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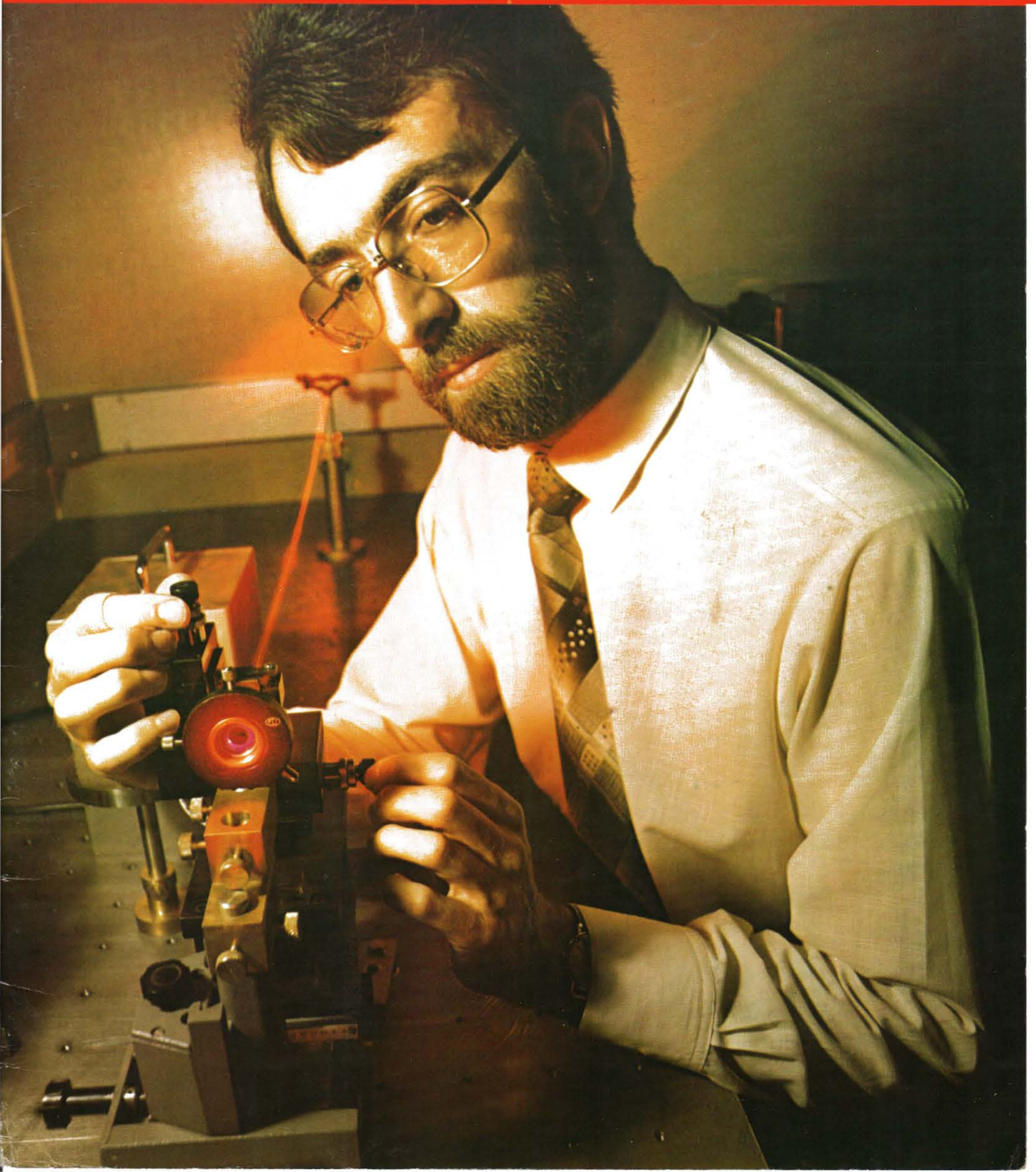

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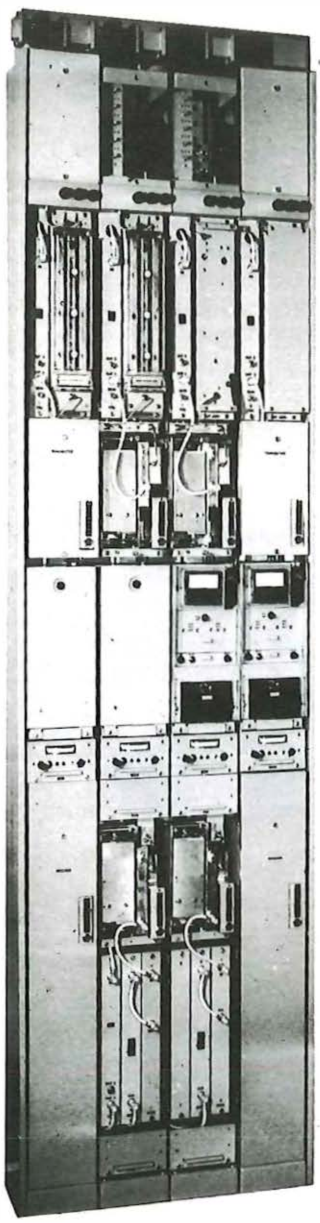

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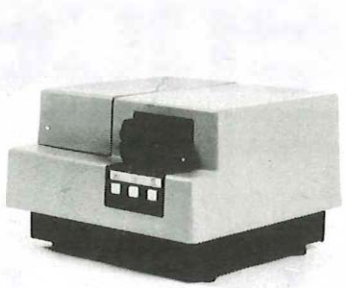

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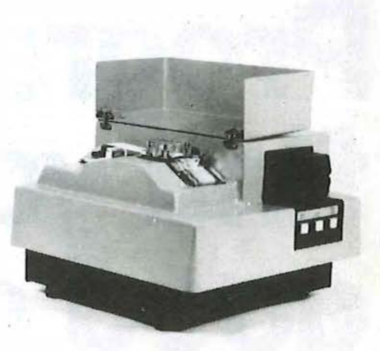

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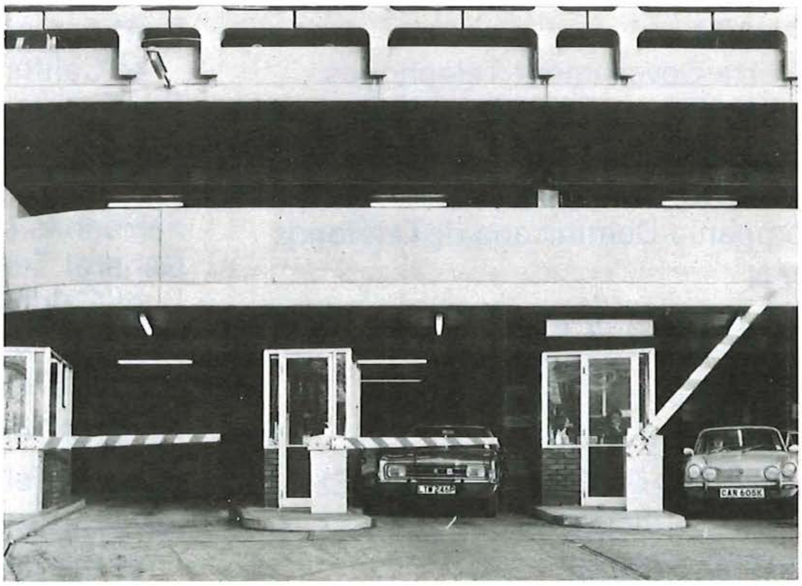

