POST OFFICE

telecommunications

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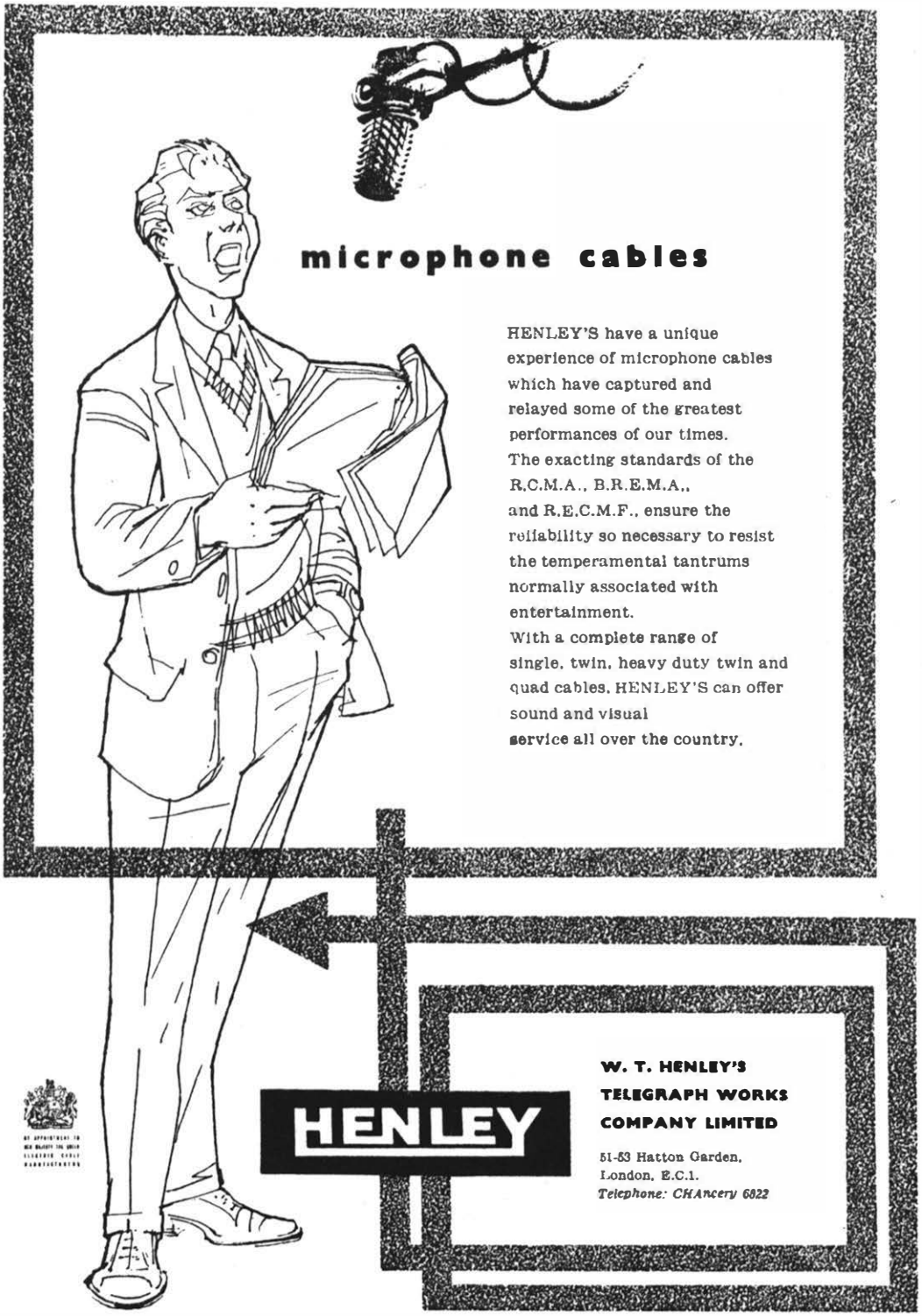
SPRING 1958



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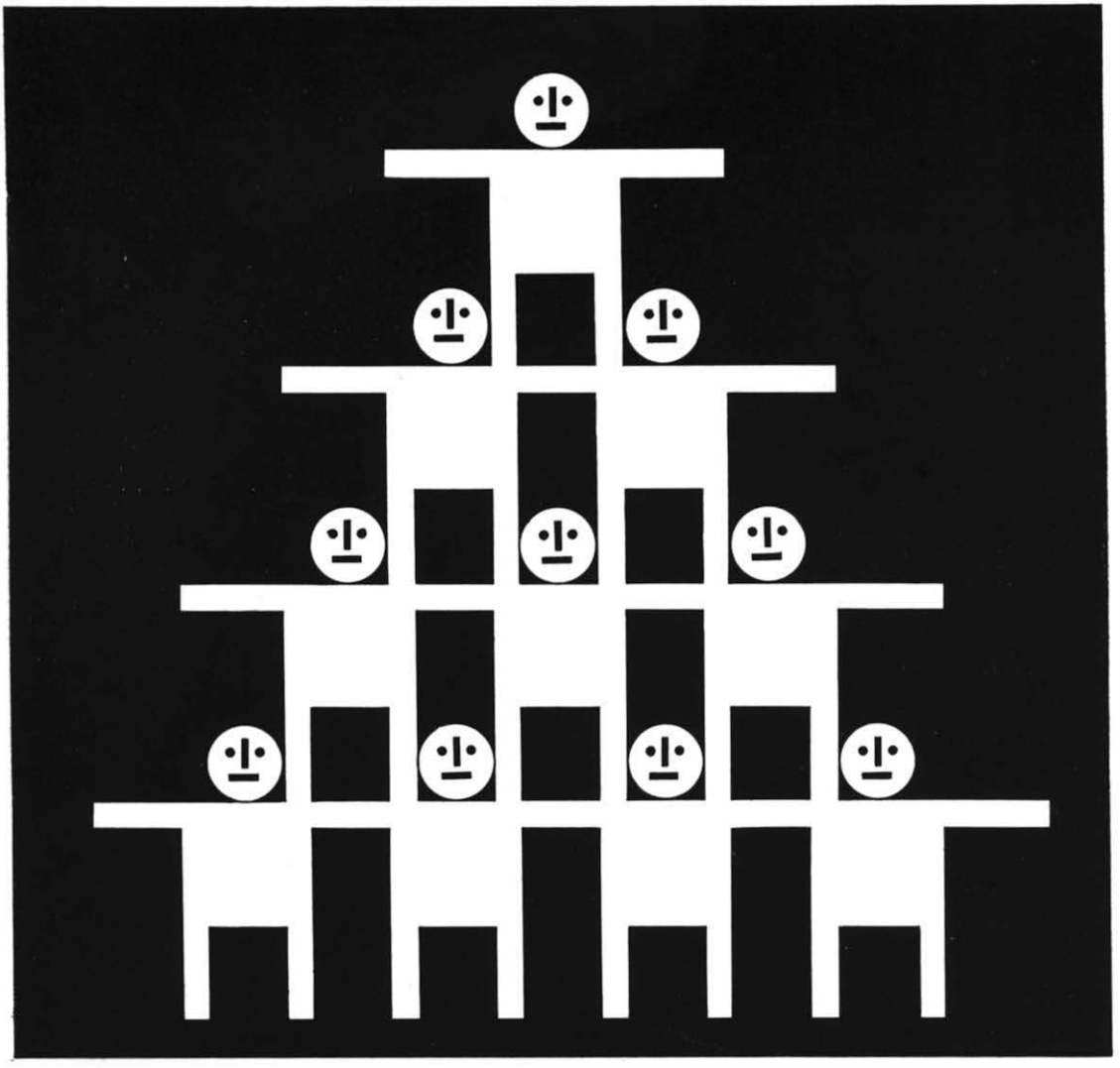

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0— 250 V.	
0—1000 V.	

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Post Office Telecommunications Journal

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

Contents

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Vol. 10 *Spring*, 1958 *No.* 3

Telephone Revolution in Ten Years

BEFORE THE WAR TELEPHONE EXPANSION MEANT persuading more and more people to rent telephones. For the past ten years or more demand has exceeded the financial resources needed to meet it. This demand has been due partly to the growth of the telephone habit and partly to the low rental. Telephones were being offered well below cost.

The tariff revisions of 1956 and 1957 brought the rental up to a fair price. Now we are setting out on a new policy of encouraging subscribers to make more use of their telephones; to use more effectively the capital invested in providing them.

That is the fundamental purpose of the new White Paper which, as outlined later in this issue, sets out a policy that should revolutionize telephone habits in the next ten years.

The new policy is to encourage the use of the telephone by calls which are cheap, quick and easy to make. With Subscriber Trunk Dialling (STD) call charges will be reduced. The unit charge will be 2d. All calls, local as well as trunk, will be timed, and subscribers will buy time in twopennyworths. The amount of time 2d. will buy will vary with the distance. The coin-box user will buy time in threepennyworths.

At the outset STD subscribers will be able to dial about three-quarters of their trunk calls and eventually all calls throughout the Kingdom.

"STD" says the White Paper, "is part of a story in which scientific and technical development have progressively lowered the cost of long-distance circuits and in which automation will reduce operating and accounting costs." We congratulate our scientific and engineering colleagues on their skill in enabling the administrative and operational staff to set out on this new and vigorous policy.

Telephone Policy for the Next Decade

New White Paper Summarized

In our Winter, 1958, *issue we published the full text of the November White Paper;* Full Automation of the Telephone System. *Policy and plans were then outlined in two Steps:*

1. Simplified Charging—*Group Charging, in fact, which came into force on January* 1; *and*

2. Automation—*Subscriber Trunk Dialling, which starts in Bristol on December* 1, 1958.

On May 21 *the Postmaster General laid before Parliament a new White Paper (Cmnd.* 436): Telephone Policy: The Next Steps: *the general aims of which are discussed in our leading article on page* 93. *Broadly this amplifies* Step 2 *of the previous announcement. Following are some of the salient points.*

"POST Office telephones have a policy for a decade ahead. . . ." These plans "should revolutionize telephone habits in the next ten years."

A large amount of capital has been invested in the telephone system: £800 million which, at to-day's replacement costs, would be more than £1,200 million.

There are more than 7,000,000 telephones in the United Kingdom. To install a telephone costs £110: £9 for the instrument, £16 for exchange apparatus, £85 for the cable. Yet the average number of calls made from each telephone is under two a day.

"The capital invested must be fully utilized. So greater use of the telephone is to be encouraged by reducing the cost and therefore the price of calls."

Having by the 1956 and 1957 tariff revisions fixed a fair rental for telephones, the aim is to encourage greater use by calls which are cheap, quick and easy to make.

The principal method of achieving this aim is Subscriber Trunk Dialling. The White Paper lists 45 cities and towns in which, after Bristol, STD will be installed at one or more exchanges by the end of 1960. Bristol STD will serve some 18,000 telephones. By the end of 1960 about 300,000 telephones will have the benefit of full automation. In 1961 a start will be made with a group of London exchanges. By 1970 three-quarters of all trunk calls should be dialled by subscribers.

"STD makes possible an entirely new method of charging for calls be they local or trunk. Where STD is introduced there will be reductions in both local and trunk call charges."

Subscribers with STD will buy time in two-pennyworths, the amount of time bought for 2d. depending on the distance of the call. The new equipment will enable local as well as trunk calls to be timed.

The tariff will be simpler. The present five steps for trunk calls will be reduced to three. The tariff will be as shown in Table A.

The new call charges, both local and trunk, will apply only where STD is introduced. The new trunk charges will then apply only to calls dialled by subscribers but the new local charges will apply to all local calls from STD subscribers whether dialled or not.

There will be no pips to show the passage of time because the three-minute interval will have little significance on many calls with the abolition of the three-minute charge; also, more frequent pips would annoy callers, and "pipping" equipment would increase the cost of calls.

Subscribers with STD will receive quarterly accounts, showing the number of units used as recorded on individual meters at the exchange and one total charge for all calls, local and trunk. They will be able to rent check meters for installation in their homes or offices.

New STD coin-boxes will be introduced to enable callers to dial trunk calls. These will be

Distance	Time bought for 2d.	Future charge for dialled call lasting :			Present minimum (3 minutes)
		1 min.	2 mins.	3 mins.	
Local call	3 mins.	2d.	2d.	2d.	3d. (untimed)
Between limits of local call area and 35 miles	30 secs.	4d.	8d.	1s. 0d.	1s. 0d.
35–50 miles	20 secs.	6d.	1s. 0d.	1s. 6d.	1s. 9d.
50–75 miles	12 secs.	10d.	1s. 8d.	2s. 6d.	2s. 3d.
75–125 miles					3s. 0d.
Over 125 miles					3s. 6d.

Table A : STD Call Charges for Subscribers

installed about a year later than STD for subscribers in each district.

The new box will have no A or B button. Callers will not be able to put money in until their call is answered. A signal tells the caller when the time paid for has been used. If no more money is inserted about 12 seconds extra are allowed before the call is cut off. There will be no penny slots but slots for 1/-, 6d. and 3d. pieces.

Local calls from STD boxes will be timed whether subscriber or operator connected. (Ninety per cent of coin-box calls are local.) These will cost 3d. for three minutes instead of 4d. untimed. (Local calls from non-STD boxes will remain at 4d. untimed.)

The full STD coin-box tariff is in Table B.

Distance	Time bought for 3d.	Future charge for dialled call lasting :			Present minimum (3 minutes)
		1 min.	2 mins.	3 mins.	
Local call	3 mins.	3d.	3d.	3d.	4d. (untimed)
Between limits of local call area and 35 miles	30 secs.	6d.	1s. 0d.	1s. 6d.	1s. 3d.
35–50 miles	20 secs.	9d.	1s. 6d.	2s. 3d.	2s. 0d.
50–75 miles	12 secs.	1s. 3d.	2s. 6d.	3s. 9d.	2s. 6d.
75–125 miles					3s. 3d.
Over 125 miles					3s. 9d.

Table B : STD Call Charges from Coin-Boxes

The 12 seconds allowed after the more-money signal and the cutting off of the call (if no more money is put in) means that the caller will, in practice, be able to speak for 12 seconds longer than shown in the table.

The Post Office now employs 50,000 telephone operators and supervisors. As automation proceeds the staff required will gradually be reduced. By 1970 only about half the present numbers may be needed. The human problems of the men and women who will be replaced are even more difficult than the technical ones which have been solved. They deserve and will get as much detailed consideration . . .

"The Post Office recognizes its obligations to those who serve it. The Post Office Trade Unions recognize that automation is a necessity for a developing telephone service. Together, we are considering the changing needs of the future and the problem of giving displaced staff new work and new prospects . . ."

Success depends on public co-operation.

Appendix to White Paper

National Telephone Numbers

National numbers will be used for dialling trunk calls. They will be in two parts:

First. A series of figures and letters to identify the required exchange.

Second. The called subscriber's existing number.

A national number will always start with "O". Dialling "O" will connect the call to GRACE.

For calls to London the next figure will be "1". The national numbers of all London subscribers will be "01", followed by the existing letters and numbers. Thus:

London CENtral 1234 *will be* 01 CEN 1234

There are five other cities where letters are already used for dialling local calls. For calls to these cities the first three figures will be:

Birmingham	021
Edinburgh	031
Glasgow	041
Liverpool	051
Manchester	061

and the national numbers will be built up thus:

Edinburgh WAVerley 1234 *will be* 031 WAV 1234

About 300 other towns, including all the largest, will have STD codes in which "O" will be followed by two letters, generally the first two letters of the name, and then a figure. Their national numbers will be built up thus:

Cardiff 56789 *will be* OCA 2 56789

The figure distinguishes between names which start with the same two letters or with letters having the same position on the dial, thus:

Leeds 56789 *will be* OLE 2 56789

Leicester 56789 *will be* OLE 3 56789

A list showing the codes to be used at Bristol on the introduction of STD is given opposite. These codes will enable subscribers on Bristol Central to dial about half the subscribers in the country and about three-quarters of their trunk calls.

When facilities are provided for dialling trunk calls to the smaller exchanges it will not be possible to give all of them letter codes derived from their present names because the dial does not provide enough suitable letter combinations. The codes for these exchanges will be allotted progressively.

All subscribers with STD will have dials with letters and figures fitted on their telephones.

Telephone directories will contain local numbers as at present. They are the numbers usually wanted. But each subscriber with trunk dialling facilities will be given a list showing the codes of all the exchanges he can dial. Similar lists will be available at STD coin-box telephones. As dialling to additional places is provided new lists will be issued.

Because "O" will be used to call GRACE a different code will be needed to call the operator. This will be "100". It will be introduced before STD. But "999" will continue to be used for emergency calls—exactly as at present.

National numbers will be used for trunk calls. For local calls existing numbers will be used as now.

CODES WHICH BRISTOL SUBSCRIBERS WILL DIAL WHEN STD IS INTRODUCED

For calls to places where letter codes are already used		For calls to other places	
Route	**Code**	**Route**	**Code**
London *all automatic exchanges*	O1	Bridgewater	OBR 8
e.g. Abbey	O1 ABB	Brighton	OBR 3
Mayfair	O1 MAY	Cardiff	OCA 2
Whitehall	O1 WHI	Chester	OCH 4
		Chippenham	OCH 9
Birmingham *all automatic exchanges*	O21	Dursley	ODU 8
e.g. Central	O21 CEN	Exeter	OEX 2
Midland	O21 MID	Frome	OFR 3
Woodgate	O21 WOO	Gloucester	OGL 2
		Grimsby	OGR 2
Edinburgh *all automatic exchanges*	O31	Kingsbridge	OKI 8
e.g. Caledonian	O31 CAL	Leeds	OLE 2
Portobello	O31 POR	Leicester	OLE 3
Waverley	O31 WAV	Newcastle-on-Tyne	ONE 2
		Newport	ONE 3
Glasgow *all automatic exchanges*	O41	Nottingham	ONO 2
e.g. Bell	O41 BEL	Penzance	OPE 6
Clydebank	O41 CLY	Plymouth	OPL 2
Paisley	O41 PAI	Portsmouth	OPO 5
		Salisbury	OSA 2
Liverpool *all automatic exchanges*	O51	Shaftesbury	OSH 7
e.g. Aintree	O51 AIN	Sheffield	OSH 2
Prescot	O51 PRE	Shepton Mallet	OSH 9
Royal	O51 ROY	Southampton	OSO 3
		Swansea	OSW 2
Manchester *all automatic exchanges*	O61	Swindon	OSW 3
e.g. Deansgate	O61 DEA	Taunton	OTA 3
Rusholme	O61 RUS	Truro	OTR 2
Stockport	O61 STO	Worcester	OWO 5

All-Night and Sunday Afternoon Cheap Rates

From July 1 the cheap rate for telephone calls will apply between 6 p.m. and 6 a.m. on week-nights, and from 2 p.m. on Sundays to 6 a.m. on Mondays.

The extension was announced in the new White Paper on STD, which points out that it will mean more Sunday and night work in exchanges until STD is available.

With STD, 2d. will buy six minutes on a subscribers local call during the cheap rate period and 3d. will buy a six-minute call from a coin-box telephone. Trunk callers, both subscribers and coin-box, will have half as much time again as for ordinary rate calls.

The Post Office is indebted to the staff for their willingness to co-operate in extending the cheap rate period.

The White Paper also shows that "STD is part of a story in which scientific research and technical development have progressively lowered the cost of long-distance circuits and in which automation will reduce operating and accounting costs. STD has had to wait for automatic exchanges and trunk circuits."

A "Time Table" recalls that the intention to introduce STD was announced in October, 1955 (Cmd. 9576), following technical studies in the previous year.

VIth British Empire and Commonwealth Games

Communications for Control, Recording and News

R. F. Bradburn, B.Sc.

In our last issue Mr. Bradburn outlined preliminary planning for the VIth British Empire and Commonwealth Games, which will open in Cardiff on July 18. Below he describes in detail the communications which will be required.

BEFORE DESCRIBING IN DETAIL THE COMmunications required at the main centre for the Empire Games a few words about the multifarious matters needing attention to convert Cardiff Arms Park from an international rugby ground and greyhound racing stadium to a first-class athletic arena will, perhaps, not be out of place. Before the cinder running track can be laid, a temporary greyhound track must be constructed inside the existing one which now surrounds the football pitch. Only after full dog racing trials have been run on the new course can the changeover be made and the existing one released for removal of turf, excavation of the sub-soil and laying of the cinder track.

