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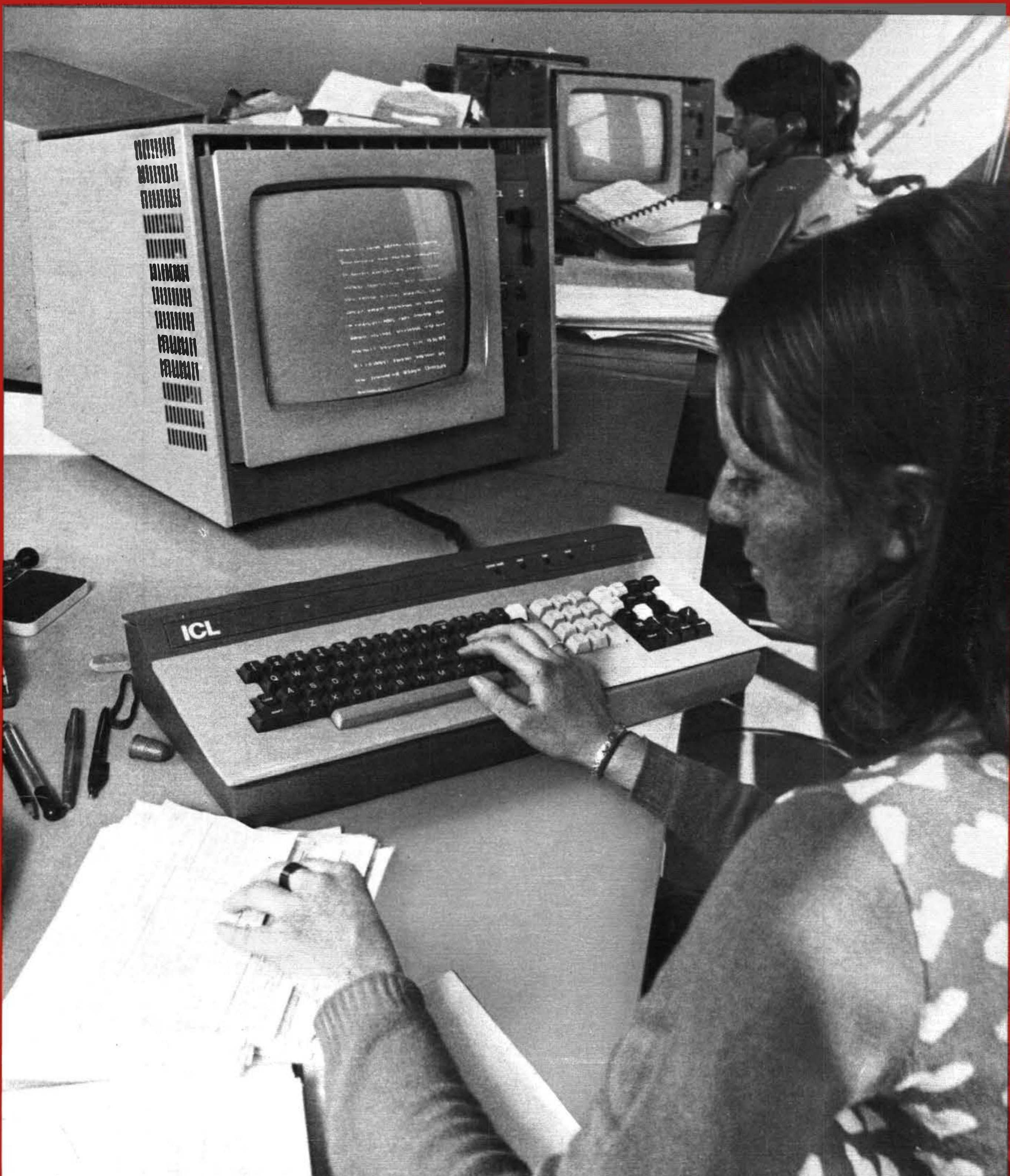

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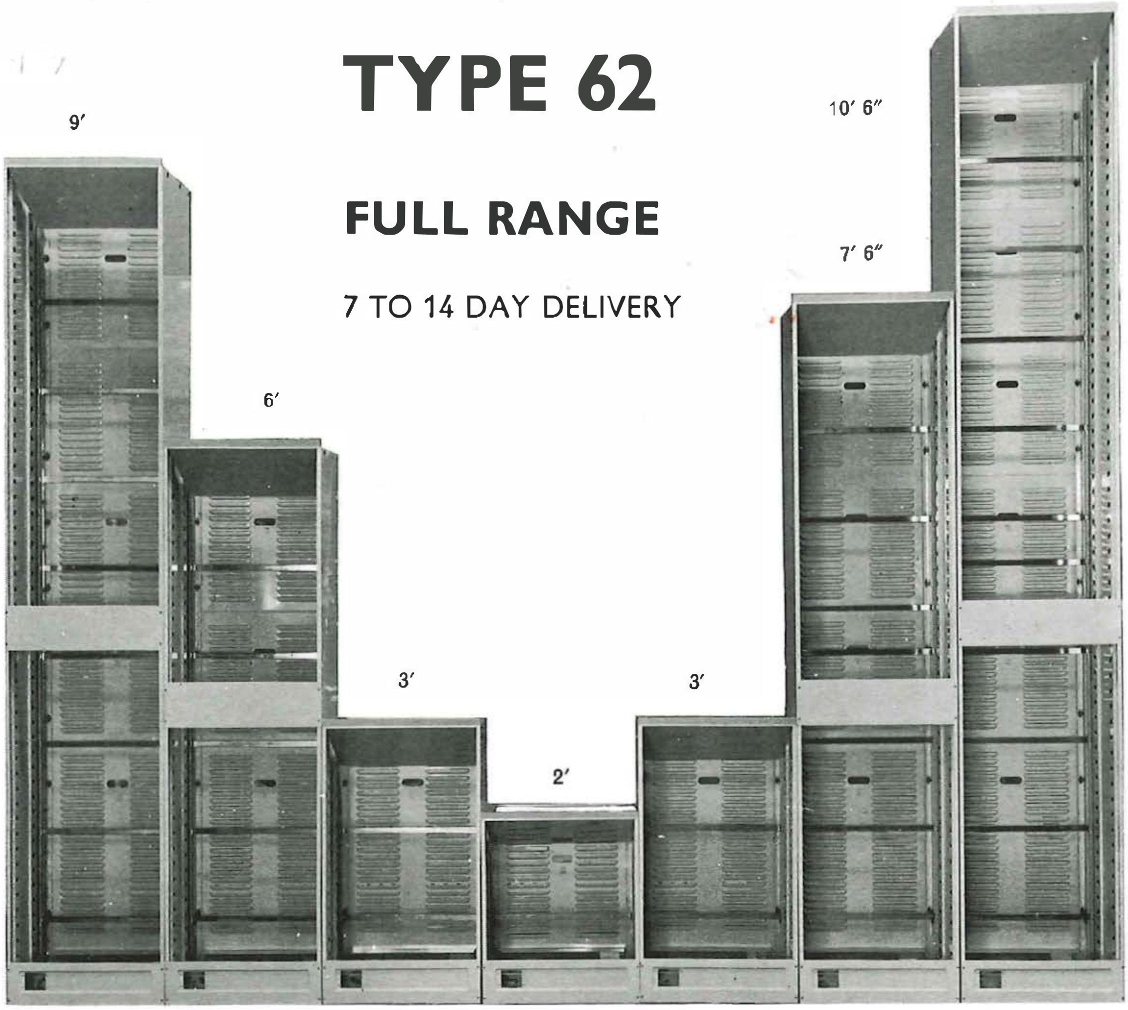

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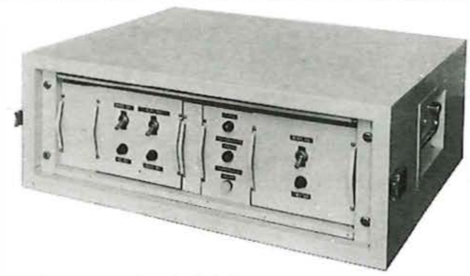

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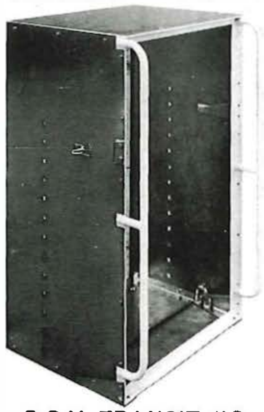

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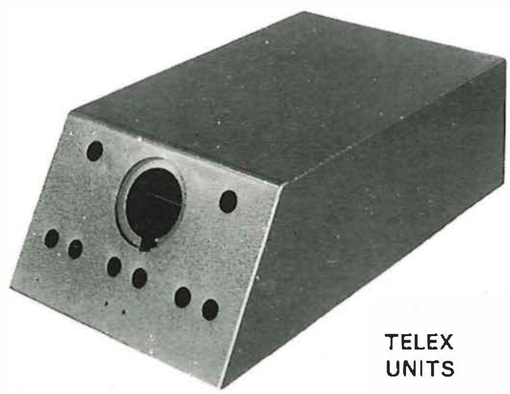

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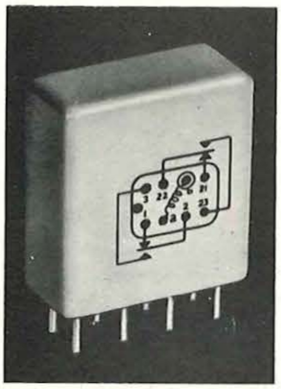

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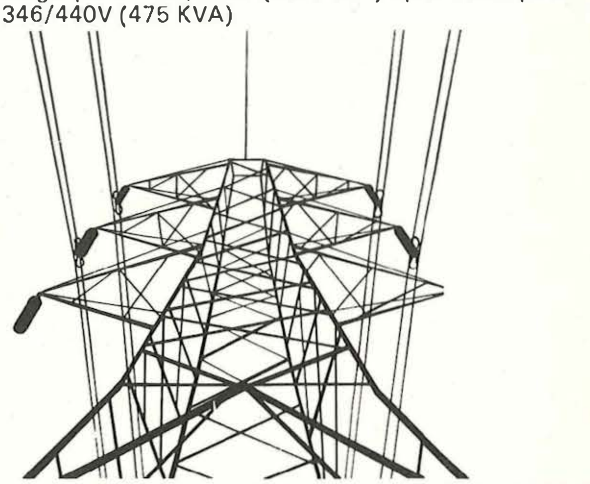

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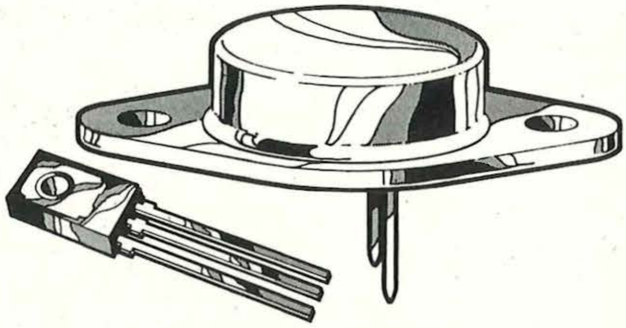

Switched Mode Power Supplies are now very much in the limelight since a wide range of transistors is now available to provide the required performance and reliability. Mullard have developed many new types for this duty and the table below summarises the present position.

These devices combine high voltages with the necessary fast fall times and are suitable for power supplies up to 800W output power.

The current range includes the BDY93 and BDY96 families of output transistors for mains-operated power supply units and the BDY90, BD131 and BDX35 families for Battery systems. Drive transistors include BD232 and BSW66.

In addition to the types shown, others are in advanced stages of development—including improved versions of the BDY90 and BDY96, and also a PNP complement to the BD232.

Full technical data on any or all of these types are, of course, available.

Type	V_{CEO}	I_C	t_f max.	Encapsulation
BDY90	100V	10A	0.2 μs at 5A; 0.05 μs at 0.5A	TO-3
BDY91	80V	10A	0.2 μs at 5/0.5/0.5A	TO-3
BDY92	60V	10A	0.2 μs at 5/0.5/0.5A	TO-3
BDY93	350V	3A	0.6 μs at 2.5/0.5/0.5A	TO-3
BDY94	300V	3A	1 μs at 2.5/0.5/0.5A	TO-3
BDY95	250V	3A	1 μs at 2.5/0.5/0.5A	TO-3
BDY96	350V	10A	0.4 μs at 5/1 /1A	TO-3
BDY97	300V	10A	0.9 μs at 5/1 /1A	TO-3
BDY98	250V	10A	0.9 μs at 5/1/1A	TO-3
BD131	45V	3A	0.15 μs at 2/0.2/0.2A	TO-126
BDX35	60V	5A	t_{off}: 0.8 μs at 5/0.5/0.5A	TO-126
BDX36	60V	5A	t_{off}: 0.8 μs at 5/0.5/0.5A	TO-126
BDX37	80V	5A	t_{off}: 0.8 μs at 5/0.5/0.5A	TO-126
BD232	300V	0.25A	f_T (typ.): 20 MHz	TO-126
BSW66	100V	1.0A	t_{off}: 1 μs at 500/50/50mA	TO-39
BSW67	120V	1.0A	t_{off}: 1 μs at 500/50/50mA	TO-39
BSW68	150V	1.0A	t_{off}: 1 μs at 500/50/50mA	TO-39
458BDY/A	400V	10A	0.8 μs at 5/1/1A.95°C	TO-3
458BDY/B	400V	10A	1.2 μs at 5/1/1A.95°C	TO-3
424BDY/A*	100V	7A	t_{off}: 0.65 μs at 7/1.7/0.7A	TO-3
426BFY/A	300V	0.5A	f_T (typ.): 60 MHz	TO-39
426BFY/B	250V	0.5A	f_T (typ.): 60 MHz	TO-39

**Also available as CV9936.*
All devices are NPN polarity except the 426BFY which is PNP.

Microwave transistors

Additions to the high-frequency families

A recent addition to the Mullard range of devices for Post Office high-frequency equipment is the 551 BFY/A: this transistor has a typical f_T of 5GHz and is in a true microwave encapsulation which makes it suitable for 'S'-band amplifiers.

In addition microminiature versions of BFR90/1 are now available (new number BFR92/3) and for BFY90 (new number BFS17R). Please ask for data sheets on any or all types.

Operating current	f_T: 1.5—2GHz	f_T: 3—5GHz
14mA	BFX89 BFW92 BFY90 BFS17R	BFR90 551 BFY/A BFR92/3
30mA	BFW30 BFW93	BFR91 BFR96
75mA	BFW16A/17A	BFR94

New Linear IC's

Additions to the Mullard range of linear integrated circuits include:

Level sense switching device, TAA320A: this device acts as a switch circuit with very high input impedance (1pA input leakage current) and high output capability (60mA). The switching reference voltage is so constant that the device can be employed as a stable reference in RC timing circuits.

Drain source voltage: 20V max.
Drain current: 60mA max.
Gate source voltage (selected):

Group 1	10.0 to 11.2V
2	10.7 to 11.9V
3	11.4 to 12.6V
4	12.1 to 13.3V

Gate source leakage current (typical): 1pA.

Clock circuit, SAJ250: a 32kHz clock comprising an oscillator, 15-stage frequency divider and supply current regulator.

Frequency division: 2^{15} (32768)
Supply voltage range: 0.9 to 3V
Supply current: 20μA (typical)
Output current: 15mA (typical)

Full technical information will be sent on request.

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U.K. extends its links with GEC microwave radio systems

GEC has supplied and installed most of the British Post Office network of broadband radio links carrying an ever-increasing volume of trunk traffic. The network includes one of the most heavily loaded routes in the world, between London and Birmingham which is equipped with 50 RF channels carrying 27000 telephone circuits and 12 television programmes. With microwave systems operating in 30 other countries, GEC is one of the world's leading manufacturers. The total systems capability of GEC covers not only an extensive range of microwave radio and associated equipment but also comprehensive planning, installation, maintenance and training resources. It includes 2GHz, 4GHz, 6GHz, and 6.8GHz systems for speech or colour television on long-haul main routes and 7.5GHz for speech on medium-haul and spur routes, and the private user market, all in accord with CCIR requirements. Associated equipments include frequency division multiplex for up to 1800 circuits, supervisory alarm indication and remote control systems, IF and baseband switching, narrowband auxiliary radio for serviceband, and antenna systems.

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Developed by Telephone Cables Ltd. in conjunction with the British Post Office, it makes possible 97,200 simultaneous conversations.

This is yet another example of TCL's experience in the design and manufacture of telecommunication cables: an experience readily adapted to meet your own particular needs, whatever they may be.

In addition to coaxial cable, TCL also manufacture a wide range of plastic and paper insulated telephone cables to meet the requirements of the B.P.O. and other telephone administrations throughout the world.

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We celebrate our silver anniversary

There are two silver anniversaries in 1973 which are of particular interest to our readers. The transistor is 25 years old – and so is Telecommunications Journal.

We can take some pleasure that we share our birthday with an invention that has affected everybody's life, and has had a profound influence on telecommunications. And we can hope that the Journal has also played some small part in the development of telecommunications over the past 25 years.

The first issue in November 1948 announced that the aim was "to promote and extend knowledge of the operation and administration of telecommunications". A glance to the right of this page will show that there has been no change of objective, although the word administration is now replaced by the more commercial term management.

The editorial comment in the first issue was concerned with the problems of the telephone service in a period when the priority given to the export of equipment and limitations on the use of manpower held back post-war recovery. The Journal also got off to a slow but steady start, with circulation rising from 14,000 copies an issue in 1948 to only 16,000 copies in 1961. Then there was a period of firm progress with circulation increases of about 1,000 a year; this has been followed in recent years by a rapid explosion in demand for the Journal's services.

In 1969, when the Post Office ceased to be a Government Department and became a Corporation, the Telecommunications Journal also took on a new appearance and style. It increased its page size, adopted modern printing techniques and introduced colour photography. This change in presentation reflected developments in content that had already begun, and more resources were made available to ensure that the Journal lived up to its aims.

There has been growing attention in our columns to the development of modern management techniques, so vital to the success of a huge enterprise. But the technologies on which Post Office telecommunications are based have not been neglected. Here our purpose has been to break down the barriers in communication that can develop in an age of heightened specialisation, and to encourage and help one group of specialists to talk to others in a language that all can understand.

The years of our maturity have brought rewarding results. Sales have been rising recently by more than 1,000 copies *an issue* and the circulation is now approaching 50,000. A substantial number of copies are read outside the Post Office in universities, the telecommunications industry and telecommunications administrations abroad.

In the future we shall continue to range our contents over every aspect of telecommunications activity, and to seek to interest and inform our readers by presenting attractive and readable material. We would like to think that in 25 years the Telecommunications Journal has developed not only a purpose but a character of its own. And when the transistor moves aside, to be replaced by a new generation of technology, we hope to be here to tell you about it.

Post Office telecommunications journal

Autumn 1973 Vol. 25 No. 3

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

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The year in facts and figures: **page 28**

Miscellany: **page 33**

Cover: Clerical staff in Southampton Telephone Area are using TV-like screens to speed the input of information to computers which calculate employees' pay. Instead of filling in forms which are sent to data processing staff, payroll details are keyed into the visual display units and transmitted on line to a computer in London. See page 21.

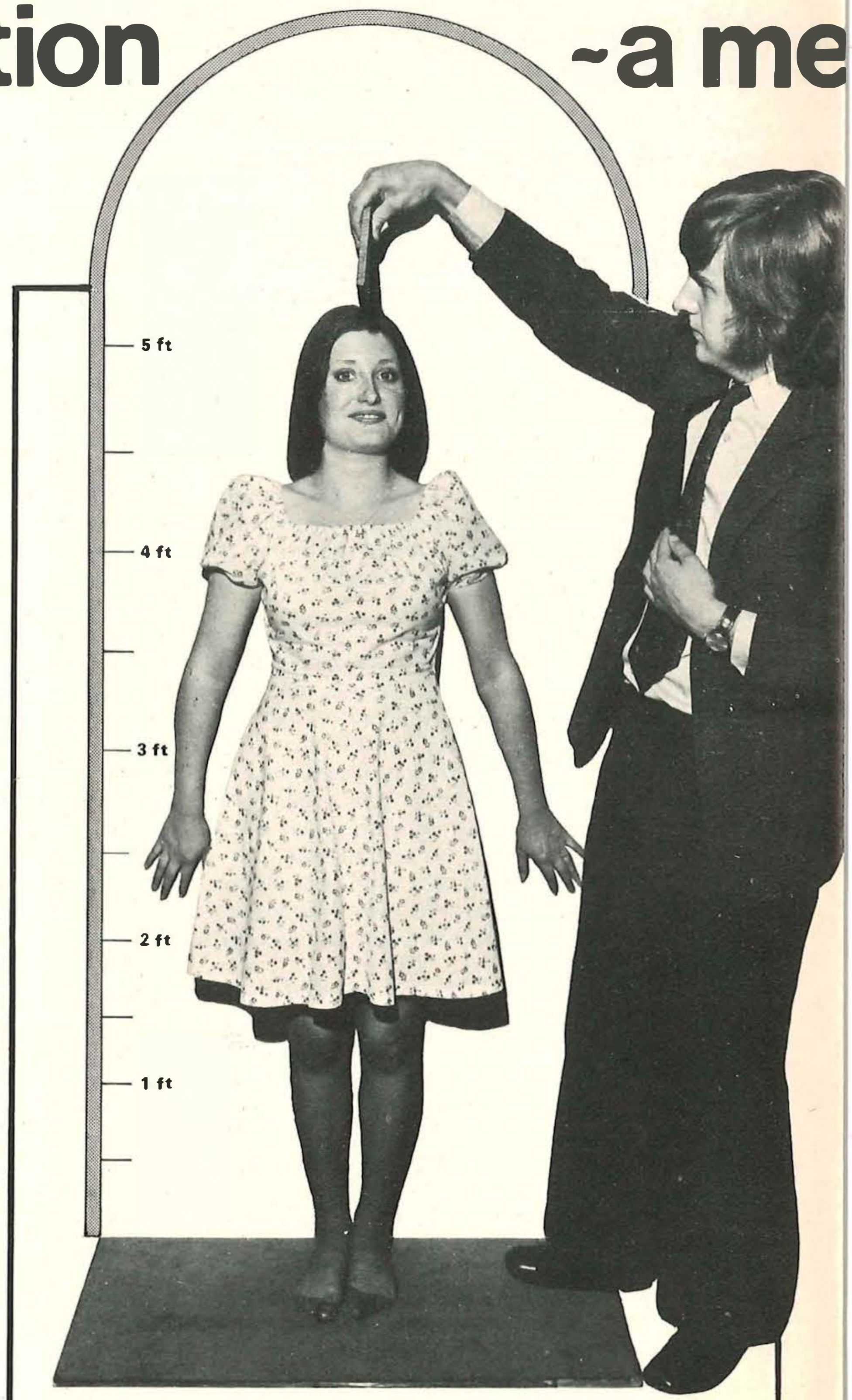
Metrication ~a me

SJ Aries

NEARLY FOUR years have passed since an article on metrication appeared in this Journal. During that time industrial metrication in the United Kingdom has made steady if somewhat unspectacular progress. The doubts and uncertainties raised by Parliamentary debates in 1970 led to some loss of momentum and the White Paper published in February 1972 did little to restore the situation. The White Paper reaffirmed the Government's support for industrial programmes which aimed for substantial conversion based on a 1975 target date, but made it plain that public purchasing power would not be used deliberately to hasten the change. The agreement with the Common Market countries allowing Britain to continue with imperial units in its legislation at least until 1980 was reported as was the decision to retain – for an indefinite period – the present system for speeds and distances on road signs and for the sale of food, fuel, milk and beer. Against this background it is hardly surprising that many interested organisations have urged the Government to follow the logic of the rest of its industrial and European policy by taking early action to foster completion of the metrication process.