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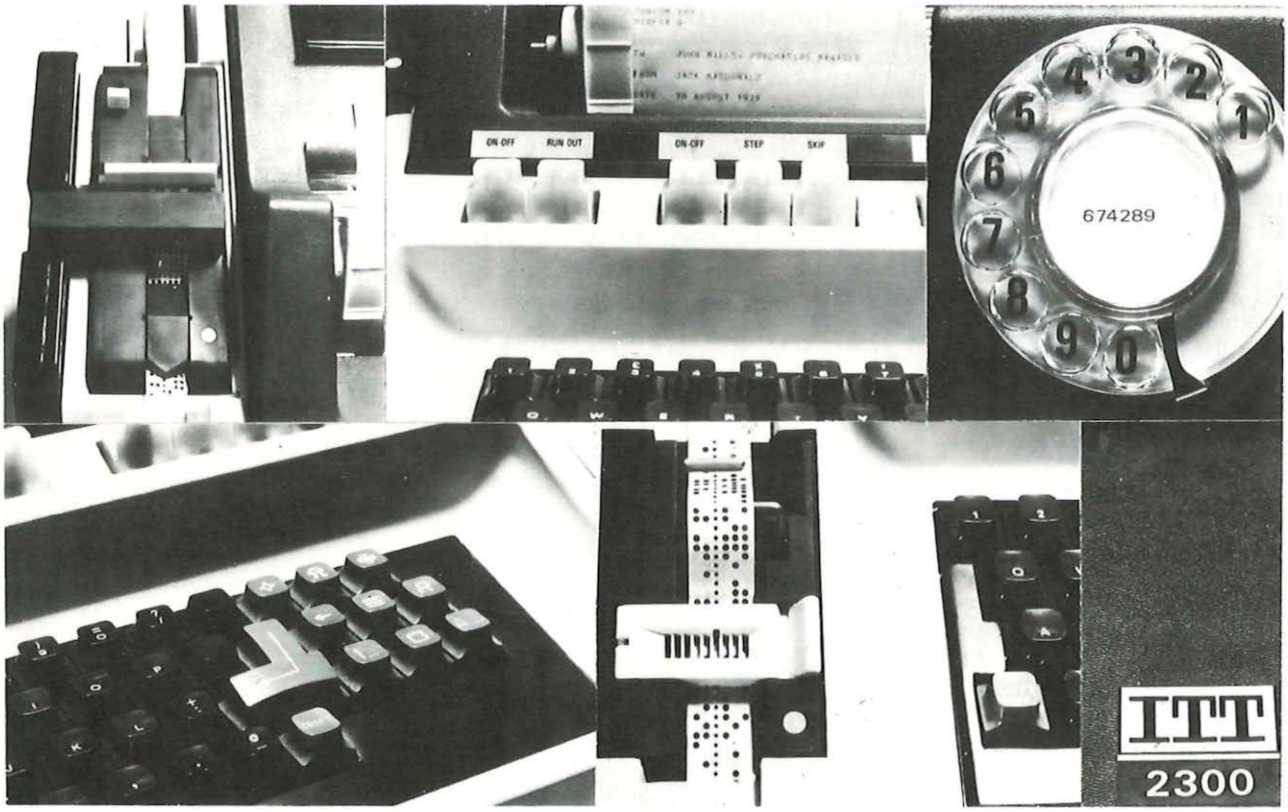

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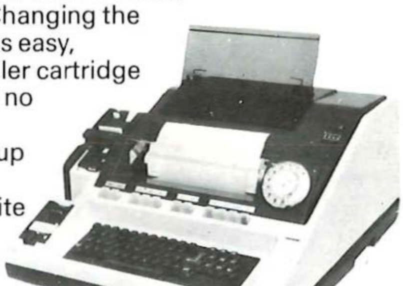

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The Atlantic Crossing–20 years on

The entry into service of TAT 6, the largest capacity transatlantic cable so far laid, not only gives a major boost to Britain's telecommunications links with North America but also throws into sharp focus the spectacular scale of development over the past 20 years in the submarine cable field. The new cable system, with its capacity for carrying 4,000 telephone calls at once, is a far cry from TAT 1 which, in 1956, was the first telephone cable to cross the Atlantic and initially could carry a mere 36 calls simultaneously.

The TAT 6 cable runs from Rhode Island in the USA to St Hilaire, France, and Britain will have the use of about 760 circuits to provide a further route for its main transatlantic telecommunications services. These circuits are extended overland through northern France and then over a new cross-Channel cable which officially came into service on the same day as TAT 6. Running between Courseulles and the Sussex coast, it is the first high-capacity undersea telephone cable to be laid between Britain and France for 25 years.

Twenty European administrations, including the Post Office, and four American companies have shared the £100 million cost of TAT 6. It has been developed jointly by the Post Office, the American Telephone and Telegraph Company and the French Department of Posts and Telecommunications.

Britain's role in the development was to design and manufacture the major part of the cable, develop methods for its jointing and for locating faults, and to specify the mechanical aids necessary for handling the cable. Research work was undertaken by the Post Office, while the United Kingdom cable manufacture was by Standard Telephones and Cables Ltd.

Because fishing fleets are exploiting even deeper waters it was decided to use armoured cable out to the edge of the European continental shelf. This makes TAT 6 the first submarine telephone cable system to have its armoured section laid to depths up to 1,000 fathoms.

The new cable to France can carry more than 2,500 calls simultaneously and is the first of two big cross-Channel cable links between Britain and France being provided jointly by the Post Office and the French Ministry of Posts and Telecommunications. The first cable system, now in use, has been supplied by a French consortium while the planned second system, to be made in Britain by STC, will be able to carry even more calls—at least 3,900 at once.

The second new UK-France cable is expected to be brought into service in 1979. Together, the two cables will not only provide extra capacity needed between Britain and mainland Europe, but will diversify communications as a safeguard against disruption.

(See "Expanding links under the sea", page 11)

Post Office telecommunications journal

Autumn 1976 Vol. 28 No. 3

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

Cover: Considerable progress has been made over the last 10 years in the study of optical fibre transmission systems. Here Dr Ken White of the Post Office Research Department measures loss characteristics of a length of optical fibre using a Krypton laser. (See page 23.)

Preparing the way for 'supercables'

PW Moore

Water is pumped out of the last repeater manhole to be constructed along the route of the 60 MHz duct. The duct ends can be seen just above the water level.

TO HELP meet demand for telephone circuits on major trunk routes the Post Office is preparing to use 60 MHz transmission systems carried on "supercables" between London, Birmingham and Manchester, together with a spur from High Wycombe to Reading. The cables, which contain 18 2.6/9.5mm diameter coaxial pairs – a potential capacity of 97,200 circuits – are the largest ever used by the Post Office, and it has been necessary to provide about 375 km of new duct route through the English countryside.

In the biggest Post Office project of its kind, the duct work has involved constructing more than 1,000 manholes and laying duct along roads and a disused railway, over private land, across riverbeds and even through a disused gas main. Factors that influenced the planning were described in an earlier article (see Telecommunications Journal, Autumn 1973). The aim was to cater for two high-capacity cables throughout and to provide a route which would be subject to the minimum of disturbance.

