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

★

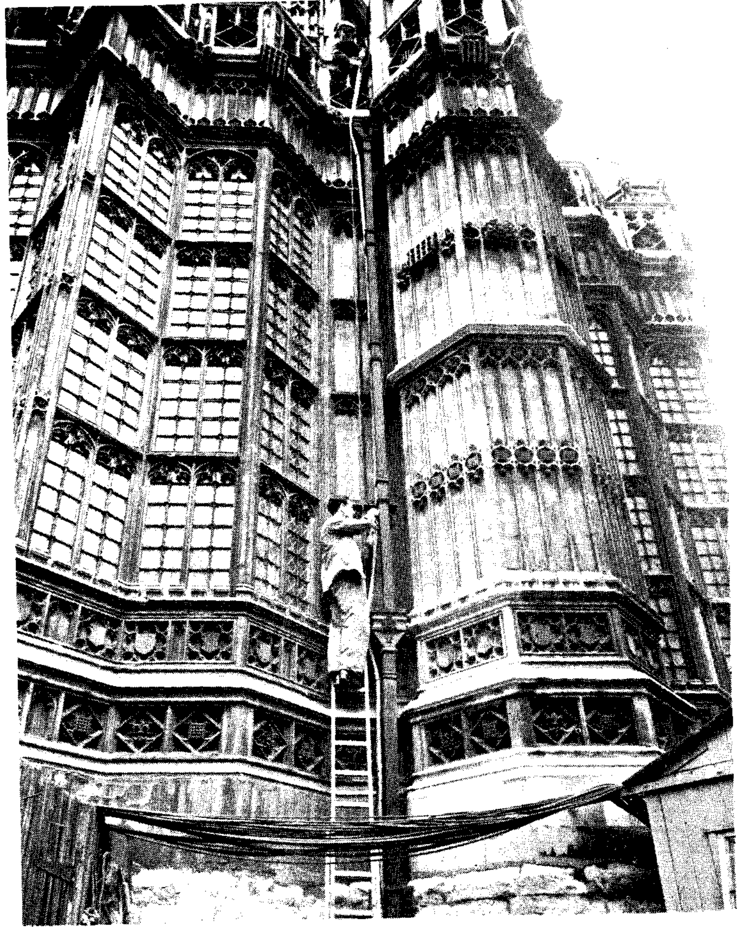
Vol. 5 August-October, 1953 No. 4

Tribute

ON JUNE 2ND THE WORLD STOOD STILL FOR MANY millions both in the United Kingdom and overseas as they joined together in their common loyalty and devotion to Her Majesty. Most of us were too deeply moved by the ancient and stately ceremony of the Coronation to reflect, until afterwards, that behind the event was a wonderful feat of organisation, or to remember our colleagues in the telecommunication services and our friends of the British Broadcasting Corporation to whom the day had been one of intense and anxious work, the culmination of many months of planning and preparation.

The Postmaster General has thanked his staff for their "very successful achievement and contribution to this happy occasion": a contribution which, besides helping towards the smooth flow of the ceremony and processions, included the provision of links carrying the magnificent sound and television broadcasts of the B.B.C.

The administrative and engineering staff whose skilful planning prepared the ground; the men who laid the lines and installed the switchboards; the maintenance engineers who stood in the background to ensure the efficient operation of the services; the telephone staff who handled traffic in the Triforium in Westminster Abbey or were on duty in exchanges adjacent to the route; the men and women who handled the immense volume of traffic reporting the event to the world: all these and many others gave of their best in order that the day should be a great one in every sense.



Telephone Cable being run to the Triforium outside Westminster Abbey

Coronation Day Caused Record Traffic

Staff Work Behind the Scenes

THE CEREMONY OF THE CORONATION OF Her Majesty Queen Elizabeth II on Tuesday, June 2, 1953, created a deep impression throughout the world. First and foremost it was received as a manifestation of deep religious significance and beauty, of the enduring spirit of a great people. But everyone was also moved to admiration of it all as a wonderful feat of organisation. In this organisation the telecommunications services played an unobtrusive but important part, contributing largely to smooth control and to the reporting of the event to all countries. Telecommunication plans prepared by the Post Office for the control and reporting of the event were outlined in our May-July issue; in this article we present a brief report of the way in which those plans were carried out on Coronation Day.

High in the roof of Westminster Abbey, in the Triforium overlooking the Coronation Theatre, a number of cubicles had been installed. Here were stationed the principal B.B.C. commentators, the Army officers who controlled the distant gun salutes, photographers, and a Ministry of Works Controller with a Post Office Liaison Officer. Nearby was a room prepared as their office and housing two 65-line telephone switchboards. From various points in the Abbey television cameras, discreetly hidden, photographed most of the ceremony for simultaneous transmission through all stations in the United Kingdom and to France, Denmark, Germany and Holland. Outside the Abbey, loudspeakers carried the commentary to the many thousands of people lining the processional route. Further afield the Central Telegraph Station, the Post Office Radio stations, and the Continental and International telephone exchanges were stretched to their limit to clear the unprecedented volume of Press messages and phototelegrams and to provide telephone circuits to all parts of the world. Careful preparation, attention to detail and enthusiastic team-work by the staff ensured that the telecommunications services operated smoothly and without hitch throughout the whole of the day.

Abbey Switchboards

Within the Abbey there could be no ringing of telephone bells, and the telephone service was indeed a silent service. What was done was to remove the gongs from all telephone instruments in the Abbey, and fit the instruments with lamp signals. Despite this, at the final rehearsal, while the Queen's substitute was at the High Altar, the sound of a telephone bell was clearly heard. The ringing bell was difficult to find, but it was eventually traced to the Press hut which had been built outside the Abbey walls. It had not been realised that the acoustic properties of the Abbey would enable these telephone bells to be heard. All gongs were, therefore, removed from the Press telephones.

The two 65-line switchboards were staffed on a 24-hour basis from Saturday, May 30, by two shifts of three girls each working for 12 hours from 6 o'clock in the morning and 8 o'clock in the evening; on June 2 the day shift took over half an hour earlier for a 12½-hour duty.

On Coronation Day itself traffic was quiet until 4 o'clock in the morning but things were very different afterwards. Calls were varied. Fire points reported regularly to the fire control. First aid services were needed now and again and there were two calls for ambulances. There were many calls between the "Gold Staff" officers who were in control of the arrangements in the Abbey and Ministry of Works officials who were responsible to the Earl Marshal for the services they provided. A call was made to the belfry so that the Abbey bells could chime at the moment of crowning; at the same time, two Army officers gave the order to fire the guns in Hyde Park, the Tower of London and Windsor, one speaking by radio and the other by telephone to make doubly sure that the order was received. The Ministry of Works Controller also reported regularly to the Coronation P.B.X. in the Horse Guards Parade, so that subsequent time-tables could be checked.

As well as being a silent service, the telephone service in the Abbey was a personal service of a very special kind. Occasionally a particular part of the building, such as the West Door, was required, but usually a particular person was needed and the operator often had to enquire on several extensions to find him. This was difficult when the official was moving about and out of sight of a telephone. Many messages were taken and passed on orally. Post Office staff on duty in the Triforium did a hard but excellent day's work: they were rewarded, however, by occasional glimpses of the magnificent ceremony.

Other Exchanges

The P.B.X's at the Palace of Westminster, the Prime Minister's Office and many others had a considerable part to play. The Scotland Yard switchboard—the well-known WHItehall 1212—was probably the busiest in London on Coronation Day. It handled reports received from barriers and traffic control points. On the Saturday before Coronation Day a further eight exchange lines were rushed in to augment the 45 lines regularly in use, and they were much needed. The Coronation P.B.X. in the Horse Guards was staffed on a 24-hour basis by Post Office girls. It comprised 6 positions, all of which had frequently to be in operation. Nothing could discourage the girls who had been on duty all night from helping during the day as well and, when they could be spared, all took turns at looking through one tiny window as the procession passed along Whitehall.

The Court Postmaster reports that the traffic on the Buckingham Palace P.B.X. rose to a crescendo on Coronation Day, when five men were needed to staff the switchboard.

The Press had originally asked for their three huts at Canada Gate (near the Victoria Memorial), Westminster Abbey and the Colonial Office to be staffed from 7 o'clock in the morning on Coronation Day. At half-past five on the previous evening, however, they asked for the hut at Canada Gate to be opened immediately, because of the excited crowds outside Buckingham Palace. Within an hour, attendants drawn from the reserve list were on duty in this hut.

The public exchanges in the processional area were also well in the picture. At Whitehall and Mayfair exchanges the day staff slept overnight at their exchanges ready to start duty at 6 a.m. As in

Westminster Abbey switch—board adjacent to the Triforium

the Abbey, the day shift relieved the night staff half an hour earlier to ensure that they might be able to travel home more easily; this was done at many of the Government P.B.X.'s as well. The exchanges were busy until 10 o'clock in the morning, but were lightly loaded during the service. Through the good offices of one of the Post Office Regional Engineers television sets were lent to those two exchanges, and as many of the staff as could be spared took it in turns to look in at the service.

A record number of 19,033 alarm calls was dealt with in exchanges in the London Region on Coronation morning. The previous highest figure was 12,000 alarm calls on the morning of the Coronation in 1937.

Owing to the rain, St. John Ambulance Brigade had insufficient space under cover to deal with casualties in Whitehall. Additional space was found by permitting the ambulance men to use the hall of Whitehall exchange and the exchange canteen as a First Aid Station.

London Telecommunications Region was called upon to provide no fewer than 3,280 circuits within the processional area and the Region is indeed proud to record that not one circuit failure occurred on Coronation Day.

It was not possible to fit the telephone to the Hyde Park gun site until the morning of Coronation Day. When the circuit was tested out, it was not satisfactory, because of a noisy instrument cord. The fitter, however, had left nothing to chance; he had a second instrument with him and this was fitted in a few minutes.

Of the millions who listened to B.B.C. commentators or looked-in at television, both in this country and on the continent, it may be that few realised the amount of work called for from the

Post Office in providing lines to Broadcasting House and Alexandra Palace, but this was a major contribution and is regarded with justifiable pride by all those whose skill helped to bring about its successful accomplishment.

Overseas Services

The very large amount of outgoing Press traffic arising from the Coronation, which reached its peak on Coronation Day, presented special and difficult problems to the overseas telecommunications services. The bulk of the traffic was handled over the public service facilities, cable and radio, the rest being passed over private wires, many of them specially provided.

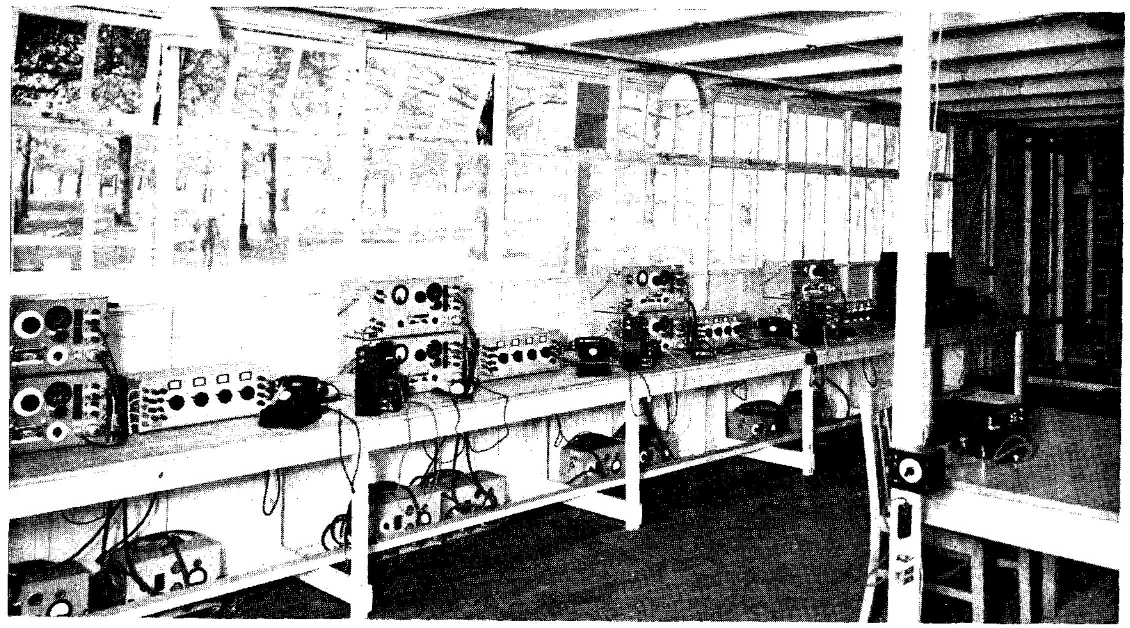
Detailed plans for collecting and forwarding the traffic had been carefully made, and tests carried out on new and additional circuits which were established specially. These tests involved a considerable amount of work with the distant terminals during the preceding month, and this had to be done without interference with normal service.

Fortunately the problem was eased to some extent on Coronation Day by the comparatively light file of normal outgoing traffic, but on preceding and succeeding days a large amount of Coronation traffic had to be handled in addition to the normal file. Radio conditions were not good on some routes throughout Coronation Day; nevertheless it was found possible to meet all commitments and this was due in no small measure to the effective team-work of the staff concerned directly with the traffic operating and engineering of the circuits.

A record total of 364,000 words of overseas Press traffic, some four times the normal, was handed in on Coronation Day; 230,000 words of this reached the Central Telegraph Station from counter acceptance points, the remainder being passed by private teleprinter circuits, telex and telephone. A substantial proportion was received by teleprinter from the Post Office Cable & Wireless branch offices at Church House (Westminster), Golden Cross (Charing Cross) and Parliament Street; and the temporary offices opened at Westminster Abbey, the new Colonial Office site (opposite the Abbey) and Canada Gate were well patronised.

Additionally, and at very short notice, telephones were installed at the stands accommodating Press correspondents in East Carriage Drive (Hyde Park), Piccadilly, the Mall and Whitehall. Each of these was attended by Post Office Cable & Wireless telegraphists and couriers.

Interior of the B.B.C. Control Centre, Canada Gate



As was to be expected, the largest proportion of the Press traffic went to the countries of the Commonwealth, some 96,000 words going to Australia, 40,000 to the West Indies, 37,000 to Canada, 18,000 to India, 16,000 to New Zealand, 15,000 each to South Africa and Ceylon and 10,000 to Pakistan. Large amounts of traffic were also forwarded to various other countries demonstrating the keen interest of the whole world.

One of the busiest places at the Central Telegraph Station was the Picture Room, which transmitted some 544 pictures over the three days from June 1 to June 3, 328 of these being transmitted on Coronation Day itself. This, again, is a record total, being more than double the number handled on any previous day. To dispose of this volume of pictures, all suitable radio senders at the Ongar, Dorchester, Bodmin, Criggion and Rugby Stations were made available and 11 picture equipments were in use transmitting pictures to 23 overseas stations. Of the total of 328 pictures transmitted, the largest number, 107, went to New York, the next highest being 49 to Melbourne and 35 to South Africa. Arrangements for pooling pictures were operated by the American, Australian and South African Press organisations and this reduced to some extent the demands on the picture telegraphy equipment.

Leased Channels

Five leased picture channels to New York were provided for private renters and two of the picture agencies cleared 29 and 35 pictures over their respective channels. Another two of the leased channels were used by an American broadcasting company to transmit some 90 pictures taken from a television screen in London for broadcast on their television network in the United States. It is understood that pictures were sent over this television network within minutes of the time at which the photographs were taken. Commentaries on the pictures were carried over the London-New York radiotelephone circuits.

Eleven leased circuits were provided to the continent for Press agencies operating their own picture transmitting equipment. Apart from the many pictures transmitted over these leased circuits, the Continental Exchange set up 102 calls for the transmission of pictures, compared with a normal daily total of 20. Eighteen additional picture transmission circuits were provided to the continent, and special operating positions were set up in the exchange to ensure speedy connection.

For some weeks before the Coronation demands had been coming in for facilities for the overseas commentators in London and arrangements had been made by telephone and telegraph with the telecommunication administrations and companies abroad for additional facilities. On Coronation Day 104 broadcast transmissions were established, 63 of these going over continental music circuits, and 41 over the radiotelephone circuits. Many of the broadcasts covered long periods of the day and, in all, some 260 hours of broadcast transmission were effected on the overseas circuits.

Eleven countries in Europe took the broadcasts, and transmissions over the radiotelephone circuits were made to Australia, South Africa, Canada, Ceylon and Singapore. The broadcasts included the transmission to France, Holland and Germany of the B.B.C. programmes, and complete coverage by the major American and Canadian broadcasting companies.