Dressing rooms built for a couple of rugby teams are totally inadequate to house the hundreds of men and women athletes competing in the Games, and temporary accommodation, complete with showers, changing, medical and physiotherapy rooms, is to be installed. Near the dressing rooms a warming up area will be available using part of the County cricket ground. An athletics scoreboard, 70 feet long, greatly augmented Press seats and television stands, a Royal box and Royal retiring room, are all required in addition to masses of arena equipment, some 17,000 temporary seats and last, but by no means least, communications for the control and conduct of all the proceedings.

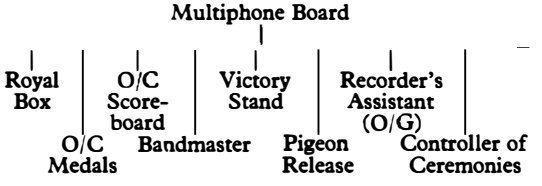
At the moment, of course, there are no telephone facilities whatever on the ground itself and a completely new system has had to be designed to cater for all eventualities during the Games. To appreciate what is required of the communications system it is necessary to visualize some of the conditions which have to be met.

Control of the events has to be much stricter than at ordinary athletics meetings. More than one event will be occurring at any one time and provision has therefore to be made to control up

Cardiff Arms Park (*Courtesy, Empire Games Organization*)

to three events simultaneously—for example, the long jump and pole vault may be going on at the same time as the one-mile race. The results have to be very carefully vetted before release to the public or Press, yet details of the final placings are required most urgently, particularly by radio commentators who will have to give listeners the authentic results with the absolute minimum of delay. Furthermore, a very strict ceremonial procedure has to be followed in the victory ceremony at which the gold, silver and bronze medals are presented to the successful competitors.

Communications have, therefore, been centred on a control room overlooking the arena—see diagram. The first intention was to use three multiphone boards for the control of the events and ceremonial but we found later that these would not provide for the required number of simultaneous connexions and that a PBX switchboard would be necessary. One multiphone board, however, is being provided for ceremonial purposes with the following connexions:—



A $\frac{10 + 30}{65}$ switchboard will be used to give internal communication between the various starting and finishing points, the field event judges, the dressing room stewards, jury of appeal, warming up area, recorders, and so on, to enable the Controllers of Games and Ceremonies to keep a firm hand on the proceedings. In addition, roughly 30 lines on the temporary Empire Games Exchange will be put in for officials such as the Controller, Recorder, Press Stewards, medical and first aid rooms, interview room steward and, of course, the Royal Box, while exchange lines on Cardiff automatic telephone exchange will be provided as necessary for other interested parties; for example, caterers. Facilities for the B.B.C., I.T.V. and oversea radio commentators are also being planned in detail.

Considerable care has had to be taken with the organization of the results system. At the end of any event the judges and timekeepers will agree the official results, consulting the photo-finish controller if necessary, and pass them to the referee who, after approving the details, will telephone them immediately to the Recorder in the control room. The Recorder will record the details on specially prepared results sheets in quadruplicate, and the completed sheets will be passed by hand to the Controller of Games for final agreement and approval of release. The four copies are intended for use as follows.

The Recorder's Assistant (O/G results) will pass full details of the results via the ceremonial multiphone board to such points as the scoreboard, the victory stand, the bandmaster and the officer in charge of medals. Speed in distribution is essential, particularly where a final is concerned, as the bandmaster must be ready with the correct national anthem for the victory ceremony.

The second copy is intended for use by the public address announcer, but the actual announcement may have to be delayed for a time to prevent interference with other events which may be in progress or on the point of starting.

The third copy is to be used in an endeavour to prevent any criticism like that expressed on a recent similar occasion when the Press representatives complained about the delay in receiving the official results. A special telephone "flash" circuit has been designed which connects the Press steward in the control room with headsets fitted to every Press seat and radio commentator in the stadium. Immediately the Games Controller approves release of the results the Press Steward, using the third copy, can read out the details at dictation speed, and the service given to the Press and radio commentators will thus be independent of any delays which may arise in announcing the results over the public address system or in displaying the results on the official scoreboard. This will be the first occasion on which such a facility has been provided.

The fourth copy is for the teleprinter operator on the omnibus or "round robin" circuit for the results to be put out over the teleprinter network to other centres such as Central Records at British Empire Games Headquarters, the Press Centre, Empire Games Village and other main sporting stadiums. At certain of the receiving points the message will be teleprinted direct on to a stencil so that mimeographed copies may be run off with the minimum of delay.

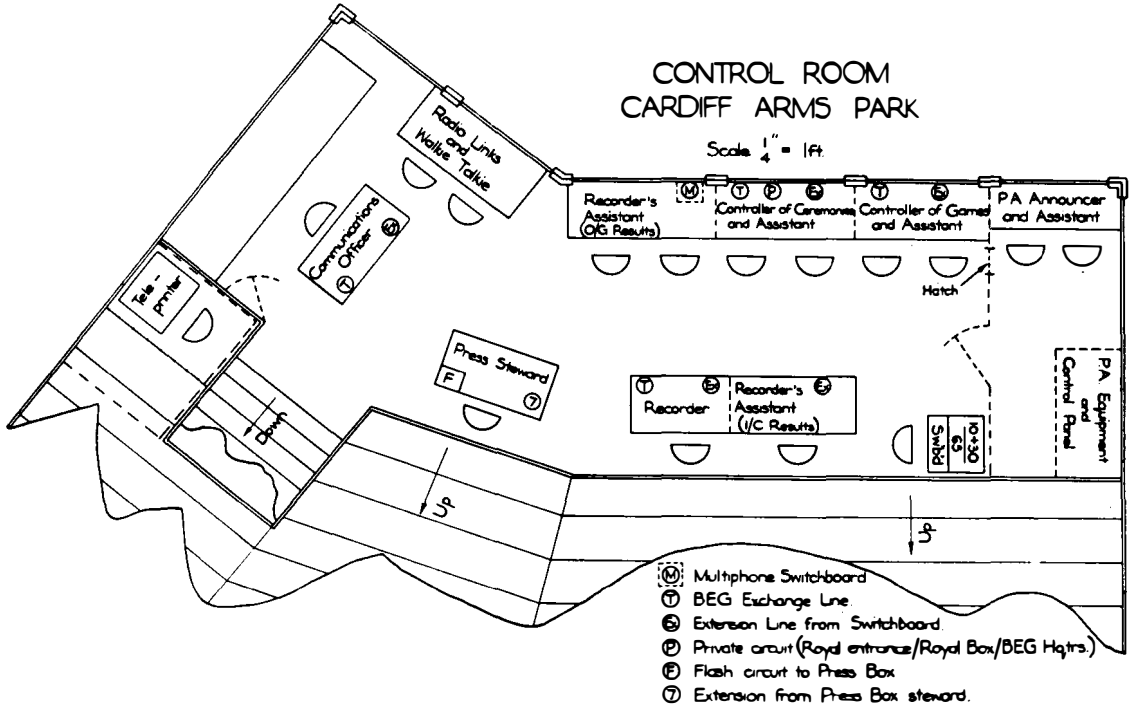
For example, at the Press Centre roughly 400 copies of results will be required to supply individual copies to all members of the Press. Each Press correspondent will, therefore, have a

locked letterbox at the Press Centre for his sole use and where he may pick up copies of the mimeographed results at his convenience. Results from venues not on the teleprinter network will be telephoned to Games Headquarters for injection into the "round robin".

A limited number of walkie-talkie sets is to be provided as a stand by to normal communications in the stadium, and for use in connexion with the opening and closing ceremonies. Mobile radio communications will be available in addition for the control of the marathon race; these are explained below. A small number of hand type transistorized loud hailers—known as transhailers —is being provided, particularly for use in the warming up area.

The existing public address system in Cardiff Arms Park has had to be reorganized to give facilities more suitable for an athletics stadium. The high volume speakers are to be replaced by a larger number of lower powered speakers designed to give complete coverage to the spectators' accommodation but to avoid interference in the arena and annoyance to the public outside the stadium. A second system for the competitors' and officials' dressing rooms, and the warming up area, is being installed with facilities for coupling up with the main system as required. Two local systems, each consisting of one starter's microphone and six small loudspeakers, each located opposite the individual starts of the staggered start events (that is, 220 yards and 440 yards) are being provided to ensure that all competitors hear the starting pistol simultaneously.

Many orders have been received for direct exchange lines in the Press Box for newspapers and agencies but these will have to be supplemented by ample call office facilities as near as possible to the Press seats. A heavy demand is expected for cable facilities, and the Post Office Cable and Wireless Mobile Van will stand in the adjacent Telephone Exchange yard virtually underneath the Press seats. Urgent rate messages from the Press Box will be passed direct to the Cable and Wireless Van by an aerial runway which, although somewhat "Heath Robinson", should be none the



Control Room layout

less effective. With these arrangements it should be possible for results to be transmitted direct from Cardiff Arms Park to the various newspaper offices in Australia, New Zealand, South Africa, Canada and elsewhere within a matter of five minutes.

A complete list of all the facilities to be provided in Cardiff Arms Park cannot be given because of limitations of space. The arrangements needed for the marathon race should, however, be described.

Competitors' feeding stations will be available at three-mile intervals, while reporting points are required at the five-mile stages—all with adequate telephone facilities. The position and time of each runner has to be recorded and reported back at the 5-, 10-, 15-, 20- and 25-mile points. Equally important is the need to keep the 35,000 spectators in Cardiff Arms Park informed of the progress of the race, particularly for the last few vital gruelling miles.

Fixed communications will not give all the desired facilities and, perhaps even more important, will not cater for the emergencies which sometimes arise in a race of this type. Army Signals co-operation has therefore been enlisted and mobile radio vehicles will travel round the course, ahead of the leading runners, alongside the main bunch of runners, and behind the last competitor. A fourth radio vehicle will be stationed at a fixed point to relay information as necessary. Suitable medical staff will be in attendance in the mobile ambulances which will accompany the last radio vehicle so that any demands for medical assistance can be attended to with the minimum of delay.

The marathon course starts from Cardiff Arms Park and stretches along the main road almost to Newport, returning by the longer coast road. Over this part of the course radio communications are excellent but when the runners re-enter Cardiff communications with the fixed vehicle would be somewhat unreliable partly because of the topography but mainly because of the trolleybus network which blankets the signals. The operating frequency will, therefore, be changed on entering Cardiff and the mobile vehicles will work to a second fixed station situated on a hill overlooking Cardiff.

The facilities so far described cover only the arrangements for the athletic events in the main stadium. Somewhat similar schemes have been designed for cycling at Maindy Stadium and for the 120-mile road cycle race near the coast at Ogmore, for swimming at the Empire Pool, for fencing at Caer Castell Secondary Modern School, for boxing and wrestling at Sophia Gardens Pavilion, for weight lifting at Barry Memorial Hall, for lawn bowls at three separate rinks in Cardiff, and for rowing at Lake Padarn, near Snowdon. The Empire Games Village at St. Athan and the Press Centre at Cardiff also need their own individual networks.

The amount of planning in particular has been by no means light and the demands made upon Post Office resources are certainly appreciable. The fullest co-operation has been received, however, from all Empire Games Committees concerned. Because the Post Office has had a representative on all the main committees from the very outset, it has been possible to bear in mind Games' needs in planning and executing ordinary development schemes, particularly so in external development work, for in several instances it has been possible to make adequate provision for the Games in conjunction with ordinary subscribers' work.

At the time of writing, the work of execution has just started; much remains to be done, but all concerned within the Post Office are looking forward to July 18–26 in the expectation that careful planning over the past two years will result in a successful conclusion.

Piezoelectricity Reports

Scientific workers concerned with crystal oscillators and resonators, and the application of piezoelectric crystals to electro-acoustic problems, will be interested in *Piezoelectricity*, one of the Selected Engineering Reports recently issued by the Post Office Research Station, and published by the Stationery Office at 75s.

Workers in this field have been seeking alternatives for natural piezoelectric materials, and this book contains the most complete and accurate data available on water-soluble materials. The descriptions of production techniques cannot be found in other books on the subject. Eleven reports, representing the findings of a number of workers, are included in the volume and both practical and theoretical aspects are dealt with.

Usually the information contained in such reports is available for use only within the Post Office, but *Piezoelectricity* can be bought from any Government bookshop or through any bookseller.

Training Commonwealth and Foreign Engineers

How School and Field Work are Planned

A. O. Milne

A FOREIGN TELEPHONE ENGINEER ONCE remarked that the British Post Office, with its high standards and years of experience, has found the best way of doing most things in telecommunications. So sweeping a generalization may merit a modest rebuttal yet there is no doubt that it is to the Engineering Department of the Post Office that Commonwealth and many foreign administrations look for help and advice and for the training of their technical staff.

Since November, 1945, when a student from Nigeria, the first trainee to arrive after the war, was accepted by the British Post Office for a four years' course, and completed it with an "above average" assessment, students have been coming from every corner of the globe, to study telecommunications engineering in all its aspects. Today, the Engineering Department, with the co-operation of the directorates and regions, arranges some 150 training courses of varying length for overseas staff every year.

The policy of the Post Office is to provide training facilities for personnel from those administrations which use British P.O. type equipment, if they so wish.

Of the many hundreds who have participated during these 12 years, only two have had to return home before the completion of their training, one because of serious illness and the other because he could not stand the cold.

In general, there are two types of visitor. First, the Senior Engineer looking for new ideas and modern developments and concerned mainly to gain an overall picture of what is new in communications; second, the rather more junior person who requires detailed instruction, often from a fairly elementary beginning. We do not provide training for men only; not so long ago an advanced training course on coaxial cable technique was arranged for two women engineers from the Norwegian Post Office. Both passed with distinction.

Senior Engineers come either directly from their own administrations or as holders of United Nations Fellowships for Technical Study through the International Telecommunication Union. Their welfare while in the United Kingdom is in the hands of the British Council. Programmes usually consist of discussions with experts from Engineering Department branches and visits to installations in various parts of the country.

More junior visitors, who form the majority of the total, come either with British Council Scholarships through the Colombo Plan for Technical Assistance in South East Asia, or directly through the Students' Department of the Colonial Office, the Commonwealth Relations Office or their own administration.

A typical example will be of interest. A request comes, say, from a West African territory for facilities to train two men both in their early twenties. One is to specialize in automatic telephony and local line planning, the other in transmission and telegraphy. Each will probably have served in his own department for several years but it is considered desirable that he shall have adequate practical training in the field, in addition to taking courses at a Regional School or at the Engineering Department's Central Training School at Stone.

This field training may include both overhead and underground line work, fitting and maintenance of subscribers' telephones and more specialized training, before and between school courses which may take eighteen months to two years to complete.

Because of the great demand for training, overseas administrations are encouraged to make their needs known with at least six months' notice; this enables provision to be made for the trainees in the appropriate annual estimates and the consequent school programme.

Immediately dates of the Central Training School courses have been fixed, one of the Post

Office regions is approached about suitable field training. Every effort is made to spread the load but it is inevitable that London and the Home Counties Region tend to get rather more trainees than others. Nevertheless a particular region may tend to get people from one part of the world; for example, normally most Ghanaians and Nigerians go to the South West Region. They like the milder climate and the South West seems to like them.

When these arrangements have been completed a final programme is sent to the sponsoring administration and the trainee. The field training is most important because the trainee is faced in the field with practical problems in their actual setting and sees the difficulties in the way of solving them and the conditions under which they must be solved. As a result he knows better what to look for in the school course and absorbs very much more of the course material.

After the course, he returns to the field to apply his knowledge and to exercise his newly acquired techniques.

Quite often, although a man from one of the less developed territories may have one or two elementary technical certificates he has probably had only a haphazard practical background. He may have little idea how to use or to take care of tools or even of so simple an operation as stripping insulation from a piece of wire. In practice, tried and tested methods are quickly assimilated, helping to give confidence to a man who might be rather uncertain of himself in a strange environment.

(Courtesy, 'News Chronicle', Manchester)

Mr. Christopher Van Lare from Ghana

To return to the two West Africans. The man who is to specialize in automatic telephony will be allocated to a course in the basic principles of automatic switching, and later to a non-director course covering switching facilities such as are in use in his own country. Such a man will probably need to be something of a jack of all trades when he returns and accordingly in addition to training in local line planning, he may be given tuition on exchange power plant and in any other ancillary subjects that can be arranged in the time available.

The transmission man will be given a basic transmission course at the school and later a course on carrier principles, multi-channel voice-frequency telegraph systems, and possibly on teleprinter adjustments. He may also have to know something about very high frequency trunk radio systems which, because of their convenience in difficult country, are superseding the more orthodox cable routes in many places.

His field training will most likely be given in a large transmission centre, such as Faraday Building in London or Telephone House, Birmingham.

From time to time, candidates may need to acquire specialized skills such as the jointing of coaxial cables. Tuition for this is given in the regional training schools.

Such a varied programme, if it is to be successful, calls for a great deal of personal interest on the part of the officers with whom the trainee will come into contact. It also requires close liaison between the Engineering Department's Equipment Branch (as co-ordinator) and its Training Branch, and with training officers in the regions. Without the wholehearted co-operation of all, the task would be well-nigh impossible. This co-operation is given in good measure and the files record many instances of the close personal interest with which the welfare of our overseas students has been watched throughout and of many acts of kindness by members of the staff in helping these men to succeed.

There has been nothing but the warmest praise and gratitude expressed to us by the students at the end of their visit to Britain, for the treatment they have received at the hands of Post Office staff.

One of the things which quickly becomes apparent is that, although racial customs and philosophy may affect a man's approach to the job, they have no bearing on his qualities as an

engineer; given equal opportunity, he can easily hold his own with United Kingdom trainees both on the theoretical level and in practical work involving, for example, the adjustment of selector mechanisms, teleprinters and similar intricate apparatus.

Realizing that the visit to the United Kingdom is the chance of a lifetime, the overseas student sometimes presents a problem arising from sheer enthusiasm.

Two Pakistanis who are well remembered, after several months of hard study, arrived at the Equipment Branch on the Thursday morning before Easter asking for an assignment until the following Tuesday, when they were due to start another course at Stone. They received with incredulity the advice that they should take the first available train to the sea coast and forget all about telephones for a few days. It took all our powers of persuasion to convince them that this would not be a waste of time. It was discovered later that they compromised by spending as much of the week-end as possible in the telecommunications galleries of the Science Museum in South Kensington!

The magnitude of the training programme provided by the Engineering Department at present can be gauged by the fact that there are 55 trainees from 23 different administrations on long term training. Among this number are men from such widely diverse places as Bahamas, Colombia, Ghana, Iraq, Malaya, Sudan and Thailand.

Apart from the purely technical aspect of training, helping men with such differing outlooks and backgrounds presents its own problems. There is the Moslem requiring special arrangements for his food; the timid and sometimes shivering arrival by air finding himself in a great city for the first time in his life and at a temperature lower than he ever dreamed possible.

Such problems are very real and call for considerable tact and understanding. They are minor troubles, however, and of small account compared with the satisfaction which comes to all concerned when a final report is prepared on one more visitor who has learned from the British Post Office the best way of doing at least some of the more important things in the field of telecommniucations.

Telecommunications Statistics

	Quarter ended 31st December, 1957	*Quarter ended 30th September, 1957*	*Quarter ended 31st December, 1956*
Telegraph Service			
Inland telegrams (excluding Press and Railway Pass)	3,327,000	4,118,000	3,764,000
Greetings telegrams	669,000	892,000	781,000
Telephone Service			
Gross demand	74,136	76,379	95,076
Connexions supplied	75,870	84,309	103,968
Outstanding applications	184,364	209,903	267,993
Total working connexions	4,481,856	4,518,815	4,412,303
Shared service connexions	1,153,115	1,189,344	1,160,441
Total inland trunk calls	80,473,000	86,262,000	79,946,000
Cheap rate trunk calls...	17,380,000	20,961,000	18,163,000
Telex Service			
Total working lines	4,159	3,962	3,324
Total inland calls	728,000	662,000	573,000
Total overseas calls	419,000	401,000	355,000
Staff			
Telegraphists (including staff employed on Telex)...	5,879	5,925	6,178
Telephonists	44,649	45,482	47,216
Engineering workmen...	64,501	64,403	64,295

Electronic Computers in the Office

F. J. M. Laver, B.Sc., M.I.E.E.

Following is the substance of a paper which Mr. Laver read to the Post Office Telephone and Telegraph Society in January

LET US BEGIN BY DEFINING OUR SUBJECT which, in stores vocabulary terms, is a computer, electronic, digital, automatic. A computer is simply a machine for doing arithmetic; and an electronic computer does its sums by means of "non-mechanical" devices such as radio valves, transistors, rectifiers and resistors; a digital computer works with digits: that is, with separate symbols representing the figures 0 to 9; and the last adjective, automatic, needs no elementary definition.