To provide such a secure route, consideration was at first given to burying the duct for the London to Birmingham section alongside the little used railway between Paddington and Moor Street (formerly Snow Hill). However, the route eventually adopted took the duct along public roads for 186 km and over private land for about 4 km. The Birmingham to Manchester section is about 153 km long of which about 20 km crosses private land. This meant many wayleaves had to be obtained as well as the purchase from British Rail of a disused section of railway, including a tunnel. Nearly all the High Wycombe to Reading spur is on public roads.

The 18-pair coaxial cable has a diameter of 78 mm. The duct must be large enough for cabling operations and allow sufficient space after the cable has been installed to pass nylon rods with a "sniffer" for detecting leaks in the cable sheath. As the internal diameter of the standard duct was insufficient a new PVC duct, with an internal diameter of 105 mm was made available.

The procedure for cable maintenance in the event of damage is to excavate at the affected point and repair the cable in situ. To help with identification when excavating, the duct was provided in a light grey colour for the first cable and black for the second.

Extra ducts have been provided at locations where it is not feasible to lay cable along the surface temporarily to bypass a damaged section awaiting repair. Extra duct has also been provided in order to eliminate the need to position heavy cabling vehicles at manholes where access is difficult.

The operational bores have been placed with the maximum horizontal separation that trench width would allow (typically 300 mm between centres), and below the maintenance or cabling bores. Duct for the 60 MHz routes has normally been laid at a depth of 1.2 m rather than the normal depth of 350 mm in footpaths and 600 mm in carriageways. And as an additional precaution, the presence of the duct is identified by a green polyethylene tape positioned over the duct and about 300 mm below the surface. The tape is marked "CAUTION HIGH VOLTAGE TELEPHONE CABLE BELOW".

Where it has not been possible to lay duct with a cover of 1.2 m, steel duct has been used. The standard steel duct will accommodate both the cable and the "sniffer", and it can be directly connected to the new PVC duct. An epoxy paint was applied to the interior surface to give a smooth lining to assist pulling-in of cables.

Sharing of the trench dug for the 60 MHz cable ducts with other Post Office ducts has generally been accepted as this reduces overall cost to the Post Office and inconvenience to the public. In general the additional requirement was for a few ducts for rural exchange development, but in congested urban areas up to 96 ways for general use were laid at the same time. Careful consideration was given to the arrangement of these ducts so that the 60 MHz route was offered some protection by the others while at the same time being accessible for maintenance. Altogether, a common trench was utilised for just under 100 km of the total length.

The duct route was planned catering for the need to provide manholes at 1.5 km intervals to house the 60 MHz repeaters. As most of the route followed public roads there were frequent bends, and the need to avoid existing underground plant, as well as to site each manhole in a safe position for personnel entry, caused further deviations.

Development work carried out before planning the route had made it possible to calculate the effect of each bend on

Above: A temporary dam had to be built across the River Brent in west London to allow the duct to be laid in a riverbed trench.

Below: At an Uxbridge roundabout the duct is prepared for its passage under the roundabout via a disused gas main.

cable pulling tension and thus the maximum length of cable that could be drawn in without undue stress. In favourable conditions this could be about 500 mm, and the ideal arrangement was to provide two intermediate manholes between repeater points, giving three cable lengths per repeater section. Unfortunately, it was only possible to do this on 102 of the 266 sections.

A field trial of various prefabricated manholes including a steel cylinder or silo, to house the 60 MHz repeaters, showed that these would provide satisfactory structures but their size was likely to cause installation difficulties, particularly at congested locations. All manholes for the routes were, therefore, constructed on site.

Three designs of jointing manhole were used for specific situations: straight joints, joints between lengths entering the manhole at right angles to each other, and for a T-junction as required at the lead-in to buildings. At a few locations the jointing manholes had to be designed to meet local conditions.

All the repeater manholes were constructed to a single design which provided a larger than normal entry so that the case housing the repeaters could be easily lowered into place. The repeater cases are made of cast aluminium with an outer protective coating of nylon. To provide additional protection against corrosion, however, four magnesium anodes were buried below the ducts at either side of the manhole and leads provided into the manhole for connection to the case.

The manhole cable supports are unconventional in having adjustment in all planes so that they can be precisely positioned. They were made from commercially available galvanised steel channel and are attached to bolts set in the manhole wall. Cable clamps fastened to the bearers can be rotated to align with the cable.

The location and alignment of ducts entering manholes were carefully checked and each duct was tested by passing through, in both directions, a cylindrical brush followed by an iron test mandrel. Any obstruction was then investigated and cleared.

Where difficulties occurred in identifying or locating minor irregularities a measuring instrument was used with spring loaded probes at the leading end and a wheel driving a recorder chart at the other. As they passed through the duct the probes determined the internal dimension and a pen marked the information on the chart, thus giving a printed record of the size of any irregularity and its distance along the bore.

On completion of construction and testing an accurate measurement of the length of duct between manholes was made by passing a marked steel rope along a bore prior to positioning a draw rope in each duct.

To ensure access for heavy cabling

A mechanical digger channels out the final stretch of trenching necessary for the 60 MHz duct in north west London.

vehicles to manholes other work was often necessary. Hard standing or lay-bys had to be provided next to some holes and several short roads had to be constructed. Along the disused railway section the embankments had to be repaired. On the private wayleave sections fencing was required during the construction work and a number of gateways on the duct route also had to be enlarged.

Conventional techniques were used as far as possible and most of the route was provided by trenching. Where this could not be done, for instance at motorway and railway crossings, tunnelling or auger boring became necessary. There were, however, a few unusual features such as the construction of a temporary dam across the River Brent in West London by using portable steel frames covered with sheeting. This was to allow the duct to be laid in a trench across the river bed.

At a large roundabout near Uxbridge the duct was taken under the road through a disused gas main and throughout the 540 m disused railway tunnel the duct was laid in the ballast. Where the route crossed a reservoir dam that was expected to continue settling for a number of years the ducts were provided with expansion joints.

Each route was divided for contract purposes into lengths expected to require six to nine months' work, and this resulted in 84 contracts being placed with 15 different contractors. In general the work was completed in the scheduled time, but the unusual nature of the route did result in some unexpected delays. During work on a moorland section near Buxton, for instance, unmapped mineshafts were discovered and work was suspended while investigations, including an aerial survey, were carried out to ensure that all such shafts had been located.

Near Stoke-on-Trent 8 km of the route consisted mainly of rock and the work took more than a year to complete. For five months, while a tunnel was constructed under the River Wye at High Wycombe, water had to be pumped out of the subsoil continuously at a rate of 200,000 litres per hour.

This was the first time this century that completely new duct routes have been provided between London, Birmingham and Manchester. High standards have been achieved throughout by the close attention of Post Office planning and works staff in Telecommunications Regions and Telephone Areas and the close co-operation of contractors carrying out the duct work.

Mr P. Moore is an Executive Engineer in Network Planning Department at Telecommunications Headquarters and a member of the team responsible for the 60 MHz duct installation.

Staff from Harwell were quickly on the scene when chemicals were spilled following this road accident in Oxfordshire.