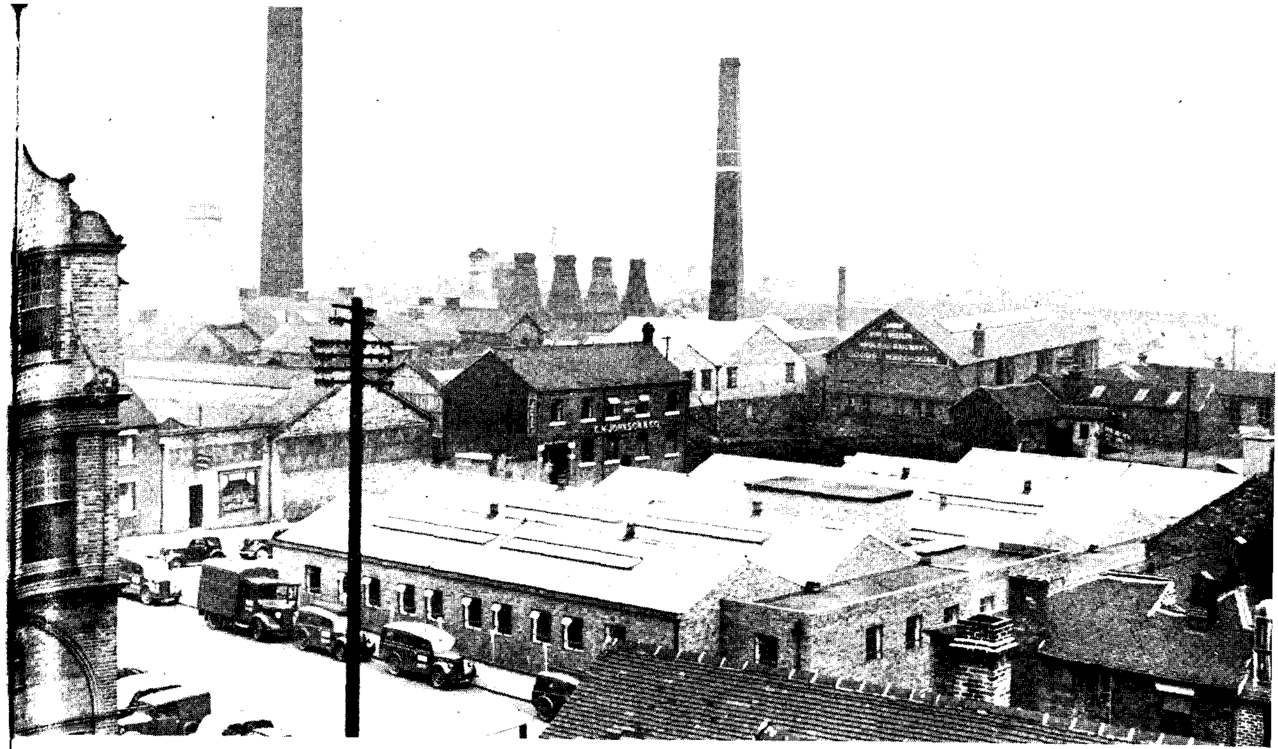
Continental Television

In addition to the ordinary broadcasts, sound transmission for continental television was passed over the continental music circuits. Commentaries for the television in France were made in French from London, but for the Dutch and German transmissions, an English commentary was given which was simultaneously translated in Holland and Germany for the benefit of the television audiences in those countries.

During the day many incoming broadcasts were taken from Commonwealth countries recording Coronation ceremonies and celebrations overseas, and these were included in the B.B.C's evening programmes.

The number of broadcasts handled on the day was a record far exceeding any previous day, and the burden of this work fell on the staff of the Continental Test Room and the Radio Telephony Terminal at Brent. The Continental Test Room had, in addition, to set up the picture transmission circuits to the continent and to look after the private wires established specially for the occasion.

This article includes a good many statistics and these themselves make impressive reading. We take pride in the fact that this large and many-sided job was so successfully undertaken, and even greater pride in the fact that the Post Office was privileged to help in the service of Her Majesty on this momentous occasion.



Telephone Developments in the Five Towns

A. C. Dinnick, B.Sc., Stoke-on-Trent Telephone Area

THE CITY OF STOKE-ON-TRENT, CONTAINING the "Five Towns" of Arnold Bennett's books, is world-famous as a centre of the pottery industry although the area has numerous other interests, such as coal mining, engineering, the manufacture of bricks, tiles, steelwork and rubber tyres. It offers many contrasts; much of the most beautiful pottery is designed and produced in surroundings which are far from attractive, and one can see cattle grazing on a farm very near the geographical centre of the city with a colliery about half a mile away in one direction and the Town Hall at a similar distance in another.

The Stoke-on-Trent non-director system serves the Potteries area, with the adjoining borough of Newcastle-under-Lyme. In order to make the position, and the development to be described, clear to readers who do not know the Potteries, I should explain that they cover an area in the north of Staffordshire about nine miles long and up to three miles broad centred in Stoke-on-Trent. The city of Stoke-on-Trent contains within its boundaries the former separate boroughs of Hanley, Burslem and Longton (as well as Stoke itself) and the urban districts of Tunstall and Fenton; some three miles south is a pleasant residential district at Trentham while Newcastle-under-Lyme lies about two miles to the west.

Automatic working was introduced in 1926-27, with the auto-manual switchboard and Central automatic exchange at Hanley, and the following six satellite exchanges:—

- Stoke-on-Trent city and Burslem, which took the name and charges of Stoke-on-Trent.
- Newcastle (Staffs.) and Chesterton, which took the name and charges of Newcastle, Staffs.
- Longton (Staffs.) and Trentham with separate identities and charges.

Except for Newcastle none of the seven exchanges has been substantially extended since the opening and, as might be expected, serious accommodation difficulties have arisen in meeting the increased demand for telephone service during the post-war period.

Before the war the auto-manual switchboard and the Stoke-on-Trent Central automatic exchange at Hanley had been scheduled for replacement about 1944. A site for the new exchange had been obtained in Clough Street, Hanley, but owing to restriction on building, the erection of premises on this site had to be postponed in favour of a temporary plan to install a new auto-manual switchboard and tandem switching equipment in the Telephone Manager's office. But even with this plan serious difficulties were encountered.

Accommodation Problems

The Telephone Manager's office occupies only part of the building in which it is situated and not only were lengthy legal negotiations necessary with the owners (from whom the Post Office rents the premises) for further accommodation, but also the scheme would have involved displacing other Government departments who rented other parts of the building.

More positions had to be installed in the switchroom in 1946 and again in 1947. This meant some lowering of standards of working and welfare accommodation, but the staff readily accepted this. Working conditions in the switchroom were improved by removing ticket-pricing and most of the exchange clerical work to a room in the Area office. Some doubt was felt whether removing these duties from the exchange building would cause a serious loss of efficiency, but it has not, in fact, produced any appreciable difficulty. By these means the exchange was extended from 46 to 57 positions.

To relieve the exhausted Central automatic exchange a manual exchange with the name Hanley was provided in the Telephone Manager's office early in 1948.

Two further measures were undertaken in 1948-49 to increase the capacity of the auto-manual board positions. The service P.B.X. traffic (two positions) was transferred from the joint trunk suite to the Hanley manual exchange, and toll working was introduced for traffic between the Birmingham and Stoke-on-Trent groups, giving relief equal to about five positions in the busy hour.

In spite of these measures, the growth of traffic during the immediate post-war years caused overloading of the auto-manual board and this condition continued from 1946 onwards, as shown in Table 1. The overload was generally limited to the

Stoke-on-Trent Exchange

	Average valued busy-hour traffic	Joint trunk positions justified	Joint trunk positions available
1939	5,850	30	33 46
1940	5,500	28	46
1941	6,900	35	46
1942	8,000	40	46
1943	7,500	38	46
1944	7,900	40	46
1945	9,000	45	46
1946	10,000	50	46 49
1947	11,850	60	49 57
1948	12,100	61	57
1949	12,300	62	57
1950	11,400	57	57

Table 1. Growth of Auto-manual Board Traffic

The decrease in the number of positions justified in 1950 was caused by the introduction of toll working to Birmingham in December 1949

period 9.30 to 11.30 a.m. and both supervisors and operators made special efforts during the afternoons to minimise the overall effect of the high time-to-answer figures which were inevitable in the morning. It reflects credit on all concerned that, except for the early months in 1947, when completion of an 8-position extension was awaited, there was no serious worsening of the service. Operating duties were adjusted to give extra grace reliefs in recognition of the arduous working conditions in the peak period.

In 1948, to avoid still further overload, acceptance of orders for telephone service at all exchange areas in the Stoke-on-Trent group had to be restricted, and an increase in the waiting list was inevitable. The figures are shown in Table 2.

While the chief difficulties at Stoke-on-Trent were caused by lack of space to carry out a major extension of the joint-trunk suite, the congestion existing in the whole main exchange building

produced similar problems affecting other portions of the equipment. By 1946 the monitorial suite was overloaded, owing largely to the very heavy directory enquiry traffic resulting from war-time economies in the issue of telephone directories. It was not possible to install more monitorial positions in the switchroom, but a separate 6-position directory enquiry bureau was installed in the Telephone Manager's office, to which subscribers were given direct access by dialling 953. This bureau was staffed during the day-time only, and concentration facilities were provided to enable the 953 circuits to be diverted to the main monitorial suite at night.

It will be clear that the Telephone Manager's office, a large modern building, was a great asset in planning relief measures which might otherwise have proved impracticable. The office is within a few hundred yards of the main exchange and this facilitated the speedy circulation of tickets, correspondence and so on between the two buildings. Some of the expedients adopted in an effort to "put a quart into a pint pot" were mildly criticised as being unorthodox. Many discussions were held between traffic and engineering staff and exchange supervisors about the chances of a particular scheme working as intended. Experience has proved, however, that any reasonable expedient can be made to work by a mixture of good-will and perseverance.

Negotiations with the owners of the building for the additional space needed broke down in 1946, and by this time it had become evident that, owing to the post-war increase in traffic, there was not enough space available either in the Telephone Manager's office or on the Clough Street site. It

Stoke-on-Trent Group

Total application for exchange service on the waiting list

Month ending	Total outstanding applications
June 1946	1,630
,, 1947	2,280
,, 1948	2,610
,, 1949	3,240
,, 1950	3,510

Table 2. Effect of restrictions on the waiting list

was decided, therefore, to install a new auto-manual board at Clough Street, to relieve the Hanley board of two-thirds of its traffic, and to avoid future growth of traffic on the old board beyond the capacity of 40 positions. This plan would also make possible restoration of reasonable standards of welfare accommodation.

Designing a scheme to meet these requirements gave rise to some unusual problems. It will be recalled that the Stoke-on-Trent satellite exchanges include one at Burslem, and that there is another satellite exchange at Longton. A suitable division of traffic was eventually found on the following basis:—

Old exchange (Stoke-on-Trent Central, re-named Trinity)	To handle all originating traffic from Central (Trinity) Burslem and Longton.
New exchange (Stoke-on-Trent Vale)	To handle all originating traffic from U.A.X's and the remaining satellites, originating trunk traffic from minor exchanges in the Stoke-on-Trent group and the whole of the traffic incoming to the group.

The new exchange was provided according to this plan and after several postponements of the advertised "Ready for Service" date, was opened towards the end of 1952.

The Potteries area is surrounded by numerous active collieries and the site for the new exchange showed evidence of an old pit shaft about 12 feet in diameter. This had been loosely filled in with rubble and attempts to find solid ground beneath it were abandoned when boring to a depth of about 60 feet had not reached bottom. The shaft has now been covered with a steel framework to support the concrete foundations for the building. To simplify the constructional work, it was decided to provide a single-storey building composed of Ministry of Works standard hutting, in which the main framework consists of (prefabricated) concrete posts and roof trusses, with brick walls and corrugated asbestos roof sheets to complete the structure. Owing to the slope of the site, portions of the exchange stand on three different ground levels. As there is a risk of the ground sinking, the building is divided into 17 sections, each supported on massive reinforced concrete beams which form an integral part of the foundations. Large inspection pits are provided beneath the floor in 14 of these sections and, if subsidence

Switchroom—an unusual feature of this is the switchboard layout

occurs, it will be possible to jack up any complete section of the building on its own beams without major interference with the rest of the structure.

These special features of the building have necessitated an unusual layout for the switchboard. The total floor area is divided into four parts, each carrying one section of the building. The switchboard is similarly divided, a 3-inch gap being left between adjacent positions immediately over the floor joints. Loops have been left in the switchboard cables near the joints to permit movement between the separate portions of a suite. To give storage space for the cable loops, the key-shelves on positions 6, 25 and 109 are unequipped, except for Class B observation equipment on positions 25 and 109. Normal panel equipment—for example, answering and outgoing multiples—is provided over the whole suite, including these special positions. All monitorial positions are fully equipped, although a 3-inch gap has been left in the centre of the suite to provide flexibility.

Welfare accommodation in the new exchange shows a marked improvement on that available in the old, and rooms have been allocated for such purposes as clerical work and an exchange superintendent's office, which could not be made available in the old premises.

Common manual access from the Vale and Trinity switchboards has been provided on all outgoing circuits on toll and trunk routes over 25 miles chargeable distance. Most of the outgoing circuits on under 25 mile routes now terminate at Vale but smaller separate groups of circuits on many of these routes have also been retained at Trinity. A through dialling scheme has been introduced with the necessary tandem equipment in the Vale building which allows operators dialling in to Stoke-on-Trent to gain access to exchanges within 15 miles of Stoke-on-Trent by dialling codes on level 7: for example, 78 for Crewe, 751 for Leek: while codes for toll routes are provided on level 1: for example, 14 for Wolverhampton, 175 for Shrewsbury. Trinity operators use these codes for alternatively routed traffic and as a primary routing for the few exchanges to which direct circuits are not provided in the Trinity junction multiple.

All incoming toll and trunk circuits terminate

at Vale either on switches or on the auto-manual board. Thus Vale acts as the terminal group centre for the whole Stoke-on-Trent group, although originating manual board traffic is controlled at both Trinity and Vale.

Table 3 shows the distribution of circuits between the two auto-manual boards.

The new exchange was opened in October, 1952, and to simplify engineering and traffic work at the time of transfer the change-over took place in two main stages:—

1. Incoming junction, toll and trunk circuits and U.A.X. 'O' levels transferred to Vale.
2. Manual board traffic from the non-director area divided between Vale and Trinity and through dialling scheme introduced.

The second stage involved a change in existing dialling codes for four exchanges within the 5-mile circle, and a considerable extension of the dialling facilities available to subscribers on U.A.X's working in to Stoke-on-Trent. About 14,000 letters and 3,000 Dialling Code Lists were sent to subscribers to advise them of these changes. U.A.X. subscribers have taken full advantage of the new facilities provided and this has caused a drop of over 20 per cent. in the U.A.X. 'O' level calls controlled at Stoke-on-Trent. The through dialling scheme for traffic dialled by distant operators has worked satisfactorily; there has been a small drop (about 4 per cent.) in the incoming long distance traffic handled on the auto-manual board, but incoming junction and toll traffic has decreased by about 40 per cent.

Operating conditions at the Trinity auto-manual board have improved considerably with the removal of the overload, and a friendly rivalry is developing between the staffs at the two exchanges over matters such as quality of service and, in lighter

Stoke-on-Trent Auto-manual Board Circuits

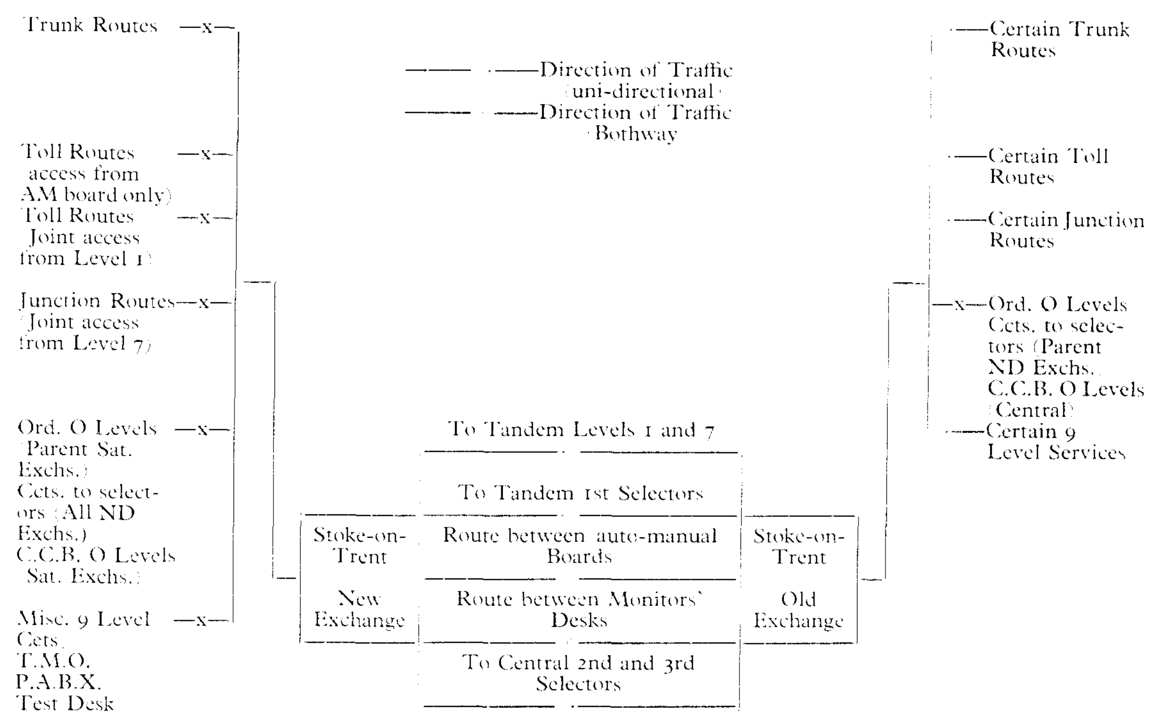


Table 3. Division of Circuits between old and new exchanges

vein, Christmas celebrations. During the summer of 1952 a start was made on the task of installing telephones for those waiting applicants who could not previously be given service because of the overload. Definite progress with this work has been made although there is still a shortage of subscribers' equipment at some of the satellites and manual exchanges in the group.