The first electronic computers were made for scientific work, which commonly requires lengthy calculations to be performed with relatively few figures. In office processes, on the other hand, the calculations are short and simple, but are repeated with little variation for thousands of items.

The office use of computers has been called automatic data processing, ADP for short, to distinguish it from pure computation, and this distinction is a useful one. Indeed, it has been estimated that office machines spend less than a quarter of their time in calculation. The term ADP emphasizes the continuous flow of information through the machine, raw data being fed in from different sources to undergo various rational processes designed to translate it into more useful forms.

It is worth pausing briefly to consider two terms that have just been used—"data" and "rational processes".

"Data" is simply the initial information on which the process is based—workmen's time sheets for payroll, requisitions and delivery notes for stores accounting and their like. By data is meant any alphabetical or numerical material supplied for processing.

"Rational processes" include both mathematical

Fig. 1 (above): Lyons' electronic office (LEO)

and logical operations. The mathematical operations are generally those of simple arithmetic; namely, addition, subtraction, multiplication and division. The logical operations include selecting, sorting, matching, comparing and merging.

ADP machines can undertake anything that can be completely specified as a series of individually simple rational operations, and surprisingly many tasks can be so described. It does not follow that all such tasks are suitable for ADP, for the costs of analyzing and rearranging the work to suit the machines are often high, which tends to limit their use to applications in which long runs of similar items are similarly processed.

Electronic methods enable computers to work very many times faster than an ordinary desk adding machine; thus, some of the larger computers can add two 12-digit numbers in 1/20,000th of a second or less. However, sheer speed is not the most important difference.

A desk calculator performs only one operation at a time for its human user, whereas an electronic computer automatically performs long sequences of connected operations without any outside assistance. Numbers representing the input data, constants, or intermediate results of the process can be held in stores inside the machine, and are shuttled between the arithmetical and logical units and the stores under the control of a pre-established schedule of instructions. This schedule is known as the program for the job, and it is the program which determines what job the machine will do. The program can very readily be replaced by a different one, and a particular computer can work to an almost unlimited variety of programs and so can be used for many different purposes.

It cannot be too strongly emphasized that ADP machines invoke no fundamentally new principles for dealing with their work. They score heavily over their human counterparts in speed and accuracy, but use identical rational processes. It has been well said that "a computer functions as a supremely competent, but quite unoriginal, clerk". A computer is, in fact, the supreme exponent of "working to rule"; which will indicate why putting a job on a computer is, like marriage, something not to be undertaken lightly or unadvisedly.

It is useful at this stage to see what an automatic data processing machine looks like. Fig. 1 shows Lyons Electronic Office, LEO for short. A machine of this size might contain 3,000 valves and 100,000 other electrical components. These

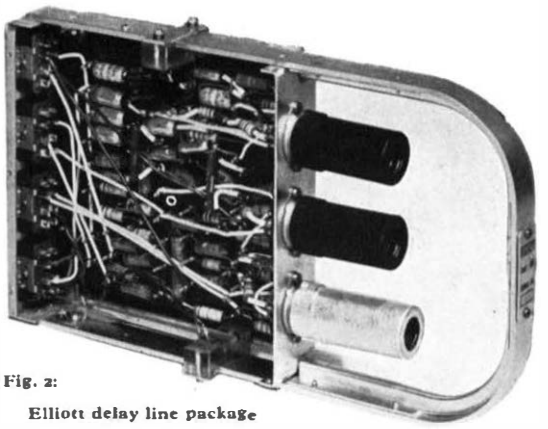


Fig. 2:
Elliott delay line package

are contained in a dozen or more large steel cabinets, like those in the background. Some 30 kW. of electric power are consumed, and all of it is eventually dissipated as heat, which has to be removed by ventilating fans.

To ease—but not entirely to remove—the problems of the maintenance engineer, the electronic circuits may be split into several hundred small packages such as the one in Fig. 2, which is from a machine of the kind the Post Office proposes to use for its London payroll. These packages plug in and out and can be replaced quickly for later repair when found to be faulty.

How Does it Work?

Many of those who are curious to know how electronic computers work are content to take for granted the equally complex mechanisms of comptometers and punched-card calculators, and an extensive knowledge of computer interiors is, in fact, necessary for electronic specialists only. Nevertheless, a broad outline of the methods of working used in ADP machines is a help to understanding their use.

Broadly then, an ADP machine has four main parts: input, output, store and arithmetical unit. These co-operate as shown in Fig. 3.

First, the initial data enter through the input unit, and are held in the store. Second, these data, with other information already in the store, are processed in the arithmetical unit and returned to the store. Finally, the processed results leave the machine through the output unit. These actions are controlled in rigid detail by the program of instructions. The instructions are themselves held in the store in a numerical coded form.

Fig. 4 reveals the anatomy of the machine in a little more detail. Thus, the store now has three parts. One part holds the program; the part called the working store holds those data actually taking part in the process at any time: and the backing store holds files of reference data—for instance the stock ledger in a stores accounting process. This backing store has to hold much more than the working store but need not yield its contents so quickly.

The ability of a computer to store information is sometimes considered to be a rather mysterious quality: the mystery, however, largely stems from the use of the term "store", and when "record" is substituted much of the mystery vanishes. The most familiar method of storing or recording information is by making ink marks on sheets of paper, but it is not easy to read such marks automatically, and it is preferable to use magnetic (or other) marks which can be readily converted into the electrical signals used to represent numbers inside the machine.

Fig. 5 shows a backing store with four machines for reading and writing magnetically on reels of plastic tape. The tape is coated with varnish containing a magnetic powder. The magnetic coating may also be applied to the surface of a rapidly rotating aluminium drum, as in Fig. 6, so that data can be written in or read off as the drum

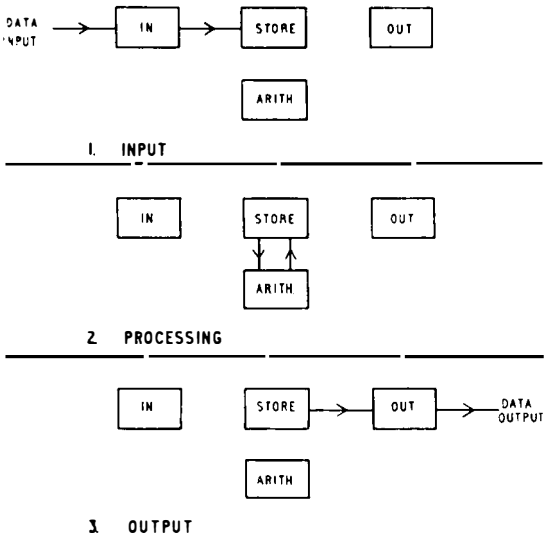


Fig. 3 : Four main parts of ADP machine

revolves. Sometimes a separate tiny ring of magnetic material is provided to record each magnetic mark as in Fig. 7. Each ring is about the size of a typewritten letter O, and there may be as many as half a million rings in a large store.

Consider again the general arrangement of the machine in Fig. 4. Signal highways and electronic gates are used to connect its parts in various ways as required by the different phases of the process. The gates are open and shut by a control unit, which acts in strict accordance with the stored program of instructions.

The apparent complexity of operation of an ADP machine in fact largely resides in its instruction, rather than in its construction. The instruction program must detail precisely every step of the operation and, because the machine has neither initiative nor common sense, every conceivable contingency must be anticipated.

The preparation of a computer program has been described as "painstaking, detailed and exacting work", and the programmer must be an analytical thinker who is capable of sustained periods of meticulous work. A large clerical program may contain two or three thousand instructions; mistakes of composition are therefore to be expected and their elimination may take a time measured in days or weeks rather than hours. Indeed, it has been quite seriously suggested that the mental ability of programmers may eventually set limits to the use of computers. Much of the work of programming has a tedious near-routine character, and ways are being sought to transfer this work to the computer itself.

A preliminary to writing the program is, of course, the statement of the work that the computer is to do. This work must be broken down into its simplest elements, for although a computer works quickly it only does so in very simple steps. The instructions which form the program are written in a code that specifies the operation to be performed and also certain storage locations or "addresses". The operations include, read-input, transfers between stores and the arithmetical unit, arithmetical operations, print-ouput and so on. A particularly valuable type of instruction is the one that allows the process to follow alternative courses depending on the results so far. Thus, it may say: "Test the result at this stage and if it is a positive number do *this*, but if it is a negative do *that*". These conditional instructions appear to give the machine a power of decision but its decisions are made only between alternatives fully

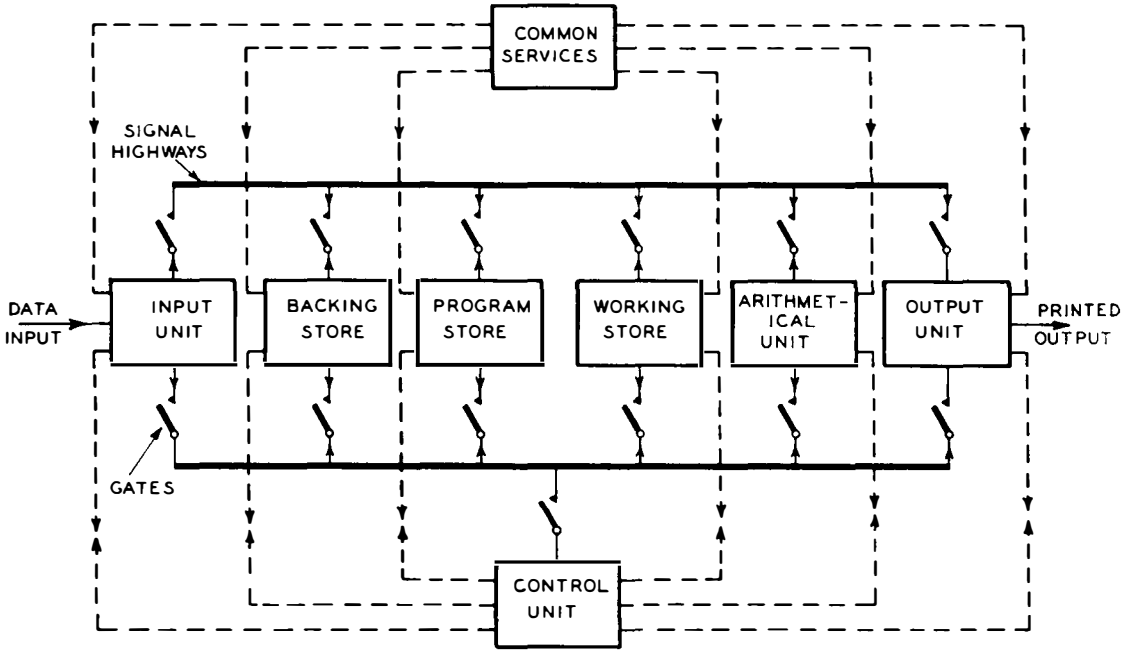


Fig. 4 : Outline arrangement of ADP machine

prescribed by its programmer, and in strict accordance with his conditions.

Sample Job

Consider now how an ADP system might tackle a clerical job: for example, a much simplified control of stores. The input data are of two kinds. *First*, there is the stock record, which lists each item of stores with its description, quantity in stock, maximum and minimum stock, average cost and so forth; one object of our process is to keep this record up to date. *Second*, there will be transactions, recorded on issue and receipt vouchers.

The stock record is assumed to be kept in magnetic form on a plastic tape of the kind shown in Fig. 5.

The transaction vouchers are assumed to be in the form of five-hole punched paper tape of the kind used by some teleprinters. This paper tape will have been prepared automatically as a by-product of the primary operations of issuing and receiving stores. For example, the storekeeper could record his transactions with a sort of cash register which prints a voucher, if one is considered essential for local use, and simultaneously punches a record tape. The tapes will have been reproduced at intervals in the data processing centre by transmitting their data over Post Office lines.

All is ready to start processing and Fig. 8 shows at top left the transactions paper tape, at top right the stock record magnetic tape and, below, the central processor. The transactions data will be in chronological order, and the same stores item may have a number of transactions. The first step is to sort the transactions data into the same item order as the items on the stock record tape. The processor itself can do this, provided the number of transactions is not too large, with the result that the transactions data are held in sorted order in the backing store. The process is now:—

(1) Bring in the first item from the Old Stock Record to the Processor.
(2) Bring in the first item from the Transactions Data.
(3) Compare their item labels.
(4) If these are *different*, *that* transaction relates to a *later* item in the Old Stock Record, so put out the first item unchanged to the New Stock Record, and bring in the second item on the old record to the Processor for comparison as before.

(5) If the item labels are *similar*, add the receipts, or subtract the issues as appropriate, from the old stock total, and bring in the second transaction for comparison.

This sequence is repeated until every item in the Old Stock Record has been processed.

One result is an up-to-date Stock Record, but this is of value mainly as raw material for the next amending process, and also for auditing. The more immediately valuable results are recorded on the bottom left-hand tape. These are reports on those —but only on those—stores items that require action; for instance, items where the stock has fallen so low that more must be ordered, items for which a new delivery has changed the average cost by more than x per cent., items which no one has requisitioned for y months, and so on. The action criteria can be as simple or as complicated as is worth while.

The advantages offered by ADP in this application are: more rapid and up-to-date posting of the Stock Record, and automatic selection of relevant items for human attention; that is, a better job than under the manual system, not merely labour saving. A successful business executive has been defined as someone who can make more good than bad decisions on the basis of information that is incorrect, incomplete and in arrears. ADP can change all that, and take many of the executive's decisions as well.

Now for some of the things that computers *cannot* do—yet.

They cannot think intuitively or originally. They cannot determine all their own instructions. They can read handwriting hardly at all and print not very well, and these are but two examples of their general inability to recognize patterns. They cannot respond to spoken data or instructions, or speak their answers. They cannot perceive any data, however relevant, without explicit instructions, and without it being in the exact form they have been instructed to expect. They cannot learn from their mistakes—though they are not alone in this. Time and change can be expected to remove some of these disabilities, if economics allow.

Applications of ADP

The first business computer to be used anywhere was developed and brought into use in this country by J. Lyons & Company, the caterers, between 1947 and 1953. Today, America is the land of opportunity for computers, and it has been estimated that some 4,000 computers are installed there, including scientific machines, and as many more are on order—this does not mean 8,000 will soon be in use, for many of the orders will be replacing last year's by next year's model.

The corresponding figures for this country are about 50 in use and 200 on order. A dozen British firms offer equipment which, with the American

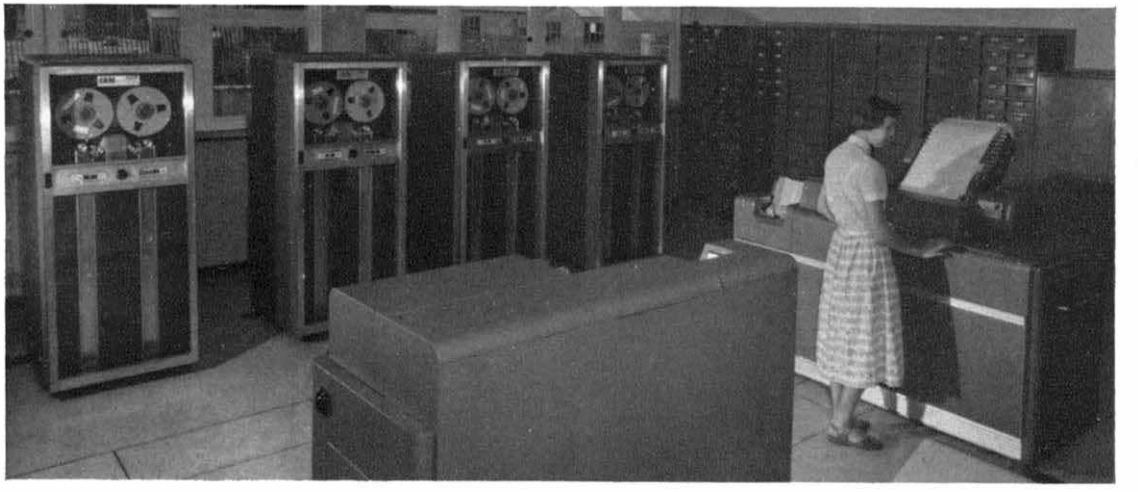


Fig. 5: Backing store with four machines for reading and writing magnetically *(Courtesy, I.B.M., Ltd.)*

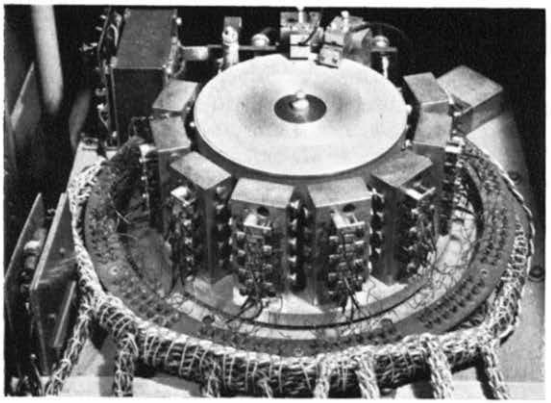


Fig. 6 : Rotating aluminium drum
(Courtesy, British Tabulating Machine Co.)

models, provides a wide choice at prices ranging from £20,000 to £1,000,000 or more.

ADP can be valuable in three main divisions of business work. First, in *productive* paper-work such as pay rolls, pay slips, and bills and receipts of all kinds. Second, in file maintenance, where ADP can not only keep stores records, staff records, lists of insurance policies, savings bank deposits and the like well up to date, but also comb the files for points requiring action. Third, in management ADP can be used to produce control statistics and "management ratios" designed to indicate the state of the business.

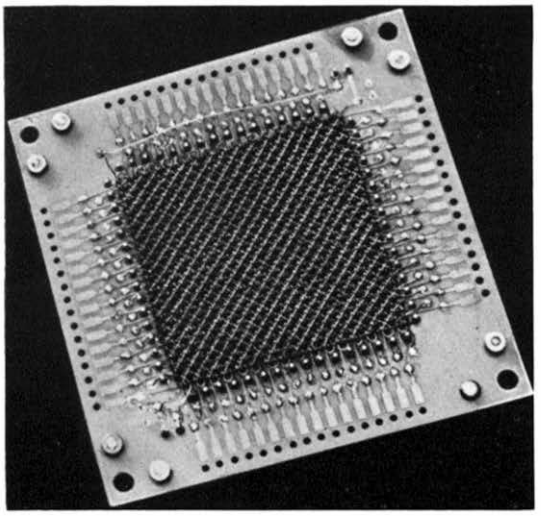


Fig. 7 : Ferranti ferrite core matrix

None of these applications can be converted to ADP in a flash; indeed, conversion has consistently been found to be a long, slow process.

The first step is a searching reappraisal of what really *needs* to be done; this, in a human system that has evolved over any length of time, is rarely what *is* being done, and is a task for the analytical skill of Organization and Methods experts. If this investigation is not well done, the result of applying ADP may be merely what has been called "decorating obsolete processes with new gadgets". Next, the procedures for satisfying the essential requirements must be carefully planned in machine terms. Finally, the machine process must crystallize out in the precise geometrical form of a program of instructions for a particular machine. All this may take 10 to 50 man-years of high-grade effort.

As a large business organization, the Post Office offers considerable scope for ADP in payroll work, in postal and telecommunications accounting, in postal and engineering stores control, in its Savings Bank and in its statistical work.

As the telecommunications authority, the Post Office must be prepared to carry data signals to and from ADP systems in business, industry and government. The close similarities between the ways in which information is handled and switched in the Post Office telecommunications network and those in which information is handled inside a computer may lead to the development of close functional links between the two.

Future computers can be expected to be smaller, cheaper and faster, to consume less power and to be more reliable than our present rather primitive machines, which are in the 1914 aeroplane stage of development.

It will become possible to write instructions for the new machines in plain English rather than in an esoteric numerical code, and for them to read their input data from documents that serve both machine and man.

More complex machines may accept, as they come, documents relating to several jobs, which they will sort, hold and process according to a range of stored programs called on as required.