THE DATEL FORMULA FOR CHEMICAL SAFETY

FR Harris

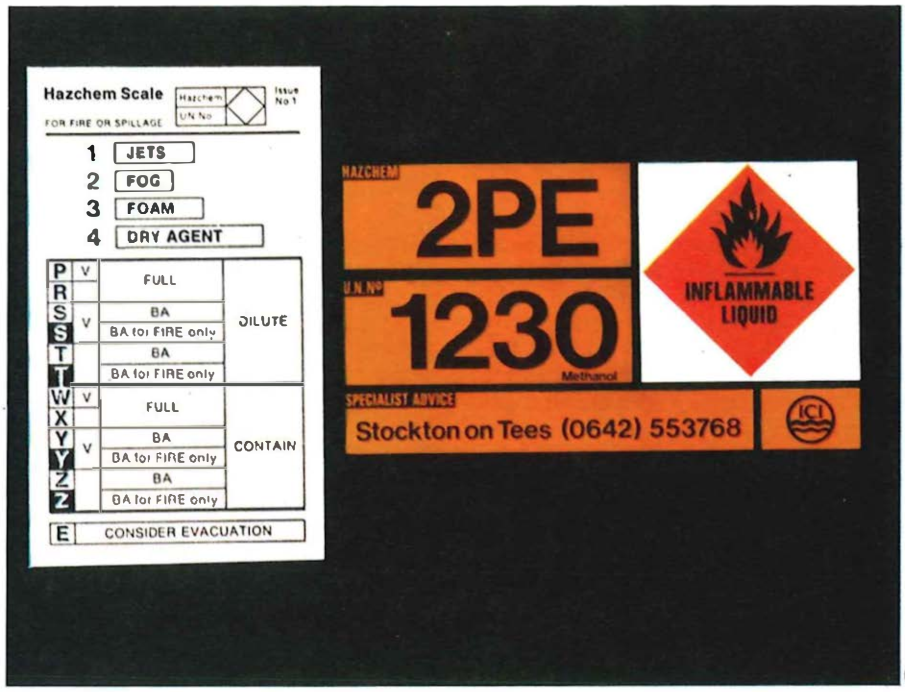
EVERY YEAR nearly 40 million tons of chemicals, many of them inflammable, explosive or toxic, are carried by tankers along the roads of Britain. In addition, huge quantities are transported in drums and bottles. The possible consequences of an accident involving one of these vehicles are obvious.

To help protect the public from this danger the Department of the Environment has, for more than three years, been trying to formulate new legislation. Now Post Office Datel services are soon likely to be playing a major role in a scheme which will make the handling and carriage of chemicals much safer.

Heart of the operation will be the Harwell Laboratory of the United Kingdom Atomic Energy Authority, which is deeply involved with emergency situations through its hazardous materials service. Here a special "Chemsafe" Centre was established in 1973 and has since been building up a computerised data bank of British and European brand names to give round-the-clock assistance in identification.

The Centre currently operates over the telephone system and an operator has to write down questions, feed them into the

An example of the HazChem panels displayed on some vehicles. The digit signifies what fire fighting agent is to be used, and the first letter shows the precautions to be taken. The letter E signifies that evacuation may be considered.



computer and then read over the answers. The plan, called HAZFILE, is to install a central computerised system in the "Chemsafe" operations room, and for the Post Office to set up direct Datel 600 Service links to emergency services' headquarters and other interested organisations throughout the country to provide quick, reliable access to the computer.

High reliability and availability will be provided by operating the computer system 24 hours a day. It will be permanently connected to the public switched telephone network via exchange lines and Datel modems – equipment which converts digital signals into speech type signals for transmission over exchange lines. A modem at the distant end converts the signals back to digital signals for input to the user's terminal.

Organisations using the new facilities – fire brigades, ambulance centres, other emergency services and probably commercial firms – will be equipped with a visual display unit (VDU) and associated keyboard, linked to a modem. A user will first type out his query, then call up the computer centre and press a "send" button on his VDU terminal to transmit the message.

The modems at the computer centre will automatically answer any call and give direct access to the computer. If the system is out of service for any reason, the user will be diverted to a duty officer. Answers from the computer will be displayed on the VDU screens of the users making the enquiries.

To ensure that valid information about all hazardous chemicals is available the prototype emergency data bank developed at Harwell will be improved. This data bank currently consists of more than 4,000 documents, collected through the "Chemsafe" scheme, each covering one material.

The need for a better scheme to deal with the movement and possible spillage of chemicals has become more urgent in recent years as more and more consignments go by road. Most chemicals present different hazards and need treating in different ways, and when two or more mix a whole range of new hazards present themselves.

Several voluntary marking schemes for tanker vehicles have been introduced, the most widely used being HAZCHEM, which was devised in part by the London Fire Brigade. HAZCHEM markings on road vehicles use a simple code to identify a tanker's contents, indicate to firemen how to handle a spillage, and give an emergency telephone number for contacting the manufacturer. Limitations of the scheme mean, however, that it applies to bulk loads only – no drums or bottles – and it has not been adopted by other countries in the European Economic Community, from where many of the vehicles travel.

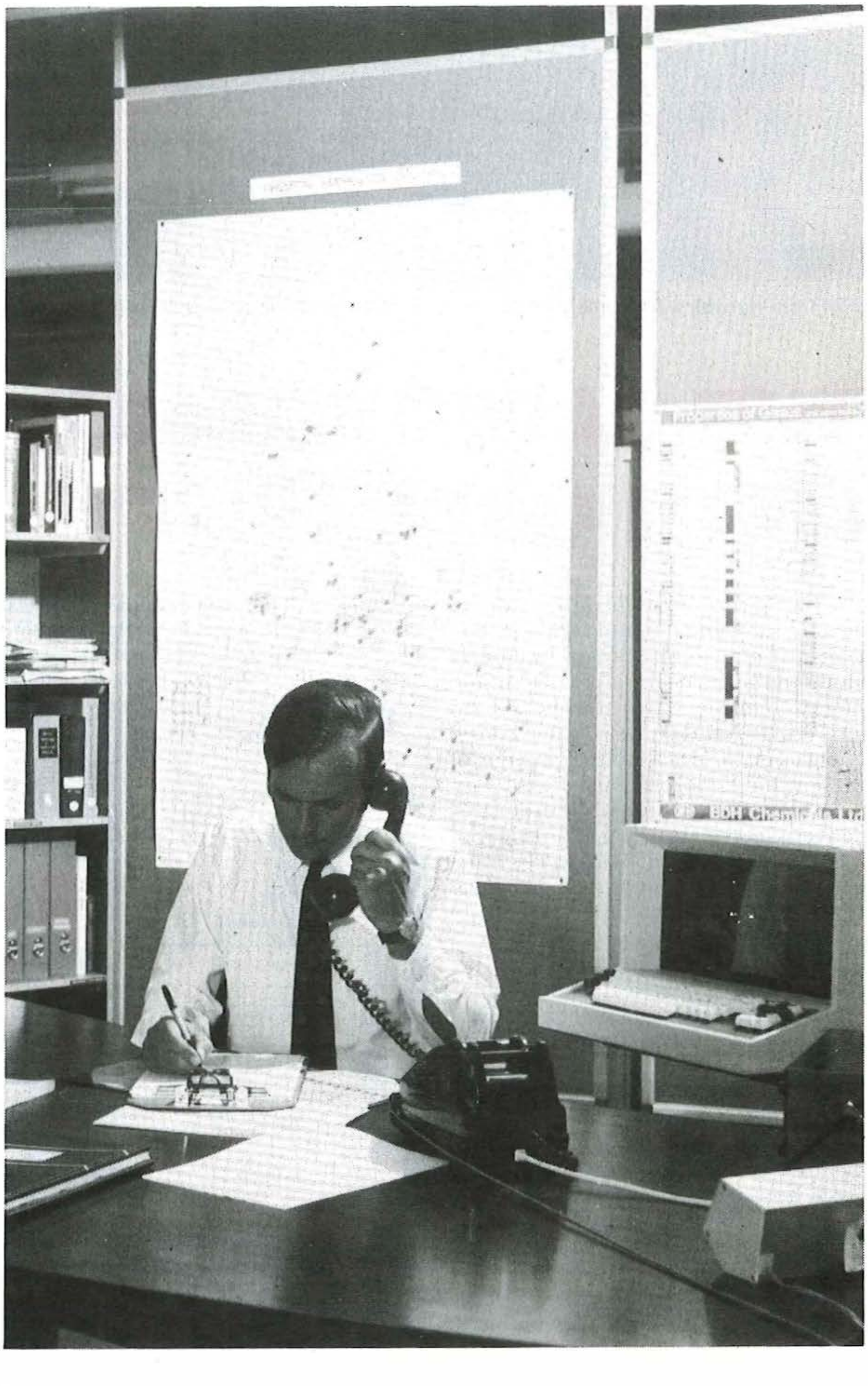
With some 10,000 hazardous materials to allow for, it can be seen that there are immense difficulties. Indeed, a survey made by the Suffolk and Ipswich Fire Service during 1975 showed that on one major trunk road alone an average of eight hazardous loads per hour were recorded, most of which displayed inadequate, if any, markings.

