Post Office Telecommunications Journal

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

Contents

Vol. II (Winter: November), 1958 *No.* 1

Ringing up the Future

EIGHTY YEARS AGO ON JANUARY 14, 1878, HER Majesty Queen Victoria received Graham Bell and witnessed a successful demonstration of the telephone, thus marking her appreciation of a new invention that was to revolutionize national and international communication.

This year, on December 5, 1958, her great, great grand-daughter, Her Majesty Queen Elizabeth II, will inaugurate Subscriber Trunk Dialling in Bristol by making the first call, so marking her appreciation of developments that, in the words of the Postmaster General, "should revolutionize telephone habits in the next ten years".

The Crown of the Commonwealth is today above all a symbol of public service. The gracious participation of Her Majesty in the inception of this revolution emphasizes the basic purpose of Subscriber Trunk Dialling and of the many other advances foreshadowed in this issue by the Engineer-in-Chief of the Post Office.

While we praise famous and anonymous men who, by their scientific genius, technical skill and administrative ability have developed the telephone from its inception to STD, we realize that all their work would have been of little worth unless it had led towards better public service; towards enabling people of all nations to exchange ideas more effectively with one another and to improve business communications.

When Her Majesty makes the first call from Bristol she will, in effect, ring up the future; a future in which, to quote the Postmaster General's hopeful expression, "anyone anywhere may be able to pick up a telephone at any time and speak to anyone else anywhere else quickly, cheaply and easily".

Another Engineer-in-Chief Looks Forward

Brig. Sir Lionel H. Harris, KBE, TD

Ten years ago, in our first two issues (November, 1948, and February, 1949) Mr. (now Sir) Archibald Gill, at that time Engineer-in-Chief of the Post Office, outlined current telecommunication engineering practices and projects, and forecast future developments.

To open our eleventh volume we asked the present Engineer-in-Chief to comment on Sir Archibald's forecasts and to look forward from 1958.

READING AGAIN SIR ARCHIBALD GILL'S articles I have been struck by the number of developments which have progressed as he forecast. It is fitting therefore to take stock of some of these and see where we are heading.

Coaxial Cables

Routes which in 1948 were carrying 600 telephone channels on a pair of $\frac{3}{8}$" coaxial tubes are now capable of carrying either 960 channels or a 3 Mc s television channel, with amplifiers at the original spacing. One route is now being equipped with amplifiers at 3-mile intervals to give 2,700 telephone channels or 1,200 telephone channels, with a very wide television channel.

With the advent of transistor amplifiers which require only small power supplies, there is a future for smaller coaxial tubes, say, $\frac{1}{8}$" diameter, with amplifiers 4,000 yards apart sunk into the ground. One use of this system will be to extend circuits from the main high frequency trunk network over distances of five miles and upwards.

Submerged Repeaters

In 1948 the design of a 60 circuit repeater had not been completed but by September, 1956 sixteen such repeaters were working in the British section of the first transatlantic telephone cable system between Newfoundland and Nova Scotia.

The negotiations now proceeding to lay a cable to Canada incorporating about 110 submerged repeaters to be completed in 1961, plan to give 60 circuits between London and Montreal.

In submerged repeaters too the use of transistors is likely in the next decade, to enable much wider bandwidths to be used without the overall power feeding voltages exceeding practical limits.

On long and costly systems it may be worth while increasing the circuit capacity by using specially designed channel equipment and speech interpolation. Speech interpolation makes use of the fact that a speech channel is occupied for less than half the time it is available because of gaps in speech and other idle periods. If therefore some scheme can be devised for picking up a channel only when one of the callers is speaking, many more conversations can take place on a given number of channels. By this means it is probable that 72 conversations will be possible on a group of 36 channels.

Radio and Waveguides

Considerable progress has been made in the microwave field since Sir Archibald's review and links providing up to six broadband channels, each suitable for television signals or 600 telephone circuits, are now an integral part of our main trunk network. In the future it may be possible to provide even wider broadband channels by radio, suitable for perhaps 1,800 telephone circuits or a television channel and 600 or so telephone circuits. The microwave radio systems in current use

Archibald Gill, B.Sc., M.I.E.E., F.I.R.E., Engineer-in-Chief 1947-1951

employ[ing] frequencies in the 2000, 4000 and 6000 Mc s [bands], and systems for use on frequencies as high [as] 11,000 Mc s are under development.

An important development (it is difficult to forecast just how important) not foreseen by Sir A[rchibald] was the use of "over-the-horizon" or "t[ropo]spheric-scatter links". These use a scatter[ing] of radio waves at heights of up to six miles [up] so, which is due to the lack of homogeneit[y] in the atmosphere; they are characterized by th[e] relatively long hops, up to some 200 or more miles, which are possible. Bandwidths suitable for up to about 100 telephone circuits, or a tele[vis]ion channel, can be provided on such systems.

In long-distance transmission by waveguides (metal tubes, without central conductors, through which radio waves are propagated) considerable experimental progress has been made and it appears feasible to transmit pulse-code modulation signals with bandwidths of the order of 300 Mc s, each suitable for some 2,000 telephone circuits, or one two television channels, on carriers in the range from about 50,000 to 100,000 Mc s (less than 1 cm in wavelength) in a 2-inch diameter cylindrical waveguide. As some 100 or more such carriers might be transmitted on a single waveguide it is evident that such a medium has an enormous potential capacity. However, a great deal more work will be necessary before such systems could be used in the trunk network, and even then it appears that only the most heavily loaded main routes of the future could possibly justify the cost of waveguide systems.

Telephone Exchange Practice

For a number of years we shall be absorbed in the expansion of Subscriber Trunk Dialling and as this develops it will probably be accompanied by a new trunk transit network. This will be a high efficiency network in both the switching and transmission sense. It will probably use high speed voice-frequency code pulsing between registers for transmitting numerical information, and operate on a four wire basis over the long distance links.

Sir Archibald mentioned "all electric" telephone exchanges using electronic rather than electro-mechanical techniques. Development has moved steadily in this field and the Engineering Department and contractors have joined forces in research and development; a trial all-electronic exchange is being constructed for completion in 1961 (*Highgate Wood*). Meanwhile research is progressing with the object of simplifying, cheapening and reducing the power consumption of this type of exchange. The application of electronic techniques to the solution of particular problems associated with existing exchanges is also receiving much attention. The register translators for the first STD installation will be electronic and the design of other similar devices using different techniques is proceeding.

International Switching

In international switching, the field trials Sir Archibald mentioned have been completed and European agreement has been reached on standard signalling systems and facilities for interconnecting national networks. Equipment to cater for operator dialling to a subscriber in a distant country will be available before the end of this year and will be extended as other countries become ready for operator dialling to begin. Intensive study of the problems involved in providing for subscriber dialling to European countries is in hand and within the next decade it is almost certain that subscribers will be able to dial their calls to those European cities where this is justified by the volume of traffic. The question of operator dialling over the transatlantic telephone cables is also being studied and such a facility will be in use well before the end of the next decade.

It is possible that the exchange area as we now know it may look quite different in the years to

come as line connectors or some electronic equivalent cause a trend towards the dispersal of switching equipment.

Telephone Instruments

The new telephone instrument (700 Type) which is now being introduced, incorporates a new receiver and certain other improvements. These will enable us materially to increase the possible electrical length of a subscriber's line. It is likely that further improvements will be made, for instance, by improving the microphone. When electronic exchanges are introduced the subscriber's instrument might well be fundamentally changed and used over very long lines indeed.

Telegraphs

The development of automatic switching for telegraph services has proceeded and the telex service is being converted to automatic working. The automatic service is likely to prove popular and designs are being completed for equipment to permit international subscriber dialling to be brought in early in 1961—that is, soon after the main London automatic exchange is opened. The development of electronic means for telegraph purposes has been pursued, including their use for the storage and re-transmission of telegraph messages. The present type of voice-frequency telegraph equipment working on an amplitude-modulated basis is likely to give way to a frequency-modulated transistorized system capable of working at higher speeds and less susceptible to circuit level changes and noise, for use where these factors are of special importance.

Data Transmission

With the advent of computers and computer-like operations a need is gradually developing for the transmission of "data" over telephone lines. Many possibilities exist for accounting, control or information purposes Such information is usually transmitted in code, like telegraph signals. There are many ways of providing such services and it is certain that means will have to be found and standardized for handling such traffic. Technically the problem is the transmission of the code pulses as quickly as possible over our normal plant with the minimum number of errors, and there is every indication that the error rate will have to be very small indeed.

A related requirement is that of closed circuit television in which information has to be transmitted almost instantaneously, using the full television type of signal of normal standards. A service of this type is being provided for certain members of the Stock Exchange in the City of London, the Post Office commitment being limited, however, to the installation of coaxial cables. The number of enquiries received for similar facilities indicates that the demand for such services is likely to increase.

Local Cables

Polythene insulated cables are being extensively used for local distribution. In the next few years it is likely that less and less lead sheathed cable will be used for this purpose. It has been found that the maintenance charges on plastic covered cables are smaller than was originally expected and this gives a bigger incentive for their adoption.

The use of aluminium for both cable sheaths and conductors is also increasing. The introduction of main line railway electrification is liable to present interference problems and as the shielding effect of aluminium is much higher than of lead its use where interference is likely will be advantageous.

Transistors

Progress with the application of transistors in telecommunications has been steady rather than spectacular but evidence from the field of their reliability and suitability is accumulating; new designs for equipment in the audio range will be on a transistor basis. Already a range of orthodox amplifiers and negative impedance amplifiers has been designed using transistors bought to standard specifications and as higher frequency transistors become available the range will be extended.

The Future

The pattern of development for the next 10 years is fairly clear: quicker, better and more world-wide communication of all kinds with equipment of increasing complexity; a minimum of manpower for maintenance and operation; increased emphasis on the mobile field. Changes can only be gradual; existing plant and systems cannot be changed overnight and really new developments can require ten years or more for fruition. Nevertheless, the process is continuous and overlapping and the accumulative effect over the years prodigious.

Sir Archibald Gill would, I am sure, agree that participation in these developments has provided many of us with a lifetime of interest and satisfaction.

Preparation for Subscriber Trunk Dialling at Bristol

B. E. Raker

HER MAJESTY THE QUEEN HAS GRACIOUSLY consented to inaugurate Subscriber Trunk Dialling in Bristol—the first in the country—n Friday, December 5.

Her Majesty, who will be accompanied by H.R.H. The Duke of Edinburgh, will inaugurate he service in Bristol Central Exchange, by making he first subscriber dialled call. The Postmaster General and the Lord Mayor of Bristol will be mong those present.

Afterwards, Her Majesty will be presented with he first of the new 700 type telephone.

The White Paper *Telephone Policy: The Next Steps* (Cmd 436: summarized in our Spring issue) recalled that the intention to introduce STD was announced in October, 1955. By that time Post Office Headquarters were already engaged in selecting a centre for the first installation.

In view of the keen interest which the first STD installation would arouse, it was essential that the project should go ahead quickly and smoothly. Equipment for non-director exchanges would be available earlier than for director exchanges. Trunk mechanization equipment would need to be available at the exchange selected by the time the STD equipment could be installed and ready for use, and there should be room in the existing exchange building for the STD equipment.

Bristol satisfied these requirements. The city is served by a non-director system consisting of a main exchange and nine satellite exchanges. Trunk mechanization was planned for introduction in

1958 and accommodation for the new equipment could be made available by the time it was needed.

The decision to provide STD in Bristol has been very well received, and subscribers are highly appreciative of the compliment which the city has been paid by being selected for the first installation in the country.

Accommodation for Equipment

It is, perhaps, appropriate to explain how space in the telephone exchange building could be made available for the STD equipment at short notice. An extension of the building had been provided for conversion to director type working—because it was expected that, with the growth of the telephone service in Bristol the number of telephones would shortly exceed the capacity of a five-figure numbering scheme. On further consideration it was decided to introduce six-figure numbers and to retain non-director equipment which needs less space. Accommodation was thus available for STD equipment.

Range at Bristol

Bristol subscribers now dial direct to 26,000 subscribers connected to 41 automatic exchanges outside Bristol, and to the operators at Weston-super-Mare for a further 5,600. Subscriber Trunk Dialling will add a further $1\frac{3}{4}$ million subscribers on about 350 exchanges.

At the outset STD will be available only to subscribers on the main (Bristol Central) exchange. Bristol Central serves the heart of the city, where the main business and commercial interests lie, and is by far the most rewarding exchange at which to begin, as it accounts for rather more than half the trunk traffic from the city.

The map in Fig. 1, shows the exchanges outside the first fee area to which STD will be available when the service opens. It includes London and the five provincial director systems, which together open up access to 324 exchanges.

At first sight it may appear that there are important omissions; for example, subscribers will dial Birmingham but not Coventry, Leeds but not Bradford, Nottingham but not Derby. This is because the initial range of access must be restricted to towns to which Bristol has direct trunk lines.

As Mr. Kemp explained in "Subscriber Trunk Dialling Simply Explained" in our Summer issue, the register translator (GRACE) is not expected to give complete instructions for calls with complicated routings via intermediate exchanges. It is no use GRACE saying (as in Mr. Kemp's analogy) "go along this way as far as the next cross roads and ask again" if we know that there will be no one at the cross roads to ask. So complicated routings via intermediate exchanges must wait until other members of the GRACE family have been installed at these exchanges.

Traffic to the exchanges to which Bristol subscribers will be able to dial initially via GRACE represents about 70 per cent. of their trunk calls to subscribers on other automatic exchanges throughout the country.

Considering the total traffic from Bristol subscribers to all other exchanges, including nearby exchanges but excluding Bristol itself, we find that subscribers can now dial 61 per cent. of their calls. With the opening of STD they will be able to dial 84 per cent. and when GRACE can give dialling facilities, via one intermediate exchange, they will be able to dial 92 per cent., as shown in Fig. 2.

Design of Equipment

Having decided to go ahead with STD at Bristol, the first task was to settle the amount of equipment required to give an efficient public service without wasteful over-provision of plant. To do this the number of calls the equipment would be required to carry, and the average duration of these calls, had to be estimated.

We knew the number of calls and their duration from Bristol to the various exchanges up and down the country, under existing conditions of operator-control. From this it would have been a simple matter to estimate the number of calls which would be made with the existing method of operating, when STD was expected to open.

But how would STD affect this traffic? Would the abolition of the three-minute minimum charge reduce the duration of calls? Would the new tariff encourage subscribers to make more calls? How long would subscribers wait before clearing the connexion on "number engaged" or "no reply" calls? Each of these questions could have a profound effect on the quantities of equipment and the number of trunk circuits needed.

On some trunk routes the evening traffic is appreciably above the level during the day, and extra circuits are provided to carry the evening traffic. On these routes a rather more stringent basis of circuit provision is adopted and in consequence operators may have to wait a short time before a circuit becomes free. With STD the

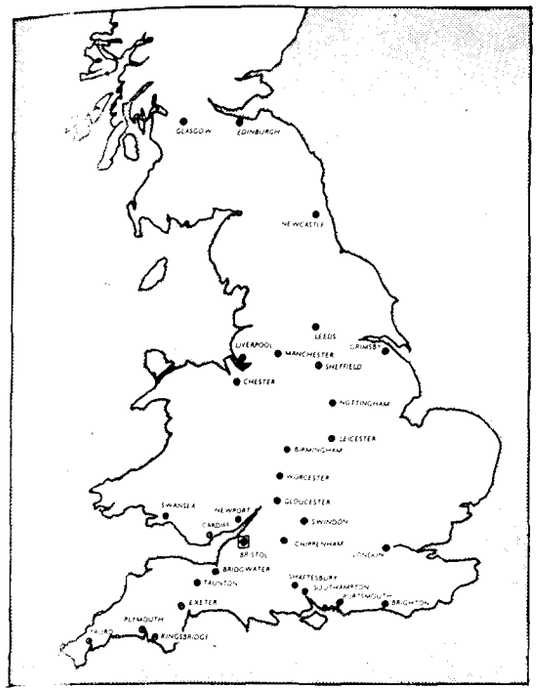


Fig. 1: Towns to which Bristol subscribers will dial

"[c]tion" between the subscriber and the trunk li[ne] will be removed; if all the lines to the distant to[ns] are engaged the caller will hear a recorded an[nou]ncement telling him so and asking him to di[al] again later. In view of this, should there be a m[ore] generous basis of circuit provision on these bu[sy] evening routes?

[By] drawing on the experience of other administ[ra]tions and observing subscribers' habits on th[e] present day dialled calls it was decided that:

- The duration of STD calls will be lower than the present operator-controlled calls.
- STD will give rise to an increase in the total number of calls.
- Subscribers will not clear as quickly as operators on hearing Busy Tone or Number Unobtainable Tone, or on No Reply calls.
- A rather more generous basis of trunk circuit provision should be adopted for "evening busy hour" routes. This applies to the Bristol installation only and will be modified as necessary in the light of experience.

A less obvious example of how subscribers' [ha]bits influenced the design of the equipment is [fu]rnished by a series of special observations to measure the interval between the last two digits dialled by a subscriber. As Mr. Kemp showed, national numbers may consists of 8, 9 or 10 digits. Technical considerations make it necessary for the equipment to know when the subscriber has finished dialling. Therefore, the equipment will "wait and see" if the subscriber is going to dial any more digits after the minimum of eight. After the eighth digit (including the prefix O) has been dialled, a timing circuit is brought into operation. If a further digit is not dialled within about four seconds, the equipment assumes that the full number has been dialled. If a ninth digit is dialled within the four second interval, the same timing circuit causes the equipment to wait a further four seconds to see if a tenth digit will be dialled.

To decide what interval should be allowed, observations were taken to measure the time between the penultimate and the last digits on calls where a subscriber dials five, six or seven digits—the maximum number dialled into the existing Bristol network. The observations showed that in 98.3 per cent. of the calls the interval was 1.8 seconds or less; in 99.9 per cent., 3 seconds or less; while in no calls did a caller delay dialling the last digit for as much as four seconds.

