POST OFFICE

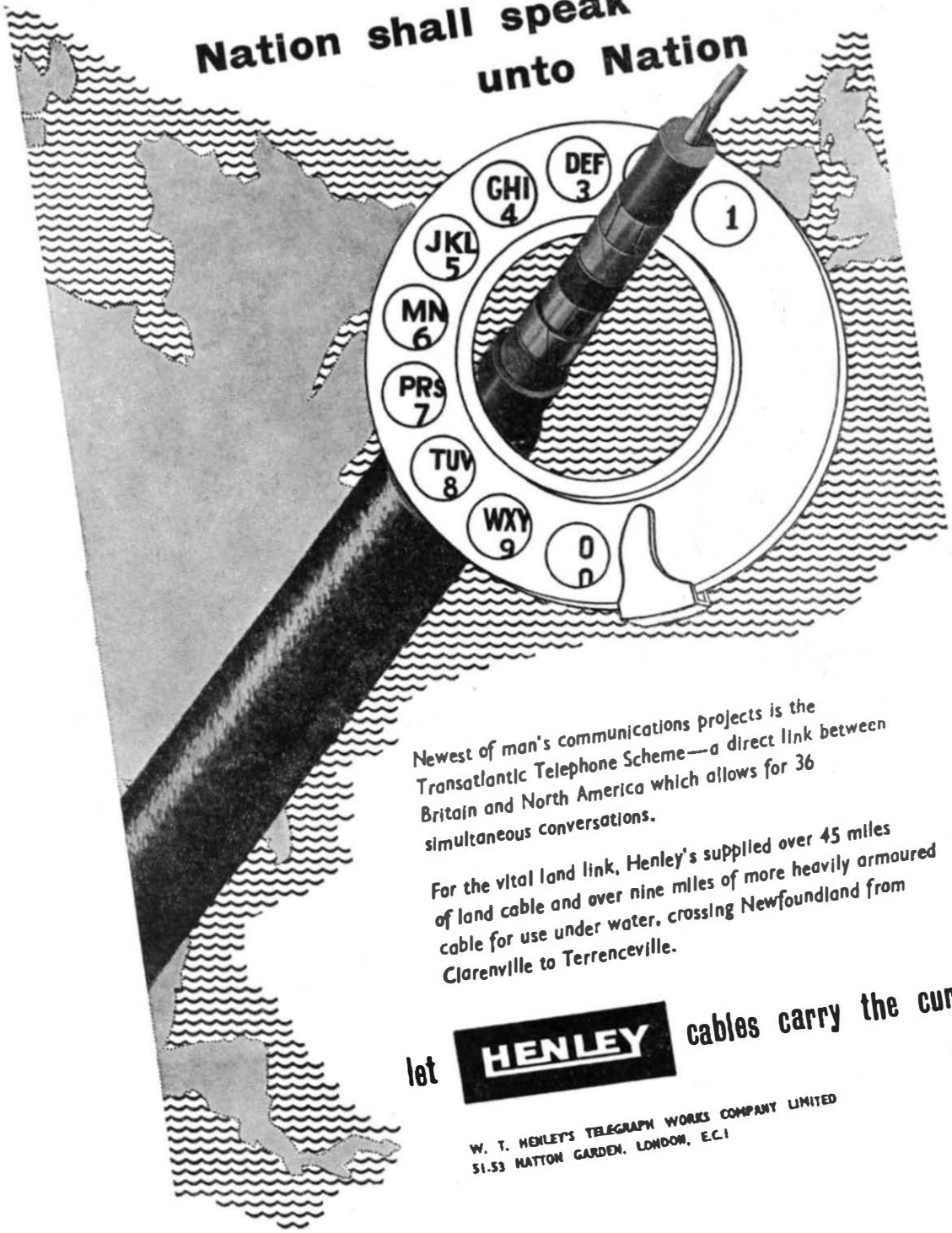
telecommunications

JOURNAL

ONE SHILLING
AND
SIXPENCE

AUTUMN 1957

Nation shall speak unto Nation



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Post Office Telecommunications Journal

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Contents

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Towards Full Telephone Automation

ALL TOO OFTEN HAS INFLATION RESULTED IN HIGHER prices for inferior goods. The Post Office White Paper, which is reproduced on the following pages, shows how a bold and imaginative programme of automation can beat inflation and give better value.

Automation means much more than automatization. Automatic machinery—lathes, presses, and so on—has been used in factories for many years, but only when machines are combined, the output of one being fed to the next in a unified chain of processes, can we talk of automation.

So it is with the telephone system. For the last 35 years the Post Office has been installing automatic exchanges for local calls. Now these exchanges are to be linked together to form one integrated unit. When this is completed, a subscriber will be able to dial any other subscriber in the country, and the cost will be debited automatically to his account.

To make this possible, the call tariff has had to be changed. This tariff was designed for a manual system, but it is not suited to a mechanical system. It has hampered progress.

In using machines to relieve mankind of arduous or repetitive work the best results can rarely be obtained by designing them to perform the same manual functions, under exactly the same conditions. Every machine has its characteristic idiosyncrasies. Only by recognizing its limitations and making concessions to them can its full potentialities be developed. Hitherto machine telephony has had to adapt itself to the tariff. Now the tariff is being adapted to suit the machine. By this change, the Post Office hopes to be able to offer a better, cheaper service to its subscribers.

Full Automation of the Telephone System

THE POST OFFICE IS TAKING TWO BIG STEPS TOWARDS FULL TELEPHONE AUTOMATION. IT WILL PRESS ON quickly with a system in which all numbers are obtained automatically and charges for calls are recorded mechanically. This will give better service at lower cost. The two steps are:

Step 1: Simplified Charges

Since 1912, when the first automatic exchange opened, progress towards full automation has been held back by a system of charges designed for manual operation. This handicap must be removed, for only if that is done can rapid progress be made.

From January 1, 1958, there will be fundamental changes in tariffs. The principles of call charging will be simplified.

The advantages of Step 1 will be:

(*a*) The area covered by the 3d. call will be greatly enlarged—in many cases up to ten times.

(*b*) 150 million calls a year now handled by operators will be dialled direct, with very little additional equipment.

(*c*) Telephone costs will be cut by £2 million a year.

Step 2: Automation

The simpler method of charging in Step 1 paves the way for full automation. The Bristol exchange will be the first to be converted.

By the end of 1958, new equipment will allow subscribers in that city to dial about half the subscribers in the country.

By the end of 1960, 40 other towns will be similarly equipped.

By 1970, three-quarters of all trunk calls will be dialled by subscribers.

The advantages of Step 2 will be:

(*a*) Quicker service.

(*b*) Automatic accounting.

(*c*) Long-distance calls of short duration for a few pence.

(*d*) Big economies.

Such is the bare outline of what is proposed. Details of the two steps follow.

STEP 1: SIMPLIFIED CHARGES

From January 1, 1958

The Post Office now has some 6,000 exchanges. Each has its own list of charges based on "crow-flight" distances to the other 5,999 exchanges.

To have 6,000 charging units is to have too many. They will be reduced by 5,400—leaving only about 600. This will be done by combining exchanges into 600 charging units which will be called GROUPS. The grouping will usually reflect local community of interest. Naturally they will be of various shapes and sizes but the average radius will be about 7 miles.

All exchanges in a Group will have the same list of charges. All distances will be measured from and to a central point. For example, Crewe is a selected central point (see Appendix 1). All exchanges in the Crewe Group will have the same charges. At present Church Minshull, Warmingham and Sandbach, for instance, have their own list of charges. In future, calls from or to these exchanges will count as calls from or to Crewe.

For 3d. any subscriber, whether he has a dial telephone or not, will be able to call any other subscriber

(*a*) within his own Group; and

(*b*) within all adjoining Groups (with very few exceptions).

The subscriber's own Group plus the adjoining Groups will become his LOCAL CALL AREA. How Groups will be combined to form Local Call Areas is shown in Appendix 2.

Today a 3d. call covers about 80 square miles. After January 1 this will be enlarged to about 900 square miles on the average.

Today calls to exchanges 5 to 15 miles away cost 6d., 9d. or 1s. 0d. After January 1 most of them will cost 3d. This change, which gives better value for money, is illustrated in Appendix 3 and Appendix 4.

Here are a few representative examples:

	Present Charge	*Charge from January 1958*
Whitehall–Windsor	1s. 0d.	3d.
Skyport–Waterloo	9d.	3d.
Mayfair–Elstree	6d.	3d.
Reading–Newbury	1s. 0d.	3d.
Bristol–Bath	9d.	3d.
Nottingham–Melton Mowbray ...	1s. 0d.	3d.
Cardiff–Newport	9d.	3d.
Liverpool Central–Southport ...	1s. 0d.	3d.
Manchester Central–Warrington ...	1s. 0d.	3d.
Leeds–Bradford	9d.	3d.
Newcastle–South Shields	6d.	3d.
Glasgow Central–Motherwell ...	9d.	3d.
Belfast–Antrim	1s. 0d.	3d.

Much automatic equipment now installed cannot be fully used merely because it is not capable of recording the present complicated charges.

Take Holborn as an example. This is the oldest automatic exchange in London, having been installed in 1927.

Existing equipment

(*a*) could be used by subscribers to dial and obtain most numbers where the cost of the call is at present 3d., 6d., 9d. or 1s. 0d., *but*

(*b*) is not capable of recording any except 3d. calls on the subscriber's meter.

Therefore, no Holborn calls costing more than 3d. (for instance the present 9d. call to Watford) are now dialled. Calls costing 6d., 9d. and 1s. 0d. have to be obtained by operators merely because they, and they only, can record the charge. In future, with the enlarged Local Call Area, Holborn subscribers will be able to dial Watford (and other places in outer London) because the new charge of 3d. can be recorded mechanically.

The same sort of thing will happen in many other parts of the country.

In this way the new simplified charges will enable existing equipment to be fully used for the first time. With only minor additions to present equipment there will be a quicker service. In fact 150 million calls a year now handled by operators will be dialled direct by subscribers.

Charges for trunk calls take into account three elements:

1. Rates for a given mileage.
2. Chargeable mileages.
3. Time.

Rates for a given mileage. These will be reduced. Here are the rates:

Chargeable Mileage	*Present Charge*	*Charge from January 1, 1958*
15–20 miles ...	1s. 0d.	If within the Local Call Area... ... ... 3d.
20–25 miles ...	1s. 2d.	
25–35 miles ...	1s. 6d.	Otherwise ... ... 1s. 0d.
35–50 miles ...	1s. 10d.	... ... 1s. 9d.
50–75 miles ...	2s. 3d.	... ... 2s. 3d.
75–125 miles ...	3s. 0d.	... ... 3s. 0d.
Over 125 miles	3s. 9d.	... ... 3s. 6d.

Cheap evening rates will not be altered.

Chargeable Mileages. In the past we have taken the chargeable mileage as the "crow-flight" distance between individual exchanges; now it will be the "crow-flight" distance between centres of Groups. Naturally this means that some chargeable mileages will be reduced while others will be increased.

Time. The present three-minute minimum charge and subsequent timing at one-minute intervals will be retained for the present.

The net result of all this is that most trunk calls will be cheaper; some will stay as they are; and a few (about 3 per cent) will be slightly dearer.

The full advantage of the extended range of local calls will also be available from call offices at the present 4d. charge. Users will also benefit from the reduced trunk rates. As at present the charge will be 3d. more than that from an ordinary telephone.

STEP 2: AUTOMATION

To follow later

The fundamental changes in Step 1 pave the way for Step 2. Step 2 has for its goal nothing less than full automation: it will revolutionize the trunk service.

The main features are:

1. *Dial Anywhere.* Local, toll and trunk exchanges will be merged into one fully integrated automatic unit. Step 1 enables 150 million more calls a year to be dialled. But Step 2, when completed, will enable ALL calls to be dialled by subscribers.
2. *Automatic Accounting.* Charges will be recorded mechanically on the subscriber's meter. This will eliminate all possibility of human error.
3. *Abolition of Three-Minute Charge.* The minimum three-minute charge will go. A subscriber who makes a 30-second trunk call will not be charged for three minutes.
4. *Economies.* There will be an ultimate saving in operating and accounting of £15 million a year.

SUBSCRIBER TRUNK DIALLING needs a system of NATIONAL TELEPHONE NUMBERS. At present every subscriber has a number. He will keep it. But to reach him from a distant part of the country extra numbers must be dialled in front of the existing number. These extra numbers will do the work now done by an operator. The national telephone number will be these additional numbers plus the existing number.

At present telephone numbers do not have more than seven digits, e.g. HOP 3333. Some have less. Under the new system no national number will have more than ten digits.

The brain of the new system is a machine devised by Post Office research engineers. It will interpret the numbers dialled by subscribers and route calls in the required direction. It will operate switches at intermediate telephone exchanges until the required

exchange is reached, and will then dial the number on that exchange. In short it is a robot telephone operator. Its full name is GROUP ROUTING AND CHARGING EQUIPMENT—GRACE for short.

How to make a call. Calls will be made as follows (*but only when the new system starts*):

Local calls	...	Exactly as at present.
Trunk calls	...	Dial the national number (which will be published at the appropriate time).
For an operator	...	Dial 100 (not "O" as at present).
In emergency	...	Exactly as at present—dial 999.

The new code for calling an operator (100) will be necessary because all national numbers will start with "O".

Dialling "O" will call GRACE.

At present the operator makes out a separate ticket for every trunk call. Much more clerical work is then needed—pricing and sorting the tickets, billing, and so on. All this is elaborate and costly. Even so, the subscriber does not get all the information he would like.

To sort annually 330 million trunk call tickets into 4 million accounts represents the work of 1,500 clerks. All this will be saved because, with a dialled call, there will be no operator and therefore no ticket. We shall record the calls mechanically (as with gas and electricity).

The existing meter at the telephone exchange will be used to register all call charges.

Not only will the new method save money but it will also eliminate the possibility of error.

Meters at subscribers' premises. A subscriber will be able to rent (for about 15s. 0d. a quarter) a separate meter at his premises. This will work in step with the meter at the exchange. It will indicate the cost of an individual call (after which it may be reset). It will also show a running total.

An entirely new method of charging for trunk calls will be used. This will mean the abolition of the existing large minimum charge.

At present a subscriber must pay for a minimum of three minutes even if he only speaks for a few seconds. Such a charge is necessary to cover the cost of a telephonist operating and accounting for the call.

With the new system a machine will do this work, and do it much more cheaply. Therefore the need for a large minimum charge has gone.

At present the three-minute minimum rate varies with the distance, e.g.:

Bristol to Edinburgh 312 miles
3s. 9d. (3s. 6d. from January 1).
Bristol to Gloucester 32 miles
1s. 6d. (1s. 0d. from January 1).

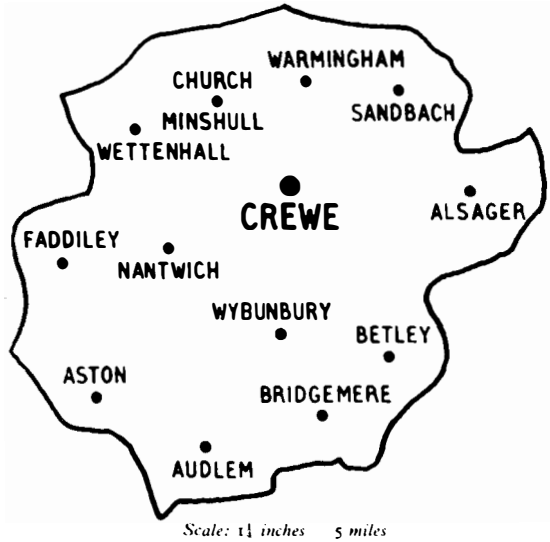
With the new system the minimum charge will be the local call charge. *This will buy time according to distance*, e.g.:

Bristol to Edinburgh 312 miles—13 seconds.
Bristol to Gloucester 32 miles—45 seconds.

The system will work like this. When a Bristol subscriber dials an Edinburgh number his meter will register once when the call starts and again every 13 seconds until the call is finished. But on a call to Gloucester, which is nearer, the meter will register only at 45-second intervals. Each registration is equivalent to one local call charge. Thus a call can be made to any part of the country for a few pence, although over the long distances such a call would have to be of short duration.

APPENDIX 1

Exchanges in the Crewe Charging Group

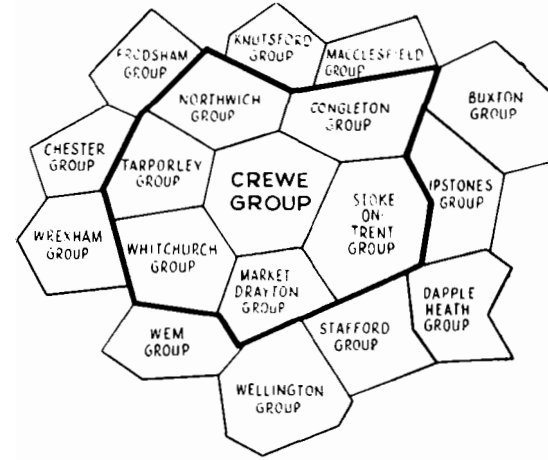


Scale: 1¼ inches 5 miles

Calls from and to all these exchanges will be charged as calls from and to Crewe

APPENDIX 2

Schematic diagram showing how groups of exchanges will be combined to form a Local Call Area



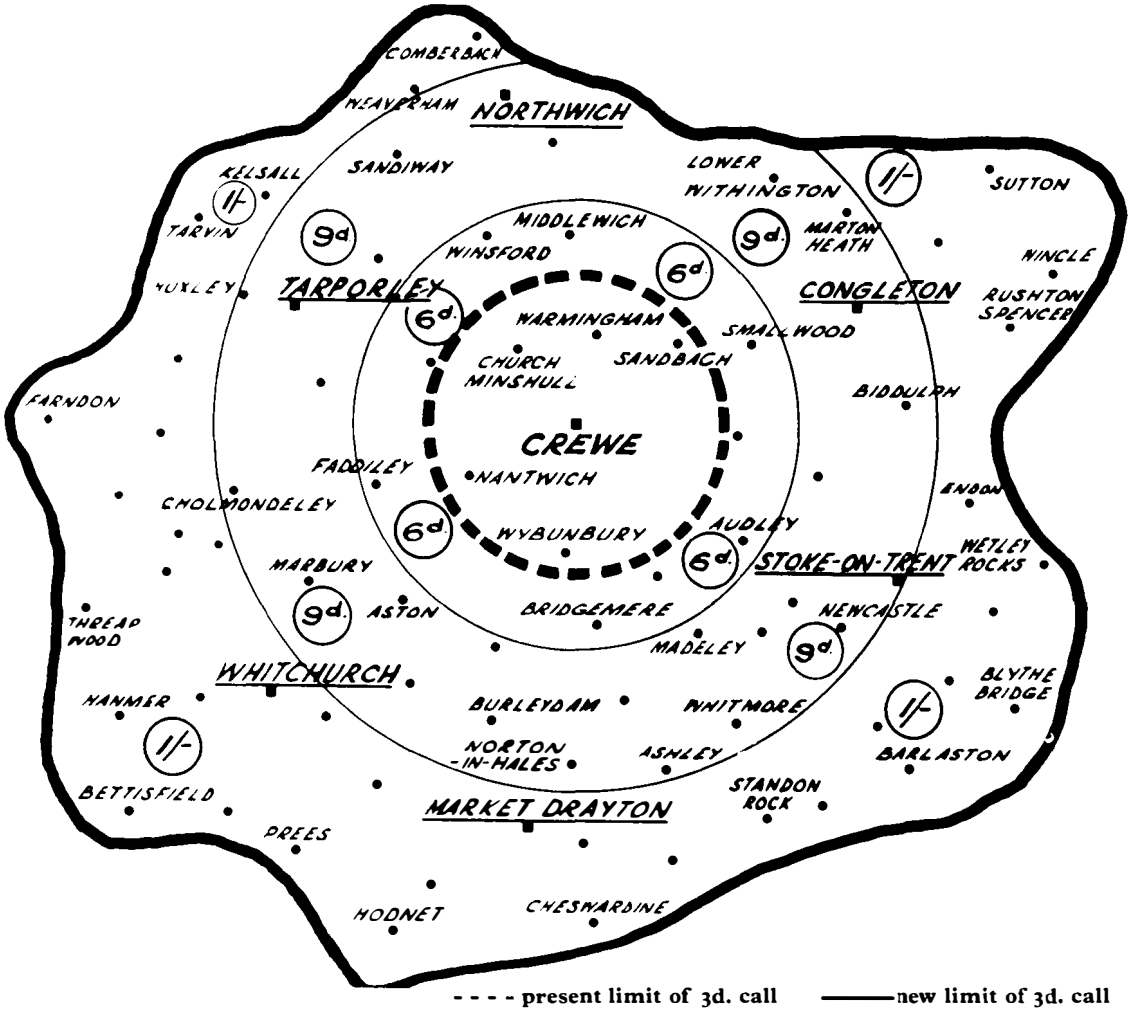
Groups of exchanges comprising the Crewe Local Call Area

Calls from exchanges in the Crewe Group to exchanges within the thick line will all be charged 3d.