Two main problems face organisations concerned with the safe passage of chemicals. First there is the need to prevent accidents and, second, if one occurs to ensure that the resultant emergency is competently handled.

The differing nature of these problems is reflected in a need for two distinct kinds of information – a fast message on demand and then a detailed advice statement transmitted on request. The fast message must be simple, short and transmitted in readily understood language. The detailed advice statement may come more slowly and should cope with the wider implications of the material or incident. Its information content should be arranged in an order of priority, appropriate to the particular user.

For organisations concerned with the movement, storage and handling of chemicals, for example, the fast message might relate to the acceptance of goods and specifications of conditions, followed by detailed advice on safe storage, movement and handling, crew instructions and so forth. For emergency services, the fast message might need to indicate methods of containment using

Mr Bob Cumberland, operations manager, at the control desk in the Harwell Chemical Emergency Centre. The visual display unit at his left elbow is the means of accessing the computer.



immediately available resources and then details on safe disposal, decontamination of property and equipment and treatment of injured persons.

There are three separate information tasks involved in handling a hazardous materials problem. First there is the need to identify the material, then formulate a rapid action response and provide a detailed advice statement.

Individual problems will dictate whether all or part of the information is needed and the order in which it is to be provided. If the material is marked with a HAZCHEM code, for example, then the rapid action response is immediately and simply available to the emergency services. Thereafter the material must be identified before detailed advice can be obtained.

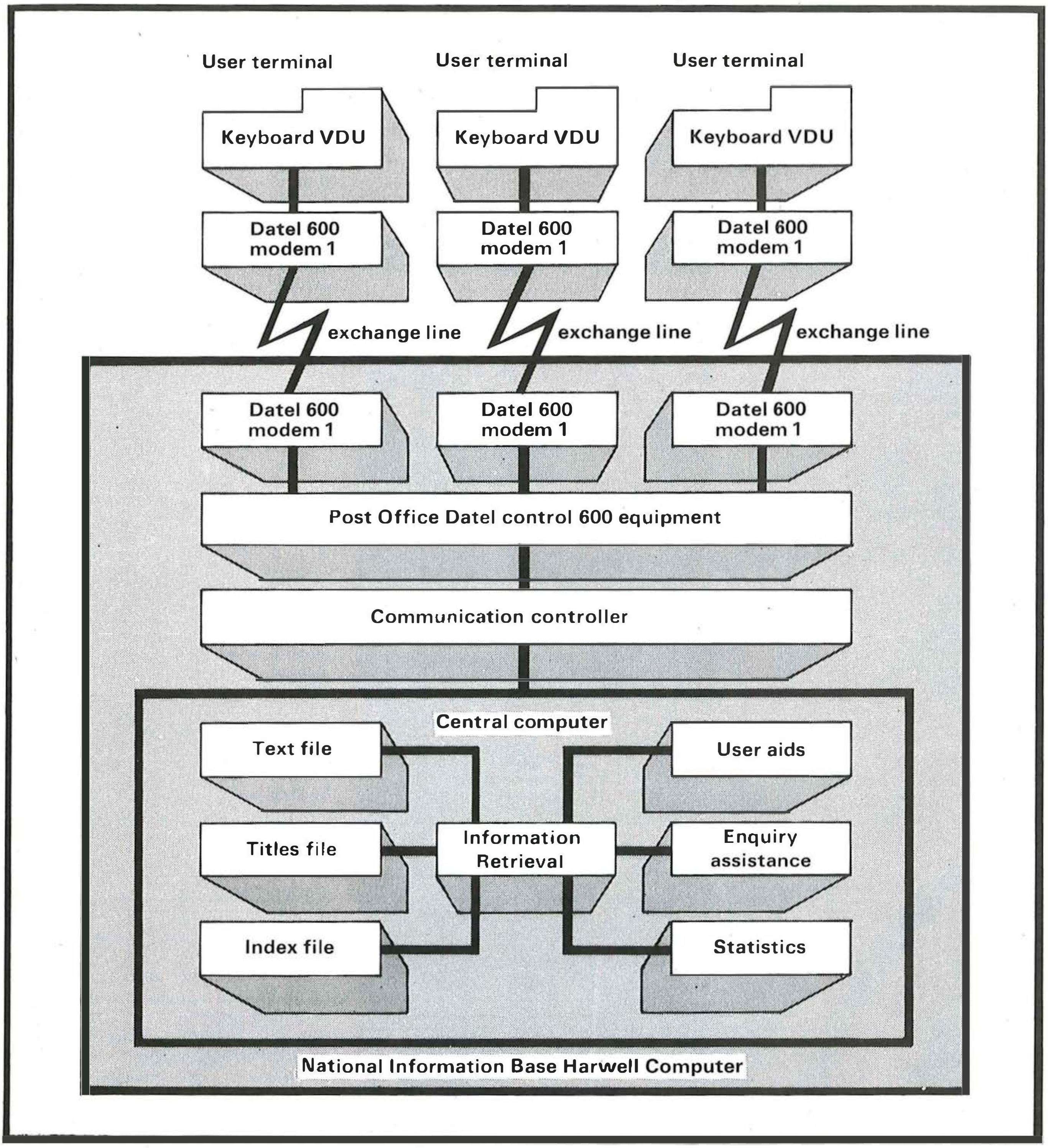
It was to discuss all aspects and possibilities of a more efficient, more meaning communications system that the Post Office was invited to a special conference at Harwell earlier this year. In all more than 200 delegates from more than 80 different organisations attended and the Post Office representatives were able to explain the value of Datel Services in providing quick, reliable access to a central computerised system.

The initial requirement is expected to be for about 180 terminals for the emergency services but it is likely that many commercial companies involved with the handling, moving and storage of hazardous chemical materials will want connection to the system once it is available.