Trunk calls dialled by subscribers will be recorded on the same meter as that used for local calls. The meters at present in use record up to 9999, that is 10,000 units. As the value of a unit is 2d, this represents a little over £80, or, with quarterly accounts, about half an hour's conversation time a day to places 50 miles or more away. A busy subscriber could well exceed this figure so a special five-digit meter, recording up to 100,000 units will be available. The new meter is interchangeable with the present four digit equipment.

The number of large capacity meters required had to be estimated, and the subscribers' lines on which they should be fitted had to be identified. Examination of recent accounts furnished the answer to both questions.

Subscribers' Private Meters

As calls will be recorded on a meter, subscribers will not be able to ask the cost of individual dialled calls—the present "Advise Duration and Charge" facility—so a subscriber (other than one on shared service) will be able to rent a meter which will be fitted at his premises and will work in step with the meter at the exchange. No existing type of meter was suitable for this purpose and the demand for

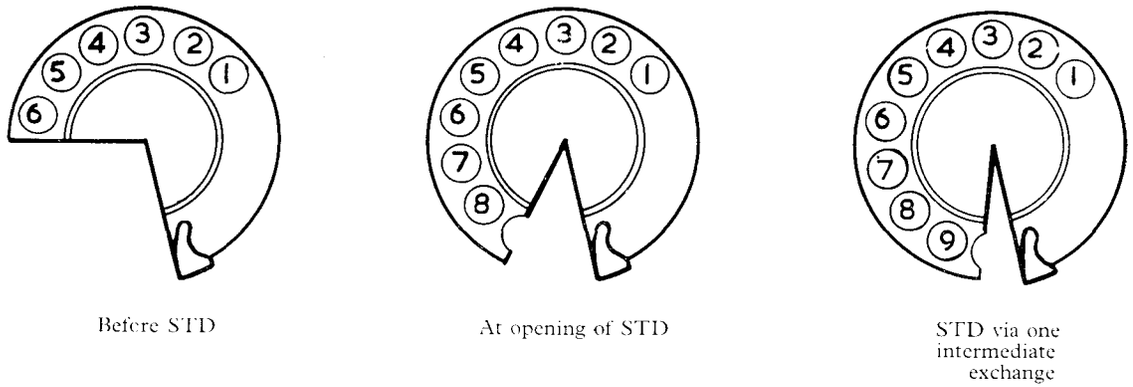


Fig.2: Percentage of calls to exchanges beyond Bristol which Bristol Central subscribers can dial. Each digit represents 10

meters had to be estimated in order to arrange for their manufacture. A study of the use made of existing facilities—for example Monthly Trunk Accounts, Detailed Trunk Statements, Advise Duration and Charge—enabled a forecast of the number of meters required. Immediately after the White Paper had been published, letters were sent to subscribers inviting those who might be interested in private meters to get in touch with the Telephone Manager. This will ensure that at least a substantial proportion of the demand is known, and satisfied, before STD starts. The meters are shown in Figs. 3 and 4.

Change of Code for Operator

With the coming of STD the code for the operator will be 100. Experience has shown that any change of dialling codes needs some little time to become fully effective. Either through habit or as a result of using an out-of-date instruction card, some subscribers will continue to use the old codes. If a change of code were made with the introduction of STD, subscribers dialling O in error would be connected to GRACE.

If this should happen on a large scale, and callers fail to realize their mistake, or are slow in realizing it, and in clearing down the connexion, some legitimate calls to GRACE may fail because the misdialled calls are blocking the lines. The change from O to 100 was, therefore, made a few months ago to accustom callers to the new code. To avoid confusion, the change was made throughout the area served by Bristol, including the satellite exchanges.

Every subscriber concerned was notified of the change in advance; a notice drawing attention to it appears on the front cover of the current directory, and in the new dialling code lists issued for Group Charging. (See Mr. Longley's article in the Winter (February) 1958 *Journal*).

The day before the change was made, operators told callers who had dialled O that the new code would apply as from the following day. Immediately the code was changed, the old code was connected to a recorded announcement telling callers of the new code. As a further reminder the new code was publicised in the local Press and over the radio. It was perhaps too much to expect that even these measures would achieve immediate and complete success—in the first days after the change even members of the staff were sometimes seen furtively replacing their receivers on hearing the announcement—but most subscribers soon got into the new habit of dialling 100 for the operator. Within six weeks the level of traffic misdialled to O had reached negligible proportions and it was possible to withdraw the announcement and connect Number Unobtainable tone. An occasional call misdialled after STD will cause no difficulty.

Lettered Dials for Subscribers

Bristol subscribers will be able to dial London and the other cities which have director working and, therefore, need lettered dials. This meant putting letters on about 15,000 dials on existing telephones; fortunately the complete dial did not have to be replaced, as the number rings are interchangeable. Since it was known the lettered dials would be needed, they have been provided as a matter of course on all new installations connected to the Central Exchange.

Service Observations

To check the standard of service, new service observation equipment has been installed. This equipment, described in the July, 1956 *Post Office Electrical Engineers' Journal*, enables a trained observer to record information about the progress of calls through the exchange. She sees on a special display panel the digits dialled by the caller, and hears the tone—ringing, engaged, and so on—received on completion of dialling. She notes the called subscriber answer, and operation of the subscriber's meter is shown on a strip of lamps which light in turn with each successive operation of the meter. All classes of traffic can be observed, including calls from one Central subscriber to another or, if desired, the observer can concentrate on STD traffic. Provision has been made for connecting the satellite exchanges to the equipment, when they have STD.

Subscriber's Dialling Instructions

The success of STD depends on its ready acceptance by the public. The tariff is, of course, a positive inducement to use STD, but in addition, the instructions sent to subscribers must be as clear and easy to understand as is possible.

Before STD the Bristol dialling code list gave the codes for about 50 nearby exchanges. With STD it includes nearly 400 more. The codes are divided into three main sections:

1. The pre-STD codes, for nearby exchanges: for example, "for Avonmouth dial 82 followed by the number".
2. Codes for towns served by non-director exchanges—those for which a subscriber dials a code followed by the required number: for example, "for Brighton dial ORB 3 followed by the number".
3. Codes for the five director areas—those for which a subscriber dials a code, then the first three letters of the exchange name, then the number: for example, "for Abbey (London) dial O1 ABB followed by the number".

To facilitate reference, the names of the director areas—London, Birmingham, Edinburgh, Glasgow, Liverpool and Manchester are included in section two, referring the caller to the appropriate page for individual exchanges in the systems.

On the same page as the dialling code the booklet shows the cost of a call to any exchange which can be dialled direct, in the form "2d for 20 seconds (30 seconds in the cheap rate period)". Also, examples are shown, on a separate page, of the charges for operator connected calls.

Visits to Subscribers

In addition to the visits to subscribers in connexion with private meters, arrangements were made to visit all the larger subscribers—those with floor pattern private switchboards—shortly before the opening of STD. By this time the subscribers' instruction booklet was available and the new trunk dialling procedure was discussed in detail with the switchboard operators. During these visits the importance of good incoming operating at the switchboard was stressed.

The visiting staff will be available for a time after STD opens, for special visits to subscribers who are in difficulty and for other visits where they may be worthwhile.

Training of Operating Staff

As well as connecting those calls which, for technical reasons, cannot be dialled by subscribers or which the subscriber does not wish to dial, the operators will be required to assist any caller who may encounter difficulty on STD calls.

This demands not only a knowledge of changes in switchboard operating procedure, but also the ability to see things from the subscriber's point of view. Every operator has been given special

Fig.3: Subscriber's meter No. 19 FRA (*Ferranti Ltd.*)

training for the work, including a period devoted to the subscribers' instruction booklet and special features: for example, rented meters, which are peculiar to STD.

Immediately following the opening of STD there will, of course, be a margin of surplus staff, but this will not be excessive. No doubt some subscribers will for a time continue to dial the operator for calls which could have been dialled direct and a small reserve of extra staff will be invaluable in giving that little extra help and advice which can mean so much when any new service is introduced.

Pre-transfer Trial

In view of the nation-wide interest which Bristol as the first STD installation will attract, the opening must be carried through as smoothly as possible, and the equipment must be as perfect

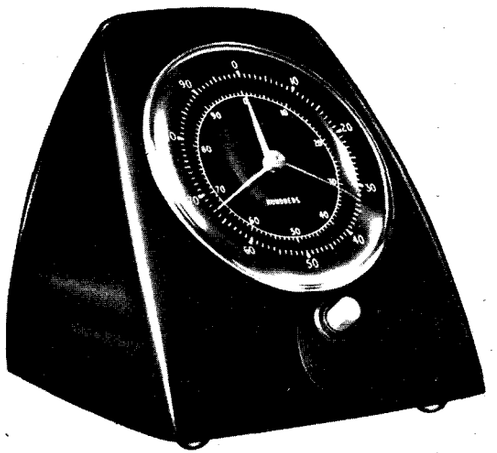


Fig.4: Subscriber's meter No. 19 SSS
(Smith's Industrial Instruments Ltd.)

and trouble free as it can be made. In addition to the comprehensive engineering and traffic testing which normally precedes any major extension of facilities, a large scale traffic trial was arranged to begin about two months before the service was made available to the public, and to continue up to the date of opening.

About 50 official telephones in the South Western Regional Director's Office, the Bristol Telephone Manager's Office and the Bristol Head Post Office were connected to the new STD equipment so that test calls could be made to all exchanges reached by STD. The target was a minimum of 5,000 test calls during the first two weeks. The users were asked to record the results of every call made, and to hold any connexion on which difficulty was encountered, reporting the circumstances, via another line, to a nominated engineering officer.

The new service observation equipment was brought into use at the beginning of the trial, to give additional data on the STD service and to enable the observers to become familiar with the new desks.

The new equipment will of course have to handle a much heavier load when the service is opened and all the Bristol Central subscribers are able to dial their own trunk calls, but the results of the pre-transfer trial from official telephones have been completely satisfactory and have demonstrated that the service given by GRACE is both speedy and reliable.

Conclusion

Preparing for STD at Bristol has been a most absorbing and interesting task. It has brought together, with a common objective, telecommunications and engineering staff of Headquarters, Regional and Area level. The co-operation and assistance so freely given at all times should go far towards ensuring that the new system arrives "Shipshape and Bristol Fashion".

The people of Bristol are justly proud that Her Majesty has consented to inaugurate the new service.

The illustration on page 5 is reproduced by courtesy of Bristol Corporation Publicity Department.

The Queen will also visit Burnham

H.M. The Queen will perform the inauguration ceremony at Bristol during the afternoon of Friday, December 5, after the Postmaster General has shown the Queen and the Duke of Edinburgh an exhibition of STD which the Lord Mayor of Bristol opened on November 24.

During the morning Her Majesty and the Duke will visit the Post Office Coast Radio Station at Burnham, Somerset.

Sinclair Committee Vindicates Telegraph Service

More Greetings Telegrams Recommended

T. P. Hornsey

LAST DECEMBER THE POSTMASTER GENERAL appointed a committee to advise him "on the future place of the inland public telegraph service as part of the communication facilities of the United Kingdom". Their report was published at the end of July.

The Chairman was Sir Leonard Sinclair, Chairman and Managing Director of Esso; members included Sir Norman Kipping, Director General of the Federation of British Industries, Dame Frances Farrar, General Secretary of the National Federation of Women's Institutes, Mr. W. B. Beard, General Secretary of the United Patternmakers Association and former Chairman of the Trades Union Congress, and Professor Frank Paish, lecturer in Economics at London University.

The wide span of interests represented on the Committee—industrial social and academic—was paralleled by the all embracing nature of the terms of reference.

Should the service continue?

This question was the basic one for the Committee to consider and they expressed a clear opinion that it will remain an essential part of our communications at least for a number of years to come. There was a number of reasons for this conclusion including on the one hand the need to deal with 1½ million overseas telegrams a year and on the other the small but vitally important proportion of life and death telegrams (200,000 a year) which the Committee say "cannot be delayed". Moreover the telegram does provide a service of peculiar merit for certain purposes giving a written record of a business transaction or speedy contact with those not available by telephone, a facility which "concerns no one very often but many people very occasionally and which when it does concern them matters very much to them. In a country with a high standard of living it would not be acceptable to be without a service of this nature".

What should be done about the deficit?

Having decided the need for the service the Committee considered the size of the deficit and concluded that it was at present too large. The service has always run at a deficit and this has also been the experience of most foreign administrations with their inland telegraph systems. The annual deficit is lower now than in many of the years between 1948 and 1955 but there has been no tariff increase for more than four years and the deficit is growing.

The Committee's recommendations for tariff changes dealt with both specific services and the tariff as a whole. Dealing with Press telegrams railway pass telegrams, telegraph money orders and telegrams from the Irish Republic, they saw "no reason why these categories of traffic should be handled below cost". For the standard tariff they recommended that an increase should coincide with the change in the structure of the tariff. Since the cost of a telegram to the Post Office does not increase proportionately with its length they recommended a fixed basic charge plus a low charge for every word with no minimum length to the telegram.

What of the future?

The Committee recognize that a very steep decline in traffic, as has occurred for several years, makes it particularly difficult to reduce staff and equipment in line with traffic requirements so as to achieve maximum economy in operation. They suggest that "some increase in Greetings traffic would therefore be beneficial" and welcome the introduction of de luxe Wedding greetings telegrams for this purpose. They comment also that these de luxe telegrams, in so far as they attract traffic that would otherwise be sent at a lower rate undoubtedly reduce the aggregate loss. The Committee recommend that the Post Office should develop special types of Greetings telegrams for the de luxe services (the example quoted "Congratulations on the birth of a child" was spontaneously christened "Storkgram" by the Press when the report was published).

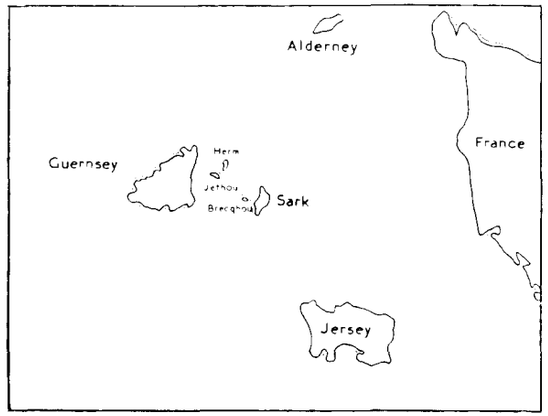
In general the report may be regarded as confirming the policy the Post Office has followed of maintaining the standard of service while containing the deficit by striving after maximum efficiency and attempting to restrain the rate of decline in traffic by developing the Greetings service. It is an encouraging report to those whose duty it is to operate the service because on the one hand, it confirms that the service is "essential though shrinking", and on the other, it encourages action to arrest the decline.

Telephone Service in the Channel Islands

R. A. Jackson and W. T. Bagnall

TELEPHONE service was opened in the Channel Islands—Guernsey and Jersey—just 60 years ago. By 1939 Guernsey had 5,900 stations and five exchanges; Jersey, 5,960 stations and 11 exchanges.

In the February, 1950, *Journal*, Mr. J. F. A. Dimes described the growth of the system during the five years which had then elapsed since the five years of German occupation during the war.



The services have been considerably expanded since Mr. Dimes wrote eight years ago. The number of connexions in Guernsey has increased from 6,344 to 8,759; in Jersey, from 7,098 to 11,299.

The trunk service, first operated in 1931, has expanded even more rapidly. Fifty trunk positions, compared with 13 in 1950, have been installed to handle the present rate of 148,000 originating calls a year from Guernsey and 316,000 from Jersey. A new submarine cable was laid between England and Jersey in July this year.

Guernsey Local System

Following a report compiled by the South-Western Region Engineering Branch in 1951, the Guernsey States Telephone Department is converting its system to completely automatic working, to cater for the large increase in subscribers' lines. The Catel and St. Martin exchanges were converted from magneto to non-director working in May, 1955; they were parented on Central and provided with guarded metering routes to other manual exchanges on the island. The two remaining minor manuals on Guernsey, St. Samson and St. Peter, should be converted by 1960. The scheme should be completed with conversion of Central exchange by 1965.

Before 1953 the five telephone exchanges in Guernsey had numbering schemes which did not overlap, but with the growth of subscribers the separate numbering ranges could not be maintained and the exchange name, as well as the number, has to be given for distinguishing purposes. Probably, when all five exchanges have been converted to automatic working, the present exchange names will be replaced by "Guernsey" followed by a five-digit number.

The 10,000th station was connected on Guernsey in July, 1956. The much smaller islands of Herm, Sark, Alderney and Brecqhou are connected with Guernsey.

Herm's 11 subscribers and three kiosks, are served by a small automatic exchange and connected to Guernsey Central by a single-channel radio link. Alderney and Sark have their own magneto exchanges and are connected to Guernsey by multi-channel radio links.

Sark had previously used the old Guernsey-Sark cable, which the Post Office abandoned in 1956 when a break occurred. However, early in 1957 local officers of the States Telephone Department located the break by taking advantage of an exceptionally low tide and swimming down

the submerged cable. As a result, the cable was paired and is now used as a stand-by should a power failure in Sark put the radio link out of service.

The rocky island of Brecqhou is separated from Sark by the quarter-mile wide Gouliot Passage, in the middle of which is St. Peter's Rock. Brecqhou is served by two exchange lines from Sark which are run to Brecqhou in two 40 lb.-per-mile cadmium copper wire spans of 220 and 240 yards respectively, supported in the approximate middle of the Gouliot Passage by a pole on St. Peter's Rock. Sea gulls often break the wires by flying into them, and the wires are to be replaced by an armoured aerial cable. Brecqhou also has a direct radio link with Guernsey trunk exchange.