Research on the logical, anatomical and physiological features of human brains in their rational activities, may lead to quite unexpected developments in data processing. Our brains are reliable organisms made from very fallible components; they appear to achieve their reliability by a

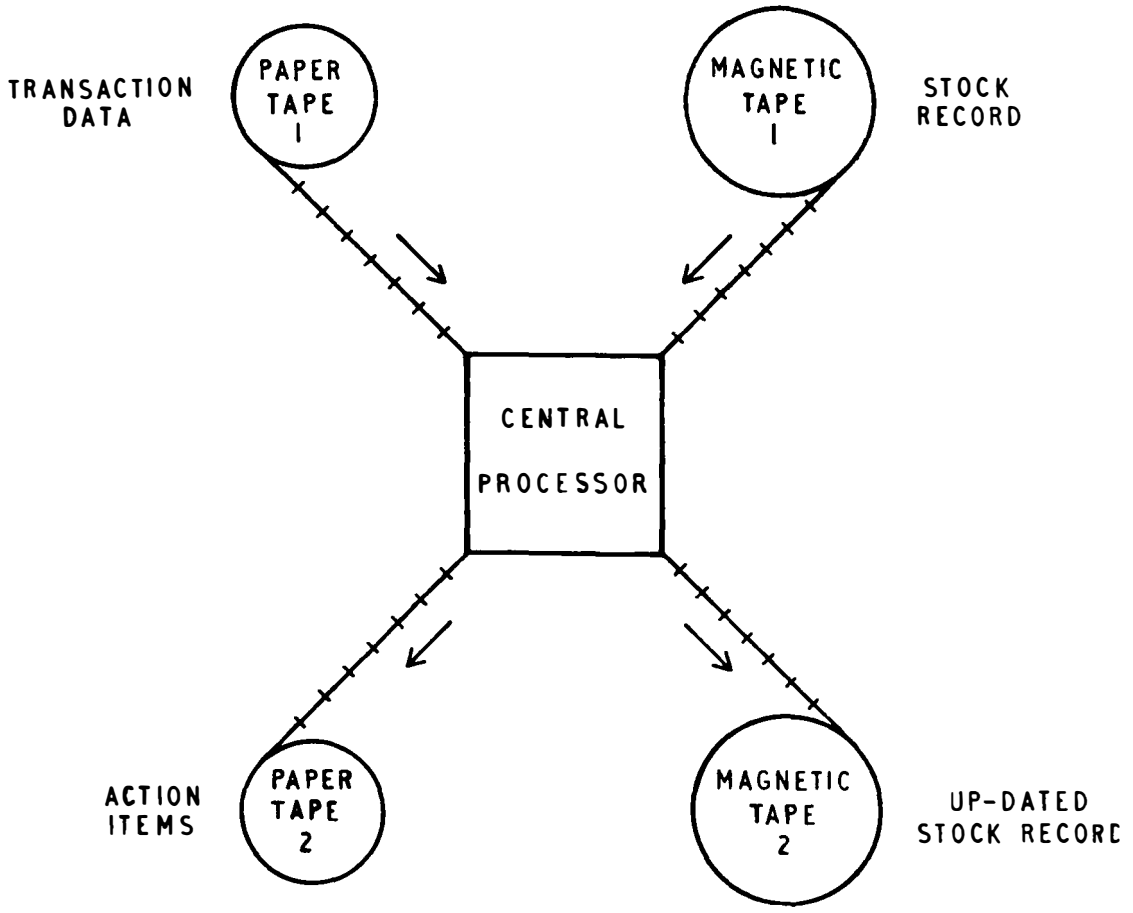


Fig. 8 : ADP for stock control

generous over provision of component cells, and future machines may do the same.

Some of the benefits of ADP are offered only at the price of extensive changes in organization and in methods. Resistance to change is a well-established, and not entirely bad, human characteristic, and the introduction of ADP into offices is likely to go neither as far nor as fast as its supporters hope and its opponents fear. Thus, many office jobs appear to be ill-suited to mechanization because they are too small or too mixed, or because they depend largely on spoken or written correspondence. Again, the great efforts of analysis, rearrangement and conversion of records that must precede any change to ADP mean that its introduction cannot be but slow, and this will do much to mitigate its effects on individuals.

Export of Telegraph and Telephone Equipment.—British telegraph and telephone equipment exports rose by 15 per cent. in 1957, with a total of £22.7 million compared with £19.7 million in 1956, excluding cables. Although this rate of increase was not so great as of exports of aeroplane engines (45 per cent.) or of cars and chassis (31 per cent.), it was a noteworthy achievement in a restricted market with intense competition.

Telephone Attachments and their Problems

H. A. Longley

MOST PEOPLE WILL HAVE SEEN ON SALE IN shops or advertised in periodicals various gadgets for attachment to the telephone, and may have wondered how much of this sort of thing goes on, and what is the attitude of the telephone service to such privately marketed attachments.

The telephone directory preface gives a lead on this. It says that "the sale to the public of certain appliances which have no prejudicial effect has been sanctioned by the Post Office", but it warns the subscriber to satisfy himself, before buying any attachment, that it has received official sanction, as "Post Office engineers have instructions to remove any attachments which have not been approved".

The Telephone Regulations which govern the provision of telephone service are even more explicit. The current Regulation on this subject lays down that, among other things, the subscriber shall not "make any attachment to an installation or place any thing in electrical connexion therewith", or "place or use any thing (unless provided for the purpose by the Postmaster-General) in such a manner . . . that it transmits or enables to be transmitted any message or other communication to or from the installation" without the written consent of the Postmaster-General. The Regulation goes on to say that the subscriber shall, on being required to do so, "cease to use and remove anything which has been attached, connected, placed or used" as described above. For failing to comply with the Regulations, a subscriber's services may be suspended or even terminated.

A group in the Post Office Inland Telecommunications Department, in collaboration with the Engineering Department, has the job of dealing with applications for the approval of devices sent in by inventors or by the sponsors of inventions. All sorts of ideas go into the great variety of devices submitted. Every application for the approval of a device is most carefully and sympathetically considered, and where, as usually happens, approval cannot be given, the reasons are explained as fully as possible to the applicant.

No one in the telephone business would claim that the telephone instrument is incapable of improvement. The Post Office is always on the look-out for ways to better the service, and has several important improvements of the telephone under development. But it is extremely difficult to improve the telephone by means of external attachments, and one may well feel that it is a pity so much time and ingenuity—and sometimes money—are expended by inventors attempting to do this.

Most of the devices sent in are for disinfecting the telephone transmitter or receiver or both; the most common idea is for a capsule, ring or block designed to fit in the mouthpiece and impregnated with fluid or containing crystals which give off

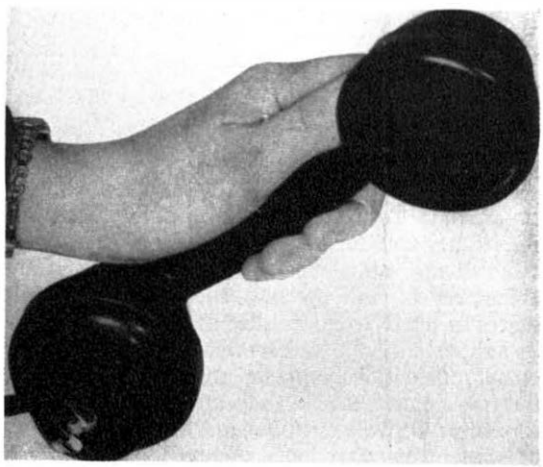


Fig. 1: Small ball germicide container clipped into mouthpiece

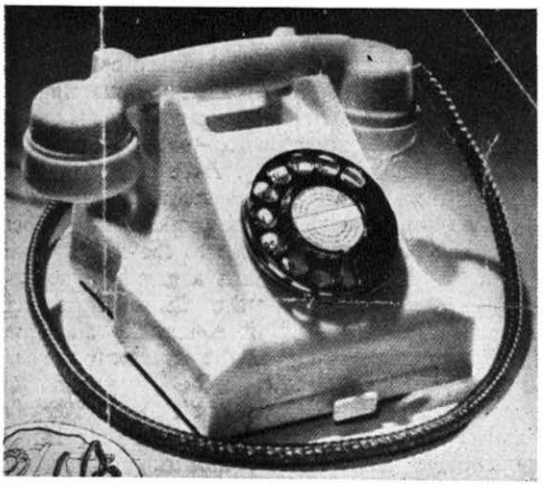


Fig. 2 : Handset cord encased in tube

fumes alleged to kill any germs that have been so unwise as to lodge on the instrument. Anything which obstructs or alters the shape of the inside of the mouthpiece will impair its efficiency and most of the devices sent in have this disadvantage. One attempt to overcome this objection by a small ball container which clips into place is shown in Fig. 1.

More elaborate ideas designed to come into operation with the weight of the handset when replaced, and to squirt powder or vapour—or even to project germ-killing rays—at the transmitter and receiver have also been put forward. Some of these have the serious snag that they would prevent the handset being properly replaced in its cradle; others would produce an objectionably strong smell, or have a corrosive effect which would damage or discolour the apparatus.

However, quite apart from such troubles as these, no device for disinfecting the telephone has been, or so far as can be seen ever will be, approved for the simple reason that medical research by the most competent bodies over the past 50 years, in both the United Kingdom and the U.S.A., has shown that disinfection of the telephone is quite unnecessary. Any germs found on the handset are mostly harmless and all have a very short life. All investigations of this problem have shown that the danger to the user of the telephone is negligible and the Post Office does what it can to discourage or answer advertising or other publicity which might tend to spread falsely-based apprehension or alarm on this matter in the public mind.

An inventor or sponsor of a disinfecting device may point out, when his application is refused, that certain firms are authorised by the Post Office to clean and disinfect subscribers' telephones, and that in fact the Post Office itself does this regularly for public call offices; therefore, he may say, it is inconsistent to withhold approval of a mechanical disinfecting device. The answer is of course that like everything else the telephone needs to have dust removed occasionally and this can best be done with a moist cloth: the liquid used contains a small controlled quantity of a well-known disinfectant, not because disinfection is necessary but because the smell left after wiping the telephone is associated in the public mind with cleanliness.

A favourite target for the inventive mind is the telephone cord. We all know the amazing propensity of some handset cords to become twisted with frequent use, and the usual solution suggested by inventors is to case the cord in a spring-like tube intended to hold the cord straight and prevent it kinking. Hardly any device of this kind is not objectionable, as it is likely to damage the cord by friction; and no such device can succeed in overcoming the twisting which is the real cause of the trouble and which, within casing tube such

Fig. 3 : French version of lazy-tongs applied to handset telephone

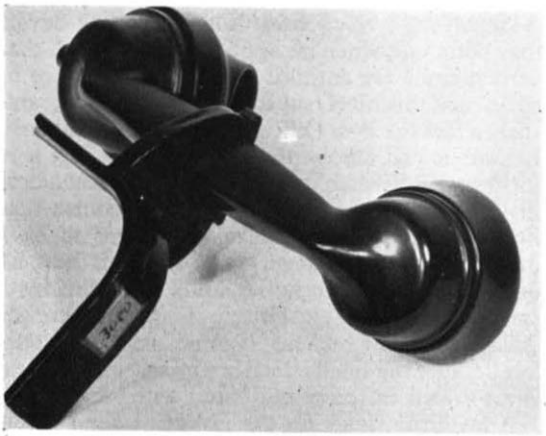


Fig. 4 : Shoulder bracket clipped to handset

as illustrated in Fig. 2, merely produces a state of tension in the cord. A person who lifts and replaces the handset with his left hand, holds it to his left ear, and uses his right hand for writing will usually have a kink-free handset cord, but any variation from this routine may produce the twisting effect. There will perhaps be no satisfactory solution to this problem until the day when handsets and handset cords are supplanted by the general use of some development such as a loud-speaking telephone.

Other ideas, too numerous to detail, aiming to improve or add to the facilities given by the telephone—for example, enlarged dial rings, dialling aids, or coloured jackets—duplicate or overlap standard facilities that the Post Office already provides for subscribers.

An interesting example of a device which has received approval is the "silent bell" which is designed to help deaf people; connected into the electric lighting circuit of a house, it causes all the lights in the house to flash in time with the ringing of the bell on an incoming call.

An idea which had a vogue in the days of the candlestick telephone was an attachment in the form of lazy-tongs fixed at one end to the desk or wall and serving to hold the transmitter in front of the user's mouth, leaving a hand free for writing. The introduction of the handset telephone met this need another way, but a French version of the same idea applied, however, to the handset telephone is shown in Fig. 3. This is rather like building a stable to contain a motor-car but, anyway, the device has the disadvantage, which the original had not, that the installation must be disconnected and reconnected in order to fit it.

A natural extension of this theme is the attempt to leave both hands free when using the telephone. A bracket clipped to the handset and enabling the user to hold the handset against his ear with his shoulder is one such device—shown in Fig. 4; another is shown in Fig. 5. As the picture aptly demonstrates all such devices encourage mis-use of the telephone, which works properly only when the speaker's mouth is close to the mouthpiece.

Having the same object is a group of attachments which pick up the incoming speech inductively and amplify it electrically and thus make it unnecessary to hold the receiver to the ear. If this were all, there would be less ground for concern than in fact there is, but if the receiver of a handset is not held to the ear, neither is the mouthpiece held to the mouth, and serious deterioration of the transmission efficiency of the instrument could result from the use of such devices, one of which is illustrated in Fig. 6.

The telephone system as a whole is designed to give satisfactory transmission between any two telephones however far distant, but only if the instruments are properly used at both ends. With the attachment illustrated the standard maximum transmission loss may be doubled if the speaker's mouth is as much as 18 in. from the transmitter. An insidious feature of this kind of attachment is that its advantages are felt only by the user and its disadvantages only by the distant subscriber. Naturally, the Post Office has not approved such devices.

Fig. 5 : Attachment designed to leave both hands free

Generally included among telephone attachments, but in a different class from those described above, are more elaborate and usually mains-operated apparatus which is switched into the telephone circuit in substitution for the telephone instrument. These attachments are generally designed to perform automatically certain otherwise human functions.

For example, a machine associated with a burglar or fire alarm system in a subscriber's premises may be connected to a telephone line, and will originate an emergency call on receipt of a signal from the alarm system: the machine dials the call and then plays a record announcing its origin and the reason for the emergency call.

Another type of machine will answer the telephone and, by means of a pre-recorded announcement, invite the caller to record a message which the subscriber can then play over on his return. Approved types of such machines are connected to the exchange line through a switch provided by the Post Office and for which the subscriber pays a small rental.

Approval of a device for sale to subscribers is usually given to the manufacturer or vendor, under specified conditions, which provide that the vendor shall maintain the device and safeguard the telephone service itself. In respect of any such device, the subscriber does not need to obtain a consent. But, in view of what is said in the paragraph above, it will not be surprising to learn that one of the conditions required of the vendor is that he will not give publicity to the approval; the onus is on the subscriber to find from the Telephone Manager if a particular attachment is on the approved list.

The testing, control and supervision of even approved attachments represents a difficult task for a telephone administration, for which it reaps little or no return. It is therefore not surprising to find that the attitudes of telephone administrations throughout the world to privately marketed attachments vary very widely, the British Post Office's attitude being intermediate between the extremes of rigid prohibition and *laissez-faire* which are found elsewhere.

No responsible telephone administration can be content to share responsibility for the maintenance, efficiency and appearance of its equipment with others whose main concern is not the efficiency of the telephone service as a whole. Both the vendor and purchaser of an attachment tend to acquire a vested interest in the *status quo* so far as it affects

Fig. 6 : Device which amplifies only incoming speech

the attachment concerned, and this fact could create serious difficulties should the administration desire to make radical changes in the design of the telephone itself or of the telephone system.

With these considerations in mind it is sometimes necessary to refuse applications for approval for reasons that can have small appeal to the applicants. On the other hand, a responsible telephone administration will recognise that the existence of a serious demand for a particular attachment will usually be an indication of the need for an improvement of its services, and this is the Post Office approach to this problem.

Since Mr. C. T. Brown wrote his article on "Lines for the London Fire Brigade", published in our Winter issue the 2222 lines, for dialling the Fire Brigade after dialling the exchange name (as an alternative to 999) have been recovered at all exchanges served by the L.C.C. Fire Brigade; 999, followed by a request for the Fire Brigade, is now the only number to be dialled to call the Brigade at these exchanges.

The illustrations for the article should have been acknowledged: "Courtesy, London Fire Brigade".

Telecommunications in South Africa

IN TELECOMMUNICATIONS MOST COUNTRIES HAVE followed the same pattern of technical development and South Africa is no exception to the general rule. Each advance in the art of telecommunications has stimulated the desire to participate in the greatly improved facilities, which add to the pleasures of living and to the conduct of business. However, economic considerations play an important part in creating and then satisfying the demand. It is because of this factor that some attention must be directed, if only briefly, to the geography and the history of South Africa.

Situated strategically at the foot of a great continent, South Africa claims international notice. Its history starts with the establishment at Cape Town in 1652 by the Dutch East India Company of a halfway station for its sailing ships *en route* to the East. Recently history was repeated during the Suez crisis.

South Africa is a land of contrasts. Its people are in various stages of development. Modern cities with all amenities contrast strongly with the kraals in the native reserves, with their beehive-shaped huts and their tribal life. Except for the coastal regions and the Low Veld in the Northern Transvaal, the whole of South Africa lies on a plateau, some parts being 5,000 feet above sea-level. The early colonists in the Cape reaching out into the interior over mountainous country found the Karroo, arid and forbidding. For the next 200

years settlement was confined to coastal regions.

Penetration into the more fertile regions took place during the Great Trek (1838) by the farmers of Dutch descent who founded the Boer republics of the Orange Free State and the Transvaal. The discovery of diamonds in 1870 followed shortly by that of gold on the Witwatersrand in 1886 ended the economic doldrums of the 19th century. Great progress was made, but this was interrupted by the Anglo-Boer War of 1899 to 1902. A great political change took place in 1910 in the Union of the four provinces: the Cape, the Orange Free State, the Transvaal and Natal.

South Africa has telecommunication ties with its neighbouring territories: three United Kingdom protectorates of Bechuanaland, Basutoland and Swaziland, the Central Africa Federation (comprising Southern and Northern Rhodesia and Nyasaland), Portuguese East Africa and the mandated territory of South West Africa. This is a very large land mass, as the map overleaf shows. The area of South Africa alone is 473,000 square miles.

South Africa's mineral wealth is considerable. First diamonds and then gold, recently supplemented by the recovery of uranium as a by-product of the gold mining industry, started South Africa on its path of development. As certain mines closed down on the Witwatersrand after working for 50 years, industries started up in the shadow of of the great mine dumps.

Recently two new rich goldfields were established, one at Klerksdorp in the South Western Transvaal and the other in the Orange Free State. Extensive coal beds in the Eastern Transvaal, Northern Natal and the Orange Free State, steel works at Pretoria and Vereeniging, manganese ore in the North-Western Cape, copper, platinum, tin, asbestos and other commodities in the Transvaal, give some idea of the extent of the mining industry. Low cost coal has led to the establishment of an oil from coal industry and the erection of large power stations at strategic points.

Agricultural development has matched the Union's mining and industrial progress and there are considerable exports of wool, skin and hides, maize, sugar and fruits to overseas markets.

It is against this background that the progress of telecommunication services must be judged. The total population of the Union of South Africa is approximately 14 million, of whom three million are whites. At current date South Africa is served by 800,000 telephones.

The provision, maintenance and operating of all telecommunication services, except those provided by the Railway Administration for its own use, are the responsibility of the Post Office. The Durban Municipality provides its own telephone services in a defined area under licence. The South African Broadcasting Corporation erects and maintains broadcast transmitting stations, but the high quality channels linking them are provided and maintained by the Post Office. Listener's licensing fees are collected by the Post Office and the major portion remitted to the Corporation. Three services are provided, one in English, one in Afrikaans and a commercial service.

The running of the telecommunication services follows the usual pattern met with in other countries with such variations as to suit South African conditions. One aspect must, however, be mentioned and that is the rise of local manufacture by private firms of plant and equipment, previously imported from overseas. Today, 50 per cent. is manufactured in South Africa and this percentage will increase materially in the future.