All the equipment, both at Harwell and the distant ends, will be co-ordinated by Eastern Telecommunications Region where staff working on the project will contact Telephone Area General Managers throughout the country advising them on what to provide and when. It is hoped the scheme will become fully operational during 1977.

Mr F. R. Harris is Eastern Telecommunications Region's Datel Marketing Officer and is responsible for co-ordinating the new service.

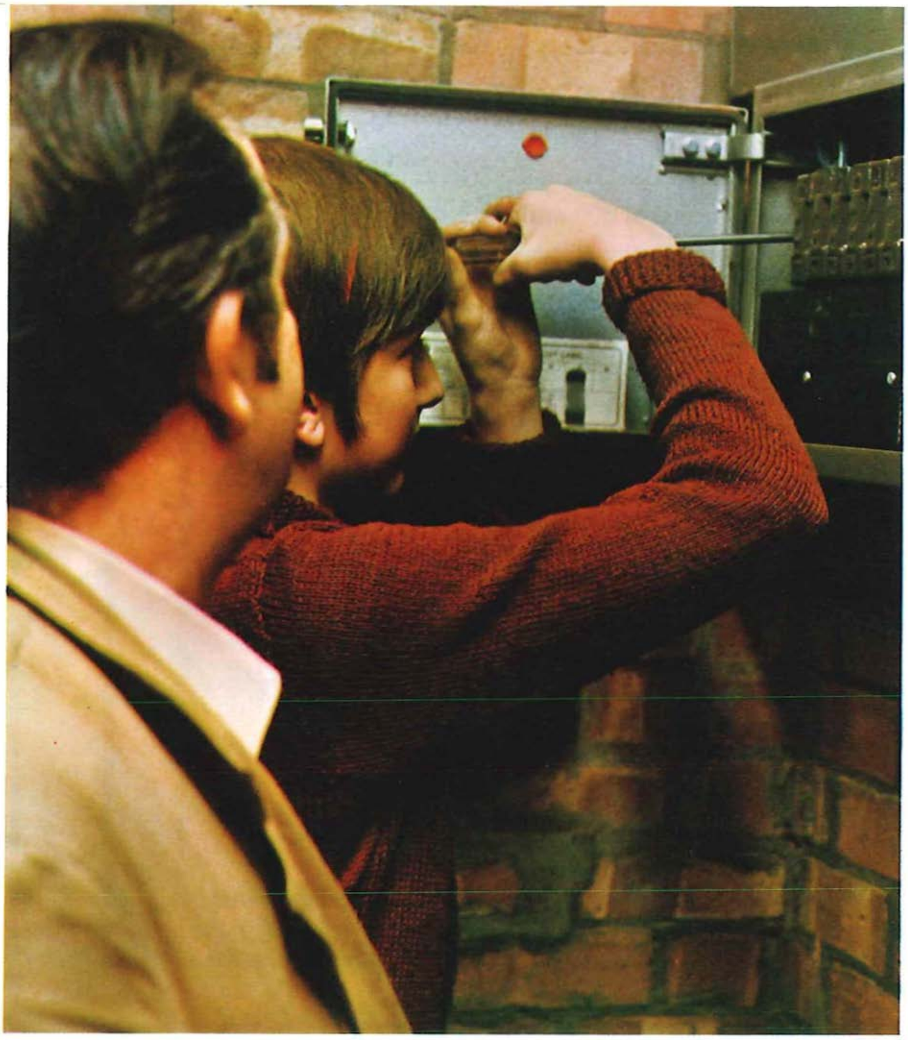
PO Telecommunications Journal, Autumn 1976



It's just the JOB

AW Hurley and RC McTurk

A youngster receives practical instruction from a member of the staff in the power division of Cardiff Telephone Area.



AT A TIME when unemployment figures still top the million mark and jobs are at a premium it is easy for the school leaver to drift casually into the first job that becomes available. And often who can blame him?

But even when the labour market is not in the doldrums probably very few school leavers really know very much about the jobs open to them and – perhaps just as important – the working environment generally. To help overcome this problem Post Office staff in Cardiff Telephone Area, in conjunction with the South Glamorgan Education Authority have been helping run a series of highly successful Work Experience courses for local fifth form pupils.

Careers nights, open days and parents meetings are a common feature of the school calendar, but the raising of the school leaving age to 16 has created special problems which the Education (Work Experience) Act 1973 was designed to overcome.

The Cardiff courses, worked out mainly by Area staff themselves, involve pupils working alongside staff at switchboards, in drawing offices, in general offices and even in motor transport workshops. They are purely to illustrate what type of jobs exist and are in no way meant to be a recruitment exercise.

To ensure the success of any Work Experience scheme, of course, the fullest co-operation of all interested parties is essential, and must include Education Authority advisers, careers advisers, head teachers, industrial training officers and management. It is their responsibility to see that correct liaison exists between the school and the organisation offering work experience. Preparatory training must be given at the schools, and sufficient opportunities made available to give the pupils a choice of jobs in which they can participate. It is also vital that the pupils understand the relationship between schoolwork and employment.

Union representatives should also be consulted because the pupils are under the supervision and care of individual employees who in turn need to know the purpose of the scheme and the extent of their responsibilities towards the pupils. The final link in the communication chain must be the parents, who need to have a clear idea about the purpose of work experience.

Cardiff Area's participation developed from the many open day visits during which groups of schoolchildren visited telephone exchanges on a series of conducted tours and talks. These were mainly with an emphasis on recruitment and a more ambitious exercise, aimed at boys interested in making Telecommunication Engineering a career, was undertaken in the summer of 1974. Twelve boys selected from local schools and chosen by the Careers Advisory Service attended and their only criticism

A computer liaison officer in Cardiff Area demonstrates the workings of a computer terminal.

A fifth former tries his hand at a lathe in one of Cardiff Telephone Area's mechanical workshops.

was that it was too short and there was not enough "live" work.

At this stage it was not the Area's intention to extend this type of training beyond potential Telecommunications Technician Apprentices, and there the matter might well have rested but for the Director of Education for South Glamorgan, Mr F. Adams, giving his views on Work Experience in the local evening paper. He raised many questions which led to a meeting at which it was decided that Cardiff Telephone Area would run a pilot course in conjunction with a nearby comprehensive school. It was also agreed that any such scheme would not be biased towards telecommunications, but would exploit the capability of the Area to offer a wide range of jobs comparable to those outside the Business.

A committee was set up chaired by the Deputy General Manager, consisting of Head of Personnel, Training Officers from around the Area, the mathematics and physics advisers for the Education Authority and the school careers master. The aim of the committee was to run three pilot courses, each lasting a week, with 12 students in each group, to start in February 1976 and be completed by mid-April 1976.

Early meetings involved general discussions on how the course should be structured and it was decided to include as much practical work as possible. This resulted in a programme of one day's induction, three days of practical work, and the final day being split between a joint morning session and an advisory /debriefing session in the afternoon. It was also decided not to rotate the pupils round the different work situations but to concentrate on one particular aspect of work.

Once job descriptions had been settled each training officer concerned drew up the necessary syllabus in conjunction with the operational group concerned.

It was also agreed that the first day would be used to introduce pupils to the concept of work and its associated responsibilities. They would also complete specimen job application forms and these would be used on the final day in a session on how to apply for a job and how to conduct oneself at an interview.