Post Office policy has always been to support industrial metrication but not to attempt to force the pace. It recognises the natural tempo for the process is determined by the rate at which materials and components to metric standards become available, and by the speed with which changes can be introduced. In general the Post Office has had no difficulty in keeping abreast of its suppliers, and in areas where matters are more directly under its control – eg the external field – very good progress has been made. A joint Metrication Steering Group from the Post Office and manufacturers has tackled problems of common concern and several joint working parties have been set up to deal with particular topics.

Before giving a summary of recent achievement, it will be as well to discuss the metrication process in the context of telecommunications equipment and



Height: 23 tomini 1.60 metres 5 ft 3 in

Metrication does not alter a measurement, but simply changes the units in which dimensions are expressed. At Dollis Hill (above) engineers concerned with human factors measure volunteers in their search to determine the best solution to a design problem – the height of a call box dial or the lay-out of operator equipment. The results of an ergonomic study will be the same whether expressed in imperial, metric or Moroccan units called tomini. The height of one volunteer – Miss Lesley Turner of the metrication group at Telecommunications Headquarters – is given in the three units to demonstrate this point.

asure of progress

to explain what is meant by complete and partial metrication.

Consider first a truly metric item. By definition this is one which has been designed in metric terms and manufactured using materials and components (eg nuts and bolts) to metric standards. Even such an item however, may incorporate some dimensions which are essentially imperial. This can occur because it has to interface with old equipment or because it complies with metric standards which were originally formulated in imperial terms. An example of the latter is the international standard module of 2.54 mm (one tenth of an inch) for printed circuit boards. This dimension was adopted fifteen years ago because it represented the most widely used industrial practice. The international committee concerned recognised that the minor advantages which could result from the selection of a round metric dimension – eg 2.50 mm – would by no means compensate for the upheaval and cost of changing a well established standard.

A completely metric item can also be produced by converting an existing design from imperial to metric units without any significant change of dimension. Such a requirement may arise from the need for strict interchangeability or to enable identical items to be manufactured in a metric environment. It should be noted that this is a valid metrication exercise in all those cases where the dimensions of an item represent the optimum solution to a design problem. Thus the height of a workbench determined as a result of an ergonomic study represents the optimum height regardless of the system of units in which it is expressed. Similarly, the dimensions of coaxial cable designed to meet given performance parameters can be expressed in any one of a number of systems of units. The specification for the trunk cable formerly known as "Cable Coaxial 0.375 in" for example, has been converted to metric units and the cable is now entitled "Cable Coaxial 2.6/9.5 mm".

It is sometimes possible in an exercise of this kind to express dimensions in metric units in round terms provided the design stays within its overall tolerance limits and essential performance parameters are unaffected. It so happens for example, that 6½lb per mile copper wire has a diameter of very nearly 0.5 mm and this figure is used in metric specifications.

Partial metrication can occur with new equipment designs as a result of a lack of metric standards and/or materials and components. Thus the new metric modular power plant employs imperial sizes of busbar as metric sizes are not yet available. This type of situation will right itself in due course. Meanwhile the Post Office is taking steps, in concert with its manufacturers, to assist in the formulation of suitable standards. It is also ensuring that up to date information on the availability of metric standards, materials, etc is held in the Engineering Information Bureau for the benefit of designers.

Partial metrication also applies to equipment originally conceived in imperial terms. Here however, one must distinguish two broad categories. The first includes all the older designs, such as strowger exchange equipment, which are due to be phased out. For this type of equipment the only changes brought about by metrication will be those resulting from shortages of imperial materials and the need to interface with items to metric standards. Metric gauges of wire and some metric bolts are already being used in strowger equipment and partial redesign to accommodate some metric steel sections is also in hand. The second category comprises all types of equipment which are likely to continue in production for a considerable time, eg TXE4. The same pressures for the inclusion of metric materials and components arise here but any partial redesign which results can be regarded as a stage in the conversion to a completely metric design. The achievement of this goal may take some time and there may be good reasons for delaying non-essential changes. Consider, for example, equipment practice parts which are produced by forming or extrusion processes with existing tools. The need for interchangeability will usually dictate the continued production of the items and the exact conversion of the documentation from imperial to metric units will be a time-consuming process of little benefit to the manufacturer or the Post Office.

As a user organisation the progress made by the Post Office has depended largely on that made by various sectors of industry. Opportunities for metricating activities, records, etc have been taken at appropriate times as indicated in the subject summaries that follow.

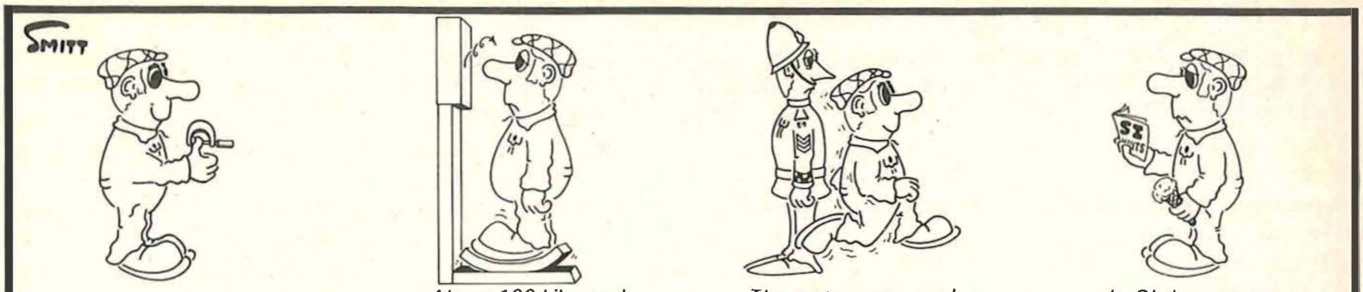
Buildings: The construction industry was the first to publish a programme (1967) and the Post Office has co-operated with the Department of the Environment in the design of metric buildings since January 1969. Planning and plant layouts are now all in metric terms, but some imperial items have to be installed. The standard N and P type buildings are now modular metric. Extensions to existing buildings are planned using metric equivalents to imperial dimensions and following the metric modular construction as far as possible. Trunking and conduit for services such as power cables are now supplied in metric sizes. Lifts, heating and ventilating plant are dimensioned by the manufacturers in either metric, dual metric and imperial, or imperial. In the latter case the interface dimensions are converted to metric by the Post Office.

Plant and equipment: The cable industry also made early plans and the production of metric cables began in 1970. The Post Office co-operated by rewriting the specifications for its telecommunication cables in metric terms. At the same time a working party was ▶

A litre is roughly one and three-quarter pints

The unit of force is the newton

Absolute zero on the temperature scale is 0 kelvin



Metric micrometers measure micrometres!

Above 100 kilos and you're almost certainly overweight

The motorway speed limit is 112 km/h. On foot go as fast as you like!

In SI the way to slim is by cutting back on joule intake

set up to see how far the metrication of related items and activities could be pursued. As a result the planning and execution of external works including the provision of cable, ducts, poles, manholes, etc are now all carried out in metric terms. Development work on new internal equipment is documented in metric units, but the actual penetration of metric items depends on their availability. All 62-type equipment (the present standard for transmission equipment) is now specified in metric terms and includes materials and components to metric standards. Other items specified in metric units include a possible new teleprinter for the UK telex network and the new designs for data terminal and test equipment, various portable testers, cordless switchboards, test desks and power units. The planning and implementation of the new 60 MHz transmission system is also being carried out in metric terms.

As a result of the change to metric sizes of winding wires, the Post Office in co-operation with the manufacturers has been revising the specifications for relays and magnet operating coils. Approximately 6,000 windings for coils have been checked and agreement reached with the manufacturers on the metric equivalents. The work is continuing. In the cases of both relay and magnet coils the many circuit applications and the need to maintain acceptable performance have called for a great deal of practical testing. The partial metrication of strowger racks and frames has been necessitated by the steel industry's adoption of metric sizes of hot rolled structural sections. This work is overseen by a joint working party of the Post Office and manufacturers.

Research: Most models, prototypes, etc are designed and made in metric terms and the internationally agreed system of SI units is used for almost all scientific work. Machine tools purchased since 1969 have all been calibrated in metric units and the majority of the older machines have been converted. The workshop at the Martlesham research station is equipped to metric standards and some 700 out of 800 stores items held there in the small tool, material and fastener categories are metric.

Training: It has not been found necessary to introduce any general training beyond the distribution of various booklets and pamphlets. (45,000 copies of the Educational Pamphlet "The Change to Metric" have been distributed to date). Metric instruction is included in normal courses as appropriate and the situation is kept under review by a training study group.

Miscellaneous: The work in Post Office factories of converting machines to dual reading is nearly completed and the necessary metric measuring aids are available. Metric paper sizes are now used for 9,000 items out of a total of 9,500 and 70 per cent of the sheets used in various rule books are also metric standard sizes. Of the 27,000 items of engineering stores stocked by Supplies Department some 3,000 have been converted and about 800 are new metric items. Opportunities for rationalisation are being taken as they occur. Thus the range of containers in which paint is stocked has been more than halved.

It is clear from the foregoing that the Post Office is playing an active role in this exercise. Problems arising from growing shortages of imperial materials will probably be with us for many years to come but if they are tackled energetically, and in good time, no real difficulties should occur.

Mr S. J. Aries is head of the metrication and standards section in Telecommunications Development Department which is co-ordinating the introduction of metrication in the Post Office.

Directories go metric

Telephone directories will be changed to metric dimensions in two years' time. The new-size telephone books will be 210 mm (8.27 in) wide and 297 mm (11.69 in) tall. This is a standard metric format known as A4 – the size of Telecommunications Journal – and is the same width as most existing telephone books, but 21 mm (0.83 in) taller.

Advance notice of the change has been given so that users of directories and suppliers of furniture, office equipment and materials associated with telephone directories can prepare for the change. The first of the new directories will reach customers in April 1975. It will take about a year to convert the nation's 105 telephone directories, at present containing 11 million entries and growing by a million new entries a year, to the new metric format.

Most of Britain's directories are printed for the Post Office by the Stationery Office at two big printing plants at Harrow and Gateshead; by working in metric dimensions, savings in production costs are expected. The new size will enable the Post Office to fit an additional 30 entries on each page of directories and this will enable the Post Office to defer dates for splitting them into two or more volumes. At present only the London and Manchester alphabetical directories are contained in more than one volume, although the Birmingham, Bristol and Liverpool books are nearing the point where division is necessary – normally when a directory gets bigger than 1,000 pages.

"Although metrication will help to contain the bulkiness of telephone directories, their growth rate will remain very big," said Mr Edward Fennessy, Managing Director of Post Office Telecommunications, announcing the change. "Continued expansion of the telephone system produces two areas of growth for directories," he added. "Not only are the books themselves growing by a million new entries a year – we must also distribute more books to the new customers whose names appear in them."

A 500 metre section of 60MHz cable is pulled into a duct during long-length cable installation trials at Marlow, Bucks.

97,000 eggs in one basket

DW Gray

The installation of "supercable" on main trunk routes has been creating problems for the planners. Among them is the special need for protecting the huge number of circuits which can be carried in only one length of cable.

HIGH-FREQUENCY transmission systems enable large numbers of telephone calls to be carried on only two pairs of wires and are therefore an economic means of providing telephone circuits over long distances. In the 4 MHz and 12 MHz systems commonly used today up to 5,760 and 16,200 circuits respectively can be carried on a standard cable containing 12 coaxial pairs of wires.

To help cope with increasing demand for trunk telephone circuits the Post Office, in conjunction with industry, is now developing a 60 MHz system to be carried on a "supercable" containing 18 9.5 mm diameter coaxial pairs. The cable equipped in this way has a capacity of 97,200 circuits – far larger than any other cable at present used in this country. (See "A leap ahead in cable capacity", Telecommunications Journal, Summer 1970.)

The provision of such large numbers of circuits in one cable is only justified on the fastest growing trunk routes and it is proposed that the main "supercables" will go from London to Birmingham and from Birmingham to Manchester. Smaller cables of eight coaxial pairs will branch off this "spine" from High Wycombe (a convenient point on the ▶

London to Birmingham section) to Reading and from Manchester to Leeds. Work has already commenced and duct laying is in progress on some sections. The first systems are expected to come into service in 1977.

In devising the route for the 60 MHz cables there are a number of problems which are not met when planning other cables. These arise from three important aspects in which provision for 60 MHz and other cable systems differ. They concern security, the use of long-length cabling and siting of amplifiers.

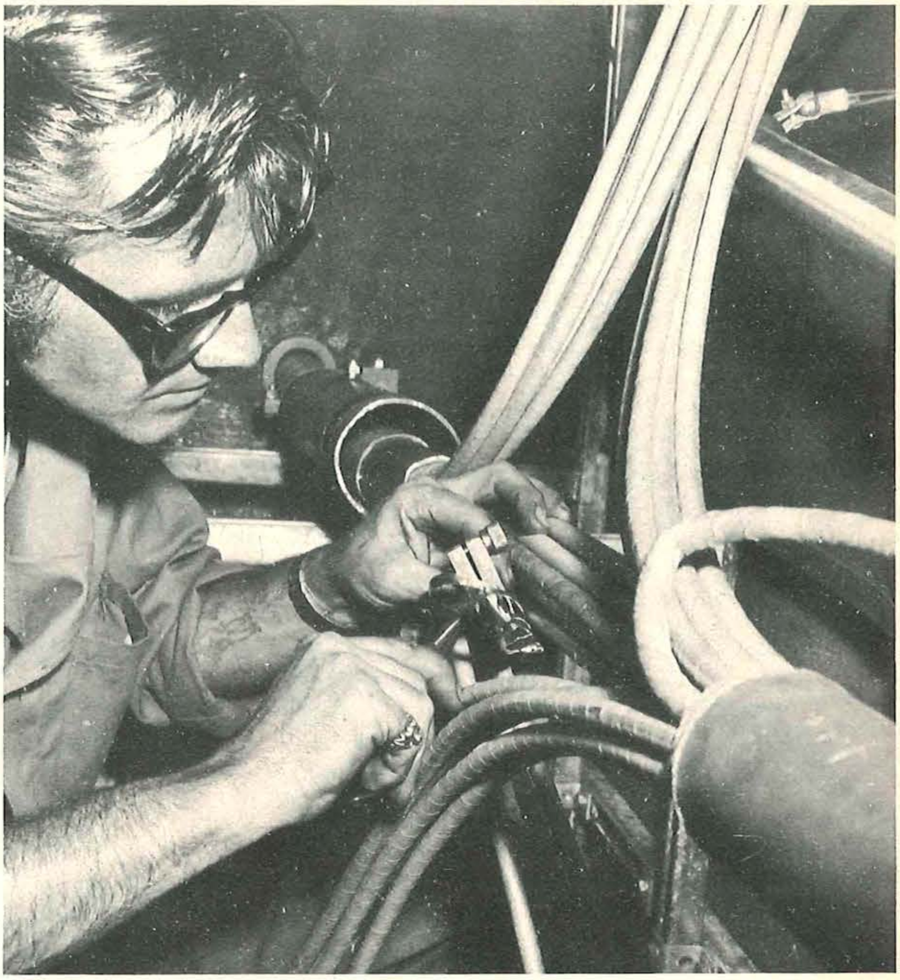
The first of these is a direct consequence of the large number of circuits carried. With a capacity of nearly 100,000 circuits any interruption in the operation of the cable or the equipment associated with it could seriously disrupt the trunk network. Special attention has been given to the equipment design to ensure high reliability and similar attention has been given to protection arrangements for the cable.

Interruptions in the operation of underground telephone cables may arise from a number of causes. Planned breaks in service are sometimes unavoidable, for example where a cable laid along a road that is to be re-routed has to be cut and diverted to follow the new route. Other roadworks, such as those by the major public utilities who have underground plant of their own, are sometimes a cause of accidental damage to Post Office cables – so, too, is the Post Office itself. Vandalism and similar activities also take a small toll.

Precautions against all these possible causes of interruption have had to be taken for the 60 MHz cables. Telecommunications Headquarters decided the precautions necessary in general, but Regions and Areas had the further responsibility of applying these precautions to the selected route, augmenting them as necessary in the light of their local knowledge.

To minimise the risk of having to divert the cable or of it being damaged, every effort has been made to find a route avoiding major towns and following minor roads wherever possible, since it is in towns and on major roads that roadworks and similar activities are most frequent. The Birmingham-Manchester cable, for example, avoids all major towns apart from the Birmingham and Manchester conurbations. It follows minor roads in several places, some of them private, and in two places follows abandoned railway lines including a section in a tunnel.

As a further precaution the cables will be laid much deeper than usual – 1.2 m below the surface instead of the more usual 0.6 m or less. Over bridges and in other places where installation at this depth is impossible the PVC duct in which the cable is laid will be covered with or replaced by steel pipe.



A cable joint is prepared in a large underground chamber. Four cable manufacturers are taking part in trials at Marlow of cable installations.

To reduce the risk of interference to the 60 MHz cables during work on neighbouring Post Office cables, the duct and manholes which contain the joints and amplifiers will be quite separate from those used for any other Post Office plant. Only those staff who actually need to work on the 60 MHz plant will require access to the manholes and there will be no risk of damage from other cables being pulled into the same duct. In fact, with the 18 pair cable, there is no room for any other cables in the duct.

The second big difference between planning for 60 MHz and other cables results from the adoption of long-length cabling techniques. The length of cable that can be pulled into a duct as a continuous section is limited and is essentially governed by the maximum tension that the cable can withstand without damage. The tension which develops as a cable is pulled in depends on its weight, its coefficient of friction relative to the duct and the bends and gradients encountered in the duct track. Until quite recently the length of cable pulled in as one section was typically between 150 m and 250 m. Further work has demonstrated that much longer lengths can be used. In the case of 60 MHz cable 500 m or more can be pulled in, provided that any deviations in the duct track are kept within carefully defined limits and that friction is reduced by lubricating the cable with liquid paraffin as it is installed.

The depth at which the 60 MHz cables are to be laid makes it necessary to house the cable joints in manholes. These are quite large underground chambers and are costly to provide and difficult to find space for in streets which are often as congested below ground as they are above. The joints themselves are also costly to make. Long-length cabling reduces the number of joints and is thus doubly advantageous in terms of cost and convenience.

As it is necessary to lay a completely new duct route for the 60 MHz cables in order to implement all the precautions against interruption, a unique opportunity existed in planning for them to take full advantage of long-length cabling. However, this has placed limitations on the planning of the duct track and made it necessary to calculate the tension required to install most cable lengths to ensure that the track as planned is acceptable. This must be done at an early stage, well before any duct is laid or manholes built; in fact before the positions of the duct and manholes are finally decided on so that any changes found necessary as a result of the calculations can be made.

At the planning stage it is, of course, impossible to assess what departures from the planned line of the duct will prove necessary during its installation. Adequate margins have therefore been allowed in the calculations for such eventualities. The opportunity has been taken to cut across fields or lay behind roadside hedges to reduce bends or avoid obstructing traffic during laying operations in minor roads. Despite the difficulties involved it has proved possible to use cable lengths approaching 500 m, and in some places a little more, for much of the route.

The third main difference between 60 MHz and other cable planning concerns the siting of amplifiers (necessary to boost the signals carried over the cables which would otherwise become progressively weaker). The distances between the amplifiers along a coaxial cable have to be controlled within strict limits to ensure adequate transmission performance. For 60 MHz systems, not only must the distance between successive amplifiers be between certain maximum and minimum figures as for other coaxial systems, but the maximum limit also depends on the length of cable between the adjacent amplifiers.