APPENDIX 3

Crewe Local Call Area

Call charges for subscribers o.t the Crewe Exchange before and after January 1, 1958



- - - - present limit of 3d. call **——— new limit of 3d. call**

Scale: 1¼ inches 5 miles
The position of each exchange in the area is shown. But some names are omitted for the sake of simplicity
Present charges are shown by the circles
Calls from Crewe to all these exchanges will be charged 3d. from January 1, 1958

(These figures are for illustration only. The actual figures will be announced later.)

No pips. There will be no "pips" to show the lapse of time, for these reasons:

(*a*) Present equipment cannot be used and new equipment would cost an extra £6 million.

(*b*) A three-minute interval will have very little significance with the abolition of the three-minute charge.

Great savings will be made by substituting machines for people on routine work. The savings will increase progressively. In ten years we expect to save £15 million a year.

Operators still available. Some operators will be retained. They will be there to provide such specialized services as personal calls, reverse charge calls, etc., and to connect calls for any subscriber who does not wish to dial trunk calls himself.

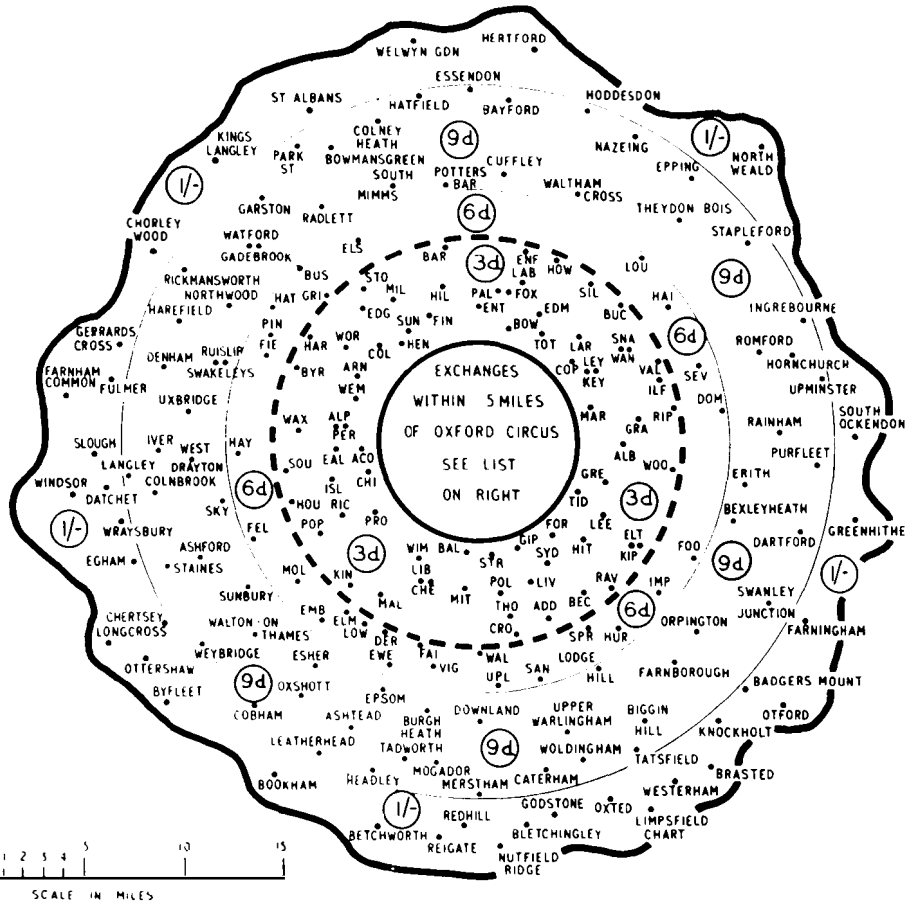
Even so, the number of telephone operators will be greatly reduced during the next ten years.

APPENDIX 4

London Local Call Area

For subscribers within 5 miles of Oxford Circus:

1. Call charges before January 1 are shown by the circles.
2. From January 1 calls to any exchange within the boundary shown will be 3d.



EXCHANGES WITHIN FIVE MILES OF OXFORD CIRCUS

ABB	MAC
ADV	MAI
AMB	MAN
AMH	MAY
ARC	MEA
AVE	MET
	MIN
BAT	MON
BAY	MOU
BEL	MUS
BER	
BIS	NAT
BRI	NEW
	NOR
CAN	
CEN	PAD
CHA	PAR
CIT	PRI
CLE	PUT
CLI	
COV	REG
CUN	REL
	REN
EAS	RIV
ELG	ROD
EUS	ROY
FIT	SHE
FLA	SHO
FLE	SLO
FRE	SPE
FRO	STA
FUL	STE
	SWI
GER	
GLA	TAT
GRO	TEM
GUL	TER
	TRA
HAM	TUD
HEA	TUL
HOL	
HOP	UPP
HUN	
HYD	VAN
	VIC
KEN	
KIL	WAT
KNI	WEL
	WES
LAD	WHI
LAN	WIL
LEG	
LON	
LOR	
LPR	

- - - - - present limit of 3d. call **——— new limit of 3d. call**

Consultation with Unions

The greatest problems of automation are not in the technical field; the human problems are much greater. Men and women are displaced, less staff is required, and career prospects are jeopardized. These things could cause much anxiety and hardship. The Post Office intends that full telephone automation shall be undertaken with the goodwill of the staff. Full regard will be paid to the interests of those who have given long service, and to such added responsibilities as may be carried by staff in the future. There will be many such problems to be solved. The Post Office and the Trade Unions will tackle these problems together.

Post Office Trade Unions have declared their willingness to co-operate in the introduction of automation. They are already serving on working parties set up to consider its introduction and problems.

Conclusion

The two steps proposed in this White Paper together constitute the most sweeping and radical reform since the Post Office took over the telephone service from the National Telephone Company in 1912. These fundamental changes are necessary to achieve full telephone automation. And only with full automation will the best service be provided at the lowest cost.

Long-Distance Radiocommunication and the International Geophysical Year

G. O. Evans, B.Sc., A.M.I.E.E.

HIGH-FREQUENCY RADIOCOMMUNICATION over long distances is made possible by the existence of an electrified region, known as the ionosphere, which extends from about 50 to 300 miles above the earth's surface. This electrified region reflects back to earth radio waves which would otherwise travel to outer space. The effectiveness of the ionosphere in reflecting these radio waves depends largely on the intensity of ultra-violet light from the sun, which not only varies with time of day and season but also with the well-known 11-year sunspot cycle. Since the frequencies that can be used for communication over a given circuit, for example, London to Capetown, depend primarily on the reflecting properties of the ionosphere, it is evident that a knowledge of the way in which the characteristics of the ionosphere vary with time and over the surface of the earth is not only of interest to the scientist, but is also of importance to the radio engineer.

The main characteristics of the ionosphere are determined by means of ionospheric sounding equipment which measures the time taken by a radio pulse (a short signal of about one-thousandth of a second duration) to travel from the earth to the ionosphere and back again. From these measurements data are obtained on the heights of the various reflecting layers and the highest frequency that can be reflected at any given time. These measurements of height and frequency form the fundamental data on which both scientific studies of the ionosphere and predictions of the most suitable operating frequencies are based.

Several countries maintain ionospheric sounding stations or ionospheric observatories. In the United Kingdom the Department of Scientific and Industrial Research operates ionospheric observatories at Slough and Inverness, while overseas it maintains observatories at Ibadan, Khartoum, Singapore, Port Stanley (Falkland Islands) and Port Lockroy (Falkland Islands Dependencies). Port Lockroy station is one of the two most southerly observatories making regular observations, the other being a French observatory at Adélie Land, on the opposite side of the Antarctic Continent. The observatories in operation before 1957 were by no means evenly distributed over the earth's surface, and while some areas were covered by a fairly extensive network of observatories, there were large areas of the world, including in particular the Ocean Areas and Polar Regions as well as large tracts of Africa and South America, for which no data on the characteristics of the ionosphere existed. This meant that, in preparing world charts showing the variations in the characteristics of the ionosphere, the characteristics over large areas had to be estimated from data measured at widely separated observatories.

It is obvious that any attempt to make world-wide measurements of the characteristics of the ionosphere must depend on a very large degree of international co-operation. Two examples of scientific co-operation of this nature are the International Polar Years of 1882-83 and 1932-33, which were organized mainly for Arctic observations of magnetism, meteorology and the aurora. During the International Polar Year of 1932-33, studies were also made of the ionosphere in Arctic regions, and observations made by a British expedition in North Norway led to the discovery of the connexion between auroral displays and magnetic storms, and the disturbances in the ionosphere which had caused severe interruptions on the Canadian beam circuit during its acceptance tests a few years earlier.

The International Polar Years of 1882-83 and 1932-33 have led to the International Geophysical Year of 1957-58. The International Geophysical Year, or I.G.Y., actually covers a period of 18 months, from midnight on June 30 this year to midnight on December 31, 1958. During this period over 60 nations are co-operating in world-

wide observations on the many branches of geophysics, that is, the physics of the earth and its surrounding atmosphere, and attention is being concentrated on those regions of the earth for which little or no data have hitherto been available. These regions are the Arctic, Antarctic and the tropical belt, and observations are also being concentrated along the meridians 70°-80° W, 10° E and 140° E. The observations are classified into a number of programmes which include meteorology, geomagnetism, the aurora, the airglow and zodiacal light, cosmic rays, solar observations, ionospheric observations, longitudes and latitudes, glaciology, oceanography, seismology and nuclear radiation.

In studying radiocommunication via the ionosphere the more interesting of these programmes are ionospheric observations, solar observations, geomagnetism and, to a less extent, meteorology. As already mentioned, data on the characteristics of the ionosphere have hitherto been very meagre for many regions of the world although some of these regions are of considerable interest to the radio engineer since they are traversed by the great circle paths, which are generally assumed to be followed by radio waves between important terminals. Thus, for example, the northerly and southerly routes to New Zealand pass close to the North and South Poles, while the South African route traverses parts of Africa for which comparatively little data on the ionosphere exist.

During the I.G.Y., many expeditions are making ionospheric observations in the Antarctic Continent. An expedition sponsored by the U.S.A. is established at the South Pole, while British and Commonwealth expeditions are based at Halley Bay, 75° S, 27° W, and Shackleton, 78° S, 37° W. In the Arctic a Russian expedition is operating near the North Pole. It is therefore to be expected that the data accumulated during the I.G.Y. will enable a more accurate picture to be built up of the worldwide variations in the characteristics of the ionosphere and that this may eventually lead to increasingly accurate predictions of the most suitable operating frequencies for long-distance radio circuits.

I have already mentioned that our existing knowledge of the characteristics of the ionosphere has been based on measurements of the height of the reflecting layers and the highest frequencies that can be reflected back to earth. To obtain a more detailed picture of the structure of the ionosphere, its chemical composition and the possible ways in which it may be formed, measurements have to be made within the ionosphere itself—that is, at heights greater than 50 miles above the earth's surface.

During the past few years preliminary experiments on such measurements have been made, using the remaining stocks of the German V2 rockets adapted to carry measuring instruments instead of warheads. These V2 rockets had a ceiling of about 100 miles and were thus able to penetrate into the lower regions of the ionosphere. As the stocks of V2 rockets became exhausted, new rockets, designed specifically for measurements in the upper atmosphere, became available. The first experiments using rockets for measurements in the ionosphere were carried out in the U.S.A., but as part of the I.G.Y. programme, British rockets will be fired from the guided missile range at Woomera (Australia) and possibly from Aberporth, on the west coast of Wales.

The time available for making measurements during the flight of a rocket is only a few minutes, and consideration has, therefore, been given to means of extending this period. This has led to the development of earth satellites by Russia and the U.S.A.

The first Russian satellite, launched in October, is reported to have weighed about 180 lb. and was carried by rockets to a height of about 400 miles before being projected into its orbit. The Soviet's second satellite (with dog) is reported to be rather heavier and to have gone higher. The satellite developed by the U.S.A., which is expected to be launched during the spring of 1958, is about 20 inches in diameter and weighs about 20 lb. Like the Russian satellite it will be carried by rockets, to a height of about 300 miles and then launched with a velocity of about 18,000 miles an hour. A satellite moving with this velocity can encircle the earth in about one and a half hours. The useful life of earth satellites is probably not less than a fortnight and may possibly be as long as a year before they finally burn up like a meteor as they reach the denser lower atmosphere.

It is well known that long-distance radiocommunication is subject at times to interruptions, but not always, as the man-in-the-street is led to believe, by sunspots. These interruptions to radio circuits are caused by disturbances in the ionosphere, which fall into two types. The first, which results in a sudden, instantaneous and at times complete disruption of all radio circuits traversing the sunlit half of the globe, is caused by an intense

burst of ultra-violet light emitted from solar flares, which are liable to occur in the vicinity of large sunspots. The duration of the interruption due to this type of disturbance in the ionosphere is usually no more than half an hour, although it may, on a few occasions, last for more than an hour. The solar flare also emits a stream of electrically charged particles, which travel with a velocity considerably slower than that of light and, if the stream is directed towards the earth, it will reach it from 18 to 36 hours after the onset of the solar flare.

Under the influence of the earth's magnetism the stream of charged particles is diverted into two belts surrounding the north and south magnetic poles. This gives rise to the second type of disturbance, which results in the reflecting properties of the ionosphere being temporarily destroyed and causes interruptions during the hours of darkness to radio circuits passing near the north and south magnetic poles. This type of disturbance usually lasts for several hours and at times several days may elapse before the ionosphere is restored to its normal condition. This second type of disturbance may be accompanied by magnetic storms and displays of the aurora. While the first type of disturbance, caused by the solar flare, is definitely associated with a large sunspot, it does not follow that all large sunspots give rise to disturbances of this nature. It has, in fact, often happened that very large sunspots have had no effect on the radio circuits, while small, but rapidly growing, spots have resulted in severe interruptions.

The second type of disturbance may also occur in the absence of large sunspots, but the fact that it is caused by some solar phenomenon is shown by its tendency under these conditions to recur at intervals of 27 days, this being the time taken by the sun to rotate on its axis in the same way as the earth rotates once in approximately 24 hours.

It is thus seen that there is a connexion between events on the sun, disturbances in the ionosphere which cause interruptions to radio circuits, magnetic storms and auroral displays. This is why the I.G.Y. programme of solar and geomagnetic observations is of interest to the radio engineer. During the I.G.Y. an alert will be issued to all observing stations when there is a likelihood of solar phenomenon occurring which may give rise to disturbances in the ionosphere, magnetic storms and auroral displays. It may happen that one of the eventual results of the co-ordination of solar observations with ionospheric and geomagnetic measurements will be the development of a fairly reliable method of forecasting the occurrence of ionospheric disturbances which appear likely to interrupt radio circuits.

From this brief account of the International Geophysical Year it may be appreciated that while the main object of the I.G.Y. is to increase our scientific knowledge of the earth and its surrounding atmosphere, it will also provide information which can be applied to the practical operation of long-distance radio circuits. During the I.G.Y., efforts will be concentrated on the accumulation of data, and it will only be during the subsequent years, when the ionospheric, solar and geomagnetic observations have been analysed and co-ordinated, that the results of the I.G.Y. can be applied to the problems of long-distance radiocommunication.

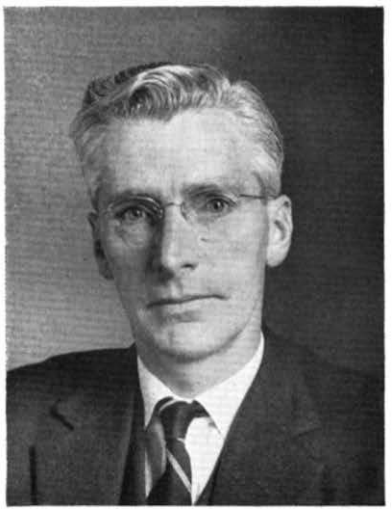
P.O. Engineers Track the Satellites

The Post Office Engineering Department's frequency measuring stations at Banbury, Brentwood and Bladock are participating in the measurement of signals radiated from the Russian satellites. These consist of very accurate frequency and time measurements at intervals of several seconds, enabling curves to be obtained showing the Doppler shift in frequency experienced during the satellite's transit over this country. From this data the angular distance and speed of the satellites is being determined.

This work is being co-ordinated with measurements made at the Cavendish Observatory at Cambridge University, enabling the true height of the satellites to be determined.

Field strength measurements of these transmissions are also being made at Banbury, and it is hoped that useful information will have been obtained on propagation conditions in the outer atmosphere when related with the results obtained from the distance measurements described above.

Mr. Ratcliffe of the Cavendish Observatory has stressed the great importance of Post Office measurements in providing information, which will be most valuable in further study of satellites. The measurements at Banbury are regarded as the most accurate of their kind in this country.



Other People's Jobs—Chief Clerk

R. B. Munro

UNLESS YOU ARE A VERY KEEN AND DILIGENT diarist, and my own enthusiasm, I confess, tends to evaporate towards the end of the first week of the New Year, it will almost inevitably happen that of the 365 (or 366) days in every year many will disappear into the limbo of time to be recalled, if at all, only with considerable effort. There are, however, many days that, for one reason or another, will stand out from the rest, and although these will vary from person to person according to his experience, there are some that are fairly generally shared. Among these is the first day at work.

Not only do I remember my own first day very vividly, but I can still visualize clearly the grey-enveloped letter signed "H. V. Main, Chief Clerk", which I received instructing me to report for duty. It was the first time I had come across the title "Chief Clerk" and the mental picture I then formed was of a somewhat Dickensian figure perched on a high stool at the end of a long room. And although the reality proved very different—and agreeably so—this preconceived image was sufficiently strong to cause me, on arrival, to make the first—though, alas, not the last—*faux pas* of my official career, by addressing the clerk who welcomed me, who *was* somewhat Dickensian, and who in those days *did* sit on a high stool, as "Mr. Main".

The title of Chief Clerk has, of course, an honourable and ancient lineage not only in the Post Office but in a number of other departments, as well as in the world of commerce. It is, therefore, perhaps only a sign of the times in an age that has come to expect long and imposing descriptions of rank, that this simple and direct designation should sometimes seem to suit its purpose less well than it did. Various alternatives—facetious ones apart—have indeed been suggested, but so far none of these has proved acceptable. Meantime the story is told of the subscriber who, demanding to speak to someone in authority, was connected by the PBX operator to the Chief Clerk, who announced himself by his title. Whereupon the subscriber, more than ever convinced that he was being fobbed off with some junior, exclaimed angrily, "I haven't time to speak to you or any other damned clerk. I want to speak to the Executive Officer"!

Most readers of the *Journal* will be aware of the basic organization of the Telephone Manager's Office in four Divisions: Sales, Engineering, Traffic and Clerical. It is by virtue of his position as Head of the Clerical Division that most of the Chief Clerk's functions and responsibilities arise.

For reasons of geography and what is known as "common interest", there are, of course, considerable differences in size between areas, and these are reflected in the size and organization of the Clerical Division, the number of clerical and executive staff of all grades varying from around 100 in the smallest to over 500 in the largest offices. The size of the office is, therefore, a relevant factor in considering the weight and complexity of the staffing and organizational arrangements. But size apart, and allowing for certain differences that have become almost traditional between London and the rest of the country, the range of duties

carried out by the Clerical Division in all areas is, broadly speaking, the same. The major difference, as far as the Chief Clerk personally is concerned, is that in the smaller areas he has direct day-to-day oversight over a number of Groups (as the sub-units of the Division are named), whereas in the larger offices, he exercises this control in the main through his Higher Executive Officers.