Unusual Services

Apart from the ordinary enquiry service with which United Kingdom subscribers are familiar, the exchanges of the Guernsey Bailiwick give a variety of services essential to a small community, which cannot easily be provided by other means. Among them are the provision of arrival and departure times of mailboats, relays of church services, weather reports, football scores, racing results and the times or postponements of social events. In Sark, particularly, but also in Alderney, the exchanges function as general enquiry offices and are a fund of information on all topics.

In 1957 Guernsey exported 49,770 tons of tomatoes and 2,564 tons of flowers. One unusual telephone facility is the fitting and maintenance of farm bells in the farm-houses, actuated by an alarm system which operates when the temperature in the glass-house varies from a predetermined range.

Jersey Local System

The Jersey States Authority has closed the small exchanges in country districts and replaced them with fewer C.B.10 type exchanges. As a result, there are now only four country exchanges, Northern, Southern, Eastern and Western.

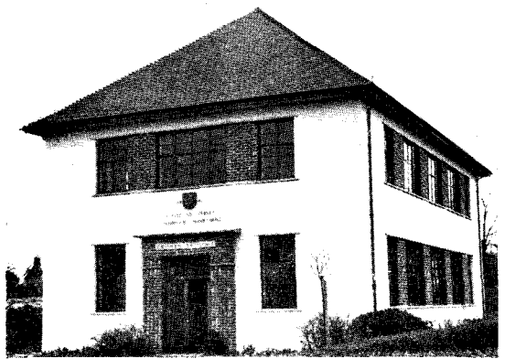
St. Helier, Capital of Jersey, is served by Central and Millbrook exchanges, both of C.B.10 type. In 1946 the British Post Office recommended the provision of an automatic system for the whole island, but because of the high capital expenditure involved the manual system was continued.

As Central was becoming exhausted, another C.B.10 exchange was opened in 1953 in the Lyric Hall on the opposite side of the street. Both main and relief exchanges use the same main distribution frame and take the name of Central. The subscribers were divided between the two switchboards on a numerical, not a geographical, basis, numbers 0 to 1,999 remaining in the main exchange and 2,000 and over being served by the relief switchboard. This avoided the need for number changes, but caused some operating difficulties; for example, many private branch exchanges with non-consecutive numbering schemes have lines in both exchanges which necessitates a special operating procedure.

In 1954, the Post Office recommended a single automatic exchange to serve both Central and Millbrook subscribers and the Jersey States Parliament gave authority for raising the capital.

The design data called for a simple non-director exchange with 9,000 multiple and with routes to its four dependants. The building for the new exchange, which is behind the present Central exchange, has been completed and the installation of equipment started in April, 1958. The exchange should be opened, with the conversion of Central main and relief subscribers, in November, 1959. Millbrook subscribers will be converted about a month later and subsequently certain area corrections will be made, in preparation for which the States Telephone authorities are now modifying the external network. For auto-manual board service the new exchange will be parented on the Post Office trunk exchange.

Like Guernsey, Jersey provides some unusual facilities. Since many people are interested in the time of arrival of the mail boat, particulars are



Jersey, Northern Exchange (CB.10)

given on request from "Enquiries". The results of important local football matches such as the "Muratti" (cup final) are also given.

Trunk Working—General

The Post Office provides the trunk lines between the Channel Islands and the mainland. It also provides the trunk exchanges in Guernsey and Jersey but these are operated by staff of the Islands' telephone authorities.

A great deal of the traffic is seasonal, for the Islands draw vast numbers of visitors each year. Jersey received 157,000 by sea and 265,000 by air in 1957, and Guernsey 118,000 and 89,000. Herm, which has only about 40 inhabitants receives about 70,000 visitors every year.

Holiday-makers' trunk calls in the cheap rate period cause heavier busy hour traffic in the trunk exchanges on both islands in the evening rather than in the day. When such huge numbers of visitors are involved, delays in ship and plane services as a result of bad weather can cause periods of very heavy pressure at the trunk switchboards especially if the delays occur at week-ends, when most of the visitors are arriving or departing. At such times stranded travellers may have to sleep in the airport lounges and restaurants and their need to advise relatives of the delay causes a great increase in traffic to the mainland.

The present volume of traffic could not have been dealt with under the system in use before June, 1950, when calls to the mainland were set up by London operators. The substitution of Demand service, whereby Channel Island operators control the trunk calls and use standard operating procedure, greatly simplified the making of such calls from the Islands. Later in 1950 two circuits from each island were provided with dialling facilities to London by using spare voice frequency telegraph channels, one channel being required for each circuit.

These improvements stimulated much traffic which previously had been suppressed, because of the difficulty in obtaining calls to the mainland. With additional traffic originating from the rapidly increasing number of visitors, the load soon threatened to exhaust the seven new positions in Jersey and six in Guernsey which had been opened in the spring of 1949.

Following a report in 1951 by the Regional Director's Office, additional positions were provided at the trunk exchanges in both islands. More circuits between the mainland and the

Guernsey flowers
(Courtesy, Guernsey Press Co. Ltd.)

Islands were also needed and these were obtained by fitting three submerged repeaters in each of the two cables between Guernsey and Dartmouth, thereby increasing the capacity of each cable to 60 carrier channels. This work was completed in 1952 but owing to congestion on mainland cable routes, the original intention of providing each island with an alternative outlet to Bristol could not be carried out and the new circuits had to be terminated at Torquay for the time being. However, the Bristol routes were provided by the end of 1953 and soon afterwards Guernsey and Jersey were transferred from the London to the Bristol Zone.

The 120 circuits in the two cables are now fully used and the new cable which was laid between Jersey and Bournemouth at about the end of June and terminated at a new repeater station at Tuckton Bridge, near Bournemouth, has a capacity of 120 circuits and contains 10 submerged repeaters.

The circuits in the two routes from each island are distributed equally over existing cables so that the failure of one cable cannot isolate either island. The Jersey to Bournemouth cable, in addition to the two between Guernsey and Dartmouth, enables

the circuits to be redistributed over all three cables, making risk of isolation even more remote.

In 1954 the opening of a new trunk exchange at Jersey provided 2 V.F. dialling on all Jersey to London circuits. Rearrangement of the Channel Islands' circuits released further V.F. telegraph channels which, with new V.F. equipment at Guernsey, were used to provide dialling by A.C. signalling on all Guernsey circuits to London and Bristol. When Bristol trunk non-director exchange is opened later this year the Jersey to Bristol route will be converted to 2 V.F. dialling, thus completing the provision of dialling facilities for routes between the Channel Islands and the mainland.

The Guernsey to Jersey route was originally part of the British Post Office trunk network, but in January, 1955, the two States Telephone Departments rented it and took over the responsibility of providing service between the two islands. The new arrangement started on January 1, 1955 with an inaugural concession of free calls in either direction, which gave rise to more traffic than has been experienced on the route before or since.

Guernsey Trunk Service

The six original trunk positions on the end of the local suite in Guernsey Central exchange were increased to 16 in 1954. The Guernsey States wished at the same time to increase the size of

and Jersey potatoes
(Courtesy, Jersey Evening Post)

their local suite and this could be done only by using positions from the beginning of the Post Office trunk suite and replacing them by the addition of a similar number to the end of the trunk suite.

By 1954 the trunk traffic was increasing by 12 per cent. a year making it obvious that a further extension would soon be required. Seven more positions were installed early in 1956, and the States Telephone Department took a further position for their local suite, bringing the total number of positions to 22 local and 20 trunk, the maximum capacity of the switchroom.

In addition to normal trunk traffic, the trunk suite controls calls between the islands in the Bailiwick of Guernsey because, since they are connected over radio links, such calls are timed.

Since 1956, the level of busy hour trunk traffic has remained fairly constant and, with savings effected by the provision of dialling facilities to Bristol and London, the trunk suite should suffice until 1965, when Central is scheduled to become an automatic exchange.

Jersey Trunk Service

The report in 1951 made it plain that more trunk positions would be needed than could be accommodated in the already crowded switchroom at Jersey Central.

A new sleeve-control switchboard with 20 positions, four monitorials and a supervisor's flat topped desk, were placed in an additional storey on top of the Jersey States Telephone Offices, which are adjacent to Central exchange in St. Helier. The new exchange, providing 2 V.F. dialling on all circuits to London and generator signalling routes to Bristol, Guernsey and Rennes, was opened in 1957.

Records taken shortly after the exchange was opened showed that the positions were more than fully justified, the busy hour calls having increased from 116 originating and 68 incoming in 1951 to 217 and 260 respectively in 1954. As previously mentioned, much of this phenomenal increase was due to traffic previously suppressed. Consequently, the ink was hardly dry on the original design data before it became apparent that a further extension would soon be necessary. An extension of 10 positions was made available by May, 1956, since when the level of trunk traffic has stabilized and it is unlikely that any further extension will be required.

When Jersey Central is converted to automatic

working, traffic incoming from the mainland will be dialled direct via Kingsway or Bristol to Jersey Central subscribers and automatic access will also be given to the minor manual exchange operators. The trunk switchboard will then handle assistance calls and coin-box traffic from Central subscribers to the four manual exchanges. The enquiry suite will be enlarged so that it will be able to handle fault reporting and local directory enquiry traffic in addition to trunk enquiries.

Special Traffic

Jersey exports large quantities of potatoes, 50,394 tons being exported in 1957. Negotiations for their sale between Jersey and the mainland merchants take place over the telephone. Some of the merchants require from 30 to 40 consecutive calls each morning.

To reduce booking delay, a system has been introduced whereby each merchant sends a written list of required calls to the exchange on the previous day. Tickets are then prepared, showing number and routing and are arranged in chronological order. On the next day, the trunk operators are given the piles of tickets, each operator dealing with the calls needed by two or perhaps three merchants. The calls are connected in sequence a fresh one being set up as soon as another finishes. This type of daily traffic lasts for three to four weeks, starting at the end of May or in early June, according to how soon the potato crop matures.

Jersey also exports tomatoes (25,265 tons in 1957), broccoli and cattle, and the marketing of these products also gives rise to telephone traffic to the mainland.

Jersey's annual "Battle of Flowers" is a popular attraction for visitors and the week during which it takes place is the peak period for trunk traffic, the exchange clearing more than 1,000 effective calls between 6 o'clock and 10.30 each evening.

Continental Service

The single circuit from Jersey to Rennes, reopened in 1949, is operated in French on a "Tête de Ligne" basis, the Jersey operator passing the name and department of the required exchange to the Rennes operator. Calls could have been made to French Zones One and Two, but for various reasons were limited to Rennes and surrounding departments.

The service was suspended for a time in 1954 because the Jersey inland end of the cable, which had become corroded, had to be replaced. It was restored later in the same year and a high grade circuit was provided. Tests were made to various French exchanges in 1955, as a result of which calls are again routed to the whole of France, and no difficulty has been experienced.

By arrangement with the French authorities, the old system of timing every call at both ends of the route was abolished. Traffic has increased since then and an additional circuit was provided in July, 1956. Some 3,500 calls originated in Jersey in 1957 compared with 1,800 in 1949.

The authors gratefully acknowledge the assistance given in the preparation of this article by the States Telephone Authorities of Guernsey and Jersey; the *Guernsey Press* and the *Jersey Evening Post*.

P. O. T. & T. Society Programme 1958-59

THE POST OFFICE TELEPHONE AND TELEGRAPH Society of London opened its winter session on October 6 with an address on "Postal Mechanization" by Brig. K. S. Holmes, C.B.E., Director of Mechanization and Buildings.

On November 3, Mr. R. F. Bradburn, Wales and Border Counties and Lt. Col. D. T. Gibbs, M.V.O., O.B.E., T.D., of the External Telecommunications Executive, spoke on "The Post Office and the VIth Commonwealth and Empire Games". Mr. W. A. Wolverson, C.B.E., Director of Radio Services, will talk on "The International Telecommunication Union" on December 8. Dr. W. F. Floyd, Consultant Physiologist to the Post Office will speak about "Ergonomics in the P.O." on January 12, and on February 2 Mr. W. S. Procter, Chief Regional Engineer, London Telecommunications Region, will talk on "Automatic Aids in Telecommunications Maintenance".

The programme closes on March 4 with an address by Col. J. Reading, M.B.E., Ericsson Telephones Ltd., on "The Telecommunications Industry and its Customers".

All lectures will be given in the Lecture Theatre of the Institution of Electrical Engineers, Savoy Place, W.C.2, beginning at 5 p.m.

In addition, the Society hopes to arrange visits to Gatwick Airport, Waterloo Station Signal Box and other places of interest to members. Mr. H. C. Edwards, Inland Telecommunications Department, G.P.O. Headquarters Building, London, E.C.1 is the Honorary Secretary.

Commonwealth to lay Round the World

"Lightweight" Telephone Cable

IT WAS ANNOUNCED FROM MONTREAL IN September, during the Commonwealth Trade and Economic Conference, that agreement has been reached in principle for a round the world submarine telephone cable system to be constructed.

In amplification of this statement it has been made clear that no attempt has yet been made by the countries concerned to reach detailed or binding commitments, as many technical problems remain to be solved and many financial question still have to be discussed. But these qualifications notwithstanding, the agreement in principle has been generally welcomed as an important step forward in the world's transoceanic communications.

The developments envisaged—a cable system 12,000 miles long, costing £88 millions to construct would more than double the length and capacity of the submarine telephone cables of the world. The only Commonwealth countries at present linked by such cables are the United Kingdom and Canada, served by the first transatlantic telephone (TAT) cable completed in 1956. Canada and the United Kingdom have already announced their intention to lay a second (CANTAT) cable connecting their two countries in 1961, and the further cables now proposed would be integrated with these cables.

The Commonwealth proposals include an 8,000-mile Pacific Ocean section connecting Canada with New Zealand and Australia; a 6,000-mile South Atlantic Ocean section linking the United Kingdom with West and South Africa; and an Indian Ocean section between South Africa and Australia which will join up East Africa, India, Pakistan, Ceylon and Malaya, and thus complete the girdle of the world.

The cable and repeaters to be used will probably be of similar design to those intended for CANTAT which was briefly described by Sir Gordon Radley in his paper, "Communications between Nations and between Peoples" reprinted in our Summer issue. This would indicate a single bothway cable system, using rigid bothway repeaters developed by the Post Office in conjunction with the new British "lightweight" cable with the strength member in the cable core instead of in external armouring wires. CANTAT will no doubt be undertaken first, as some of the proposed new sections include long difficult cable links at very great ocean depths. The whole project, including CANTAT, would be expected to take about 10 years to construct.

Planning was begun in 1956, when the coming into service of the TAT cable showed how much the Commonwealth, with its extensive network of radio communications subject to all the hazards inseparable from radio working, might benefit from a large-capacity, stable cable system.

The first blueprint was prepared by the Commonwealth Telecommunications Board, and this was elaborated in London this summer by a technical conference at which all the countries of the Commonwealth were represented. It is the plan prepared by this conference which Commonwealth Ministers have endorsed in principle at Montreal.

The next stages have yet to be settled in detail. Commonwealth Governments will need to decide when, and to what extent, they can each participate financially in the project. When this background has been clarified, it is likely that there will be further discussions regarding the precise arrangements of the successive stages of the scheme.

AUTUMN BECOMES WINTER

We print on the front cover of this issue, and under the contents list, the name of the month as well as the name of the season, of publication.

This is to keep the records clear and to prevent readers being confused when they discover that this is the second "Winter" number of 1958, the first having been published last February. We shall not use such a double description again.

The designation of the issue as "Winter", instead of "Autumn" as it would have been normally, arises from the decision, notified in our last issue, to change the seasonal designation of the four issues published during the year from the names of the strict solar seasons during which they are published (which we have used since November, 1955) to those more in line with common usage, and with the periods during which each successive issue is current (that is, until the next issue appears).

Thus, this issue, the first of our 11th volume published on November 20, becomes "Winter" instead of "Autumn". With our next number, due on February 20, readers will find with Shelley, "bare 'winter suddenly changed to spring' ". It follows that the issue due on May 20, 1959 will be named "Summer"—more appropriately, we hope, than this year—and the following August 20 number will become "Autumn".

Post Office Clocks in London Exhibition

The Post Office Quartz Clock and the Speaking Clock ("TIM") were included in the "Pendulum to Atom" centenary exhibition illustrating the development of timekeeping during the past 100 years, organized by the British Clock and Watch Manufacturers' Association at Goldsmiths Hall, City of London, in October.

The Quartz Clock (which was the subject of a *Journal* article in February, 1951) was described in the Exhibition catalogue as follows:—

"This quartz clock consists of a standard Post Office quartz crystal oscillator, the 100 kc s output of which is used to control a chain of electronic frequency dividers. In the division equipment the frequency is reduced first to 50 c s by hard valve multi-vibrator-type dividers, and thence to one pulse per second by a cold-cathode ring-type divider having a time stability of ± 3 sec."

"In terms of timekeeping, this clock, if set to have zero rate at the beginning of a year, would have a gaining rate not exceeding 1/500 sec. per day at the end of the year. The timekeeping performance is predictable several months ahead and hence this type of clock is an essential item in observatories where a time service is maintained".

The Speaking Clock exhibited was the Mark II, 1954, the prototype version made for the Australian Post Office.

"The Mark II clock", said the catalogue, "operates from a quartz crystal-controlled oscillator which maintains the accuracy to within 1/200th second with a check every 24 hours . . .

"The 4,320 different announcements required during any twelve hours are 'constructed' from 80 separate phrases which are recorded as circular sound tracks on three glass discs. Thus, one track on the hours disc contains the phrase 'At the third stroke' and is reproduced by a fixed photocell, while a series of tracks containing the hours phrases are reproduced by a moving carriage. Similarly the minutes disc carries all the minutes tracks from 'one' to 'fifty-nine' and 'o'clock', and the seconds disc has the seconds announcements and the pip signals."

The Post Office purchased 216,900 telegraph poles last year, 12,400 of which were from home woodlands.