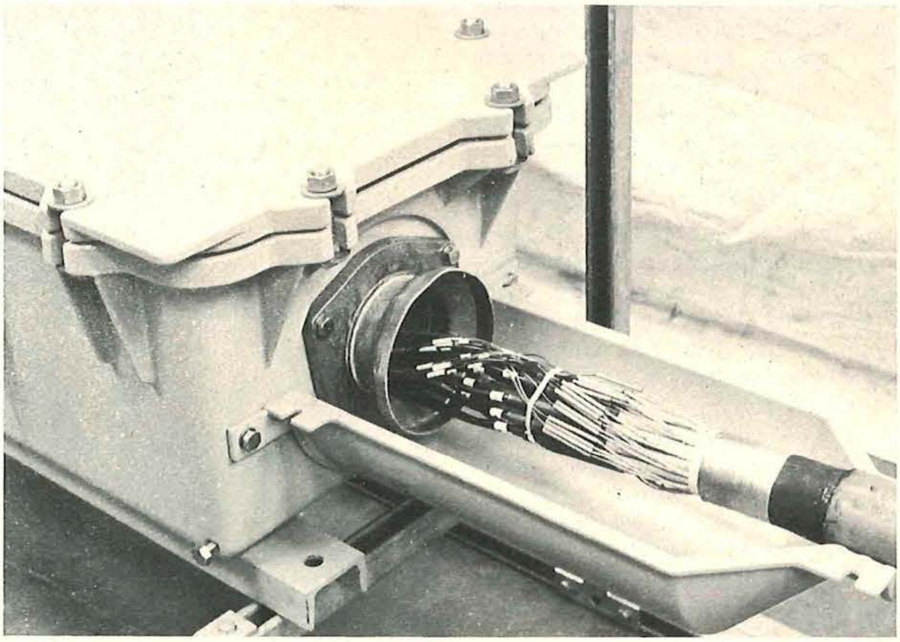
Furthermore the manholes required to house the 60 MHz amplifiers are much larger than those required for other coaxial transmission systems. Bearing in mind that the amplifiers are required nominally every 1.5 km along the route and the considerable congestion underground, it will be readily seen that finding suitable sites for the manholes can present major problems.

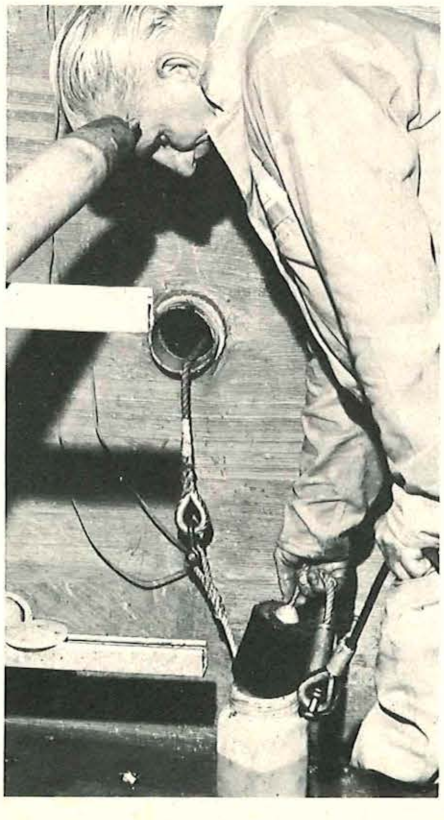
The three main points described in this article give only a broad outline of the differences between planning 60 MHz and other routes. The need to meet the requirements means that new duct will have to be provided throughout the length of the 60 MHz cables. This is not the case for other trunk cables as a new cable normally follows an established route for much of the way and duct is usually available over a large proportion of the route.

The 60 MHz cable network will require over 400 km of duct. To plan and provide such a long duct route requires a great deal of work and this, coupled with the many new practices involved has made it necessary to set up groups dealing solely with 60 MHz work in Telecommunications Headquarters and in some Telephone Areas. Planning the optimum route to meet the requirements has been an arduous task for the Regions and Areas involved. Many changes have had to be made to planning guide lines as a result of experience gained during the early stages of planning, but the lessons learned will smooth the way for future 60 MHz cable routes and installations.

Constructing the route and laying the cable, with all the precautions against interruptions which must be taken into account, will be costly despite the savings resulting from long-length cabling. The 60 MHz cables are, however, the most economic way of catering for the expected growth in traffic on principal trunk telephone routes over the coming years, and they represent a significant step forward in the augmentation of the country's main (trunk) telephone network.

Mr D. W. Gray is an Executive Engineer in Network Planning Department at Telecommunications Headquarters. He is a member of the group responsible for planning inter-city, high-capacity cables.





Amplifiers needed to boost the signals carried over the new cable will be housed in water-tight cases installed in manholes. In the top picture part of the amplifier case has been removed to show how the cable is connected to the amplifier. Various types of manhole were installed in trials, and above is a pre-fabricated concrete type.

Left: In a manhole on a trial 60 MHz cable route liquid paraffin is applied to a brush which is pulled through the length of the duct just before the cable is installed.

Helping the police

DA Tidswell
& D Walker

THE POST OFFICE is helping the police with their enquiries. Staff in the London Telecommunications Region are co-operating with the Metropolitan Police to set up an automatic telephone network linking all its main establishments. The network has been designed to replace an existing, largely manual system with one better able to cope with the requirements of a modern police force. It will provide fast communication over private lines, with alternative access on the public telephone network, and serves both operational and administrative needs.

More than 260 police stations and allied buildings in the 770 square-mile Metropolitan Police District, including its famous headquarters at New Scotland Yard, are to be connected to the new network. The introduction of automatic service will not only speed communication between these establishments but also give a high degree of security. When fully operational, it will enable calls to be made between any two telephones on the network by dialling not more than seven digits, and without involving an operator. Work is already in hand, and two of the 12 communication switching centres being established for the network come into operation this Autumn.

Planning of the new network followed the setting up of a working party in the early 1960s to consider telecommunications requirements for the new headquarters building of the Metropolitan Police. These needs were met by the installation of a large automatic exchange (PABX 3) at New Scotland Yard. The working party, consisting of members from the Metropolitan Police, Post Office and Home Office, then started a study of telecommunications requirements for the whole District.

The Metropolitan Police District is made up of 23 Divisions. Each Division has a Divisional headquarters station, together with two or more sub-Divisional stations and a number of Sectional police stations serving defined areas. New Scotland Yard is the centre of the existing private telephone network, and inter-switchboard circuits connect every Divisional station to Scotland Yard and to their sub-Divisional units. Sectional police stations are linked to either the nearest sub-Divisional or Divisional

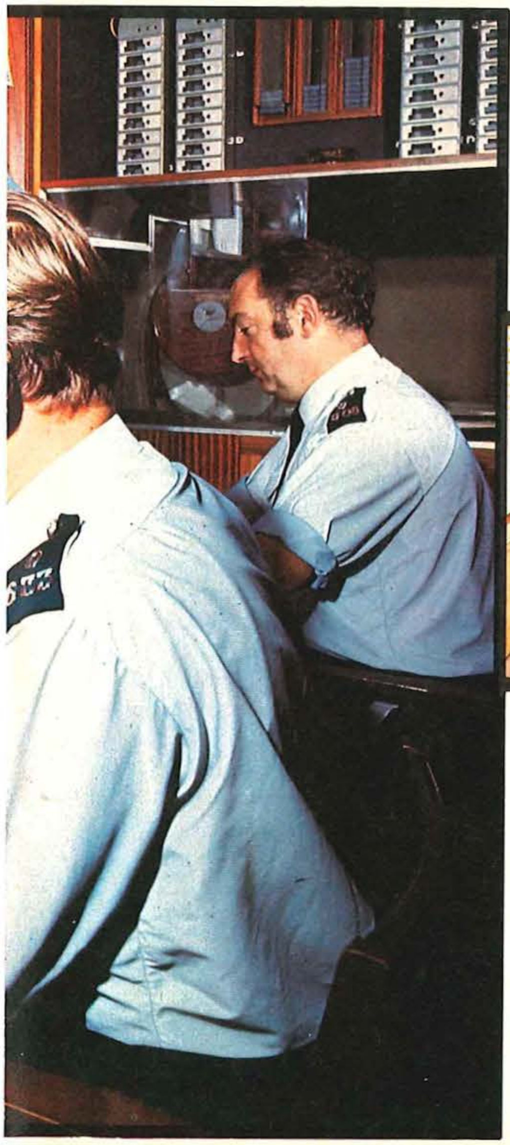
with their enquiries

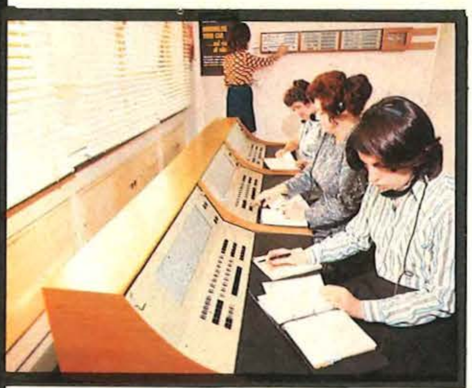
station. Private circuits are also used to interconnect some Divisional or sub-Divisional stations with neighbouring Divisions, or county police forces in surrounding areas.

Telephone installations vary at each location, although a degree of standardisation has been aimed at in recent years. At Divisional and sub-Divisional stations modern, small manual switchboards (PMBX 4) have replaced older manual types. Small automatic exchanges (PABX 5 or 6) are favoured at Sectional stations because they relieve police officers from switchboard duties, and recently other automatic exchanges (PABX 1) have been used where a greater number of lines or extensions has been required. Every installation is also served by public exchange lines, and the numbers are usually published in the public telephone directories.

Ever increasing use of telephone communication by the Metropolitan Police is imposing a load upon this largely manual system for which it was not designed. For example, a police officer at a Sectional station requiring a call, say, to New Scotland Yard must first request his own switchboard for a line to the sub-Divisional station, then ask the operator there for a line to the Divisional station. Finally, an operator at the Divisional station connects the call to the required Scotland Yard extension. This means that the call cannot be set up if any of the necessary links are engaged, forcing the officer to start the whole call routine again.

With the new, automatic network, the officer will be able to dial such a call direct. Facilities are also being provided to enable callers from outside the network to dial extensions provided they know the numbers, thus reducing the number of operators required. To provide service by the present system at all police stations, most of which must be manned 24 hours a day, requires some 350 full-time and 600 part-time operators. Police officers also have to man switchboards at certain times. The new network will eliminate the need for operators at every station. Only 150 full-time staff, centrally located at the 12 communication switching centres, will be required to handle calls from outside the network, deal with enquiries, and to provide assistance on some police telephone calls.





Above: Cordless manual switchboards will be installed at communication switching centres in the new network. Operators will handle calls from outside the network, deal with enquiries and provide assistance on some police calls.

Left: A communications control unit in the operations room at Wembley police station. In the new Metropolitan Police telephone network these desk top units enable telephone, radio and telegraph circuits to be concentrated at one point.

New Scotland Yard will be at the centre of the network, acting as a central routing point for calls between the communication switching centres. The groups of circuits linking switching centres to New Scotland Yard will allow intercommunication of any two extensions on the network at an acceptable grade of transmission and service.

With one exception, each switching centre has been planned to serve two Divisions of the Metropolitan Police. Located at one of the Divisional stations, a centre will be equipped with a large automatic exchange (PABX 4), cordless manual switchboard and enquiry positions. Connections from the centre to every police building within the boundary of the two Divisions it serves will be by means of internal and external extensions. Where the distance between the switching centre and some buildings is too great intermediate "satellite" switching equipment (PABX 4) is being provided at police stations suitably located in the network.

Outgoing public exchange line service will be available to extensions through their switching centre or satellite switching equipment. To enable callers outside the network to dial extensions, each switching centre will have direct dialling in (DDI) lines from a public telephone exchange.

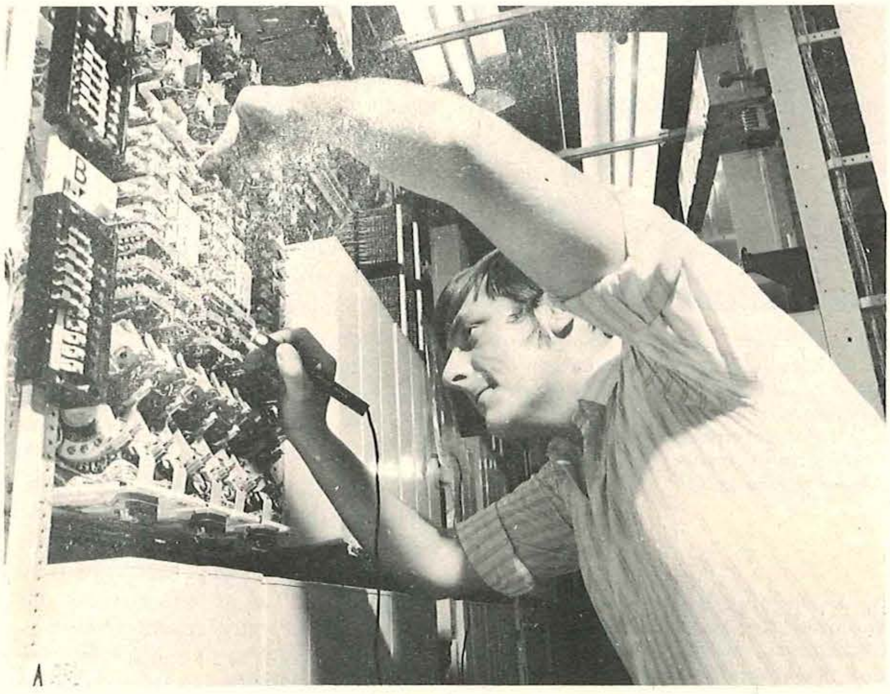
A group of lines in the DDI range is to be allocated for public access to the switching centre switchboard. All police stations served by the centre will be listed under one number in the public telephone directory so that a call to any station is first received at the central switchboard. Having ascertained the nature of the call an operator can then put it through to the appropriate station officer, or pass it to an enquiry position. Staff at the switching centres will be able to deal with many routine enquiries, such as the location of streets, etc, ▶

leaving station officers free to handle more essential calls.

For use in emergency conditions, a system is being incorporated at each switching centre in which the least essential extensions can be quickly disconnected. Called a preference system, it is controlled by keys in the operators' room and can be used to "turn off" a pre-selected number of extensions. It could be brought into operation, for example, in the event of a major power cut to avoid overloading standby generators which would be used to operate the switching equipment.

An automatic telephone network of the type and size designed for the Metropolitan Police obviously poses some technical problems. A call from an extension in one Sectional police station to an extension in another Section may have to be routed over six links. This could impair speech transmission, causing the call to fail, but by the careful adoption of transmission standards it will, in fact, be no worse than that experienced by any inland call over the public network. Dial pulses, also when routed over as many as six links, could be distorted and cause a call to be misrouted. To overcome this problem pulse regeneration equipment – which receives incoming pulses and sends out new ones – is being provided at the communication switching centres.

Mr David Tidswell, one of the authors, demonstrates the preference system being installed at the communication switching centres for use in emergency conditions. By turning one of the keys a pre-selected number of telephone extensions from the centre can be disconnected.



Pulse regeneration equipment is tested at a communication switching centre. The equipment enables calls to be routed over as many as six links.

Siting of the switching centres and satellite PABXs has been carefully planned by the Post Office to keep external extensions to a suitable length. The availability of DDI, local public exchanges and local line plant also had to be taken into account. Traffic and economic studies have assisted in siting the switching centres, and adequate planning time has enabled the Post Office to provide DDI or line plant in most cases to meet the Metropolitan Police ready-for-service dates. Where this has been impossible the Post Office has used other means, such as out-of-area service for the DDI and satellite switching equipment or small, standard PABXs to act as satellites.

The availability of suitable accommodation at police buildings also had to be taken into account in siting the PABX equipment. This has proved difficult at some police stations, and purpose-built accommodation is being provided in station yards. Some switching centres will have to be delayed until new stations are built

The main operational area in a police station requires telephone, radio and telegraph circuits to be concentrated at one point, and a communications control unit has been designed for this purpose, with Post Office help. Basically it consists of a key and lamp panel built into a special desk-top unit provided by the police. A PABX extension circuit and radio transmitter/receiver set circuits are terminated on the key and lamp panel, and a combined hand/head set can be switched to either the radio or telephone circuits. A lamp on the panel also indicates when messages are received on the teleprinter, which is normally located in a special cubicle.

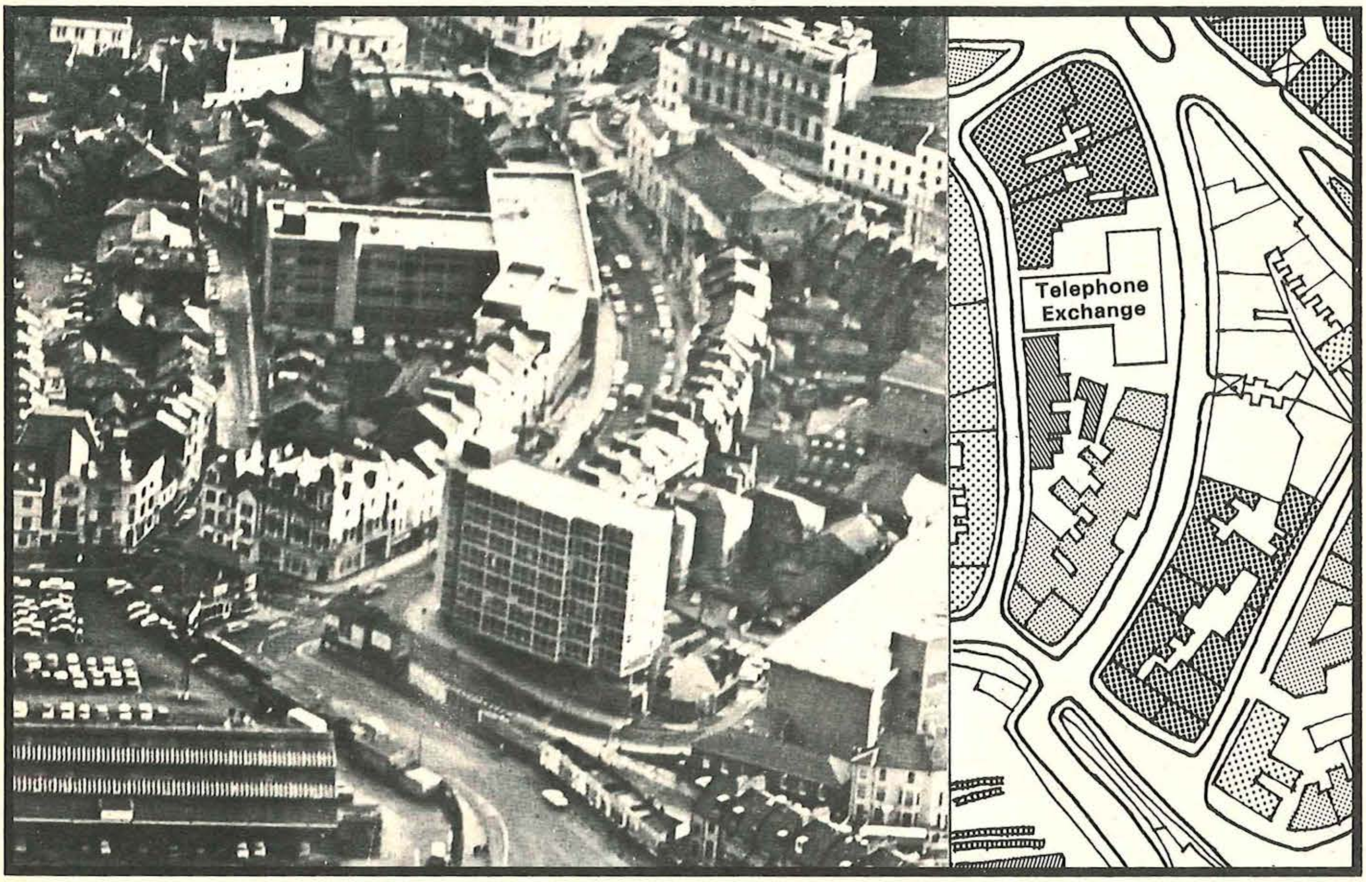
Co-ordination for implementing the Post Office aspects of the new network, and transmission standardisation, are the responsibility of Headquarters Divisions of the London Telecommunications Region. Sub-committees have also been formed with General Managers in Telephone Areas as many new cables and ducts have to be provided, as well as complete re-wiring at the various locations for internal distribution.

Mr D. A. Tidswell is on secondment from the Post Office to the Metropolitan Police where he is responsible for the District's telephone and telegraph network.

Mr D. Walker is a Senior Sales Superintendent at London Telecommunications Region Headquarters. He is acting as liaison officer with the Metropolitan Police on telephone network matters.

Why build it here?

DJ Kinder



It is often necessary to site a telephone exchange in the heart of a town or city, although planning authorities may prefer it elsewhere. The position of existing plant and equipment and good access to roads are among the various factors involved. The illustrations to this article are taken from a booklet "Telecommunications Buildings and Environmental Planning" which is being distributed to all local and planning authorities to give them a better understanding of Post Office proposals.

LAND WHICH will provide about 800 sites for Post Office telecommunications buildings will be purchased over the next five years. In the same period the Telecommunications Business will spend £450 million on the construction of new buildings, extensions and the installation of heating and ventilating plant. All these sites and buildings are needed, in suitable locations and at the right time, to meet expanding demand for service in industrial and residential development areas.

Delays in acquiring a site or in obtaining planning permission to develop it will inevitably retard the provision and improvement of telephone service for a community. At least three years must be allowed to acquire a site for a large telephone exchange and it can take seven or eight years to plan, build, equip and bring the exchange into service. Of the overall period, planning the building takes about two-and-a-half years, and in complicated projects it could be even longer. A large part of this time is occupied in obtaining planning approval from the local authority.