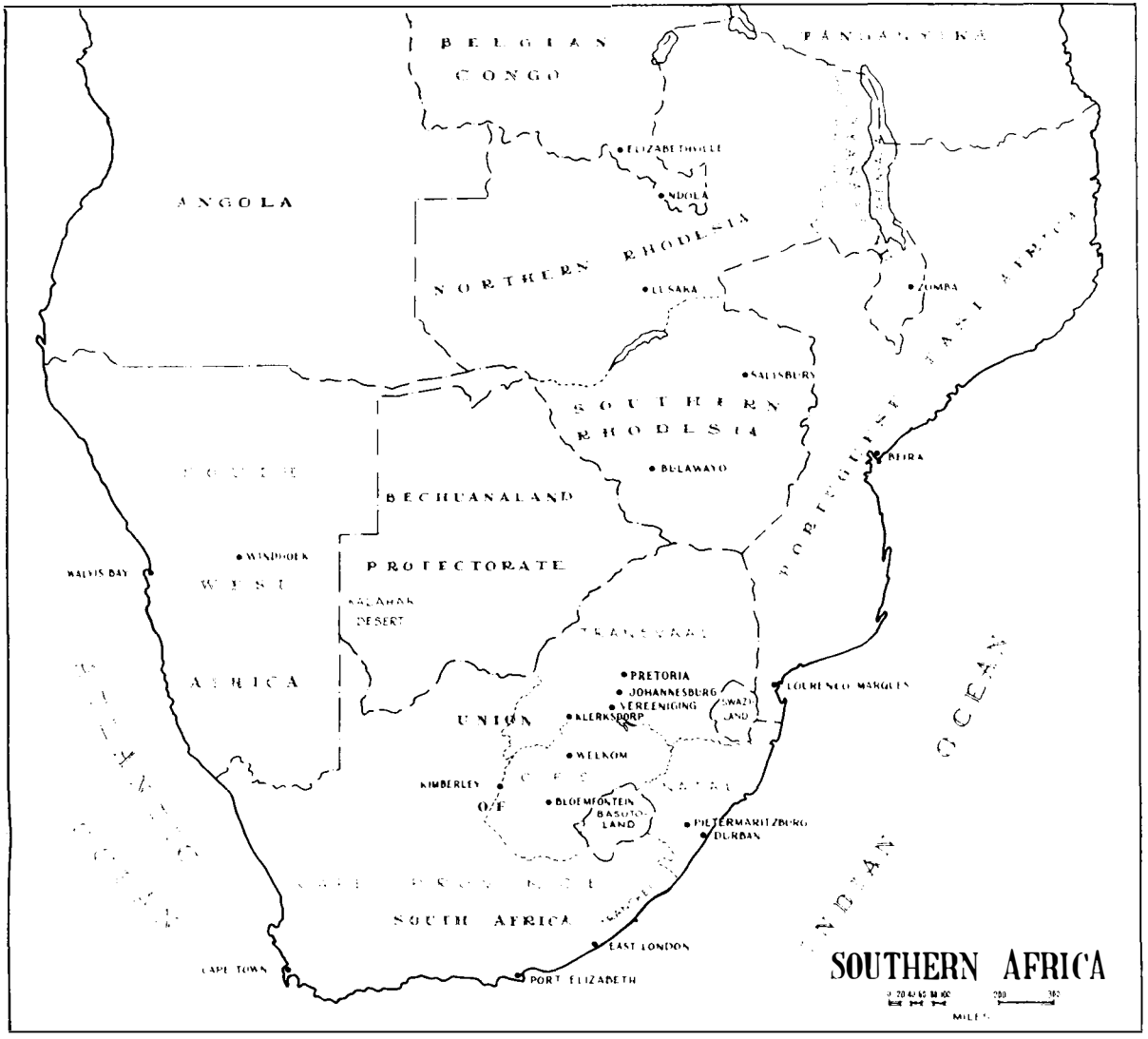
The Telegraph

The scientific discoveries of the 19th century gave the civilized world first the telegraph and later the telephone. Their introduction into South Africa was slow at first, but the discovery of diamonds and then of gold speeded up the development of the telegraph.

The first telegraph line was built by a private company in 1860 between Cape Town and Simonstown. During 1862–64 a line was erected by the same company between Cape Town, Port Elizabeth and Grahamstown. It was expropriated by the Cape Government and in 1876 was extended to Kimberley, linking that centre of diamond mining with Cape Town and Port Elizabeth. The telegraph frontiers were, thereafter, pushed out in all directions.

The completion of the submarine cable between Aden and Durban in 1879 led to the extension of this channel of overseas communication from Durban through the Transkei and via the existing telegraph network to Cape Town. This activity was matched by the Orange Free State and the Transvaal and soon after practically the whole subcontinent was linked up.

The telegraph fired the imagination of Cecil John Rhodes, whose colonizing ambitions extended beyond the borders of the Cape Colony to the Rhodesias. A telegraph line was pushed northward



from Kimberley and by 1898 had reached the shores of Lake Nyasa, and would have progressed further but for the Anglo-Boer War.

The technical developments of the telegraph overseas to increase the carrying capacity of the available lines found ready acceptance in the Union. Duplex working and quadruplex and duplex repeaters were introduced in quick succession. Creed working was introduced in 1913, multiplex in 1922 and teleprinter (teletype) working in 1924. An outstanding change in telegraph working took place when a 12-channel voice-frequency telegraph system was superimposed on one of the channels of a 3-channel telephone system, established in 1934, between Johannesburg and Cape Town. This was followed shortly afterwards by a similar system between Johannesburg and Durban.

The major portion of the telegraph traffic today is handled by voice frequency and high frequency telegraph channels. Today, 347,000 channel miles are in use, compared with 38,000 miles of circuit

provided physically or by superimposition. The number of circuits is approximately 1,200.

A telex system, started in 1935, now links telegraph subscribers in all major centres. There are at present 1,144 subscribers and the number is increasing. An extensive private wire network for the Press, airway companies, meteorological services, and so on, has been established.

Most of the telegraph business handled is by teleprinter of which 3,200 are in operation. Hand-operated morse circuits are still being used, but their number is rapidly declining.

The competition of the telephone and the air-mail services has had its inevitable effect on the telegraph service. Nevertheless, the telegraph still has its attractions, as can be gauged by the fact that over 12 million messages are handled annually.

With a view to reducing operation costs and speeding up the handling of messages, arrangements are in hand to install automatic telegraph exchanges at all the main telegraph offices. The effect of this scheme will be to provide for direct transmission of messages without the expensive retransmissions which take place at present at main telegraph offices. The scheme will include the present telex service and will displace the manual switchboards used at present for handling long distance and local telegraph telex calls. Central telegraph offices of the future will be much smaller versions of those which are currently in use.

The Telephone

Old reports show that telephones were used in Cape Town in 1880, four years after Alexander Graham Bell's invention was announced. But these were private installations. The first telephone exchange was installed in Port Elizabeth in 1882. Other centres followed this lead and at the time of Union 13,650 telephones were in use, served by 90 telephone exchanges.

Central battery working gradually displaced local battery working in the major centres, the first installation being that at Johannesburg in 1911.

The demand for telephone service in the large centres increased to such an extent that it was plain that conversion to automatic working was the only solution. In 1922–23 a small automatic exchange was installed at Camps Bay and by 1925 automatic working was available at Pietermaritzburg, Port Elizabeth, Rosebank and Parkview (Johannesburg).

Nothing further was done until 1931, since when all the principal centres have been converted to automatic working. At the moment some 370,000 lines of step-by-step equipment have been provided, involving 80 exchanges, and it is anticipated that within the next 10 years the number of lines and exchanges will have more than doubled.

The Witwatersrand, Pretoria and Vereeniging areas have a total of 46 automatic exchanges. Inter-dialling between some 300,000 subscribers in these areas is available except between Pretoria and Vereeniging. Plans have been formulated to have a complete inter-dialling system with greater flexibility and capacity than at present and to cater for an ultimate of 93 exchanges. Inter-dialling is also possible between subscribers connected to the Durban and Pietermaritzburg automatic exchange system.

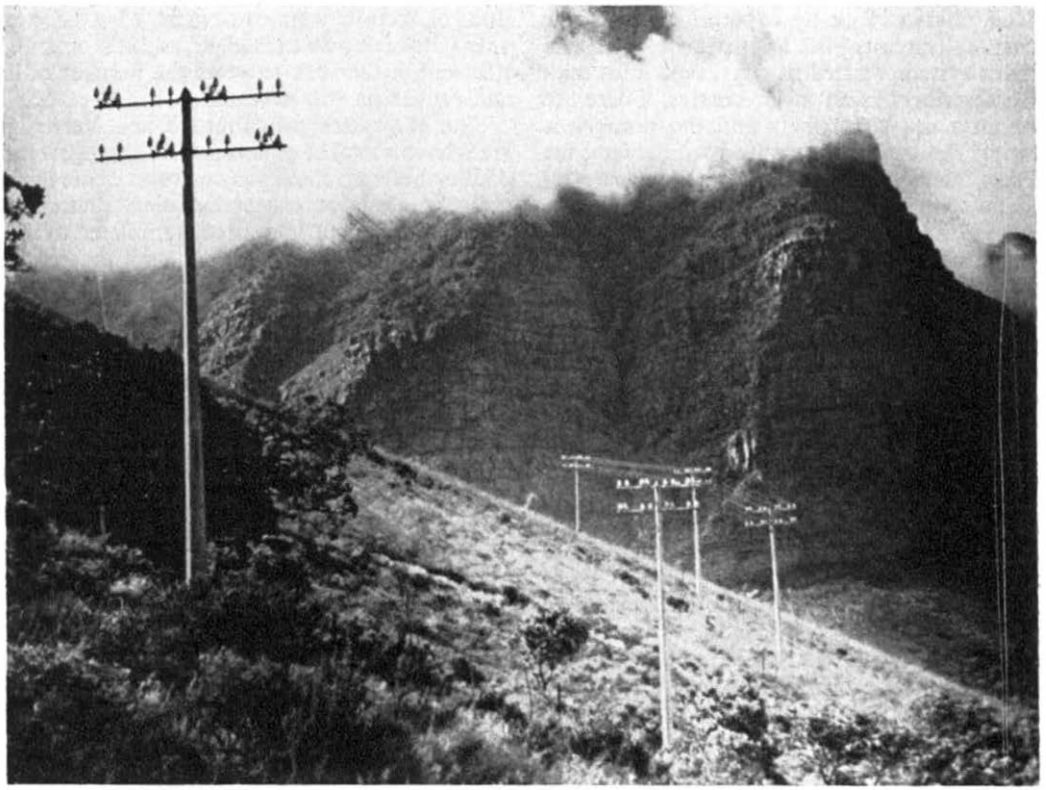
Most of the country towns in the Union are served by local battery exchanges. Here the development has increased to such an extent that the large exchanges are marked out for automatic conversion during the next ten years.

The general telephone development in the Union over the past 30 years is set out in the table below.

The expansion of the trunk service must be mentioned. Up to 1923 the use of the telephone was limited to local communications and to subscribers in exchanges up to some 200 miles away. However, in 1923 the first long distance link using voice frequency repeaters was established between Cape Town and Johannesburg, nearly 1,000 miles apart. It heralded the future telephonic link up of the Union.

The first three channel system was installed between Johannesburg and Durban in 1927 and the second between Johannesburg and Cape Town in 1934. It was clear, however, that future expansion of the trunk system depended on the creation of high grade carrier transposed trunk lines. Starting in 1936, practically all the main links in the trunk network have now been rebuilt along national and provincial roads. What remains of the old network, much of which parallels the railway tracks, is used for secondary circuits.

	1927	1947	1957
Number of—			
telephone exchanges	1,218	1,725	1,885
exchange connexions	50,949	187,679	410,276
call offices	7,232	8,357	11,903
farm lines	1,502	3,551	9,002
farm line stations ...	9,466	25,098	75,529
local calls per annum	129,974,097	390,176,508	873,463,701
trunk calls per annum	8,904,736	27,776,168	59,800,171
telephonists ...	1,064	2,014	6,446
trunk lines ...	198	2,506	6,173



Du Toit's Kloof, near Cape Town: typical carrier route using concrete poles

At present the trunk network comprises 6,000 individual trunk circuits, involving 470,000 channel miles. In addition, there are 17,000 channel miles linking broadcasting stations. There are in all 100 12-channel systems and 220 3-channel systems operating on open wires. Additionally, there are four short distance coaxial systems. Twenty-four-channel carriers on cable systems are being used to increase the capacity of the junction cable system on the Witwatersrand. Six are in use at present and 18 additional are planned.

A microwave system is planned and will shortly be in operation between Johannesburg and Klerksdorp. This system will probably be extended to Bloemfontein in the near future. A radio link (four telephone and four telegraph channels across the Kalahari desert) will be provided shortly between Pretoria and Windhoek in South West Africa.

Six automatic trunk exchanges, four with transit switching facilities, have been installed. In addition, facilities are available to allow subscribers in large exchange areas to reach a manual exchange operator within a radial distance of 120 miles by direct dialling. While ticketing and timing of calls by distant operators still obtain, conversion to Variable Time Interval metering, to be initiated by the operator, will be introduced in due course. By these means it is anticipated that about 70 per cent. of originating trunk traffic will be removed from the trunk boards concerned. Incoming trunk traffic to subscribers in automatic areas is disposed of to a considerable extent by operators dialling-in from distant exchanges.

The following is a brief description of the hexagonal grid zone system as applied in the Union of South Africa. The zoning of exchanges for call charge purposes was used in this country even before the introduction of automatic exchanges.

Originally the zones were based on contiguous circles of five miles radius. The main exchange was taken as the centre of the circle and the other

circles were centred at convenient points so that the circles touched each other. Tangential lines were then drawn to the circles and each zone was therefore approximately a 10-mile square; see Fig. 1. A call within the zone was one unit, two units to an adjacent zone and three units to exchanges more than two zones distant.

Following World War II telephone growth throughout the country and particularly on the Witwatersrand had reached such proportions that a re-trunking of the Director network of exchanges centering on Johannesburg was necessary.

A 6-digit director system had been provided in 1931 to serve the Witwatersrand, and this was later modified to partial 7-digit to cater for the Pretoria and Vereeniging exchanges with mixed 5- and 6-digits to provide inter-dialling by means of access digits to and from the Witwatersrand.

It was then envisaged that with the rapid growth on the Witwatersrand which was extending to 25 miles to the east and west of Johannesburg respectively and about 36 miles to Pretoria in the north and the same distance to Vereeniging in the south that all these areas should be linked in one director numbering scheme. Ribbon development had started and it was felt that it would not be many years before the areas were integrated. Plans were then made for the conversion of the Vereeniging area to 7-digit director numbering and this area has now been linked with the Witwatersrand. It has since been decided not to include the Pretoria area.

To retain the simple and inexpensive method of meter-fee determination on the second digit it was necessary to zone the codes for metering purposes. The modified director also required the zoning of 3-digit codes to meet the trunking conditions. Hence, it was necessary to continue to employ a zone system for conservation of codes and the determination of call charges.

It was obvious that the use of the "squared circle" method would be impracticable for such a large integrated area and a search was made for a more suitable method which would provide equitable call charges and allow for growth in any direction.

The new zone system would have to meet the following requirements:—

(i) Subscribers should pay similar trunk charges whether their exchange was included in the multi-exchange area or not.
(ii) The zones within the system should be so arranged with respect to other zones that no undue advantage or disadvantage would result in charges for any particular zone.
(iii) The introduction of the new system should be possible without requiring major modifications to existing equipment.
(iv) The zone metering should be independent of routing so as to avoid uneconomic trunking to satisfy metering requirements.

In some places a zone boundary cuts between two exchanges which may have a large community of interest. This cannot be avoided in a zone system in which a dividing line must be drawn somewhere and any disregard of this principle defeats the object of applying a zone system.

The hexagon was finally chosen as the basic figure as it lends itself to the design of a system capable of indefinite expansion in any direction without overlapping of zones and also because of

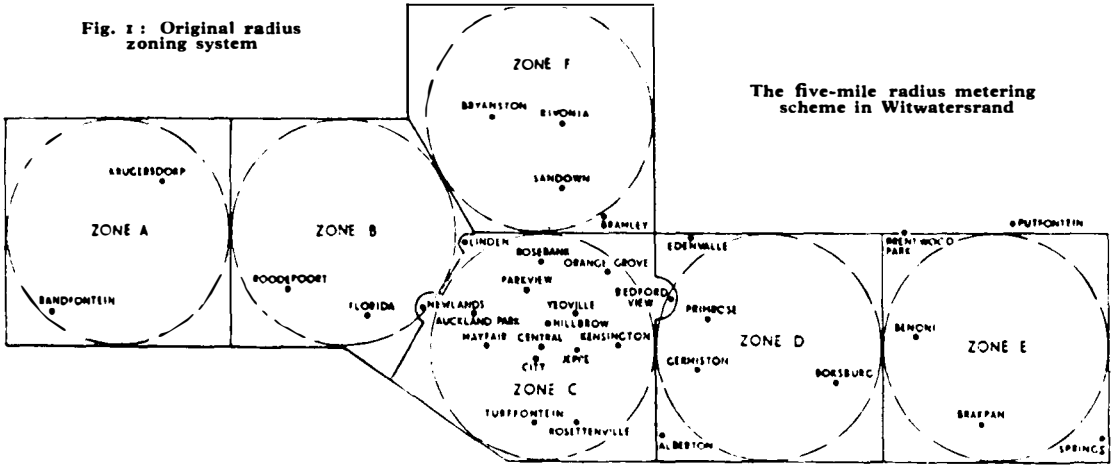


Fig. 1: Original radius zoning system

The five-mile radius metering scheme in Witwatersrand

its implicity and close approximation to the circle which had been used as a basis in previous schemes.

The hexagon grid zone scheme is, however, still subject to the general zone system anomaly and offers advantages only in areas which are, or are tending to become, a linked entity and where a zone scheme is in any case necessary because of existing equipment limitations.

The hexagon chosen was one of $6\frac{1}{2}$ mile sides, which has an area of approximately 110 square miles. The size of the zone was governed by the necessity to disturb existing charges as little as possible and the hexagon grid was so placed over the whole area as to retain the existing charges between the separate areas. In the other multi-exchange systems of the Union such as the Cape Peninsula and Durban the grid was placed on the same basis. These other areas were comparatively small and the "squared circle" system could have been retained, but in the interests of uniformity it was decided to apply the hexagonal system.

Fig. 2 shows the hexagonal grid applied to the areas of the Witwatersrand, Pretoria and Vereeniging.

Direct interdialling between subscribers in the Witwatersrand network and subscribers in the Pretoria and Vereeniging networks had been in existence before the introduction of the hexagonal grid zone system. These charges were applied in the form of multiple registrations on the subscriber's meter as for message rate calls, but repeated every three minutes.

Because a call between the Witwatersrand and Pretoria had always been 6d. for three minutes it was decided that this charge should not be disturbed. Fig. 2 shows that Johannesburg is actually four zones away from Pretoria and the charge should have been 8d. for three minutes. (The unit charge in the Union is 2d.) To meet this requirement it was decided that all four zone calls should be rebated to three zones and charged 6d. for three minutes, hence calls between Johannesburg and Vereeniging were also reduced to 6d. for three minutes.

Furthermore, in keeping with the foregoing, it was decided that a rebate of one zone should be allowed on subscribers' calls between exchanges more than three zones apart. Six unit pulse meter machines are employed in the Union. It will thus be seen that the call charges were not strictly applied in accordance with the grid and that timing of calls applied only to calls between different exchange systems of four zones and more apart.

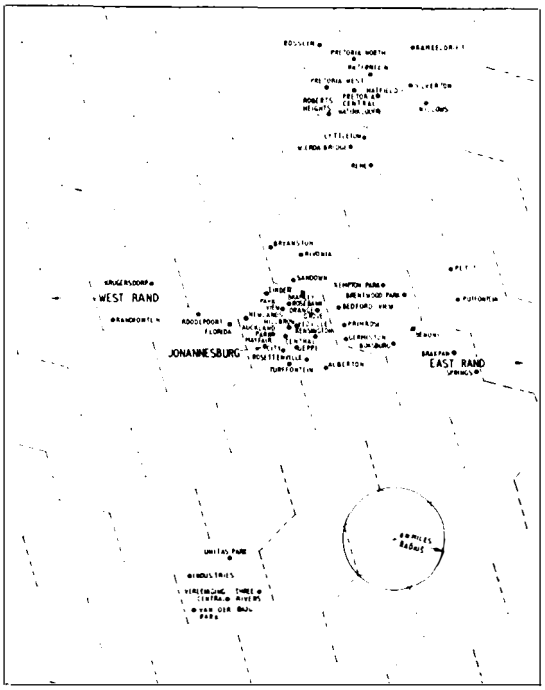


Fig. 2 : Hexagonal zone metering scheme

The charges to be applied were therefore:—

Calls between exchanges	
within same zone	... 1 unit—2d. unlimited.
in adjacent zones	... 2 units—4d. unlimited.
three zones apart	... 3 units—6d. unlimited.
four zones apart	... 3 units—6d. per 3 mins.
five zones apart ...	... 4 units—8d. per 3 mins.
six zones apart ...	... 5 units—10d. per 3 mins.
seven zones apart	... 6 units—1s. per 3 mins.