Extension of Trinity Exchange

Developments in the Potteries have not been limited to providing the new Vale exchange and the old Trinity building has been enlarged. This building is on a corner site immediately next to a furniture repository in one street and some large wooden huts on the other frontage. The Post Office has acquired the repository building and structural alterations have been made to enable automatic equipment to be installed. This will give space for an extension of the Trinity exchange to cater for about 1,600 additional lines and will provide better welfare facilities and a staff canteen. The Post Office has also taken over the wooden huts, which previously housed a local office of the Ministry of Works. Exchange accounts and clerical work was performed in this accommodation for some months before the Vale exchange was opened, and engineering workshops and store rooms have been provided there. Since Vale exchange opened the directory enquiry work has been transferred from the Telephone Manager's office back to the Trinity monitor's desk with a consequent gain in efficiency and saving in staff.

The provision of additional equipment on the Trinity exchange will allow the Hanley manual relief exchange established in the Telephone Manager's office in 1948 to be closed. At the same time trunk mechanisation equipment will be installed to cater for long distance dialling. While the Trinity exchange building is far from modern, since it was built by the National Telephone Company whose assets the Post Office acquired in 1911, it will soon contain equipment permitting the latest developments for handling trunk traffic to be introduced at Stoke-on-Trent.

Apart from the extensions of the service which are taking place in Hanley other parts of the non-director area are also receiving attention. Plans to replace Longton by a new exchange are well advanced and the opening of two new satellites in order to achieve line plant economies has been agreed. By these means it is hoped to hasten the day when the full telephone requirements of the Potteries can be met on demand.

Some Statistics of the Inland Telecommunications Services

	31st March, 1951	31st March, 1952	31st March, 1953
THE TELEPHONE SERVICE AT THE END OF THE YEAR			
Total telephones in service	5,426,100	5,716,300	5,927,000
Exclusive exchange connections	2,966,200	2,999,000	2,998,700
Shared service connections	324,800	464,000	592,200
Total exchange connections	3,291,000	3,463,000	3,590,900
Call offices	58,300	60,400	61,800
Automatic exchanges	4,201	4,297	4,383
Manual exchanges	1,666	1,584	1,507
Orders on hand for exchange connections	532,600	482,000	427,200
WORK COMPLETED DURING THE YEAR			
Net increase in telephones	254,700	290,100	210,700
New exchange connections provided	390,200	439,000	417,000
Net increase in exchange connections	151,500	172,000	127,900
TRAFFIC	*(millions)*	*(millions)*	*(millions)*
Inland telephone trunk calls	250	262	264
Cheap rate telephone trunk calls	54	62	66
Inland telegrams (excluding Railway and Press)	41	38	35
Greetings telegrams	2*	6	6

* *Service restored 20th November, 1950.*

(*Photo.. Chas. White*)

The Mobile Post Office at Sussex Agricultural Show, Midhurst, 1952

Post Office Services for Special Events

H. F. Mintern and L. G. Fackes, Home Counties Region

EVERY YEAR THERE ARE NATIONAL AND LOCAL events necessitating the provision of Post Office facilities at places where little or no normal arrangements for dealing with postal, telephone and telegraph traffic exist. These occur, of course, throughout the country and each Region has to cater for its own particular occasions, as, for example, the Welsh Eisteddfod, in the Post Office Headquarters, Wales and Border Counties Region. In this article it is proposed to deal only with those special events occurring in the Home Counties Region, where, by virtue of its size and its position in relation to the Metropolis, there is a very full programme. No doubt a description of the *modus operandi* in one Region of the Post Office will also be true of similar activities in other Regions.

From the Post Office point of view, as already implied, a special event is an occasion when special arrangements are made to provide Post Office facilities on a temporary basis where services do not normally exist, or, if they do, are inadequate to meet heavy additional demands. What are these events? Mainly race meetings, exhibitions, agricultural shows, sporting events and conferences, but there are many other occasions of importance where special Post Office services have to be provided, sometimes improvised, maintained and staffed. These events fall into two categories which may be classed as "regular" events and "occasional" events. Regular commitments in the Home Counties Region cover such famous gatherings as the Henley Royal Regatta, the National Rifle Association's annual shoot at Bisley Camp and numerous race meetings. The occasional events are so called since they are not always located in the same place, and agricultural shows, exhibitions and conferences, nomadic by nature, are included under this heading.

During 1953 arrangements were made to provide telegraph, telephone and sometimes postal facilities at no fewer than 57 race meetings, covering 132 days of racing. These include the meetings at Ascot, Goodwood, Newmarket and Windsor. By far the most important special event of the year is Royal Ascot, and the Post Office plays an important part in ensuring the smooth running of the meeting by providing communications for the Ascot authority, the Press, the B.B.C. and the public. As many as 80 telephone circuits are provided, including the communication network used for the actual running of the races. This is provided by an elaborate network from the weighing room to various points on the race-course, including the starting gates and the number boards on which the runners and results are exhibited. Telephones for the public are provided by 16 kiosks placed in convenient positions in the various enclosures. While a number of exchange lines to the race-course are permanently rented, some 30 temporary installations are set up specially.

Ascot Arrangements

Telegraph traffic dealt with at Royal Ascot has declined in recent years, but facilities for handing in telegrams in the various enclosures and the provision of teleprinters for the speedy disposal of traffic, are still justified. The teleprinter circuits terminate at the Central Telegraph Office, T.S., and some at the London Teleprinter Manual Switchboard, X.T.S. The Ascot authority provides accommodation for Post Office use, and during the 1953 Royal Ascot, 2,000 telegrams, including 250 delivered, and 10,000 words of Press were despatched from the Grand Stand Instrument Room which is, of course, equipped and staffed by the Post Office. Telegram acceptance points are located in the Paddock, Tattersall's Ring, the Silver Ring, the Grand Stand Instrument Room and the Mobile Post Office which is situated on Ascot Heath. Telegrams are delivered on the course, but apart from those addressed to a specific place they are held at central points for collection.

Another famous sporting event but of a different kind is the National Rifle Association Shoot at Bisley Camp. This is a three-week event and during this period Bisley Camp is transformed into a small town. Competing teams live on the camp, mainly under canvas, and they rely on the Post Office to a great extent for contact with the outside world. A temporary Post Office is opened in accommodation provided by the Association and during this year's Shoot, some 17,000 letters were posted, and 18,000 letters and 600 parcels were delivered within the camp. Telegraph traffic, mainly for the provincial newspapers, this year amounted to 1,500 telegram-pages (or "takes") of Press, totalling 78,000 words.

Each year, in the delightful Thames-side setting at Henley, there is held the Royal Regatta which attracts visitors and competitors from all over the world. Post Office services are usually provided by a Mobile Post Office situated near the Stewards' Enclosure. A unique feature of the Henley arrangements is a special installation of telephones for the Press. The Henley authorities erect a temporary wooden structure right in the centre of the river near to the finishing line, and reporters have a complete view of the 1¼ miles of the rowing course. The Post Office installs telephones on tables in this structure so that the reporters can keep in direct touch with their papers and telephone details of the result of a race as it occurs.

For occasional events, such as agricultural shows, much use is made of the Mobile Post Offices and it is fitting to record here how popular and useful these vans are, not only for the service they provide, but also for their publicity value. Tribute must be paid to the staff who maintain them in such excellent condition.

Transportable Counter

For conferences and exhibitions it is not usually possible to make use of the Mobile Post Office; instead a transportable Post Office Counter is employed. This provides for postal and telegraph traffic, and with the provision of telephone kiosks meets the needs of many of the large annual conferences.

A new transportable counter was completed and used for the first time at the Trades Union Congress at Margate in 1952. Its attractive design and finish reflected credit on the Post Office and compared favourably with the facilities offered by other undertakings at these special events.

The organisation, provision, maintenance and staffing of these Post Office services is a combined operation, involving both the Head Postmaster and the Telephone Manager. At Regional level the Telecommunications Branch and the Public Relations Officer are concerned with the overall planning and presentation and in maintaining liaison with other branches involved. Obviously these occasions require considerable thought and care, but the Post Office personnel concerned regard it as a privilege to be selected for this work. From the point of view of the public, they provide most useful facilities.

The Area Engineer's Job as I saw it

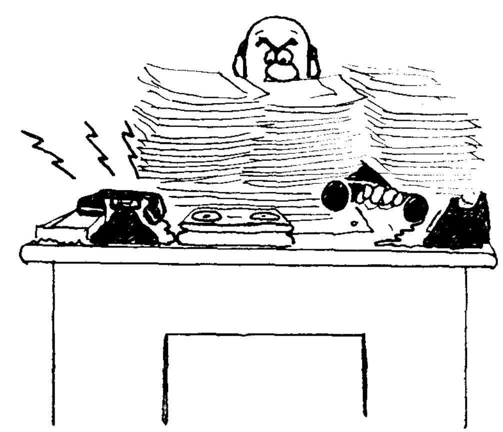
N. C. de Jong,

Telephone Manager, Preston Area

THE AREA ENGINEER IS ONE OF THE SEVERAL heads of divisions in the management team of an Area; he is, in fact, the Telephone Manager's engineering controlling officer and technical adviser, or one of them in the larger Areas. While he is normally regarded as an electrical engineer, much of the work he controls usually includes civil and mechanical engineering practices. The annual expenditure involved may well be upwards of £1,000,000 with a staff of perhaps 700 men or more. His authorities and responsibilities, therefore, cover a very wide range. For example, before the "Lumley" Report on Regionalisation (dated October, 1951) some 80-odd official forms required his signature. In the Engineering Instructions and other directives there are even more numerous financial, technical and managerial authorities which he is called upon to exercise.

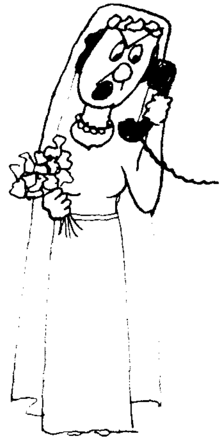
As most of the time is taken up in dealing with matters concerning these authorities, this article would give a complete though prosaic picture if it consisted solely of a detailed list of them, but in order to provide interesting rather than instructional reading, I shall describe a few only of the more important aspects of my own experience and opinions. Others which would serve equally well to illustrate the job would include work on planning; organisation; committees; contracts; telegraphs; submarine cables; mechanical aids; transport; accommodation; training or co-ordination. Much could also be said on the importance of contacts with other heads of divisions, local authorities, the Regional Engineering Branch and the need for a general interest in the office welfare and social activities.

Obviously, the job is one of those in which the newly appointed can become completely immersed in details from the outset. This is much the easiest road to tread and in these days, when so many phases of working efficiency are handled by various committees, more and more of us may be following that path. The Area Engineer may, however, approach his job with the intention of working out the most worth-while long-term engineering objectives which conform to the Telephone Manager's general policy and arrange his daily affairs so that he has sufficient time to pursue a selected few himself and keep in touch with those he delegates. They may concern such projects as improving the standard of service, decreasing waiting lists, better performance ratings, or more efficient organisation. The right targets should emerge from a study over the first few months of the staff and work, and all the available relevant statistical information.



". . . obviously, the job is one of those in which the newly appointed can become completely immersed . . ."

While the pre-occupations of day-to-day work may cause temporary setbacks to these objectives, the man is fortunate indeed who can either not see, or shut his eyes to, the need for continual improvements.



". . . at the expense of domestic affairs . . ."

Perhaps the most difficult task facing an Area Engineer is to become so conversant with several hundred men that he can assess them fairly in matters of appraisement, promotion and everyday dealings. There is no universal method; in fact, this is fully capable of achievement only if, besides the other qualities necessary, as, for example, good judgment, the Area Engineer possesses a better than average memory. Even then this is usually achieved only at the expense of domestic affairs! Otherwise, much reliance has to be placed on the opinions of subordinate officers and allowances made for their prejudices and variations in standards. Assessments based on superficial knowledge are often most misleading and damaging to staff morale.

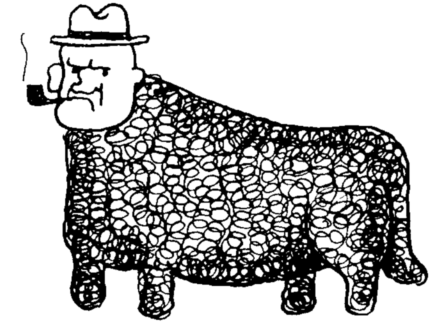
The influence exerted by the Area Engineer on the Area's future should, therefore, be most marked in his dealings with recruitment, training, selection, appraisement, promotion and discipline. Over a long period he can do much towards getting the right men in the right jobs, and getting the best out of them. Some changes may be very desirable, but it is often necessary to bide time; there is not only the danger of making too frequent changes but an essential condition is to retain the co-operation and keenness of the individuals concerned.

Staff matters usually mean spending several hours each week in interviews. The issues dealt with cover a very wide range, particularly personal problems concerning welfare, promotion, and unsatisfactory conduct or work. Many factors contribute to the technique for successful interviewing, but the most important is probably the prior gleaning of accurate background information.

Appraisements take up much time during the latter months of the year, not only because several hundred may be prepared annually, but the forms are much more detailed for engineering grades than for others. The Area Engineer is the reporting officer for the supervising grades and countersigns the reports on the workmen. To ensure a fair promotion policy he must not only see that his Executive Engineers set comparable standards, but he should also know his men sufficiently well to ensure that their good and bad points are faithfully recorded, as well as the extent of their knowledge and experience. With the variations possible, this is no mean task. The usual procedure includes a series of meetings with supervising officers at which the appraisements of certain well known men are agreed and used as a datum in assessing the others.

Discipline also takes up a good deal of time and, in fact, represents one of the most difficult post-war problems. It usually happens that for several years, following a major war, previous standards of discipline are difficult to maintain. An equally important factor nowadays is the evolution of industrial democracy which has forced more reliance on self-discipline. These are the main reasons for the need of a most careful reorientation on the part of senior controlling officers in the management of staff, and particularly as regards discipline. Moreover, it has to be realised that much unsatisfactory performance of work may have been initially due to lack of skill and training, or other causes which have to be corrected before disciplinary action is invoked. It is, therefore, necessary to change attitudes, by creating more interest and enthusiasm, making individuals appreciate their contributions and responsibilities, and developing team spirit.

An example of the frequent staff problems dealt with concerns the "trouble-maker". This is the man who may be potentially a good worker, but for whom no one has a good word. He is often "palmed off" from one supervising officer to another and eventually turns up on the carpet. All too often there is no specific case against him—he may fail to get on with his fellow workers, be the cause of constant strife, or he may be a "lead swinger", but too smart to be caught. Many such



"an example of . . . the 'trouble-maker'"

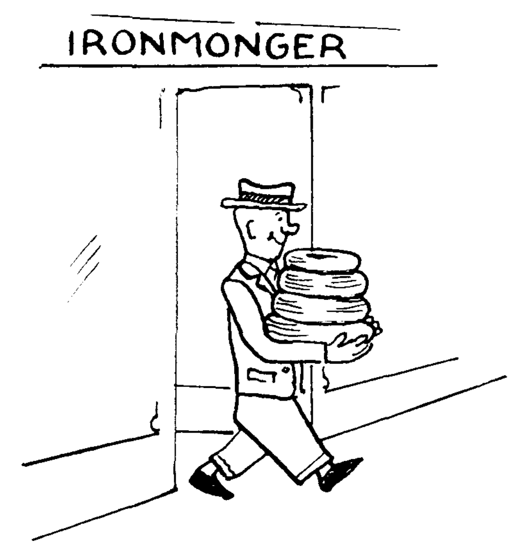
men, apart from their personal character weaknesses, may have a social difficulty in the background. In years to come these staff problems may be dealt with by a welfare service, but engineers are as yet obliged to seek the remedies themselves: perhaps just as well so far as some of these characters are concerned! Fortunately, the majority finally respond to the right treatment, as they have seldom expected to find themselves under critical surveillance. It is important to pick out the incorrigibles at an early stage and, if unestablished, to dispose of them quickly. Most offenders should be put on probation under selected supervisors and be the subject of regular reports and attention. The more difficult cases are those of established officers, and these often require unlimited patience.