Before the Post Office became a Corporation in 1969 its building proposals were simply notified to local authorities. Wherever practicable their wishes were met, but the Post Office as ▶

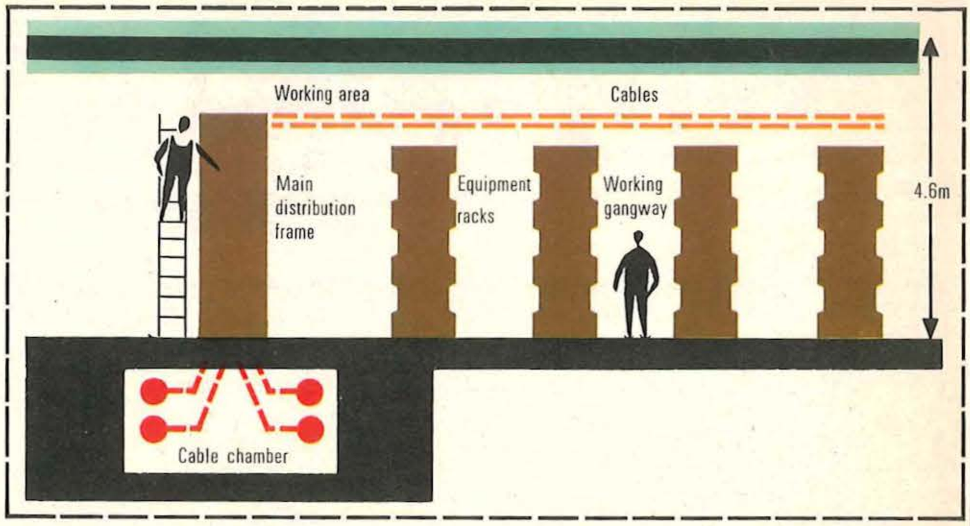
a Government Department did not have to obtain formal planning permission. On gaining Corporation status, however, it became statutorily bound to conform to planning law. Relations with planning authorities are now more formal, and negotiations may often be protracted. The main problem is that telecommunications buildings, particularly telephone exchanges, are generally large and need to be located in centres of communities, often conflicting with local environmental conditions.

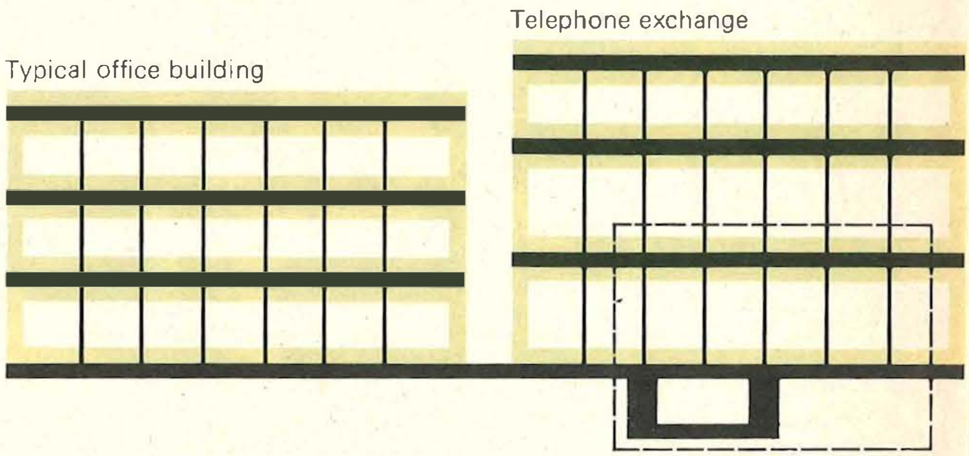
To give local authorities a better understanding of its planning proposals the Telecommunications Business has produced a booklet which explains the special reasons governing the siting and design of telephone exchanges and other major installations. Produced in consultation with the Property Services Agency, the Business's professional agents for sites and buildings, the booklet ("Telecommunications Buildings and Environmental Planning") is being distributed to all local and planning authorities It illustrates typical buildings and deals with points likely to be raised by planning officials and committees when considering Post Office planning applications.

Factors which must be considered by the Business when planning sites and buildings and problems created by local environmental demands are described in this article.

Telephone exchanges, ranging from small automatic types in villages and small towns to large trunk and switching centres, are the main types of building for which sites and planning permission are required. Exchange buildings are provided initially to meet requirements for between 10 and 20 years, but sites large enough to meet requirements for the next 50 years are needed. The Post Office may therefore want to buy large pieces of land and develop them only in stages, but local authorities sometimes require the whole development to be built at the outset. This is expensive and creates problems in making use of space which will be spare for some years.

To make efficient and economic use of existing ducts, cables and equipment, a telephone exchange must be as near as possible to the centre of the area it will serve. There must also be good access to roads for deliveries of stores and equipment. These factors often mean that the site should be in a town centre. Sites adjacent to industrial developments such as chemical works, smoke or dust producing activities or high-power electric cables are not usually suitable. Environments of this type can severely affect the working of exchange equipment. Exchanges must be designed to meet the precise requirements of modern telephone equipment. Their proportions therefore differ from those of, say, office buildings and they may conflict with environmental conditions laid down by planning authorities. Requirements include a floor-to-floor height of 4.6 m (15 ft) and adequate structural strength to house and support heavy equipment. A closely controlled internal environment is also needed to provide sufficient heating for staff and cooling for exchange equipment.





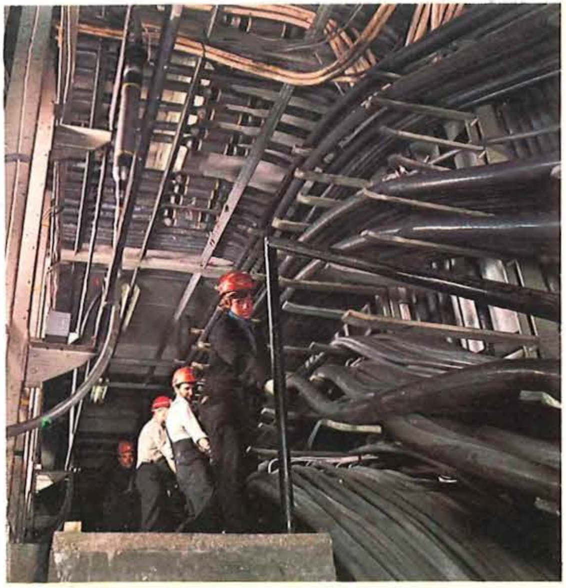
Ideally an exchange should be cube shaped to provide an economic layout of equipment and the easiest design for future extension. Windows should be restricted to about 20 per cent of the total wall area to limit the "greenhouse" effect caused by heat from the sun's rays on glass. Tower blocks are not favoured for a variety of technical reasons, but may have to be provided if the site is restricted in size.

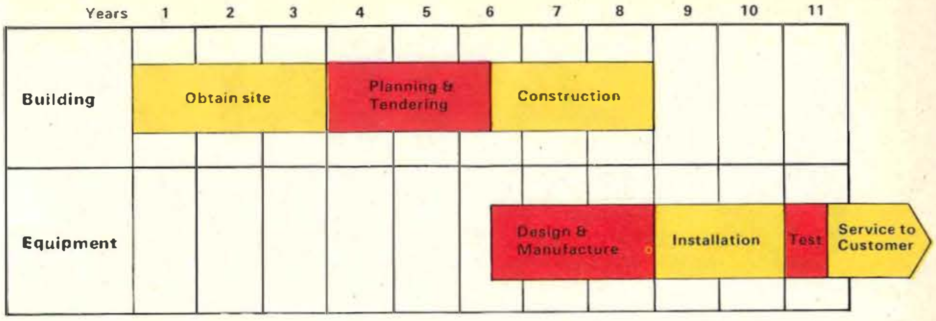
In designing a new exchange building the nature of its surroundings must be considered. As far as possible, within the constraints of operational needs and costs, buildings are designed to blend with the environment. This is especially true where they form part of an extensive development plan for a town and in villages of exceptional beauty.

Extending a building is the most economic and efficient method of providing additional exchange capacity, even where there is insufficient room on the existing site and adjacent land has to be acquired. Providing a new building elsewhere involves heavy capital expenditure on ducts and cables, which could cost as much as £500,000 for every kilometre (£800,000 per mile). The extra equipment needed in a separate exchange also increases the amount of new building required.

Buildings are planned for horizontal rather than vertical extension because structural support is less costly and interference with working equipment is kept to a minimum during building operations. The design and siting of the original building or extension must therefore take into account the fact that the whole site may ultimately be used.

The type of facilities required at telephone engineering and service centres can lead to difficulties in obtaining a site which meets local environmental conditions. These centres serve as bases for staff who install and maintain telecommunications cables, plant and customers' apparatus. They provide a stores depot and small equipment

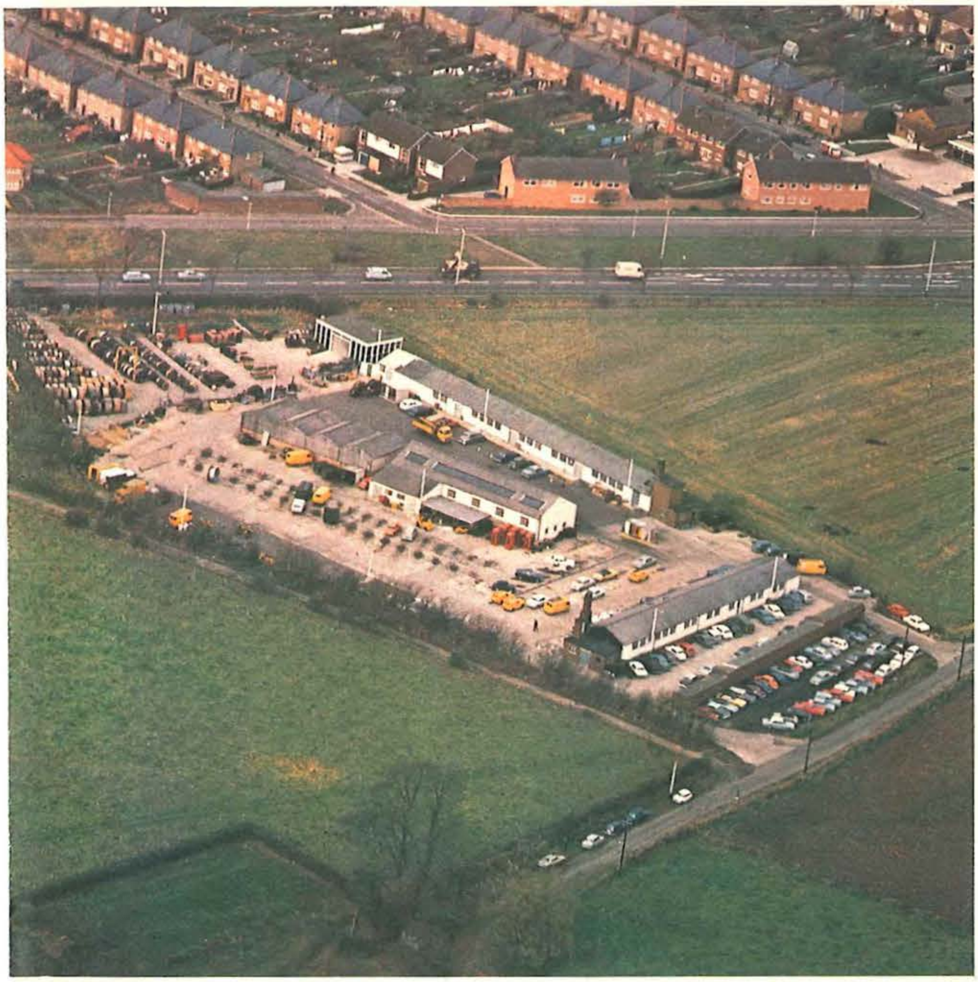




Above: Typical schedule for setting up a large telephone exchange.

Far left: The design of a telephone exchange, showing how the proportions differ from those of a modern office building.

Left: Cable chamber located below the equipment room in a telephone exchange.



Sites for telephone engineering and service centres should normally be adequate to meet present requirements plus double the expected growth over 20 years. As shown here, the centre should have good access to the main road network, and suitable entry and exit points for vehicles.

maintenance facilities, and often also contain a motor transport workshop for servicing telecommunications vehicles. The site should therefore be as near as possible to the centre of the area served to keep vehicle travelling time and costs to a minimum. There must be good access to the main road network, as well as suitable entry and exit points to allow for the easy flow of vehicles.

A site for one of these centres should be adequate to meet current requirements plus double the forecast 20-year growth, and usually covers an area of 0.6 to 1.2 hectares (1.5 to 3.0 acres). The centres are designed initially to meet requirements for 10 years and not more than 20 years, and buildings are preferably single-storey. Where land costs are high or site space is restricted multi-storey accommodation may have to be provided.

Post Office radio stations present a different environmental problem. The towers carrying aerials at these stations are a prominent feature of the skyline and close liaison on their design is maintained with the Royal Fine Art Commission. The most common type of aerial-supporting structure is a lattice-steel tower, but large radio stations may have concrete towers.

Most radio stations provide long distance point-to-point communications for trunk telephone calls and television programmes. Generally they must be located on hill tops in rural areas to provide "line of sight" transmission paths which clear intervening high ground or other obstructions between adjacent stations. Where practicable sites are shared with other authorities requiring radio facilities.

The height of radio station towers depends on the clear "line of sight" path and varies from about 30 to 120 m (98 to 390 ft) with a small single-storey building close to the foot of the aerial. The size of the whole structure depends upon the ultimate number of aerials to be carried, which is determined by the building's use as a relay, junction or terminal station.

Clearly everyone concerned with the planning, development and ultimate use of telecommunications services will benefit from close liaison between Post Office managers and local authorities. By such co-operation the Post Office can become aware in good time of future developments in local areas which will require telecommunications services. At the same time local authorities can take account of Post Office needs for sites and buildings to provide these services when they consider their own development plans.

Mr D. J. Kinder is a head of section in the Accommodation Policy, Procedures and Programming Division at Telecommunications Headquarters. His responsibilities include liaison with local planning authorities.

CANTAT 2 GOES TO SEA

THE BIGGEST single submarine telephone cable across the Atlantic will be completed this year. Capable of handling more than 1,800 conversations simultaneously, it will carry more calls than all the existing transatlantic telephone cables combined.

The new cable system, CANTAT 2, is being provided to help meet the massive growth of telecommunications between Britain and North America. Its undersea route linking Britain and Canada will run about 2,800 nautical miles between the shore ends at Widemouth Bay, Cornwall, and Beaver Harbour near Halifax, Nova Scotia.

The cableship Mercury, on charter to the Post Office from Cable and Wireless, left Southampton in June to lay the first 200 miles of the deep-water section from Widemouth Bay. The ship is laying more than 2,600 nautical miles across the North Atlantic in five operations, returning to Southampton four times to reload with cable sections.

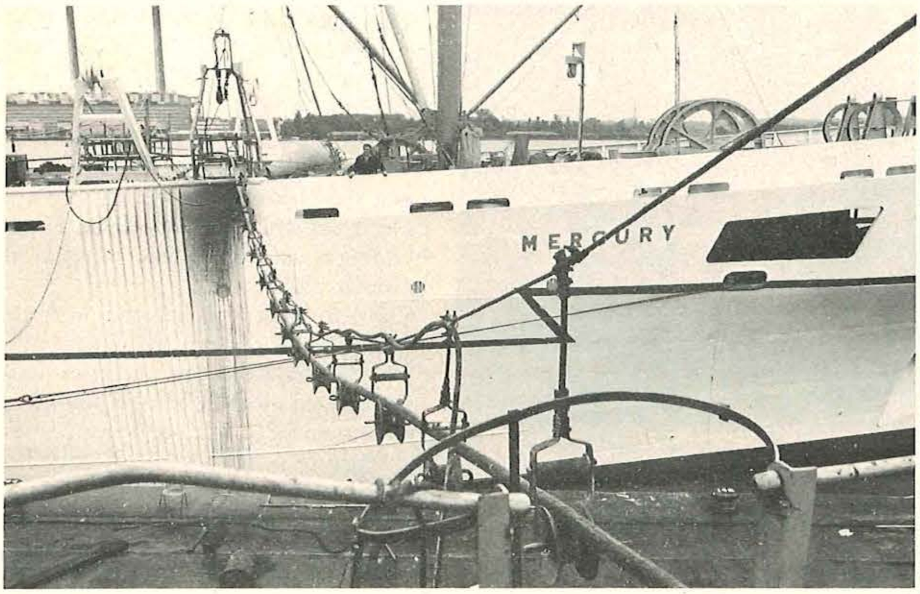
Earlier this year the Post Office cableship Ariel carried out the first step in the laying operations. With the aid of divers the ship laid the first mile of the UK shore end at Widemouth Bay, where it was connected to the national network. The seaward end of the cable was sealed and dropped to the seabed ready for the start of major cable laying.

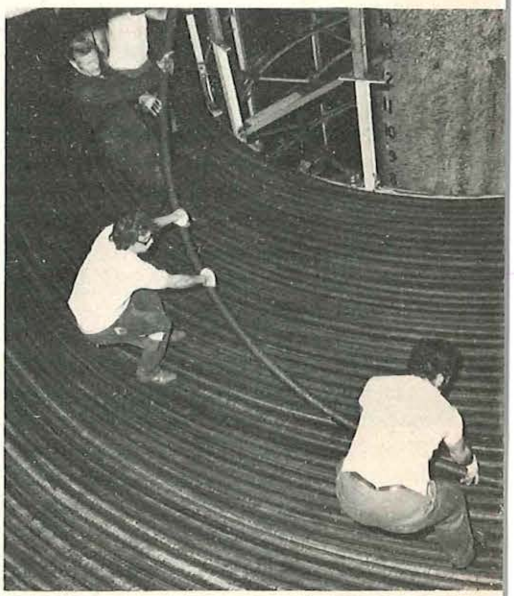
At a point 170 miles out from Nova Scotia Mercury will link the cable with a section laid from Beaver Harbour by the Canadian Coastguard Ship John Cabot. The final link-up will take place in mid-December when Mercury is scheduled to complete splicing of the cable into one continuous length. The CANTAT 2 system will be completed and in service next year.

Both cableships laying the major sections of cable have been fitted with a new design of linear cable engine developed by the Post Office to speed laying. The engine enables cable and repeaters (spliced into the cable at intervals to amplify the telephone signals) to be paid out in a continuous line. Previously the fact that the torpedo-shaped repeaters could not pass around the drums or sheaves used to pay out the cable slowed laying operations. The linear engine enables the cableship to proceed at a constant speed, and Mercury is now able to lay repeaters at about five knots compared with her previous speed of one or two knots.

The route of CANTAT 2 picks a careful path down the slopes of two continental shelves and through the valleys and passes of the mid-Atlantic ridge. Surveys of the ridge were carried out in 1971 by John Cabot and the French cableship Marcel Bayard, with Post Office marine specialists on board. Detailed information about the Atlantic seabed was also obtained.

To enable the cable route to be charted with extreme accuracy Mercury has been fitted with a navigation system, called Hydroplot, which uses US Navy navigation satellites to pinpoint the ship's position to within 300 ft. A computer integrates all the ship's other navigation aids and cable-laying information and provides a visual display unit for the navigator. When CANTAT 2 has been laid the Hydroplot system will be transferred to the Post Office cable-





Above: A section of CANTAT 2 cable goes aboard the cableship Mercury at Southampton. The ship is laying more than 2,600 nautical miles of cable across the North Atlantic in five operations.

Above right: Armoured cable for the shallow water parts of CANTAT 2 is loaded into a cable tank on board the Mercury.

Right: Linear cable engines have been fitted aboard the two ships laying the major sections of CANTAT 2. The engine draws cable from the ship's tank and pays it out in a straight line for laying in the ocean. Pairs of wheels on the engine's traction system push apart to allow the torpedo-shaped repeaters, spliced into the cable, to pass through without interruption.

ship Alert, which is responsible for maintaining transatlantic cables.

The £30 million CANTAT 2 system, financed and operated jointly by the Post Office and the Canadian Overseas Telecommunications Corporation, is to be used for communication between the UK and mainland Europe, and Canada and the USA. Telephone calls between Britain and Canada have risen from 135,000 in 1962 to their present level of more than one million a year, and will increase to nearly six million calls a year by 1980. In the same period calls between the UK and the USA have risen from 500,000 to more than 4½ million, and by 1980 will have reached 24 million a year.

CANTAT 2 will be the third submarine telephone cable linking Britain and Canada, its laying coming 17 years after the first transatlantic cable, TAT 1, was opened. Until then only telegraph cables spanned the Atlantic and telephone calls were sent by high frequency radio. TAT 1 could originally carry only 36 calls, and the second UK-Canada telephone cable link, CANTAT 1, came into service in 1961 with 80 circuits. The new cables will have 1,840 circuits.

The application of modern transmission techniques in the latest cable has also reduced the cost of each circuit to £16,500. In TAT 1 each circuit cost at the time £294,000, and those in the first CANTAT cable cost £100,000.