The Clerical Division was dramatically affected by the large scale reorganization carried out in the telephone service during the late 1930s, when the Telephone Areas were brought into being. As a result, the Chief Clerk is the heir to two completely different roles and traditions: that of the Chief Clerk of the District Manager's Office and that of the Staff Officer in the Sectional Engineer's Office, as well as to certain other responsibilities previously exercised by the Superintending Engineer. This organizational schizophrenia shows itself to the present day in the two sides "Commercial" and "Engineering".

In the Liverpool Office, under the Chief Clerk, there are four HEOs—two Commercial and two Engineering—individually responsible for the control of a Section comprised of Groups, each of which is led by an Executive Officer or Higher Clerical Officer. For the time being, the responsibilities of the two Commercial HEOs are arranged functionally, though evidently the split will be on a largely territorial basis. Of the two Engineering HEOs one takes charge of the Engineering Groups proper, while the other is responsible for staff, accommodation and allied matters.

The Commercial side of the Division is responsible for all matters concerning the preparation, issue and follow-up of subscribers' accounts. All its operations are on a very large scale and are geared to a quarterly cycle, although as most readers will know, in pursuance of an economy measure first introduced during the war, accounts are at present issued to only half the total subscribers each quarter. Statistics are inclined to make dull reading, but some idea of the magnitude of the task involved will be gathered from the fact that in the Liverpool Area at the present time 7½ million tickets have to be sorted and entered each quarter to more than 150,000 accounts; the total revenue, even before the recently announced tariff increases, was at the rate of over £6,000,000 a year.

In the past, the solution of the problems involved in handling these very considerable quantities of documents has seemed to lie in a functional form of

'All its operations are on a very large scale"

organization in order to gain such benefits as specialization can provide. In a number of offices this was carried to the point where some girls were employed full time sorting and posting local tickets, while others concerned themselves with trunk tickets only—all this sometimes to the accompaniment of "Music While You Work". Current thought tends to the view that such assembly line methods when applied to clerical processes create problems which may well outweigh their advantages. As a result, many offices have now either changed over or are in process of changing over to a territorial form of organization, in which a "team" consisting of a Clerical Officer with one or more Clerical Assistants, will be responsible for all accounts work for a block of subscribers.

It remains to be seen to what extent this arrangement may itself require to be modified to meet the changed conditions that will be brought about by the introduction of subscriber trunk dialling and the extension of a fully mechanized accounting system on the lines of the experimental installation at Canterbury (Summer, 1954, *Journal*).

Subscribers' accounts enquiries and normal reminder and follow-up procedure are handled by the Ledger or (in "territorial" areas) the Accounts Groups. Readers who buy the *Journal* may never have had to be reminded that their telephone accounts were overdue, but unfortunately around 25 per cent. of our telephone subscribers need to have their memories jogged. The red printed "Final Notice" form, issued over the Chief Clerk's name, which threatens disconnexion if the account is not paid within seven days, has been a source of much complaint, recently resulting in the introduction of a new gently worded "Second Application", which also contains an invitation to the subscriber to "let me know" if the account has already been paid.

Most of these calls find their way direct to the Ledger Clerk concerned, but a sufficient number of subscribers accept the invitation literally, and insist on speaking to the Chief Clerk personally to eliminate any risk that he should sit in an ivory tower oblivious to "the gale of the world" without. It is informative and salutary that this should be so; it can also be diverting and even exciting. I have been offered bodily violence which almost made me write to my Staff Association suggesting danger money for Chief Clerks. There was also a woman subscriber who said, "It has been a great pleasure to hear a Scot's voice again. Do you mind if I ring you up again some time when you are not so busy" ?

The comparatively small number of subscribers who fail to respond to our ordinary reminder procedure becomes the concern of the Outstandings Group, who may invoke court action and arrange to terminate the service if this step should become necessary. Their success may be judged by the fact that only from 0.05 per cent. to 0.07 per cent. of our debts become irrecoverable.

The Commercial side is also responsible for call office accounting, for the preparation of "copy" for the Area and local directories, and for receipt and banking of cash.

The work of the Engineering Clerical Groups is linked closely with that of the Engineering Division and covers a wide variety of functions often within the same Group. One very large Group, known as the Estimates Group, which is associated with the Major Works Control, is concerned with pricing estimates for engineering works that have been prepared in the Engineering Development Group; with the control of expenditure on works which are in progress; and with closing those works which have been completed and ensuring that the manhours and stores used are in agreement with the original estimate, or that variations have been properly explained and authorized.

The importance of this sort of control, where engineering works worth many thousands of pounds are involved, will be readily apparent. It will also be realized that, if it is to be carried out effectively, and in such a way as to avoid irritating the engineering supervising staff with petty and irrelevant questions, there must be an intelligent appreciation of the engineering problems involved. These remarks indeed apply not only to all the Engineering Clerical Groups, but also, though to a lesser degree, to the Commercial Groups as regards enquiries which they may have occasion to make regarding works carried out on subscribers' premises. The Estimates Group is also concerned with wayleave matters and the calculation of performance ratings.

The Stores Group is responsible for accounting for all engineering stores used in the Area, and this includes not only pricing and indexing thousands of vouchers each quarter and correspondence with the Supplies Department and others, but the regular physical stock-taking of the different engineering stores in the Area.

The Budgetary Control Officer is the handmaiden of the Telephone Manager in controlling expenditure within the Area, while other Groups are concerned with letting and paying for contracts,

"irritating the Engineering supervising staff"

and control of motor transport, including negotiation with insurance companies in accident cases.

There is also the payment of miscellaneous accounts, wages and salaries. The calculation and payment of wages and salaries for staff of some 2,700, excluding telephonists, in itself no small task, has to be performed against the clock. There is no room for the proverbial "pending tray" in wages work. Come rain, hail, wind and flood, to say nothing of sickness, machine breakdowns, bank holidays and pay revisions, the wages envelopes must be in the hands of our people without fail every Friday morning. They always are (touch wood!) but many is the time that we wish we could call on the extra staff that someone once jokingly suggested we kept "locked up in the dungeon" to meet such eventualities. This is a section of the office where automation should play an increasing role. Even now our payroll is prepared on electric multi-register accounting machines, but this is small beer compared with the possibilities which sppear to be offered by electronic computers, of which we shall no doubt increasingly hear more.*

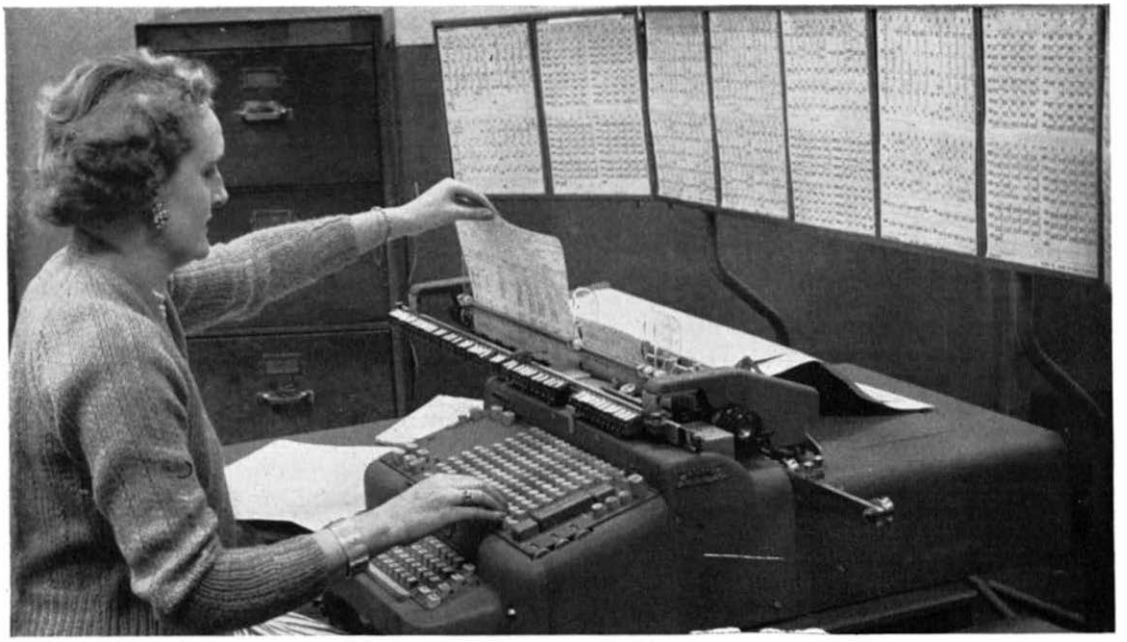
I shall not attempt to describe the work of the Staff, Accommodation and Training, Typing and Registry Groups since, although their work is extremely important, the titles themselves are largely self-explanatory, and most folk will have experience of the functioning of similar duties within their own establishments.

The prime duty of the Chief Clerk with respect to the many and varied operations of his Division is the same as that of the head of any other organization: to keep it functioning in an efficient and business-like manner. It will obviously be quite impossible for him to deal personally with all the problems which arise, and in fact, if the Division is working as it ought, it should be quite unnecessary, and indeed undesirable, that he should attempt to do so. What he must do, however, is to dispose his staff so as to make the best use of their different skills and abilities and, having done so, keep his finger on the pulse of the organization to ensure that things are running smoothly.

There is no magic formula for doing this and how he achieves his aim will depend in large measure on his own personality and inclination. There is the evidence of the incoming mail, the execution of prescribed checks, the examination of important returns to Regional and Post Office Headquarters, the handling of those cases which must come to him because his personal authority is required, statistical and graphic information on selected items, and last, but not least, consultation with his supervising staff and what he sees for himself as he goes about the office. He must give special attention to Groups where new developments are in progress, where a change in supervising staff has taken place, or where urgent special work—for example, the alteration of records necessitated by the recent tariff revision—is being dealt with. When he discovers something that is not as it ought to be, he will endeavour to obtain the desired improvement by encouragement and exhortation, by wise and timely counsel, by suggestions orthodox and otherwise, by personal intervention, or even in extremes by wholesale reorganization.

"locked up in the dungeon"

* *The Post Office is installing electric computing and printing equipment, which should be ready in 1959, to handle the payroll of more than £70 million a year for 112,000 staff in the London area.*



"our pay-roll is prepared on electric multi-register accounting machines"

In this matter of keeping in touch I count myself extremely fortunate in that, except for those Clerical Assistants in engineering outstations, all my staff are at present under one roof. Some of my colleagues are, I know, by no means so happily placed for, owing to accommodation problems, their staffs may be spread over many buildings in different parts of a town. It is difficult to assess properly the loss in efficiency which arrangements of this kind must involve. They also seriously impede what is probably the single most difficult job in any large organization, that of getting to know and become known by one's staff.

To describe a typical day in the life of the Chief Clerk would be well nigh impossible. No two days are alike and this is part of the fascination of the job. I find that much of my time, as most people in similar positions also find, is taken up with what can best and most simply be described as speaking with people: consultations with the Telephone Manager, Deputy Telephone Manager, heads of other Divisions, my own supervising staff and representatives of the different Staff Associations; discussions with visiting Regional and Headquarters officers and the local officers of the Ministry of Works; interviews with new members of the staff, and with others on promotion, retirement, disciplinary and other matters, not excluding at times their domestic and other worries; and sometimes, the reception of subscribers and others affected by our operations.

Then there is the preparation of annual reports, of staff estimates and the regulation of complements in consultation with the Regional Inspector of Clerical Establishments; arrangements for the visits of the audit staff of the Accountant General's and Exchequer and Audit Departments, and investigation into such matters as may arise in the course of their inspections; participation in the Area Board, Office Whitley and Joint Production committees, as well as a number of other semi-official activities of the kind which tend to grow up in a large organization and which deserve encouragement and support; and from time to time, membership of Promotion, Appeal and Civil Service Selection Boards.

This I realize is the point at which my article runs the risk of degenerating into a mere duty list, and this I have no intention of inflicting on my readers. I hope, however, that for those of you who have borne with me so far, what I have written, sketchy as it must be, may help to give some idea of the varied, interesting and satisfying job that goes with the title "Chief Clerk".

The Post Office Research Station Holds an "Open Day"

T. Kilvington, B.Sc. (Eng.), M.I.E.E., F.T.S.

TO THE MAN IN THE STREET A RESEARCH establishment is usually surrounded by something of an air of mystery. Strange stories of what goes on inside gain currency and it is seldom that the opportunity arises for them to be proved or disproved. The Post Office Research Station is no exception but its Open Days, which have been held every three years since the war, do enable it to display some of its secrets; not to the man in the street exactly, but at least to the Press and to many people in industry and the academic world as well as to the senior officers of the Post Office itself and of other Government departments. Many of the visitors are intimately concerned, through normal day-to-day contacts, with some small facet of the work of the Research Station, but they are not normally able to get a very clear picture of all the different activities in progress.

The latest Open Day, held on September 27, gave them that opportunity and some 500 visitors inspected the 75 exhibits illustrating the current work of the Station. These included many different subjects, ranging from the delicate processes involved in making very reliable valves for underwater repeaters, to the heavy engineering involved in the testing of those repeaters at the very high pressures they will encounter at the bottom of the ocean.

Any large establishment providing goods or services to the public must, if it is to keep up with modern developments, devote a proportion of its effort to research and development. The Post Office realized this as long ago as 1870 when experimental work was started, but it was not until 1917 that the site at Dollis Hill was purchased as a permanent home for the Research Station. At first the work was carried on in ex-army huts, but in 1933 the main block of the present building was opened. Now there is a score or so of separate buildings containing both the Research Branch and the Radio Experimental and Development Branch, and the staff numbers about a thousand.

The aim of the Research Station, of course, is research and development to improve, extend and cheapen the many different services operated by the Post Office. These may be broadly classified under the headings: posts, telephones, telegraphs, television and miscellaneous. Let us take them in turn and see what the exhibits tell of the work being done in these different fields.

Until comparatively recently all the operations involved in collecting and distributing letters had to be carried out by hand. The letters coming in from the collection rounds arrive in higgledy-piggledy piles with some envelopes upside down, others back to front and so on.

First it is necessary to "face" the envelopes—that is to arrange them so that all the addresses are uppermost and the right way up so that the stamps can be cancelled and the letters sorted. Stamp-cancelling, once the letters are faced, has for many years been mechanized in all but the smallest offices and ingenious machines to assist in sorting have been constructed and are now under trial, but facing is a more tricky problem.

However, a machine developed at Dollis Hill and shortly to be tested under practical conditions at Southampton, has been designed to do the job rapidly and efficiently. Each envelope from the pile fed into the machine is electronically sensed and the position of the stamp is found. In passing through the machine the letter is then inverted and/or turned over as may be necessary to bring it into the desired orientation ready for the subsequent processes. In its final form the machine will also separate the fully-paid letters from those carrying only the printed matter postage.

Perhaps the greatest proportion of the work of Dollis Hill has always been directed, in one way or another, towards improving the telephone service, both internal and overseas. On the switching side the most interesting development is undoubtedly the electronic exchange which uses silently operating electronic switches instead of the noisy mechanical devices at present employed in automatic exchanges. Such an exchange on a small scale—only 100 lines—was built at Dollis Hill

and operated for an extended period. Further development, illustrated by two or three of the exhibits, continues in conjunction with the major telephone manufacturers and it is hoped that it will soon be possible to assess the performance and reliability of electronic exchanges in public service. (An article on "Britain's First All-Electronic Public Exchange" appears on page 32. -Ed.)

On the telephone transmission side the transatlantic cables steal the thunder. Cable telephony under the Atlantic is an extension of the coaxial cable technique, with repeaters at intervals. The first transatlantic telephone cable has proved successful during its first year of service; for the second, to be laid in 1961, Dollis Hill has designed a new lightweight cable, a section of which is pictured on this page. The indicators show:—

(*a*) is the non-twisting high-tensile steel strength member which will withstand a tension of 7 tons. Being placed in the centre of the cable where it is protected from corrosion it can be made lighter than if it were wound in a helix on the outside as with conventional cables

(*b*) is the centre conductor formed from copper tape and seamed longitudinally

(*c*) The low loss polythene dielectric 0.99 inch in diameter

(*d*) Six aluminium tapes which form the outer conductor of the coaxial pair

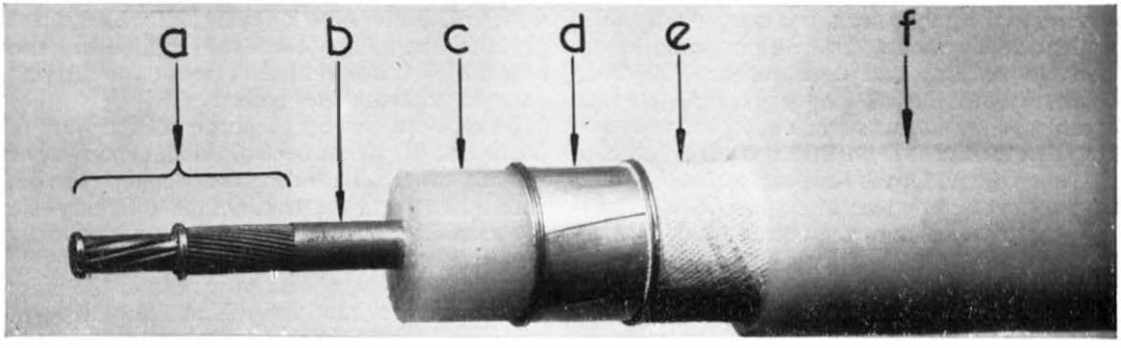
(*e*) Two cotton tapes impregnated with a corrosion inhibitor are wound over the aluminium tapes. They serve the dual purpose of keeping the aluminium tapes from "cockling" and guarding against the consequences of accidental damage to the external sheath

(*f*) The polythene outer sheath

Curiously enough, whereas cable is superseding radio for the transatlantic telephone service, radio, using microwave transmission over relatively short hops, is becoming a serious rival to cable for overland transmission. Television signals have been carried by this means between Manchester and Kirk o'Shotts for some years and a circuit capable of carrying 240 telephone channels has recently been completed across the Moray Firth. New equipment displayed by the Radio Branch aims at increasing the number of channels that can be carried by microwave links to 600 or even 960. The links are, of course, particularly useful in terrain where geographical features make cable laying very difficult.

Radiotelegraphy, the oldest form of communication by radio, is perhaps the one that has received least development attention in the past. However, work is being actively pursued on the development of a new detector for radiotelegraph signals which will work under worse conditions of interference, and fading of the radio signal, than has been possible heretofore. It is hoped that this will reduce the duration of periods over which some radiotelegraph circuits are unusable. This equipment was exhibited in conjunction with a "fading machine" which simulates in the laboratory the propagation conditions encountered in practical operation.

At the same time an electronic error-correcting telegraph equipment has been developed for use on two-way circuits. At present the normal practice on radiotelegraph circuits when conditions become bad is to transmit every message twice so that errors can be seen by inspection. This obviously halves the speed of transmission. The new equipment however will automatically detect an error as it is received. When this happens a signal is sent in the reverse direction and the equipment at the sending end repeats the required character.



New lightweight coaxial cable proposed for U.K.-Canada telephone cable to be laid in 1961; for description see col. 1.

Testing in progress on ERNIE

Thus repetitions are only called for when required and valuable time is saved.

The Post Office's part in providing and maintaining the country's television service is perhaps not as widely realized as it should be. In addition to the extensive Post Office network of cable and radio links connecting the B.B.C. and I.T.A. transmitters, the Post Office provides short temporary circuits for outside broadcasts and a multiplicity of short permanent links between studios, transmitters and switching centres. Many of the latter are now provided by direct video transmission; that is, without modulation of a carrier, on coaxial cable—a technique that was considered impracticable a few years ago. The Research Branch has also devoted a great deal of attention to the development of waveform correcting devices. These are designed to correct the distortions introduced in a television transmission circuit so that the signal delivered to the customer shall be of the highest possible quality. An impressive demonstration of the performance of one of the latest forms of corrector was given.

Apart from its main functions in the communications world, the Post Office acts as the Government's maid-of-all-work whenever easy contact with the public is desired. Thus when the Premium Savings Bond scheme was devised it was obvious that the most convenient method of distribution was through the vast network of Post Offices already existing in all the towns and villages of the country. But for the Bonds the Post Office was asked to do something more—devise a method of choosing the winning numbers. The result is the much publicised ERNIE—the Electronic Random Number Indicator Equipment—developed at Dollis Hill. The machine is now in active operation at the beginning of each month but some of the techniques employed and the methods of testing the output for randomness, were illustrated by exhibits.