A regular office duty is to deal with the more important letters and papers. It may be sufficient to see only specially selected items, but these must cover a wide range if the Area Engineer is to keep in touch with events. One of the alleged weaknesses of civil service departments is procrastination in dealing with correspondence, and it must be admitted that engineering officers concerned with the supervision of large bodies of staff and other pressing daily activities often find such delays hard to avoid. It should, therefore, be a personal task of an Area Engineer first to set a good example, and then to try continually to train his subordinates accordingly. Two aspects are particularly worth stressing; the first that the replies will take as long, perhaps longer, to do the next day or the day after; the second that genuine reasons for delaying replies in order to get later information should be subject to a time limit, at the end of which the final or an interim reply should be given.

The Area Engineer's responsibilities for financial control are nowadays of ever-increasing importance. At one time it was almost sufficient that he should be by training an economist, in the sense that he should always be attempting to get work done in the most economical way. This age of planning has changed this outlook and he must now spend a good deal of his time on the various aspects of financial control, including the preparation of annual estimates, budgetary forecasts, labour and stores controls, allotment, commitment and expenditure returns, programmes and priorities. During a period in which scores of items of stores have varied in delivery delays of anything from several weeks to several years, and work priorities, prices, wages, and policies have kept fluctuating, the need to spend more and more time on financial work has conflicted seriously with the natural urge to get on with the job that was there to be done.

The opinion which some of us hold that the present accounting system might well be improved, does not, however, excuse a widespread lack of knowledge and interest in it, and this may well be another field in which the increasing interest which now has to be taken by field engineering officers will result ultimately in improving the system.

The chief bogey of Area Engineers (and some others) since the war has been stores shortages. These have created difficulties of many kinds, not only with the basic issue of getting on with the job in the field. Consideration of that alone, however, places constant demands on the engineering



". . . a temporary local supply"

staff concerned. Many and ingenious are the methods which have been used to solve such problems and it may be of interest to mention some.

The appearance of an aerial cable lasher was most welcome as it seemed the answer to the severe ring-cutting experienced on aerial cables affected by coastal gales. Unfortunately, however, the new method had been in use only a short time when the supply of lashing wire completely dried up and it was to be over two years before requisitions could be met. Rather than revert to the known menace of rings, efforts to acquire a temporary local supply of lashing wire were made. Ironmongers' shops in my Area were combed to find those with stocks of suitable galvanised iron wire and adequate quantities in large coils were obtained. The next problem was that of winding the wire into the small coils required for the lasher. Initially, this was solved by adapting the mechanic's shop lathe with a suitable bobbin and "Heath Robinson" counters and tensioning devices. This proved quite satisfactory, but later an armature winding company was persuaded to do the job at an acceptable price. The Area Engineer's part in such affairs may be to suggest or encourage improvisation and lend his support and influence in getting outside assistance.

Another instance occurs in the occasional shortages of spikes and brackets and other fittings for subscribers' installations; when these threaten to hold up service, a local blacksmith is engaged to turn out a sufficient number of corresponding items to keep us going.

A means of relieving some bottle-necks which the Area Engineer must keep under close review is the recovery and renovation of spare plant. This used to be mostly restricted to external ironwork, but during recent years of economic stringency it has been extended to many types of internal apparatus, including small switchboards, coin collecting equipment and stamp vending machines.

It is often suggested, and with some measure of truth, that an Area Engineer's job is mostly managerial. While it is difficult to avoid spending the major portion of time in affairs of management, it is very necessary to continue a professional interest and act as consultant in as many phases of the work as possible. There is every justification in the importance of the work itself for an Area Engineer to spend part of his time out of his office and it is also necessary in order to get a proper

". . . important not to show a suspicious attitude . . ."

appreciation of the staff. It is important, however, to have definite objectives in such visits, if not regarding the work, then in pursuance of the knowledge required of specific individuals. It is normally good practice to make sure the men concerned are aware of such journeys beforehand. An Area Engineer should rarely want to pay a surprise visit and any tendencies to slackness are better countered if a visitor is expected some time during the day. Another practice which pays is to stop, if only for a few minutes, whenever any working party is met on the road.

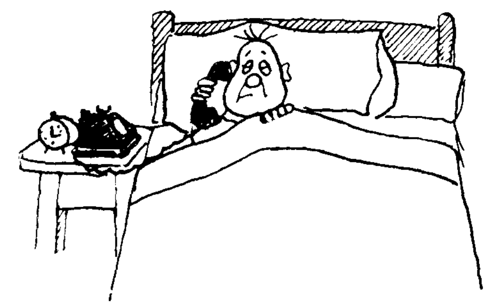
While the Area Engineer's visits to staff are of first importance, he should avoid the supervisory approach. Although, for example, on arrival everyone may not be found busily engaged, it is very important not to show a suspicious attitude in dealing with this, but rather to display a keen interest in the staff and the job being done, and to look for features of the job on which some helpful suggestions can be made; also, to impart some useful information on Area progress and policy.

The many engineering works always being planned or in progress afford the Area Engineer ample opportunity for following his true profession. Apart from those such as exchange conversions, development works, main underground routes and repeater stations, in which he should exercise a controlling interest, he has a wide choice from scores of smaller jobs.

Most of our work is carried out according to specifications or standard methods, and much of our time is devoted to the interpretation of these

and the supervision required to see that they are properly carried out. The importance of interpreting many official instructions for the men in the field cannot be over-emphasised. Most of us can see the need for this in all instructions except our own! An example of what is necessary occurred recently in connection with pole testing:—A comparatively simple definition of what constituted decay conditions justifying renewal has been replaced by more complicated directions which quite properly permit more extensive decay before a pole is classified as dangerous. In this particular case it was decided to put the information in the form of a ready reckoner which, for various circumferences of poles, indicated at a glance the extent of decay which warrants consideration for the "Suspect" and "Dangerous" categories.

In the field of overhead construction and maintenance, however, there is nowadays plenty



". . . incidents . . . during the normal hours of sleep . . ."

of scope for local enterprise. This is because most of the plant is obsolescent and it is to be expected that national research and further development of materials, tools and methods for it will be strictly limited. The Area Engineer, who is responsible for an annual certificate that such plant has been maintained in a satisfactory condition is, therefore, free to encourage some enterprise and ingenuity. An example concerns a method used to defer wire renewal. The effect of arrears in renewal and development of aged overhead routes in the Area caused an abnormal increase in wire breakage rates, due to wear at the binding-in points at the insulators. As resources did not permit extensive renewals, the solution which finally emerged from a study of the problem was to "piece-in" three feet of new wire by means of soldered joints. The soldering aloft presented some difficulties and novel means were tried out to overcome these.

The expedient represents some 90 per cent. savings on stores and 60 per cent. on labour, as compared with immediate renewal, and will defer the latter many years.

Keeping abreast of innovations provides an interesting feature of the daily round. Quite apart from the personal need for the information, it also helps to ensure that instructions on new methods are being correctly interpreted and proper arrangements for their use being made. Some items can be examined in the office, which makes it easier to demonstrate also to the Telephone Manager and others. Usually it is preferable to see what happens in the field where the unforeseen practical difficulties have to be solved.

Examples which come to mind of such field trials are nickel sleeves for overhead jointing work, a V.H.F. radiotelephone link, cathodic protection devices, battery discharge alarms at U.A.Xs without power supply, U.A.X. floor treatment, a device to prevent shillings lodging in coin boxes, a special route for insulator comparisons, a junction testing selector for tandem U.A.X. 12s, artificial traffic equipment, providing telephone service for tankers mooring in tidal waters by means of plug and socket connections to a submarine cable, and modifications at U.A.Xs parented on manual to give coin collecting box conditions from kiosks when dialling 999.

The Area Engineer is frequently called on to deal with individual complaints, usually of telephone service, but increasingly nowadays of radio or television interference. These complaints may arise from faults which have not been satisfactorily cleared by his staff or from those people who believe in getting "the man in charge" at the outset. While he may sometimes be tempted to do

"If one's profession leaves its mark . . ."

otherwise with the latter cases, especially when they are accompanied by invective, he must deal thoroughly with all cases, as the good name of the Department is always at stake. Usually it is clear from the outset that the staff concerned have either not done as good a job of work as they should, or are out of their depth. Where unsatisfactory work is involved it is a desirable rule that the individual responsible be made to put it right, but in the other case, specialist attention is immediately necessary.

A recent instance concerned overhearing on junctions between a main exchange and one of its satellites. The trouble was first localised between the satellite exchange side of its junction relay sets and the main, and as it was known that jointing work had recently been carried out on the cable, crossed pairs within quads were suspected. This proved a red herring and further tests showed the fault to be in the junction relay set equipments. These appeared all right on first test as each side of the bridge consists of two coils in series, but measurement disclosed that short circuits existed in one coil only of each of five repeating coils. These unbalanced the circuits, causing reflections and subsequent crosstalk.

Another intriguing case was reported as "bell tinkle when flu in the house". Special investigation proved electrical contact to earth in the bedroom when the electric fire (not there on previous visit) was switched on. The power supply earth was found elsewhere on the same water pipe as the Post Office earth and the A.C. leakage, feeding back through the Bell Set No. 41 rectifier, operated the relay and tinkled the bell.

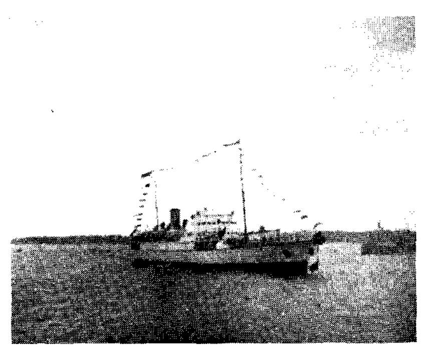
No picture of an Area Engineer's life would be complete without reference to such occurrences as major cable breakdowns, storms, exchange isolations, fires, fatalities, and those many other abnormal incidents which usually seem to happen during normal hours of sleep. Much can be done to prevent or minimise the effects of some of these misfortunes; the personal interest of the Area Engineer in plant conditions, particularly underground cables, may well reduce the number of times he is disturbed at rest! In particular, he should check the precautions exercised against damage by contractors or other working parties; the measures being taken against corrosion; and other major contributory causes.

While some of these emergencies, especially storm, justify a measure of advance preparation, the value of detailed planning for such eventualities is doubtful. This is essentially a field for engineering improvisation by those with both the ability for it and the local knowledge. A soundly organised concern will deal promptly and effectively (not necessarily economically) with all kinds of emergencies, despite shortages of material or other handicaps.

If one's profession leaves its mark the Area Engineer's will be most influenced by the continual flow of problems and the constant endeavour to maintain the right balance of efforts between getting the best results and running a good office.

Cable Ship in Spithead Review

The Cable Ship *Edward Wilshaw* (Cable & Wireless, Ltd.), "dressed overall", was near the head of the line of merchant ships at the Spithead Naval Review when the Queen reviewed her Fleet on June 15. When Her Majesty signalled "Splice the Mainbrace", Major-General L. B. Nicholls, Chairman, sent a service message to the other seven ships of the Company's fleet in various parts of the world, inviting them to apply it.



Among the guests on the *Edward Wilshaw* were the Postmaster General, Sir Edward and Lady Wilshaw, the Assistant Postmaster General and Mrs. Gammans, Mr. Wm. H. J. McIntyre, Telecommunications Attaché, U.S. Embassy, and Mrs. McIntyre, Mr. W. A. Wolverson, Director, External Telecommunications Executive (Post Office), Mr. Bent Suenson and Count H. Brockenhaus Schack, Vice-Chairman and Representative in England of the Great Northern Telegraph Company, Mr. K. B. Mitchell, Vice-President, International Communications, Western Union Telegraph Company, and Captain Leech (Submarine Superintendent, Post Office Engineering Department) and Mrs. Leech.

The American Telephone System

Wm. H. J. McIntyre

In our February-April issue we published the first part of an article on this subject based on a lecture given by Mr. McIntyre, who is Telecommunications Attaché to the U.S. Embassy in London. In this concluding part Mr. McIntyre discusses general Toll Switching with some comparisons between British and American practice.

THE NOMENCLATURE OF TELECOMMUNICATIONS in the U.S.A. differs somewhat from the British. We use the term "inter-office trunk" to designate the network which inter-connects the exchanges in a local service area, such as London Wall, Temple Bar, Victoria and Regent in London. To us, a "toll line" or a "long distance" line is the circuit connecting exchanges in different local service areas between which a charge is made. Calls over such circuits, both intra-state and inter-state, are known generally as toll calls, the term "long distance" referring roughly to toll calls over the longer circuits of no specified distance or destination. Rates for toll or long distance calls between telephones in the same State are subject to the jurisdiction of the regulatory commission of that State, and rates for inter-state calls to that of the Federal Communications Commission.

This leads naturally to a discussion of how toll and long distance service is furnished in the United States. First, just let me mention—but not yet define—some terms. These are terms which are applied throughout the United States and Canada, and are: Tributary, Toll Centre, Primary Outlet and Regional Centre.

The plan frequently called the General Toll Switching Plan has been in effect in the United States and Canada for upwards of 20 years.

About 2,600 cities have been selected as toll centres. A toll centre has associated with it the exchanges of the city itself plus near-by exchanges, which are called tributaries. All are connected to the toll centre, generally by direct circuits, so that a toll centre is equipped to handle both inward and outward traffic for all of the exchanges associated with it. The circuit from the toll centre to any of its associated exchanges, plus the equipment of the exchange, plus the cable and wire circuit from the exchange to any subscriber on it, plus the equipment on the subscribers' premises, in their totality are so designed as to provide a satisfactory grade of transmission. Circuits between toll centres are designed with transmission losses within certain tolerances. Thus, by inter-connecting two toll centres, a means is provided for furnishing satisfactory transmission between any two of the more than 50,000,000 telephones in the United States and Canada.

How is this inter-connection of toll centres achieved? The first step involves equipping some 150 of the 2,600 toll centres to be primary outlets. Every toll centre, which is not in itself a primary outlet, has direct circuits to at least one primary outlet, which might be called its "home" primary outlet. At the primary outlets the inter-toll trunks can be operated in their "through" condition at lower transmission losses than in their "terminating" condition. It is in this manner that two or more links can be inter-connected so that the overall connection of the links is only slightly poorer than any one of the individual links. Thus the overall connection is kept within tolerable transmission limits.

The next step in the pattern is that eight of the 150 primary outlets are designated as regional centres. From a transmission standpoint, these eight regional centres are the same as any other primary outlet. The only difference lies in their status in the switching chain. Every primary outlet, which is not in itself a regional centre, has direct circuits to at least one regional centre, which might be called its "home" regional centre. To complete the picture, every regional centre has direct circuits to every other regional centre.

Thus every toll centre can be connected to any other toll centre with a maximum of five links (Fig. 3). The maximum for any call would be as follows: (1) Toll centre to primary outlet, (2) to regional centre, (3) to regional centre, (4) to primary outlet, (5) to toll centre.

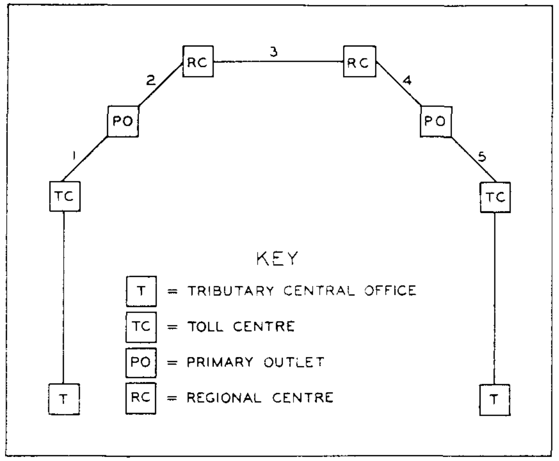


Fig. 3. General Toll Switching Plan: Maximum number of links required to complete a call

The eight regional centres are located at New York, Atlanta, Chicago, St. Louis, Dallas, Denver, San Francisco and Los Angeles (Fig. 4).

Such is the basic pattern of the General Toll Switching Plan. Any call can be completed on the basis of the plan. There are many cases where the volume of traffic between two points justifies the establishment of short cuts. Direct circuits are indeed provided between any two toll centres, regardless of their classification, when the volume of traffic warrants it. For example, an ordinary toll centre in New York State might well have enough traffic to warrant its own circuits direct to Chicago. Thus the spider's web builds up—your own imagination can now carry you forward. I doubt that you can overdo it, try as hard as you will!

With the new transmission and toll dial switching instrumentalities, it is contemplated that the present General Toll Switching Plan will be modified. The changes would be two:

First, the introduction of three new categories of switching centres to the existing five. The new ones (Fig. 5) would be: (1) a Tandem Outlet—this will fit into the same rank as a primary outlet in the pattern, but will not have all of the dial switching flexibilities of a primary outlet; (2) a Sectional Centre—this will fit in between a primary outlet and regional centre in rank; and (3) a National Centre, which will act as a final "route" between regional centres when a no-circuit condition is encountered. It will be located at St. Louis, in the centre of the country. You will recall that under the present General Toll Switching Plan the maximum number of links was five. Under the modification it might be eight.

The second change to the General Toll Switching Plan will be that the sectional centres, the regional centres and the national centre will have 4-wire switching. This will be advantageous with the increased number of links which might enter into a connection. The toll switching equipment will be capable of automatic alternate routing on an extremely rapid and economical basis compared to manual handling by an operator. It is therefore expected that the toll network will be provided economically and yet with a probability of encountering a delay, a no-circuit condition, about as low as in local dial trunking. It is this that will make the pattern satisfactory, from the point of view of service to the public, for permitting customers to dial their own long distance calls, even all the way across the country.