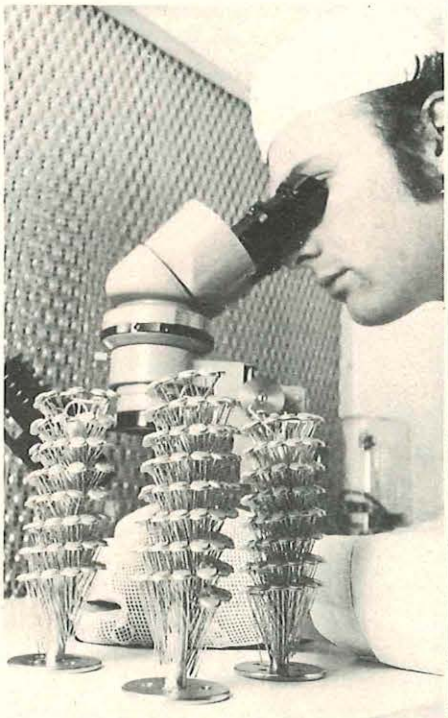
The 14 MHz cable for CANTAT 2, manufactured at Southampton by Standard Telephones and Cables (STC), is predominantly of lightweight design, less than 2 in. diameter and weighing no more than five tons a mile. A steel rope running through the centre of the cable acts as the strength member. The centre conductor of copper tape is firmly shaped around the rope and welded along its length to form a tight, continuous sheath. This is then coated with polyethylene. After cooling the polyethylene is shaved to a precise diameter and checks are made to ensure that the centre conductor remains exactly in the middle. An aluminium outer conductor is then folded around the centre section and also coated with polyethylene.

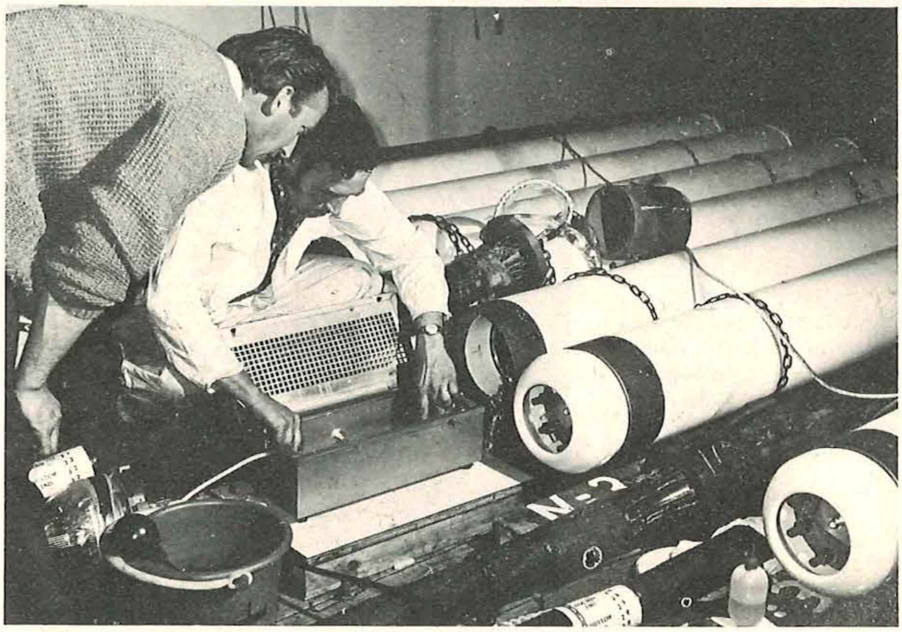
This lightweight cable, developed by the Post Office and STC, is being used over the majority of the new cable route. For the shallow water parts of the lay where risk of damage is greatest – normally from the shoreline to 300 fathoms – the basic lightweight cable is armoured with steel wire wound around the cable between layers of jute and bitumen.

CANTAT 2 will have 473 repeaters, spaced at about 6-mile intervals. The repeaters are sleeved in polyethylene ▶

A clinical operation

The CANTAT 2 repeaters, containing a total of some 2,800 transistors, have been designed to give a trouble-free life of more than 20 years. The smallest speck of dust will contaminate a transistor, and their production – together with that of the repeaters – is carried out in an atmosphere of clinical cleanliness. Staff dress like surgeons to avoid contaminating the components.





Top left: Batches of "headers" – tiny gold-plated beds on which the transistors will rest – are examined for flaws at the Post Office Research Department at Dollis Hill.

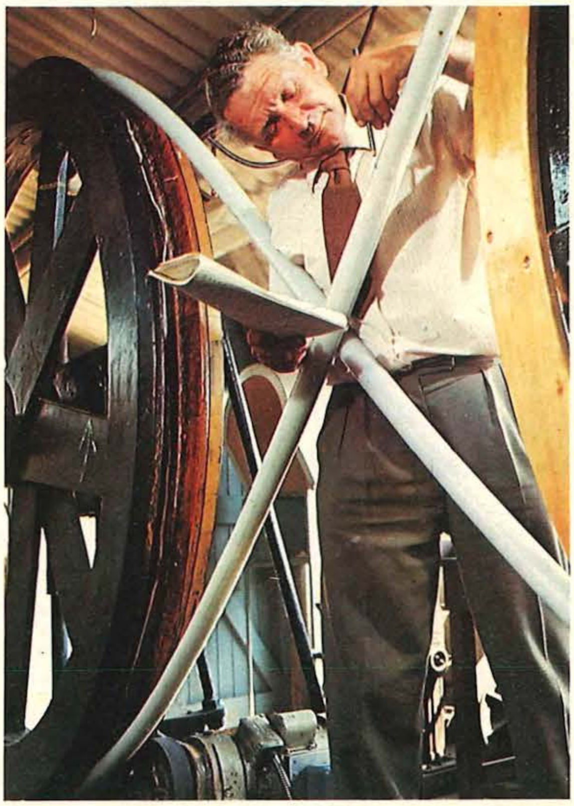
Top right: A repeater is assembled at the Greenwich factory of Standard Telephones and Cables Ltd in an area known as the "dairy".

Bottom: Repeaters are spliced into armoured sections of CANTAT 2 cable aboard the cableship Mercury. The centre conductor is welded to the corresponding conductor on the special cable termination. After jointing, the weld is covered with polyethylene and inspected by using X-ray photographic techniques.

Endurance tests

Extensive research has been carried out at Dollis Hill to ensure that the CANTAT 2 cable will be able to withstand the rigours of life on the Atlantic seabed. This research has included testing lengths of cable to destruction.

Above: In the deepest parts of the CANTAT 2 route the cable will be subjected to an undersea pressure of 3 tons per sq in. Here a section of cable is prepared for testing in a device which creates in the laboratory pressure conditions encountered on the seabed.



Right: An experimental length of the cable undergoes stress testing. The figure-of-eight, reverse bend test is used to detect wrinkling of the cable.

and hermetically sealed in a brass cylinder with dry nitrogen. They are then encased in steel housings to withstand undersea pressure, which in the deepest parts of the Atlantic route will be 3 tons per sq in.

Splicing cable into the repeaters takes place on board the cableship. The ends of the cable sections remain outside the ship's storage tanks and the repeaters are joined to specially prepared cable terminations. The centre conductors of the repeaters are welded to the corresponding cable ends and polyethylene is formed around the joins by a portable mould. X-ray photographs are then taken of the joins to check their quality.

Some 2,800 transistors will be used in the CANTAT 2 repeaters, each with a design life of at least 25 years. The transistors have been developed and produced by the Post Office Research Department at Dollis Hill, and to ensure their reliability a further 18,000 – which will never be used operationally – have been exhaustively tested.

Great attention has been paid to eliminating causes of failure in the transistors, the development and production of which last year won a Queen's Award to Industry for the Research Department. They are made in "clean" areas with a filtered and conditioned air supply, and every person in these areas wears special clothing to avoid contamination of the product. A new method of bonding the very fine lead wires to the semiconductor chip overcame a hitherto dominant weakness, and over 100,000 such bonds have withstood testing. Already this type of transistor, on the seabed in earlier cable systems, has achieved 65 million device-hours without a single failure.

CANTAT 2 will also have 31 equalisers spaced at about 90-mile intervals in the cable and placed in pressure housings similar to the repeaters. Equalisers are electrical circuits used to balance out small differences between the gain characteristics of repeaters and the loss characteristics of cable sections. The electrical characteristics can be affected by sea temperature and pressure, and equalisation compensates for differences between the predicted and actual change.

Inserting equalisers into the system approximately every 15 repeaters ensures that the performance of telephone circuits over the whole of CANTAT 2's frequency range will be virtually identical. The equalisers are initially assembled at the cable works and completed at sea. As the system is laid it is continuously monitored and tested and the data collected is used to design and build the final circuitry for the equalisers.

Flashback to the moment of rescue for the brave crew of Pisces III. Divers open the hatch as the submarine is hauled to the surface by the rescue ship John Cabot.

Burial at sea

The dramatic rescue of two crewmen trapped on the Atlantic seabed in their miniature submarine Pisces III attracted world-wide attention. Their task on the seabed was to bury sections of the CANTAT 2 cable as a protection against damage.

One of the biggest dangers to undersea telephone cables is from trawlers whose fishing gear may accidentally cause damage while being towed along the ocean floor. Measures were therefore planned to protect the new cable where it crosses the fishing grounds of the continental shelves.

The Canadian Coastguard Ship John Cabot, equipped with a seabed plough, has buried a 170-mile section of the cable beneath the Canadian continental shelf. A Pisces submarine assisted the ship by burying the repeaters in this section.

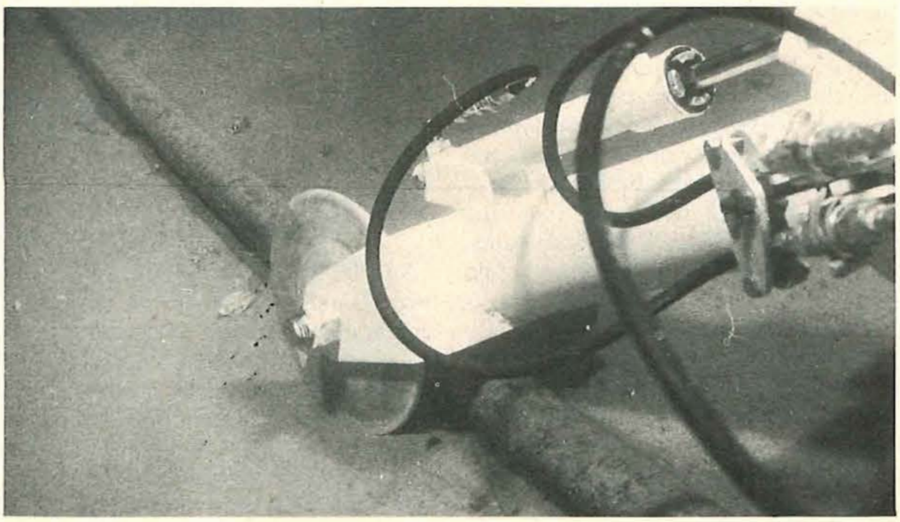
Originally, heavy armouring of the UK end of CANTAT 2 was considered to be sufficient protection. Later surveys carried out by the Post Office showed clear signs of increased trawler activity in the area and it was decided to bury the high-risk sections.

The 19 ft long Pisces III first buried a six-mile section of the cable 60 miles west from the UK shore end at Widemouth Bay. Her two-man crew used high pressure water jets to excavate a trench in the seabed beneath the cable. The water jets are supplied from a 5 hp pump held by a manipulator arm on the submarine, and a minimum depth of 8 in is trenched, into which the cable drops. Batteries of floodlights on the submarine illuminate the seabed, and the crew are able to watch operations through port-holes.

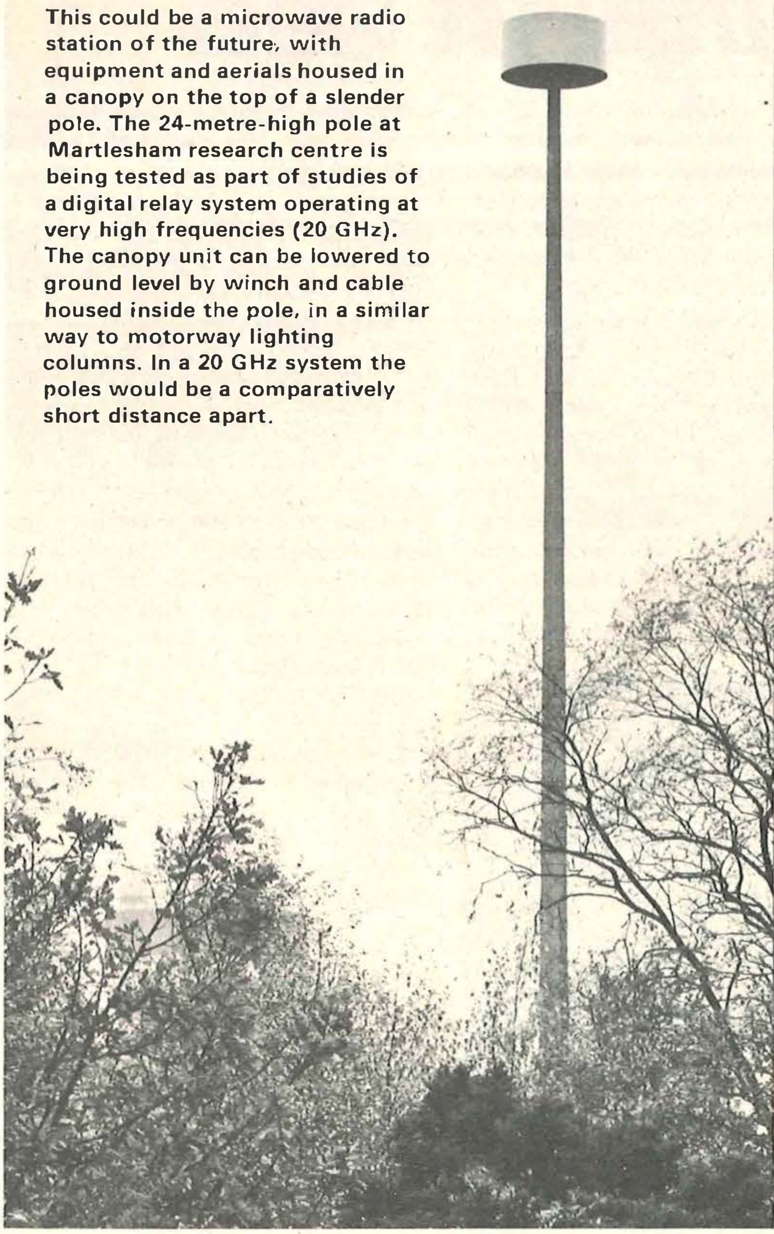
When the six-mile section had been completed Pisces III was moved to a point 250 miles out from Widemouth Bay where the UK continental shelf drops sharply away into deep water. Here the plan was to bury 12 miles of cable at depths ranging from 1,200 ft to 3,000 ft, then turn back and bury a further 25 miles on the shallow part of the continental shelf. Pisces III had completed six dives and buried two miles of cable when the accident occurred.

The Post Office plans to continue burying CANTAT 2 when Pisces III is ready and weather conditions suitable. It is hoped to start operations before the end of the year.

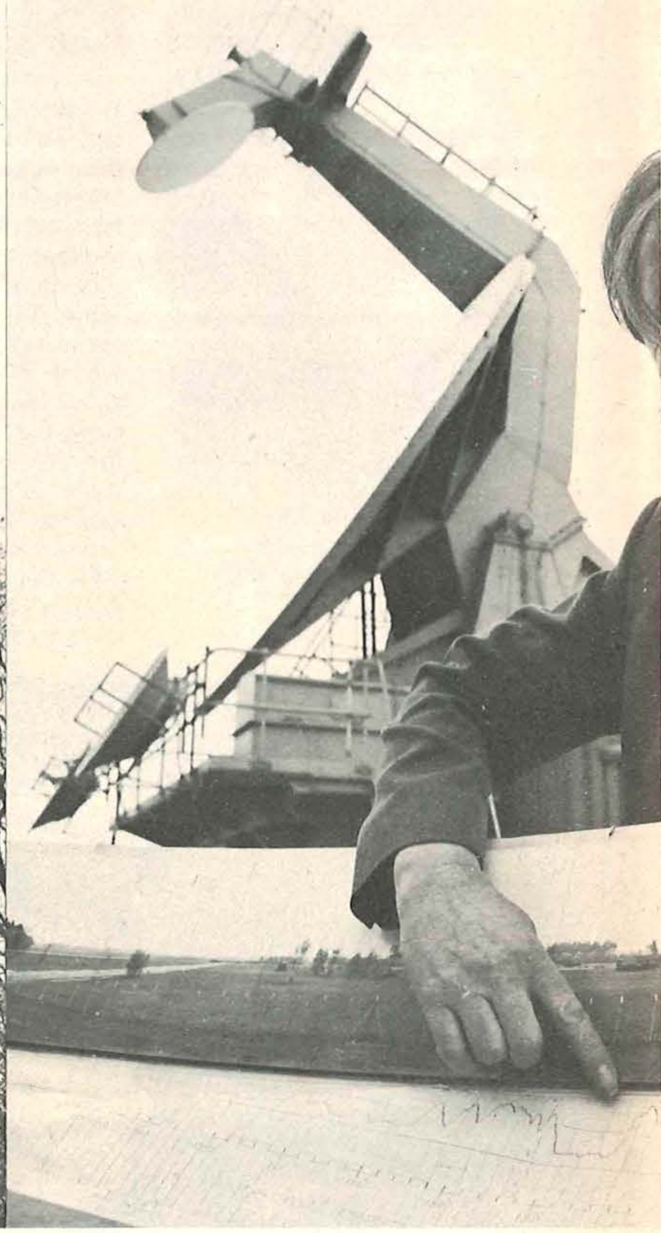
Above: The normal recovery operation when Pisces III was brought aboard her mother ship, Vickers Voyager, during earlier cable laying operations.



Right: A section of CANTAT 2 is buried in the Atlantic seabed. Equipment attached to Pisces III guides a high pressure water jet along the cable path. The picture was taken from the submarine.



This could be a microwave radio station of the future, with equipment and aerials housed in a canopy on the top of a slender pole. The 24-metre-high pole at Martlesham research centre is being tested as part of studies of a digital relay system operating at very high frequencies (20 GHz). The canopy unit can be lowered to ground level by winch and cable housed inside the pole, in a similar way to motorway lighting columns. In a 20 GHz system the poles would be a comparatively short distance apart.



20 MILLION MILES OF MICROWAVES

WJ Bray

A version of this article by the Director of Post Office Research originally appeared in The Guardian.

MICROWAVES have played a significant role in Post Office telecommunications since the early 1950s when developments stemming from wartime radar made it apparent that they offered a valuable means for expanding rapidly the inter-city trunk routes as an alternative to buried coaxial cables. An important stimulus came from the need to provide a nation-wide network for distributing television signals, first between the BBC studios and their broadcast transmitters and later for the ITA (now the IBA). In this application the wide bandwidths offered by microwave radio relay systems were particularly advantageous for preserving the high quality of the television signals. Having created a microwave trunk network it was natural and economic to deploy it further to provide for the future growth of trunk telephony, for example, by adding equipment at existing radio relay stations.

Another major application of microwaves came with the advent of satellite communications by the launch of TELSTAR in 1962 and the establishment of the Goonhilly earth station. More recently work has been put in hand, in co-operation with industry, on the advanced development of an inter-city waveguide system providing up to one third of a million telephone circuits or the equivalent of 200 both-way television channels in a 50 mm diameter hollow pipe.

The role of microwaves in telecommunications is seen as an active and continuing one, with progression towards the use of even shorter wavelengths and larger system capacity,

At higher frequencies microwave signals can be seriously weakened by adverse weather conditions and the aerial pictured here has been built at Martlesham to study the effect of weather on radio transmissions to and from satellites. It will eventually work with a satellite placed in orbit specially for this purpose. Meanwhile it is recording radio noise from outer space as a measure of signal attenuation. Mr Dennis Knox, head of the Post Office aerial research group at Martlesham, is comparing a photograph of the surrounding area with a sound trace produced as the aerial scans the horizon. Buildings and trees are indicated by high signal loss.

together with advanced digital modulation methods to improve performance and solid-state devices to provide high reliability. These developments are expected to have special value, not only for meeting growth of inter-city trunk telephony but also to provide for a range of new services which may include fast data transmission, facsimile, Confravision (conference television), Viewphone (the picture telephone) and Viewdata (access to computer data banks and other information services).

The present-day network comprises a total of 165 radio relay stations generally using lattice steel masts or ferro-concrete structures on hilltops so that one aerial can "see" its neighbour. The hop lengths average about 40 km, but may occasionally be as long as 65 km. The radio equipment is normally housed in a single-storey building at the foot of the mast and is connected to the aerials by hollow metal tube waveguides. An exception is the PO Tower in London which provides the focal point of the network and from which television signals are sent to and from places as far afield as Inverness in the North, Folkestone for onward transmission to Europe and Goonhilly where the satellite service conveys signals to America and many other parts of the world.

These systems carry monochrome or colour television signals, or large blocks of telephone circuits (960 or 1800) assembled as an analogue frequency division multiplex somewhat analogous to the radio channels on an AM broadcast receiver. Nearly 10,000 miles of television channels are in service linking BBC and IBA studios with their transmitters throughout the United Kingdom. Some 10 million miles of telephone circuits are in use and this will be doubled in the next five years.

Microwave radio relay links have also proved of value for connecting to the main transmission network those places which are particularly remote or geographically difficult to reach by cable, for example in the Highlands and Islands of Scotland.

The television or multi-channel telephony signal is superimposed on a radio carrier wave using frequency modulation, a modulation method which minimises noise and distortion. The carrier frequency is in one of the bands allocated to the PO, typically 2, 4, 6 or 11 GHz. However, the frequency bands up to 11 GHz are almost fully utilised in several areas of the country, and future development will depend in considerable degree on the use of higher frequencies.

The equipment techniques involved have advanced rapidly during the relatively short history of the service. Modern equipment is smaller, more reliable and performs far better than that of even five years ago. The active components are all solid-state devices with the exception of the final power amplifier of the transmitter which uses a travelling-wave valve amplifier with an output power of a few watts. Even the travelling-wave tube may be replaced by solid-state devices offering greater reliability in the near future.