Private Mobile Radio Services

Ten years ago the Post Office licensed the first private mobile radiotelephone service using VHF equipment. There are now 1,900 of these services with a total of 2,100 base (fixed) stations and 16,000 mobile stations. They provide communication with all kinds of mobile units such as ambulances, taxis, commercial vehicles, tugs, oil tankers, shunting engines and cranes. The effective range of communication of a VHF mobile service may be as little as half-a-mile with walkie-talkie sets, or as much as 30 miles with transmitters of normal power (10–15 watts) if the base station aerial is on a hill-top. In the following article Mr. A. A. Mead of the Radio Services Department at Post Office Headquarters gives a general outline of the licensing arrangements. His article is followed by a description of the service operated by the Automobile Association, one of the most highly developed systems in this country, as an example of the growth and use of a private mobile service.

The Post Office and the Services

A. A. Mead

THE ADMINISTRATION OF PRIVATE MOBILE services is centralized in the Radio Services Department at Post Office Headquarters and, as the growth of the services suggests, the licensing policy is a liberal one. Indeed, a licence is granted to anyone who has a genuine need for communication with mobile units, provided that

(i) the messages passed relate only to the business of the licensee (that is, no "third party" traffic), and

(ii) the equipment used meets the technical standards prescribed by the Post Office.

Calls may not be extended over the public telephone network.

The annual licence charge is £3 each for the first two stations and £2 for each additional station. Thus, for example, a business firm with one base station and five radio-equipped vans would pay £14 a year in licence charges. The licence charges are intended to cover the Post Office's administrative costs and not to make a profit; they have been reduced from time to time as the number of services has grown.

The frequency bands available for private VHF services are around 80 Mc s and 170 Mc s for land services, and around 160 Mc s for private maritime services (including a small band of frequencies for shipping agreed internationally at a recent Radio Conference). The frequency channel to be used by each private service is allotted by the Post Office and is specified in the licence; usually a "channel" consists of two frequencies, one for transmitting to the mobile stations and another for receiving from them. Under the frequency plans now in force, groups of channels are allocated to the main categories of user: one group for ambulances, another for taxis and other commercial vehicles, another for fuel and power services, and so on.

In many parts of the country, particularly the big cities and industrial areas, the demand for channels exceeds the number available and the users have to share the same frequency channel. Although the general philosophy seems to be that a shared channel is better than no service at all, channel sharing is and will remain the cause of a large proportion of the interference complaints made by users. It is a feature of mobile radio on which the Post Office takes some pains to forewarn people who apply for licences; in fact, most applicants agree in principle that channel sharing is necessary, until it happens to them!

Radio Interference Problems

Apart from channel sharing, the steady growth of mobile radio has unfortunately brought its own interference problems with it. These services are low powered and must use sensitive receivers to obtain a reasonable range of communication with their mobile stations. In consequence they are rather vulnerable to many forms of radio and electrical interference. Complaints about interfer-

ence are investigated locally by Telephone Area staff, or by the Post Office Engineering Department, unless it is clear from the information given that the interference is due solely to channel sharing.

Future Developments

The VHF part of the radio spectrum is already so fully equipped by broadcasting and television, navigational aids, civil and military communications and other services, that the prospect of providing more space for private mobile services is remote. The most practical way of relieving the congestion on mobile radio channels without adopting a restrictive licensing policy is, therefore, to make more channels available by introducing narrower channelling within the present mobile radio bands. This course was recommended by the Mobile Radio Committee, which advises the Postmaster General on matters affecting the users of mobile radio, and steps are being taken to put it into effect.

The standard channel width for frequencies around 170 Mc s has already been reduced from 100 kc s to 50 kc s, and advances made in equipment design will shortly enable the channel width in the 80 Mc s band to be reduced from 50 kc s to 25 kc s. These changes will, in time, almost double the number of channels available for private mobile services. However, the benefit of the narrower channelling cannot be gained immediately because, in fairness to existing users, one must allow them a period of about five years for the change-over from old type equipment to the new. The new equipment, incidentally, is somewhat more expensive and this sounds the warning note about aiming for even narrower channel spacing. Technically, this may soon become feasible, but it would defeat the object of licensing private radio services if the equipment became too costly for the small user, or if it became so complex and temperamental as to need frequent maintenance by expert engineers.

The advantages of being able to direct the movements of vehicles by radio from a central point are obvious. To the operator of a fleet of vehicles, the ability to send radio instructions to drivers en route can result in substantial savings in petrol, tyres and, above all, time and even in the number of vehicles required. As a means of reducing "wasted" mileage, mobile radio has made a significant contribution to the efficiency of the organizations using it and, judging from present trends in the growth of services, the demand for service is likely to continue for many years to come.

The Automobile Association's Radio Network

D. J. A. Stevenson

In 1949, the Automobile Association, now 53 years old, started its first experimental mobile radio scheme in London as an addition to its many aids to happier motoring. Below, the Association's Communications Manager describes the development of the service over the past nine years.

DESPITE INNUMERABLE RESTRICTIONS AND difficulties, the immediate post-war period was one of intense activity in the motoring world. It was obvious to the Automobile Association that, with the eventual removal of petrol rationing and the increasing availability of cars on the home market, not only would additional benefits have to be provided for members, but existing services would have to be extended and improved.

One very obvious way of extending and improving existing services was to exploit the many technical advances in radio communications which had resulted from wartime research. So, early in 1949, the A.A. installed experimentally on the roof of its London Headquarters, Fanum House, a transmitter to maintain contact with two breakdown vehicles fitted with two-way radio. This service formed an extension to the free breakdown scheme and operated after normal working hours to assist members whose vehicles had broken down at a time when many garages were closed. The experiment was highly successful and during the year additional radio-controlled vehicles were brought into service. However, the transmitter at Post Office did not give a sufficiently wide range, and in 1950 another was installed at Hampstead, the highest point in London, linked to the A.A's headquarters by land-line. This same year saw the inauguration of a similar radio control scheme in Birmingham, while Leeds was brought into the network a year later. The breakdown vehicles operated within the city areas at nights and at weekends, being directed from breakdown to breakdown by the emergency staffs in the local A.A. offices.

But while the night breakdown scheme had amply proved its value, it was obvious that there was a need for maintaining contact with A.A. mobile units outside the urban areas. So, early in 1952, experiments were carried out to determine whether or not it would be possible to instal two-way radio equipment in the motor-cycle sidecar patrols of A.A. Road Patrols. The experiments were successful and eight motor-cycle outfits were so equipped in the London area; 10 more were brought into use in Surrey in 1953.

In 1953 also A.A. mobile radio was inaugurated in Glasgow, where breakdown vehicles operated night in the city and motor-cycle patrols covered the approach roads during the day. To begin with, a transmitter was installed on high ground at Tollcross near Glasgow, and linked by land-line to the A.A. headquarters. More recently a 54-foot mast was erected on the roof of the A.A's new headquarters in Blythswood Square, Glasgow, and the transmitter was installed in the building.

By the end of 1953 the enormous value of radio control had been demonstrated beyond all doubt and a concerted effort was made towards establishing a nation-wide coverage. The scope of the existing schemes was extended and new radio control centres were set up in the Association's offices at Newcastle, Manchester, Nottingham, Bristol and Cambridge. The very considerable difficulty of ensuring that qualified staff were available to operate the schemes was overcome by installing radio equipment for instruction at the A.A's Patrols' Training School near Nottingham.

In 1955—the A.A's Golden Jubilee year—the radio network was extended still further to the headquarters in Reading, Chelmsford, Maidstone, Cardiff and Edinburgh, and a year later Radio Patrols were introduced in the Jersey and Brighton districts, and around Dublin and Belfast. By this time some 38,000 square miles of the British Isles were covered by the A.A's radio "umbrella" which was further extended in 1957 to take in the areas administered by Exeter and Stoke-on-Trent.

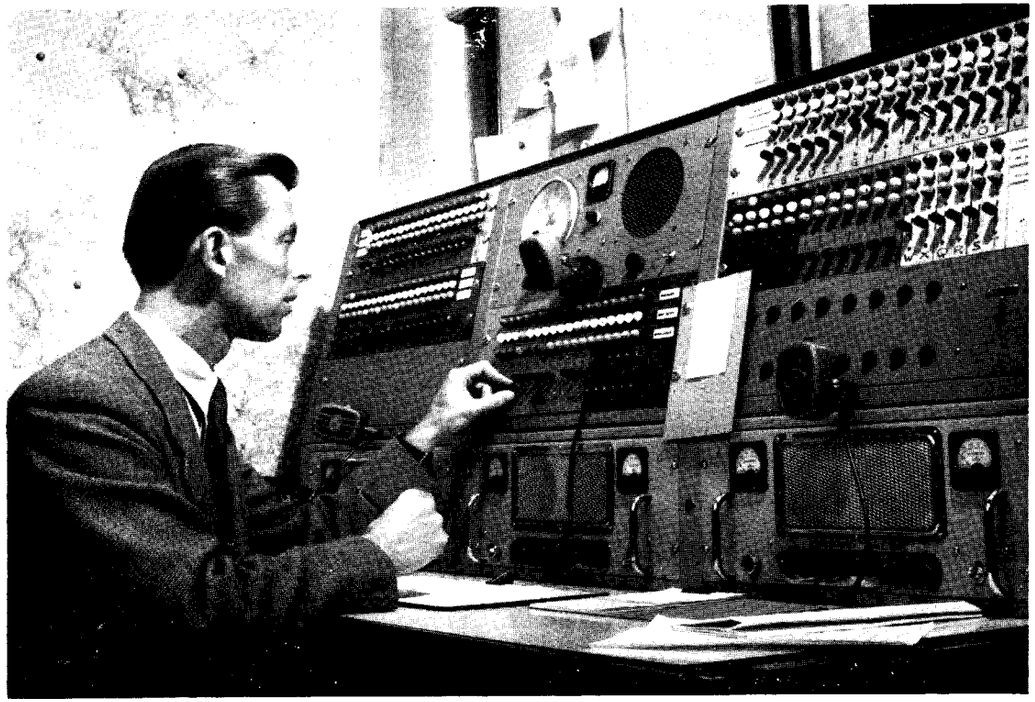
There were now 28 fixed transmitter stations at carefully selected sites enabling direct contact to be made with over 400 mobile units, including 86 Land Rovers, 200 motor-cycle Patrols, over 50 staff cars and some 70 portable stations—that is, mobile offices, transportables and walkie-talkie sets. Besides this impressive array radio equipment, operating on both the fixed and mobile frequencies, is installed in the A.A's "spotter" aircraft. By this means air to ground contact can be maintained with control rooms or mobile units over very considerable distances during special events like the Derby.

Avoiding Interference

Throughout the country, each of the A.A. fixed stations transmits on the frequency of 85.525 Mc s and all mobiles transmit on 72.025 Mc s. To avoid heterodyne interference in districts where the coverage from two fixed stations overlap, adjoining area control sets have been "offset" 7 kc s. With three exceptions, where 25 kc/s bandwidth radio equipment is in use, all existing fixed station transmitters are standard 50 kc s bandwidth apparatus.

Mobile radio service has now been extended to the Bournemouth and Southampton areas. Three fixed transmitter stations were installed, including one on the Isle of Wight, bringing the total area covered by the A.A. network to over 44,000 square miles of the British Isles. The Land Rovers which form the "Highland Patrol" in the north of Scotland were also equipped with radio last July.

In London and in 18 other radio control centres, round the clock service is available to members who telephone for information or help. But in some of them, to avoid the necessity of maintaining a night staff, there is a unified system of control during the "silent hours". For example, although breakdown vehicles are on duty in Chelmsford, Maidstone, Guildford and Reading, members who ring these offices at night are automatically connected to the Operations Room in London via



London control console

inter-switchboard private wires. The breakdown vehicles in these outlying districts are controlled by the London emergency staff who operate the respective local transmitters by remote control landlines. A similar system links Liverpool with Manchester and Sheffield with Leeds.

Since the A.A. radio network operates on land and in the air, it is not surprising that it also operates at sea. There is a control room in the Association's port office at Dover which maintains radio contact with A.A. port officers travelling on four of the car ferries sailing on the short sea routes between England and France: S.Ss. *Lord Warden*, *Dinard*, *Halladale* and the new M.V. *Compiègne*. The great advantage of this link is that information regarding changes in members' reservations, registration details, documentation and other formalities can be exchanged between the port office and the A.A. representatives on board, and much of the necessary work can be completed while the ship is still at sea.

Besides the various fixed installations, the A.A. has equipped its fleet of mobile offices with radio. These are all headquarters in miniature, which are moved about the country to attend all kinds of outdoor events where motoring service is likely to be required. They are used as local control stations to provide temporary radio communication with A.A. vehicles and Patrols in the immediate vicinity, and to maintain contact with Patrols equipped with walkie-talkie apparatus who may be engaged, for example, on car parking duties.

In this fleet there are also two super mobile offices each mounted on an articulated chassis; they have hydraulically operated masts capable of being extended to a height of 50 feet. Each has its own radio room with a 15-watt transmitter/receiver, besides plenty of space for receiving visiting members. These super mobile offices, nicknamed Jumbo I and Jumbo II, are equipped with a generator to provide power, heating and lighting, and even have sleeping accommodation for the crew of two.

But true to its tradition, the A.A. is still experimenting with new and improved techniques. Today's traffic conditions have inevitably impaired

ne mobility of the A.A. Radio Patrol mounted on is motor-cycle combination, and so a new type of dio set is being tried, which can be mounted on solo machine. It is unlikely that these solos will persede the familiar yellow and black combina-n, but there is no doubt that on congested roads ey will make a valuable addition to the A.A's ad service organization.

In an amazingly short space of time, the A.A's dio network has been extended to virtually all the most densely populated parts of the British Isles bringing with it, literally, help in a flash. No service even remotely approaching it in extent, comprehensiveness and efficiency is offered anywhere else in the world. The scheme will be expanded until the ultimate goal of complete national radio coverage is attained, for the A.A. is convinced that the flexibility of communication which only radio can give is essential for efficient motoring service under modern traffic conditions.

Twenty Years of a Rural Exchange

S. G. Coulson

THE MAIN OCCUPATION IN NORTHERN IRELAND is farming, in which some 11 per cent. of the population is engaged wholly or part me".

This is the laconic opening sentence in an article n the economic features of Northern Ireland in he official *Year Book*. A local poet, Carroll Culbert, aw agriculture differently, however:—

> "This was the scene, these ruins called to mind.
> Once home of simple people—loyal—kind,
> Where son had followed father: tilled the earth,
> Prepared the soil for seed at Spring's rebirth,
> And reaped the harvest due, as Nature meant:
> A way of life that brought a deep content—
> A quiet world, alive to Nature's ways,
> Where healthful sleep the honest toil repays".

And the poet's picture is very close to the popular dea of what life in the countryside is like, but, as he saw, the pattern of the rural community is changing and in Northern Ireland, as elsewhere, here is a steady emigration to the towns.

Industrially, Belfast is playing an increasing part in the economy of Northern Ireland but there is little doubt that the prosperity which the encouragement of agriculture brought to the rural areas has lessened the impetus of the migration. Farmers and farmers' wives no longer regard such amenities as electric power, mains water and telephones as the prerogatives of the towns and cities only. In consequence, the Post Office is expected to install telephones at the same time as power and water supplies are laid on. This demand has increased steadily since the war and it is interesting to trace the development of a typical rural exchange in Northern Ireland.

Killinchy is a small village near Strangford Lough about 12 miles from Belfast. The village itself, with the church, school and forge, is about a mile from the main road along which the 'bus service passes. But while the old village still retains the traditional peace associated with such places the Post Office, the bank and petrol stations have established themselves on the main road. As this road was the obvious route to outlying parts of the locality, the first choice for the site of a telephone exchange was nearby. Here the Killinchy Rural Automatic Exchange was built in 1935.

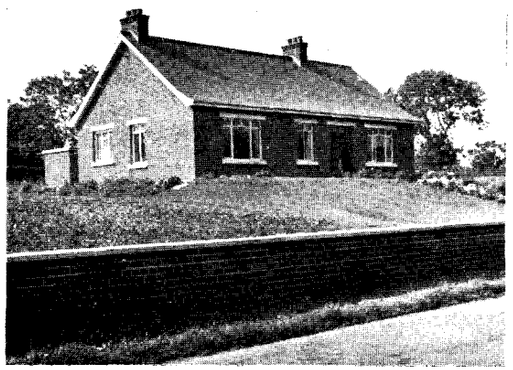
Records show that there was difficulty in obtaining the minimum number of subscribers—eight—to justify the provision of an exchange, so much so that the exchange area as originally proposed was enlarged to include some distant farms where telephones would probably be required. The forecast of telephone growth—26 lines by 1958, against an achievement of 184 among 450 tenancies

Killinchy, the old—

—also shows how different the ideas of telephone development were then.

The war demanded greatly increased supplies of home produced food and Northern Ireland farmers in doing their best to increase production readily accepted increased mechanization as a means to that end. In many other ways, too, new ideas, which in normal times would have progressed slowly, were eagerly sought by a community which was traditionally conservative. It is not surprising, therefore, that the demand for telephones increased rapidly at this time.

Because the amount of equipment which could be installed during the war, and in the immediate after war years, was restricted, provision in Killinchy, as everywhere, could not keep pace with the increasing rate of orders. By the summer of 1951, however, after several years of waiting, the original exchange designed to serve 90 subscribers was replaced by a larger one which could take 200. At the same time the range which Killinchy people could dial was extended from five to 15 miles, and as this enabled them to dial Belfast, their chief market and source of supply, it was a real advantage.



and the new

Between 1951 and 1956, as line plant was extended, over 90 subscribers were connected and by 1956 all arrears of work had been overtaken and there were no outstanding applications. In 1957, a cable was laid from Comber; this meant that the circuits to Belfast—the main outlet for the exchange—were placed underground with a resultant improved maintenance for less cost. On January 1, 1958, Group Charging and the extension of subscriber dialling enabled Killinchy subscribers to dial to 30 exchanges instead of 18, and increased the number of exchanges in the 3d. call area from two to 51.