You will immediately perceive that to make nation-wide customer toll dialling feasible, it will be necessary to have a nation-wide numbering plan. One thing leads to another. Every customer in the United States and Canada, all 50 and more millions of them at present, will be assigned a distinctive 10-digit number, which will not conflict with any other customer's number. Of the 10 digits, only the last seven will be used for local calling. The toll dial equipment will be arranged to route on these ten or seven digits, regardless of where the call originates, or how it is routed to its destination.

To accomplish this, the United States and Canada will be divided into some 90 Numbering Plan Areas (Fig. 6). An Area will not contain more than approximately 500 central offices. Each such Numbering Plan Area will be assigned a 3-digit area code, no one of which will conflict with any other. Within each Area each central office will be assigned a 3-digit code, so selected as neither to conflict with the code of any Area or of any central office within the particular Area. The central office code will usually be publicized as the first two letters of an office name plus an office numeral; for example, AD3 for Adams 3. Within each central office, four numerals will be used, thus permitting a maximum of 10,000 numbers per office. A subscriber's local number would therefore be, for example, AD3-1234. Preceding this would be his 3-digit area code, for example, 514-AD3-1234. This would be his complete number.

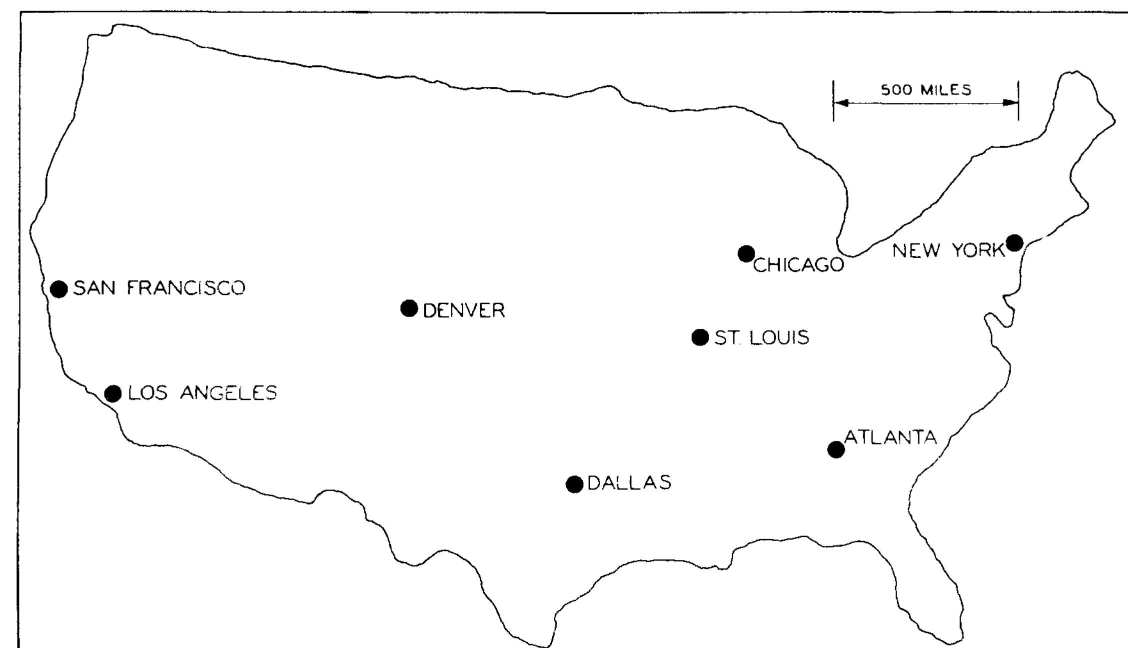
When the plan is fully in effect some years from now, any customer in the United States or Canada will be able to call any other customer by dialling these 10 digits. One way of looking at it is that at some future day more than 50,000,000 subscribers in the United States and Canada will be pulled together into one intimate telephone community, in which, by not more than 10 strokes of a dial, anyone will have almost immediate access to his telephone neighbour, be he three or 3,000 miles away.

The Bell System objective is 100 per cent. mechanization of local service. In Pennsylvania, by the end of 1952, about 80 per cent. of the local exchange service furnished by the Bell Telephone Company of Pennsylvania will have been mechanized, and within the next few years the 100 per cent. objective will be closely approached. There may be individual situations which may indicate that manual operation should be continued. There are a number of connecting companies, financially independent of the Bell Company in Pennsylvania. The strong ones are rapidly being mechanized. Economic pressure is causing the merger of many weaker ones into the strong; thus, many of these too will soon be dial-served.

Before the introduction of operator and customer dialling of toll and multi-unit calls, Bell System studies indicated that the annual charges on equipment necessary to secure call distribution at manual toll switchboards were greater than the operating savings. The future elimination of an operator dialling toll and multi-unit calls leaves a residue, such as reverse charge and particular party calls, in the longer work-time class. Hence there are fewer calls to be distributed by expensive equipment, and call distribution becomes even less attractive. With regard to sudden peaks that occur during normal business days, the engineering of switchboard positions and the provision of operating force are such that most of the peak traffic is absorbed with an acceptable grade of service. The balance is held within tolerable limits. However, in the cases of auxiliary services—such as information and intercepting—where the work-time per call is short, call distributing types of switchboards are used extensively throughout the Bell System.

The question is not infrequently put to me, even by experienced telephone people: "How does the British telephone service compare with American?" Usually, the enquirer begs the answer. If he be an American, there is no doubt but that I am supposed to say "terrible". Should he be an English-

Fig. 4. Geographical locations of the regional centres



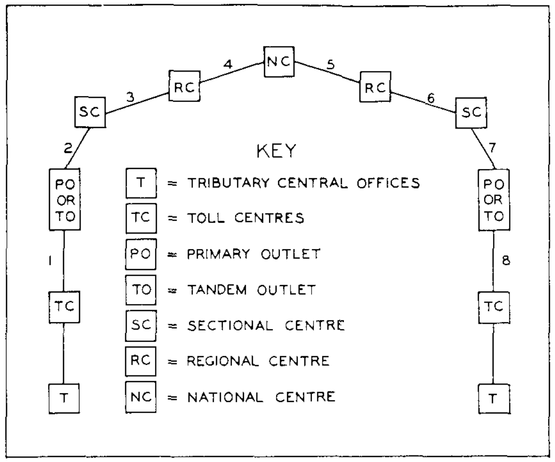


Fig. 5. Subscriber's Toll Dialling Plan: Maximum number of links required to complete a call

man, you yourselves can answer that question. Let us between ourselves reframe the question into the somewhat more objective form:—"In the circumstances, is your telephone service reasonably adequate to the needs of the public it serves?" And let me answer this question flatly and unequivocally: "In my opinion, absolutely yes. I believe that you have done and are doing a remarkable job, worthy of the utmost commendation when tested in the fire of the exacting traditions of the business".

But suppose I were to ask any of you: "Are you *satisfied* with the service you are providing?" This indeed would be a most foolish question, for it is pointless; of course you are not satisfied. What good telephone man ever was, and—I hope—ever will be satisfied that the job cannot be done better? For a dynamic evolution is in the blood that permeates the whole body and spirit of the telephone business.

This is but another way of saying rapid obsolescence. You will be amused, I think, to turn back with me to some 40 years ago. At that time the Bell Telephone Company of Pennsylvania was having its rates investigated by the Public Service Commission, Pennsylvania's then newly created regulatory body. Mr. Hayward, Chief Engineer of the Company, was in the witness box, and was being closely examined on switchboard obsolescence by some of the doubting-Thomases on the bench.

Q. (*By a Commissioner*) "But now that a switchboard is supposed to be a perfected machine, do you think that obsolescence will be as great?"

A. "I cannot assume, Sir, with the history behind us, that we will stop thinking."

Q. "But your answer is not quite candid, because the object of development is to get at, as nearly as you can, the perfect work. Now the history of all arts has shown that the time comes when you can go no further. You take a simple thing like the axe; it has not changed in a thousand years. You take the game of chess; there has been no addition to the moves in chess for ages. It is so in your development. You work up as far as you can go; while you may go on thinking, or moving as you say, you do not move simply for the sake of moving, you move to get somewhere, and when your avenue has reached a straight line, there you stop your moving and you go along on that particular line, do you not, and it is so with the switchboard. You are trying to get a switchboard which will answer the purpose and do it with the best facility, and do it at the least expense. Now when you have reached that point, there you stop, so that the future may not be changed."

In the light of the wonderful developments that all of us here have already witnessed, and not by any means ignoring the future switching problems of customer toll dialling, which we have discussed, does not the foregoing sound unbelievable? And yet, these words were not spoken by a man who trod the lowly pathways of life; quite the reverse, in fact. They are words from a mind, which with all of the clarity of hindsight we now are able to discern as stultified and myopic beyond all belief. Fortunately, stewardship of the telephone business has reposed in the hands of men of far greater vision than that. Even at the very outset, some 70 years ago—think of it, 70 years ago—Alexander Graham Bell wrote:

> "It is conceivable that cables of telephone wires could be laid underground, or suspended overhead, communicating by branch wires with private dwellings, country houses, shops, manufactories, etc., uniting them through a main cable with a central office where the wires could be connected as desired, establishing direct communication between any two places in the city. Such a plan as this, though impracticable at the present moment, will, I firmly believe, be the outcome of the introduction of the telephone to the public. Not only so, but I believe that in the future, wires will unite the head offices of the telephone company in different cities, and a man in one part of the country may communicate by word of mouth with another in a distant place."

This brilliant mind not only conceived the technical aspects of transmitting speech by electricity. Far more: it also comprehended how a technical device could be put to everyday use as a great public service.

But I would not want to give you the impression that all myopia is concentrated on my side of the Atlantic Ocean. In 1677 one of Britain's very great men said to the House of Commons: "By the King's personal application to shipbuilding, skill in the art has been advanced to a degree beyond the memory of man—perhaps even beyond all possibility of improvement". And who was this very great man from whom such wisdom emanated? He who, probably more than any other single person, is responsible for creating British sea power—Samuel Pepys. Yes, Samuel Pepys, great and far-visioned man as he was, 300 years ago envisaged the then naval ship as quite possibly having achieved the zenith of naval architectural design. In the light of events since 1914, and the glorious role played by the Royal Navy in them, perhaps we can all take a bit of comfort that the progress of British fighting ships was not arrested 300 years ago.

And so, many of us in the telephone business today have seen unusual and wonderful developments take place within our relatively short life-spans. But the end of this business is not yet written, and will not be written within the life of anyone reading this article. This business is still on the threshold of expanding vistas which another 20, 30, 40 or 50 years will open up far beyond all those marvellous things which thus far have been achieved. A young man entering into this telephone business today is indeed a very, very fortunate person. A whole world of opportunity lies before him.

There are some differences between the telephone service in Great Britain and in the United States. These are not differences of engineering principles; rather they are but normal consequences of satisfying the demands of the public we serve. Taking it by and large, I think the American public is probably the more telephone minded. I have no statistics to prove it, but my impression is that in the United States a telephone is looked upon as a necessity—not merely as a convenience—by a wider spread of income groups. Telephone service is, I am inclined to believe, rooted deeper in the soil. I also have the feeling that our calling rate may be considerably higher. Except in those relatively few cases where a written record is a must, a business need may be served with despatch by a mere call. To a considerable extent, unidirectional letter writing is regarded as a time consumer and a nuisance. A few minutes on the telephone in back and forth discussion, and a question is settled.

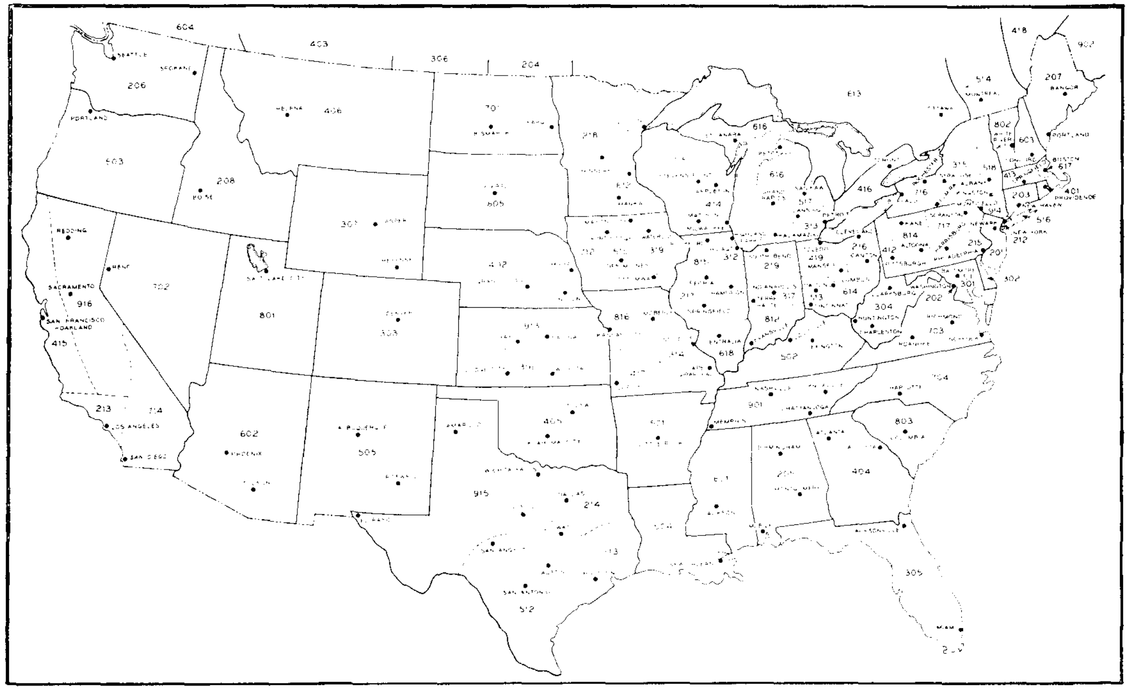


Fig. 6. Nation-wide toll dialling areas in the United States and Canada

Speed is an element of dissimilarity in our respective services. Now please do not raise your eyebrows and say: "These blinking Americans. Always in such a hurry". It isn't that at all; at least, that's only part of the story. And what is more, I have observed that an Englishman moves quite as fast as anyone else when he knows where he is going and when there is reason for speed. It could be that the American business man's demand for fast service stems from his psychological kinship to the telephone. It is a part of him; it is a part of his daily life. He casually picks it up to talk to someone three, or 300, or even 3,000 miles away. A thought passes through his mind; while his left hand is reaching for the instrument, he has almost started to talk. Hence a delay of but a few moments seems to him like minutes. Fortunately, he is willing to pay for his wish—and it is the company's obligation to serve.

Duct Economy

Another point of some dissimilarity is that of underground feeder-cable plant in our large cities, resulting from the density of development. When, in 1920, I entered the business, most of the cables leaving the exchange were 440 pairs at 41.2 lb. per circuit mile (which was full size for a 3-inch duct), tapered at some critical point to 330 pairs, then at the next critical point to 220, then to 110, and finally to 55 pairs. Before 1920 it had come to be recognized that, in metropolitan centres with duct space at a premium, and with rapid subscriber growth, a more economical use must be obtained from each available duct. This situation brought about the re-design of cables so as to permit as many as 2,100 pairs of fine gauge (8.12 lb. per circuit mile) conductors to be placed in these 3-inch ducts. While tapering of individual cables is still considered practical, the step reductions are not as frequent.

With the increase in central office supervision limits, refinement in subscriber instruments and the use of more frequent loading, it has been possible to reduce the major portion of the conductor gauges from a coarse gauge to finer gauges. In most instances, in order to take advantage of each finer gauge, it has been necessary to re-arrange the lateral cables closest to the office to each gauge as it was developed to permit the use of the coarser wire for the more distant subscriber. This arrangement of gauges is developing into what might be classified as 26 gauge (8.12 lb.), 24 gauge (12.92 lb.) and 22 gauge (20.6 lb.) areas. With the present day range of the most modern central office equipment, in the metropolitan centres, 22 gauge (20.6 lb.) is much in the minority.

In the rural territories of Pennsylvania, highways are constructed quite differently than in England. The concrete paving of a highway is about 18 feet in width. Outside of this is a 3-foot "burm" of asphalt, and then a drainage ditch. The full width of the highway easement is frequently 50 feet or more, which places the farmed land well back from the travelled way. Hence, pole lines, built within the highway easement, are well back of the paving. When aerial wire is used, 10-pin cross arms are therefore practicable, which thus permits of shorter poles. With less cantilever, the poles can be lighter too. Aerial cable, wrapped to the messenger strand, is a common feature of rural feeder and distribution plant. Because service, immediate or potential, is extensive, numerous terminals are placed when the cable is erected.

Residential distribution is generally in the rear of properties, and is usually 50 and 100 per 26 gauge (8.12 lb.) cable, supported on 18 feet poles on 60 to 75 feet spans, or else is carried on strand secured to the brick walls of the residences. Cable terminals are spaced 60 feet, more or less, apart, to minimize wiring runs.