To cope with the growth of inter-city trunk telephony and provide for new services a range of new microwave radio relay systems is being developed, in addition to new designs of coaxial cable system. These will exploit digital modulation techniques – the use of "on-off" coded pulses to transmit telephone, data and visual signals. Digital transmission offers significant advantages compared with the earlier frequency-modulation/frequency division multiplex analogue systems, including lower costs, better performance and the ability to combine several different types of signal such as telephony, data and visual signals, in a common system.

Since an extensive microwave system already forms part of the existing trunk network, it is attractive to arrange for expansion of the network by using existing repeater stations with their radio masts and buildings, and to employ digital techniques.

As a first step, the development of a digital radio relay system operating at about 6 GHz has been carried out and a field trial is in hand on a section of the existing network. The 6 GHz system accommodates four radio frequency channels, each within a capacity of about 6 Mbit/s and two channels with a capacity of 2 Mbit/s. Although of modest capacity in terms of equivalent telephone channels (2 Mbit/s corresponds to 30 telephone channels) the system will have particular value for data transmission. It will operate over the same routes as the existing lower 6 GHz FDM analogue system, and by using the same aerials and feeders will achieve considerable cost saving. The first production systems are expected to be available by 1975.

Work is in hand on the development of a system operating at frequencies around 11 GHz, with digital rates of about 120 Mbit/s, corresponding to a television channel or some 1,800 telephone circuits. Small dishes, possibly complete with repeater equipment, would be bolted to existing masts and will, like the 6 GHz system, provide an economically attractive system by utilising the large capital investment in existing sites. Feasibility trials are being carried out with the aim of determining the practicability of providing a reliable service over hops which may reach 65 km in ▶

length. The tests will also enable optimum system parameters to be derived and provide reliable cost figures and a frequency plan so that maximum traffic can be carried within the available frequency space.

In addition, a 20 GHz system, which will operate at bit rates as high as 240 Mbit/s, is being studied. This system will employ a new concept in which compact low power solid-state equipment is installed behind aerials which are mounted on poles, similar to lighting standards, erected by the roadside so that expensive buildings, site works and masts will not be required; it is anticipated that planning permission for these modest structures will be readily available in most situations. This type of system could find important applications in providing high-capacity spurs to the main digital trunk network, junction routes between centres in different towns and short links between centres within towns; there could also be an application for the links required at short notice in which case the provisioning time must be short.

Light rainfall will not affect the performance of a 20 GHz system but under exceptionally heavy rainfall conditions signal attenuation will be severe. The need to meet exacting standards of performance even under very heavy rainfall means that hop lengths must be restricted to some 5 km, or perhaps 10 km using route diversity. In the latter technique, traffic is automatically switched to a broadly parallel route 1 or 2 km away which is not at the time subject to severe rainfall. Extensive propagation studies are in hand to determine maximum hop lengths and the optimum arrangement for parallel routes in diversity systems.

The development and planning of terrestrial radio relay systems using the higher microwave frequency bands are critically dependent on reliable propagation data. At the lower microwave frequencies, propagation via multiple paths can occur with possible signal distortion and severe signal attenuation; at frequencies above 10 GHz rain and snow can produce significant additional signal loss. To obtain the required propagation data a network of radio links has been set up in the Martlesham area in collaboration with the Radio and Space Research Station. Fading due to precipitation and multipath transmission is being measured at frequencies within the range 11 to 40 GHz for radio path lengths of up to 25 km. Measurements on parallel links at various spacings will give data indicating improvement in reliability to be expected by using route diversity. The correlation between radio path attenuation and rainfall data will enable radio relay system performance to be predicted in other parts of the country with the minimum amount of additional meteorological data.

Like terrestrial radio relay systems, satellite communication systems will be forced to use the higher microwave frequencies to cater for the growth of traffic. Long term statistical data on the effect of precipitation on path loss between earth station and satellite are therefore required so that systems with adequate reliability of service can be planned. Ideally this information should be obtained from the measurement of received strength of signals radiated by geostationary satellites, but a satellite for this purpose will not be available in the European sector until mid-1975 when the National Aeronautics and Space Administration satellite ATS'F' will be moved to a position over the Indian Ocean.

Meanwhile the sun has been used as a signal source and the PO, again in collaboration with the Radio and Space Research Station, has accumulated limited data for a wide range of angles of elevation. At the PO Research Centre, Martlesham, radio noise from the atmosphere is being measured at fixed angles of elevation using a 6 m diameter earth-station type aerial, the radio noise being a measure of signal attenuation. Experience with present satellite systems has shown that under certain meteorological conditions serious interference to satellite earth stations can occur due to over-the-horizon propagation from distant terrestrial radio relay system transmitters. Data regarding such propagation conditions at the higher microwave frequencies over 200 km paths will be obtained during the next few years.

The tower at Charwelton, Northants, is to be used in trials of 11 GHz digital equipment which will test the practicability of providing a reliable service over tower to tower hops as long as 40 miles. The digital equipment will be added to existing towers.

Forecasts of inter-city trunk traffic of all kinds, including telephony and new services, likely to arise by the 1980s are such that the inherently large capacity of a waveguide may well be justified and could lead to a substantial reduction in the cost per unit of bandwidth transmitted. This could, in turn, stimulate the use of visual telecommunications services such as Confravision that require relatively large signal bandwidths compared with telephone speech.

The waveguide currently being studied uses the circular TE_{01} mode of propagation in a 50 mm diameter fine wire helix, with frequencies ranging from about 30 to 100 GHz. This bandwidth could accommodate up to one third of a million telephone circuits, 2,500 Viewphone circuits or 200 bothway television channels or a combination of these. The lightweight design developed by the PO employs a rigid epoxy-resin impregnated glass-fibre structure to provide mechanical support for the wire helix. This unique design is low in cost and convenient to lay since it is readily jointed in 3 m lengths and pulled in to 100 mm diameter steel ducts in the ground.

The multi-channel telephony or television signals are transmitted by pulse code digital modulation at some 500 Mbit/s on a number of microwave carriers, although even higher bit rates, for example, 1 or 2 Gbit/s, are envisaged for later developments. The small losses in the waveguide, 2 to 3 dB/km, mean that repeater stations can be spaced some 15 to 20 km.

Preparations for a field trial in 1975 over a 15 km mainly road side route in East Anglia, near the new PO Research Centre at Martlesham, are in hand. The UK telecommunications industry is participating in the work. The English Electric (Marconi) Company is preparing repeater and terminal equipment and British Insulated Callender's Cables is manufacturing waveguide to the Post Office design.

SCREENING THE PAYROLL

KJ Leech

STAFF IN THE Southampton Telephone Area are pioneering the use of visual display units (VDUs) to speed the input of information to computers which calculate employees' pay in the Telecommunications Business. The VDUs are being tried in readiness for the introduction of a new computer payroll system in 1975 which will produce more informative payslips for employees, provide automatic calculation of pay award arrears, and supply a more comprehensive range of management statistics.

A clerk in the Southampton area keys employees' pay details on to the screen of a visual display unit. The information is then transmitted over private wire to an on-line computer in London.

The payroll handled by computer is extremely complex. It caters for some 250,000 payees in 280 grades, many with additional courtesy titles, and over 360 allowances which may be pensionable or non-pensionable, taxable or non-taxable, reckonable or not for extra duty payment.

At present payroll information is written on documents by clerical staff and passed to the Data Processing Service (DPS) of the Post Office. The DPS staff convert the information into punched card form and it is then processed by computer.

Clerical staff preparing payroll input for the computer continually work under pressure to meet essential deadlines and, because of the complexity of the information, mistakes and omissions may occur at the document preparation or punching stages. These are detected by the computer during processing and printed as a report which is sent to pay groups with the payroll, normally on the Wednesday morning of each week. Pay staff then have to correct the errors ▶

The security badge which must be inserted into a visual display unit before it can be operated. The badge identifies the operator.

and produce manual pay advices at short notice. The amended information is sent to the computer to bring its files up to date with what has actually been paid.

To help pay groups meet their tight time schedule a study team considered ways of transmitting payroll data to computers. In June 1972 it recommended that a trial of VDU input be carried out and the General Manager's office in Southampton Telephone Area was asked to pioneer the new system. The advantages of using VDUs were anticipated as being largely those of quicker input, early detection of errors, ease of staff training and the convenience of having a visual display of keyed information. All these benefits have been realised in the trial and the method of working has proved popular with pay group staff at Southampton.

The VDU has a screen similar to a conventional television set, and those in use at Southampton provide a display of up to 2,000 characters in a format of 25 lines each of 80 characters. The display is bright enough to be used in normal office conditions without the need for special screening, and unlike domestic television, is flicker-free. The brightness can be varied to suit individual preference. A keyboard linked with the VDU has a normal typewriter layout with additional blocks of numeric and control keys. The keyboard is connected to the viewing unit by a flexible cord and can be positioned up to 5 ft from it. Each clerk has a VDU on her desk and, by the use of a special line-sharing adaptor, they are all connected for simultaneous use over a private wire to the Spectra computer at the Post Office Barbican computer centre in London.

To use a VDU the clerk must first insert a special security badge into the machine. This badge identifies the operator and defines the authority of the holder. A list of the various types of input available – such as for new employees, changes to tax, etc – is then displayed on the screen. There are eight different basic input formats and the most commonly used are indexed with employees' names and pay numbers so that only variable information needs to be keyed. The clerk selects an input format by keying in a code and information identifying the pay group section required; a facsimile of the punching document is then displayed on the screen.

Using her keyboard, a clerk copies information directly from documents such as time sheets on to the screen. A special key is then pressed to transmit the keyed in data to the Barbican computer which checks its accuracy. The computer will reject incorrect information and highlight the error on the screen with a flashing signal so that the clerk can correct the error and resend. Correct information is acknowledged by the computer and stored on magnetic tape. This tape is sent to the Post Office computer centre at Portsmouth each week for processing the payroll. Salary information can be input at any time and is put aside for the monthly processing. The Portsmouth computer calculates each employee's pay and prints payslips for despatch to the pay group.

Five VDUs were installed at Southampton to start operator training in October 1972. Clerks were already familiar with the input formats because they were identical to punching documents used in the existing system. A specially written programmed learning course helped to teach staff the mechanics of operating the VDU, and by using a "training" badge in the VDU clerks were able to practice using the full payroll index and information without affecting the actual payroll output. The average training period was less than two days for each clerk. Two weeks later parallel running of the VDU system with the manual system commenced, and on 27 November the Southampton payroll "went live".

There have been very few teething troubles. Operational problems have been negligible, and some intermittent problems on the private wire were soon resolved. The staff at Southampton have played a prominent part in the success of the trial, and as it continues operating times are improving and the use of VDUs remains popular.

Lessons learned from the trial and those that will follow will help to lay foundations for the proposed Telecommunications On-line Data (TOLD) system which would establish data links between most Telecommunications offices and a centralised data collection centre for on line transmission of information using VDUs. The collection centre would in turn be connected by links to processing computer centres, saving time and transportation costs over the present physical carriage of documents and tapes between areas and centres.

The success of the payroll VDU trial opens the door to wider use of this swift and accurate method of computer input. Already trials of VDUs are planned for billing payments and directory compilation input at Southampton and other locations, and it is not difficult to foresee other uses.

Mr K. J. Leech is head of the Management Services group at Telecommunications Headquarters responsible for planning and implementation of the Telecommunications On-line Data system (TOLD). He has direct responsibility for the Southampton payroll trial.

The Royal exchange

DH Pentecost

TELEPHONE SERVICE for Her Majesty's Household at Buckingham Palace and other Royal Households nearby is now provided through a new automatic exchange installed earlier this year. The change-over involved replacement of old-style manual equipment by a new private automatic branch exchange (PABX) and the complete re-wiring of a large installation; not such an unusual event these days, but this particular installation inevitably posed some special problems for staff of the South Central Area of London Telecommunications Region.

Planning started in 1971 and there was the immediate and important question of how we should advise the Royal Household between a strowger installation and other proprietary PABX systems that were then becoming available. After careful consideration the Post Office advised in favour of the well tried and established strowger PABX 3, and this was accepted. The detailed planning and operations, extending over a period of 18 months, had to be carried out with meticulous care.

The original CB10A manual installation, with a capacity of 280 extensions, served only Buckingham Palace. The other Royal Households had their own separate installations, and a network of private circuits and external extensions had developed linking Buckingham Palace with the other residences and with Windsor Castle. The new installation provides an integrated service for most of the Royal Households in London, at St James's Palace, Clarence House, York House and Kensington Palace, and will provide an increased capacity for up to 500 extensions to cater for future requirements.

The technical features of the new installation presented only a few unusual problems, although special arrangements had to be provided for security; important extensions appear on the answering panel of only one switchboard position and cannot be overheard from other positions. The number of operators has been halved, but the type of work done by the all-male staff remains unique. For example, a personalised manual service for members of the Royal Family is still provided by the Palace operators.

The PMBX positions which were recovered from the Palace had been festooned with instructions and orders of the day concerning the principal members of the Household, and these testify to the special qualities required and the demands made on the operating staff. Among their duties they may be required to find a member of the Household in any corner of the globe and to meet the demands of State occasions and the activities of the "lunatic fringe" with equal tact and courtesy.

At the same time as the contractors ▶

A group of 10 telephonists work on rota to man the new Buckingham Palace switchboard 24 hours a day. On duty here are (from nearest camera) telephonists Wilf Reeve, Pat Pope, Len Lay and John Birchenought who holds the Royal Victoria Medal for service to the Queen after 17 years at the Palace. Members of the Royal Family are given a personal service by one of the telephonists at the switchboard.

▶ (GEC) were proceeding with the equipment installation an extensive recabling was carried out to cater for automatic working and to provide a flexible reserve of spare lines at strategic points at Buckingham Palace. Whatever difficulties were encountered, it was decided that the work had to be done without disturbance to the Households and without interruptions to the existing telephone service. This presented some sizeable headaches, especially in important rooms and galleries housing priceless objects where particularly fine floors had to be raised so that cables could be concealed. The comings and goings of the Royal Family and the Household staff had also to be known, and contacts had to be made at all levels from the Housekeepers to the Master of the Royal Household. A project team was set up and saw the exercise through to completion with very few hitches, and even these were sometimes in character. At one progress meeting at Clarence House, for example, a full band of the Grenadiers, with bearskins bobbing, marched past the window of the conference room and drowned all further discussion.

About 50 kilometres of cable was run to provide telephones in Buckingham Palace and large new cables were also laid to link it with Clarence House and Kensington Palace. At one time over 50 Post Office staff were engaged on the work. The most intensive phase occurred when Post Office engineering tests were carried out, particularly to ensure absolute security of the auto equipment.

Timing of the cut-over arrangements was also particularly sensitive. The date had to be selected between various state visits and the Royal Family's removal to Windsor Castle, and a normally clear Saturday morning was chosen. However, detailed contingency arrangements were made for deferring the change or for cutting back to the manual if the unexpected occurred. This included, at that time, the rumoured announcement of Princess Anne's engagement.

However, the cut-over went smoothly and the new system has settled in satisfactorily. When the job was finally done, the Queen's Private Secretary wrote to the Minister of Posts and Telecommunications, on behalf of Her Majesty, thanking the Post Office for "the skill and efficiency with which this difficult and complex operation has been carried out".

● *Windsor Castle is also to be provided with a* PABX3 *service.*

Mr D. H. Pentecost is Deputy General Manager of South Central Telephone Area.

All the authors of the books reviewed here are Post Office men, past or present. D. L. Richards is head of section in the Transmission Division of the Research Department. He was recently awarded the Annual Electronics Division Premium by the Institution of Electrical Engineers for a paper published in 1972. P. B. Johns a Lecturer in Communications at Nottingham University was formerly in the Research Department where T. R. Rowbotham is head of group working on microwave microcircuits. R. N. Renton has retired after serving in the Telegraph Branch of the former Engineering Department.

A definitive work

Telecommunication By Speech
D. L. Richards
Butterworth £12

This must be considered as a definitive work on the foundations of telephone performance assessment, objectives and planning. It leads from the subjective aspects of the overall voice/ear communication, which define the quality of the telephone system, to the objective design and planning parameters from which the transmission engineer writes his specifications and planning rules. The book embodies the outstanding personal contributions which the author has made in this field, to which he has been dedicated for over 25 years, but puts this in historical perspective against the pioneering work done in the Post Office and in other organisations. Indeed, a valuable feature of the book is the careful and thorough way in which it traces the evolution of present-day standards and techniques from their beginnings in the early days of telephony.

D. L. Richards has an international reputation; his long association with Study Group XII of the CCITT (Telephone Transmission Performance) was marked by his recent appointment as vice-chairman in succession to Mr F. T. Andrews of Bell Telephone Laboratories. He is also Chairman of the Laboratory Working Party of the Study Group, concerned with establishing and maintaining the international reference system and its use for comparing individual telephone standards.

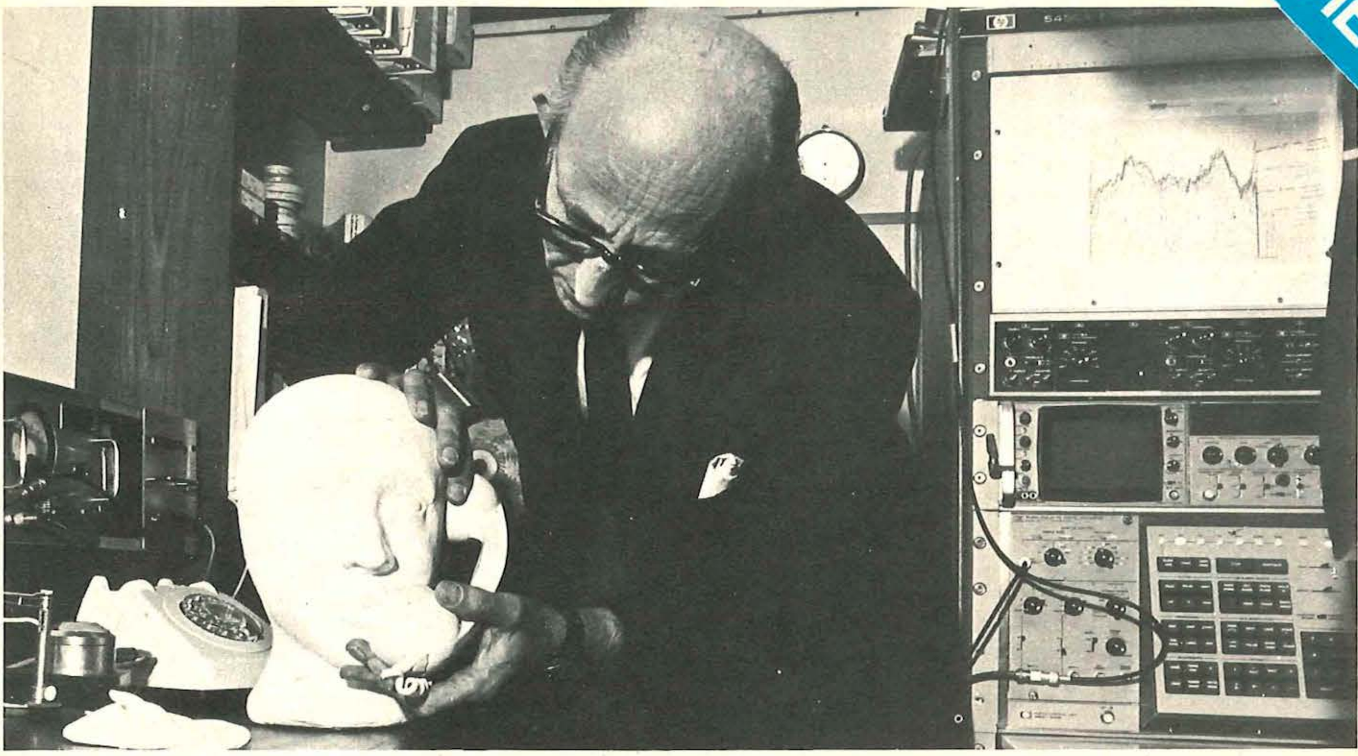
The author explains his aim as to provide a vade-mecum rather than a thesis; to give an orderly classification of knowledge in sufficient depth for reference but with guide lines to original sources for further reading in depth. Its bibliography is extensive and conveniently classified.

The book falls naturally into two main parts following an introductory chapter. This introduction reviews the development of public telephony and the early evolution of transmission plans and standards. It includes an introduction to subjective assessment and to some of the mathematical and statistical tools which are used in the process. The author's sense of history is a feature of the book and is well illustrated in this section by his quoting from the 1891 British Association Meeting in Cardiff. A lecturer formulated a condition for transmission performance of a popular telephone exchange service as "speech must be loud and distinct and privacy of communication complete; and a subscriber's line and apparatus must be adapted equally well to speaking to another across the street or to one 500 miles away. There must furthermore be absence of all disturbing sounds". The aim of the transmission engineer could not be put more simply or effectively today.

Chapters 2 and 3 form the first main section of the book and are concerned with the properties of speech and hearing and its measurement in terms of electrical signals followed by a study of the overall voice/ear connection and methods of measuring and rating the complete transmission path from person to person.

Chapter 4 is a bridging section in which the various factors that are typical of the impairments introduced by practical telephone systems are displayed (bandwidth, loss, noise, side-tone etc) and evaluated in terms of customer satisfaction. Chapters 5-7 form the other main section of the book dealing with telephone sets, transmission systems and the planning of telephone networks. Finally, Chapter 8 reviews the transmission performance of telephone networks with particular reference to the performance, over the years, of the United Kingdom telephone network deduced from surveys, field measurements and plant records. This information is used to estimate the improvement in transmission performance that current changes in technology can lead to; particularly, the extensive introduction of pcm junctions associated with tdm switching at a tandem exchange.