Under the former system of charging the demand for telephones from the smaller farmers exceeded expectations, so even greater increases may follow the increased dialling range and cheaper calls now available. As the telephones likely to be required will probably be fairly evenly distributed throughout the district, rather than concentrated in clusters, the cost of providing service will be high and the charge on Post Office resources of men and materials will not be light. In these circumstances such developments as the automatic line connector to utilize line plant more efficiently, and polythene cable to save expensive construction costs will be especially welcome.

This little sketch of the first two decades of Killinchy telephone history shows how rapidly a rural exchange has developed because of the greater prosperity of agriculture; and it shows, also, the great advantages of the telephone in a rural community, and how the Post Office has met this challenge using traditional methods. With the coming of the new system of charging, will even the smallest Killinchy farm want a telephone? If so, the new techniques the Post Office will have to use to answer its new challenge will provide the story of the third decade of Killinchy telephones.

On January 7 the BBC will televise "Medico", a documentary programme about the free ship-shore medical service maintained by Post Office Coast Radio Stations. Written by Robert Barr, the programme shows how a sailor, injured in an accident, is treated by a doctor through Lands End Radio.

Medium Frequency Radiotelephony for the Merchant Navy

V. Bourdeaux

Mr. Bourdeaux discusses the development and practice of medium frequency services. We hope to publish shortly a complementary article on the high frequency radiotelephone services.

TODAY IT WOULD SEEM STRANGE IF IT WERE not possible to telephone to ships at sea. It is common knowledge that one of the earliest uses of radio was to provide telegraphic communication between ships and the shore. While this telegraph service dates back more than 50 years it was not until 26 years ago, in 1932, that the first telephone service to ships was provided through certain Post Office short-range coast radio stations.

The Post Office's connexion with radio services to merchant ships dates back to 1908, when its first Coast Station was opened at Bolt Head, in Devon. In 1909 the Post Office took over the Marconi Coast Stations, and by 1913 a reorganized and augmented chain of coast stations provided telegraphic communication with ships in coastal waters around the British Isles, within a range of about 150 to 300 miles.

Radiotelephony did not become practicable until the development of the thermionic valve. Experiments were being made before the 1914–18 war, but the need for mobile communications for the armed services stimulated development and by the end of the war radiotelephony over a limited range was practicable.

The more immediate post-war developments were for sound broadcasting and for long distance overseas telephony. Before 1932, however, the possible use of radiotelephony in the maritime mobile service had not been overlooked, as can be seen from the Radio Regulations of the International Telecommunication Convention at Washington in 1927, which provided for the use of telephony in the maritime mobile bands. But it was the next conference at Madrid in 1932 that took the first steps to organize the medium frequency maritime telephone service, and made provision for a distress service on 1,650 kc s.

International Radio Regulations require that no transmitting station shall be established or worked without a licence issued by the Government to which the station is subject. They also require operators to possess a certain standard of knowledge and ability. For the United Kingdom, the Postmaster General is responsible for administering the regulations. The Post Office is therefore responsible for licensing radio stations on merchant ships and for issuing to qualified radio operators certificates of proficiency and authorities to fill the position of operator of a ship's radio station.

While the radiotelegraph operator has to be comparatively highly qualified, the International Regulations impose less onerous requirements on the operator who is to have charge solely of low power radiotelephone equipment, and leave it to each administration to fix the conditions for obtaining a restricted certificate if the power is less than 50 watts.

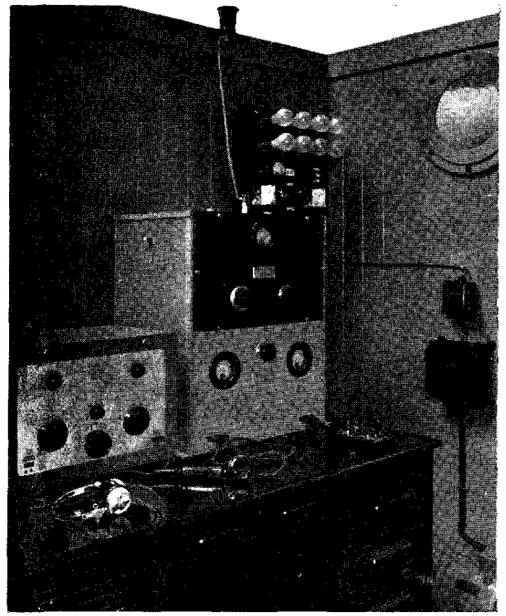
Nowadays the equipment itself is simple to operate. The operator therefore need know only the operating procedure for the telephone service, the rules and regulations relating to the safety of life at sea, and how to handle the equipment.

Medium Frequency Service

When the short-range telephone service was started in 1932, the frequency spectrum was not overcrowded nor was there a large volume of traffic. The requirements imposed by International Radio Regulations on equipment performance were not very onerous. This medium frequency service has developed considerably since then and more than 4,500 British ships are now fitted with medium frequency radiotelephone equipment. Coast station traffic handled is steadily increasing by more than 15 per cent. each year.

From the start these radio circuits to ships were arranged so that they could be linked to the inland telephone network. Originally, the service operated on "simplex" or the well-known "over" procedure only, but all the coast stations are now equipped for "simplex" or "duplex" (simultaneous "speak" and "listen" conditions) working as required.

The current Radio Regulations result from a conference at Atlantic City in 1947, which made only minor changes to the medium frequency bands for the maritime mobile service. Bands between 1,605 kc/s and 3,800 kc/s were then



An early (1930) trawler installation
(Courtesy International Marine Radio Co. Ltd.)

allocated and a world-wide calling and distress frequency was introduced on 2,182 kc/s. An Extraordinary Administrative Radio Conference (E.A.R.C.) at Geneva in 1951 planned the changes required to implement the frequency table of the Atlantic City Radio Regulations, and the changes affecting this service were made in 1953.

For the purpose of planning the use of frequencies the United Kingdom divided ships into two categories. The first, "Coasters and Deep Sea Ships", includes tugs, pilot vessels, cross-channel passenger boats, yachts and other miscellaneous craft; the second, only fishing vessels. Each category has frequency complements exclusive to its use, including frequencies for intership working. In the United Kingdom the ship-shore frequencies have been designated as Channel 1, Channel 2 and so on, to assist speedy working and avoid the possible errors resulting from quoting the ship working frequency when changing from calling to working conditions.

The United Kingdom plan provided for certain ship to shore frequencies to be regarded as for primary use to alternate coast stations round the coast, thus avoiding interference to adjacent stations. By equipping for a minimum of two frequencies a ship can thus communicate with any United Kingdom coast station on an appropriate primary frequency. Four frequency channels are allocated to each category of ships for working to coast stations and an additional channel is available for working to the coast stations at Wick and Humber.

The main ship channels use frequencies between 2,009 kc/s and 2,555 kc/s. The corresponding coast station frequencies lie in two groups between 1,715 kc/s and 2,754 kc/s.

Early Equipments for Medium Frequency

Before the service was opened in 1932 the leading marine radio equipment manufacturers submitted their proposed equipments as "types" for testing by the Post Office; this procedure simplified problems associated with licensing and installation.

The International Marine Radio Company was first in the field towards the end of 1930 with a combined equipment for telegraph or telephone service. The telegraph transmitter consisted of four 50-watt triode valves all used in parallel in an adjustable frequency oscillator circuit directly coupled to the aerial. For telephony the four valves were divided into two pairs. One pair operated in the same oscillator circuit while the other pair provided a parallel amplifier for anode modulating the master oscillator. A low power condition was provided by altering link connexions in the equipment to disconnect one valve of each pair.

For Interrupted Continuous Wave telegraphy a note frequency of 1,000 cycles was provided by use of a tone wheel interrupter. The 12 volt filament supply and 800 volt H.T. supply were provided by generators, double-wound for operation from ships' mains at either 110 or 220 volts D.C. The total power consumption was about 750

watts and the power delivered to the aerial for telephony about 100 watts. Satisfactory tests were conducted and the equipment was accepted in March, 1931.

Later in 1931, the Marconi International Marine Communication Company put forward two equipments for type testing. Types 503 and 506 were rated on input power as 300 w. and 60 w. sets respectively. Both equipments provided Continuous Wave and Interrupted Continuous Wave telegraphy, with telephony facilities. The 503 was for operation from a 24 volt battery and the 506 from a 12 volt battery. Both sets covered the two frequency bands 1,300-2,750 kc/s and 360 to 515 kc/s. The 506 employed two valves, one used as the master oscillator and the other to provide anode modulation. The tuned closed circuit was coupled to a tuned aerial circuit. For I.C.W. operation a note frequency of 550 c/s was provided. Both equipments were accepted in October, 1931.

Thus far the new telephony facility was regarded as something to be added to telegraphy rather than as a separate and distinct service.

Next, Siemens Brothers put forward their equipment, type S.B.222. This was the first purely telephony equipment submitted for type testing. It covered the band 1,365–2,750 kc/s. The set consisted of a master oscillator, two valve amplifier and a modulator valve. Grid modulation was employed. Filaments were supplied from a 6 volt battery and H.T. at approximately 1,000 volts was provided by a machine driven from a 42 volt battery or from the ship's D.C. mains. A filter to eliminate ripple was provided. On test the equipment gave an output of about 80 w. and 55 per cent. modulation. The equipment included a receiver, covering 1,300—2,750 kc/s, and the broadcast band. This receiver had a single tuning control. The S.B.222 was tested and accepted in June, 1932.

Further and improved models were submitted by the leading manufacturers in 1933 and 1934, and in ensuing years these were followed by sets from other manufacturers. The design tendencies during this period were directed mainly towards developing equipment specifically for telephony use, improved frequency stability using driven amplifiers rather than open oscillators, and to improving quality and depth of modulation. The main improvements in receivers arose from use of the superheterodyne principle to obtain good stable selectivity and sensitivity.

Before 1939 testing was usually limited to exploring frequency coverage, measuring output, and conducting a full load run for six hours to prove satisfactory operation without danger of overheating either the transmitter or generator. The whole equipment was required to be of good workmanship and robust construction suitable for use under conditions experienced on board ship.

By 1939 many of the older equipments were still in service but the growth of the service and the need for more efficient use of this part of the frequency spectrum called for equipment of a higher technical standard. However, the war intervened, and it was not until some years after that the fitting and use of new equipments of improved technical performance could be achieved.

Safety of Life

The Ministry of Transport and Civil Aviation set up a committee on which all the maritime organizations were represented, including the radio equipment manufacturers, to prepare for a revision of the Safety of Life at Sea Convention and review the Merchant Shipping Rules. With certain exceptions, the fitting of medium frequency radio equipment on ships over a certain tonnage (then 1,600, now 500 tons) is compulsory under the Convention—ships over 1,600 tons radiotelegraphy, ships between 500 and 1,600 tons either radiotelegraphy or radiotelephony.

A technical sub-committee, under the chairmanship of the Post Office, was given the task of preparing minimum performance specifications for all the items of radio equipment required for compulsory fitting and for certain other radio items fitted voluntarily. Specifications for telephone equipments for both compulsory and voluntary fitting on British merchant ships were prepared and published by the Stationery Office in 1949. These specifications set out the minimum performance standards for equipments, both transmitters and receivers, for use in this short range medium frequency telephone service.

The Merchant Shipping (Radio) Rules, revised in 1952, imposed certain new requirements on existing equipment in the "compulsorily" fitted ships. Subsequently, all interested parties agreed on a date after which all new installations, on both compulsorily and voluntarily fitted ships, would have to meet the specification requirements.

Since 1949 about 20 different radiotelephone equipments have been tested and proved to meet specification requirements. All these equipments

have employed piezoelectric crystals to stabilize the radiated frequencies. The majority have been for voluntary fitting because the ships carrying radiotelephone equipment purely voluntarily outnumber those required to carry radiotelephony equipment compulsorily by about three to one.

Future of Medium Frequency Service

The present minimum specifications call for sound but not by any means the highest technical standards in design. However, little can be gained in future by tightening the present requirements and alternatives will have to be sought if the service is to go on expanding. One way is to transfer some of this short range traffic to very high frequencies (V.H.F.). This was appreciated at the time of the Atlantic City Conference in 1947 and certain V.H.F. bands were made available to the mobile services. This opened up new possibilities which might well form the subject of a further article.

Single Sideband Technique

There is, however, another way in which some expansion could still take place on medium frequencies and which deserves consideration. It would require a complete change in the method of working in this frequency band but offers an improvement of service as well as a means to fit more channels into the available frequency space. This could be achieved by using the single sideband technique.

In this system the speech transmission occupies only about half the frequency space required by the present double sideband emissions. Moreover, if transmitters and receivers were made to have a frequency stability sufficient to enable the transmission of a carrier frequency to be dispensed with (and this order of stability is not of great difficulty to achieve on medium frequencies) the service would no longer suffer from the objectionable heterodyne interference which is particularly annoying when the interfering carrier is only lightly modulated and obviously causing difficulty to reception over an unnecessarily wide area.

Many problems would have to be solved before such a change could be made. They arise mainly from the need to preserve the efficiency of the distress service. Ship and shore stations must at all times be able to intercommunicate without difficulty. On many ships there would not be space to accommodate two sets of equipment while a changeover took place. It might, however, prove possible to devise an equipment which could maintain the intercommunication requirement during an interim period and yet be capable of ultimate operation in the desired mode—that is, single sideband with, preferably, completely suppressed carrier—when all the present types of equipment had been replaced.

The interim period would obviously not be short and might have to extend over a number of years. In view of the continuing growth of traffic in the service this problem is already being given serious consideration in the United Kingdom.

Personal

Mr. R. G. Griffith, formerly Engineer-in-Charge, Electra House (Cable & Wireless Services) has been appointed vice-President of the Canadian Overseas Telecommunication Corporation. He joined the Corporation in 1954 as Chief Engineer.

At one time Chief Development Engineer with Creed & Company, Mr. Griffith produced in 1951-53 the first teleprinter to be developed in Canada. In England during the war he supervised the development of a machine cypher telegraph system and developed the first British error detecting teleprinter multiplex system for radio use.

* * *

Mr. Harold Ellis, who spent 18 years in the United Kingdom Post Office Engineering Department, has succeeded Mr. R. E. German as Postmaster General in East Africa. Mr. Ellis, a Plymouth man and a member of the institutions of Electrical and British Radio Engineers, was Postmaster General in Nyasaland from 1949 to 1954 since when he has been the Director of the Nigerian Post Office and Telegraph Department.

Mr. German, who has retired, was an Assistant Secretary in the United Kingdom Post Office. In 1942 he was appointed Assistant Director of the Sudan Posts and Telegraphs Department, becoming Postmaster General, East Africa, in 1950, after a three year interval in the home administration.

* * *

Mr. R. J. S. Baker, Assistant Secretary in charge of the Sites and Buildings Branch at Headquarters, has been awarded the 1958-59 Webb Research Fellowship at the London School of Economics. During the year—for which he will be seconded from the Post Office—he will conduct research into the methods of dealing with capital investment programmes in various other public authorities.

Mr. Baker, who joined the Post Office as Assistant Principal 21 years ago, won the first prize in the 1958 Haldane Essay competition conducted annually by the Royal Institute of Public Administration. His subject was "Post Office Building Programmes".

Modern Methods in Post Office Factories

G. Haley

THE POST OFFICE FACTORIES DEPARTMENT operates eight factories with a total staff of about 3,500. Three of the factories are in London, three in Birmingham, one at Cwmcarn in Monmouthshire and one in Edinburgh.

The Factories Department has behind it a long tradition of service, largely to the Engineering Department, in the repair of a wide range of everyday equipment. With such a long tradition some methods of working may appear antiquated in comparison with modern factory standards. They should not necessarily be criticized because of that—there is always a place for the skilled craftsman and his special abilities in any industrial organization. But economics and volume of work together have shown clearly that many traditional methods have to be abandoned and mass production methods adopted instead.

The Factories Department took a major step in this direction in opening the new factory at Cwmcarn in 1950.* This is now a well established factory engaged in repairing telephone instruments and bells.

The Cwmcarn repair methods are adapted to handling a very large quantity of items. In one peak year, half a million telephones and bells were repaired. The operatives work as a team; flowline belts carry the work from position to position as each instrument is dismantled, cleaned and adjusted, then reassembled and tested; items are carried from process to process by overhead conveyors wherever possible.

Standard methods are used to care for the appearance and protection of the work, and for refinishing some parts of the instruments. Enamelled parts are spray-painted and then hardened in stoving ovens. Automatic electroplating plant produces the steady stream of plating work for many other parts from the dismantled instruments.

**This was described in the August, 1951 Journal.*

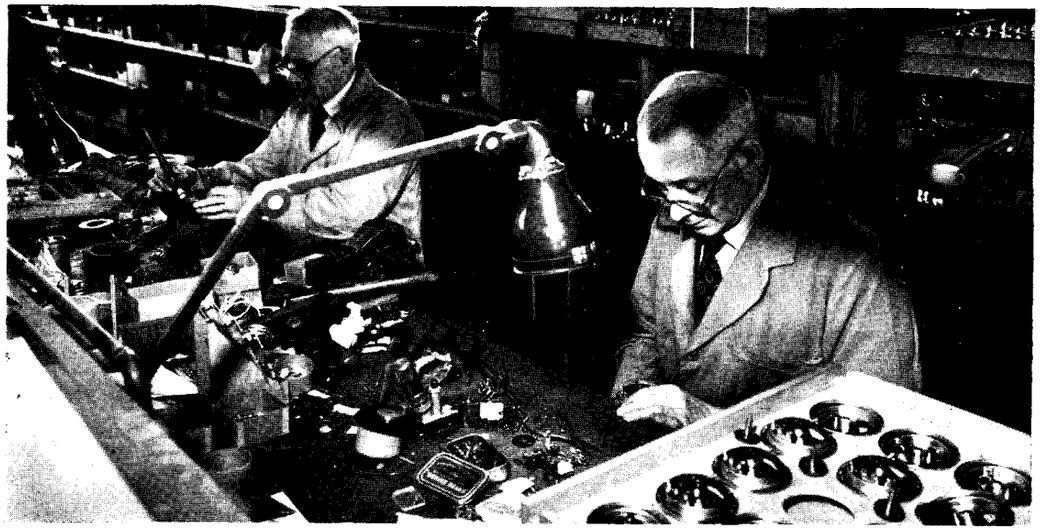
Much study has been given to the work along the flowlines. Each working position is equipped with production aids such as jigs to hold the work in position, air-operated screwdrivers and automatic electronic testers.