Another somewhat unexpected activity of the Research Station is the co-operation it has given to the National Health Service by designing hearing aids. Many deaf people have benefited greatly by the issue of these aids in the past few years. The latest designs incorporating transistors and having a greatly reduced battery consumption were displayed.

It is safe to say that all the visitors found something of interest which they were able to discuss with the demonstrators on the spot. Apart from the main Open Day on the Friday and the Press Day on the Thursday, the station was open to the staff on the Saturday. In spite of the five-day week a large number of the staff attended with their wives, sweethearts and friends who had come to see what their menfolk—or womenfolk—do at that mysterious establishment at Cricklewood.

Liverpool Telephone Society, formed early this year, is to discuss Subscriber Trunk Dialling at its November meeting and Budgetary Control in December. The Society was established following a staff association request for lectures on work in divisions of the Telephone Manager's Office other than that in which the Association's members work, and to help members who might have to attend promotion boards. Sales Development, the Post Office Directory Services, and Problems of Post Office Finance have been discussed at earlier meetings.

Road Weather Service.—Since November 1 telephone callers in London, Birmingham, Liverpool and Manchester have been able, by dialling ASK 6611, and in Edinburgh, Glasgow and Cardiff by dialling 938 (unprefixed) to obtain a recorded report of the weather on the roads.

The Post Office records reports received by the Automobile Association by radio and telephone from their patrol men.

Making Selectors for Automatic Exchanges

S. J. Wheatley

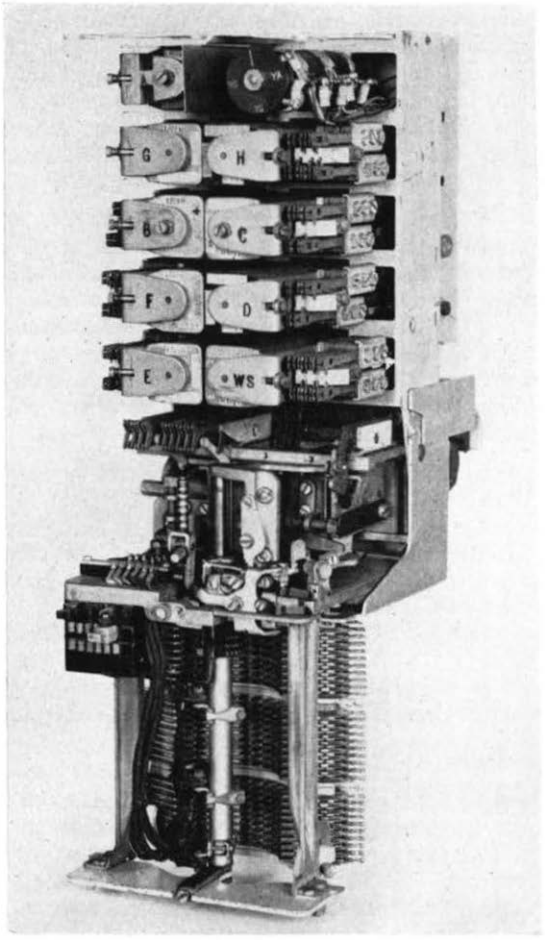


Fig. 1 : Final selector

THE EXPRESSION "AUTOMATIC TELEPHONE equipment" means simply, to many people, the switching apparatus in a telephone exchange which has largely replaced the manual operator. The visitor to an exchange is perhaps attracted mostly to the two-motion selector, partly because of the noise it makes and partly because of its "up and round" movement. It is this movement which simulates an operator searching for an outlet for a call, so that an electrical connexion may be completed or passed on. Exchange engineers and some others know how this selector functions electrically, but few people know how it is made. A short outline of the manufacturing processes may be of interest and help towards greater understanding of its function.

The Post Office does not make its own automatic equipment, although it does repair work. While the manufacture of telephone plant generally is spread among many contractors, only five make the automatic exchange equipment. The Post Office gives each of these five contractors full information about its ultimate requirements. Since the mechanism of the selector is standard, the information needed for its manufacture consists mainly of circuit detail, type of relays and the type of ancillary parts needed for its particular function.

The Post Office maintains control of the equipment by issuing specifications, drawings and diagrams which detail overall performance, dimensions and circuitry. This ensures that, although more than one contractor produces a common item, it will be interchangeable with any other of its type. But the Post Office information gives the final requirement; it does not include sufficient detail to enable a manufacturer to produce in the workshop the component parts making up the main item. The contractor therefore has to produce his own drawings which cover the various stages and processes of fabrication and are known as works specifications, drawings and diagrams and are derived from a break-down of the Post Office information.

The tolerance allowed in works information needs to be closer than ultimate allowance, to allow a margin of safety to cover any production error which may prejudice the correctness of the finished article and so lead to its rejection. This will be

appreciated when it is realized that many parts may have to undergo several operations of, say, bending, before they reach their final form as specified by the Post Office. To maintain correctness of operation on most parts, gauges are used for stage as well as final checking. On repetition work a system of quality control is introduced to keep parts within any permitted tolerance. This avoids waste and may be termed a form of insurance; it is standard practice throughout the engineering industry.

The selector consists mainly of two parts, electrical and mechanical. The electrical parts are mainly a collection of relays; the mechanical parts are electro-magnets giving mechanical movements to a shaft carrying the wiper. The wiper is the medium through which the electrical connexion is made.

Fig. 1 shows the detail of the selector. The mechanism contains some hundred different parts each being produced to its own specification or drawing. With the exception of the frame, the magnet cores and the shaft, all parts are stampings (sometimes referred to in the trade as punchings) and are produced from sheet material. Such parts as screws and washers, unless special, are normal commercial engineering products with standard tolerances as accepted in the trade.

The frame is the foundation of the selector. It is a casting of aluminium silicon alloy and its production is a specialist's job; while some telephone manufacturers may do their own casting, they usually buy the castings from a firm dealing solely with this class of work. The casting (Fig. 2) is of an accuracy such that it may be positioned in a jig correctly at three points, from which drillings may be related. Although this type of casting is fairly close to the required dimension, it needs to be machined to remove its inherent roughness so that other parts may be mated to it—that is, a flush fit obtained.

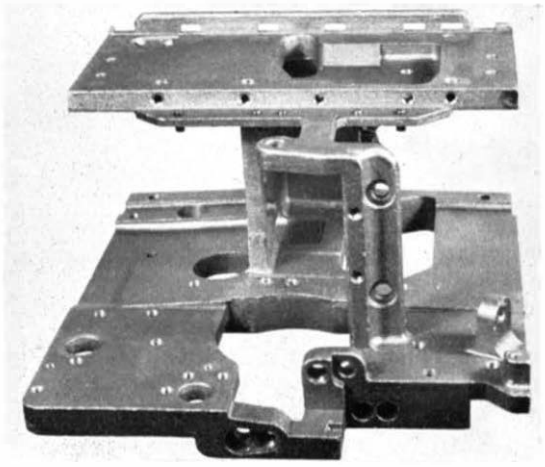


Fig. 2: Frame casting

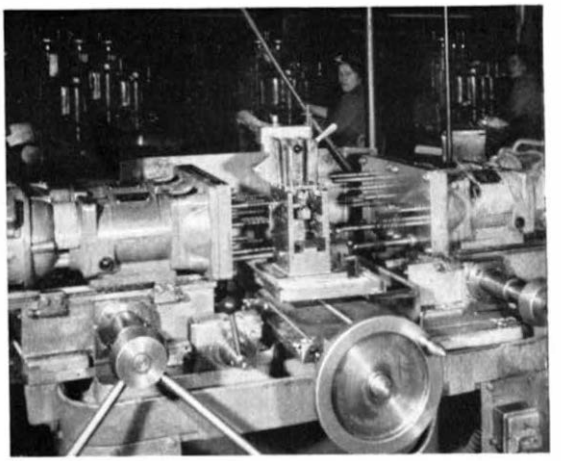


Fig. 3: Automatic multiple driller. (*Courtesy of General Electric Co. Ltd.*)

In all castings on which further work is to be done there must be a "reference" from which all measurements are taken. Since the main operation of the selector is to move the shaft up and round, the hole carrying the shaft bearing is made the "reference". The frame has some fifty holes to be drilled and in some cases tapped by a multiple driller; Fig. 3 shows the tool in use. The driller operates entirely automatically, the operator needing only to place the frame in a jig on the drilling machine. Thus there is little, if any, chance of an incorrect drilling and the whole process takes only a few minutes. After being gauge checked the frame is ready for its component parts to be attached.

As already said, the mechanism is an assembly of punchings which are produced on power presses ranging from 50–100 tons capacity. Fig. 4 shows a small power press punching out parts from strip metal. Metal of the chosen economical width is fed into the press and the parts are automatically punched out at approximately 100 pressings each minute. For a part which cannot be punched from a continuous strip, or which has to be bent, a hand press is used. Fig. 5 shows such a press in operation. Although this type of press is termed hand operated the actual pressure is from an external source and will be of several tons. The

Fig. 4: Automatic power press showing scrap strip from which punchings have been produced. *(Courtesy of General Electric Co. Ltd.)*

dimensional accuracy of these punchings—or bends—is such that they are kept within required tolerances. The only fault which can occur is the appearance of burrs on the edges of the punching from tool wear. When this occurs the tool is removed and re-ground.

Because of the speed at which the selector functions, there is considerable mechanical wear on some working parts. Those who are familiar with the close adjustment of the parts and the fine tolerances imposed will readily understand that any undue wear will quickly put the selector out of adjustment and mis-operation will very soon follow. To avoid excessive wear on certain parts the working surfaces are "case hardened". The technique of case hardening varies among contractors but the principle is common. The effect of hardening is to cause the material—mild steel for selector parts—to absorb carbon so that with heat treatment a hard grain structure is obtained. This condition may be controlled to any depth, depending on the degree of hardness required.

The area of the part to be processed is deliberately left over-size in anticipation of a later operation. The whole of the part is copper plated, including the area to be treated, which is then ground off to the correct size. Thus we are left with a part completely copper plated except the area—now correctly dimensioned—which is to be processed. The part is submerged in a bath of sodium cyanide, made liquid by closely controlled heating to a temperature of 900°C. After a specified time the part is withdrawn and quenched in oil the area not copper plated being case hardened in this process. As a rough indication of depth of hardening related to time of immersion, .005 inches depth results after 12 minutes, and .010 inches after 30 minutes. The actual depth of hardening is specified for the particular part. The quenching produces a hard but brittle surface, which is undesirable, so it is necessary to temper and thus relieve the stresses by subsequent reheating and quenching.

The relay seen in the upper part of the selector is in common use throughout any telephone system. As its name implies it relays a signal, and one use is to control the stepping "up and round" movements of the selector shaft, that is, to control the conversion of electrical impulses into mechanical impulses.

The relay is of simple construction. It consists of a solenoid, yoke, armature and contact springs. The core of the solenoid, the yoke and armature are of soft iron; the springs are of nickel silver with platinum of gold-silver contacts. Fig. 6 shows the disposition of the parts making up the relay. The core is made from iron wire of correct diameter, punched up one end and threaded the other. The

Fig. 5: Hand press for binding

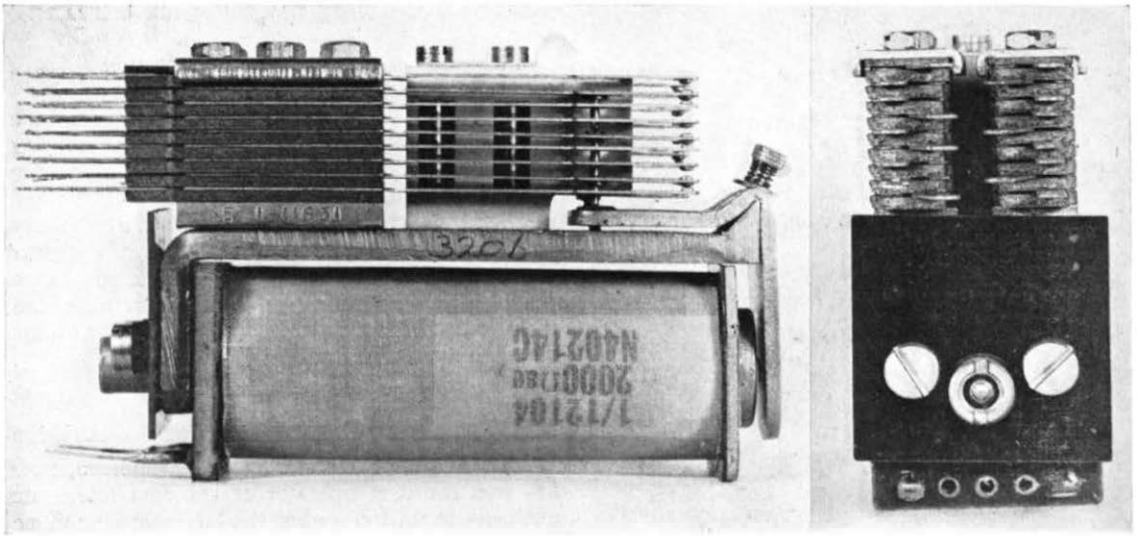


Fig. 6: Relay side and end

punched end, when the coil is electrically energized, attracts the armature and the threaded end the yoke which is bolted to it. (Fig. 7 shows yokes being drilled.) At each end of the core a bakelite coil cheek is fixed to retain the wire which is wound on it.

In the coil cheek remote from the armature end, two tags are impressed to form the connexion of the inner and outer end of the winding. The wire is wound on the core automatically by a machine which indicates by a mechanical counter the number of turns applied. The number of turns is always in excess of final requirement, so that resistance adjustments may be made. The inner end of the wire—that is, the start—is soldered to one tag and the outer—the end of the winding—to the other. The whole of the winding is covered with paper and empire cloth to preserve it from damage. The yoke is stamped out and bent up in power presses.

The armature is produced similarly. The contact springs are stamped out in a multiple press from strips of nickel silver. The actual contact is riveted to the spring by a press and individually handled by an operator. The contact is taken from a coil of wire of the required material, placed in a hole at the end of the spring and formed over each side in the same way as a rivet is treated.

When finally assembled the springs are adjusted to the required tension so that when the relay is energized electrically it will operate and the contacts make or break—or both—as specified. The adjustment of these contacts calls for extreme skill and patience on the part of the operator, who needs some months of training before becoming proficient. Each relay is subjected to stringent electrical and mechanical checks.

The bank is in the lower part of the selector and it is into this that the wiper enters. It may be likened to the outgoing jack field in a manual exchange and consists of several hundred contacts, insulated from each other and assembled into a compact unit. The contacts are punched out from brass strip, again automatically, on a power press and in sets of five and six. Fig. 8 shows this and successive stages of production.

The contacts are usually left connected at the initial stages for ease of assembly. Each set of contacts is insulated from the others by separators of synthetic rosin bonded paper sheet punched from a strip. These separators have one side sprayed with a thermosetting cement, allowing the contacts to be firmly secured by application of heat under pressure. Surplus metal is sheared off after the contacts are secured leaving the contact strip ready for assembly.

To build the bank to its final form, other separators—or spacers—are inserted between the sets of contacts in the following order; metal end plate, contacts, PVC (poly - vinyl - chloride) separator, contacts, metal spacer, contacts and so on until the opposite metal end plate is reached.

Fig. 7: Drilling the yokes

The metal spacers are aluminium, and the end plates mild steel. The whole assembly is bolted up in a power jig so that the overall dimension meets its requirement. The final operation is to tin the tags of the contacts by rolling the assembly into a bath of solder maintained at heat of approximately 300°C.

The Post Office and its contractors are anxious to prove the success of the manufacturing methods used and to preserve the tolerances and high standards required in the finished products. There is, therefore, considerable co-operation between them and it will be no surprise to learn that an inspecting staff from the Post Office is permanently on the scene during production at contractors' works.

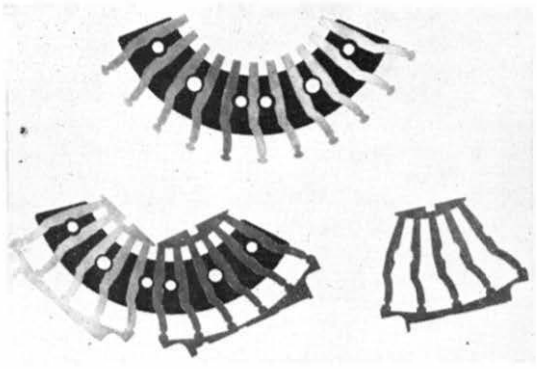


Fig. 8: Contacts punched from brass strip

The functions, coverage and responsibilities of the inspecting staff are another story, but considering the number of parts and processes in the manufacture of, say, a selector and remembering that each article requires inspection and check, the magnitude of their job is easily seen. The cynic might regard the resident inspector as a necessary evil but there is no doubt that the producer welcomes his observations and suggestions which may lead to improved production methods and techniques; in any event his presence helps ensure they are maintained at a high degree of efficiency.

Miss Kennerley Remembers her Subscribers

Miss Florence Kennerley of Llandudno, now 86, was the first operator at the first telephone exchange in the town when the National Telephone Company opened it in 1892. Sending an article (in her own handwriting) about it to the *Post Office Magazine*, she included a complete list of the first 50 subscribers, with the numbers of 43, regretting that she could not remember the numbers of the remaining seven.

Later, the Clarence Hotel took over the building and promised to give overnight service. "Well do I remember", wrote Miss Kennerley, "going on duty one morning and finding all the indicators plugged with matches". When the hotel manager was asked about it he replied, "Oh, those subscribers bothered me too much, so I plugged them up".

Line faults were reported to Head Office, Liverpool, by post; an electrician would come to Llandudno in three or four days. In a short time a local office was opened at Chester and a manager, with an electrician, was appointed, a local man being engaged as lineman.

Submarine Cables Ltd. are making at Erith, Kent, more than 2,200 nautical miles of the new telephone cable to be laid in 1959 between America and France by their own C.S. *Ocean Layer* and H.M.T.S. *Monarch*. As with the first transatlantic telephone cable, this project will involve two cables for the main crossing, equipped with American one-way repeaters and providing 36 telephone circuits; the single cable between Newfoundland and Nova Scotia will contain British-type flexible repeaters (Standard Telephones and Cables).

Team Staffing at Bradford Exchange

A. Scarborough, E.R.D., D.P.A.

IN ALL ORGANIZATIONS EMPLOYING LARGE numbers of staff the problem arises of making the individual, particularly a newcomer, feel that he or she is still a personality and not just a cog in the machine. There is also a need for mutual confidence and a happy personal relationship between the rank and file and those in charge. These needs are, however, much easier to state than to meet and in many fields of human endeavour a good deal of thought has been given to ways and means of satisfying them. The Post Office is no exception.

In telephone exchanges, the idea of associating telephonists in small teams of nine or ten under a supervisor is almost as old as the service itself and this system goes some way towards meeting the objectives that have been mentioned. But people also like some variety in their work and the staffing of a telephone exchange requires a good deal of variation in the hours of attendance. These two factors lead to duty rotation schemes which can cause constant changes in the composition of the teams, so that much of the benefit is lost.

In an endeavour to get the best of both worlds—never an easy thing to do—systems known as "Team Staffing" have been introduced in a number of large exchanges. The aim is to keep a team of telephonists and their supervisor together for most of the day and possibly over a period of several months. There are many variants of the system. Readers of the *Journal* may be interested to hear of the experience with one such system which has been operating in the Bradford exchange for nearly 10 years.

The new system of staffing was introduced at Bradford Telephone Exchange in March, 1948. A few months previously the exchange and four

A junior team at the switchboard

satellites had been converted from manual (central battery type) to automatic working with a central automanual switchboard in a new building. The consequent concentration of work in one large room favoured the adoption of a system having working units of a size convenient to supervise.

The system previously used was a variety of the well-known "seating plan" and was based on the allocation of individual operators to particular operating positions for a specified period, such as one month. In this plan supervisors had a rotation scheme of their own, which, while loosely related to the number of staff on duty, had no close relationship to any particular group of operators.

Outline of the Bradford System

Because of the comparatively small night staff and the complexity of their duties the team system at Bradford is limited to the day staff, whose hours are 8.0 a.m. to 6.0 p.m. Monday to Saturday.