You will appreciate at once the profound difference in plant design which results from offering party line service. As one example, the counts of cable terminals overlap each other considerably in order that, let us say, a four party line, once opened, may be filled by adding stations to it on the same cable pair at numerous points.

Reference Back

Let me close on a light note. A little while ago I extracted something from the records of 40 years ago. While searching for it, by accident I came across a mention of Maxwell, the great British scientist, which I feel I should pass along to you. It appears as merely another lawyer's dry question and witness's equally dry answer; and neither lawyer nor witness intended to be amusing. In fact, read on United States soil, I doubt that they would seem even remotely so. But they do read quite differently here on English soil. Just listen to this unwitting gem, mined 40 years ago in the staid atmosphere of a Pennsylvania court room:

Q. "Who developed phantom circuits? You said it was known from the time of Maxwell. Was Maxwell a telephone man?"

A. "No. Maxwell was kind of the father of all modern electrical science. I do not exactly know how to describe him. He was an Englishman."

MIDDLESBROUGH TELEPHONE AREA

Left to right: J. TATE, Senior Sales Superintendent; F. W. ALLAN, A.M.I.E.E., Area Engineer; Col. J. R. SUTCLIFFE, O.B.E., A.M.I.E.E., Telephone Manager; F. K. GENT, Senior Traffic Superintendent; D. C. WYATT, Chief Clerk.

Middlesbrough Area covers North Yorkshire and South Durham. It consists of a heavy industrial belt on Tees-side, which has grown up in the past 100 years and is still rapidly expanding; and sparsely populated agricultural country spreads over Weardale, Teesdale, Swaledale and Wensleydale extending to the watershed of the Pennine Range. The Area has the distinction of providing the communications for the largest chemical plant in the world, namely, Imperial Chemical Industries Ltd., to whose established works at Billingham has recently been added the vast new works at Wilton; the two being connected by a tunnel under the Tees. The other main industries of the Area are steel and shipping; one-fifth of Great Britain's output of steel comes from Tees-side which makes it the largest steel producing area in the country. 42 per cent. of Great Britain's tonnage of new ships is built on the Tyne, Wear and Tees.

The Area is 2,075 square miles in extent; it has 76 automatic exchanges, 25 manual, 34,227 exchange connections, 58,247 stations and 817 total staff. The total annual revenue of the Area is £1,034,700.

PLYMOUTH TELEPHONE AREA

The Plymouth Area, at the extreme south-west of the British Isles, includes Cornwall and part of Devon. It extends from the beautiful South Hams near Salcombe in the east (now recovered from war-time use by the Americans as a training battle-ground, using live ammunition) to the Isles of Scilly, noted for their early spring flowers, 30 miles from Lands End. The main island, St. Mary's, is served by a magneto exchange, named Scillonia, to which the "off islands" are connected by submarine cable. One island is served by a country satellite exchange, parented on Scillonia. The junctions to the mainland are routed via a V.H.F. radio link. At the other end of the Area is Dartmoor Prison, originally built for French prisoners-of-war, set some 1,360 feet above sea level at Princetown.

The Telephone Area of 1,850 square miles has a perimeter of 384 miles of which 300 are coast-line. In addition to the large holiday resorts such as Newquay, there are numerous smaller ones scattered all round the coast. Camborne, near Truro, is still the centre for the manufacture of mining equipment, and the famous School of Mines is situated there. St. Austell is the centre of a thriving china clay industry which was the third highest dollar earner last year.

The present temporary office overlooks the world-famous Plymouth Hoe, with the statue of Sir Francis Drake and the memorial commemorating the victory over the Armada in the foreground, and beyond, the English Channel. From the upper windows can be seen ships of the British and other navies passing to and from the Royal Dockyard, and liners discharging their passengers and mail. The spot from which the Pilgrim fathers sailed in the "Mayflower" is only a short distance away. The city centre was devastated during the war, but Plymouth began to plan its reconstruction even before the war ended, and has since made quite remarkable progress with the rebuilding of the shopping centre.

As readers of this Journal will know from the February-April 1953 issue, what is believed to be the first effective telephone installation in Britain was set up in Plymouth by Graham Bell in 1877, and the actual instruments used are in the Plymouth Museum.

There are 43,150 exchange connections in the Area and 137 exchanges of which 101 are automatic. The total staff (excluding telephonists) is 1,158 and the annual revenue is £1,000,000.

Left to right: E. H. JOHNSON, Budgetary Control Secretary; J. A. MARTIN, Chief Traffic Superintendent; R. CAMPBELL, Senior Sales Superintendent; H. C. O. STANBURY, B.Sc.(Eng.), M.I.E.E., Telephone Manager; C. P. INGRAM, Area Engineer; G. K. HALL, O.B.E., Area Engineer; G. H. PITT, Chief Clerk.

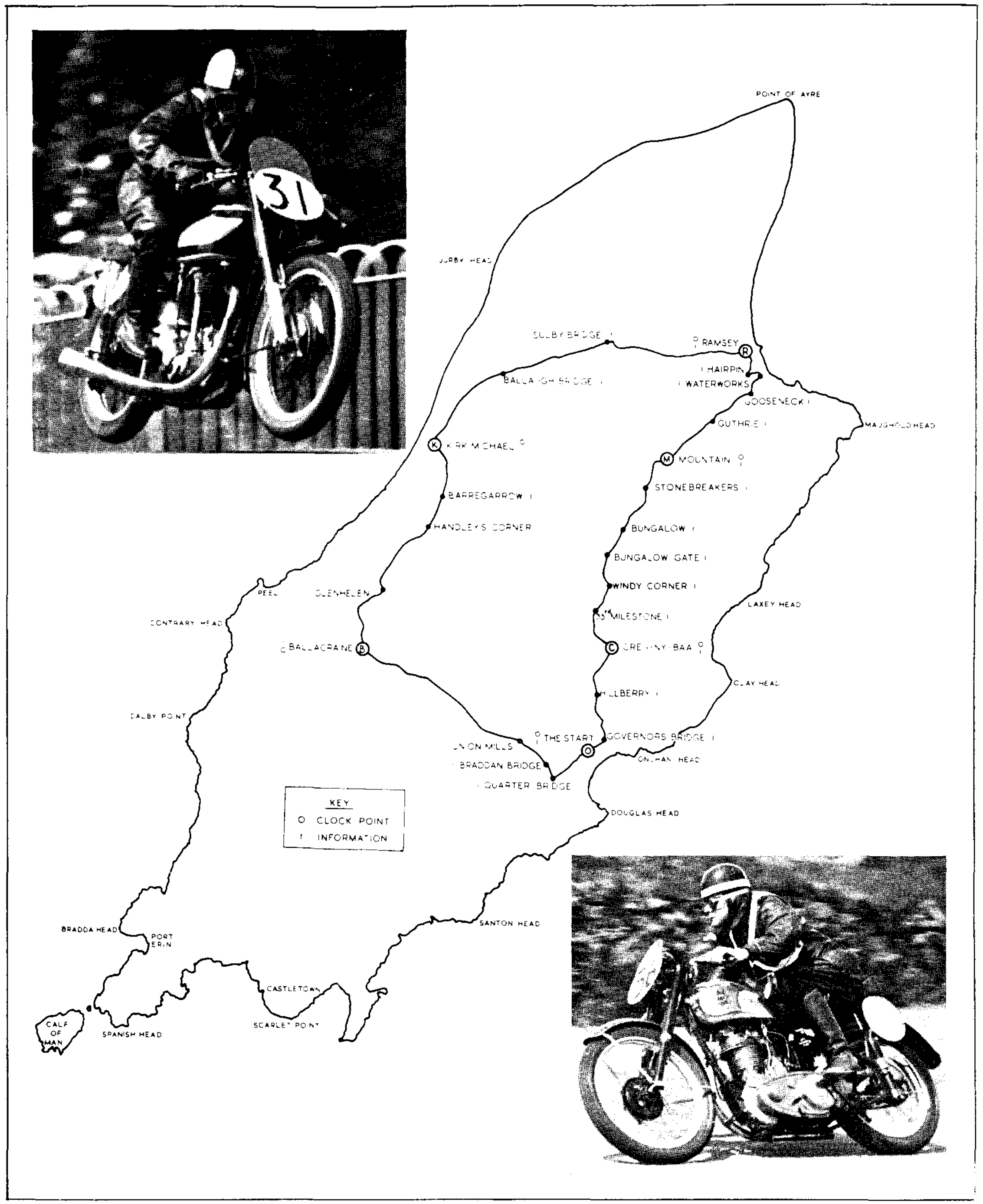
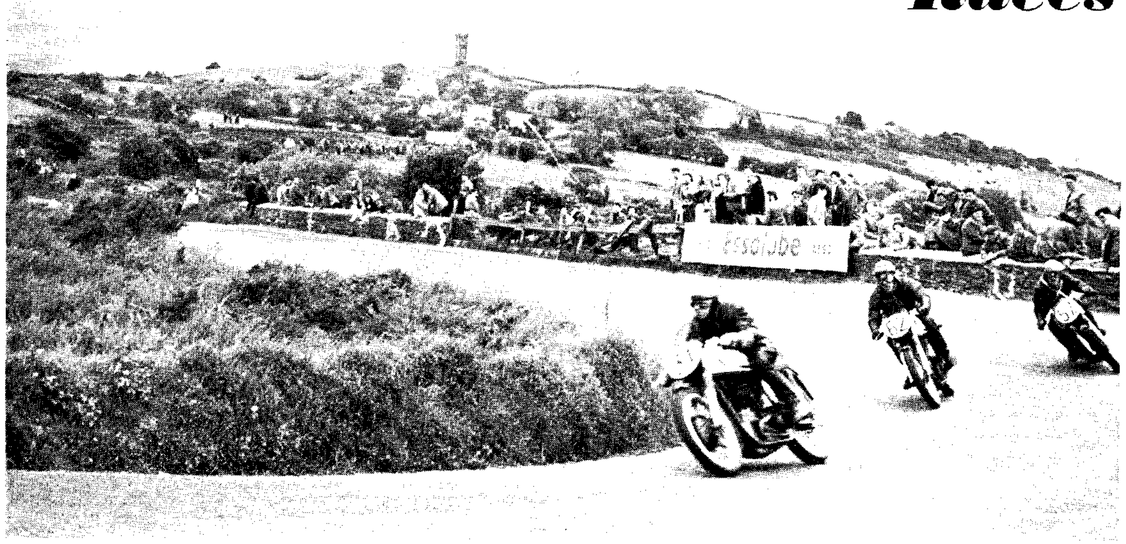


Fig. 1. Isle of Man T.T. Race Course giving Clock and Information Points

Tourist Trophy Motor-Cycle Races



S. G. Coulson & J. H. Kirk, Liverpool Telephone Area

TRIBUTE HAS OFTEN BEEN PAID TO THE PART which the Tourist Trophy races have played in improving the efficiency and reliability of motor-cycle engines. Perhaps it is not so widely known that the Post Office in turn is called upon annually to play a part, behind the scenes, in staging these great sporting events.

The Tourist Trophy races, which are divided into three classes according to the size of the engines, were first held in 1907 and have been run annually in the Isle of Man except during the war years. In 1911, to take advantage of the climb and descent of Snaefell, which was and is a thorough test for tourist machines, the course was changed to the present circuit. Since that time the winners' average speed has increased from under 50 to over 93 miles an hour, and the spills and thrills last year attracted 50,000 visitors to the Island, which has normally only 55,000 population. These visitors justifiably expect the same standards of telephone service during their stay as they enjoy at home. The races also receive great publicity in the motor-cycling journals and national Press, and by running commentaries in the B.B.C. programmes, so that adequate telephone lines have to be provided for these organisations in addition to those used by the general public.

The races present many problems for the organisers because the course is over 37 miles long, and the sport is fast and not without risk of serious accidents. Centralised control is essential and, therefore, a network of lines is set up to control ambulance services and crowd marshals, to provide public address systems, and to give the public through the scoreboard an up-to-the-minute picture of the progress of the race. The prestige and commercial value of victory is internationally recognised and competition is now so keen that

The photograph above shows competitors at Goose Neck, near Ramsey. The T.T. photographs in this article are by permission of the Isle of Man Tourist Board.

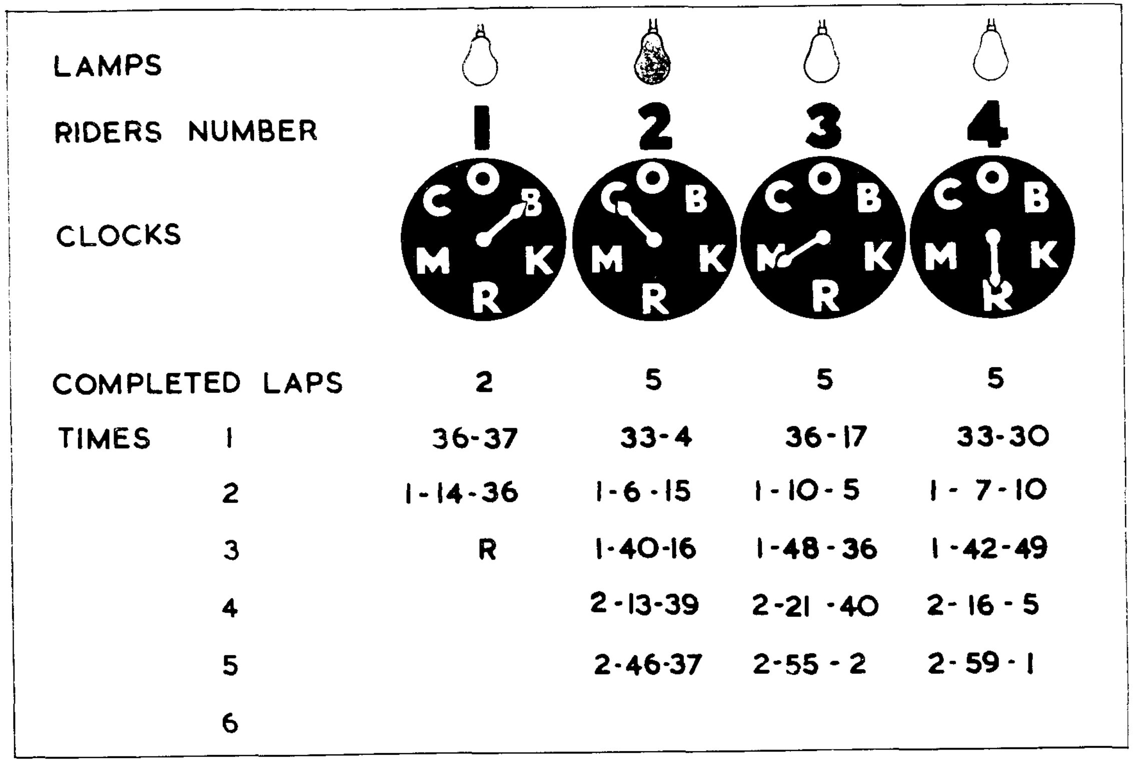


Fig. 2. The scoreboard in detail: the lamps, riders' numbers, clocks (with letters, instead of figures, which indicate the various points on the course), completed laps and the times taken

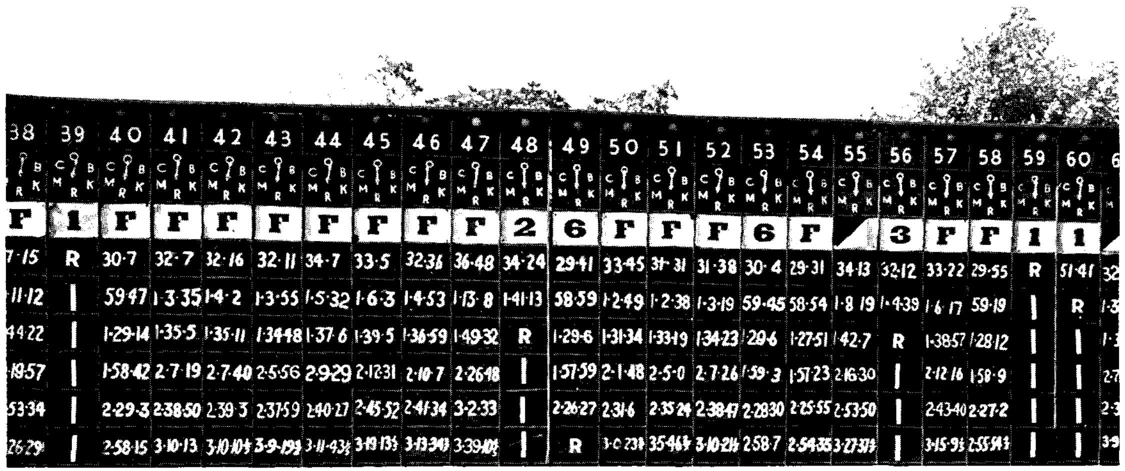


Fig. 3. The general layout of the complete scoreboard at the grandstand

manufacturers' teams have telephones installed at signalling points from which riders pick up their instructions from the team manager.