The use of systematic testing during the production process is in itself a major change that flowline methods first introduced. Before this, each operative was responsible for his own testing work and had the responsibility of ensuring that this work was of acceptable standard. The new principle of *in-line* testing relieves the staff of this duty and—by ensuring a most uniform product—enables less expensive testing methods to be employed.

Cwmcarn presents a marked contrast with workshops where the traditional pattern of working exists. In many of these shops, telephone mechanics work individually at rows of benches. Each man repairs a batch of work of the same item and does the job in his own way, generally using no special production aids. All our mechanics have experience in a wide variety of work and their work places reflect this adaptability.

Jobs are stored close to the bench, and often a man has two or three awaiting the return of parts he has sent to another shop for painting, plating, cabinet repairs or repolishing, while he stores on the bench the odds and ends of spare parts. Many workshops specialize in repairing particular classes of equipment and accordingly are provided with appropriate testers for the work.

Obviously, such a workshop is not only a self-contained community but has a fund of knowledge and experience of the vagaries of the work involved. The introduction of improved methods in such shops requires a careful combination of old and new. If the volume of repairs is very large the problem is to divide it into a series of separate operations and give the maximum assistance to each worker by providing special production aids. The sheer volume of work may justify the use of



Old repair method for telephone dials

quite elaborate equipment to this end.

The automatic telephone dial provides a good example. Dials used to be repaired in at least three of the eight factories in batches of perhaps a hundred, by men working as individuals; the illustration shows typical working arrangements and methods that existed to deal with this work.

All No. 10 dials are now repaired at one of the Birmingham factories by flowline methods. Each dial is first dismantled, washed by machine and the parts then checked for wear, and replaced if necessary during the reassembly. Eventually the dials leave the line completely rebuilt and thoroughly tested.

Three assembly lines are fed by one dismantling team. Between them they can easily repair and complete well over 1,000 dials a day. Not only is the cost of the repair reduced by these methods but there has been a major improvement in the quality of the repaired dials, which now have life-test performances as good as those of new dials.

From the mechanic's point of view, working conditions have been improved and more closely prescribed working methods and testing arrangements during production have done much to eliminate faulty work. In fact the quality is so consistent that the Engineering Department is prepared to accept a day's output based on tests of a few statistically determined samples, as distinct from the 100 per cent. testing that was necessary on dials individually repaired.

Much of the development in working methods is due to the application of Work Study,† which consists of two complementary parts: Method Study and Time Study.

The essential aim of method study is to find the best way of doing the job having regard to the circumstances; that is, to find means of improving the efficiency of each process or group of processes—in our factories, the repair of a complete piece of equipment. The results of method study appear, to many people, as merely common sense, and to some extent this is true. The method study approach is to study and break down into elements the conventional way of doing a job, to challenge every step to determine its necessity, and then to propose a new method free of the faults of the old. It is a common experience to find a number of unnecessary steps—either actual operations or merely movements—taken on a piece of equipment during factory processes.

In the work of improving the methods, the engineers are trained to be critical in their approach and must be free to propose unorthodox solutions. The range of activities with which they come into

† *A 1957 Institution of Post Office Electrical Engineers lecture entitled* Work Study—its Purpose and Application *by R. A. Cooper fully surveys the subject.*

ntact covers all aspects of factory work; they are oncerned with the layout and design of the factory nd the workplaces within it, the working pro-edures and the best use of everything within the ctory, as well as with the detailed study of perators' working movements with the aim of notion economy leading to improvements in the orking environment in all its aspects.

A simple example of the sort of solution that may esult from method study is to be seen in the lustration of the dial dismantling line. The opera-r on the extreme left, having unpacked the dials nd removed the old labels and so on, feeds them nto the main flowline through an inclined shute. his simple device avoids the need for filling, ansporting and emptying trays, yet keeps the ork flowing quite smoothly, while isolating the ust and dirt of the unpacking area from the roduction area.

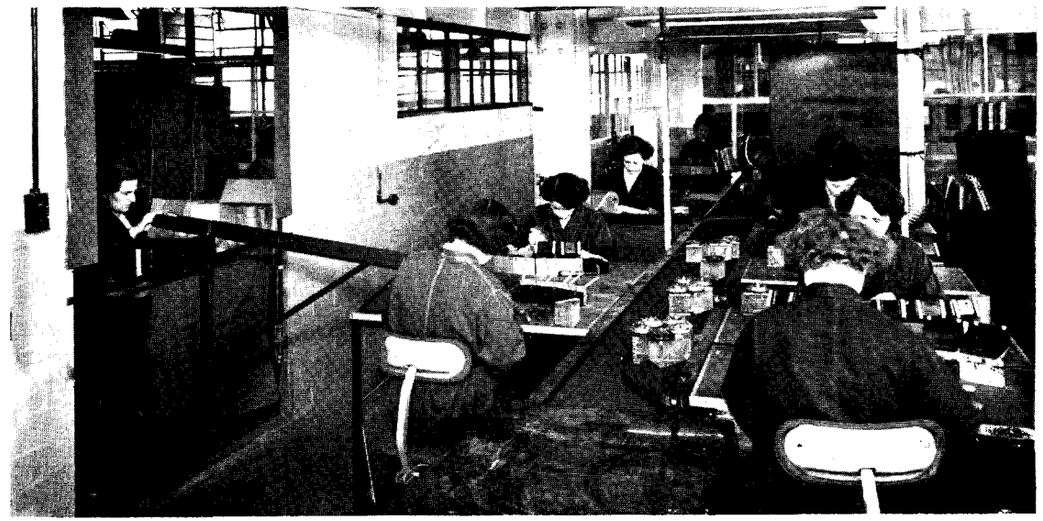
The other part of work study is the much riticized time study function. In its present form, t bears little resemblance to that of 25 years ago, hen the "stop watch" was often used as a means f successively increasing the output from a orker without any matching compensation. resent techniques of time study are aimed at stablishing the time to be allowed for specified asks performed in a specified way. Care is taken hat the performance being studied is related to that of an average person; due allowances for personal requirements and fatigue are included and a time allowance for the job is proposed.

Once the time allowed has been accepted between management and staff it is regarded as fixed and generally will not be changed unless some aspect of the job is altered. Nearly all Factories Department staff are employed on piecework so time study is used to ensure that the time or price allowed for completing each job is fair to both sides.

Closely associated with such advances in managerial methods have been innovations in machinery. One of the most interesting has been the development of washing machines. The one common feature of all the equipment arriving in the Factories Department is that it is dirty, and much of the dismantling is necessary merely to clean up otherwise satisfactory parts.

A range of washing machines has been designed and built within the Department which can wash and dry many types of equipment automatically. These have brought considerable benefits, both in reducing costs and in eliminating unpleasant and tedious work.

Among the many other innovations are shot blasting and vapour blasting machines for rust removal and contact cleaning, automatic polishing processes for plastic parts, automatic glueing and



Flowline repair of telephone dials—dismantling line

Cwmcarn—a typical flowline work position

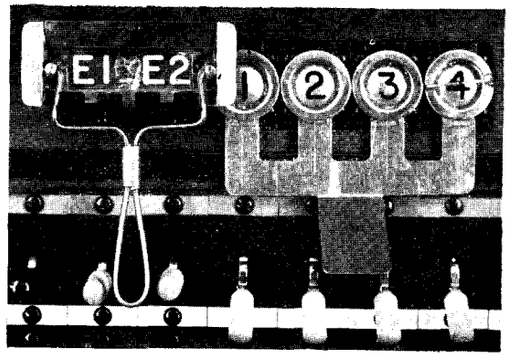
sealing of telephone instrument cartons, and a winding machine which will wind 10 bell coils simultaneously. Handling and storing the large volume of raw materials, spare parts and equipment have been steadily mechanized, and fork-lift trucks and palletized loads are to be seen everywhere.

Not only have large scale operations been changed. Small improvements are of great importance and can represent considerable contributions to an overall programme. Some changes reflect the availability of new materials, as shown by the replacement by moulded nylon screws of individually made ebonite adjusting screws on PBX indicators. A bottleneck on the signwriting of indicators on PBX switchboards was overcome by providing the simple stencils shown in the illustration; paint is applied by a miniature paint spray gun. This particular method was developed in London Factory and has proved so effective for many standard signwriting applications that it is being used increasingly. In one of the toolrooms at Birmingham Factory a simple trolley and roller conveyor now enables one man to handle with complete safety a heavy machine table used on a jib boring machine. Before this aid was introduced several men were required each time the table had to be moved, and even then the operation was dangerous and time-consuming. This particular example is one of many that could be quoted of devices which in themselves have little apparent bearing on increasing production but, in fact, do so by avoiding accidents and by eliminating delays.

Present facilities for repairing teleprinters (including a large volume of overhaul work for the London Telecommunications Region) are now being reviewed. Laboratory tests of new methods are showing promise and it seems likely that flow-line methods of working will be feasible. This will enable the provision of a very wide range of special jigs and fixtures both to simplify the job and to improve its quality.

As a result of this laboratory study the aid of the Consultant Physiologist to the Post Office was enlisted in deciding such questions as the best height of bench, the most comfortable chair design, and the most suitable colour for the bench tops. The results look unconventional by factory standards but the effect can be judged by the remark of one man: " It seems funny to be comfortable when you're working"! It is too early yet for us to be sure that we have found the correct formula for this but the results so far are most promising.

In all its activities the work of the Factories Department is under constant review, with the aim of improving methods of working so as to provide the Post Office with an increasingly efficient repair service which itself enables the staff of the Factories Department to take an increasing pride in their achievements.



Spray stencils for marking switchboard indicators

The Regional Board (seated left to right): Mr. A. H. WOODLAND, Postal Controller; Mr. H. F. RODGERS, Deputy Regional Director; Dr. L. E. RYALL, Regional Director; Lt. Col. J. BAINES, O.B.E., Chief Regional Engineer; Mr. P. D. H. KING, Finance Officer. (Standing left to right): Mr. P. S. BELL, Staff Controller; Mr. C. FLETCHER, Secretary to the Board; Mr. J. GIBBIN, Public Relations Officer, Mr. N. F. SEPHTON, Telecommunications Controller.

The North Eastern Region

THE NORTH EASTERN REGION OF THE POST Office shares with the Post Office in Scotland the distinction of having pioneered the present regional organization.

Formed in 1936, it continues through its 49 Head Post Offices and seven Telephone Areas to cater for expanding services to 7,500,000 people in Northumberland, County Durham and Yorkshire, and the northern parts of Lincolnshire, Nottinghamshire and Derbyshire, a total area of 10,751 square miles.

Many people imagine the North Eastern Region as a country of grim and densely populated industrial areas but it includes also large tracts of unspoiled and beautiful country: Yorkshire's "broad acres", with their dales and moors; Northumberland with the English slopes of the Cheviots, and the Roman causeways, with the remains of Hadrian's wall; the Pennine Chain; the walled city of York with its Minster; many historic castles and abbeys; a long and rugged coastline dotted with seaside resorts like Scarborough and Whitby; and a number of inland health resorts such as Harrogate, and Ilkley on "Ilkla Moor".

Yet, with one-seventh of the Kingdom's population, it has many dense industrial centres among its sturdy agricultural communities, producing coal, steel, textiles and ships, including Bradford and Leeds with their wool and textile factories, Scunthorpe with its modern steel works and Sheffield, home of the Master Cutler. Shipbuilding and shipping are represented in Kingston-upon-Hull—third port of the United Kingdom—and the Tyne, Wear and Tees ports, and fishing by Grimsby.

Modern agricultural and industrial techniques demand modern telecommunications. We were not selected for the inauguration of Subscriber Trunk Dialling—although Doncaster, Lincoln, Middlesbrough, Redcar, Scunthorpe, Skipton and York are on the list for STD by the end of 1960—but in September the first automatic telex exchange in the country was opened in Leeds and next year we

shall have, also in Leeds, the first Sovex Parcel Sorting Machine.

The postal services are operated under Regional Headquarters and the 49 Head Post Offices through 47 branch offices, 59 salaried sub-offices and 3,277 scale payment sub-offices.

The Region contains, in Hull, the only city in the Kingdom to retain its own municipal telephone service. Elsewhere, the seven Post Office telephone managers are responsible for 596 automatic, 27 auto-manual and separate trunk, and 85 manual exchanges, with 735,000 telephone stations. Two coast radio stations, Cullercoats and Humber, provide day and night watch over the fishing fleets and general shipping using the ports.

A staff of 30,213½ (we insist on the half in the staff statistics which count part-timers as half persons) look after the services, which bring in a total revenue of £40,680,000.

The staff give strong support to social activities and regional sporting competitions. Since we "march" on our western border with the North Western Region, the annual battle with the Lancastrians, a modern war of the roses, produces keen rivalry in a friendly spirit.

"Freefone" on Trial in South Wales

A fictitious new telephone exchange, "Freefone", will come into service in South Wales on December 1—the beginning of a trial of a new service the Post Office will offer to business subscribers in Cardiff and Swansea telephone areas.

Business subscribers to "Freefone", which is a development of the transferred-charge service, will be given a number on the fictitious exchange and undertake to pay the charge (and certain other payments) on trunk calls made to them by the public.

Subscribers and call office users will be able to call without payment to a "Freefone" subscriber. Calls will be handled similarly to normal transferred-charge calls.

The service will be for trunk calls only. For the South Wales experiment calls from Swansea, for example, may be accepted by a Cardiff "Freefone" subscriber or calls from Cardiff by a Swansea "Freefone" subscriber.

If the experiment proves successful, it will be extended to other parts of the country and the area from which calls may be made will be widened.

Telecommunications Statistics

	Quarter ended 30th June, 1958	*Quarter ended 31st March, 1958*	*Quarter ended 30th June, 1957*
Telegraph Service			
Inland telegrams (excluding Press and Railway) ...	3,349,000	3,109,000	3,756,000
Greetings telegrams	752,000	737,000	814,000
Telephone Service			
Gross demand	88,753	90,044	104,594
Connexions supplied	83,820	83,503	96,938
Outstanding applications	160,216	171,415	238,548
Total working connexions	4,516,285	4,499,637	4,521,361
Shared service connexions	1,147,296	1,153,093	1,201,677
Total inland trunk calls	82,318,593	77,266,289	82,886,678
Cheap rate trunk calls	18,738,521	16,594,531	19,348,912
Telex Service			
Total working lines	4,448	4,308	3,748
Total inland calls	818,000	788,000	637,000
Total overseas calls	444,000	438,000	371,000
Staff			
Telegraphists (including staff employed on Telex) ...	5,939	5,914	5,959
Telephonists	45,235	44,688	46,168
Engineering workmen	63,551	63,902	63,774

Materials Research in the Post Office

C. E. Richards

THE POST OFFICE ENGINEERING RESEARCH Branch, with a staff of about 900, has the primary duty of advising the Engineer-in-Chief on developments in telecommunication research; it also works on postal problems, particularly mechanization, and does some work for other ministries.

Operating at the Research Station at Dollis Hill in north-west London, it is sub-divided into several functional divisions, one of which, the Materials Division, with a staff of 60 to 70, most of whom are in the scientific grades, specializes in the chemistry, physics and metallurgy of materials.

It is difficult to say when materials research in a recognizable form started in the Post Office. At least four different early records exist which overlap to some extent; none, however, specifically claims to be the first. They are: *Experiment Book* 1878–1899—manuscript; *Reports* 1890—part manuscript, part typed; *Experiment Room Reports* 1901–1908—the first 70 missing since before 1908, and *Research Section Reports* 1–100—starting 1910.

In these records the first experimental work which would now be considered proper to the Materials Division was done on June 21, 1890, when W. H. Preece (later Sir William Preece, Engineer-in-Chief) made an experiment to see if "heat is generated on changing bichromate cells and does this affect their internal resistance"? The "changing" referred to is actually replacing spent energizing fluid by fresh acid which is warm when mixed.