The book demonstrates very clearly the value to a telephone operating organisation of its investment over many years in the basic research into the nature of telecommunications and its interchange with other organisations through the medium of international study groups. Knowledge so acquired can provide a proper foundation for crucial decisions which are periodically necessary as new technologies appear. This reviewer can



In a laboratory at Dollis Hill Mr D. L. Richards examines progress on the design of equipment to test telephone connections. The ultimate aim is to incorporate in a moulded head an artificial ear and mouth through which sounds simulating those of human speech can be transmitted. The device will be associated with a special computer.

recall questions which have arisen in transmission system evolution during the past two decades and which called upon the methodology and techniques displayed in this book for satisfactory answers to be found. Such questions included the establishment of a conventional speech power for the loading of multi-channel carrier systems; the formulation of objectives for noise on international circuits and connections; the implications of very long delay times and echo suppressors on the introduction of communication satellite circuits into the international telephone system and, most recently, examination of the consequences of introducing pcm into the telephone system with the necessity to consider the effects of quantisation and companding. In conclusion it is perhaps appropriate to say that the book should be required reading for all having a responsibility for the design and planning of a telephone system; although the first main section (in chapters 2 to 3) is for the specialist, the second half of the book (chapters 4 to 8) will be a valuable and continuing source of information and reference to the design and planning engineer.

Data Telecommunications

R. N. Renton
Pitman £2.75 (limp)

The author, for many years a prominent member of the Engineering Department, has an international reputation and served on CCIT and CCITT Telegraph Study Groups. With this background one would expect an authoritative, well documented presentation of Post Office techniques and international standards. This expectation is competently fulfilled.

Chapter 1 introduces codes, alphabets and error control; the latter topic being dealt with in more detail in Chapter 7. Chapter 2 gives a summary of line transmission practices and circuit characteristics, including both PO and CCITT objectives for circuits and connections used for data transmission. The following chapter describes in considerable detail a range of typical terminal machines on the UK market including teleprinters, line printers, tape perforators and readers, and concludes with a brief description of visual display units.

Chapters 4, 5 and 6 describe in detail the PO Datel services; the modems, the testers and the automatic calling and answering units with a full description of the interchange circuits and procedures.

The detailed descriptions of the PO Datel modems and testers are based on the earliest designs which are now technically out-dated. Technical detail of the operation of these items is not a necessary feature of the book and it would have been more useful to have described general principles if up-to-date circuit information could not be given.

The final three chapters provide an introduction to data processing systems and networks using the data transmissions techniques described earlier, concluding with a review of proposals for new data networks and possible future developments. Software aspects of on-line systems are not considered.

As the author points out in his preface, the subject is under active and continuous development. Consequently much of the detailed information given will soon go out of date. Indeed, the timing of preparation and publication is a little unfortunate since it was not possible to include the new and revised Recommendations approved by the Vth Plenary Assembly of the CCITT in December 1972. Nevertheless, the book is a valuable introductory guide to UK data transmission practices for students of telecommunications and data processing, although they will need to refer to official texts and recommendations when current information on standards and practices has to be obtained. Its clarity and presentation should serve as a model for other books in this and related fields.

Communication Systems Analysis

P. B. Johns and T. R. Rowbotham
Butterworth £2.20 (limp): £3.40 (hard covers)

The authors have aimed this book at second and third year university undergraduate courses and have attempted to relate an appropriate mathematical treatment of basic principles to the practical problems of real transmission systems. Most of the examples relate to radio-relay systems.

This volume gives a useful introductory treatment of some of the basic topics in transmission systems. It will be of use to line and radio system engineers seeking a theoretical groundwork on particular aspects and on guidance to references for appropriate in-depth treatment.

MBW

Traffic on tape

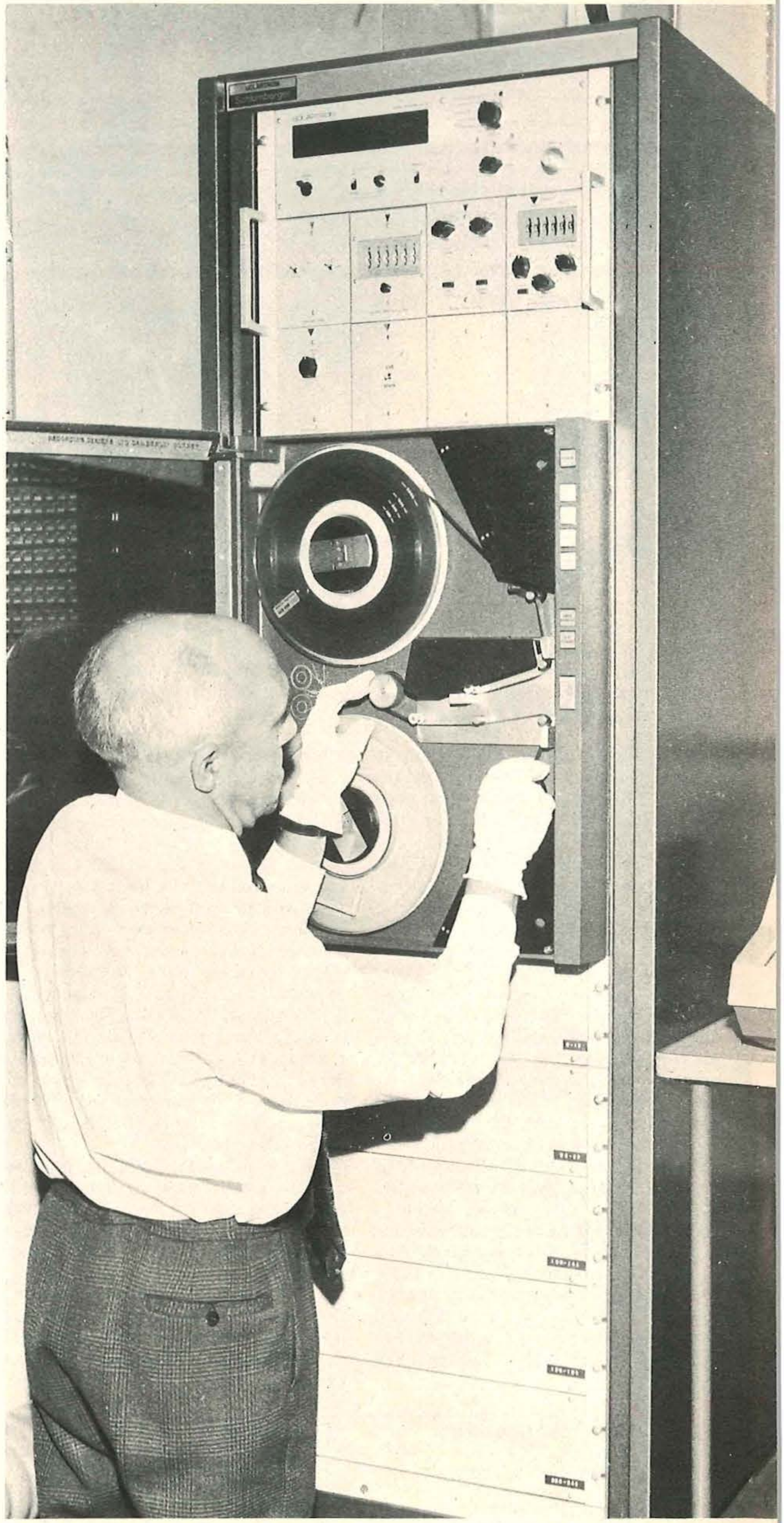
JD Watson & F Kinston

Successful trials have been completed at Stafford of a computerised system for recording the flow of traffic in a telephone exchange. The print-out traffic record includes information not previously available.

FORECASTS of future levels of telephone traffic form a basis for planning and development in the telephone network. As capital expenditure on plant and equipment involves vast sums of money it is essential that these estimates are as accurate as possible.

In order to forecast future traffic quantities accurately, and to determine the standard of service being given to customers, the present use of telephone circuits and routes must be measured. To do this it is first necessary to identify the busiest 60 consecutive minutes in each 24 hours on all individual switching stages and routes in the telephone network. The amount of traffic carried during these periods – known as the busy hours – must then be accurately measured.

Continuous records taken on individual routes illustrate that the time of the busiest hour varies widely. On some trunk routes, for example, it does not coincide on any two days in a week, and since the introduction of the peak rate tariff this variation has become



Co-author Mr Frank Kinston threads a magnetic tape on to the traffic recorder at Stafford. He is wearing gloves to protect the tape. A whole week's recording can be contained on one reel.

even more pronounced. Accordingly, the prime requirement of any telephone traffic recorder is that it should be capable of continuous recording.

A new, computerised system of traffic recording, which has successfully completed trials in the Stoke-on-Trent Telephone Area, is equipped to provide continuous monitoring of up to 5,000 circuits. The equipment can measure traffic flow on groups of circuits and routes in a telephone exchange, recording the data on magnetic tape for direct input to a computer. The whole of a week's recording is contained on one magnetic tape, and the data can be processed to provide information in printed form in many ways not at present available. Individual route busy hours can be identified and measured together with the busy hours for an exchange or part of that exchange. Results can be produced on a daily, weekly or monthly basis, averaged in any way convenient for circuit estimating.

At present the new recorder is connected to the trunk equipment at Stafford Group Switching Centre – an exchange whose main task is to switch calls between a group of local exchanges under its control and the rest of the telephone network. Arrangements are in hand to extend the recorder's scope to cater for the local and junction network. As the equipment permits continuous recording, a great deal of information not at present available concerning seasonal and abnormal traffic conditions can easily be extracted from the recordings. This method of traffic recording can also be applied to other equipment – for example, it appears suitable for Transit Switching Centres.

The system at Stafford is based on a device which can record up to 1,000 different voltages in one minute. It consists basically of a digital voltmeter which is switched to the different voltage sources via reed relays under the control of a scanner and digital clock. To use the equipment as a telephone traffic recorder a means was developed for converting a voltage measurement to a count of circuits in use and recording this information on the magnetic tape.

To reduce operating costs of the system a method was also evolved for grouping circuits together. The measuring points of circuits at Stafford GSC are grouped in blocks of 20 or less, ie into channels, and connected to the reading equipment by means of a small distribution frame. Up to 250 channels can be handled by the equipment. The rate at which channels can be scanned varies from once in two seconds to 12 times per second, or at the same speed as the recording device. Any number of the channels can be scanned, starting and stopping at any desired point. A one-minute interval is used between scans when recording on all equipment in the exchange.

A pulse from the digital clock to the scanner controller is connected via two time switches. One switch selects the days of the week and the other the hours in the day when recording is to take place. The equipment is operated on four-weekly cycles, running from 9 am to 11 pm daily for seven days in one week and for five days in the other three weeks. It is also run from 3 am to 3.30 am on each of these days and any circuits measured on P wires, as distinct from traffic recorder wires, found continuously engaged in this period are deducted from all readings for the previous day to allow for artificially busied equipment.

Every 40th day recording takes place only on the exchange's registers, ie short holding time equipment which receives and stores dialled digits and controls the setting up of a call. A four-second interval scan is used on these days and no recording takes place on other equipment.

Readings by the digital voltmeter can be recorded on a printer or magnetic tape recorder. The magnetic tape is used for normal recording, while the printer is used for setting up the equipment and for checking purposes. Every Monday morning before 9 am the equipment is run to check that circuits are correctly connected to the recorder, information being printed out on the printer and compared with an accurate list of circuits. Any necessary corrections are then made before recording on magnetic tape is allowed to start.

A 2,400-ft tape is required for one week's operation. The time at which each scan is made is recorded on the tape, followed by each channel number and the number of its circuits in use. One channel, designed to simulate 19 busy circuits, is used as a check at the start of each scan. The computer checks this channel and if it does not read 19 busy circuits the remainder of the scan is ignored.

Information fed back to the Area consists of: 1 A daily graphical plot of the GSC busy hour; 2 Data vet results which identify every abnormality; 3 Busied equipment (3 am to 3.30 am) and working circuits information; 4 Total trunk traffic entering the GSC during each half-hour period of the record; 5 Information about periods when 90 per cent of all circuits on a route are engaged; 6 Traffic balances on all inter-switching stages and the overall day to busy hour ratio; 7 Details of individual route and switching stage traffic in four defined busy hours.

The route busy hour is the busiest 60 consecutive minutes during the 14-hour day under consideration. The time-consistent busy hour has been computed by adding together the number of engaged circuits at each time at which the recorder scans for the days over which the average is calculated, and taking the busiest 60 consecutive minutes of the resultant composite day. From an analysis of the different traffic levels recorded during these periods to date it is evident that no route had its busy hour consistently in the morning, afternoon or evening.

Route traffic levels in the GSC time-consistent busy hour have been considerably lower than those found by averaging the route busy hour traffic for the same five days. The difference becomes even more noticeable when the time-consistent busy hour traffic is compared with the route busy hour traffic in the single and the two busiest days of the same five days. It has been found impractical to estimate the traffic carried in the route busy hour from the level of traffic carried in the time-consistent busy hour since the ratios of these quantities vary widely from week to week. The fact that the true route busy hour may overlap the GSC time-consistent busy hour by a considerable amount is no guarantee that similar traffic levels on that route will be measured in the two periods.

If a traffic recorder of the type installed at Stafford were fitted at all exchanges the preparation of traffic design data for new exchanges and extensions could become more complicated but designs would be a great deal more accurate. For example, every switching stage could be designed individually instead of as at present having to make the assumption that common switching equipment must simultaneously carry the summed total of all the forecast busy hour traffic on each individual route.

Mr. J. D. Watson, until recently General Manager of the Stoke-on-Trent Telephone Area, now holds a similar position at Coventry. He was formerly in Network Planning Department at Telecommunications Headquarters.

Mr F. Kinston, an Executive Engineer at Stoke-on-Trent, is currently engaged on extending the capability of the traffic recorder to deal with the whole of Stafford exchange.

The year in figures

	1972–73		1971–72		1970–71	
	Result	% growth over 71–72	Result	% growth over 70–71	Result	% growth over 69–70
TELEPHONE SERVICE						
Size of system						
Total working connections	10,946,992	9·2	10,028,158	8·8	9,214,499	7·8
Total working stations	17,600,368	8·9	16,157,467	7·9	14,978,751	7·3
Call office connections	76,301	0·5	75,905	0·1	75,799	0·6
Shared service connections	2,028,904	7·7	1,883,893	9·7	1,716,496	9·7
% of connections on auto exchanges	99·2	0·2	99·0	0·2	98·8	0·3
Growth of system						
Net demand for connections	1,431,029	−0·8	1,442,917	32·4	1,089,940	−1·5
New supply of connections	1,420,911	9·5	1,297,068	19·5	1,085,238	4·2
Waiting list	200,066	−8·2	217,975	79·7	121,266	12·0
Penetration						
Stations per 1000 population	314	8·6	289	7·0	270	6·7
Traffic (in millions)						
Inland effective trunk calls	1,944	14·4	1,699	12·0	1,517	12·2
Inland effective local calls	11,595	12·2	10,330	11·9	9,230	11·6
Continental: outward calls	20·85	12·8	* 18·48	11·7	16·54	16·4
Inter-continental: outward calls	4·28	24·0	* 3·45	53·3	2·25	60·7
Telephone usage						
Calls per connection	1,291	3·0	1,253	3·4	1,212	3·2
Calls per head of population	244	11·9	* 218	13·5	192	11·0
Exchanges						
Local manual	48	−30·4	* 69	−19·8	86	−18·1
Local automatic	6,140	0·7	* 6,099	0·6	6,065	0·5
Local electronic	374	91·8	* 195	119·1	89	187·1
Local crossbar	143	85·7	* 77	126·5	34	209·1
Automanual and trunk	365	−1·3	371	−1·6	377	0·5
TELEX SERVICE						
Total working lines	43,292	14·6	37,774	14·7	32,945	13·0
Metered units	398,011,000	12·6	353,534,000	9·4	323,257,000	25·0
External originating traffic	32,660,000	13·2	28,841,000	14·4	25,210,000	23·4
TELEGRAPH SERVICE						
Inland telegrams	7,303,000	6·6	6,847,000	2·7	6,669,000	−15·2
External telegrams: UK originating	7,073,000	0·5	* 7,040,000	4·8	6,730,000	−11·2
UK terminating	6,774,000	−2·1	* 6,917,000	4·6	6,615,000	−4·3
UK transit	5,477,000	−4·8	* 5,755,000	6·9	5,407,000	−11·6
TELECOMMUNICATIONS STAFF						
(Part timers count as half)						
Total	240,204	2·7	* 233,965	0·7	232,377	1·8
Minor engineers	105,532	4·9	100,550	2·3	98,241	2·8
Telephone operating force	50,709	0·3	* 50,575	−4·0	52,672	−0·9
Clerical staff	28,597	0·5	28,452	−0·6	28,631	0·9
Other staff	55,366	1·8	54,388	2·9	52,833	3·2

* Revised figure

A BIG GROWTH – AND A WARNING

In a year of operations at record-breaking levels there was a disappointing financial result for Post Office Telecommunications. The Post Office report and accounts for 1972-73 shows a big growth in telecommunication services, but a loss of £9.7 million. The report says that the £64.1 million overall Post Office loss – the first for 16 years – was the result of price restraint, continuing inflation and some heavy new costs. These included £26.7 million for writing off existing equipment more quickly following the decision to modernise the telephone service and £32.1 million to meet a pension fund deficiency. There is a warning in the report that continued pricing limitation could have long-term consequences for the Post Office if customers become used to subsidised prices. Extracts from the telecommunications section of the report are given here:

The large local electronic exchange (TXE4) which is a major element of the modernisation plan.

The most important single event in the year was the Board's conclusion, announced in February, to proceed with plans for modernising the telephone network. This followed a series of intensive and detailed studies to which the telecommunications industry helpfully contributed. The plans have the industry's support and have been endorsed by the Government.

Modernising the network is a long-term task involving the replacement of strowger equipment at 5,617 exchanges. It will not be completed until the end of the century, although the benefits of faster, better and more versatile service will begin to be noticed by customers over the next decade. In the meantime, extensive work goes on to raise the quality of the present service. The percentage of local calls for which plant was adequate and satisfactory during 1972-73 was raised to 97.5; for trunk calls the figure was 93.5 per cent. Further improvements are planned for 1973-74.

In international telecommunications – where the traffic has increased by nearly 150 per cent in five years – the standard of service was much less satisfactory. The relatively poor results were due mainly to shortages of switching capacity both in the UK and in overseas countries. To help overcome the problem at the UK end construction delays underlying the present shortages are being vigorously attacked by short-term expedients, while an investment programme of £150m over the next five years aims to safeguard the service in the longer term.

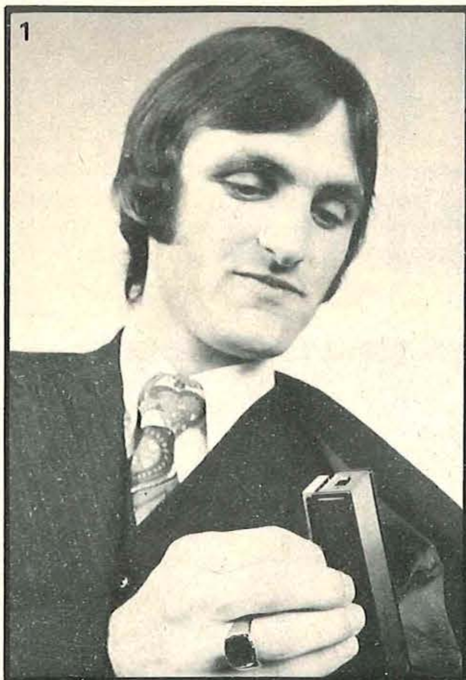
During the year the telephone waiting list was reduced by 8 per cent to 200,000. This was still too high, but the trend was in the right direction. The manufacturers and the Post Office are continuing to work together to reduce the list still further in 1973-74.

The telecommunications service has continued its record of consistently improving productivity. In 1972-73, the improvement in performance was equivalent to savings of 6,500 engineers; 1,600 clerical staff and 120 telephonists.

Inland services: Orders for new exchange connections and telephone extensions continued at record levels. During the year 1.421m exchange connections were supplied at an average rate of 5,570 each working day. This was 9.5 per cent more than last year and brought the total at the end of the year to nearly 11m. This involved the installation of 2.661m telephones and increased the total in service to over 17.6m.

Since the formation of the Corporation in October 1969, 4.4m exchange connections have been supplied and 8.2m telephones installed. In terms of growth the telecommunications business has done almost half as much in less than four years as the old Post Office did in 25 years. During the past year the waiting list for telephones has been reduced to 200,000, equivalent to about seven weeks' supply. Supported by the manufacturers' efforts to have the extra plant needed ready on time, the business will continue its drive to reduce the waiting list further.

Inland telephone calls increased by 12.6 per cent to a total of 13,539m, nearly 1,300 calls per connection during the year. By the end of the year 99 per cent of local calls were diallable. STD facilities were available on 96 per cent of connections and 84 per cent of trunk calls were dialled by customers. More inland plant was provided to eliminate pockets of serious congestion; more ▶



Various new products have been put on trial during the year. They include:

1. The Radio-pager which bleeps a summons when its number is dialled on the ordinary telephone network.
2. The Card-Callmaker which automatically dials a required number when a pre-punched plastic card is dropped into the device.
3. The Keyphone with a push-button dialling system.

night routiners were installed to identify faulty switching plant; and the replacement of fault-prone items of plant by modern electronic equipment continued.

With the addition of 5,500 stations the telex network increased by nearly 15 per cent to 43,300 at the end of the year and inland telex calls increased by 12.6 per cent. The number of data transmission terminals increased by 28.6 per cent to 24,450. This is more than the total in use in all the other countries of Europe.