Size of Establishment

Chief Supervisor ...	1	Telephonists	110
Divisional Supervisors	2	,, Leave Reserves	25
Assistant Supervisors	14	,, Educational ,,	9
Total ...	17	Total ...	144

Organization of Teams

Over the years many changes have been made and it would be tedious to mention all of them. The most important (apart from the intermingling of a junior and senior team which will be referred to later) is the reduction in the period for which a supervisor stays with her team. This was originally 36 weeks with a senior team and 30 weeks with a junior team, but in 1953 this was reduced to 20 weeks with each. This, coupled with a period of four weeks occasionally with an enquiry team, provides sufficient variety to eliminate much of the original criticism by the supervisors.

At the time of writing, the teams are organized as follows:—

(i) One non-rotating team of 13 telephonists with clerical allowance (includes one reserve).

(ii) Five senior teams with nine telephonists (includes one reserve).

(iii) Five junior teams of 11 telephonists each, four of which have two reserves and one with only one reserve.

(iv) One team of 14 enquiry telephonists.

The five senior and five junior teams are, of course, the backbone of the scheme and work weekly through the ordinary duties, which are arranged in "blocks" to suit the size of the teams. Each block contains duties with the same starting and finishing times and similar reliefs. If, however, it should prove desirable minor differences can be introduced into individual duties or sub-blocks. One week in five each senior and each junior team becomes a reserve team.

The senior telephonists in the non-rotating team are employed on clerical work, for which they receive a monetary allowance, but they have to work five hours weekly at the switchboard; this is achieved by using them for reliefs to senior teams, usually on the basis of one hour each day Monday to Friday.

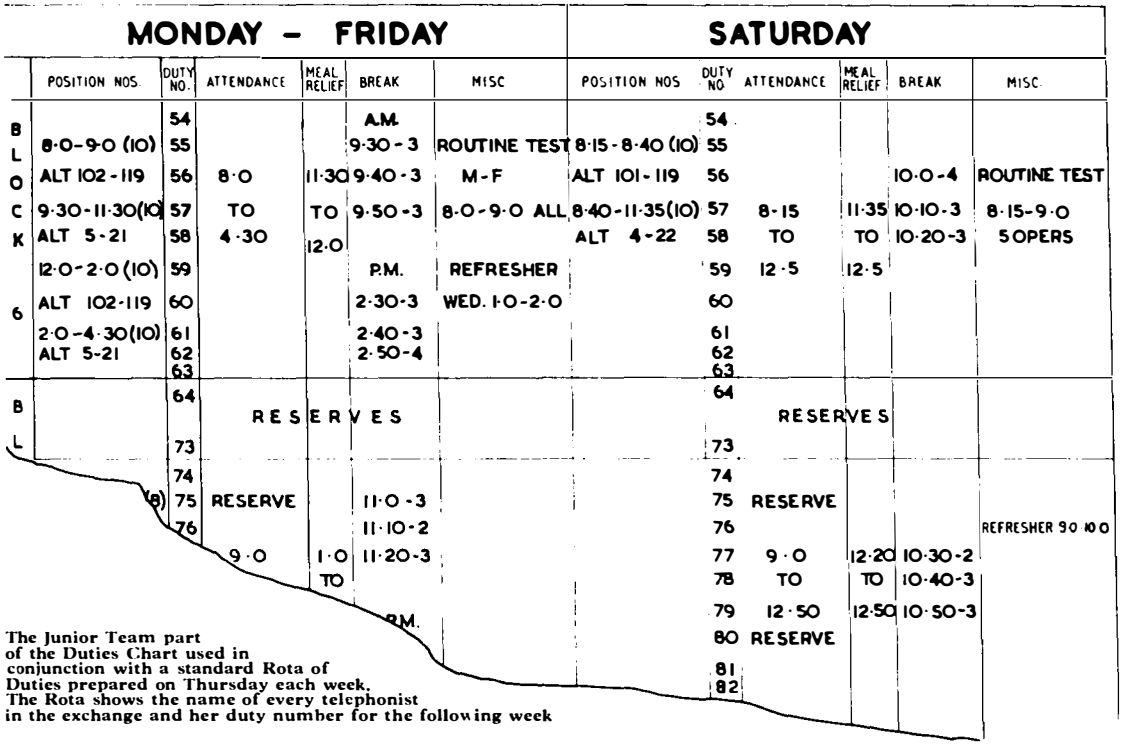
The team of 14 enquiry operators was organized on its present basis in 1953. They have to cover two separate suites: a cordless suite of eight Directory Enquiry positions and a cord-type suite on which ordinary enquiries and faults are dealt with. Operators from senior teams are fed into this team at the rate of two a week, and two who have served their "enquiry period" of 14 weeks are returned to their operating teams. This gives the experience to all the trained enquiry operators and avoids the complete change of the whole enquiry team each Monday, which had proved quite unsatisfactory in the original plan.

Telephonists on certain duties are outside the regular rotation scheme; they are those staffing the Post Office and Inland Revenue private branch exchanges, one testing telephonist, five accounts telephonists and the Dining Club secretary. The holders of these posts are changed at rather longer intervals than would be possible with team rotation, and at times convenient to the exigencies of the service they give.

Disadvantages and Advantages

Has the system at Bradford any disadvantages? I shall not try to minimize these because some are quite important.

The withdrawal of a whole team from the suite with their supervisor at one moment leaves a long gap of "dropped" positions, the standing calls on which have to be supervised and "finished off". This extra work is beyond the ability of the adjoining telephonists and their supervisors. Originally this was covered at Bradford by employing a "clearing down" operator who



MONDAY - FRIDAY

BLOCK	POSITION NOS.	DUTY NO.	ATTENDANCE	MEAL RELIEF	BREAK	MISC.
		54			A.M.	
	8·0-9·0 (10)	55			9·30-3	ROUTINE TEST
	ALT 102-119	56	8·0	11·30	9·40-3	M-F
	9·30-11·30(10)	57	TO	TO	9·50-3	8·0-9·0 ALL
	ALT 5-21	58	4·30	12·0		
	12·0-2·0 (10)	59			P.M.	REFRESHER
6	ALT 102-119	60			2·30-3	WED. 1·0-2·0
	2·0-4·30(10)	61			2·40-3	
	ALT 5-21	62			2·50-4	
		63				
		64				
	RESERVES					
		73				
		74				
(8)		75	RESERVE		11·0-3	
		76			11·10-2	
			9·0	1·0	11·20-3	
				TO		
					P.M.	

SATURDAY

POSITION NOS	DUTY NO.	ATTENDANCE	MEAL RELIEF	BREAK	MISC.
	54				
8·15-8·40 (10)	55				
ALT 101-119	56			10·0-4	ROUTINE TEST
8·40-11·35(10)	57	8-15	11·35	10·10-3	8·15-9·0
ALT 4-22	58	TO	TO	10·20-3	5 OPERS
	59	12·5	12·5		
	60				
	61				
	62				
	63				
	64				
	RESERVES				
	73				
	74				
	75	RESERVE			
	76				REFRESHER 9.0 10.0
	77	9·0	12·20	10·30-2	
	78	TO	TO	10·40-3	
	79	12·50	12·50	10·50-3	
	80	RESERVE			
	81				
	82				

The Junior Team part of the Duties Chart used in conjunction with a standard Rota of Duties prepared on Thursday each week. The Rota shows the name of every telephonist in the exchange and her duty number for the following week

combined this work for the whole exchange with other non-operating duties. Intermingling (referred to below) now satisfies this requirement by eliminating the long gap.

The arrival at the canteen counter of a complete team of operators tends to overload the refreshment staff and causes delays to all users. Better organization of the canteen has largely overcome this trouble. In addition it has been found possible to stagger the times for tea breaks in some teams.

The departure of a complete team at lunch time when traffic is falling can produce a poor adjustment of staff to traffic for short periods (usually up to about 10 minutes). This is a problem not unknown in exchanges without team systems but in such exchanges the necessary adjustments are easier to make. At Bradford the problem has never been much in evidence but recently the matter has been given some thought in view of the reduction in call values following the national adoption of the unified operating procedure for toll and long distance traffic.

Extra work and some complications are caused when staff quantities need adjustment. Inevitably teams sometimes have to be reorganized at short notice.

The work of the Assistant Supervisors in charge of junior teams is more arduous than that of their colleagues in charge of senior teams. This has been largely mitigated by intermingling junior with senior teams. Thus:—

L K L M N M N M N M N M N M N M N M N M N M N
SM SN

Supervisor "SM" has a team of operators M1, M2 etc. interspersed in their setting with the N1, N2 etc. operators of supervisor "SN". For all minute-by-minute supervision SM's control is as shown by the brackets and SN's similarly. But for all personal matters, including granting of any casual absence or special requests, SM is still ultimately responsible for all "M" operators This has the incidental advantage of putting experienced operators on either side of the inexperienced. Intermingling was introduced in 1953.

The system cannot be maintained on Bank Holidays.

Some of the more positive advantages we feel have been secured are:—

An improvement in relations between the rank and file on the one hand and manipulative supervising grades on the other with consequent improvement in efficiency, working conditions, understanding and goodwill.

Management is improved because the lines of communications through the usual channels are less likely to be confused by misunderstandings and suspicion.

The newcomer to the service feels more at home. The similarity in size between the Wing School training group and the team provides the continuity of one characteristic of the work group which can be beneficial to the newcomer in her early years.

The complete team, including the supervisor, attend refresher training together. This is of particular benefit to the supervisor who can observe the reactions of the individual members of her team. "Quizzes" have been arranged which are popular and provide a measure of results.

Movements in the switch room are minimized and the exodus of a team supervised. The use of a revolving door—which at one time proved an obstruction—is supervised.

A co-operative spirit in the exchange has been engendered by team working although, before the adoption of intermingling, there were some who thought that the tight formation of a team tended to breed cliques with consequent loss of friendly relations. Movement from one team to another may however take place where this can be shown to be desirable, while the natural movement caused by staff loss is not inconsiderable.

Conclusions

It would be unwise to make any claim about increased output because the controls necessary to allow for other variables would be too cumbersome to apply. It must be admitted that an entirely different staffing system might have been devised which would have given similar, or even better, results. Undoubtedly the Bradford scheme would not have been so successful if the exchange had been much smaller or if the positions had been arranged in many suites or in a number of different rooms. The greatest single asset has been the keen interest of the staff throughout the past decade and the general feeling is that any disadvantages in the scheme have been far outweighed by the benefits.

Inland Telecommunications Statistics

	Quarter ended 30th June, 1957	*Quarter ended 31st March, 1957*	*Quarter ended 30th June, 1956*
Telephone Service			
Gross demand	104,594	108,225	94,703
Connexions supplied	96,938	111,485	100,560
Outstanding applications	238,548	246,115	317,626
Total working connexions	4,521,361	4,473,753	4,313,170
Shared Service connexions	1,201,677	1,187,019	1,113,542
Traffic			
Total inland trunk calls	82,886,678	75,926,643	82,673,000
Cheap rate	19,348,912	16,509,750	21,402,000
Inland telegrams (excluding Railway and Press)	3,756,000	3,423,000	4,092,000
Greetings telegrams	814,000	808,000	887,000
*Staff**			
Number of telephonists	46,168	46,466	49,495
Number of telegraphists	5,959	6,043	6,559
Number of engineering workmen	63,774	64,140	63,235

*Staff figures relate to the 1st July and 1st April respectively.

Overseas Radioteleprinter Circuits for Commercial Users

A. K. Walker, M.B.E.

THERE WAS A REFERENCE IN THE SUMMER issue of the *Journal* to the installation in 1929 of a private teleprinter circuit between Imperial Chemical Industries' offices in Birmingham and London. Provision of private telegraph circuits on Post Office overseas radio routes did not begin until 1953 and is only now starting to gather momentum.

The demand for private two-way radioteleprinter circuits (or leased circuits, as they are normally called) has arisen mainly from the very rapid growth in air travel since the war and the intense competition which developed between airlines.

Airline telegraph traffic falls into two main categories. First, there is the operational traffic relating to the safety and control of aircraft movement. Such messages are handled in the United Kingdom by the Ministry of Transport and Civil Aviation who, in conjunction with their opposite numbers in other countries, have established their own network (known as the Aeronautical Fixed Telecommunications Network, or AFTN) for the purpose. The other main class of traffic (which is not generally accepted over the AFTN) is that generated in the general commercial and administrative business of the airlines, the major portion being related to the reservation of seats and freight space in aircraft.

The air traveller of today expects to be able to book a passage over any portion of an airline's routes at relatively short notice and will tend to give his custom to the airline which can confirm the booking with the minimum delay. The amount of delay depends mainly on the speed with which messages can be exchanged between the points at which enquiries are received and the points at which the seat reservations for particular flights are controlled. From the airline's point of view, it is highly desirable to fill as many seats as possible on each stage of a flight and reservations relinquished at the last moment at one station must be offered to the following station in case any would-be travellers are on the waiting list there. With a stage flight time of perhaps only two or three hours the margin is small, especially if the intended passenger has to be traced. An airline also has a good deal of urgent administrative traffic: for example, passenger lists, diversion of aircraft to relieve others which have had breakdowns, where speed of communication is essential.

There was little doubt that the public telegraph service could not always meet the new and heavy load of airline traffic at the speed required, if only because of the inevitable delays incurred in handing in, processing and delivery. This problem did not affect this country alone but, as London is one of the major air cross-roads of the world, the Post Office External Telecommunications Executive was very much concerned, and was consulted by British Overseas Airways Corporation at an early stage. In discussion between B.O.A.C., Cable and Wireless, Ltd., and the E.T.E., the conclusion was reached that the best solution would be to provide a network of teleprinter circuits connecting the airline's offices in the various parts of the world, with the airline itself being responsible for handling the traffic.

When this demand for leased circuits arose, new techniques were being developed to allow a number of teleprinter circuits to be carried on one radio transmission. It was thus possible, at least on some routes, to provide leased circuits by "channelling": that is, by using existing public radiotelegraph systems to provide extra circuits without having to provide extra transmitters or receivers and without having to find extra unoccupied frequencies. Frequency congestion was, and is even more so today, a most important consideration, since as many as eight frequencies (four in each direction) may be required for one radio route alone. But acceptance of the idea that some leased circuits could be provided by channelling existing systems also required acceptance of the responsibility for providing equipment and frequencies to carry any leased circuits which

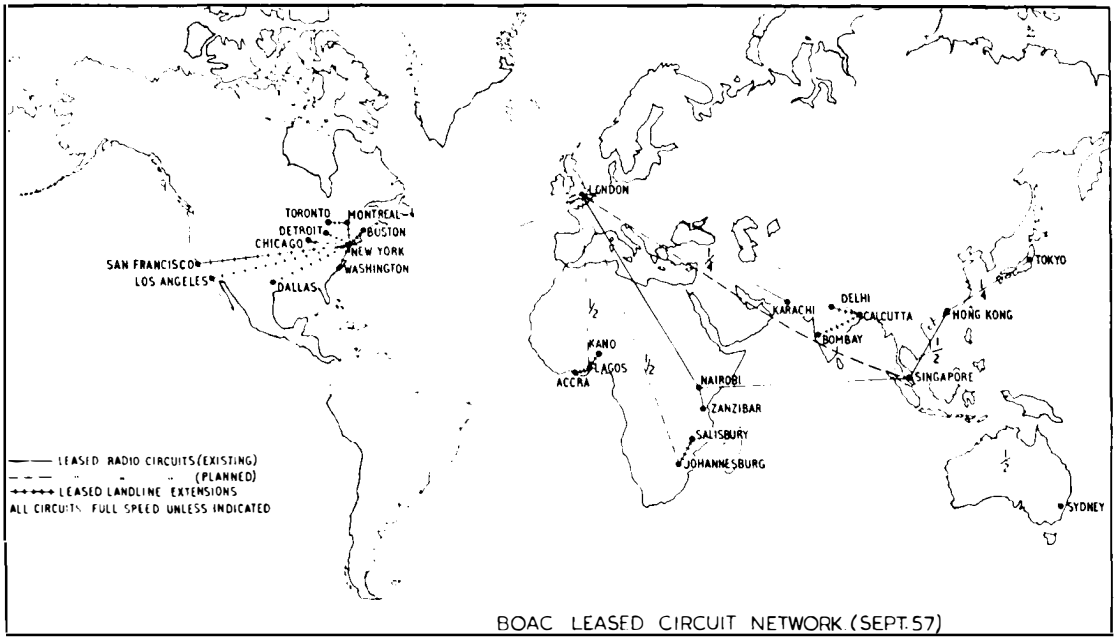
needed the special provision of a new system.

Where it was possible to pair a leased circuit with a public service, a solution was also offered to the problem of maintaining the leased circuit at an acceptable standard of performance. Radio circuits are liable to interference from other transmissions operating on adjacent frequencies and they suffer from fading, which can cause loss or mutilation of some or all of the signals. These difficulties cannot be brought to the notice of maintenance staff by alarms, and a close watch has, therefore, to be kept on circuit performance. Two circuits carried in the same transmission can, however, be expected to behave similarly, and as a public service circuit is usually manned continuously, it is possible to assess the performance of the leased circuit without having to monitor it all the time.

It was, therefore, practical and economical to provide leased circuits for commercial users by adapting public service facilities. An annual charge of £18,000 for the United Kingdom terminal of a continuous "full-speed" (66 words per minute) both-way circuit was fixed as the normal rate, and Cable and Wireless Ltd., adopted the same tariff for the terminals for which they are responsible. An additional charge was to be made for the local line from the Central Wireless Control office to the customer's office and for the terminal equipment installed in the latter. The tariff was comparable with that being quoted by other telegraph carriers —who had independently reached the same conclusions in regard to the method of meeting the airlines' requirements.

Any conception of a mass of leased circuits radiating from London to all B.O.A.C's overseas offices was quite unrealistic. Few routes could justify an annual expenditure of £36,000, and there were several key centres like Hong Kong, Singapore and Sydney to which direct working was not possible at all times, even during the most favourable period of the sunspot cycle. What was envisaged was a trunk network centred on London to a number of points of major importance, each of which would serve points of secondary importance by tributary facilities. The nature of these tributary facilities would have to depend on the local conditions and would sometimes mean using the public service. Traffic would, therefore, be able to circulate between any two points on the network, switching of the transit traffic at the major centres being undertaken by tape-relay methods: that is, by producing a punched tape which can be used to transmit the received message automatically via another circuit.

Even with a network of these lines, the airlines found that they could not financially justify full-speed circuits from London to all the major centres. Equipment was, however, available, which



BOAC LEASED CIRCUIT NETWORK (SEPT. 57)

would enable a full-speed channel to be sub-divided to give either "half-speed" (30 w.p.m.) or "quarter-speed" (15 w.p.m.) circuits. These could be offered at a reduced tariff in the expectation of the remainder of the channel being leased to other customers.

The problem of propagation on routes to the Far East and Australia, was resolved by planning a chain linking London with Nairobi (the normal radio relay point for Singapore and itself a suitable centre for serving Central and East Africa), Nairobi with Singapore and Singapore with Hong Kong and Sydney. This chain would not only ensure that good radio circuits would be provided, but also meant that traffic between distant points could circulate without having to pass through London.

As Cable and Wireless Ltd. were responsible for the overseas telegraph services in Nairobi, Singapore and Hong Kong, and as this route was at the top of B.O.A.C's priority list, a start was made with the Far East chain. Now, in just over three years, a worldwide network of leased radio circuits, supported by leased landline extensions, has been built up on behalf of B.O.A.C. Further expansion of the network is being planned and includes a direct circuit between London and Singapore, in which the propagation difficulty is being surmounted by a permanent radio relay at Aden or Nairobi. The need for the direct circuit has been brought about by a heavy increase in traffic.

A number of circuits has also been provided for another major airline, Pan American Airways, who have an extensive leased circuit network based on New York, with London as a major switching centre. Further circuits for P.A.A. are likely to be provided in the near future, along with circuits for several other airlines. Demands for similar facilities are now coming from other quarters: for example, half-speed circuits to the Argentine have been rented by grain firms, and a stockbroker is renting a quarter-speed channel to New York, over which the firm's traffic circulates between the European offices in Brussels, Geneva and London and Head Office in New York.

The provision of these leased circuits has so far seemed rather a slow task, but with the practice of leasing circuits becoming more widely accepted, most of the current order list of circuits from the United Kingdom is likely to be met by the end of 1958; this will almost treble the existing provisions. By that time leased radiotelegraph circuits should be working direct from London to Bombay, Buenos Aires, Calcutta, Istanbul, Johannesburg, Karachi, Lagos, Melbourne, Nairobi, New York, Singapore, and possibly elsewhere, and there will be several separate circuits on nearly all these routes.

