service that restricts only trunk and toll calls would therefore provide little more than a token contribution towards load relief.

Measurable Relief

On the other hand, full restricted service with all call-originating facilities disconnected by a key switching device would provide measurable relief to automatic switching equipment, because many more directly-dialled calls than trunk and toll calls are made in the busy hour over residential lines. Similarly, in a manual exchange where call-originating facilities are disconnected and where all calls—local, toll and trunk—are handled by operators, material saving in busy-hour traffic results from the use of Restricted Service. In one year, the saving would probably be equivalent to as much as half the normal traffic increase due to natural causes.

If the amount of the annual saving, either manual or automatic, could be aggregated over a number of years, the effect on the busy-hour call switching equipment requirements would be considerable. It could in fact be adjusted to meet any required condition if applied in time. Hence, if we are to reap the full benefit of the scheme for Restricted Service, we must apply it several years in advance of normal exhaustion dates.

At Group Centre exchanges, it means that for every extension by one year in the life of the present operating positions, for example, we should have to introduce Restricted Service at the Main Exchange and at others dependent on it for a period of about two years in advance of the normal load exhaustion date. At manual exchanges, the period would generally be rather less.

It follows that to implement the scheme properly it would be necessary to modify the basis for equipment extensions at least. For instance, in all exchange extension work, the physical rather than the traffic load capacity of the switchroom or automatic apparatus room (in terms of accommodation for subscribers' line terminations) would be the limiting factor for design purposes. Restricted Service for all new residential, and where applicable small business, lines could then be introduced as and when necessary by reason of the actual realised rates of connection of new full-facility lines and of growth in busy-hour traffic. The date would be sufficiently early to ensure that the resultant saving in busy-hour load at the anticipated relief date balanced the position and switching equipment growth needed to cater for the natural traffic increase through causes outside local control.

Alternatively, Restricted Service could be introduced at the very outset, on the assumption that delay in the further relief date was likely. This would produce an accumulation of Restricted Service lines with a gradually increasing effect on the busy-hour growth. The number could be limited to that estimated to be necessary for the ultimate condition and maintained at that level by bulk transfers at regular intervals of the oldest restricted users to full-facility service; it could be increased or reduced as desired in keeping with later circumstances and prospects. This arrangement would provide a valuable safeguard against the changing conditions and is therefore likely to be the better one as a basis for policy.

Practice will not be the same everywhere, because in some places the difference between the physical and load capacities of exchanges will not be big enough to warrant the use of Restricted Service, and there may therefore be objection on the grounds of lack of uniformity. For a long time to come, however, there will be many places where the service will be justified as a device for load shedding and load spreading and consequently for easier and more balanced staffing.

There is, of course, the possibility that an actual demand for Restricted Service might develop before the time comes for it to be no longer necessary for economic reasons; but that time seems to be so far distant that we can discount the possibility as an objection to the scheme, in the certainty that new facilities and new refinements will become available in the meantime to alter the complexion of the case. In the past, the future has always produced the development to confound the prophets. There is no reason to suppose that it will fail to do so when to-day becomes the past.

NOTES AND NEWS

Improving Channel Island Service — P.O. using Mine Detectors — Telephone Relics — Farmers' Lines — Cordless Switchboards for Thanet — Greenwich Time Ball — Speaking Clock

Improvements in Communications with the Channel Islands.—Trunk telephone communications for the Channel Islands are provided by two submarine cables and one radio link, and the number of circuits originally available was 30 (12 in each cable and 6 on the radio link). In recent years, this total has become quite inadequate for the volume of trunk traffic between the Islands and the mainland, and temporary expedients adopted to provide more circuits were, firstly, the use of army-type carrier equipment to give additional channels on the cables and, secondly, the increase in capacity of the radio link from 6 to 12 channels. These arrangements have provided only a very limited measure of relief, but the position will soon be substantially improved.

As the first step towards a major improvement in the service, submerged repeaters have recently been inserted in both of the cables, each of which can now carry 60 circuits. When other associated work has been completed, the increased capacity of the cables will be used to provide additional trunk circuits between the Islands and London, as well as new direct routes from both Jersey and Guernsey to Bristol. On completion of these arrangements, the radio link will be recovered.

The submerged repeaters (three in each cable) were laid by Post Office staff operating from H.M.T.S. *Alert*. A full description of submerged repeaters and the method of laying them appeared in the *P.O. Telecommunications Journal* for November, 1951.

* * *

Post Office Experiments with Mine Detector.—The Post Office is using a mine detector borrowed from the military authorities to trace buried footway boxes and manholes. It is also useful sometimes inside buildings for tracing cables under plaster.

On one estate where plant was provided while the footways were unmade, metal boxes were covered with ashes, paving stones and asphalt, but they were quickly found.