By Christmas 1975 all the preparatory work was completed. Training officers had visited the school to meet the pupils, and the school arranged a parents' night. The scheme was also presented to the Unions, and all the supervising officers involved in accepting pupils in their operational group received a personal letter and attended a group meeting to discuss any problems. By then this had become the biggest scheme that South Glamorgan Education Authority had encountered in Work Experience.

From the first course it became clear that less talking and more practical work was the order of the day, while the second course was restructured to increase the practical work by a further half day. The opening day also included a syndicate exercise on "Responsibility – Worker and Employer". This mix proved about right and was used on the third course. Later a fourth course was run at short notice to make sure that on a routine basis the courses would have no adverse affect on the day to day operations for the school and Business.

On the final afternoon of each course a young Clerical Assistant and a final year Trainee Technician Apprentice took part speaking about their jobs and answering questions on their careers so far. The highlight of each course was the presentation of a certificate which indicates the pupil has attended a Work Experience Course and the type of work undertaken.

A total of 51 pupils attended the four courses. Their behaviour was exemplary, and their desire to get on with the task in hand was encouraging. The pupils were all aware that this was not a recruitment exercise, and general opinion was that one week was not long enough for all they wanted to do.

Reaction from the school authorities was also encouraging and they reported marked increases of interest in school work. It is known, too that many of the pupils have been successful in obtaining jobs – in a depressed labour market – and have used the advice given to conduct themselves in a mature manner when attending for interview.

And now what of the future? Cardiff Area have agreed that for the experiment to be worthwhile, courses will be run between October 1976 and February 1977 at the rate of one per month. The school will meet out-of-pocket expenses, and the Education Authority will look at the scheme again with a view to encouraging other employers to join in similar ventures.

The South Glamorgan Education Authority have, in fact, been so impressed with the success of the scheme that formal committee papers are to be submitted to the Youth Employment Committee. In addition a seminar is planned to which the Authority will invite major business organisations in order that they in turn can be persuaded to participate in the scheme.

It would, of course, be ideal if all senior pupils could take part in Work Experience Courses because this would ease the transition from classroom to work environment.

But perhaps the highest compliment to the scheme came from Post Office staff themselves who were involved. The general reaction was: "I wish I had had a chance like that".

Mr A. W. Hurley is Deupty General Manager in Cardiff Telephone Area and **Mr R. C. McTurk** is head of Personnel. Both have played leading roles in organising the Work Experience Courses.

Girls make the grade

EXCHANGE apparatus rooms, equipment racks and roadside manholes are no longer the preserve of mere males. As a result of the Sex Discrimination Act, several young women throughout the country have begun Post Office careers in grades that were formerly exclusively for men.

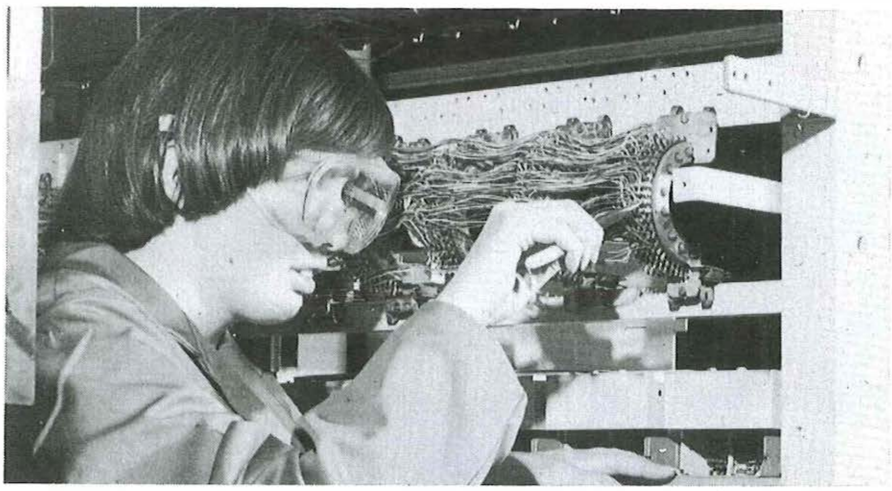
In North Central Telephone Area, for example, 17 year-old Michelle Salle made history by becoming the first girl in London Telecommunications Region to be accepted as a Trainee Technician Apprentice. The three-year TTA course includes attendance at technical colleges and Post Office regional training centres. There is also practical work in the field on external cables, customer apparatus and internal maintenance and construction.

Other girls in LTR quickly followed Michelle's lead in passing the selection board in competition with boys in the same age group. And in the North Western Telecommunications Board Mrs Hazel Hughes, 29, has become the first woman Technician 2A. Formerly a drawing office assistant, she is now one of two signwriters in Manchester Central Area.

The Sex Discrimination Act is not all gloom for the men, however. In the LTR, for example, 16 year-old John Cousins has become a junior drawing office assistant – previously a grade exclusively for women.

Michelle Salle receives some practical instruction from Technical Officer Colin Sharp at a City Telephone Area exchange in London.

Miriam Conheeney, a Trainee Technician Apprentice, tackles exchange work in London's Centre Area training school.



Expanding links under the sea

MJ Ansell

Poles are laid out on the beach at Cuckmere, near Eastbourne, to bring ashore the first high-capacity undersea telephone cable to be laid between France and Britain for 25 years. The cable came into service in September.

BRITAIN'S dependence on submarine cable systems to help meet ever increasing demand for international communications is evident from the rapid increases both in the number of systems and circuits per system being provided. Six years ago the Post Office was providing systems with a capacity of 480 circuits of 4 kHz bandwidth. Since then large increases in circuit capacity have been achieved by exploiting transistor and cable technologies. In the Spring of 1977, for example, a cable system to Belgium will be brought into service which will add a further 3,900 telephone circuits to countries in the European Economic Community.

Development of United Kingdom submarine cable systems from the beginning of the 1970s has, in fact, evolved in two stages. First an approximate tripling of bandwidth from earlier 5 MHz systems to 14 MHz gave an increase from 480 to 1,380 telephone circuits of 4 kHz, and now the development of 45 MHz systems will give a further increase of over 2,500 circuits.

The 45 MHz systems can carry 4,140 (4 kHz) or 5,520 (3 kHz) telephone circuits in one cable and still meet stringent internationally agreed requirements. Systems between the UK and continental Europe normally employ 4 kHz circuits, but 3 kHz is used on transoceanic cables where submerged plant accounts for a high proportion of the total cost.

Transistor developments by the Post Office Research Department have made major contributions to these advances in cable systems. The transistors are incorporated into electrical circuits that are housed in repeaters which are spliced into the cable at regular intervals to amplify the telephone signals. Having developed the highly successful silicon planar transistor (type 4A) used in the repeaters of 5 MHz systems, ResD followed this with a type 10A for use in 14 MHz repeaters. These transistors have a reliability such that they should not cause more than one repeater failure in 20 years. For a transatlantic system this implies a transistor failure rate of not more than one in 4,000 over that period.

Now ResD has developed a type 40 transistor with exceptional reliability for use in 45 MHz systems. To gain the necessary stability when many amplifiers are connected in tandem, the transistors have parameters that are specified to many times their working frequency and the type 40 has performance ratings up to 4,000 MHz.