The races are generally run in June. Very early in the year, the interested organisations ask for the private wires and telephones they need. The requests are dealt with in the Sales Division of the Liverpool Telephone Manager's Office and advice notes are issued in the normal departmental routine. The circuits are rented on a temporary basis and are recovered as soon as practicable after the events are over.

The main control room is in the grandstand where the races start and finish. A small P.B.X. $\frac{5-20}{25}$ with four outlets to Douglas exchange is provided for administration.

There are 23 Information Points round the course, which is shown diagrammatically in Fig. 1. These are served chiefly by temporary exchange lines and connection with the control P.B.X. is, of course, through the public telephone system. These Points are used primarily for controlling the race and to enable the Clerk of the Course to issue instructions to his marshals at these points, to trace riders, and to arrange the movement of ambulances and doctors. Information is also passed from the course to the control about retirements from the race, accidents and items of general interest.

Under each rider's number on the scoreboards at the grandstand are clocks (Fig. 2) which, instead of the usual figures, have six letters indicating points on the course. Above each number is a clock which is lit whenever the rider has passed Governor's Bridge and is approaching the start. Under the clock dials the number of completed laps is shown and under this again the cumulative time taken. Thus in Figure 2, No. 1 retired after passing Ballacraine on the third lap; No. 2 is approaching the grandstand on his last lap; Nos. 3 and 4 have passed the Mountain and Ramsey, respectively, on their last laps also. No. 2's time for five laps was 2 hours 46 minutes and 37 seconds. The general layout is shown in the photograph (Fig. 3.)

As the riders pass the clock points, their numbers are passed back over private wires to the score-

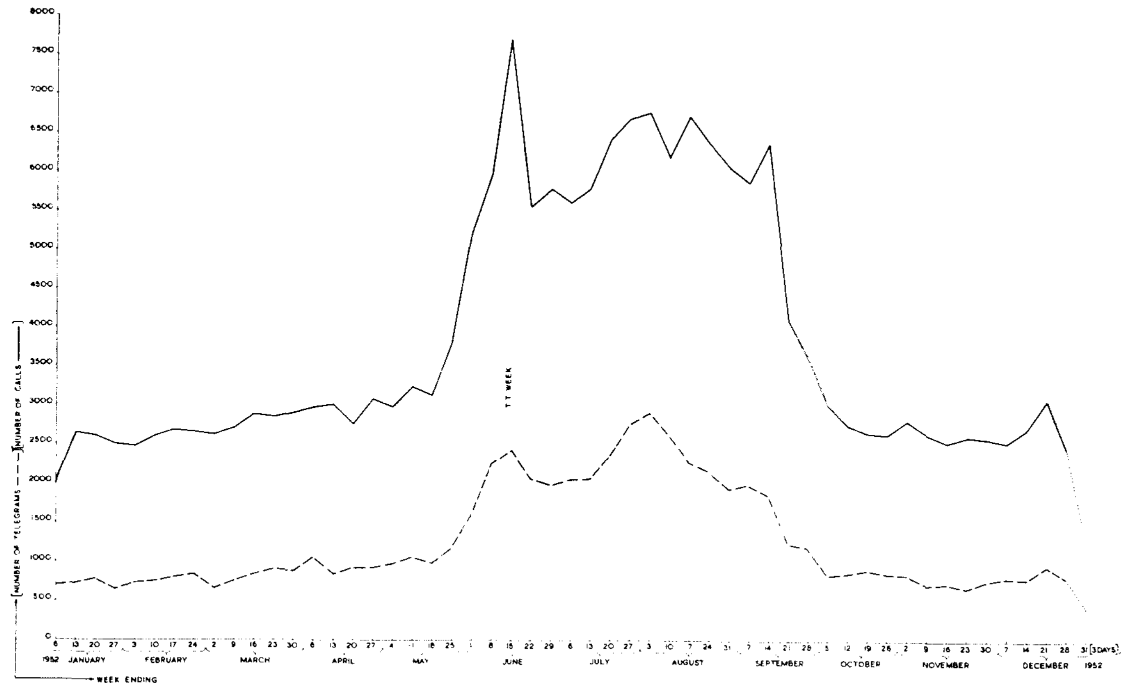


Fig. 4. Graph showing statistics of traffic

board control where they are recorded and passed to the controllers, who then instruct the scoreboard assistants to move the hands to the corresponding points on the dials. The controllers have breastplate transmitters and the assistants at the scoreboard have headphones. A similar procedure is used for the lamps above the clocks except that a controller has direct control of the lamps from the scoreboard control. The completed lap figure is changed by the scoreboard assistants when they see the rider passing; the times are passed to the markers by messengers from the timekeeper's office. To enable all spectators in the grandstand enclosure to read details easily, there are two scoreboards, and associated circuits are duplicated.

For broadcasts of running commentaries on the race, private wire and omnibus circuits, some of which are four-wire, are set up to selected points. In addition to these circuits public exchange lines are installed as required for the Press, manufacturers and organisations entering teams.

Statistics

To provide all these circuits, about 600 miles of wire in local underground and junction networks are used, 50 miles of temporary wiring are erected and 100 telephones are fitted.

The number of calls to the mainland each week in 1952 is given in graph form in Fig. 4, which shows the marked peak during the T.T. week. To handle this traffic, 25 additional telephonists and assistant supervisors are employed and all annual leave is suspended. (Early in his career Geoffrey Duke, who was the outstanding rider of the post-war years and was awarded the O.B.E. in the 1953 New Year Honours, worked in the automatic exchange at St. Helens.) The additional staff consists, chiefly of volunteers from the Liverpool Telephone Area. While the greatest number of calls is made in T.T. week, the seasonal traffic is so much higher than the non-seasonal that all the staff on loan during the period of the races can be usefully retained to help handle the seasonal load. The normal tour of duty on the Island is eight weeks, but the staff may volunteer for longer periods. Operating staff also act as call office attendants at the two attended kiosks which are provided for the use of the public at the grandstand enclosure.

In 1952, 37 circuits between Douglas and Liverpool were available for trunk calls. Six further channels were equipped in readiness for the 1953 season.

In addition to the normal trunk calls, circuits are required for picture calls to the national newspaper offices in London and Manchester. The pictures are developed, printed, and transmitted from the apparatus room of Douglas telephone exchange. In 1952, 70 pictures were transmitted and mainland circuits were taken for about 20 hours.

Every aspect of Post Office activity is affected by the Tourist Trophy. Fig. 4 shows the number of telegrams forwarded from Douglas each week in 1952. An additional circuit is provided to London during the week of the races and an extra operator is sent from Liverpool. The roads are closed by Act of Tynwald, the Island Parliament, and road mail services have to be diverted to other routes.

Some cynics may ask "What is achieved by all the effort?" The answer of the motor-cycle industry is that the export of motor-bicycles brought over £10,000,000 to this country in 1952, much of it in dollars, and the Island was the testing ground where the merits of these machines were proved.

Parliament Telephone Service

The Postmaster General received the following letter from Lord Cholmondeley, the Lord Great Chamberlain :—

"It is now over a year since I became Lord Great Chamberlain and in that time I have used the telephone in the Palace of Westminster much more than in former times so I consider I can express an opinion. In all my experience I have never known such courtesy, good manners or efficiency as shown by the operators who man the House of Lords telephones. Not only do they obtain the required number or person with speed and accuracy but they will hunt their quarry from room to room and bring it to bay.

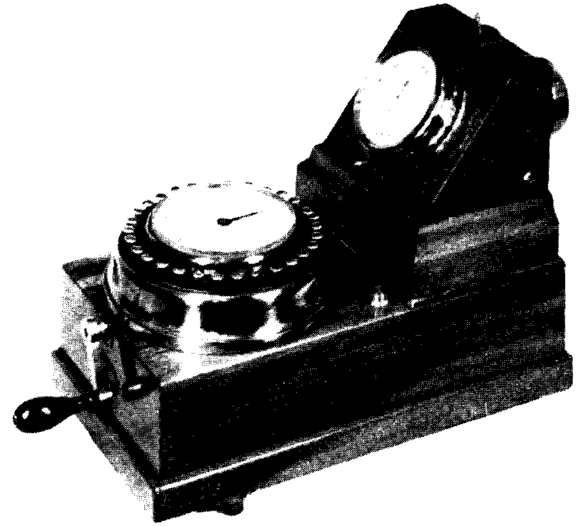
Complaints are voiced, praise seldom."

In reply the Postmaster General wrote as follows :—

"Many thanks for your most generous appreciation of the efforts of our staff on the Parliamentary Telephone Exchange.

I have sent your remarks to the staff concerned, to whom, I know, they will give very great pleasure and encouragement."

Early Electric Telegraph Instruments



ABC telegraph instrument

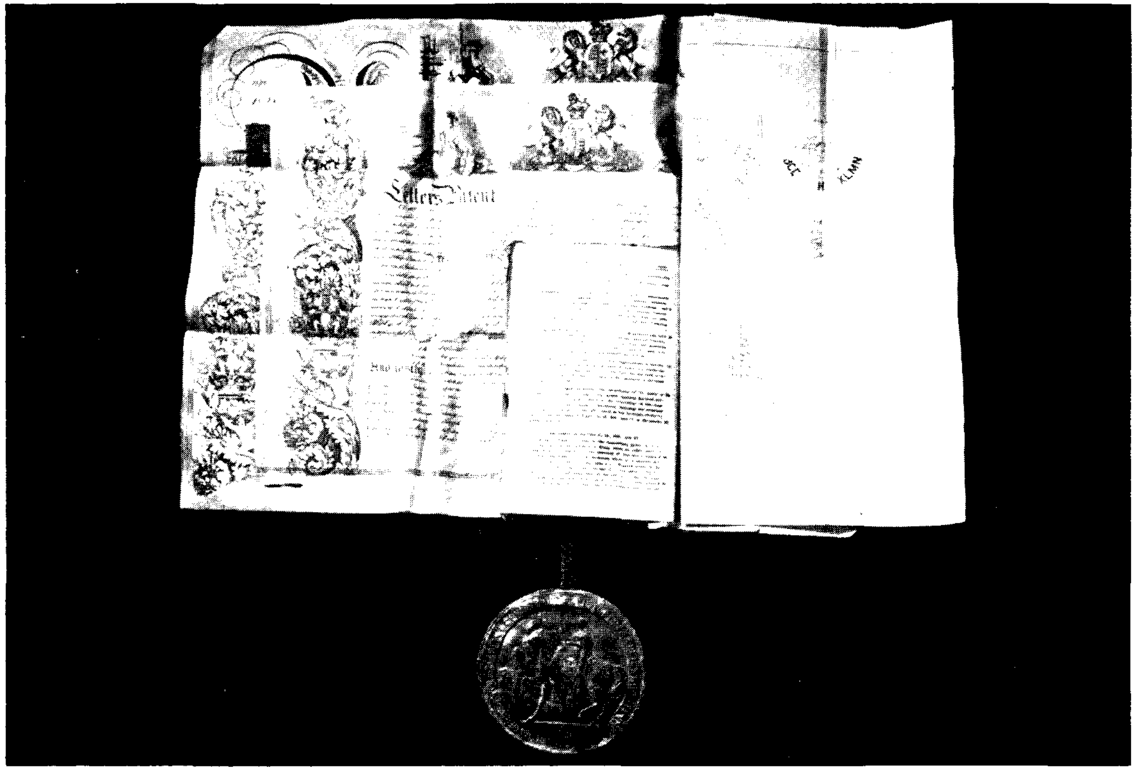
E. C. Baker, Post Office Librarian and Archivist

THERE WERE MANY EXPERIMENTERS IN electrical phenomena during the eighteenth and early nineteenth centuries. Once any of them had appreciated that an electric current travels apparently instantaneously along a conductor, the idea that this might be used to signal long distances naturally occurred to him. A striking, if not particularly elegant, demonstration of the rate of electric flow was that by the Abbé Nollet in Paris during the latter half of the eighteenth century. He passed a discharge from a Leyden jar through the bodies of 200 of Louis the Fifteenth's Royal Guard, holding hands in a circle, to show that they jumped as one man, and not one after another. Louis was amused; whether the guardsmen saw the joke has not been recorded.

Before knowledge is adapted to practical ends, there must be a demand for such a use, and by the third decade in the nineteenth century a need was being created. Railways were developing in the United Kingdom and for traffic control they required a means of communication between stations ahead of the trains. Thus William Fothergill Cooke and Charles Wheatstone were encouraged to develop an electric telegraph for use by the railways, whereas twenty years earlier Francis Ronalds received no such encouragement from the Admiralty, whose semaphore telegraph systems were then meeting their needs.

Cooke and Wheatstone had been experimenting independently for several years, but in 1837 they went into partnership and that year were successful in producing a practical electric telegraph, which was used between Euston and Camden engine house, to control the working of a rope haulage system for trains leaving Euston to climb the Camden Bank, too steep for steam locomotives of that time.

The instrument was a needle telegraph, a visual system giving transient signals. Movements of a pointer were controlled by a small magnetic needle suspended between two coils of insulated wire, the direction of current flowing in the coils determining whether the needle moves to left or right. Two small ivory stops restrict the pointer's swing. Letters of the alphabet were indicated by combina-



Documents of Wheatstone's patent for improving A.B.C. telegraph instrument (patent was purchased by the G.P.O.)

tions of movements to left and right. The first telegraph had five indicators, a number which Cooke and Wheatstone soon reduced to two. Later a single-needle instrument became general. This progressively cut down the number of lines needed for a circuit, but a two-lever commutator mechanism was needed for sending, to control the current's direction of flow. The first acoustic telegraph to be developed in the United Kingdom worked on the same principle. This was Bright's bell, in which two bells of different tones were used, the hammer of one being actuated by current in one direction and that of the other by current in the other direction. It was capable of being read at considerable speed and continued in use for many years.

In the United States of America, rapid communication was needed between widely dispersed townships and by 1844 Samuel F. B. Morse was telegraphing messages between Baltimore and Washington. His system depended for its signals, not on the direction of current flow but on its duration. He devised the Morse code, in which time is divided into an arbitrary unit, the dot. Letters are made up of combinations of dots and dashes, a dash being equal in duration to three dots. The space between two elements of a letter equals one dot, between letters of a word three dots, and between two words six dots. A simple circuit-closing key was all that was needed as a transmitter. The key-sender that Alfred Vail designed in 1840 was substantially the same as the modern hand-tapper. Early Morse telegraphs were recording and not acoustic instruments, signals being embossed in dots and dashes on a paper tape. This was difficult to read and so an inking device soon followed for making more legible marks on the tape.

In the meantime the visual needle instrument was extending in use on British railways. The warning alarum bell that had preceded a message had been dispensed with as making too much din,

NOW KNOW YE, that we, the said Sir Charles Wheatstone and John Matthias Augustus Stroh, do hereby declare that the following Complete Specification under our hands and seals fully describes and ascertains the nature of the said Invention, and in what manner the same is to be performed, in and by the following statement, that is to say:—

The first part of our Invention relates to improvements in the construction of step-by-step telegraphs, the object of which is to enable the hand or indicator of a large dial, or in some cases the dial itself, to be moved rapidly with the same certainty as the indicators of the small dials usually employed.

To attain this object we transfer the propelment of the index or pointer to the action of a maintaining power, limiting the work performed by the transmitted currents to the controlling of the scape wheel, and introducing a special arrangement obviating the retarding effect due to the weight of the index hand, as will be clearly shown by the following description of Figures I., II., III., and IV. of the accompanying Drawings.

Enlargement of part of the specification

the click of the pointer against a stop pin being sufficient to attract attention. The story was told of a somnolent station clerk who, in order to enjoy a nap when on night duty, trained his terrier to scratch and awaken him at the first sound of the clicking pointer.

Normally in the 1840s railways used telegraphs only for their company's business, but the South-Eastern Railway was an exception in that it transmitted news bulletins from France for *The Times*. Some English shareholders in the Boulogne-Amiens railway, disturbed that the longer Calais-Lille line had been given the London-Paris mails contract, staged a demonstration on December 11, 1849. They delivered 150 copies of that day's issue of *The Times* in Paris at 1.30 p.m., having left Charing Cross for Folkestone at 7 a.m. and crossed to Boulogne for a four hours' run to Paris on their own railway. Usually copies of the paper arrived at noon on the day following publication, but what amazed the speculators on the Bourse was to read their closing prices for the previous evening. These had been telegraphed to London as usual during the night by the South-Eastern railwaymen at Dover, *The Times* Paris correspondent's dispatch having been received by them at 1.30 a.m.

The electric telegraph did not, however, extend quite as rapidly on the railways in its early years as had been hoped. Too many signalmen could neither read nor write and railways were often forced to use the simplest systems their traffic could tolerate. William H. Preece, afterwards to become the most famous Engineer-in-Chief of the Post Office, made in 1862 a number of valuable contributions to electrical block signalling on railways. (Block signalling is the term used for controlling trains on the space-interval system.) One suggestion of his was to overcome the difficulty some signalmen had in understanding needle indicators by making them resemble the, by then, familiar semaphore arms. He contributed notably to railway safety with a 'check' device associated with the signalling bell of a block telegraph instrument, which enabled a signalman to know that his bell signal had been received and acted upon at the distant box.