Expansion: Capital expenditure on telecommunications fixed assets at £617m was 22 per cent more than in 1971-72. About one-third was for replacing and extending telephone exchanges. Local plant shortages are being rapidly eliminated and proper margins of spare capacity provided for future growth. Exchange capacity was provided for 940,000 more connections, the local cable network was augmented by 1.3m main pairs plus a similar number of distribution points. More than 16,000 long-distance and 70,000 short-distance circuits were provided between exchanges. This, together with improved maintenance practices, resulted in a continuing improvement in the automatic service.

International services: International telephone calls increased by 15.4 per cent. More than 60 per cent of calls from the UK are now dialled direct. During the year direct dialling to Canada was introduced for customers in seven major cities. An additional switchboard at Brighton was brought into service in January to carry international calls from provincial customers and relieve the hard-pressed operator service.

International telex calls increased by 15.5 per cent. More than 95 per cent of calls from the UK are now dialled direct.

In May a new submarine cable system to the Netherlands with an ultimate capacity of 1,260 circuits was brought into service. A third aerial for satellite communications became operational in August.

In February 1973 a permanent International Telecommunications Satellite Organisation succeeded the INTELSAT consortium which had operated since 1964. The UK and the Irish Republic jointly hold about 10.8 per cent of the investment shares and are the second largest shareholder in the Organisation. They are represented on the Board of Governors by the Post Office.

New products: The range of products and facilities continues to be improved and extended where there is market potential.

Some 40,000 Keyphones – in which push-buttons replace the dial – are already in use on specially designed large private automatic branch exchanges. A new design of Keyphone, intended to be directly interchangeable with a dial telephone connected to any type of exchange, is undergoing market trials and if these are successful this attractive facility will be made available. A new telephone designed specifically for the needs of the domestic user also started field trials.

A low-cost Card-Callmaker was added to the range of Tape and Key-Callmakers already available. With this device, for which there is expected to a be a substantial demand, customers can dial even the longest telephone number automatically by dropping in one of a library of pre-punched plastic cards.

The wide range of Post Office Datel services was extended by the introduction of the Datel 2400 dial-up service. The Post Office data multiplexing facilities – which enable a number of local data calls made over the public telephone system to a remote centre to be transmitted simultaneously over one private line to a central computer – were extended by the addition of Dataplex 2 offering a wider range of transmission speeds and more transmission channels.

A new public radio-paging service was introduced in the Thames Valley. This is a pilot service to evaluate operational techniques and market potential which is expected to be nation-wide.

Customers continue to be given a wider choice of large private automatic branch exchanges. During the year two proprietary models were approved by the Post Office and a further seven began final service trials.

Technology: As part of the move to apply electronic techniques to older systems, where it is beneficial to do so, electronic directors and pulse regenerators were introduced, and a widely used signalling system was miniaturised through the use of micro-electronic devices, with substantial savings in cost and space.

New design principles were developed to give present standards of service to customers with much less telephone exchange and line plant provision.

Computer applications: Preparation is in hand for a large computer, six times as powerful as any at present used by the Post Office, to meet scientific research and development needs.

MISCELLANY

Trunk expansion

A £28 million expansion programme for Britain's trunk telephone network is planned in 1974-75. Orders will be placed for extra capacity on existing coaxial cables, new high-capacity trunk telephone cables and for additional microwave radio relay systems. More new terminal transmission equipment and underground duct for new cables are also included in the programme.

The equipment and systems ordered will be in service in 1977-78. They will provide the trunk telephone transmission system with an additional 54,000 circuits, the biggest planned increase to date.

Announcing the expansion programme Mr Edward Fennessy, Managing Director of Post Office Telecommunications, said the increased capacity would cater not only for the expected growth in inland trunk telephone calls by 1977-78, but also for the increased needs of telex and data transmission services and privately rented circuits.

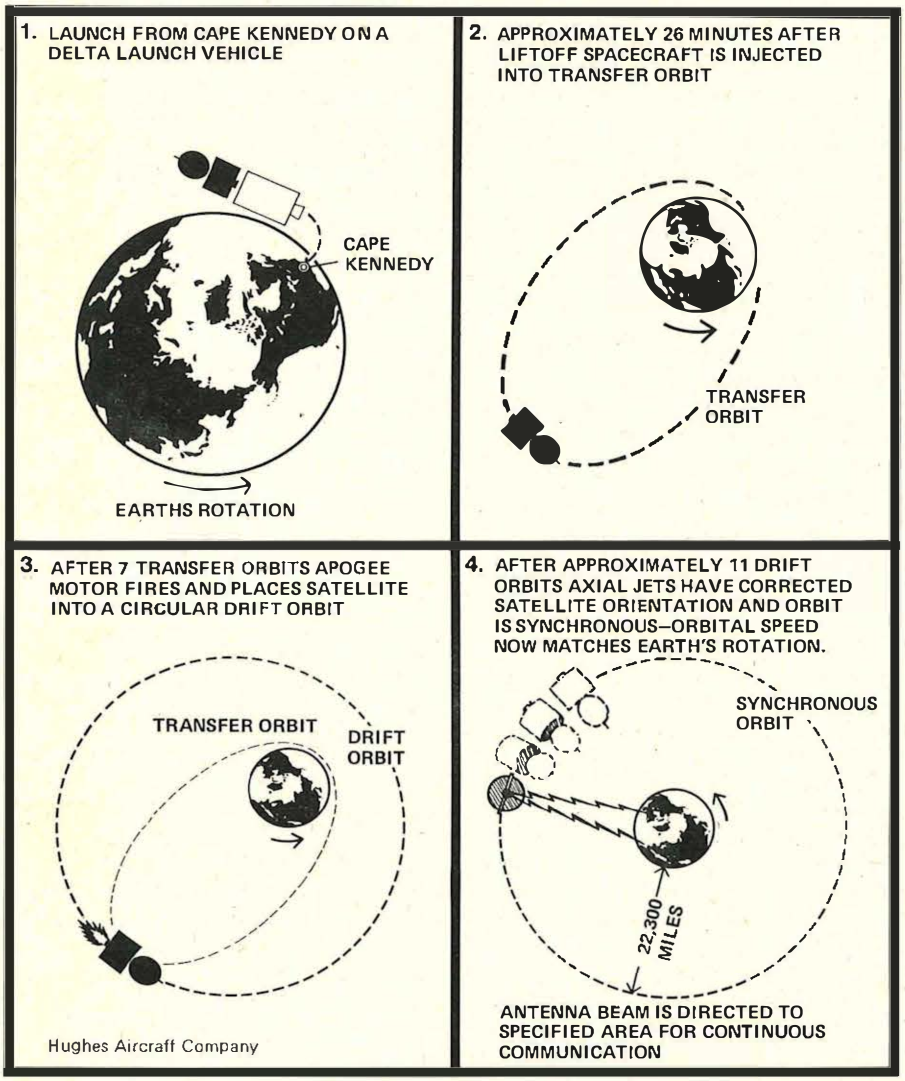
Several big schemes in the expansion programme are related to international communications. For example, new microwave radio systems, each providing an extra 4,000 telephone circuits, are planned between Goonhilly and Plymouth and between Widemouth Bay and St Just, Cornwall. The Widemouth-St Just link is one of two new inland routes to serve a new submarine cable between Spain and the UK, which will come ashore in Cornwall. Among the new cables is a link between Aldeburgh and Lowestoft, capable of carrying up to 10,800 telephone calls simultaneously, to serve new submarine cables with mainland Europe landing in East Anglia.

Other schemes for strengthening inland trunk telephone links in many parts of the country include a project for the Highlands and Islands of Scotland. This will provide new microwave radio "hops" giving extra trunk carrying capacity between Gairloch and Ullapool, Oban-Tobermory, Kyle-Skriaig and Skriaig-Tobermory.

Contest of words

A total of £50 in prize money is offered by the Institution of Post Office Electrical Engineers in its 1973-74 essay competition. Entrants are asked to write 2,000-5,000 words on the subject of engineering activities in the Post Office, and the prize money will be shared between the best five papers. There are also five certificates of merit to be won.

The competition is open to all Post Office staff up to and including Technical Officers, and the closing date for entries is 15 January 1974. Leaflets giving details of the competition can be obtained from the Secretary of the Institution, THQ, 2-12 Gresham Street, London EC2V 7AG.



An INTELSAT IV satellite has been launched to act as a spare on the transatlantic telecommunications route. This drawing shows how a satellite's orbit makes it appear to hover in space. See "On standby".

On standby

The fifth INTELSAT IV communications satellite achieved a successful orbit 22,300 miles above the Atlantic Ocean following its launch from Cape Kennedy, Florida. The satellite, capable of handling up to 5,000 telephone conversations simultaneously, is being provided as a spare in orbit on the busy transatlantic telecommunications route, where two satellites are already carrying five million calls a year between Britain and North and South America, Africa and the Middle East. The new satellite will take over the event of any breakdown in either of the two operational satellites, ensuring continuity of service.

Four INTELSAT satellites now provide the world with communication on a global scale. In addition to the two working over the Atlantic two others are positioned over the Pacific and Indian Oceans. They are provided and operated by INTELSAT (International Telecommunications Satellite Organisation), the 83-nation organisation of which the UK (through Post Office Telecommunications) is the second-largest shareholder.

Down under

Mr John Bray, Director of Research of the British Post Office, visited Melbourne recently as the guest of the Australian Post Office. He was invited to give the inaugural lecture at the Golden Jubilee symposium of the APO Research Laboratories at Melbourne University.

During his stay in Melbourne, Mr Bray visited Australian Post Office laboratories and projects.

(Mr Bray writes about microwave developments on page 18.)

Contracts

Plessey Telecommunications – for hardware, software, installation and personnel training for the UK's first international gateway public telex exchange to be computer controlled and able to handle 200-baud traffic. The duplicated twin processor Plessey 4660 system is to be installed at St Botolph's exchange in London. It will handle international 50-baud "gateway" traffic, high speed (200-baud) continental traffic, provide speed and code change between the two standards, and eventually initiate 200-

A "novel" way of promoting the telephone service is being used in Wales and the Marches. Bookmarks encouraging readers to make use of the 'phone have been distributed to most libraries in the Region. They are available in Welsh and English versions, and our pictures show the same message.

baud traffic within the UK. System 4660 is computer based and was developed for handling record-type information with primary use in national and international telex networks. Because such networks transmit digital information, the application of digital computers to provide control and switching becomes particularly relevant. Additionally, computer control allows many features to be incorporated which would be impracticable or uneconomic in an electromagnetic system.

Pye Telecommunications Ltd – £500,000, including the largest single contract ever obtained by the company for transportable microwave radio link equipment.

GEC Telecommunications Ltd – £1.5 million for line and multiplex frequency division multiplex (FDM) equipment and 24-channel pulse code modulation (PCM) equipment. GEC is a major supplier of PCM equipment to the Post Office and about £1 million worth of 24-channel equipment is currently in production. GEC is also developing 30-channel PCM equipment in response to the Post Office plan to adopt the European PCM standard – a 30-channel, 2048 kbit/s system – as the basis for extending digital transmission into the main telecommunications network. A 30-channel PCM system will be installed between Liverpool and Formby for field evaluation.

Ferranti Ltd – £750,000 for the provision of three packet-switching exchanges (PSEs). The PSEs will form the hub of a Post Office Experimental Packet Switched Service (EPSS) and will be set up in London, Manchester and Glasgow by 1975.

Standard Telephones and Cables Ltd – £6 million for a new UK-Spain submarine telephone cable, placed by the Post Office and Compania Telefonica Nacional de Espana (CTNE). The 475 nautical mile cable, one of Europe's largest, will run from southern Cornwall to northern Spain. It will be able to carry up to 1,380 telephone calls simultaneously, and is needed to meet the growth of telephone and telex traffic between the two countries.

Robb Caledon Shipbuilders Ltd – £7.5 million to build two new cableships for merchant bankers Samuel Montagu and Co, who in turn will charter the ships exclusively to the Post Office. The two ships, which will be used to maintain shallow water parts of the undersea telephone cable network linking the UK with the rest of the world, will be identical in design and the most advanced of their kind in the world. They will be 310 ft long, with a displacement of 3,500 tons. Their hull design, and extra manoeuvrability from a bow thrust propeller and powered rudder, will make it possible for them to operate in severe weather.

Board change

Responsibility for the Data Processing Service on the Post Office Board has been taken over by Mr Edward Fennessy. This will be additional to his present Board responsibilities as Managing Director of Telecommunications. The appointment follows the retirement from the Post Office of Mr F. J. M. Laver.

NASA thanks

A team of British Post Office communications experts which has played a key role in keeping America's astronauts in touch with mission control at Houston, Texas, has received a special "thank you" from America's National Aeronautical and Space Administration (NASA). The 100-strong team has been congratulated for its "superior achievement" in providing vital communications during Apollo flights seven to 17 in the manned spacecraft programme. Certificates were presented to staff by Mr Larry DeHays, Station Manager of the Nascom Centre (NASA Communications) London.

Since 1958 London has been an important communications control centre for NASA. Tracking stations in the Canary Islands, South Africa, Spain and Ascension Island, constantly monitoring the astronauts' conversations and receiving technical information about the performance of the spacecraft, are linked directly to the London control centre, on the first floor of Electra House, the International Telegraph Office.

Meeting informally

The programme of informal meetings arranged by the London Telecommunications Region for the winter months is as follows: 14 November – "Personnel Management" by G. E. Price, Personnel Controller, LTR; 6 December – "ISOCC – Input System for Operator Controlled Calls" by N. H. Harper, THQ/TFD; 8 January – "History, Development and Present Policy on Telephone Numbering" by G. W. Adams, THQ/OPD; 6 February – "The Post Office Staff Superannuation Scheme" by F. J. L. Clark, the Secretary; and 7 March – "Regional Management – Application of Reserved Powers" by E. W. Weaver, Director LTR.

All meetings will be held in the Staff Restaurant, 10th Floor, Camelford House, Albert Embankment, London SE1 7TS. They begin at 5.00 pm and finish at 6.30 pm, and all Post Office staff are welcome.

Reel service

The development of satellites for carrying telephone calls and the provision of cable highways under the sea are among the wide range of subjects covered by films available from the new film library of Post Office Telecommunications. The library contains 17 short films – most in 16 mm colour – available to borrowers free of charge and highlighting dramatic developments in modern telecommunication and the worldwide benefits for millions of people.

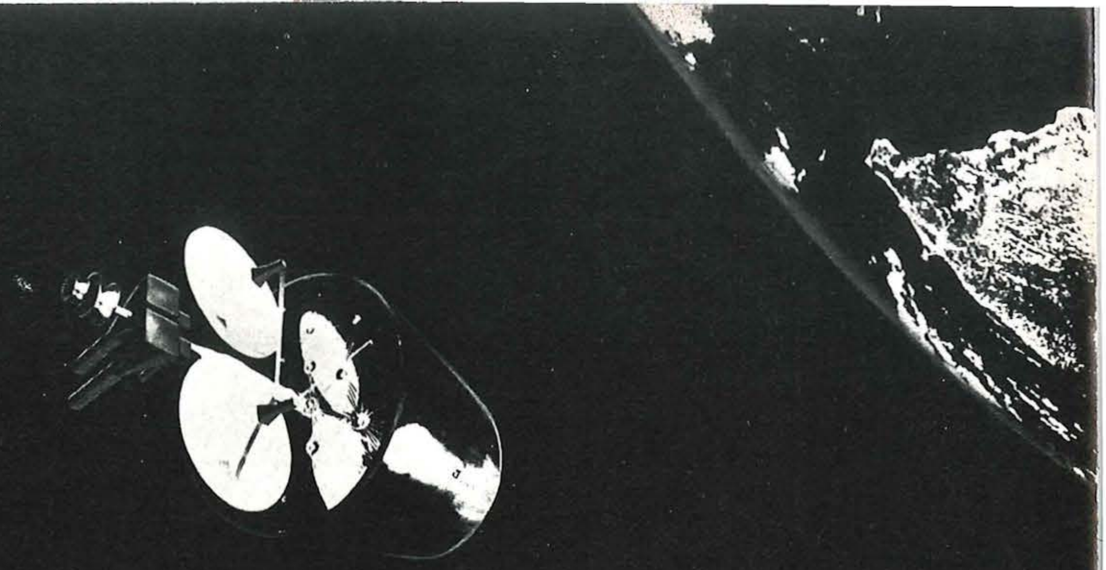
Until recently all films about the activities of Post Office Telecommunications were held in commercial film libraries. Because of the heavy demand for the films – there were 6,000 borrowings last year – the Post Office decided to form its own film library in London so that borrowings may be made from a single source.

The new library holds up to 30 copies of each film. Its address is: Post Office Telecommunications Film Library, 25 The Burroughs, Hendon NW4 4AT. Film bookings may be made by telephone: 01-202 5342.

At the helm

Captain Richard M. Tuckwell (53) is the new commander of the Post Office cableship Iris, replacing Captain D. P. S. Chisholm, who has command of the cableship Alert.

Mr Maurice Bell (54), General Manager of the international telegraph service, has been appointed Principal of the Management College of Post Office Telecommunications. He succeeds Mr Edward Loosemore, who is retiring.



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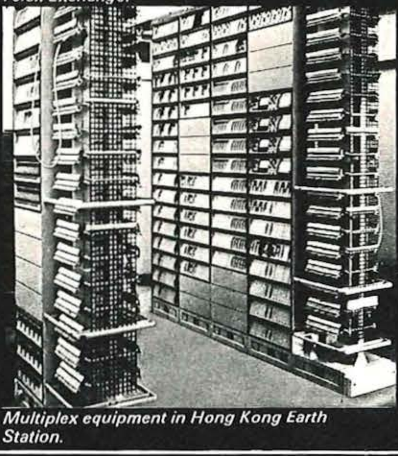

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Contributions:
The Editorial Board will be glad to consider articles of general interest within the telecommunications field. No guarantee of publication can be given. The ideal length of such articles is between 1,000 and 2,000 words. The views of contributors are not necessarily those of the Board or of the Post Office.

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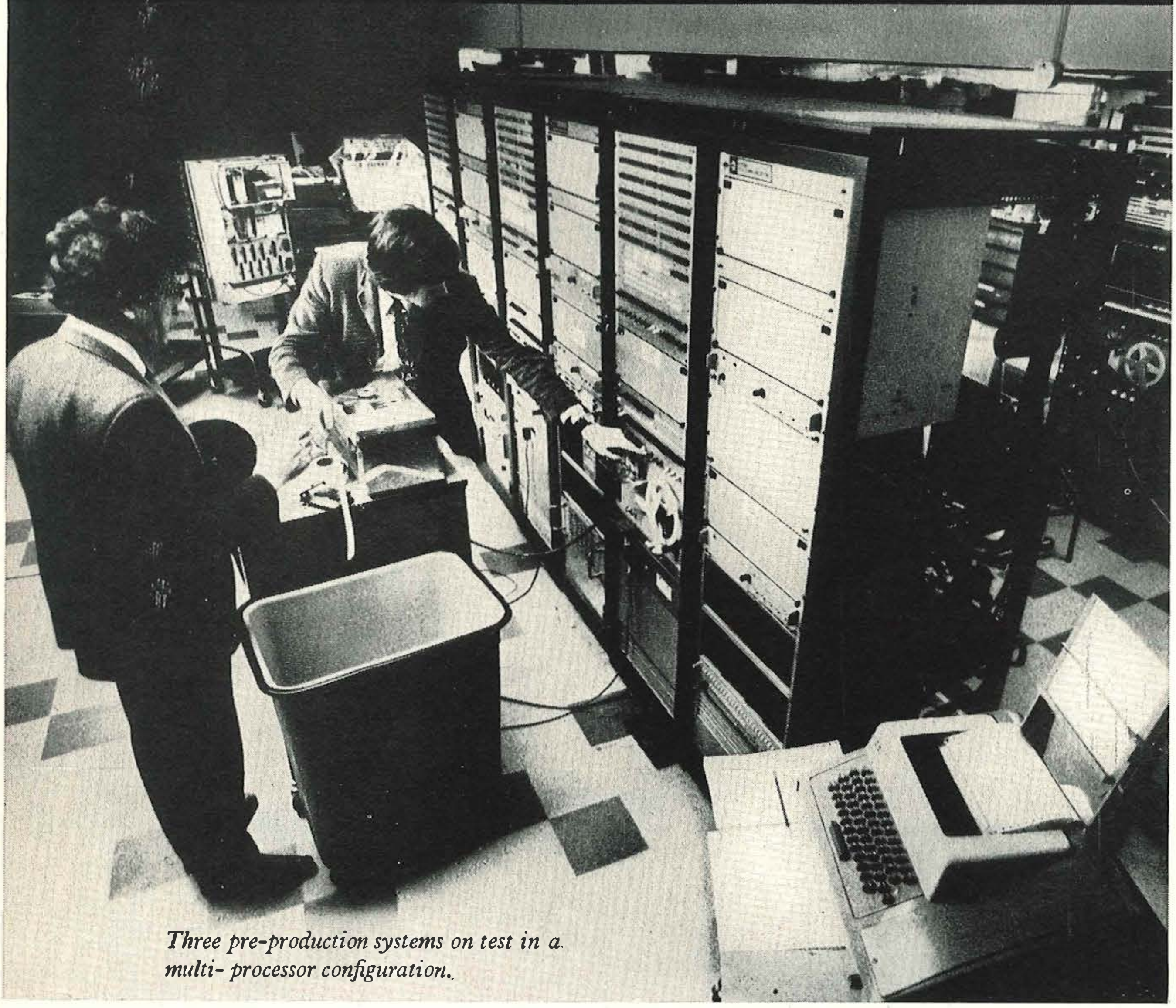

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