Experiments with the mine detector have been made for locating nails and other metal objects in poles before cutting up, checking the depths of cables and conduits and checking for joists and girders in concrete floors of buildings before cutting holes.

* * *

Sturdy Veterans.—The Gower-Bell telephone illustrated on this page was recently presented informally to the Post Office by British Railways. It had been in constant use from some time before 1897 until it was recovered last year.

This type of telephone was the first subscriber's instrument to be produced on a large scale for the Post Office. From 1880 to 1885, it was fitted with a Gower "pencil" transmitter. In 1885, this was superseded by the Hunnings carbon-granule transmitter, which was much more satisfactory and is shown on the instrument in the photograph.

Another historical telephone is the one that was presented by the Postmaster General to the Mayor of Tunbridge Wells on the 28th November last.

The instrument, magneto wall-type, emblazoned with the Coat of Arms of the Royal Borough of

The Gower-Bell telephone as used in the 1880's

Tunbridge Wells, is thought to be the only remaining relic of the 1901 Tunbridge Wells Municipal Telephone System when the Borough became the first municipal authority in the country to compete with the National Telephone Company.

This unique telephone, which is in a remarkable state of preservation, was recently recovered from the Pembury Waterworks, and until then was in daily use for fifty years.

When the Municipal Telephone Exchange was opened in 1901, it catered for 229 square miles and had 330 subscribers. The first call was made from Tunbridge Wells by the Lord Mayor of London to the Lord Provost of Glasgow, where a similar municipal system was under construction.

The Tunbridge Wells venture was sold to the National Telephone Company sixteen months after its origin, because of the heavy loss being incurred owing to the original calculation being unsound. At first, the then Postmaster General, Sir Austen Chamberlain, resisted the transfer of the licence from the Borough to the National Telephone Company, but after the matter had been debated in Parliament the transfer was agreed.

* * *

Broadcast Receiving Licences.—12,870,101 broadcast receiving licences, including 1,732,882 for television and 168,106 for receivers fitted in cars, were current in the British Isles at the end of October, 1952.

During the month, the number of television licences increased by 77,436.

* * *

Farmers' Lines.—Because of the large amount of work and stores required to provide telephone service to remote farms, and of the many claims on the Post Office's limited resources, it has been the practice to encourage the farmers to help in the erection of their lines by providing poles and labour. A new scheme has been introduced recently, under which a farmer may erect and maintain the wire for that part of his line between the last Post Office pole and his premises. For this he will buy insulated wire from the Post Office, but as compensation he will be allowed a concession on his rental.

* * *

The New Ringing Tone.—For some time it has been known that faint ringing tone occasionally experienced on calls dialled over 2 V.F. circuits was due to the fact that the fundamental frequency of 133 c. s. was too low to be transmitted satisfactorily over the equipment in use, and this has become more serious with the extension of operator dialling over the trunk telephone network. A new frequency of 400 c. s. has been decided upon and arrangements are in hand for the modification of all appropriate ringing machines.

The new tone, which is of the same pitch as the existing "engaged" tone but follows the familiar pattern ("burr-burr, burr-burr"), has already been provided at Paddington exchange in London and has been favourably received by subscribers and the press.

* * *

The New Look.—Nearly 200 telephone kiosks and over 300 letter boxes and stamp-selling machines in Sheffield (about one-third of the city's total) were scheduled for repainting during the closing months of 1952. This operation represents the expenditure of some fifty gallons of "Post Office red", five gallons of black paint and 25 gallons of varnish. Generally, every kiosk, box and machine in the Sheffield postal area gets a new coat in a three-year period, but boxes and kiosks in the grimier areas of the city receive more frequent treatment.

* * *

Cordless Switchboard.—The first two of the 30 controlling positions required for the first British cordless switchboard (Thanet) were manufactured towards the end of 1952 and were supplied to Headquarters, where they were kept for a time for demonstration and display. The exchange is expected to open early in 1955.

* * *

Greenwich Mean Time.—The Time Ball at the Royal Observatory, Greenwich, was installed in 1833 for the purpose of enabling masters of vessels proceeding down the Thames to adjust their chronometers. The Time Ball is raised half-way up a mast, on which it slides, at five minutes to one, hauled to the top at two minutes to one and released electrically on the hour.

The operation of the ball was suspended when the Observatory was evacuated during the Second World War, but was resumed temporarily at the start of the Festival of Britain. The practice of dropping the Time Ball was resumed at 1 p.m. on the 26th October, 1952, and will continue as long as members of the Observatory staff remain at Greenwich.

The system has now been superseded, of course, for all practical purposes, by the six "pips" broadcast at fixed times by the B.B.C. and by the speaking clock operated by the G.P.O.

* * *

The Speaking Clock.—During the four weeks ended 10th September, 1952, telephone subscribers in London made 3,728,000 calls to "TIM". This brought the London total of calls since the introduction of the service in July, 1936, to 12,605,000.