An advantage of the railroad for telegraphs was that its verge provided an ideal track along which to run straight lines of conductors. By comparison, apart from the few main mail-coach routes, the Queen's highway was very much a rolling English road. Once railways had demonstrated the practicability of electric telegraphs, private companies began to be formed and some of these used, to a great extent, overhead lines alongside railroads. Many of their directors, too, were already gracing railway company boards. Problems of service provision tended to force companies into amalgamation, a process that was completed when the State took over telegraphs. There were only five main companies when the Post Office assumed control and, on February 5, 1870, opened 2,400 public telegraph offices; the majority of these were at railway stations.

Telegraph Street

The largest company, the Electric and International Telegraph Company, had equipped its central office in 1860, in Little Bell Alley, a name that was soon changed to Telegraph Street—giving rise to the London telegraph code TS.

The new service was causing social changes, for we read that in 1867 the Company was employing 200 young unmarried women of from 18 to 25 years of age, "under the careful supervision of a matron". "Unmarried" was specified as a condition of employment "as it is considered that maternal and domestic duties would interfere with the strict system necessarily observed". Men only were employed at night. There were comfortable rooms in which the girls could take "dinner or tea, under very economical but satisfactory arrangements". Pay varied from 10s. to as much as 30s. a week, depending on the operator's skill. Of the girls employed some had been governesses, some orphans of professional men and some the daughters of tradesmen who could not afford to keep them at home unemployed. We were assured that "there are always more candidates than there are vacancies for them".

The Telegraph Street office became the Post Office's Central Telegraph Office at the transfer in 1870, when it contained 500 circuits (160 to provincial offices) and a variety of instruments—double and single needle, Bright's bell, Morse inkers and, of particular interest, Wheatstone's telegraphs, the ABC and the Automatic instruments.

The ABC was, appropriately, the simplest of instruments to operate, for it did not convey letters or words by conventional signs requiring a specially trained operator for their interpretation, but by a pointer moving successively to selected letters of the alphabet. Its speed was not high, averaging only 15 messages an hour, but it was particularly suitable for small country telegraph offices. A description of an Oxfordshire village postmistress operating one is to be found in Flora Thompson's classic, "Larkrise to Candleford". Such an instrument could have been found in a number of remote country offices before the telephone found its way to them as recently as 20 years ago.

How it worked

The ABC consists of transmitter and receiver, each with a clock face divided into 30 equal spaces on which are marked letters of the alphabet and punctuation points. The transmitter has a magneto generator; when its handle is turned a series of impulses pass to the distant receiver, the pointer of which steps around in unison with that on the local transmitter. Opposite each symbol on the transmitter is a lever key; these keys are connected with an endless chain below, in which the depression of a lever will put a kink, but the chain is sufficiently tight to allow only one key to be depressed at a time; depressing a second key restores the first to normal. The key of the first letter to be sent is depressed and, moving from zero position, pointers rotate simultaneously on sender and receiver till the kink is reached, when, before the sender's hand generator can be turned further, a second key has to be depressed for the next letter to be sent.

The Wheatstone Automatic was to play a big part in the technical history of the Central Telegraph Office. At the time of the transfer it was being worked at the slow speed of potentially 60 words a minute. It consists of three parts: the Perforator by which a message is prepared by punching holes in a paper tape; the Transmitter which sends dot and dash impulses under the control of the perforated tape and the Receiver which produces an inked record on paper tape of Morse signals that have been transmitted.

Sampling the Telephone Service

A private subscriber using the telephone

By "Argus"

THERE IS A TECHNIQUE WIDELY USED IN industry whereby a critical assessment of the quality of products is made by testing a proportion of them. This technique is employed in the Post Office and nearly every other telephone administration for watching the quality of telephone service given to subscribers. As employed in the British Post Office it consists of:—

(i) *Observing samples of the service,*
(ii) *Summarising the observations statistically,*
(iii) *Analysing them mathematically, and*
(iv) *Applying the results of the analysis towards improving the service.*

The physical side of the procedure consists in connecting a number of subscribers' lines to observation equipment so that Observation Supervisors can watch and time the progress of a call from a remote point, and record the speed of answer and other factors on operator-controlled calls. The observation results are set down in a prescribed order on specially prepared forms; the Traffic Division of the Telephone Manager's Office summarises, studies and compares the results.

The fact that a line is under observation is not apparent to the subscriber or his caller and the quality of calls is not affected in any way; neither need the subscribers fear loss of privacy. For operator-controlled calls the main items studied are speed of answer, time taken by the called subscriber to answer and by the operator to disconnect, percentage of calls not answered in 10 seconds, percentage of operators' irregularities and percentage of charging errors. For automatic calls the items are percentages of failures due to the subscriber—for example, distant party engaged or failing to answer and to causes within Post Office control—for example, wrong number or no tone.

Selecting Lines

It is sometimes suggested that a more useful purpose would be served if the time spent by the engineering staff putting lines under observation could be directed instead to bringing defective plant to light at the earliest possible moment; and that, in any case, plant found faulty during service observations should be held so that the faults can be traced and remedied. But skilfully designed routine testing—which is current practice—tests *all* the equipment and "holds" that which is faulty much more quickly and cheaply than if service observations are used instead. Operators, for their part, do not always take kindly to the logging of individual speeds of answer by Observation Supervisors, but although bad performance of an

The pen-name "Argus" covers, if not a hundred eyes, a number of commentators who prefer to appear jointly and anonymously under that disguise.

exchange as a whole may be quoted at Refresher Classes, no record is taken of the individuals responsible for service deficiencies, and no disciplinary action is taken against the staff as a result of something picked up from service observations.

The primary aim of the Department is to gauge the kind of service the customer receives in normal course, and not to show the service in its most favourable light. To hold faulty engineering apparatus for test would reduce the effectiveness of the time set aside for service observations; to ignore operators' irregularities would give the Department a false picture when it sets out to turn critical assessment of the service into constructive efforts towards improvement.

Genuine Observations

It is sometimes said also that more effective time would be available for taking observations if the lines to be connected to service observation equipment were first proved to be fault free. Against this it must be accepted that the observations would be unreal unless taken on subscribers' circuits in their normal condition of maintenance efficiency. Exchange apparatus is required to function satisfactorily within upper and lower limits of adjustment, line insulation, dial speeds and so on, and the service can be sampled with confidence only if all the circuits selected for observation purposes are reported upon *as found after they are connected to the observation equipment*.

It is, therefore, not only a regulation but also a good rule to remember that lines scheduled for connection to service observation equipment must be connected without any attempt to ascertain their serviceability. The only exceptions to this rule are clear cut and obvious: lines which are temporarily out-of-service (T.O.S.) ceased, or already faulty and receiving attention should be excluded. It sometimes happens that a line not quite up to standard will be connected and a high number of no-tone, wrong-number or number-unobtainable tone failures recorded against it. To prevent the summary being unduly weighted by such exceptions, the lines under observation are changed frequently. It is, of course, imperative to include lines of all kinds in their due proportion; only by so doing will service observations reflect the kind of service the customer gets on the average.

Another question which is often asked is whether the observation results are affected by the kinds of line on which the observations are taken. Up to 15 years ago *all* subscribers' lines were connected to the equipment in turn, despite the fact that some 70 per cent. of the subscribers did not make any calls while under observation. This was obviously wasteful, for the observation staff did not get enough observations during the month to produce a representative sample. Therefore, since 1937, subscribers making fewer than three calls a day on an average have been excluded from service observations. Every care is taken to see that the observation results are as truly representative as possible and in choosing lines for connection at one particular time, endeavour is made to spread them over the whole line-finder or uniselector groups.

In London, coin box lines set their own problem, because they are often very much busier than other lines. Special care is, therefore, taken to ensure that the number of coin box calls included in a month's observations are not so disproportionate that the summary is not representative of the exchange as a whole. For that reason they are connected to observation equipment on three days only during the month, ordinary lines being connected for the rest of the month. There is no evidence that the service given to a P.B.X. line is significantly different from that given to a single line; therefore, P.B.X. lines are not specially segregated, but are treated as exchange lines.

"Likes" Compared

Another question sometimes asked is whether the summarised results pay heed to the fact that the service given by an automatic exchange surrounded entirely by other automatic exchanges is different from that given by an automatic exchange adjacent to a large and busy manual exchange. It is to prevent the comparison of "unlikes" that summary sheets separate the different kinds of calls into those to automatic and those to manual exchanges. At the analysis stage, direct comparison is made only between "like and like".

The statistics require little explanation; the figures for each exchange and for all the exchanges of one type are summarised and the requisite percentages worked out. The service observations enable comparison to be made with the service given by individual exchanges, by different telephone systems and by foreign administrations.

The question most often asked is whether a sample can be truly representative.

If we take repeated samples of the same size at an exchange giving a stable service, the majority of readings will obviously be very near to "average";

if the results are plotted graphically they will cluster mainly about a central point (corresponding to "average") but a minority will be scattered, showing an abnormally high or low variation from the real average of the readings taken. Manifestly each sample reading is liable to a "sampling error" which will be increasingly apparent as the size of the sample diminishes. Remembering that the exchange concerned is regarded as giving a stable service, a reading from a sample can be taken as being of an acceptable standard if it is not worse than "average plus the sampling error". The "acceptable standard" can be varied according to requirements, but by way of illustration let it be assumed that it is set so that nine in ten of the samples are to be truly representative; then if a later sample for the same exchange is outside "average plus or minus the sampling error" it is a nine-to-one chance that the exchange service has deteriorated.

Statistical tables are published which give the sampling error appropriate to samples of various sizes, and also the odds that a sample giving a worse reading genuinely comes from an inferior product.

The general formula is $E = \frac{100t}{n}\sqrt{np(1-p)}$ where E is the sampling error expressed as a percentage so that it can be added to the service observation figures (which are already expressed as percentages), n is the number of calls in the sample, p is the underlying probability of defect or "average" and t the odds, t being 1.28 for odds of 9 right out of 10 and 1.64 for 19 right out of 20.

It may help to take a concrete case using a sample of 400 calls. Say the percentage of calls meeting the busy tone for all the comparable exchanges in a Region is 10. Applying the formula, p is 0.1, n is 400 and taking t as 1.28 (for odds of 9 right out of 10), then E is 1.92. If the reading of the exchange is worse than (10 + 1.92) per cent. for that item, the odds are 9 to 1 that the exchange is really giving an inferior service in that particular.

Those who are interested in elementary statistical analysis should consult the following publications:—

1. *"Statistical Control of the Quality of Telephone Service" by W. F. Newland and E. E. Neal. Supplement to the Journal of the Royal Statistical Society, Vol. VI, No. 1, 1939.*
2. *"A Simple Introduction to the Use of Statistics in Telecommunications" by J. F. Doust and H. J. Josephs, P.O.E.E. Journal, Parts I to IV, Vol. 34, 1941-1942.*

Experience has shown that a sample of 200 calls is generally sufficient for all the purposes in mind and that the added accuracy from a larger sample is small. This can be shown by substituting various values of n in the formula above, when the following results appear:—

No. of calls in Sample	*Sampling Error*
50	5.43
100	3.84
200	2.72
300	2.22
400	1.92
500	1.72
1,000	1.21

A few words about traffic fluctuations and random sampling will be appropriate at this stage. There may be a whole host of odd factors affecting service performance, such as sick absence, weather, staff vacancies, travelling difficulties, traffic fluctuations affected by changing business, or social activities. (Even changes in the national scale of food rationing, which encourage or discourage more meals out, affect the level of traffic!) These factors, which operate quite at random, provide the very situation represented by those probability distributions on which modern statistical theory rests. There should, therefore, be no fear that there is anything unique about telephone operating to make the quality different from other physical phenomena and therefore unpredictable; in other words, there is no reason why deductions made about the telephone service from service observations should be less accurate or less valuable than those in industry, or in any other branch of the Post Office.

To the mathematically minded, the theory and application of service observations is extremely fascinating. Obviously it has been only briefly touched upon in this article, but it is hoped that sufficient has been said to show that the Department's method of observing the service it gives (through the medium of samples) is representative, accurate within closely definable limits, and economical.

This article has been written from the telephone point of view, but the Engineering Department Research Branch has for many years made analytical studies of the quality of the telephone, telegraph, radio and postal services. Many new and valuable results based on service observations have been obtained and interesting exhibits can be seen at the Research Station.

NOTES and NEWS

AMERICAN BROADCASTING COMPANIES AND news agencies made special arrangements to cater for the enormous interest in the Coronation displayed by their countrymen. The National Broadcasting Company synchronised two cameras to high definition 15-inch television receivers, the screens of which were blanked down to about 6 8 inches. The pictures were "on the air" within five minutes of exposure, were transmitted at twice the normal speed, and were received in New York on Muirhead facsimile receivers using electro-sensitive paper. As the picture began to build up on the receiver it was televised seven minutes after action in London. Some 90 pictures were sent in this way.

On a second radio circuit the same Company sent more carefully selected and processed pictures. A picture of the crowning ceremony was televised by 67 United States stations within a few minutes of the ceremony. The B.B.C. commentary was sent out on 186 transmitters.

The Associated Press also took television pictures, direct from a 2½-inch tube, and used an exclusive radio circuit. The first, of the Queen leaving the Palace, was in time for the last edition of the June 2 *New York Daily News*, which claims to have been on sale with a procession picture before the London evening newspapers.

* * *

"See as you talk" telephones.—A hint of the further development of the television-telephone is to be found in the recently published report of the Department of Scientific and Industrial Research, which states that "the possibility of using single conductors as efficient wave guides at extremely short wavelengths has been under investigation at the Radio Research Station and also at University College, London."

The television-telephone—the Americans call it "phonevision"—was shown at last year's National Radio Exhibition. The set there was the size of an average kitchen and cost £1,000. Two distant stands were linked and callers could see each other on screens as they spoke over the telephone. In Chicago "phonevision" was demonstrated to the public in January, 1951.

The British experiments are still in the laboratory stage and, before it is possible to say whether the system is to be of commercial value, it will be necessary to try the transmission of television-telephone speech and electric power over a long length of the conducting medium.

* * *

Radiotelephone developments in Turkey.—The equipment for the recently opened radiotelephone link between Turkey, Western Europe and the United States is housed in a number of major radio stations which are connected by underground cables to a central office in Ankara where the circuits are controlled. In addition to the radiotelephone equipment these stations will contain apparatus which will enable the existing radiotelegraphic service from Istanbul to be increased and teleprinter working to be introduced.

The new transmitting station at Ankara houses two 40 k. w. peak-power transmitters, one for the telephone and the other for the telegraph service. The telegraph and telephone transmitters are interchangeable so that the former can be used as a stand-by.

* * *

Television teaching.—A pilot experiment with broadcasts to six London schools was conducted in May, 1952, and at that time it was hoped to conduct larger experiments. The School Broadcasting Council has completed its report but it is clear that there is still to be much discussion with interested bodies before anything else is done. The Council has advised waiting until the national economic position improves, but it is intended nevertheless to approach the Ministry of Education for their views.

* * *

Electronic key-sender.—An electronic key-sender is shortly to be tried at a London P.B.X. installation. This will provide a convenient opportunity for testing certain principles of electronic design as developed by one of the telephone equipment manufacturers.

Information Theory for Engineers

INFORMATION THEORY AND ITS ENGINEERING APPLICATIONS. By D. A. Bell, M.A., B.Sc. (Oxon.), M.I.E.E. Sir Isaac Pitman & Sons, Ltd., 138 pp. 20s. 0d.

In recent years, telecommunications engineers have observed the increasing frequency at which terms such as "white noise", "bits per second", "epochs", "binary digits", "redundancy" and so on have been occurring in their deliberations. So far, the interested student has had no comprehensive publication to refer to which will explain, co-ordinate and develop these and kindred terms. Mr. Bell's book fills this gap admirably, its arrival is opportune and its content adequate. It assesses and compares the potential information content of communication systems, whether they be electrical, such as telegraph, telephone, or television, or spoken and written in a specified language or code.

The classical formulæ of Hartley, Nyquist, Shannon and Gabor are critically examined, and certain differences of nomenclature, which may have confused students of these earlier pioneers, are satisfactorily explained, and by making a good case for a logarithmic measure of transmitted information, the resultant convenience of the binary digit unit is the more readily appreciated. The application of these theories, as developed concisely and convincingly by the author, covers the essential relations between band-width, signalling speed and signal-noise ratio. The comparative advantages of various coding systems are discussed, with examples of their practical application, though it is surprising that the most tangible of these, error detecting and correcting systems, should not be included.

The subject matter is essentially one for analytical treatment, and all but advanced students will have to take the mathematics as read, but, nevertheless, non-mathematicians will find the development of the fundamental theorems quite easy to follow, as the author makes liberal use of apt and convincing analogies.

A comprehensive bibliography gives valuable references to related publications, though it may be a matter of concern to our readers that the contribution from Post Office sources is negligible. There are also appendices on comparisons with thermodynamics, on the information content of the English language, on Fourier transforms, and the Morse code. In considering the reasonable size of the volume, the entropy, in the author's idiom, must be judged to be commendably low.—*N.V.K.*

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."

GPO