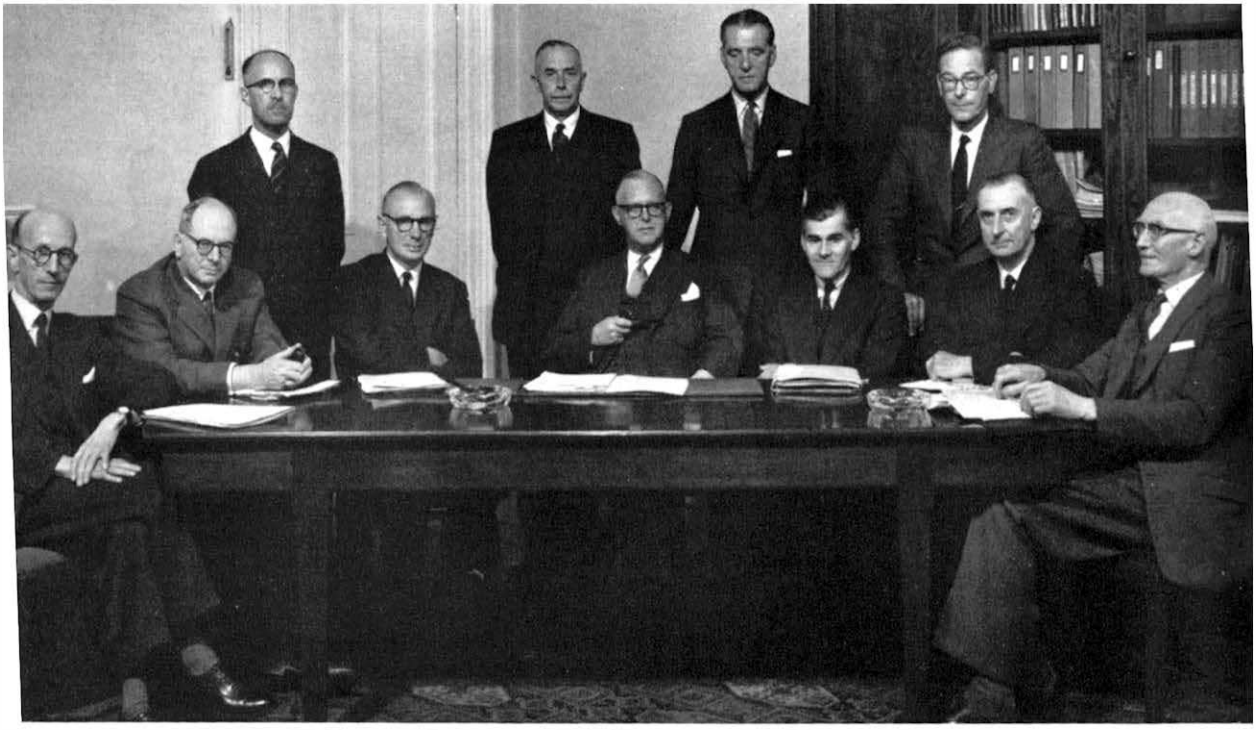
One of the keystones in this rapid expansion is the widespread introduction of a particular type of channelling equipment, which not only provides quarter-, half- and full-speed circuits up to the equivalent of two (and in some cases four) full-speed circuits on one radio channel, but also provides an automatic error correction (ARQ) facility. More than forty of these equipments will be in use in the London station at Electra House by the end of 1958.

From the customer's viewpoint, ARQ is very attractive. By an ingenious device, practically all faulty or extraneous signals received are rejected and only signals received correctly are printed; mutilated signals are not lost, because the ARQ equipment at the receiving end sends an "instruction" back to its complementary equipment at the sending end to repeat the signal which was faulty until it is correctly received. While the repetition is going on the auto-transmitter in the customer's premises is stopped and no signals are passed forward to the receiving teleprinter. The result is that copy almost free from errors is received, and the sender knows that once his tape (perforated tape must be used) has passed through the auto-transmitter, the message has been received.

In discussing the leased circuits facility with senior executives of several firms in different types of business, it has been found that there are certain features which make a definite appeal to prospective customers. Without doubt, chief of these is the fact that there is immediate contact with the distant office and the knowledge that the message is being received correctly at the same time as it is being sent. Another attractive feature is that, because of the flat rate tariff, there is no need to abbreviate messages or to use codes in order to keep down costs; as a result, direct staff savings can be made. Furthermore, less urgent traffic, which might otherwise be mailed, can be sent in quiet periods at no extra charge. Most firms welcome the fact that traffic can be passed in both directions simultaneously.

A factor which has emerged from the discussions is that in many ways a firm's habits, procedures and, indeed, organization have been formed round

(*Continued on page* 31)



The Post Office in Scotland

"Land of brown heath and shaggy wood
Land of the mountain and the flood"
Lay of the Last Minstrel.—SCOTT.

SCOTT'S SUMMARY DESCRIPTION MAY WELL represent the Sassenach's impression of Scotland today. It is certainly true of a large part of the country's 30,000 square miles, but the great majority of the 5,150,000 inhabitants now live and work in the industrial areas which have grown tremendously since Sir Walter Scott's time.

Scotland is a land of startling contrasts—from the quiet waters of highland lochs to the busy Clyde where the world's two largest ships were built; from the vast open spaces with no telephones at all to the capital city of Edinburgh with Britain's second highest telephone density; from the rugged grandeur of the Grampian Mountains to fertile farmland; and now from the peat fires of crofters' cottages to the electricity supplies of hydro-electric and atomic energy plants.

Shipbuilding, whisky, tweed, knitwear are Scottish products known all over the world but there are many other industries, both old and new, including coal mining, heavy and light engineering, fishing, linoleum, paper making, carpet manufacture, jute products, cotton thread, aluminium, sheep and dairy farming, fruit growing. Tourism caters particularly for those interested in golf, mountaineering, ski-ing, angling, hiking and many other outdoor activities, while the Edinburgh International Festival of Music and Drama brings visitors from all parts of the world.

Scotsmen are justifiably proud of their heritage, and many of them have made notable contributions in such diverse fields as medicine, engineering, literature, exploration and, of course, in the invention of the telephone itself. The Post Office in Scotland can claim with equal pride to have played its part in the development of the country, and not least since 1936 when this Headquarters was established in replacement of the offices of the Secretary for Scotland and the Superintending Engineers.

The Directorate (*seated, left to right*): Mr. J. A. BEAVER, Telecommunications Controller; Mr. R. J. HINES Chief Engineer; Colonel M. G. HOLMES, Deputy Director; Mr. A. G. ROBERTSON, C.B.E., M.M., Director; Mr. J. S. BLAKE, Postal Controller; Mr. D. W. L. HUGHES, Staff and Buildings Controller; Mr. N. A. SMEDLEY, O.B.E., Finance Officer and Chief Accountant.
Standing (*left to right*): Mr. M. W. RAMSAY, Telephone Manager, Glasgow; Mr. B. St. J. BROWN, Head Postmaster, Glasgow; Mr. A. J. FULLERTON, Public Relations Officer; Mr. E. HARRISON, Secretary.

Extension of the telephone service to the remoter districts has involved the provision of long overhead lines, submarine cables and radio links, and although modern developments and techniques have resolved some of the earlier difficulties there are still many unusual problems which call for ingenuity and initiative. The Highlands and Islands are mainly the concern of the Aberdeen and Scotland West Telephone Areas which cover respectively over 14,000 and 10,000 square miles of territory, but progress in the cities of Glasgow—for many years Britain's "second city"—Edinburgh, Aberdeen, and Dundee and the many smaller industrial towns has been much the same as elsewhere in Great Britain. In spite of the modernization of the telegraph service, there are still many outlying districts where no satisfactory alternative has been found to the use of casual messengers for delivering telegrams. There is, indeed, practically no telecommunications problem that has not been met somewhere in Scotland.

The Post Office in Scotland comprises, in addition to Headquarters in Edinburgh; five Telephone Areas and 73 Head Post Offices, and there are approximately 2,620 other post offices (including 1,880 telegraph offices) and 1,180 telephone exchanges. About 70 per cent. of the exchanges have automatic equipment and serve the same percentage of the 430,000 exchange connexions. The total staff is 30,500.

Post Office Films

Two Central Office of Information documentary films were selected for showing at the Edinburgh Festival—and one was the Eastmancolour film showing dramatically how the first transatlantic telephone cable was made, and laid by H.M.T.S. *Monarch*.

This will be shown to staff in the Post Office directorates and regions and has been shown commercially in Birmingham.

A short film, produced recently for television and possibly cinema "fill-ins", aims to make clear to the public what happens when "999" is dialled, and how they can help the Post Office to give them a rapid and effective emergency service. It will also be used in the training of telephonists. Many people still do not realize that 999 calls are answered at a telephone exchange and not direct, by the Police or the Fire Service. The confusion this sometimes causes can waste time.

"Introducing Telex", the film made by Creeds the teleprinter makers in association with the Post Office, took first prize in the Sales Promotion section at the Harrogate Film Festival. "Atlantic Link" got a certificate of Hon. Mention in the Public Relations and Prestige Section.

Two more films, one produced by the R.A.F. and the other by the British Transport Commission, and both intended for training purposes, contain helpful sequences about the use of the telephone for emergency calls.

Overseas Radioteleprinter Circuits

(*continued from page* 29)

the communication system they have used. The introduction of leased circuit working calls for many adjustments, which in practice tend to simplify methods and improve the firm's efficiency.

At one stage it was thought by some that once the airlines' needs had been met, the bottom would drop out of the leased circuit market. This is probably true as far as the full-speed facility is concerned, for only the very large international organizations requiring an urgent service can afford the tariff, but there seems to be a great opportunity for expansion in fractional speed circuits. The advantages listed above are rated so highly that some firms are prepared to increase their expenditure on communications to reap the business advantages that swifter service can bring.

Switchboards for Disabled Operators

London Telecommunications (South West Area) staff have recently completed work on three interlinked dummy switchboards which will be used to simulate live working for training disabled people. The installation is at the Queen Elizabeth Training College for the Disabled at Leatherhead and is devised in such a way that the instructor can play the part of the calling or the called subscriber and can apply the appropriate tone to a circuit by operating a key.

Similar facilities on a smaller scale are being considered for the Ministry of Labour Industrial Rehabilitation Unit at Egham.

Britain's First All-Electronic Public Exchange

THE POSTMASTER GENERAL ANNOUNCED IN the House of Commons on July 31 that the first fully-electronic public telephone exchange in this country will be serving more than 1,000 subscribers at Highgate Wood, North-West London, by the Spring of 1960. He added that improved electronic equipment, of the kind which was working experimentally for some years at Richmond, Surrey, would soon be in use at Lee Green, South-East London, and that when telephone subscribers in Bristol have their own trunk dialling facilities in 1958, the equipment which controls the routing of calls, and the charges, will be electronic.

Highgate Wood exchange will be a prototype which will provide data for further development. It is being designed so that the principles of electronic working can be tested in actual practice without affecting the existing service to subscribers.

This development is the first result of the collaboration between the Post Office and manufacturers in the Joint Research Committee announced in the *Telecommunications Journal*, Summer, 1956. The manufacturers concerned are Automatic Telephone and Electric, Ericsson Telephones, the General Electric Company, Siemens Edison Swan, and Standard Telephones and Cables.

The Highgate Wood exchange will provide all the facilities offered by the present standard public exchanges, and will be able to give subscriber trunk dialling and other services as and when required in conformity with the programme for introducing such services throughout the country. Although it will be the first exchange to carry public traffic, it will have been preceded by a number of experimental developments and installations on a less ambitious scale which have been constructed to gain experience of various possible techniques. Such developments, both fully electronic, and using electronic control of electro-mechanical switches, have already been carried out by the Post Office and by the firms now co-operating in the joint electronic research programme, and experimental units have been constructed and installed for use within the organizations concerned to provide the sort of service which would normally be given by a P.A.B.X. Several of these installations have been in use for more than a year, and much useful information has been obtained.

As described in the Winter, 1957, *Telecommunications Journal*, the Post Office has a fully electronic exchange working at its Research Station at Dollis Hill, North-West London; there is also a semi-electronic installation serving the Telephone Branch Circuit Laboratory.

In August this year, British Telecommunications Research Ltd., an organization sponsored by the Automatic Telephone and Electric Company and British Insulated Callenders Cables, announced the latest of these installations to go into service—an electronically controlled exchange now working as a practical unit at its own Headquarters at Taplow Court, Buckinghamshire. The electronic control system of this exchange is based on a magnetic drum "memory" device.

Experts from the Post Office and the five leading manufacturers of telecommunication equipment are working at high pressure on electronic exchange development. Many complicated problems have yet to be solved in connexion with this telephone system of the future, and the introduction of electronic exchanges will not be an overnight revolution. Nevertheless, the opening of this experimental exchange at Highgate Wood will represent a major step forward and it is confidently expected that this combined telecommunications operation will keep the United Kingdom telephone service in the forefront of modern developments.

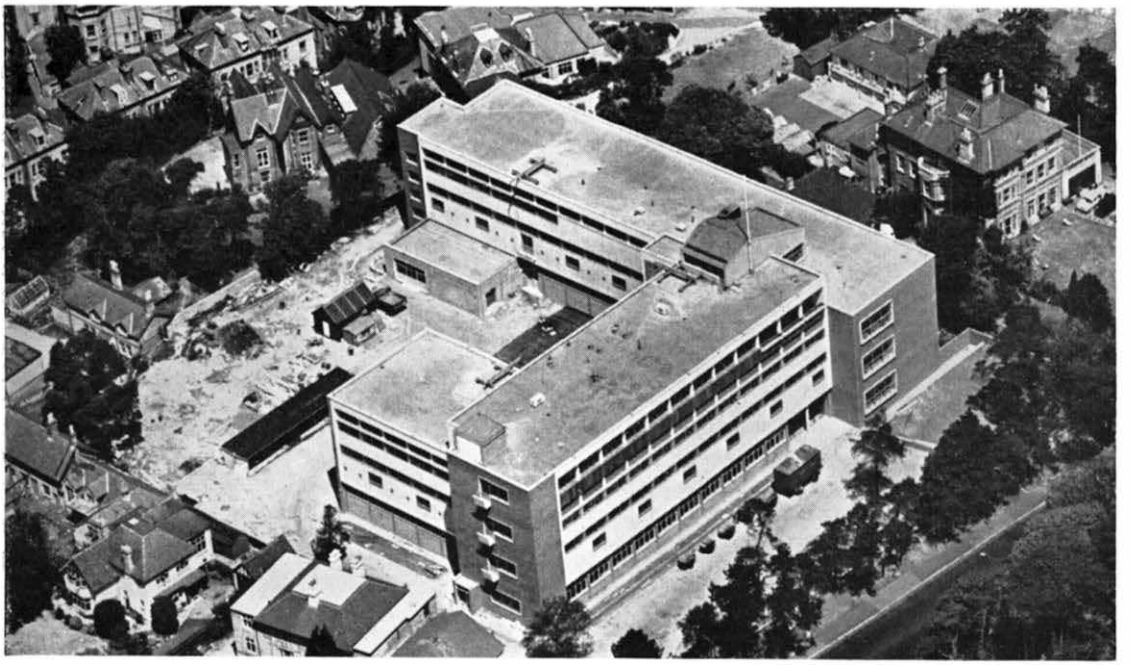
New Telex Services

The Post Office has opened telex service with Japan—a route of some 6,000 miles which goes by cable from London and on by radio from Amsterdam or Hamburg.

The longest Post Office international telex circuit is between London and the Philippines, about 11,000 miles: London–New York, radio, 3,000 miles; New York–San Francisco, cable, 2,000; San Francisco–Manila, radio, 6,000.

The Post Office has also opened the first telex connexion between Western Europe and the U.S.S.R. It links London and Moscow via Denmark, Sweden and Finland. The minimum charge is 14s. for up to three minutes.

New Bournemouth Telephone Exchange



IN THE AUGUST, 1949, ISSUE OF THE *Journal* the telephone problems in Bournemouth were explained at some length. The solution to the majority of them, the conversion of Bournemouth itself, is now within sight. In the late Spring of 1959 the new auto-manual exchange will open and will replace—

(*a*) *Bournemouth CB1 minor exchange.* This exchange which has been in service since January 1, 1912, was, until 1939, the group centre for the present Bournemouth and Boscombe groups and part of the Shaftesbury group. During recent years its age has given rise to increasing maintenance problems. Some 130 multiple numbers are faulty and cannot be repaired, necessitating about 100 subscribers working on other numbers.

(*b*) *Boscombe auto-manual group centre switchboard and tandem equipment.* This exchange, which is housed in the Telephone Manager's Office, was opened in 1949 to provide an auto-manual parent exchange for Boscombe, Canford Cliffs and Southbourne non-director exchanges and replaced the Boscombe CB1 group centre exchange. (The latter was upgraded to group centre status in 1939 to relieve Bournemouth.)

(*c*) *Bournemouth Trunk group centre exchange.* This exchange was opened in 1950 as a further relief measure for Bournemouth. It is housed on the top floor of the Boscombe non-director exchange building which formerly housed the Boscombe manual exchange. The trunk switchboard is the redundant Boscombe CB1 switchboard suitably modified.

The conversion will simplify the existing somewhat complex set-up and Bournemouth town will then have only one group centre. "Boscombe" will not only disappear from a trunk routing point of view but also from all records since, in company with Southbourne, it will lose its separate identity and be known as Bournemouth. Satellite type automatic equipment was installed at Boscombe, Canford Cliffs and Southbourne exchanges in anticipation of the eventual provision of a main exchange. Canford Cliffs will retain its separate identity in deference to the wishes of the local authority since the exchange area is in Poole.

The new exchange, which is now completed, is the only modern building of its type in Bournemouth, and from the upper floors fine views of Bournemouth (or Poole) Bay and the town itself

can be seen. The front of the building is faced with green Westmorland slate and Portland stone and at the north east end has a bas-relief cut in the brickwork representing, in contemporary style, the figure of Hermes, son of Zeus, who was the Messenger of the Gods. "Insulight" glass bricks are fitted on the second floor as an experiment in high-level lighting for the switchroom.

The layout inside the building follows conventional lines with engineering administrative, staff and lecture rooms, MDF and test room, battery room and power room on the ground floor; apparatus on the first floor; switchroom, staff welfare and wing training school on the second floor; and dining and recreation rooms on the third floor.

The switchroom has a capacity of 100 positions, of which 89 will be installed initially. Further extension is unlikely as it is expected that the first extension will provide Subscriber Trunk Dialling for at least the Bournemouth Central subscribers and so keep the manual board requirements within 89. Until some twelve months ago it was intended to retain the Boscombe auto-manual switchboard in Telephone House as a second switchroom. Reductions in traffic levels and call values now indicate that during the day period the new switchboard will be adequate for the design period and that only a small overload will result during the evening. This latter is being met by the retention of Trunk Control Centre working, for the cheap rate period only, at three minor manual exchanges in the town area, thus eliminating the need for the second switchroom.

To avoid exceeding the capacity of 4 ft. 8½ in. switchboards it has been necessary to limit the amount of outgoing multiple. This has resulted in approximately one third of the multiple being common to all positions with the remainder divided between the two separate suites. A further factor which assists in limiting the amount of outgoing multiple is the decision not to include circuits to any exchanges beyond the multi-exchange area. Access to these exchanges by the auto-manual board operators will be via three groups of circuits to second selectors—to level 1 for access to trunk routes and to levels 7 and 8 for access to junction and toll routes. Since trunk offering is not possible to UAXs via selectors, however, provision has been made for the last two circuits to each UAX to appear in the multiple. Similarly a reduction by nearly 200 jacks in the amount of answering multiple has been effected by the provision of a common group of 'O' level circuits for parented UAXs instead of individual access.

Enquiry work will be dealt with on 16 enquiry positions and, in a separate room, 14 directory enquiry positions with call queueing facilities.

The transfer will be effected in two stages. At the first stage the new manual board and tandem automatic equipment will be brought into service and Boscombe and Bournemouth Trunk exchanges will close. Then, some four to six weeks later, will come the event under consideration at least as long ago as 1924—Bournemouth manual exchange will close and Bournemouth subscribers will be transferred to the new automatic exchange. At the same time Boscombe and Southbourne will lose their separate identities and become known as Bournemouth. We in the Bournemouth Area will then be able to enter into discussions with colleagues outside the Area on a more or less equal footing instead of having to explain, half apologetically, that Bournemouth is still predominantly a manual area.