In counting the number of zones to a distant exchange the home zone is counted as the 1st zone.

A few exceptions had to be made regarding individual exchanges where the hexagonal zone system would have meant an increase in call charge which it was felt subscribers would not tolerate. For this reason, calls to exchanges four to seven zones apart within the same exchange system are not timed.

Call office charges were arranged to coincide as closely as possible with subscribers' charges.

With the coming of Subscribers' Trunk Dialling, which was necessary to relieve the congested manual trunk boards, the automatic metering and timing of short distance trunk calls on a three minute basis up to a maximum of 1s. was therefore possible. The

range of S.T.D. to more distant manual trunk exchanges of up to 150 miles away has been provided, as an interim measure, by making codes available within the automatic exchange numbering scheme. The calls are then ticketed at the distant manual exchange. Because reliance has to be placed on the honesty of the subscribers making the call and the possibility of errors in recording the number quoted, this can be regarded only as an emergency measure to relieve the larger trunk exchanges at the main centres.

The whole question of S.T.D. is, however, receiving attention and it has already been decided to introduce Variable Time Interval (V.T.I.) metering of trunk and junction calls. Initially, automatic metering of trunk calls to exchanges 120 miles distant for manual exchanges and 170 miles for automatic exchanges is planned. The V.T.I. system will ultimately replace the existing multi-metering system and all new exchanges will be equipped for V.T.I. metering.

The change-over to V.T.I. metering must necessarily be gradual and as it is planned on a radial distance basis, with some grouping of exchanges because of equipment limitations, it will also ultimately replace the hexagonal grid zone system. It will be necessary, however, to use the hexagonal grid measurement and the group-radial measurement for some time yet. When V.T.I. equipment is installed all local and trunk calls, with the exception of local calls up to 6½ miles will be timed.

International Telecommunications

Overseas communications by radio and cable are handled exclusively by the Post Office, which took over these services from Cable & Wireless Ltd. in 1948. This Company, besides operating two submarine cables via the East and West coasts, had a radio transmitting and radio receiving station near Cape Town.

As over 70 per cent. of overseas traffic originates in the Johannesburg area, a new transmitting station was opened at Olifantsfontein and a new receiving station at Derdepoort near Pretoria. These stations, designed on the most modern lines and with extensive directional aerial systems, will be opened shortly, taking over from installations in temporary buildings.

Services operated today include:—

(1) Four radiotelephone channels to London and single channels to Sydney, Buenos Aires and Rio de Janeiro, and to the following four centres in Africa: Nairobi, Ndola, Leopoldville and Elizabethville.

(2) Six telex channels to London (extensible when necessary to nine) and single telegraph circuits to Nairobi, Ndola and Leopoldville.

(3) Six Overseas Press services in London and New York. All telegraph services, with one exception, are operated 5-unit start stop (teleprinter).

The Cape Town stations provide a telephone service to New York and a telephone and four telegraph channels to London.

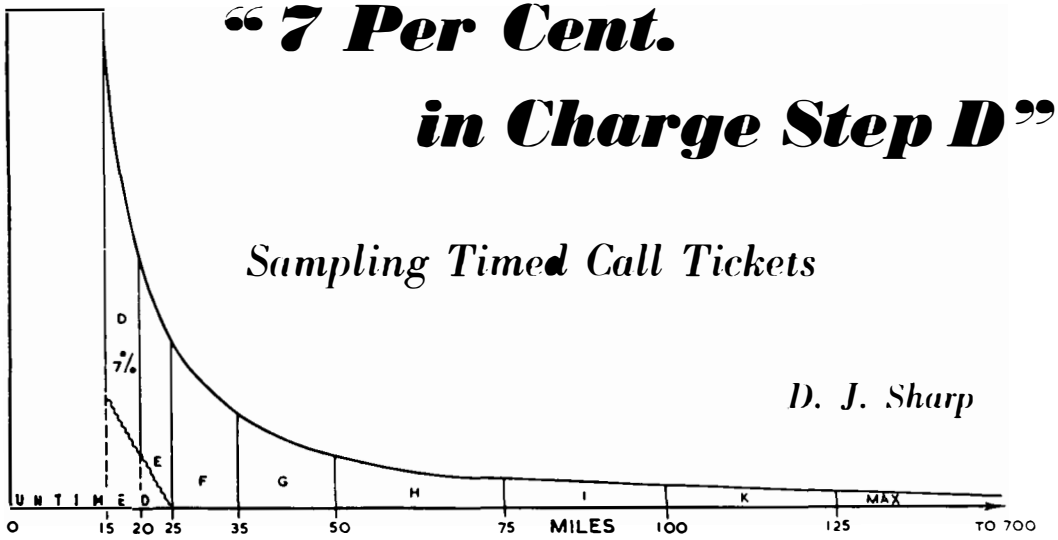
A pleasing feature has been the remarkable growth of overseas telephone communications and the international telex service.

We are indebted to the South African Administration for the above article.

"7 Per Cent. in Charge Step D"

Sampling Timed Call Tickets

D. J. Sharp



"THE CHARGE FOR A THREE MINUTE CALL TO Bishops Stortford is 1s. 0d." is the reply we get from a Braintree exchange operator when we ask the cost of a call to Bishops Stortford. As one of the general public we accept the statement, and decide whether to make the call or to withhold our custom. As part of the telephone administration, however, we must know how this "1s. 0d. for 3 minutes" is related to the cost of the call. Is it too little—or too much—or just right?

We are not concerned so much with the balance struck between cost and revenue on each individual call as with the need to ensure that the call tariff is so adjusted to the cost of the service that there is a reasonably good balance between them.

Now, telephone calls outside the untimed area are charged according to the distance between the charging points for the groups in which the two telephones are situated. The distances are conveniently grouped into "belts" and designated by a letter. It is roughly 17 miles from Braintree to Bishops Stortford—"as the crow flies"—and our call becomes "pigeon-holed" in charge step D. Each charge step has a different tariff, and as the Post Office supplies a cheaper service between 6 p.m. and 10.30 p.m., we need to know how many calls are made in each charge step during the full and the cheap rate periods, and then how much revenue is obtained from these calls. With similar information about the costs of handling calls—operators' wages, equipment and line plant costs, and so on—we can arrive at a profit—or loss—in terms of pence per call. We can then see whether the "charge for a three minute call" in any charge step needs adjustment—up or down.

How are we to get this information?

About 320 million timed calls are made each year, so that to count the number for each charge step would be impossible. We therefore resort to sampling. We can either record the numbers of *all* calls for each charge step for two or three days, or we can pick out a ticket every now and then, and analyze all the sample tickets when we have enough.

Until a few years ago we used the former method, making a full analysis of all calls for a few days every five or ten years. This meant a very great deal of work for a lot of people for a week or two. Furthermore, however carefully we chose the days for the record we could not expect our results to reflect conditions over a whole financial year. For these reasons, we have recently adopted the second method—continuous sampling.

Timed call tickets are counted (or weighed in very large exchanges) each day to give totals of chargeable and non-chargeable calls in both full and cheap rate periods. It is convenient, therefore, to select our sample tickets at this stage, as part of the counting process. One ticket in every thousand produces a sample of over 300,000 in

a year and this is quite adequate for our purpose. Tickets are counted in the same order each day, starting at the point where the previous day's count finished. As tickets numbered 1,000, 2,000 and so on are reached, the characteristics of the call they record are noted on an analysis form.

We have been rather particular about the order in which tickets are counted; also, that ticket No. 1,000, and *not* No. 999 or 1,001, should be extracted. Does it really matter in which order we count—or whether we extract ticket No. 999 or No. 1,000? The real point at issue is whether we are to allow the telephonist concerned any discretion in the selection of the sample ticket. A moment's reflection will show that we dare not. If we did we might get all coin-box calls—or all transferred-charge calls—or none of these! Only by specifying the exact way in which the sample is to be selected, without regard to the kind of call it may be, can we ensure that it will be representative of all timed calls.

Let us suppose that we have made our call from Braintree to Bishops Stortford and that, by a 1 in 1,000 chance, it has been extracted as a sample ticket. The details of the call will be recorded on the analysis form (Fig. 1). The information is put into "boxes" on the form, most of it as numerical codes. The analysis form is sent to a tabulating installation where a card, similar to an ordinary postcard, has holes punched in it to represent the information contained on the analysis form. The box numbers on the analysis form correspond with column numbers on the punched card (Fig. 2) and a hole is punched in the appropriate position in the column. Boxes not used are struck through, and a hole punched in the O position of the related column of the card. At the end of each quarter the punched cards—over 75,000 of them—are sorted mechanically to give us the percentage of calls in each charge step. Exceptionally, weekly figures were obtained during the first few weeks of 1958 and a comparison of the percentage calls in each charge step, before and after the introduction of group charging, is shown in Fig. 3; this comparison indicates the extent to which D calls have become untimed unit fee.

There are, of course, many other things that we want to know about the composition of our timed traffic so that we may keep under review the revenue and the cost of the facilities we offer. How many "personal" calls are made? How many calls are made from coin-box telephones? On how many

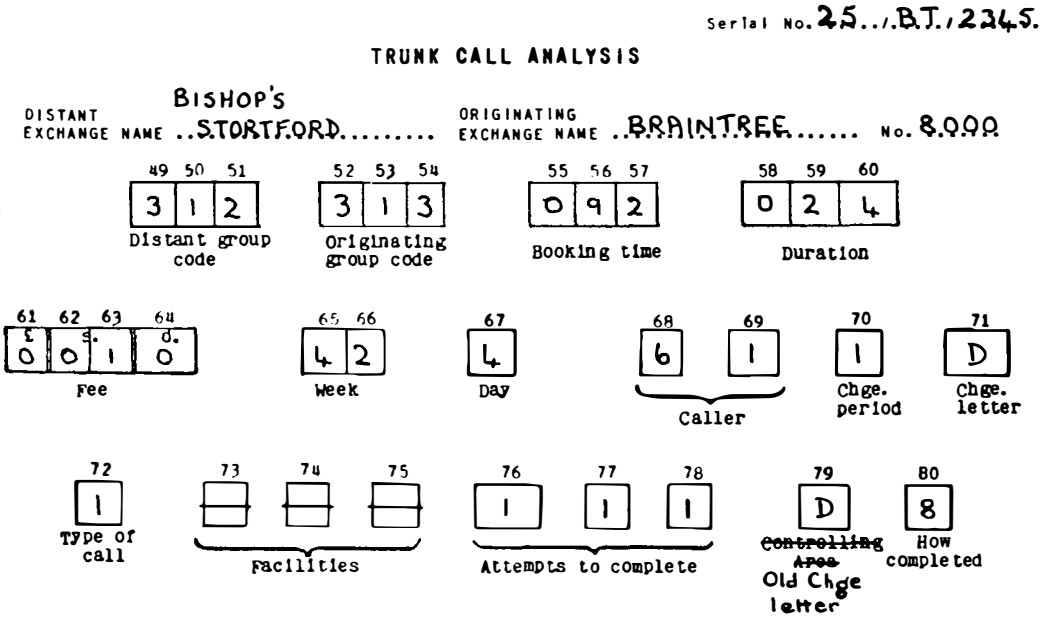


Fig. 1: Analysis form

calls are the charges transferred to the called party? What is the average revenue from an effective call? We get our answers to these questions from monthly and quarterly sorts of the punched cards.

How accurate are the results which we get from this 1 in 1,000 continuous sample? Because we do not examine the ticket for every call we cannot get 100 per cent. accurate results. Sampling leads to error—within limits which we can calculate—in the figures we obtain. This sampling error is related to the size of the sample. Some idea of the sampling error arising from our present 1 in 1,000 sample of telephone tickets can be obtained from Fig. 4. It is always necessary to bear in mind the effect of these error limits in using the sample figures. If more accurate figures were required a larger sampling fraction (say 1 in 100) would be necessary with an attendant increase in cost. For most Headquarters purposes the 1 in 1,000 sample of trunk traffic produces figures of adequate accuracy.

Having found out the characteristics of our timed telephone traffic could we not drop the sampling procedure? Unfortunately, these characteristics do not remain constant. They change as surely as other aspects of human activity. Some of these changes result from administrative action such as tariff revisions, others from external influences, a boom or slump in the economic field or even a wet summer. A continuous sampling process is the only way in which we can measure the effect of these influences on telephone traffic.

What of the future? Our first aim is to do away with the tedious hand counting of tickets. Where the conventional ticket pad is in use, we expect to incorporate two pink tinted tickets in each pad of

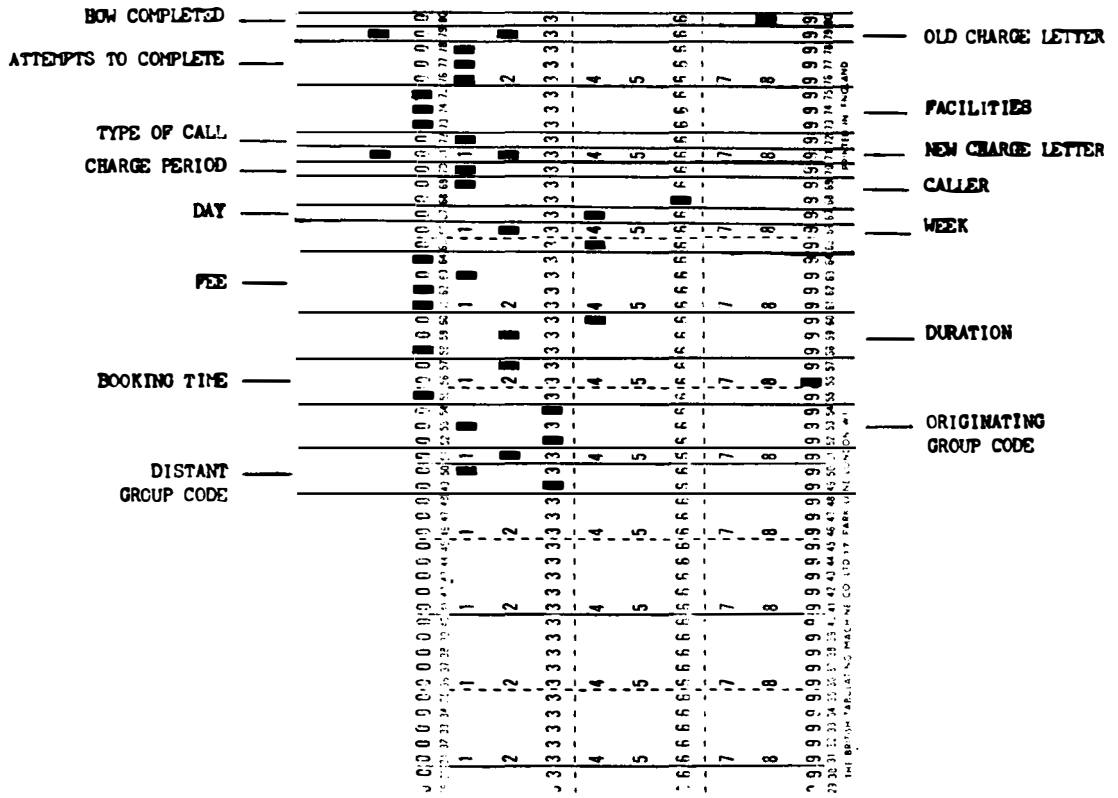


Fig. 2: Part of punched card

Charge Letter	Distance between charge points in miles	Full Rate (8.0 a.m. to 6.0 p.m. and 10.30 p.m. to 8.0 a.m.)		Cheap Rate (6.0 p.m. to 10.30 p.m.)		24-Hour	
		Jan. to Mar., 1957	Jan., 1958	Jan. to Mar., 1957	Jan., 1958	Jan. to Mar., 1957	Jan., 1958
D	15–20	22.5	7.8	13.0	4.1	20.4	7.0
E	20–25	13.8	17.0	9.2	10.1	12.8	15.5
F	25–35	14.5	20.6	12.3	15.5	14.0	19.5
G	35–50	12.4	14.1	13.8	14.8	12.7	14.2
H	50–75	10.5	12.2	13.2	15.6	11.1	12.9
I & J	75–100	6.5	6.6	8.7	8.6	7.0	7.1
K	100–125	6.2	6.7	7.1	7.3	6.4	6.8
L and over	over 125	13.6	15.1	22.7	24.1	15.6	17.0

Fig. 3 : Percentage distribution over charge steps—U.K., 1957-58; before and after Group Charging

200. This will enable us to select a 1 in 100 sample quite readily without counting and, at the same time, to assess totals of both timed and untimed ticketed calls. At first, every tenth pink timed ticket will be extracted for our national analysis.

The next objective is to use the sample for local control purposes, the adjustment of staff to traffic in individual exchanges, and traffic aspects of equipment planning. This may well require the extraction of a larger sample than 1 in 100; the use of tickets of other tints, green for 1 in 20 or buff for 1 in 10, is a possibility. The facility would then be available for Telephone Area staff to extract such statistics relating to ticketed calls as they require.

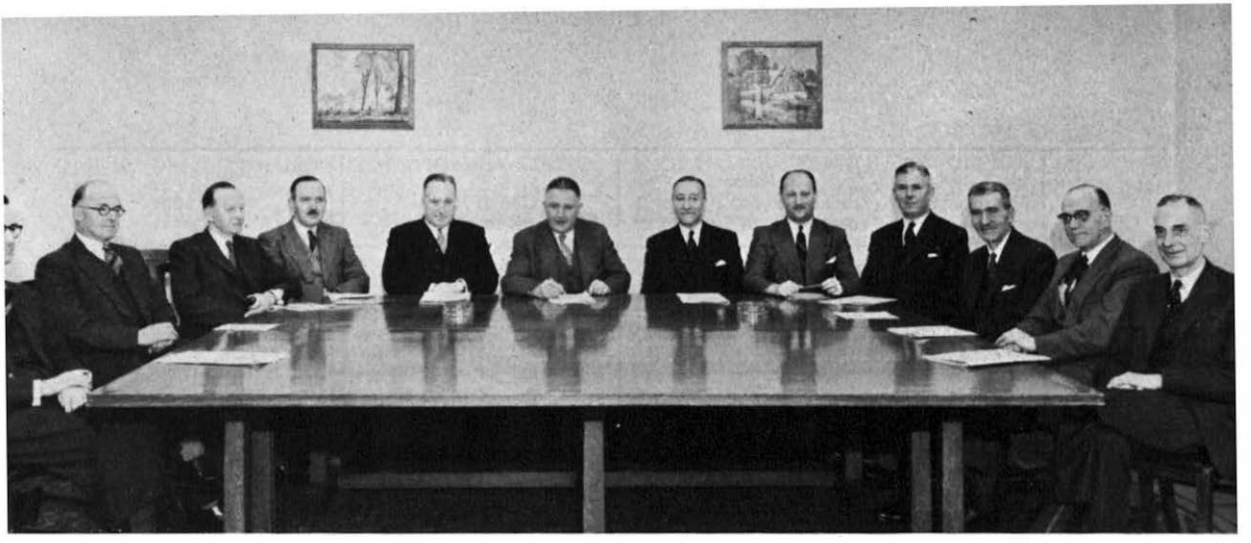
We have also to take into account the development of mechanical methods. A ticket counting machine, as described in the Spring *Journal* last year, may be used at the largest exchanges. More revolutionary is the introduction of punched card machinery in a few Telephone Area offices for the production of telephone accounts, described in the article on the Mechanization of Trunk Fee Accounting in the *Journal* for August-October, 1954. At exchanges in these Areas a special type of ticket is used and the pink ticket scheme cannot be applied. It is expected, however, that the punched card machinery will be used for the analysis of all tickets (and, maybe, other statistical purposes), making sampling unnecessary.

I have touched on the regular analyses for which continuous sampling of timed call tickets is used, and taken a glance at the future. It remains only to mention several studies carried out at Headquarters which, but for this continuous sampling scheme, would have meant taking elaborate special returns covering, of necessity, a limited period and being of doubtful reliability. A sample of 25,000 calls was used in the Spring of 1957 to estimate the changes in charge step distribution which would result from group charging; these estimates are now confirmed by the results shown in Fig. 3. Other studies have been made into the personal call service, the use of the ADC ("Advise Duration and Charge") facility, the characteristics of Post Office Service calls, circuit occupancy time and the half-hourly distribution of timed traffic.

Continuous sampling of timed calls has become a sure foundation on which we can build future policy. The coming of subscriber trunk dialling will take from us the convenient ticket from which our information comes. Much of our effort today is concerned with ensuring that we shall be able to sample subscriber dialled calls in the future. But that leads us to another story.