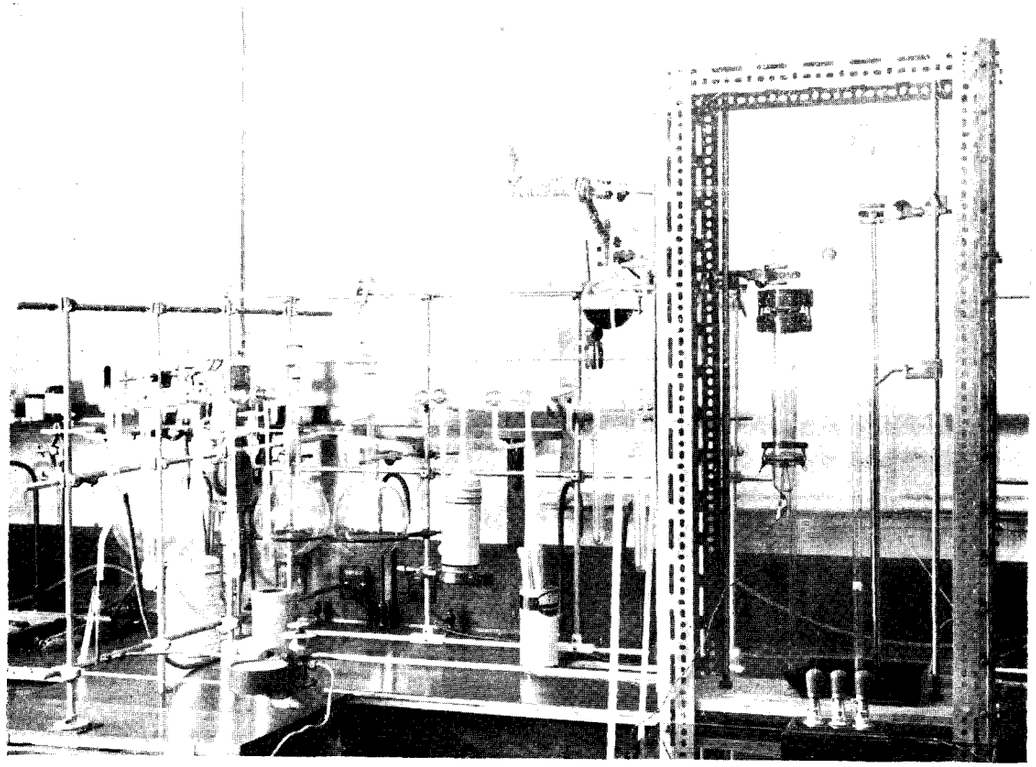
These early reports are intensely interesting and were compiled by people whose names linger, some even as personal memories; H. R. Kempe, Matthew Cooper, W. H. Preece, T. F. Purves (1895), J. E. Taylor (1896), F. Tandy (1897), W. J. Stubbs, W. J. Medlyn, E. H. Shaughnessy and F. Tremaine. With one exception they wrote their notes in beautiful and legible script.

There seems to have been little specialization in those early days. Most of the pioneers tackled any problem set before them, ranging from wood preservation to wireless telegraphy. One cannot but be impressed by the gusto with which they attacked their problems; they must have had lots of fun.

Shaughnessy, for example, reports on experiments at the works of the Haskin Wood Vulcanizing Company. His description of the process is not clear but one can infer that the method of preserving poles was to treat them with some compound and bake them in air under pressure. The report has the following illuminating section: "The treatment commenced on Friday, February 23rd (1901) at 6.45 a.m. and continued throughout the day until 11.45 p.m. At that time a loud report was heard and smoke began to issue from cylinder No. 3 (containing the *newer* redwood poles), the pressure rising by 30 lb. in 10 seconds. By 11.57 p.m. all pressure had been taken off this cylinder . . . found that all the newer poles had caught fire first and were severely burned . . . "

The remaining poles so treated seem to have been given a field trial for we read: 8.1.04. "The Secretary, It will be observed that the system has been an entire failure. In fact the poles decayed far more rapidly than if they had not been subjected to any 'Haskinize' preservative at all . . . J. Gavey".

In 1904 the Section—as it was then known—issued a long report on "The Deterioration of the Lead Sheath of 7-pair cables". This was a good piece of work by any standards though the passage, "All the specimens were pitted more or less, in some the pitting had become quite nebulous and in some others the nebulosity had resulted in holes", would probably be expressed differently today. In this year also the Section was introduced to Monolithic Concrete Ducts which, for single way ducts, were only half the cost of the normal earthenware type. A similar proposal was investigated about 1930 and the present author took part in the tests.



Apparatus for studying the gas-phase erosion of germanium with chlorine

Many readers will sympathize with the author of a letter to the Secretary in 1891 explaining and apologizing for a discrepancy in stocks: one resistance box, value £1.

From these beginnings the Materials Section began to grow towards its present form. For some years its activities were restricted mainly to testing manufacturers' products and there was a fair amount of short term development work such as is now carried out in the development laboratories attached to Engineering Department Headquarters, but gradually the pattern was beginning to emerge. The 1914 war must have thrown things into some confusion because although the Section is known to have been active in many ways, making hot-wire microphones for gun and aircraft ranging, anti-submarine work and even a little innocent sabotage, such reports as are available are on work of a wholly pacific nature.

The real build-up of the Section took place after 1918 and must always be associated with the name of F. O. Barralet, who, besides being a chemist and metallurgist, had qualified as a telecommunications engineer. He had a fund of original ideas and his work had the enthusiastic backing of the Staff Engineer, S. A. Pollock (colloquially "Sam"). In the early 1920s his team included the present Director General, whose first upward move was to take charge of the Section. Then, like the modern Division, the Section had a very varied load which could be reasonably split into two main parts, Materials and Measurements, so it was re-titled the Materials and Special Measurements (MSM) Section by which it was known until recently when it was shortened to Materials. The Section dealt with such things as iron for relays, telegraphists' cramp, corrosion of plant (overhead, underground and indoor) the replacement of

natural products by the growing class of synthetics, interference from power lines, fires and explosions and the growing of piezoelectric crystals.

One of Barralet's outstanding contributions was his study of extrusion faults in lead covered cables. The bulk of this work was done before 1916 but it established the cause of the trouble so firmly that such faults have been almost unknown since. It is a pity that this work received no permanent publicity beyond incorporation in a Research Report.

In the years between the wars, although there was still a lot of work such as examination of insulating materials, textiles and different kinds of primary and secondary batteries which was not strictly research, it was not without its useful side since it encouraged the development of the very precise measurement techniques which are now so great a part of the Section's tradition. In the intervals, time was found to design and supervise the manufacture of the first British Speaking Clock (TIM), to make the first tentative experiments in postal mechanization and to introduce dogs for locating leaks in buried pipe lines; a Labrador, *Rex of Ware*, was trained to distinguish the smell of amyl mercaptan, which was introduced into compressed air pumped through transmission lines. The dog indicated leaks in the lines by digging at spots where he found the scent. On his first trial he "bagged" eight leaks over a mile.

With the outbreak of war in 1939 the Section found itself studying the use of substitutes for all kinds of materials which had suddenly become scarce; a disheartening job, for no sooner was a substance proved usable than it, in turn, became scarce and the chase began again. Ways were found of speeding the rehabilitation of exchange equipment damaged by blast and fire and much time was spent advising other Government departments and industry in fields where the Section had special knowledge—primary and secondary batteries, sheathing for special cables, insulation, magnetic and dielectric materials, and so on.

Since the end of the war there has been an attempt to limit the field activity in the belief that more good is done by concentrating the available effort on a few projects than spreading it thinly over many. There is a bewildering array of new synthetics, polythene, P.V.C., P.T.F.E., acrylic polymers and so on.

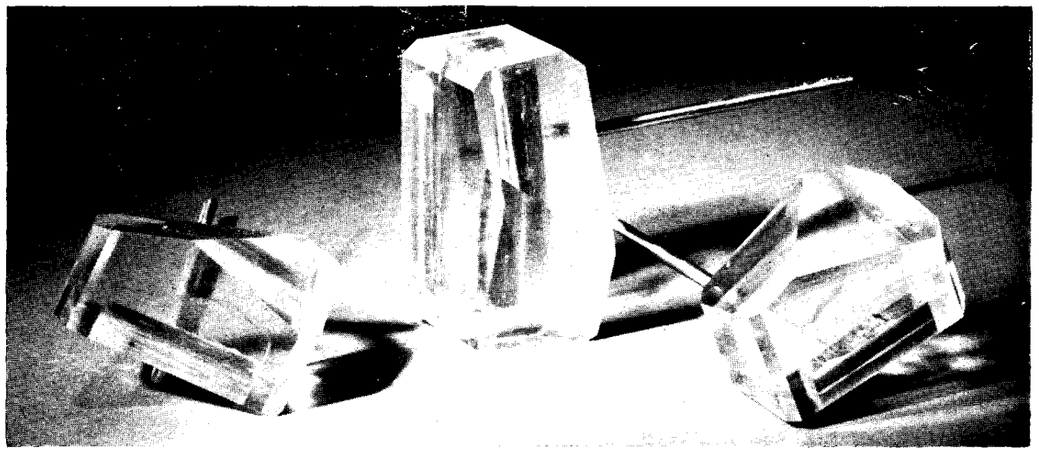
All have been superficially studied but the main effort has been on polythene; it was supremely important to know the properties of polythene, precisely, to make the provision of the transatlantic telephone cable possible. How do its electrical properties change with temperature and pressure? How fast will water permeate the material, what difference is there between saturated and dry polythene? Can we use X-rays to examine the quality of joints and can we make polythene stick to metal? All these questions had to be answered. One involved the design of an X-ray set specially for the purpose which could be used not only in the laboratory but also on the foredeck of a cable ship during a laying operation. Another called for the development of a new precise method for measuring the permittivity* of polythene to an accuracy never before attained. Now, with the new lightweight submarine cable being considered we have another crop of queries, mostly associated with the liability of the aluminium conductors to corrode should sea-water penetrate the polythene belt.

Much effort has been devoted to magnetic materials. Real interest in these started before the war and has continued unabated. The study of nickel-iron alloys has helped to raise the standard of those available industrially and at least one new alloy has been introduced to commerce for use in computer-like devices. In this kind of work it has been necessary to go right back to the initial manufacture of the alloys and a scheme of investigation based mainly on powder metallurgy has been built up. The experience so gained in making precisely controlled alloys has proved useful in other fields.

The growing of large single crystals is still an important technique; different kinds of piezoelectric crystals, ethylene diamine tartrate and di-potassium tartrate were at one time thought suitable for resonator manufacture for filter circuits. The easing of the quartz crystal position made continuance of this work unnecessary and at present attention is directed to growing large single crystals of metallic germanium having their properties controlled so as to make them suitable for special semi-conductor devices which are not commercially available. A present interest is making high speed diodes which can be used in conjunction with the magnetic switching materials, already mentioned, to build fast switching circuits.

One of the difficulties with semi-conductor devices is their sensitivity to surface reactions.

*Measure of the ability of a dielectric to hold electric charge.



Di-potassium Tartrate (D.K.T.) Crystals

Ambient gases absorbed on the surface can compete for electrons with the surface layer of the semi-conductor and so affect its electrical properties; some gases will deplete the surface of electrons and others enrich it; in either event the result is disastrous and until the effect is better understood and controllable the reliability of transistors cannot be assessed.

A novel problem which arose recently was to produce a phosphor (a material which glows after it has been illuminated and the light extinguished) which would be suitable for coding letters to make mechanical sorting possible. All known phosphors were either unsuitable or too expensive. A new material was produced which has all the essential properties and is quite inexpensive.

When electrical circuits were simple it was not always important that individual components should have long lives; in fact, it might well be that a cheap article with a short life would be economically sounder than a longer lived but more expensive one. The coming of complicated circuits with many thousand of components has changed this and great emphasis is now laid on the use of long life components.

Some of the worst offenders are quite common ones, such as resistors and capacitors (particularly electrolytic capacitors), and considerable attention is being paid to these components. Life tests on hundreds of components under severe conditions of voltage and temperature are used to discriminate between good and bad and an examination of failed components is used to assist in identifying the cause of the trouble.

A few years ago the statistical life of an electrolytic capacitor was only short (about five years). Today, with extreme attention to purity of materials, cleanliness in the factory and improved design, the best capacitors last much longer and can therefore be incorporated into designs with greater confidence.

It is not always fully realized that however brilliantly designed a circuit may be the inclusion of an unreliable component will make it useless; the aim of the components group is to produce bricks from which equipment can be built which will need no maintenance during the whole of its scheduled life. This could perhaps be regarded as the aim of the whole Division; though most of its work concerns the materials of which the components are made. Materials are the foundation of the whole structure.

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

The Institution of Post Office Electrical Engineers announces five prizes to be awarded for essays submitted for the year 1958-59. Closing date for entries is December 31, 1958 and further information will be given by the Secretary, I.P.O.E.E., G.P.O., 2-12 Gresham Street, London, E.C.2, the Engineering Department's new home.

How Auto-Telex was Planned

Leeds First of Twenty-one Exchanges

THE ASSISTANT POSTMASTER GENERAL CEREMONIALLY opened Leeds Automatic Telex Exchange on September 1. Service had started two days earlier.

Leeds, which serves some 250 subscribers in the Leeds and Bradford, Lincoln, York and Middlesbrough areas, was the first of 21 automatic telex exchanges to be opened by early 1961. Some 900 subscribers were on Shoreditch (London) Exchange by the end of September. Leeds exchange will continue to serve Lincoln and York, but separate exchanges will be opened in due course in Bradford and Middlesbrough.

The story of how the automatic telex service was planned provides an interesting example of how progress can be made in spite of financial restrictions.

The Post Office decided in February, 1956 to convert the United Kingdom telex network to automatic working. During the past two years or so a planning committee with representatives from the Inland Telecommunications, Engineering and Accountant General's departments, and the External Telecommunications Executive have worked out the plans. They may be summarized under six headings.

First, the committee had to plan for an ultimate network for some 50,000 subscribers with equipment in some 30 automatic exchanges in London and the other large cities, and to determine numbering schemes, dialling codes, links between exchanges and with other countries.

Secondly, they had to decide on facilities (in this, simplicity has been the keynote), design the equipment and carry out laboratory tests. TIME ZONE (TZ) equipment has been developed which controls the setting up of a call, starts the charging, and supplies the meter pulses at the appropriate intervals according to the call distance. This is the Telex equivalent of the GRACE equipment used in telephone STD.

The equipment functions in this way for inland calls now, but in 1961 it will, without modification, serve to control the setting up of calls to other countries dialled by subscribers, determine the rate, start the charging and supply the pulses to operate the meters at appropriate intervals. It can cater for charges up to £1 per minute.

Thirdly, the committee had to plan the 21 exchanges and equipment to be installed to meet the needs of the service for the next seven or eight years. This initial equipment will have capacity for 12,000 to 15,000 subscribers, each making some 10 calls per day.

They had also to find accommodation for the equipment in 20 different cities. The main London Exchange, which will cater for 6,000 subscribers at first and something like 20,000 subscribers ultimately, is to be in the new Fleet Building, which was accorded the highest priority; this building was described in our last issue.

They had to arrange a financial programme, involving an expenditure of £2¼ million on equipment at the rate of nearly a million per year, and an equipment ordering and installation programme. Two British manufacturers are making and installing the equipment: Ericssons and the Automatic Telephone & Electric Company.

Finally, two pilot exchanges (Leeds and Shoreditch) had to be opened to prove the functioning of the equipment and to check the facilities under working conditions.

Accommodation is available now or will be in the next three years for another 20 exchanges serving 45 areas. Orders are placed and manufacture is going on for more than half of these. The time-table for opening the automatic service in these areas is:—

Mid 1959:	Sheffield.
Autumn 1959:	Liverpool, Manchester, Preston, Chester, Blackburn, Carlisle and Lancaster.
Late 1959:	Glasgow, Aberdeen, Inverness, Edinburgh, Dundee.
Early 1960:	Birmingham, Peterborough, Shrewsbury, Stoke-on-Trent, Nottingham.
Mid 1960:	Bristol, Plymouth, Bournemouth, Exeter, Gloucester, Taunton, Swansea, Southampton.
Autumn 1960:	Belfast.
Late 1960:	London, Reading, Luton, Cambridge, Canterbury, Norwich, Colchester, Southend, Oxford, Guildford, Portsmouth, Brighton, Tunbridge Wells, Leicester, Coventry, Newcastle-on-Tyne.
Early 1961:	Cardiff and Hull.

During July and August a team of engineering and traffic staff put the equipment at Leeds and Shoreditch through its paces. First, each item of equipment was examined in detail. This was followed by functional tests of the different types of connexions likely to be set up by subscribers in making calls, followed by load tests to check the adequacy of the equipment.

The equipment came through with flying colours and we are confident that it will give subscribers a first class service for many years to come.

The staff who have been concerned in the project are to be congratulated on an excellent piece of team work.

Going over to M.A.T.S.

How Edinburgh Switched to Mechanical Accounting

I. Todd

IN DECEMBER, 1955, RUMOUR REACHED EDINBURGH Telephone Area that it was likely to be selected for an experiment in complete mechanization of telephone accounting. In March, 1956, we learned that the decision had been taken: Canterbury (which since 1953 had been experimenting with mechanized trunk accounts) and Edinburgh Areas would use Powers-Samas 40 column punch card equipment for the new procedure. This meant a change for Canterbury, which previously had been using Powers-Samas 36 column equipment, but mechanical accounting was quite new in Edinburgh.

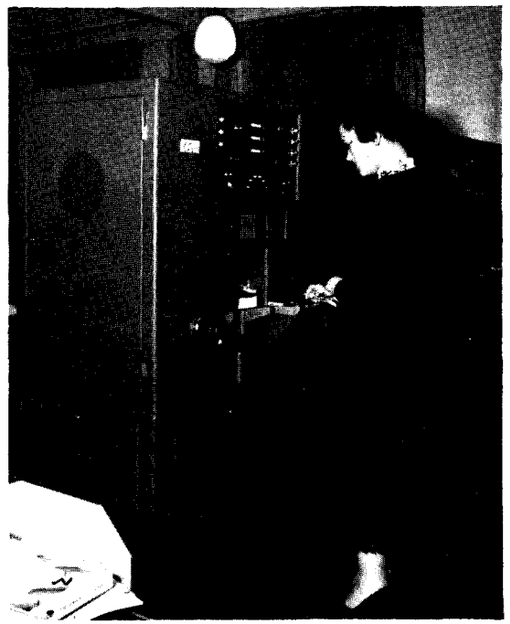
The programme in Edinburgh provided for the change-over to mechanization of Trunk calls from October 1, 1956, Local calls and Rentals from January 1, 1957, and the first fully mechanized accounts to be despatched in April, 1957.

Much preliminary work had to be considered and started; for example, adjusting accommodation, training telephone operators in the new code marking of tickets, selecting and training suitable candidates to work the new machines, and costing the existing system to allow in due course for a comparison with the cost of the new. Finally, all staffing matters had to be discussed with the Staff Side.