Hermes, son of Zeus : bas-relief on front wall

Training Staff in

Telegraph Supervision

T. E. G. Lang

The recent introduction of a two-week training course for telegraph Assistant Supervisors marks a further step in the development of supervisory training in the Post Office. In this article an Assistant Telecommunications Controller in the North-Eastern Region describes the course held in Leeds and comments on its value.

THE LAST SERIES OF TRAINING COURSES FOR telegraph supervising officers was held in 1949. This course became outdated and was replaced in 1956 by a revised course for Acting List officers which proved very satisfactory. Headquarters, assisted by Scotland and the North-Eastern Region, were then able to tackle the job of preparing a general course for Assistant Supervisors.

A great deal of thought and work went into planning the course in the North-Eastern Region. To help to shape it as closely as possible to the needs of telegraph supervisors, we called a meeting with a group of Assistant Supervisors and a representative of the Association of Post Office Controlling Officers. This proved to be most valuable. The discussions established that the broad pattern of the proposed course was on the right lines, and a number of useful suggestions made by the Assistant Supervisors were embodied.

Plans were made for courses to be held at London, Bristol and Leeds, each centre having a team of two instructors: a Telecommunications Traffic Superintendent and a Telegraph Supervisor, with a second Supervisor as reserve. While the course was designed primarily for Assistant Supervisors, higher supervising officers and "in-charge" allowance holders could also attend at Regional discretion.

In considering a course of this kind and what it it aims to achieve, it is well to remember the background against which it is placed. Since the war telegraph traffic has steadily declined. Further,

modern processes have tended to reduce the number of times a telegram has to be handled, with increasing emphasis on the need for greater productivity, study of the best methods of further streamlining telegraph processes continues.

A substantial reduction in the number of telegraphist and telegraph supervisor posts since the war has led to a marked decline in opportunity, with an ever present threat of redundancy. It is a great credit to the telegraph supervising force that, despite these circumstances, they showed a lively and enthusiastic interest in the courses.

Aims and Content

The course aims to throw into sharp relief the vital role and responsibilities of the first-line supervisor in maintaining the efficiency of the telegraph service. Efficiency may be defined here as giving the customer the highest quality of service commensurate with economy.

There are two main themes in the course—"human relations" and "job knowledge". In the "human relations" sessions the supervisors study the problems of supervising staff. Many aspects of supervising problems are dealt with, including advice and correction, discipline, individual differences, leadership of a working group, written and oral communication.

The "job knowledge" sessions enable supervisors to expand their basic knowledge of the telegraph service and to widen their background knowledge of the Post Office organization. Among the subjects are quality of service, operating procedures, staffing standards and deployment, current and future telegraph developments. In recent years the telegraph deficit has been reduced, but economics remain a problem, particularly hand delivery costs. For this reason a whole session is devoted to telegraph finance.

The supervisors in the North-Eastern Region have welcomed the chance to hear and question visiting speakers. In Leeds these included the Telecommunications Controller, who opened each course, a Head Postmaster, a panel speaker on Whitleyism and Joint Production, and an Assistant Telecommunications Controller who came to answer "Any Questions" and was always kept busy! The Regional Director gave a talk at the end of the course.

An essential feature is the opportunity given to Assistant Supervisors to take full part in discussions and freely put forward their views and suggestions. Many officers were pleasantly surprised on coming to Leeds to find that it really was *their* course, dependent to a large measure on their own contributions. One group suggested that the word "course" was misleading and that "Assistant Supervisors' Discussion Group" would be a better title. The syndicate discussion method is used in a number of sessions, while studies of situations drawn from everyday working life provide much good discussion material. Gramophone recordings and film strips are also used.

The supervisors who have attended have commented favourably on the course. Most of them said that the discussions had done much to give them confidence in the future of the telegraph service. They regretted that the instructors were unable to forecast a definite halt in the decline of inland telegraph traffic but they appreciated the fact that the Post Office regarded the expense of the course as worthwhile.

Many quite senior experienced officers readily admitted that they had learned or revised points in telegraph procedure which beforehand they thought they knew completely. The background information sessions "Finance and Economics" and "Review of Developments" went over very well. The supervisors welcomed the chance to seek information in sessions such as "Any Questions"? and made good use of these opportunities. The Assistant Supervisors appreciated a visit to the local telegraph office at Leeds, made at their own suggestion.

Taking Stock

Some people think that only those taught benefit from training but, in fact, the teachers learn a lot, too. Not only have we been able to clear up many minor questions, but also we have gained a much keener appreciation of the special problems of telegraph supervisors.

In our view the courses have been well worthwhile. They have underlined the valuable part that supervisors can play in keeping costs and therefore the price of telegrams down. We feel, too, that the courses have helped to reassure supervisors that the telegraph service is still a vigorous concern, which will continue to be a vital part of our telecommunications organization.

We hope that all those who attended the course feel that they derived some benefit from it, and that they will have pleasant memories of their discussions in Leeds and the friendships they made there.

Memory for Long Telephone Numbers

R. Conrad, M.A., Ph.D. and Barbara A. Hille

ONE OF THE CHANGES THAT THE PUBLIC WILL have to accept when subscriber trunk dialling is introduced is the use of longer telephone numbers.

Most of us carry a good many four or five figure numbers in our heads as a result of frequent use. When we do have to refer to a directory, we can generally, but not always, remember the number for time enough to dial it. But suppose the codes used as preamble had eight or nine digits in them? What would we need to do to ensure correct dialling, and how often would we fail if it turned out we underestimated the mental task ?

This problem already exists in the long dialling codes arising out of trunk mechanization referred to by Mr. J. E. Dawkins in his article on Trunk Mechanization in the Winter, 1957, issue of the *Journal*. He pointed out that 8-digit codes plus a four or five figure number are not uncommon. When long numbers are to be handled by the general public, one begins to wonder about the size of failure rate that can be expected.

The term "span of immediate memory" has long been used by experimental psychology to define the number of digits (or other numerically definable material) that can be immediately recalled in the correct order after a single hearing or reading. The size of the span varies greatly from one person to another. Low grade mental defectives can cope with only two or three digits, while there are a few eccentrics who can manage twenty or more, usually by rapid encoding of groups of digits into some other form. Within the middle range of ordinary telephone users one can fairly safely say from the considerable research that has been done that half the adult population of this country could not with certainty repeat back a 7-digit number every time, when they had heard it only once.

In some tests recently carried out in Cambridge, fifty G.P.O. telephone operators listened to 8-digit numbers which had been recorded on magnetic tape at a rate of 120 digits a minute. After each code the operators wrote down what they had heard. Only 17 repeated every number correctly. Everyone got some right and, overall, 77 per cent. of the numbers were correctly recalled. When the number of digits was increased to nine, only two operators achieved 100 per cent. scores and nine of them scored no success at all. Overall 41 per cent. were correct. With 10-digit numbers the overall score fell to 32 per cent. One might reasonably suppose that a representative sample of subscribers would give slightly worse results.

There seems to be little doubt then, that oral communication of long numbers will be beyond the ability of most people unless the number is repeated several times and the hearer writes it down while it is being spoken, and therefore only provided the speaker talks at a suitable rate.

In a sense the results just quoted reflect the extreme case where a subscriber dials after hearing a number only once without noting it. A more probable instance would be a subscriber reading a number from a public or private directory or from a scribble on a scrap of paper or a letterhead. He can follow one of two procedures; either read and dial digit by digit or in small groups, or "memorize" the number by reading it carefully and then dial it in one burst, in the way in which many operators use the Visible Index File.

In another experiment, 8-, 9- and 10-digit numbers were printed on cards. Operators were told to memorize the number and then write it down, but once they had begun to write they were not allowed to check. No time limit was enforced. Surprisingly, not much more than 70 per cent. of the 8-digit numbers were correctly recalled, but there was improvement with longer numbers over the listening method to 56 per cent. with 9-digits and 46 per cent. with 10-digits.

One of the disturbing features about all of these figures was that most operators believed that they had remembered correctly. Quite often the number was wrong only because two adjacent digits were

transposed, but the operator did not know this. It seems likely, therefore, that the introduction of subscriber trunk dialling will pose a memory problem of considerable difficulty for many people with the consequent risk, of a costly kind, of increased incidence of wrong numbers.

The manner of speaking and printing telephone numbers has always had careful consideration. Long numbers, though, greatly increase the importance of the memory factor. It seemed worthwhile, therefore, to begin some controlled experimental studies outside of the confusing condition of the operational situation, aimed at seeing how the presentation of numbers would need to be changed in order to affect the ability to remember them. Several experiments were carried out using operators in all cases. Groups of about 10–12 operators were tested together, using the method of presenting a number described above. The number of operators taking part in any one experiment varied between 30 and 50 selected at random, and the duration of any one test session was an hour.

Numerals Versus Letters

There can be little doubt that groups of letters which are abbreviations of place names (that is, symbols with meaning) are valuable memory aids. Because the number of suitable meaningful arrangements of letters is limited, the effect of random arrangements was tested. With a 10-letter vocabulary chosen to minimize sound confusions, four conditions were compared:—

(*a*) All letters ... for example, GRLI UOZT
(*b*) Letters–Numerals „ „ RTIA 6835
(*c*) Numerals–Letters „ „ 4295 RAGT
(*d*) All numerals ... „ „ 9014 6208

For each 8-, 9- and 10-item combinations of "groups" were used. When listening was adopted there was a clear advantage in using numbers. Only 30 per cent. of the 8-item all-letter combinations were correct, compared with 77 per cent. correct for all-numerals. With the 10-letter combinations 80 per cent. of the operators failed to get a single one correct. Conditions (*b*) and (*c*) showed much improvement though with little to choose between them. The increase in error when the size of the combination was increased by a single item was marked. Success with the all-letter combinations fell from 30 per cent. (8 letters) to 11 per cent. (9 letters).

When the numbers were read there was an all-round improvement, but those numbers with letters in them improved most, so much so that conditions (*b*) and (*c*) now became the easiest by a small margin over (*d*). Condition (*a*) was still the most difficult. Clearly the extra time that reading gave enabled the operators to invent "words" out of the letter arrangement and this encoding proved to be helpful.

Summarizing the results of this experiment, one should conclude that although all-numeral combinations were not the best when read, because their inferiority was small when read and they were greatly superior when heard, there is no real advantage in using relatively non-meaningful letter arrangements. Where letters could be spoken in a meaningful way (as in "London now") then they would obviously be advantageous.

Size of Numeral Vocabulary

We suggested earlier when discussing memory for letters that coding groups of letters extended the memory span. We all know that it is easier to remember 999 than, for instance, 285. Obviously one way of increasing the opportunity for coding would be to reduce the size of vocabulary "set" from which digits are drawn. Although reducing the size of digit set would mean that there would be fewer different numbers available for use, one might suppose that this loss could be offset by an increase in the memory span.

Accordingly, a group of 40 telephone operators was asked to listen to, and memorize as before, numbers of 8, 9 or 10 digits, the digits being drawn from three different sizes of "vocabulary", either 2 or 4 or 8. A 9-digit number drawn from a 2-digit vocabulary, might be 2233 32223; an 8-digit number from a 4-digit vocabulary could be 4223 5442. The numbers were spoken at a rate of 100 digits a minute.

In fact it was found that not only did memory span decrease with longer numbers as one would have expected, but that it also decreased when the vocabulary size was reduced. There was in fact a sharp drop in the amount of "information transmitted". For example, considering 9-digit numbers this group of operators got 32 per cent. correct with an 8-digit vocabulary and 14 per cent. correct with a 2-digit vocabulary.

It seems probable that at the rate at which the digits were heard there was insufficient time for coding, and this view is supported by the results of a similar test in which the numbers were read rather than heard. In this case the 9-digit series gave 40 per cent. correct with an 8-digit vocabulary, 50 per cent. correct with the 4-digit vocabulary

and 70 per cent. correct with the 2-digit vocabulary. Clearly, when there was sufficient time, the expected grouping did occur.

Grouping

The experiments described in the previous section showed that when material was suitable and time was available operators appeared to group digits to some advantage. Some further experiments were therefore carried out which pursued this point a little more. This time a normal decimal vocabulary was used with 9-digit numbers but the numbers were spoken in six different ways as follows:—

(*a*) spoken as a single group, for example, 123456789;
(*b*) spoken in two sub-groups, for example, 1234 56789;
(*c*) spoken in three sub-groups, for example, 123 456 789, enunciated: "one two three, four five six", etc.;
(*d*) spoken in three sub-groups as in (*c*), enunciated: "one twenty-three, four fifty-six", etc.;
(*e*) spoken in five sub-groups, for example, 12 34 56 78 9, enunciated :"one two, three four", etc.;
(*f*) spoken in five sub-groups as in (*e*), enunciated: "twelve, thirty-four, fifty-six", etc.

In another experiment in which the numbers were printed on cards and were read by the operators, the same arrangements were used, except that (*d*) and (*f*) could not occur.

Whether the numbers were heard or read arrangement (*b*) turned out to be best, giving most correct recalls. But with the listening task (*c*) and (*d*) were very nearly as good. This suggests that although a long string of digits is difficult to memorize, if the string is broken up too much the task can become even more difficult. There were, for instance, twice as many errors with (*f*) as with (*a*) when numbers were heard.

Conclusion

One knows very well, of course, that most subscribers handling long numbers will do so with care. They will find that they need to have the number clearly legible before them, and to dial it digit by digit, or at any rate in very small groups. However, in making a connexion over a long distance an error may be costly, and even if only a very small proportion of attempts fail the absolute number could be quite large. When a subscriber makes an enquiry for a number he might hear it incorrectly, he might wrongly write it down, or wrongly remember it, or having evaded these pitfalls, he could dial it wrongly. If he were reading the number from a directory or scrap of paper he could quite easily misread it.

It is almost certain that with longer numbers the chance of errors of these kinds increases out of all proportion to the increase in the number of digits. Unfortunately, the relatively short numbers now in use give little guide in this problem, because they are within the immediate memory span of most people and the errors referred to are only likely to become significant when the memory span is exceeded.

We have drawn attention to the difficulties of using even 8-digit numbers, but we have also shown that the probability of error depends to a large extent on the way in which numbers are designed, and this is within our control. The examples cited represent only a few of the more obvious factors which will be important. There will be others, such as the design of the dial itself and the use of a prefix digit to give access to wider networks, discussion of which is beyond the scope of this article. It is, anyway, abundantly clear that careful thought and study now will reduce the cost of operating a national subscriber trunk dialling system. We have, perhaps, indicated certain particular lines that might be followed with profit.

We are grateful to the officers and staff of the Cambridge Telephone Exchange for their willing participation, and to the Union of Post Office Workers for their ready co-operation.

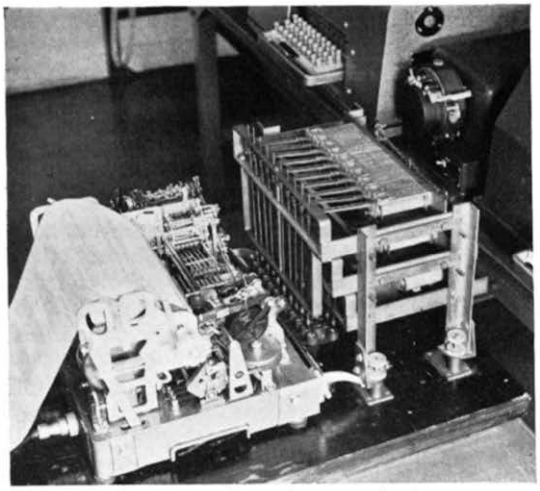
Lightning Strikes TV Masts During Distant Storm

During a thunderstorm estimated to be about eight miles away, moving from south to south-west, and in local cool weather with sun, some cumulus cloud and a slight south-west breeze, lightning struck the 500-foot lattice steel B.B.C. television mast at Tacolneston, Norwich, running down the mast and stays, which are earthed. Part of the discharge leaped across from the top of the B.B.C. mast to the Post Office mast, about 150 feet away which was being dismantled and was 105 feet high and ran to earth similarly.

As the discharge struck each mast, there was a sudden flash and a loud report, accompanied by the sizzling characteristic of electrical discharge. Men working inside the Post Office mast noticed a strong "burnt gunpowder" smell but no one was hurt.

"It would appear", says the official report, "that on a large flat plain, such as exists in East Anglia in the area of the Norwich site, a high electrical potential can build up in seemingly harmless cloud formations, and in the presence of a prominent structure can produce a lightning strike well outside a storm centre".

Telegraph Laboratory Shows Its Paces



Endurance testing of new teleprinter (robot operator)

MOST POST OFFICE PEOPLE, WHEN THEIR thoughts turn to research and development for Post Office services, naturally think of the Engineering Department's Research Station at Dollis Hill. But while fundamental research and development are carried on at the Station and the Radio Experimental and Development Branch is housed there, with its laboratory, other branches do a great deal of more day-by-day operational experimental and development work in their own laboratories in various other places away from Dollis Hill.

For instance, the Radio Planning and Provision Branch does its own experimental work at small non-operational radio stations, such as Banbury, at the Radiotelephony Terminal at Brent, and at a small laboratory in Castle House, Aldersgate Street contiguous with the Engineering Department's Headquarters; the Local Lines and Wire Broadcasting Branch has a laboratory in the old Palace of Engineering at Wembley; the laboratory of the Transmission and Main Lines Branch occupies a part of the building in Crucifix Lane, near Southwark Cathedral in south-east London; the Telephone Development and Maintenance Branch laboratory is in Armour House, just by Alder House, and there are laboratories elsewhere in London for the Power, External Plant and Protection; Subscribers' Apparatus and Miscellaneous Services, Test and Inspection and Telegraph Branches. A Research and Development Sub-Committee of the Engineer-in-Chief's Co-ordination and Development Committee co-ordinates the work of Dollis Hill and all these independent laboratories.

The Telegraph Branch laboratory recently held an "open day" for the Engineer-in-Chief and other senior officers of the Engineering Department. The occasion was held partly to mark the establishment of the laboratory in new quarters in Crucifix Lane, to which it was moved a short time ago from Aldersgate Street, where it has been since its original home, the Central Telegraph Office, was burned by incendiary bombs in 1940. 24 items or groups of equipment were demonstrated, from teleprinters to picture telegraph equipment. The demonstrations showed clearly that a great deal of work is being done towards more effective and more economical telegraph services.

Work on developing telegraph machines has expanded considerably during the past 10 years, mainly as a result of the introduction of machines to meet the special needs of commercial private users and the telex service.

The Telegraph Branch has itself developed a model of the automatic telex system, pilot automatic exchanges for which should be installed in London and Leeds by the middle of next year. The relay set selector equipment and dialling units have been constructed and wired at Crucifix Lane.

Testing manufacturers' equipment is part of the laboratory's regular function. On the open day visitors were shown tests of the new Creed Tape Teleprinter No. 75; the test control equipment enables a repeated cycle of tests of the transmitting, receiving and answer-back equipment. A mechanical manipulator actuates the keyboard; the manipulator is controlled by a uniselector, which helps to reproduce as near as possible the transmission of test messages from the keyboard. Tests are also being made of A.C. motors and start relays for automatic telex installations, and a 75 baud automatic transmitter and printing reperforator to be used in a tape relay system.

Another item shown was a prototype five-wire tape reader, developed for use with error correcting on radio printer circuits. An electro-mechanical two-channel error detecting equipment in the laboratory is connected to typical imput arrangements as used for public, private wire and telex services.

Also demonstrated was a telegraph distortion analyzer, which records the distribution of distortion in various periods of observation. This analyzer is being used to investigate the transmission limits to be used for telex subscribers lines when automatic telex is introduced.

Work on voice-frequency equipment includes the investigation of changes in design to reduce distortion at high signalling speeds. A commercial distortion set, modified in the laboratory, is being used for testing higher speed working on wider band telegraph systems.

Transistors were shown at work in prototype frequency modulated voice-frequency telegraph equipment being tested for performance.

Among its many activities, the laboratory investigates reports of maintenance difficulties revealed during operations, and continually experiments towards improvement in design and maintenance technique to increase reliability and reduce maintenance cost. In the life test room machines are tested continuously on a 24-hour basis. All tests for durability and lubrication are carried out in this room.