Fig. 4 : Sampling error limits

Size of Sample (Thousands)	Typical Period covered by Sample (U.K.)	PERSONAL Call Facility %	COIN-BOX Calls %	FINALLY EFFECTIVE %
400	YEAR	3.7 ± 0.1	16 ± 0.1	89 ± 0.1
100	QUARTER	± 0.1	± 0.2	± 0.2
30	MONTH	± 0.2	± 0.5	± 0.4
20	QUARTER—Cheap Rate only	2.3 ± 0.2	34 ± 0.7	86 ± 0.5
7	MONTH—Cheap Rate only	± 0.4	± 1 4	± 0.8



The Post Office in the North West

A STAFF OF NEARLY 33,000 RUN THE POSTAL, telegraph and telephone services for a population of 6,500,000, in the North West Region of the Post Office. The Region includes nearly 5,700 square miles, from the Border to Cheshire and Derbyshire and from the west coast to the industrial districts around Manchester. Across the western sea, the Isle of Man is part of the Region. The terrain includes cities such as Manchester and Liverpool, popular holiday resorts like Blackpool and the Lake District.

The postal services are operated through 37 Head Post Offices. The Region is divided into five telephone areas and has about 500,000 connexions on 409 exchanges. The present total annual revenue from telecommunications is about £18 millions.

The greatness of the British Empire was achieved not so much by force of arms as by the peaceful penetration of traders, and this is one of the factors which is facilitating the transformation from an Empire to a Commonwealth of Nations. In Britain's wide trade relations both Liverpool and Manchester have for centuries linked the North West of England with the far ends of the earth.

Liverpool, on the right bank of the river Mersey, is one of the greatest trading centres of the world and the principal port in the United Kingdom for the Atlantic trade. Its Gladstone Dock can accommodate the largest vessels afloat. The Mersey Tunnel (Queensway), connecting Liverpool and Birkenhead, is one of the most important engineering achievements of recent years; begun in 1925, it was opened to traffic in July, 1934. Nearly 10 million vehicles passed through it in the year 1956-57.

Manchester is a commercial rather than an industrial centre, the industry of the area being largely carried on in the neighbouring towns. Within a 25-mile radius 4,500,000 people live, engaged principally in the engineering, chemical, clothing, food processing and textile industries and in providing the packing, transport, banking, insurance and other distributive facilities for those industries. Manchester is connected with the sea by the 35½-mile Manchester Ship Canal capable of taking ships up to 15,000 tons. The municipal airport has direct passenger service to America, Canada and to most European countries, and freight services to the United States, Europe and Africa.

The presence of these two great cities in the North Western Region of the Post Office accounts for the rather larger than usual Regional Board; in addition to the more usual members, the Head Postmasters and Telephone Managers of both Liverpool and Manchester also sit on the Board.

The Region's industrial interests are far from being restricted to Liverpool and Manchester. Blackburn and Preston, both Telephone Managers'

The Regional Board (*left to right*): Mr. J. E. MORRIS, Finance Officer; Mr. H. C. JONES, O.B.E., Telephone Manager, Liverpool; Mr. W. D. EVANS, Staff Controller; Mr. W. SCOTT, O.B.E., Postal Controller; Mr. S. A. MANSER, Deputy Regional Director; Mr. H. A. ASHDOWNE, Regional Director; Mr. H. G. DAVIS, O.B.E., Chief Regional Engineer; Mr. J. B. CROCKATT, Public Relations Officer and Secretary to the Board; Mr. R. R. WALKER, Telephone Manager, Manchester; Mr. J. R. E. AITKEN, Head Postmaster, Manchester; Mr. F. R. B. BUCKNALL, Telecommunications Controller; Mr. C. H. ANDERSON, Head Postmaster, Liverpool.

headquarters, are old but still developing manufacturing centres born to produce cotton fabrics but daily becoming better known for a wider range of products.

It is impossible in a few lines to do justice to the versatility of the North West but St. Helens' glass, the aluminium and cables of Warrington, Widnes chemicals, Leyland lorries and Barrow ships are examples which show the great variety of its productivity. Another recent and far reaching development is the Atomic Energy Power Station at Calder Hall in Cumberland, the first industrial scale power station in the world connected to the electricity grid.

The North West is not, however, an entirely unrelieved scene of industry. A different picture comes to mind at the mention of Ambleside, Coniston and Keswick which suggest the dignity, loveliness and calm of the Lake District at the northern end of the Region, where Lancaster provides the Telephone Manager's headquarters.

Still further variety is suggested by Blackpool, Morecambe, Lytham St. Annes, and Southport, which cater in a very big way for the holiday moods of people from all parts of the country. Any who are not satisfied within the extremes suggested by Blackpool and the Lake District may venture across the sea to the Isle of Man, whose ancient Parliament, the House of Keys, has not found it necessary to impose many of the restrictions which are commonplace on the mainland.

Among the technical highlights of the Region are the largest Television Centre and one of the most important High Frequency Switching Centres in the provinces, both in Telephone House, Salford; the reserve speaking clock in Liverpool which takes over if the main clock in London fails; and the Premium Savings Bond installation at Lytham St. Annes where the Telephone Manager, Preston, is responsible for maintaining ERNIE'S intricate equipment and providing telecommunications facilities for the Press on draw days.

"Impressive Steps" in Commonwealth Communications

The Sixth General Report (1956) of the Commonwealth Telecommunications Board records that the first transatlantic cable (TAT) "has exceeded the most optimistic hopes of its sponsors, in traffic carried and revenue earned", so much so that the United Kingdom and Canadian national bodies have planned the second cable (CANTAT), "designed on British techniques using a single cable with both-way repeaters".

"It would appear", the Report adds, "that with the TAT and CANTAT cables the transatlantic communications of the Commonwealth will be adequate to meet demands for many years ahead."

"Moreover, the new radio channels across the Pacific"—telephone and telegraph circuits between Canada and Australia and via Australia with New Zealand—"can be integrated by connexion across Canada with channels in the CANTAT cable". Direct radiotelephone and radiotelegraph communication between Canada and New Zealand will eventually be established.

"In short", the Report summarizes, "some really impressive steps have now been taken towards developing the Commonwealth telecommunications network on really modern lines".

Sad Georgian—Pleasant Elizabethan?

"At last—and none too soon—we may see a Post Office telephone kiosk designed in a 20th-century manner", commented the *Manchester Guardian* on the Postmaster General's announcement (*Journal*, Winter issue, page 88) that new kiosks are being planned.

"That sad semi-Georgian hybrid designed by Sir Giles Gilbert Scott"—1927, which the P.M.G. described (December 5, 1957) as "brilliant at the time"—"is the only kiosk that many of us remember. The occasion for its removal will be the installation of the new equipment for trunk dialling.

"The Postmaster General said in the House of Commons recently that he wished to see more standardization and pre-fabrication in Post Office building. It appears, greatly to his credit, that he also wishes to see the job well and stylishly done, since the advice of the Royal Fine Art Commission and the Council of Industrial Design was sought, and evidently taken.

"As a result a limited competition is at present being held between Mr. Neville Conder, Mr. Frank Howe and Mr. Misha Black".

Mechanized Engineering Stores Accounting in the Supplies Department

F. G. Welch

If Post Office engineering work is to be carried out efficiently, stores must be made available to the man on the job as and when required. The Supplies Department is responsible for arranging for these stores to be bought, for maintaining adequate (but not excessive) stocks, and for issuing supplies to the field. It is concerned with some 26,000 different items of stores, and from its depots over £30 million worth of stores are issued to Telephone Areas in the course of a year. All these transactions must be recorded; so also must be the intake of fresh supplies from manufacturers. The stocks held of each individual item, and the outstanding and prospective demands for them, must be readily ascertainable, so that replenishments can be arranged in good time.

These requirements call for a vast amount of clerical work, and it has been natural to consider whether some of that work could be done more quickly and efficiently by mechanized processes, and whether it would be easier in that way to produce statistics for purposes of management control. Examination has shown that mechanization has promising possibilities, and this article gives a general account of the way in which it is to be applied.

EARLY IN 1954 THE POST OFFICE SUPPLIES Department introduced mechanization for the receipt, issue and documentation of engineering stores. A punched card system using Hollerith type of machinery was adopted.

The possible introduction of a punched card system had been examined early in 1939, but because of the war no progress was made until ten years later. Even then, owing mainly to machine supply difficulties, the first steps to bring mechanization into effect could not be taken until 1953.

Several ways of introducing punched cards were examined. Ultimately a pilot punched card unit was installed in London and a few selected Telephone Areas were asked to participate in the initial arrangements.

The punched card system requires the punching of cards with holes in a variety of positions according to the numeric codes which have to be allotted for each piece of information to be recorded. The type of card now used in the Supplies Department has a capacity of 80 columns, and each column may be punched in any one of 12 positions. The cards, once they have been punched by a hand operation keyboard type of machine, and verified by another operator using a similar type of machine, are fed into various kinds of punched card machines which interpret the punched holes and thereby sort, tabulate, print or otherwise process the cards as desired.

One of the first big problems in starting the system was the coding of each item's description in the standard vocabulary of engineering stores, familiarly known as the Rate Book. This was overcome by giving each item description a six-figure code, the first two digits indicating broadly the section of the Rate Book in which the item could be found. For example, Telephones, No. 1 232 CB Black, are coded 416059; Lamps, General Service, 230 v. 60 w., Pearl, 530525.

Then, each Telephone Area required a code number. Each address to which stores and documents were to be sent also required codes; the full postal address, Telephone Manager, Section Stock Stores, Block 57, King's Norton Factory Centre, Birmingham 30, for example, is coded BHAM 22. The Supplies Department allotted codes for the Areas; the Telephone Managers helped by listing all their addresses and coding them. Each stores accounting reference used by the Areas was also provided with a code. Although at first the two-letter and four-figure requisition numbering methods were still used, they had to be superseded later by a fully numeric code.

Early major tasks were to select and train staff for machine work and to obtain the requisite punchers, verifiers, sorters, tabulators, collators and multiplier machines. All staff had to be adequately trained and all machinery installed and working before the system could be put into operation.

Hitherto, the Supplies Department had sent stores out without any advice; information about delivery followed at a later date, in the form of a delivery note. Under the new system a packing note accompanied the stores; this was a duplicate of the issue slip on which the stores were issued from stock. Consequently, new stationery had to be designed and provided before the new system could be started. New style delivery notes were also obtained. By the beginning of 1954 all essential coding had been done, staff had been trained, and stationery and machines were ready.

After a three months' trial, the new system had shown its advantages over the old manual system and steps were taken for its eventual extension from the few selected Areas co-operating in the trial to all Telephone Areas. At the same time arrangements were made to expand the pilot unit and to set up other units in Birmingham and Edinburgh. This expansion involved providing more machinery which needed enlarged accommodation, recruiting and training further staff, and supplying yet further types of stationery.

The London unit now caters for the Metropolitan and Bridgwater depots; the Birmingham unit for the Birmingham and Hereford depots; Edinburgh for the Scottish depots.

The system works, broadly, on the following lines. When Area requisitions are received they are quickly scrutinized visually, to ensure that they are fully coded, before being sent to the punch room. The punch room operators, using manual keyboard machines, punch detail cards for each item description on the requisitions.

The information punched into each card consists of the requisition reference number, the Area code, the delivery and document address codes, the accounting code, the item code number and the quantity required.

After the cards have been punched they are immediately verified by a different operator who uses an electrically operated machine. The verifying machine "senses" the holes punched by the first operator and if any one of the holes has not been correctly punched, the verifying machine refuses to function. When a punching error is found, a fresh card has to be accurately punched and the incorrect card destroyed.

After being verified, the detail cards are automatically punched with the date of receipt of the requisition, and with a class of transaction code to indicate the type of document from which the card was prepared. At this stage the requisitions have fulfilled their purpose and are filed; the detail cards are passed to the machine room for processing.

The system requires that a master card shall be maintained for each item description. Each master card is punched with the appropriate item code number and the source of supply—which may be

A 1663

REQUISITION FOR ENGINEERING STORES

BIRMINGHAM Area 3.3. 1958

Required by Engineering Clerk / Telephone Manager

at W.O. STORES, 1st FLOOR, (BLOCK LETTERS)

32 LANCASTER STREET, BIRMINGHAM

A copy of delivery note to be sent to MR PEPPER (Official designation and postal address of officer who should check and acknowledge receipt of the stores)

(as above)

†Conveyance

Area Code	65	§Transaction Code	30		
Requisition Reference	Originator's Code	Year	Serial No.		
	004	7	847		
SDA Code	21				
Account	Class of Work: Index Letters	Code	Number	Year	
	CSI IP	201	016604	7	
DNA Code	21				
Waybill	Depot L	Number	302		

ITEM CODE NUMBER (1)	ITEM DESCRIPTION (2)	QUANTITY (Units or yards/ft.) (3)	For SUPD use or for AREA use on receipt of stores (4)	Date wanted by and Remarks (5)	§Special Instructions (6)
310672	Fuses No.20/10	2		CEN.4225	
				(Rendale	
				Conveyors	

Upper half of requisition note, showing code

a depot or a contractor's works—the alphabetic description, the rate and other essential information.

The alphabetic description is used only for printing on documents and is inserted in the card by punching two holes in each column (in a separate part of the card) according to a specially devised combination. To keep within the printing capacity of the tabulator—the machine which does the printing—the alphabetic description must not exceed 22 characters and spaces. This means that all item descriptions of greater length have to be abbreviated.

Separate subsidiary master card files are maintained for use with each day's work, for preparing statistics, and for other purposes.

In the machine room the detail cards are sorted to item code number order by the high-speed sorting machines. These machines sort the cards on a single column at a time.

Next, the cards reach the collating machine which merges two or more cards bearing identical punching—for example, the item code number. This machine has two feed positions; the detail cards are placed into one feed position, in batches, in item code number order: the master cards for the corresponding range of items are placed into the other feed position.

Both batches of cards are passed through the collator; all the detail cards for a particular item are associated with the master card for that item, falling into a box followed by the next master card and its detail cards.

From the collator the merged cards are passed to another machine which punches into the detail card all the information punched in its master card. Then the master cards are sorted out from the detail cards, remerged with the balance of the master pack and filed for further use.

The next step is to sort the detail cards according to the source of supply and to merge them with address cards, an address card being kept for each coded address. The cards are then ready for tabulation.

For stores which are to be issued from depot the tabulator prints the issue slip and its carbon copy (the packing note) from the batch of cards consisting of the detail card and its associated address card. The issue slip and packing note are sent to the stores sections for issue and despatch of the stores.

After the stores have been issued each issue slip is associated with the detail card from which it

Requisition cards being mechanically sorted

was produced. Each card is then punched with the date of the issue of the stores and a code to indicate the method of transport used.

After being sorted according to the accounting reference, the cards are passed through the electronic multiplier, which calculates the value of the stores issued and, with its linked machine, punches the value into the cards.

From this stage several sorting operations are made to place the detail cards in the correct sequence.

After being merged with the address cards, the detail cards are placed in the tabulator, which prints a four-copy delivery note, addressed to the Area concerned and showing full particulars of the stores which have been supplied with their value.

Before the punched card system was introduced, the Supplies Department had maintained stock ledgers by manual posting. The punched card system offered the opportunity to mechanize the stock ledgers. Ledgering is now done by associating the detail cards for stores issued with other detail cards for stores received into stock.

Where these groups of cards are in item code number order they are merged with ledger balance cards for the items concerned. The tabulator, with

its linked machine, then prints a complete ledger statement showing each transaction which has taken place during the ledgering period—weekly ledgering is current practice—and at the same time produces an up-to-date ledger balance card, which in its turn is used at the next ledgering operation. It has been found possible to show in each ledger balance card not only the stock particulars but also particulars of the issues of the item to the field, cumulative for the financial year.

For stores issued from contractors' works the detail cards are run through the tabulator separately. The tabulator prints a statement, showing particulars of the requirement, which is used by the clerk for preparing the order on the contractor. When the contractor advises that he has despatched the stores, the card from which the statement was prepared is punched with the date of the issue of the stores and is then released for association with other detail cards for statistical purposes.

For stores recovered from Areas a detail card is punched for each item put to stock. Like the detail cards for new stores, these recovered stores cards are ledgered once a week. A separate series of ledger balance cards is kept for recovered stores.

Tabulator in operation

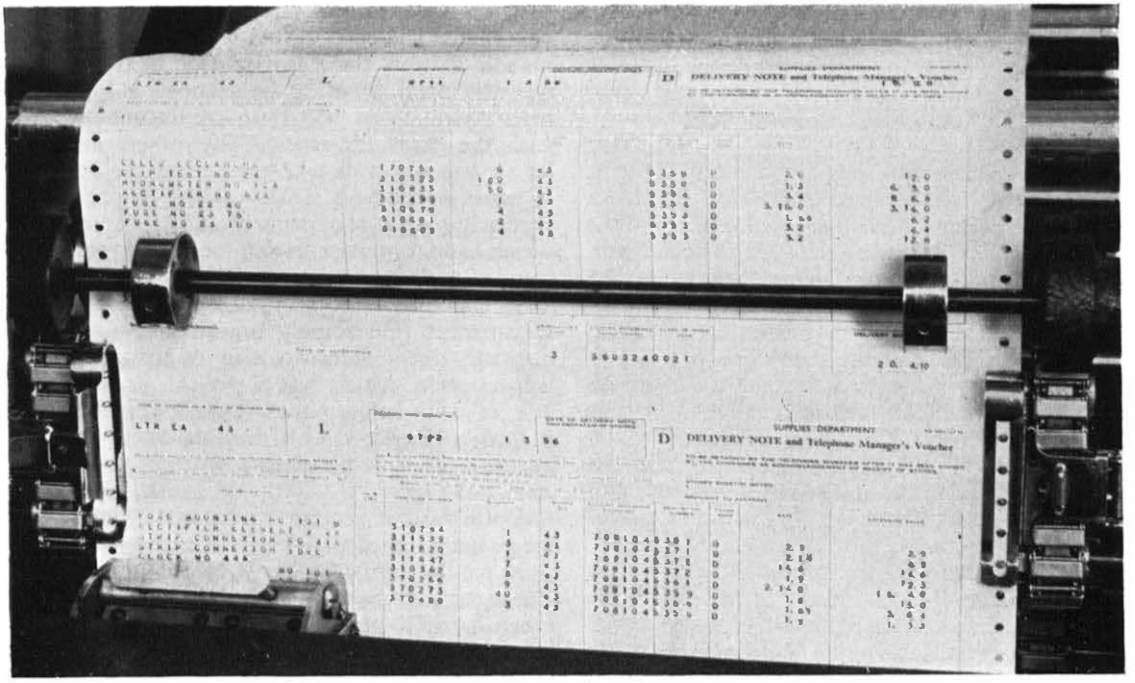
After the punched card system became fully operational and mechanized ledgers had replaced manual ledgers, the statistical side of the system was developed. By using the detail cards for issues made from depot and from contractors' works, with the cards for receipts into stock, and the ledger balance cards with their cumulative record of issues to the field, it was possible to produce a regularly phased statement of all the transactions which had taken place during the period reviewed, coupled with particulars of depot stock holdings. This statement was produced for the Supplies Department provisioning branch and made unnecessary the tedious scrutiny of manually kept ledger cards, which had been the provisioning officers' work before punched cards were adopted. A further development of this statement was the inclusion in it of particulars of recovered stores stock holdings.

A still further product of the system has been the preparation of statistics of demand from, and issue to, the field of a range of dominant items. These statistics have been provided, broken down according to Regions and Areas, and into various groups of items.

So far, the punched card system in the Supplies Department has been concerned mainly with documenting stores, converting long and tedious manual operations to machine operations, and supplying statistical statements upon which the initial processes of provision work could be based. The system has thus given a measure of relief to typing and ledger staffs and has obviated the need to increase clerical staff greatly to cope with the growth of supply work for the telecommunications service.

The time has now been reached when the system can be developed further for statistical work and for this purpose a computer (Hollerith Electronic Computer 1201 type) is to be installed in the Supplies Department. The introduction of this computer will enable the Department, to a very considerable extent, to improve its methods of provisioning stores, and will open up a new statistical field for stores supply and control.

Before a computer of this type can be brought into use a planning team has to embark on a very close study of all the procedures relating to the proposed objective and then to prepare a meticulously detailed programme to which the machine will work. For provisioning, it is intended that the computer will not only supply complete statistical statements of the assets and use of items



Delivery notes being printed by the tabulator

but will also work out forward quantitative requirements from data which will be fed into it. Initially, however, only the complete statements will be produced, from which provision officers will calculate the future need.