The Commercial Section in Edinburgh is in a Government Temporary Office Building designed as a wartime hospital containing large rooms. We selected one room of roughly 2,000 square feet, and cleared it of all furnishings and fittings. The Ministry of Works provided power points and sound absorbing treatment. Earlier, representatives from the Central Organization and Methods Branch had surveyed the room and planned the lay out of the new equipment. All was now ready for the machines as soon as Powers-Samas could deliver them.

Normally, in a telephone exchange, the operator receiving a call writes on a ticket details of the caller's number, the exchange number required, and the time of the call. Under the new system, the operator records the caller's number and the price by making pencil strokes against the appropriate figures in space provided on the ticket.

About a thousand supervisors and telephonists in the Area required instruction in ticket marking, including guidance in pricing by marks. A trial of ticket marking began in all exchanges a month



The mark scanning punch
(Courtesy, Powers-Samas Accounting Machines Ltd.)

efore the experiment was to start. Meantime, the echnique of ticket marking was thoroughly xplained to operators during refresher training, nd practice in marking at the switchboard was ut in hand. Later, operator trainees received struction in marking as part of their initial aining.

Vacancies for Senior Machine Operators, Machine Operators and Machine Assistants were dvertized in May, 1956. Clerical and Subclerical grades in Post Office Headquarters, cotland and the Supplies Department in Scotland, well as those in the Area were eligible. Six enior Operators, 23 Machine Operators and five Machine Assistants were required initially and the election Board gave consideration to seniority, ge, fees experience, machine experience, health cord and general ability. The staff chosen have, general, proved eminently suitable. It is perhaps markable that so many fees staff, who had been lected originally for clerical work, have adapted hemselves so well to machine operating.

Punched card companies normally train customer's operating staff for new installations and as ar as possible Powers-Samas have trained our Machine Operators. To ensure flexibility they ere trained on as many different kinds of machines s possible in the time available. Local instruction ould later increase the versatility of staff as pportunity offered. The courses at the Powers-Samas Training School were supplemented for SMOs and MOs by practice on live work at Canterbury for a week or two. The training programme lasted from June to December, 1956, nd every effort was made to avoid disturbing eave.

The Post Office developed the new telephone ccounting method in conjunction with Powers-Samas. Trunk, local call and rental accounting is lealt with mechanically or electronically by unched card machinery. The cards prepared by elephonists referred to earlier are fed to a photolectric scanner which reads the pencil marks and utomatically punches holes in the card to correspond with the marks. This scanner has a powerful lens and 10 photo-electric cells which pick up he marks and set the punch mechanism working. This converts the details into punched holes and he machine itself verifies each card for accuracy. Cards which are not properly marked (and some which have fleck marks in the paper) are rejected; he whole process takes place at the rate of 100 ards a minute.

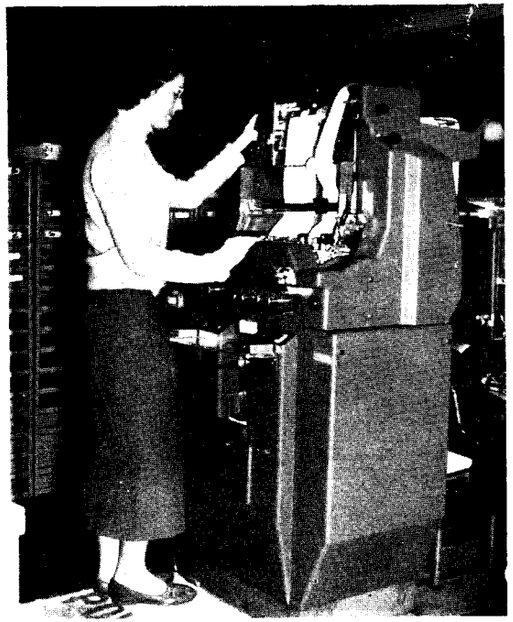
The Sorter
(Courtesy, Powers-Samas Accounting Machines Ltd.)

After being punched the cards are filed until they are required for the preparation of accounts when they are fed through a machine (sorter) which arranges them for individual subscribers at a speed of 40,000 cards an hour.

Summary cards punched to show rental charges (for one quarter in arrears and one in advance) with the cards recording the totals of trunk call charges and local call charges obtained from the machines, and miscellaneous charges, if any, are fed to a tabulator which prints the amounts on the account form.

The main machines for the job are Mark Scanning Punch, Sorter, Tabulator and Electronic Multiplying Punch (EMP for short, but better known as "IMP") but in addition Hand Punches, Universal Automatic Key Punches, Typewriter Key Punch, Auto Verifier, Burster, Interpreter and Interpolators—some 32 machines in all—are required.

The preparatory work was enormous. Accommodation being ready, including power points for the machines, and new furniture, stationery (including redesigned trunk statements, and half-yearly and monthly trunk accounts), envelopes for accounts, call office ledger sheets, installation



The tabulator
(Courtesy, Powers-Samas Accounting Machines Ltd.)

record cards and account receipt stamps being to hand, all was set for the new venture.

The punched card system relies upon guide cards to tell the machine what it must do. This entailed punching either by machine or by hand nearly 500,000 cards.

Because the scanners were delivered late, the new telephone ticket cards which had been introduced in September could not be purchased automatically and we had to fall back on manual sorting. This was disappointing. Fingers which had been very nimble when sorting the old style flimsy tickets suddenly lost their dexterity when dealing with card type tickets.

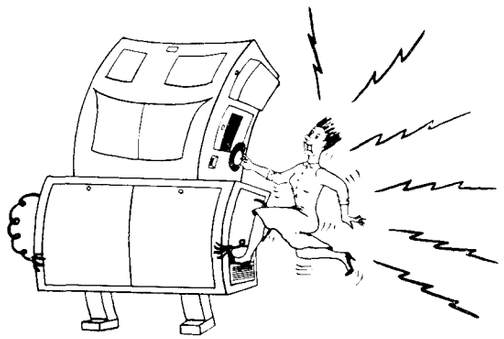
Transferred charge tickets from other Areas required translation to card type tickets and this should have been done by the Machine Assistants. The volume of preparatory punching work was so great, however, that telephone operating staff agreed to help by translating transferred charge details to card type tickets so that these could be fed through the scanners with the other tickets. The original and duplicate tickets are numbered so that in the event of enquiry the original can be traced and compared.

In due course the scanners arrived and we began to process the trunk call tickets. We watched this anxiously, but need not have worried—our operating colleagues had done their work well and rejects were few.

The preparatory work for transferring local call and rental charges had now to be speeded up for the accounts due to be issued in January, 1957. This called for setting up local summary cards, meter reading cards, rental guide cards and preparing a miscellaneous charges card. The pressure at this stage was tremendous and we could well have done with a three months' break after trunk call mechanization to consolidate and allow more time for preparation for the next stage.

More preparatory work and we were ready for the issue of fully mechanized accounts, which was due in April, 1957. The problems during the experimental period were legion—amalgamation of PBX lines, especially those which were non-consecutive; shortage of operators for the old type of accounting machines while the old and new systems were running simultaneously—we had made the ablest fees staff into machine operators and could not withdraw them from the new machines to work the old ones; operating inexperience and machine failures which caused the destruction of so many main account forms in the July, 1957 quarter that 4,000 old style account forms had to be machined by the old methods; shortage of suitable envelopes for trunk statements, which are much bulkier than the old; subscribers mistaking carried forward figures for call charges; subscribers failing to extract the main account form and attempting to pay the trunk statement

"E.M.P. better known as IMP"



account only. These are only a few of the many problems we had to contend with.

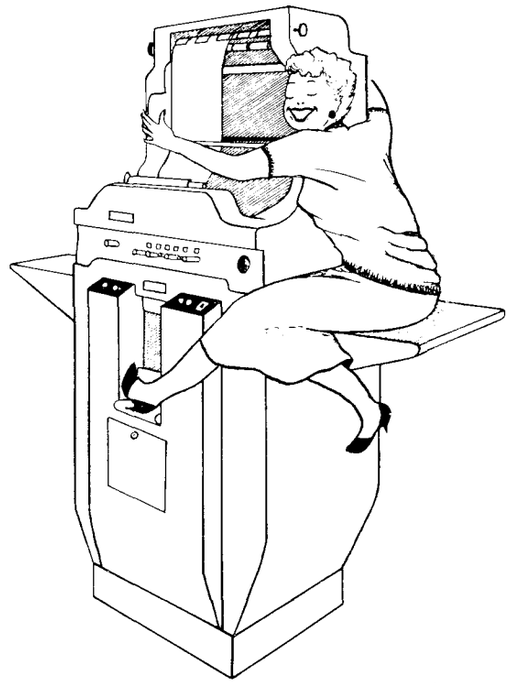
The backbone of the experiment was the Central Organization and Methods Branch staff, who became our guides, mentors and friends even on the golf course. Problems which could not be dealt with locally were passed to a C.O. and M.B. expert who, in consultation with Powers-Samas staff had to decide whether machines should be modified or procedure altered. We soon learned that machines are not nearly so flexible as humans!

As soon as accounts go out payments begin to flood in, subscribers ask for details of certain trunk calls and staff must be found to record payments on ledger sheets. Under the old system it was easy to suspend sorting and posting work in the Fees Group and withdraw the staff for pressure duties elsewhere but expensive machines cannot be allowed to stand idle. So great was the volume of work that regular overtime for mechanical accounting staff was the order of the day from Midsummer, 1956 until February, 1958.

Little did we realize when the experiment was agreed to that within 12 months the additional work thrown up by conversions involving three exchanges and 2,657 connexions in Edinburgh multi-office area would prove to be so complicated. No one had foreseen two tariff revisions within 15 months—one of which necessitated punching 200,000 new rental cards.

As shown earlier, we began with six SMOs, 23 MOs, and five MAs, under the control of a Higher Clerical Officer but a few were added temporarily from time to time to deal with preparatory and other exceptional work. Wastage of machine grades at 19 during the past 18 months has been high and new recruits, mainly from our own clerical staff, had to be selected and trained locally. In the main they have all done remarkably well and quite soon became experts at the job. The morale of the machine room staff and their supervisors has been exceptionally high. Operators develop strong affection for their own machines and some do not like to be moved. It is, however, our policy to get all equally expert in Scanner, Sorter and Tabulator work.

Despite our best preparation the issue of accounts has sometimes fallen behind. Since April this year we have been processing up to date for the first time, but we were nearly there before July, 1957. Unfortunately the Electronic Multiplying Punch broke down for three weeks at this period and work was thrown behind very seriously.



"Strong affection for their own machines"

This has been the most temperamental machine. It substracts old from new meter readings, deducts test calls, adds ticketed calls (and at the time in question deducted the free call allowance) then multiplies the answer by the appropriate local call charge. The breakdown of this machine can therefore be most upsetting.

We have had much help from many sources and we would like to record our indebtedness to C.O. and M.B. for planning, guidance and encouragement; to Canterbury Telephone Area for training facilities and generous hospitality; to the Supplies Department, Edinburgh for improvising stationery requirements and lending two Punch Operators; to remaining Telephone Areas in Scotland for helping out with envelopes at a critical moment.

We have been through stormy seas and are now in calmer waters. The experiment is nearing completion and its success is in the main due to the strenuous efforts and devotion of the mechanical accounting staff and of Powers-Samas resident engineers, for all of whom the experiment has at times almost amounted to "blood, toil, tears and sweat".

OUR CONTRIBUTORS

W. T. BAGNALL (joint author, "Telephone Service in the Channel Islands") joined the Post Office in 1931 as a Youth-in-Training in the Tests and Inspections Branch, Birmingham. Later he was stationed at the Automatic Telephone & Electric Company's Works at Liverpool and in 1953 was appointed Traffic Officer in the Bournemouth Telephone Area.

N. BOURDEAUX ("Medium Frequency Radiotelephony for the Merchant Navy") is a Senior Executive Engineer in the Radio Planning and Provision Branch of the Engineering Department. He joined the Post Office in 1920 and has been engaged on radio work since appointment to the Research Station, Radio Branch in 1927. He was concerned with setting up the Radio Branch outstation at Banbury in 1940 and was promoted to the then newly formed Radio Maintenance Branch at Harrogate in 1943. He joined his present Branch when, with the formation of the External Telecommunications Executive, the Radio Maintenance Branch was disbanded. Since 1943 he has been connected with work for the maritime services, both radio equipment for merchant ships and the equipment of the coast radio stations.

S. G. COULSON ("Twenty Years of a Rural Exchange") is the Public Relations Officer in Northern Ireland. After a short period in the Northern Ireland Civil Service as a clerk, he became an Assistant Traffic Superintendent in the Post Office in Belfast—his native city—in 1938. He was promoted Senior Traffic Superintendent in North West Region Headquarters in 1947 and, following a period in the Telephone Manager's Office, Liverpool, returned to Northern Ireland in 1954 to take up his present post.

G. HALEY ("Modern Methods in Post Office Factories") is Senior Executive Engineer in Post Office Factories Department Headquarters, concerned with future planning and development of modern methods of factory work. He joined the Post Office in 1936 as a Youth-in-Training in Preston Engineering District and went to the Research Station Radio Branch in 1941. In 1947 he became an Executive Engineer and, after a year in London Telecommunications Region, Long Distance Area, re-joined the Research Branch, remaining there until 1958. In the latter part of this period he was closely involved in the manufacture and laying of repeaters and cable for the British section of the trans-atlantic telephone cable.

BRIGADIER SIR LIONEL H. HARRIS ("Ten Years of Telecommunications") succeeded the present Director General, Sir Gordon Radley, as Engineer-in-Chief in November, 1954, after five years as Controller of Research. He joined the Post Office as a Probationary Assistant Engineer in 1922 and has spent his whole career in the Engineering Department except for four years, 1945 to 1949 as Regional Director in Scotland. He left school to learn farming in Australia in March, 1914 but enlisted as soon as he was 18 (in 1915) and volunteered as a signaller. In World War II he rejoined Signals, rising to Brigadier and worked on cross-Channel communications ready for D-Day. His autobiography, *Signal Venture* records his experiences in between the two wars. He is M.SC., F.C.G.I. and M.I.E.E.

T. P. HORNSEY (Sinclair Report Vindicates the Inland Telegraph Service) joined the Post Office in 1950 as an Assistant Principal. After a year's training in the North West Region he worked in the Establishments and Organisation Department until 1955 when he was promoted Principal in charge of the Telegraph Division, Operations Branch, Inland Telecommunications Department.

R. A. JACKSON (joint author, "Telephone Service in the Channel Islands") a Telecommunications Traffic Superintendent in Bournemouth Telephone Area, entered the Post Office in 1931 as a Youth-in-Training at Norwich. After serving with Royal Signals from 1943 to 1947, he was promoted Assistant Engineer and attached to the Ministry of Supply's Signals Research & Development Establishment at Christchurch until his present appointment in 1950.

B. E. RAKER ("Preparation for Subscriber Trunk Dialling in Bristol") is an Assistant Telecommunications Controller Class II in the South Western Region. He entered the Post Office Engineering Department in 1925 and joined the Traffic Grade as Assistant Traffic Superintendent in 1932. His present range of duties includes responsibility for co-ordinating the traffic aspects of S.T.D.

C. E. RICHARDS ("Materials Research in the Post Office") is Deputy Director of Research, Engineering Department. He joined the Post Office in Liverpool in 1922 and transferred to the Engineer-in-Chief's Office Research Branch in 1923. He has been there ever since spending most of his time studying materials and their application to Post Office engineering requirements.

D. J. A. STEVENSON ("The Automobile Association's Radio Network") is Communications Manager of the A.A.

A. TODD ("Going Over to M.A.T.S.") is Chief Clerk, Edinburgh Telephone Area. He entered the Post Office at Ayr as a Boy Messenger in 1910 and was appointed Sorting Clerk and Telegraphist at Linlithgow in 1913. He served in France from 1914, being severely wounded in the March, 1918, offensive, and spent two years in hospital before he resumed civilian duties. In 1920 he went to the Returned Letter Branch, G.P.O., Edinburgh and in 1921 transferred to the Sectional Engineer's Office, Inverness. He was appointed Clerical Officer in 1922. At the beginning of regionalization of the Post Office in 1936 the Inverness office was closed and he moved to Aberdeen Telephone Area, later transferring to the Finance Branch, Scotland. He was promoted to Higher Clerical Officer in 1940, and in November, 1948 on promotion to Higher Executive Officer was posted to Edinburgh Telephone Area, at which office he became Chief Clerk fourteen months later.

Manual Exchange Survey

The Post Office is conducting a survey of manual exchanges with a view to preparing a programme of conversion to automatic working. The pre-war programme of conversion within 10 years having been interrupted by the war, the policy since 1945 has been (owing to limited resources) to convert only those manual exchanges which were completely "exhausted"—that is, incapable of meeting the increased demands of the public for new lines—or too old to be of further use.

Nevertheless, the total number of manual exchanges has been reduced since 1945 from 2,240 to 1,099. Five exchanges out of six are now automatic.

Because capital investment is limited, it is still necessary to restrict conversion to those cases where the present accommodation is fully used, where further extension within the present accommodation would prevent subsequent conversion on site, or where maintenance costs are excessive. The object of the present survey is to produce a uniform programme of this work and to avoid too many cases occurring in any one year.

* * *

Regional Representative.—Mr. V. T. Dodson has become *Journal* representative for the Home Counties Region, Mr. K. Ridehalgh having joined Headquarters Central Organisation and Methods Branch.

Mr. Ridehalgh has represented the *Journal* in the Home Counties for nearly eight years. His services have been very much appreciated and we wish him success in his new post.

* * *

"The subscriber must not forget that he has certain work to do and that he is to a certain extent an operator of the service".—*Commercial Handbook of the Telephone Service*, 1906.

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

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

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