The speaking clock service is available to subscribers in eighteen of the larger towns throughout the country, and plans are in hand to extend the service to other towns.

Two speaking clocks, one at Holborn Exchange in London and the other in Liverpool, provide the service and all "TIM" calls are connected to one or other of these.

* * *

Telephone Trunk Service.—During the month ended 30th September, 1952, the Post Office handled a total of 22,646,000 trunk and toll calls. Of these 5,742,000 were at the cheap night rate. In the comparable period of 1951, the total was 21,919,000 of which 5,611,000 were at the cheap night rate.

At the end of September, 1952, there were 18,325 telephone circuits over 25 miles in length in use in the public network. This was a net increase of 334 on the number in use on 1st April last.

Lynmouth Flood Damage

Pictures recently received showing damage to telephone equipment during the disaster

Top

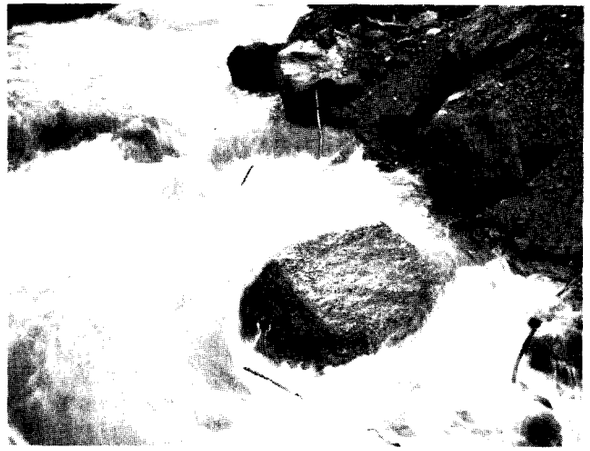
Where the kiosk stood, at Barbrook

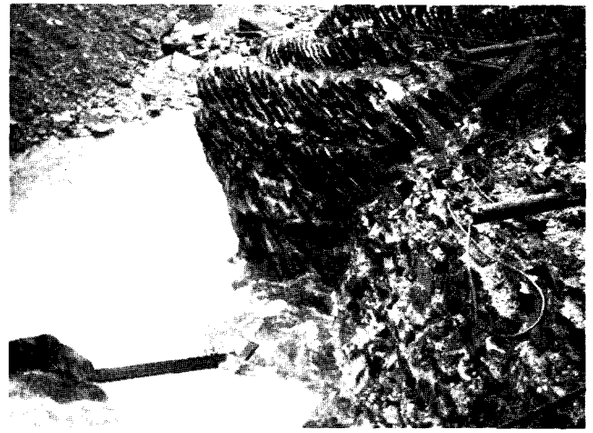
Centre

The solid mass of a main junction box. The duct can be seen on the left. This box is lying in the new course of the West Lyn, near Countisbury Bridge.

Foot

The damaged cable and conduit at the bridge at Lynmouth





Book Review

ALTERNATING CURRENT IN TELECOMMUNICATIONS. By W. T. Palmer, B.Sc., Wh.Ex., M.I.E.E., A.M.I.Mech.E. Sir Isaac Pitman & Sons, Ltd. 36 pp., 41 ill., 4s. 0d.

Alternating currents have such a wide field of application in modern communication engineering that one might be forgiven for regarding the title of this modest volume with surprise. As the author states, however, this book has no pretension to the status of a work of reference on either alternating current theory or telecommunications, but sets out to focus the attention of the new student on the relationship and interdependence of these subjects.

There is, therefore, nothing included which is not more fully covered elsewhere, but for the student desirous of pursuing a career in telecommunications this book should act as a starting point and a stimulus to further study, presenting, as it does, the basic facts in an ordered and understandable form and without the use of mathematics.

Beginning with a consideration of mechanical oscillation, the author proceeds by easy stages to electrical oscillations and the application of alternating currents to wide-band carrier systems, each section being given in sufficient detail to whet the student's appetite.

In its 36 pages, there are no fewer than 41 diagrams, and there is a page of references to publications recommended for further reading.

Another Cable Ship.—Cable and Wireless, Ltd., have ordered a new cable ship, which, with gross tonnage of 3,300 and a cruising speed of 12 knots, will be the largest and fastest ship in the company's service. She will maintain the company's cables under the Pacific, including the longest and, in parts, the deepest submarine cable in the world: Bamfield, Vancouver to Fanning Island, 3,500 nautical miles, lying in places three miles deep.

The new ship will be the third new addition to the company's fleet and, like her predecessors, *Edward Wilshaw* and *Stanley Angwin* (each 2,500 tons gross), will be built by Swan, Hunter and Wigham Richardson, Ltd., at Newcastle. The keel will be laid this summer.

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

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

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