A first step in this programme planning involves setting up a complete master file, consisting of a separate record for each item showing all the details of its characteristics; for example, the places where it is stocked, its sources of supply, loss of stock rate,* suitability for repair of recoveries, expected future use, and so on.

A complete record in a single file of all the assets available under contracts for supply is another essential feature in feeding the computer with the appropriate data; at present such information is held in the individual contract papers. Hitherto, the control of requisitions which cannot be met because supplies are inadequate has been exercised from several points according to the nature of the items concerned. Central control of these requisitions is another necessary feature of computer working.

The task of converting the Supplies Department manual processes on provisioning into mechanized processes is still in its early stages but the computer will probably come into full operation for provisioning towards the end of 1958. Thereafter, the scope of this equipment in the field of mechanized stores accounting will be widened.

* *The loss of stock rate may be defined as the monthly rate of demand of an item by the Areas less the normal monthly rate of recovery from the Areas.*

D.G. at Brussels Conference.—Sir Gordon Radley, Director General of the Post Office, spoke on "Communication between Nations and Peoples" at the 1958 British Electrical Conference in Brussels on May 16 and 17 during the Brussels Universal and International Exhibition. The Conference was held to support the British Electrical Industries exhibit.

New Exchange at Bolton.—A £240,000 telephone exchange is being erected at Bolton. The exchange, which will provide subscriber trunk dialling, should be opened in 1962 when the manual exchange will have been in use for 40 years.

Telecommunication Economics

J. Reynolds, Engineering Department

THERE ARE ALTERNATIVE SOLUTIONS TO MOST engineering problems of plant provision and the choice between them is largely determined by financial considerations. Frequently, of course, schemes will contain important features which cannot be expressed wholly in financial terms but which must be given due weight in arriving at a decision. Problems may vary from a small scheme of local line plant provision to one concerned with a major issue of national policy.

The study and use of economic principles belong mainly to the field of the planning engineer and many Post Office engineers spend some part of their careers on planning works. Other engineers need a general knowledge of economic principles for a full understanding of the methods adopted for plant provision.

Economics has been the subject of occasional articles and papers by Post Office authors but each has usually dealt with a particular aspect of the subject. In his new book, *Telecommunication Economics* (Macdonald, 50s.), however, Mr. T. J. Morgan, Senior Executive Engineer in the Engineering Department, has treated the subject comprehensively. It deals in great detail with the general principles used in economic cost comparisons and with the particular methods used in each of the main fields of application in the Post Office; for example, exchange planning.

The first few chapters deal with general principles starting with emphasis on the need for making economic cost comparisons and leading up to how to do so.

A comparison of capital costs of alternative schemes is sometimes of over-riding importance if capital expenditure is restricted but otherwise gives the correct answer only in simple cases. Comparison is more fairly made on the basis of annual charges which consist of interest on capital, capital repayment charge, maintenance and operating costs, and such a comparison can suffice for alternative schemes each consisting of a single installation of plant.

More generally, a scheme will contemplate installation of plant at intervals during a future period, the planning period being usually taken as 20 years, so that the annual charge is not constant during the period and a direct comparison with another scheme also having a changing annual charge cannot be made.

This difficulty is overcome by referring each annual charge to its "present value" at the start of the planning period; that is, the present value of an annual charge is the sum of money at the start of the planning period which, at the agreed rate of interest, will become equal to the annual charge at the appropriate time. Thence, by summing the present values of all the annual charges during the planning period, a single figure is obtained to represent the cost of the scheme.

This figure is the Present Value of the Annual Charges, P.V. of A.C., of the scheme and it can be compared directly with the P.V. of A.C. of another scheme. The calculation of present values involves the use of various formulæ based on the rate of interest.

The derivation of these formulæ is given in Chapter 2, and tables of multiplying factors for various rates of interest which have been calculated from these formulæ are given as Appendices.

The actual P.V. of A.C. calculation must, of course, be preceded by the acquisition of all necessary data. Thus, a forecast of requirements is obviously necessary, the lives of the various types of plant must be estimated, and maintenance and operating costs must be assessed. Often it will be appropriate to refer to standard data to determine the average service life of plant, residual values of plant at the end of life, and annual charge percentages for maintenance. When standard data cannot be used, or when this data is being determined, a considerable study may be needed to determine, for example, the service life of a particular item of plant. The considerations involved in such studies are given in separate chapters on depreciation accounting, service life and forecasting. A chapter on statistics and probability is also included in view of its application in this field.

When the basic date is available, alternative schemes can be defined for costing purposes; that is, the type, amount and time of each installation of plant can be laid down, the calculation of, say, the P.V. of A.C. of each scheme can be carried out and a comparison made. Considerable engineering knowledge and experience are, of course, necessary in order to be able to plan the schemes.

Such economic cost comparisons have been used in the Post Office for many years and Mr. Morgan

has collected the results of this experience to give a guide to the methods of dealing with problems in each of the main fields of work. Thus, separate chapters deal with automatic exchange equipment, multi-exchange area layout, buildings, local line plant, main line plant, etc. Each chapter gives an account of the engineering principles and methods used, followed by worked examples in which schemes are planned, tested and compared.

The connected account given of each type of problem is not readily available elsewhere and should be very useful to anyone requiring an introduction to the subject, while the bibliography appended to each chapter gives a guide to further reading. The appendices also include a number of traffic capacity tables.

The book is long and I feel that it could have been noticeably shorter without loss of content. It would have been easier to read and to refer to if the chapters had been sectionalized to mark a change of subject and if the examples had been clearly set apart from the rest of the text. It gives a valuable and comprehensive account of the methods used in the Post Office for making economic cost comparisons and of the reasons underlying those methods. The chapters dealing with general principles are equally applicable to engineering problems of plant provision other than in telecommunications.

Thomas Jefferson Morgan (better known to his friends as John or T.J.) author of this book was born at West Hartlepool in 1918, *and educated at a local Secondary School and St. Cuthbert's Grammar School, Newcastle-on-Tyne. He started with the Post Office Engineering Department at Newcastle in* 1936. *After serving with Royal Signals,* 1939-41, *he won the First Prize and Silver Medal of the City and Guilds Institute for Transmission and Lines,* 1943. *He was promoted to the Engineer-in-Chief's office in* 1945 *and two years later elected an Associate Member of the Institute of Electrical Engineers. For the past* 10 *years he has been actively concerned in the design and planning of exchange systems. In* 1955 *he visited Kuala Lumpur, Malaya to advise on the extension of existing multi-exchange system and was one of the Post Office team under the Technical Co-operation Scheme of the Colombo Plan who went to advise on a new exchange for Colombo.*

OUR CONTRIBUTORS

R. F. BRADBURN ("VI British Empire and Commonwealth Games") contributed the first article on this subject to the Winter, 1958, issue of the *Journal* and his career is outlined in that issue.

F. J. M. LAVER ("Computers in the Office") is an Assistant Staff Engineer in the Engineering Organization and Efficiency Branch of the Engineering Department. He joined the Post Office as a Probationary Inspector in 1935, entering the Radio Experimental Branch at Dollis Hill to work on the Post Office Frequency Standard and later on television cable systems. In 1951 he transferred to the Radio Planning Branch as a Senior Executive Engineer, and in 1956 was moved to the Engineering Organization and Efficiency Branch becoming Assistant Staff Engineer in 1957. In October–November, 1957, he visited the U.S.A. and Canada to study the use of automatic data processing equipment in government agencies, and to visit the principal manufacturers.

A. J. LONGLEY ("Telephone Attachments") contributed an article "Simplified Charges" to the Autumn, 1957 issue of the *Journal* and his career was outlined in that issue.

A. O. MILNE ("Training Commonwealth and Foreign Engineers") is an Assistant Engineer who joined the Engineering Department in 1926 as a Youth-in-Training. In 1929 he transferred to the Circuit Laboratory and was promoted Inspector in Equipment Branch in 1936. During the war he served with Radio Branch and since 1945 he has been in E. Branch Consultative Services Group dealing with overseas visitors and students. He is a Past President of the Radio Society of Great Britain.

D. J. SHARP ("Seven per cent. in Charge Step D") is a Senior Telecommunications Superintendent in the Statistics Section of the Inland Telecommunications Department. He entered the Post Office in 1939 as a Youth-in-Training and spent nearly four years in the Engineer-in-Chief's Circuit Laboratory before being discharged on health grounds. In 1945 he joined Ericsson Telephones Ltd., and was engaged on telephone circuit design and development work until re-entering the Post Office as an Assistant Traffic Superintendent in 1949. He was employed in Colchester Telephone Area until taking up his present appointment two years ago. He is an A.M.I.E.E. and a Fellow of the Royal Statistical Society (F.S.S.).

F. G. WELCH ("Mechanized Engineering Stores Accounting in the Supplies Department") is a Chief Executive Officer in the Supplies Department where he is Depot Manager of the London Group of engineering stores depots. Entering the Post Office in the Clerical Class he served in the postal stores depot and later in the engineering stores depot; he also served for a short period in the former Money Order Department. After promotion to Executive Officer in 1938, he was engaged on ARP organizational work in the department for some of the War years.

Subsequent promotion to HEO was followed by training in organization and methods work and service in the methods and editorial field for six years. Later he was engaged as SEO on staff and buildings and for three years on the organization and introduction of the punched card system into the Supplies Department.

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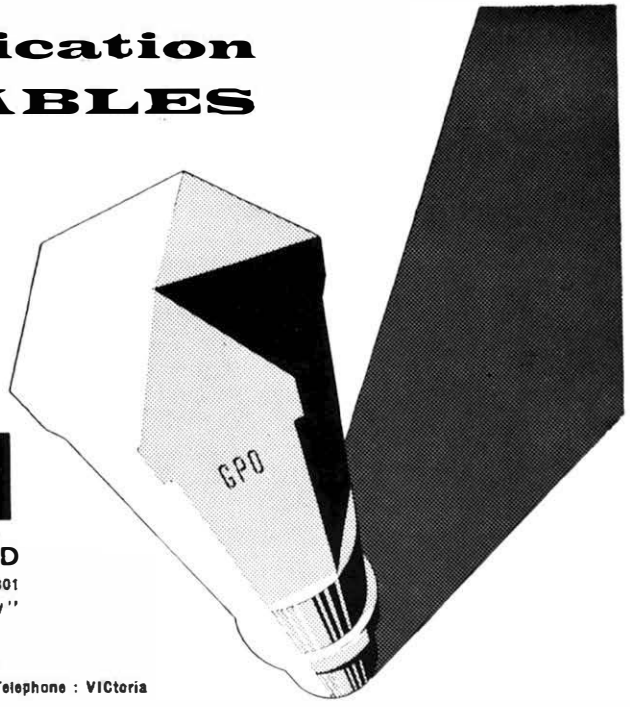

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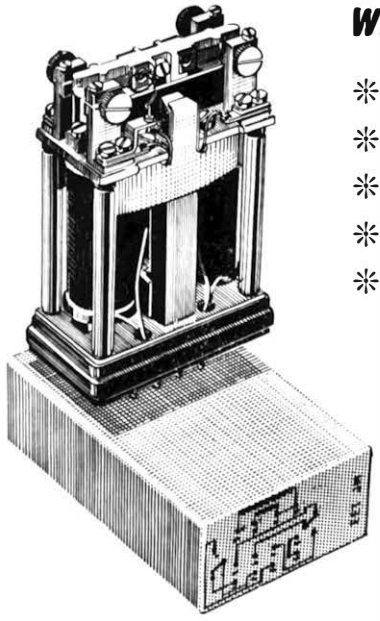

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Notes and News

New Amplifier for Deaf Subscribers

The Post Office is developing a new type of amplifier for deaf telephone subscribers.

By using a transistor, the amplifier is so reduced in size that it will be accommodated inside the telephone handset. The volume control will consist of a small rim-operated device on the handset similar to the kind used on hearing aids.

The new equipment will dispense with the need for the separate valve amplifier and, as it will draw its power from the exchange line, no battery will be necessary; this will avoid the need for maintenance visits to change batteries.

The equipment is about to undergo a field trial, but is unlikely to be available for general use for some time to come.

★ ★ ★

VHF to Catch Cattle Thieves.—Police in the Karamoja district of Uganda have installed a Marconi VHF radio network to forestall sporadic raids of local tribes on the herds of neighbouring villages. The network links 14 local police posts with a Headquarters post. Any suspicious activities observed by local constables are reported to the HQ post and a patrol is sent to investigate in radio-equipped vehicles. Local police work from fixed-station transmitter/receivers into HQ post via a repeater station on a convenient high point within range of all the fixed stations. The repeater station is designed to operate unmanned, but should a fault arise in the radio equipment or generating plant, a warning bell is rung in the guard hut nearby. Patrol vehicles are also fitted with mobile transmitter/receivers.

★ ★ ★

TAT Traffic.—The first TAT (United Kingdom —Canada—USA) cable carried nearly 300,000 calls with Canada and the United States during its first year of service, to September 25, 1957, 130,000 calls on circuits leased to Germany, France, Belgium, Holland, Switzerland, Denmark and Sweden, and some 25,000 broadcast transmissions. It provides telex between the United Kingdom and Canada.

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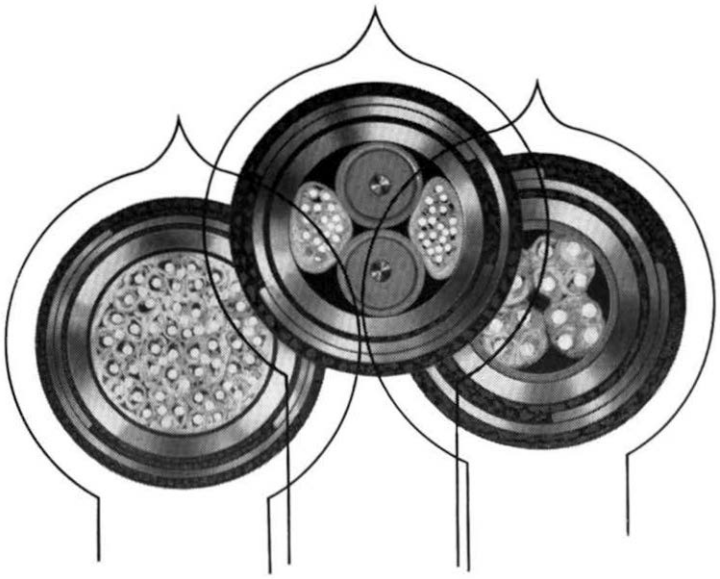
Sections of the three cables ordered by the Department of Posts and Telegraphs of the Government of India from Standard Telephones and Cables Limited. *These installations are indicative of S.T.C.'s lead in communication cable engineering.*



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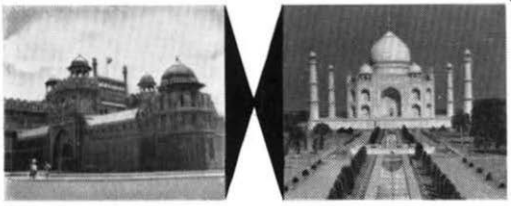

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Radio Telecommunications Network for Angola

The Angolan Postal and Telegraph Authorities have placed an order with Automática Eléctrica Portuguesa, S.A.R.L. for equipment to be manufactured and installed by Marconi's Wireless Telegraph Co. Ltd. and Automatic Telephone & Electric Co. Ltd. for a multi-channel radio telecommunications system linking the towns of Luanda, Malange and Marechal Carmona in Portuguese West Africa. The total distance is 600 Km. The radio equipment comprising 12 terminals and 16 repeaters is being supplied by Marconi's and A. T. & E. Co. Ltd are supplying the carrier telephone equipment. This, the first multi-channel radio system in Angola is the first stage in the implementation of a much larger scheme.

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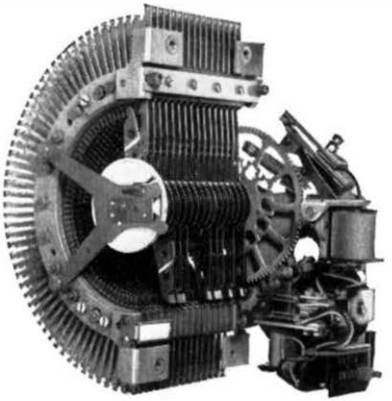

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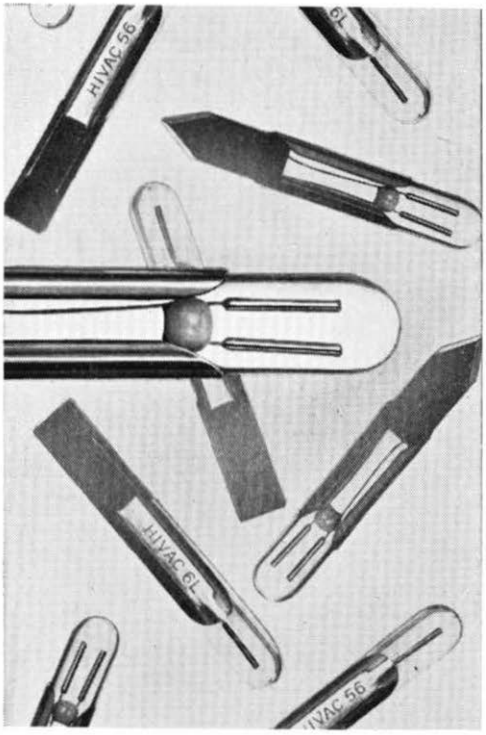

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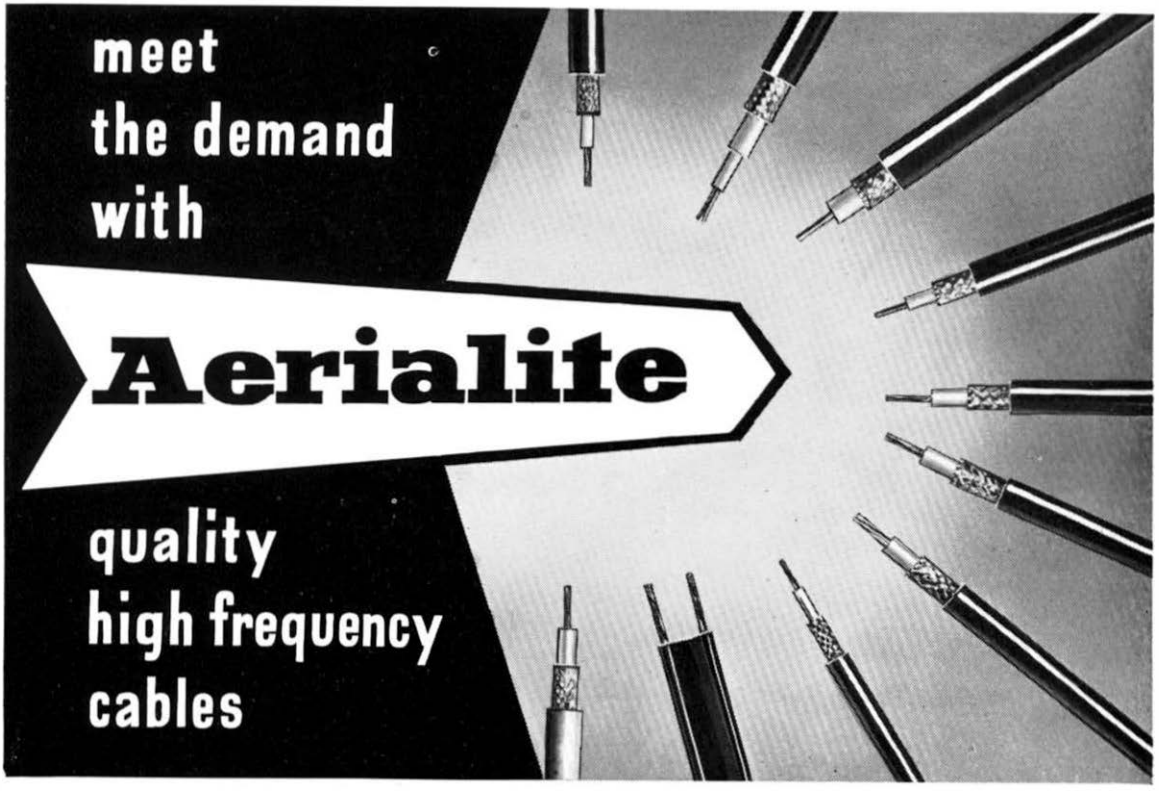

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