The Telegraph Branch, as part of its telegraph function, works on phonogram equipment; the Switching Development Group showed a model of the automatic distribution and queueing equipment now working at Newcastle, Liverpool, Bournemouth and the Central Telegraph station at Electra House in London.

A pushbutton torn tape relay system, developed by the Telegraph Branch and an electronic serial numbering transmitter, with time injection, were also shown, with various types of facsimile telegraph systems, including Nufax and Deskfax and picture telegraph equipment.

These are only a few of the current tests and developments on which the Telegraph Laboratory is working, and which were shown to visitors on open day. The accommodation provided in the Crucifix Lane building allows nearly twice as much floor space as the previous accommodation in Aldersgate Street, and so has helped to make it possible to undertake a wider range of development work in connexion with the extended use of telex and private telegraph services for commercial organizations.

OUR CONTRIBUTORS

R. CONRAD, M.A., Ph.D. ("Memory for Long Telephone Numbers") joined the research staff of the Medical Research Council's Applied Psychology Research Unit in 1948. Miss B. A. HILLE joined as his assistant in 1953. Their research work is primarily concerned with fundamental aspects of human behaviour, but with an eye continually cocked in the direction of practical working situations. This interest, though mainly pursued in the laboratory, has led to investigations in textile mills, a munitions factory, a jam factory and, recently, telephone exchanges. The study reported is part of a series of theoretical experiments on the nature of memory.

K. CURTIS ("New Bournemouth Telephone Exchange") is a Senior Telecommunications Superintendent on the equipment side in the Bournemouth Telephone Manager's Office, Traffic Division.

G. O. EVANS, B.Sc., A.M.I.E.E. ("Long-Distance Communications and the International Geophysical Year") is an Executive Engineer in the Radio Planning and Provision Branch. He is an honours graduate of the University of Wales and joined the Post Office Engineering Department in 1947 as a Probationary Engineer after 10 years' service with Marconi's Wireless Telegraph Company.

T. KILVINGTON, B.Sc. (Eng.), M.I.E.E., F.T.S. ("The Post Office Research Station Holds an 'Open Day' ") is an Assistant Staff Engineer in the Radio Experimental and Development Branch at Dollis Hill. He was educated at Bournemouth School and University College, London, and entered the Post Office as a Probationary Assistant Engineer in July, 1936. He has been with Radio Branch since January, 1937, working mainly on problems concerning the transmission of television by cable and radio except during the war years when attention was turned to navigational aids. In recent years he has been a member of the United Kingdom delegation to a number of international television and radiocommunication conferences. He is a Fellow of the Television Society.

T. E. G. LANG ("Training Staff in Telegraph Supervision") is Assistant Telecommunications Controller Class II in North-East Region. He entered the Post Office in 1938, serving as an Assistant Traffic Superintendent at Newcastle-on-Tyne and North-East Region HQ. He has assisted in planning courses for telegraph and telephone first-line supervisors.

R. B. MUNRO ("Other People's Jobs—Chief Clerk") is Chief Clerk of Liverpool Telephone Area. He entered the Post Office as a Clerical Officer in

(*Continued on page 46*)

Hugh Townshend Retires

An outstanding figure in international telecommunication, Mr. Hugh Townshend, has just retired from the position of Assistant Secretary-General of the International Telecommunication Union at Geneva. Mr. Townshend, then Director of Telecommunications in the Post Office, was the first Chairman of the Editorial Board of this Journal. *The following appreciation of Mr. Tounshend has been written for the* Journal *by Mr. L. V. Lewis, Senior Counsellor, I.T.U. since* 1949, *previously a Principal in the Post Office.*

HUGH TOWNSHEND, who is 67, entered the Post Office in 1914, after a brilliant career at Cambridge where he took his degree with First Class Honours in Mathematics. After active service as an officer in the Royal Engineers in the first World War, he occupied a series of important posts at Headquarters, culminating in his appointment as Director of Telecommunications in 1944. He was gazetted C.B. in 1947. In 1949 he was elected Assistant Secretary-General of the International Telecommunication Union and he took up his duties in Geneva at the beginning of 1950.

These are but a few landmarks in a long career of public service. It would, indeed, be easier to write a book on Townshend than to produce an adequate and balanced tribute to him within the limits of space inevitably imposed by the *Post Office Telecommunications Journal*. We may, however, confine ourselves to the selection of an outstanding characteristic of Townshend the official and of Townshend the man, particularly as in so doing we may at least form a picture of an integrated personality in which official and human qualities were exquisitely blended.

As a member of the United Kingdom Civil Service, Townshend had a great and enlightened sense of responsibility to the Government and to the public it represented. Dealing, for the greater part of his Post Office career, with international services, he was ever conscious of the wider background of world affairs. He was thus well fitted to occupy a high position in the International Telecommunication Union where he was the living embodiment of the obligation to discharge his duties with only the interest of the Union in view without being required to renounce national sentiments or personal beliefs.

As regards Townshend the man, it would be difficult to imagine a more stimulating colleague. He had strong views which he expressed forcibly but he had a readiness, if not an avidity to hear the views of others. This was perhaps the greatest of his multifarious virtues and in exercising it he displayed some of his most endearing foibles. However busy, Townshend was always accessible to high or low and the visitor would at once be motioned to a comfortable armchair. Faced with ready acquiescence in an important proposition, Townshend would often look deflated. The intelligent presentation of a good counter argument had a quite different effect. Townshend would rise from his desk and pace back and forth driving home his arguments with irrefragable logic and consummate debating skill. *Solvitur ambulando* would indeed be the order of the day, and more often than not a good solution would be hammered out by dint of such discussion. Since, alas, we shall no longer enjoy these discussions in an official setting, we may reveal a technique which sometimes prevailed when the colleague had expended his ammunition. Full of guile, he could gradually move his chair, on the pretext of avoiding an open window or of approaching the fire, so as to restrict Townshend's promenade. Forced to a standstill, Townshend would declare "There is some confusion here"! This would be the victory signal for the colleague, who would quietly withdraw in the knowledge that when he presented a memorandum setting out his own solution, it would be blessed with the famous initials "HT".

If we have perforce written in the past tense, it is the measure of our hope that in the years to come we shall see much of Townshend on both sides of the Channel, since he plans to season residence in England with continental travel. We wish him long years of good health in which to enjoy the retirement which he has so well earned.

Notes and News

"Drive in" Telephone

(Courtesy of Bell Telephone Laboratories)

New Post Office Link for I.T.A.—An independent television link over 237 miles of Post Office coaxial cable, via switching centres at Manchester, Glasgow and Kirk o' Shotts to Black Hill, Lanarkshire, was opened on August 31, giving alternative TV for the first time to some areas in Scotland.

Amplifiers in wayside repeater stations are provided at six mile intervals throughout the cable in both directions and most components are provided in duplicate to minimise fault liability. Power for the amplifiers is transmitted from intermediate stations, up to 70 miles apart, in the large towns *en route*. In addition to the television link circuits are provided for music and control.

A further provision planned for completion with Black Hill service is a second vision channel on coaxial cable from Birmingham to Manchester which will give Scotland the choice of two programmes from any I.T.A. studio south of Manchester.

★ ★ ★

London and St. Helena are now in telephone communication via the Post Office Rugby Radio Station, Accra (Ghana), and Ascension Island. The service is open for half an hour each afternoon, except Sunday, at a basic charge of £3 for three minutes.

"Drive-in" Telephones for Motorists.—Two "drive-in" telephones enabling motorists to talk while in their cars, have been installed on an experimental basis at a Chicago street corner, and one in Mobile, Alabama. The telephones have been installed on trial to test their durability in a complete range of weather.

The weatherproof drive-in telephones are enclosed in a plastic hood, set on a steel post at the level of an average passenger car window, a little over 4 feet above the road level, with a directory in a metal box below the instrument. A retractile cord and a three coin box is provided.

★ ★ ★

Jamboree Exchange.—The complete telephone exchange—"Jubilee"—installed by the Post Office at Sutton Park, Warwickshire, for the World Scout Jamboree, provided service for some 30,000 scouts from all over the world from four switchboards with 90 lines to and from telephones at various points in the Park.

Twenty-one public telephone kiosks were erected, and 25 exchange lines to shops, banks, and so on, 8 Press lines, and several special circuits for broadcasting and television.

Some four and a half miles of underground cable were laid and seven miles of aerial cable and five and a half miles of overhead wires were erected on about 90 poles.

★ ★ ★

"London Classified" Re-Set.—The London Classified Telephone Directory appeared in August, for the first time, set in Bell Gothic type, the adoption of which for directories was discussed in the Summer, 1956 *Journal*. The new type has reduced the number of pages needed by 240, to 1,120, which means a saving of 130 tons of paper and an all-round economy of 17.5 per cent.

Telex at Wrexham

Before the N.T.C.—Enthusiastic local staff staged telephone and telex displays for an Industrial and Ideal Home Exhibition held to celebrate the centenary of the granting of the Borough Charter to Wrexham, North Wales.

Ancient telephones—one, operated privately before the National Telephone Company started in Wrexham, given by the 90-years-old widow of a man who worked as Telephone Manager (as well as running his own shop)—were displayed to show the development of equipment. A length of pole hollowed to 20 feet by 6 inches and containing a woodpecker's nest, was also shown. During the fortnight of the exhibition 17,000 calls were put through an auto demonstration set. Teleprinters were linked with Liverpool to demonstrate telex.

Local staff worked voluntarily after normal hours—up to 10 o'clock each night and all day on three Saturdays.

★ ★ ★

World's Longest Call.—The Post Office in London provided a major link on October 8 for the longest telephone call in the world—16,850 miles, routed Washington-New York-London-New York -Seattle-Ketchikan (Alaska)-Seattle-San Francisco -Honolulu; the 8,200-mile double Atlantic crossing was over the translantic telephone cable. The calls were part of the opening ceremony of the new San Francisco-Honolulu telephone cable, half of which was made by Submarine Cables Ltd., whose ship, C.S. *Ocean Layer*, and H.M.T.S. *Monarch*, laid it. Mr. S. A. Manser, Deputy Director, External Telecommunications Executive, spoke from London with Mr. J. Ballard Atherton, President, Hawaiian Telephone Company (which owns the cable jointly with the American Telephone and Telegraph Company) in Honolulu, Mr. Henry Killingsworth, vice-President, A. T. and T. in Washington, and Mr. Carl Seierup, Bell Telephone engineer, in Ketchikan.

★ ★ ★

Call of the Road.—Telegrams may now be sent from London to people travelling by car over certain trunk roads in France; some service stations on the routes display the addressee's name and car registration number on boards illuminated at night.

★ ★ ★

Order of Interest.—More than 1,300,000 of the 1,500,000 Press words handled (in and out) by the Post Office Cable and Wireless Services last July were in connexion with five special events.

In order of volume of traffic the five events were: West Indies Cricket Tour (to the end of July) 835,850; Commonwealth Prime Ministers' Conference in London, 277,864; Wimbledon Tennis Championships, 115,473; the Queen Mother's tour of Rhodesia and Nyasaland, 55,000 words; St. Andrew's Golf Championships, 18,825.

Special arrangements at Electra House (London Station) enabled automatic re-transmission of some 66,000 words to Sydney, Australia, in connexion with Wimbledon.

★ ★ ★

The Editor Regrets.—That, changing a name at the last minute in the paragraph (page 181, Summer issue) about the Telephone and Telegraph Society's programme, he omitted to amend the "consequentials". The result was that Mr. J. M. Newton, now Director of Personnel, was described as having recently become Director of Postal Services. The Director of Postal Services is, of course, Mr. Wolstencroft, and it is Mr. Newton's (not Mr. Wolstencroft's) meeting that is to be held at Waterloo Bridge House on December 4.

Power without fail

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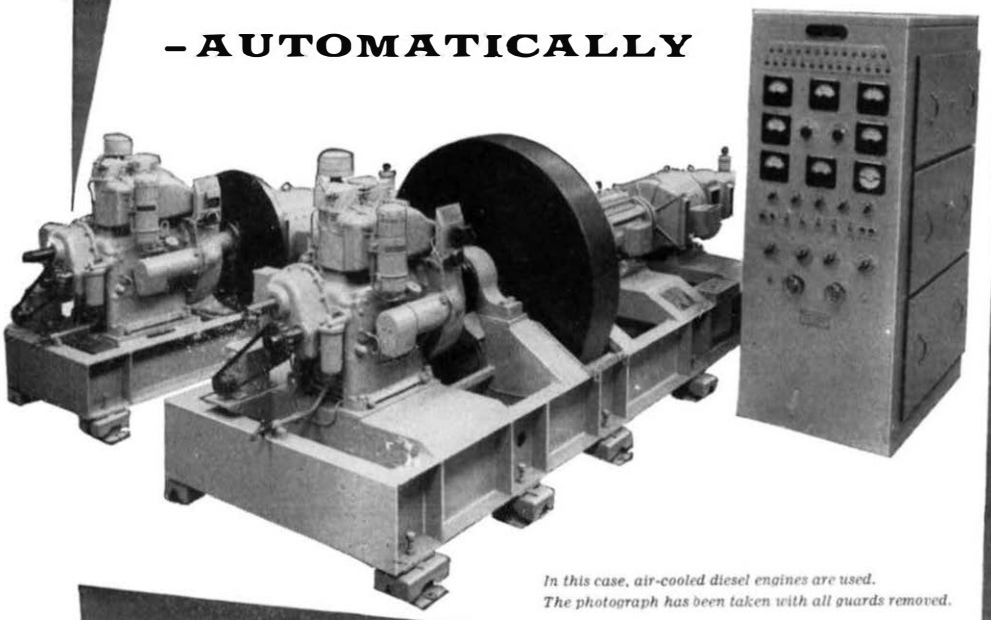

In this case, air-cooled diesel engines are used.
The photograph has been taken with all guards removed.

This mains standby plant is one of seventeen manufactured for Standard Telephones and Cables Ltd. and is for installation overseas.

It comprises two fully automatic units controlled by a single switchgear cubicle. One unit is a Regenerative Flywheel 'No break' set, the other a 'Normally Stationary' set. Dual standby is provided because of site conditions and the vital need for continuity of supply.

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1. *Mains within limits.* The three-phase electric motor drives both flywheel and alternator of the 'No-Break' set (foreground), the alternator supplying regulated single phase current to the telecommunications equipment.
2. *Mains outside limits.* The electric motor is disconnected, the diesel engine starts automatically and when up to speed is connected to the alternator by the magnetic clutch. During this cycle, stored energy in the flywheel drives the alternator, thus maintaining a continuous power supply within the closest limits of frequency and voltage.
3. *Mains restored within limits.* The electric motor is automatically reconnected and resumes the drive, the magnetic clutch opens and the diesel engine shuts down.
4. Should the 'No-Break' set develop a fault, the 'Normally Stationary' set (background, left) starts and takes over supply to the equipment. The sets are designed to restrict the supply interruption to the minimum possible under the circumstances of the fault. Manual paralleling of the two sets is provided for maintenance periods.

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CRAWLEY, SUSSEX.

OUR CONTRIBUTORS *(Continued from page 41)*

Scotland West District in 1935. Returning from service with the Royal Signals, he was appointed Executive Officer and was subsequently promoted H.E.O. at Post Office Headquarters, Edinburgh. From December, 1950, until his appointment to Liverpool in 1954, he was Regional Inspector of Clerical Establishments, North-West Region.

ARTHUR SCARBOROUGH, E.R.D., D.P.A. ("Team Staffing at Bradford Exchange") was appointed Chief Telecommunications Superintendent at Bradford in 1950. He joined the Post Office Engineering Department at Grimsby in 1923 after some experience in mechanical engineering. He entered the traffic grades as an Assistant Traffic Superintendent at Gloucester in 1928, and has since served in seven Districts and Areas. On the outbreak of war he went to France with the Royal Signals and was continuously overseas until 1945. Since the war he has served on several Departmental Joint Committees. He was awarded the Diploma in Public Administration by the University of Leeds in 1956. His earlier articles were "Gainsborough A Break with Tradition" which dealt with the introduction of switchboards in light oak and "D-day at the Fish Docks".

A. K. WALKER, M.B.E. ("Overseas Radioteleprinter Circuits for Commercial Users") entered the Post Office in 1939 as an Assistant Traffic Superintendent in the Bradford Telephone Area. During the war he served with the Royal Signals and was a Staff Officer (Signals) at Second Army HQ during the Normandy invasion and the subsequent operations in N.W. Europe. After VE Day, he became the Army representative on the British Joint Communications Board Secretariat. On demobilization in 1946 he joined the Aberdeen Telephone Area and was appointed Senior Telecommunications Superintendent five years later on transfer to the Inland Telecommunications Department, Organization and Methods Branch. Two years ago he was appointed to his present post in the Operations and Planning Branch of the External Telecommunications Executive where he is responsible for the planning of extra-European telegraph circuits for the public, leased and telex services.

S. J. WHEATLEY ("Making Selectors for Automatic Exchanges") is an Executive Engineer in the Test and Inspection Branch of the Engineering Department. He was educated at Northern Polytechnic and entered the Post Office in 1925, being engaged on the inspection of apparatus. Before 1939, as a Chief Inspector, he was responsible for acceptance of main telephone cables, and during the war was seconded to the Ministry of Aircraft Production. As Executive Engineer in Test and Inspection Branch headquarters, he is responsible for co-ordinating inspection at telephone contractors' works.

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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.

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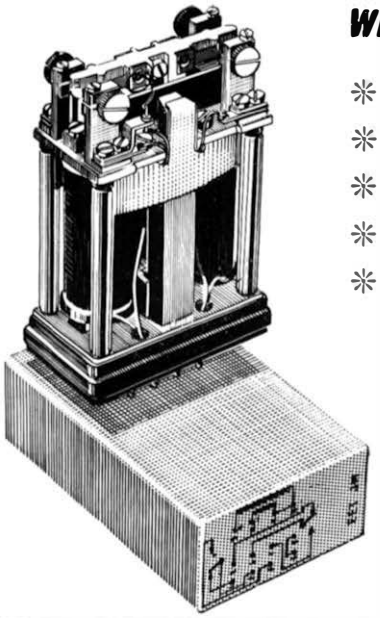

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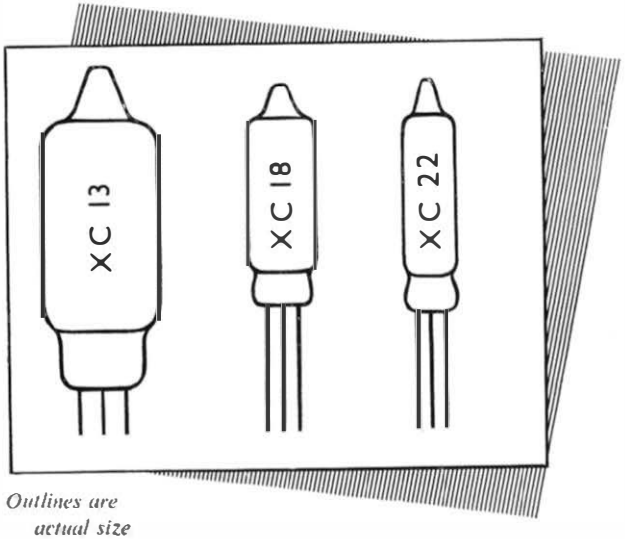

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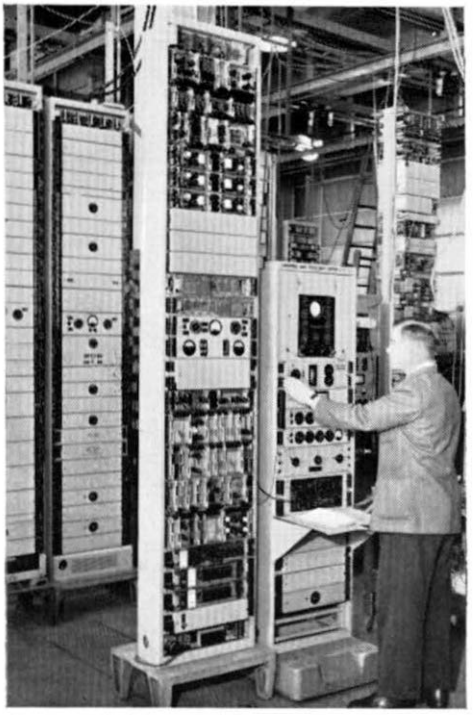

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