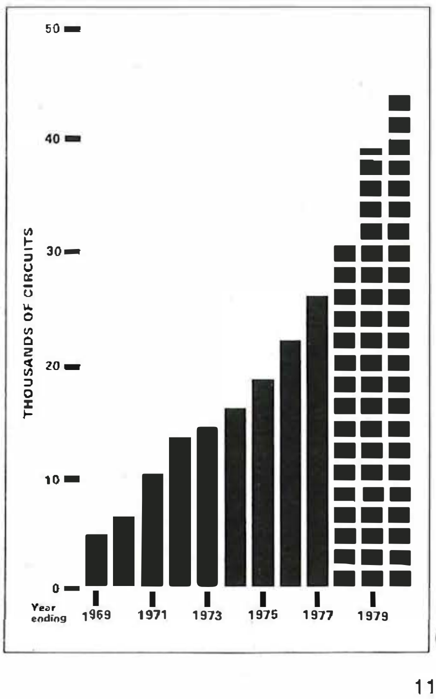
Lightweight coaxial cable developed by the Post Office, and first used in 1961 for the CANTAT 1 telephone cable laid between the UK and Canada, has also kept pace with technology. New polyethylenes which result in a lower loss of transmitted power are now being used to manufacture cables to tolerances that would have been considered impossible a few years ago.

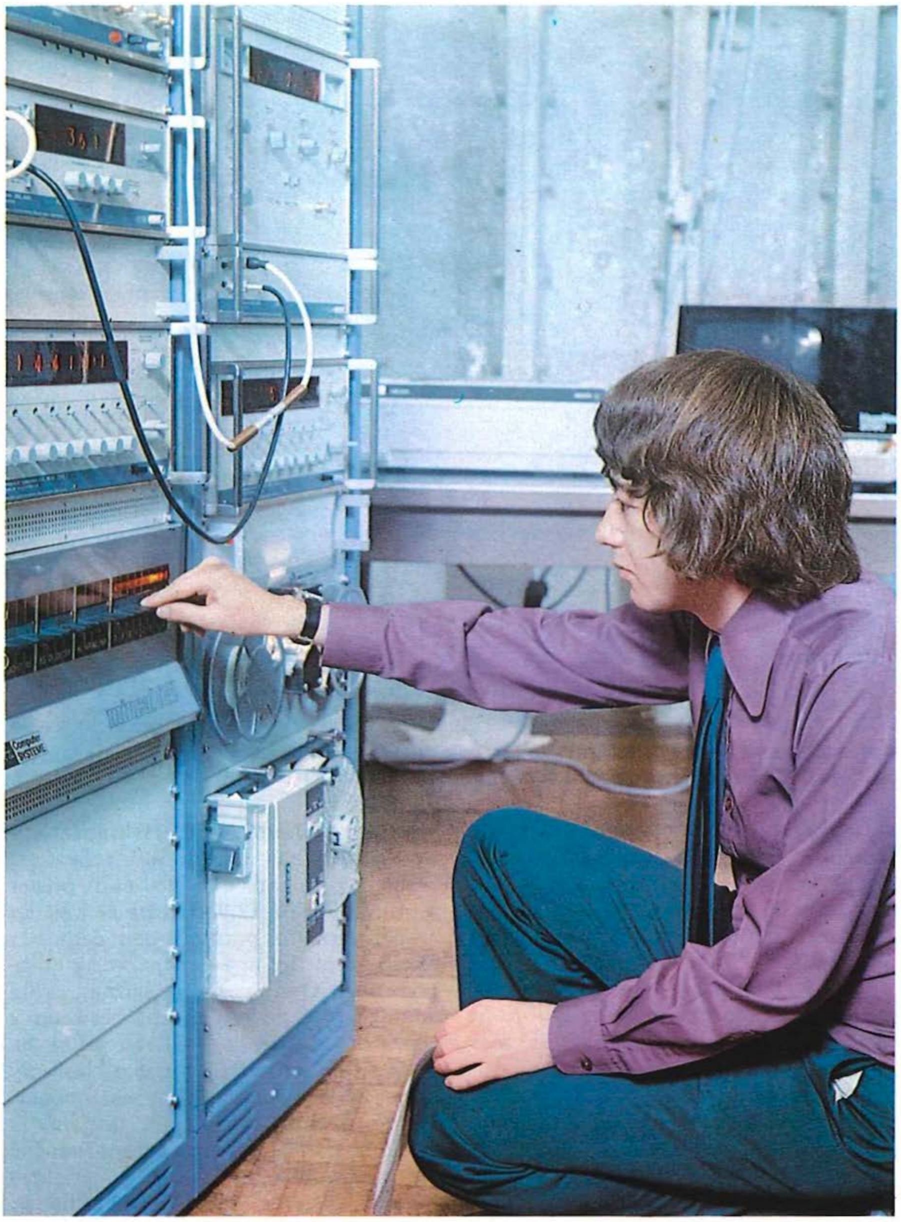
One of the factors governing cable loss is the cable diameter, and this is therefore related to repeater gains and spacing – by increasing the cable size the number of repeaters can be reduced. The final balance between cable size and repeater gain is an economic decision that is bounded by practical considerations such as handling and cableship capabilities.

Direct current is fed over the cable to the repeaters, and in each one power is split from the speech signals by power separating filters. A 14 MHz transatlantic system has about 500 repeaters, resulting in an end to end power requirement of 12,000 volts at half an ampere, and this puts stringent demands on some of the power separating components. Owing to possible cable damage, the power circuit between a repeater's separating filters must be extensively protected against the very high power surges, that can occur. Without this protection transistors could be damaged to the extent that the repeater would fail.

When systems with bandwidths in excess of 5 MHz were introduced it

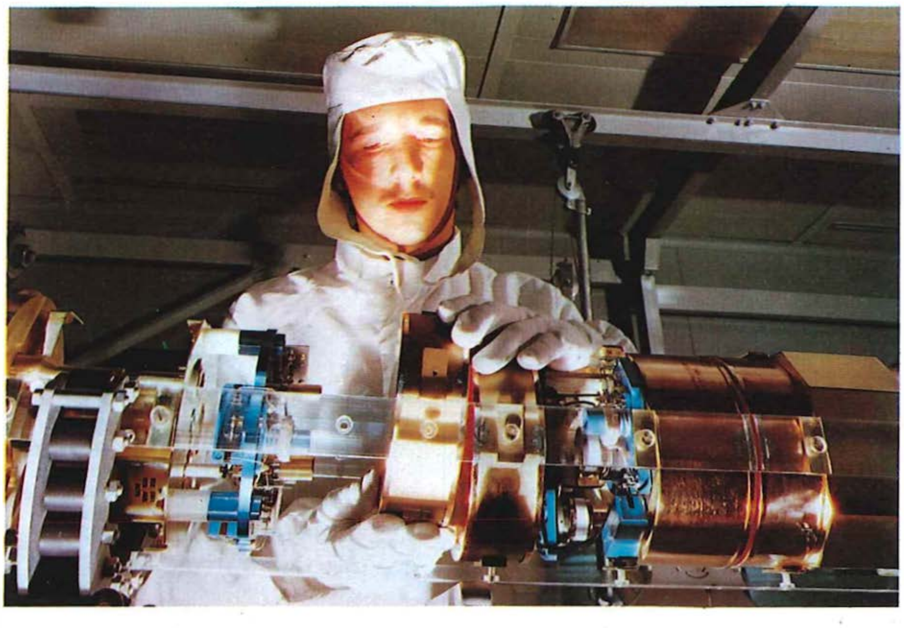
Total number of UK submarine cable circuits.





Above: Peter Clark, an Assistant Executive Engineer, sets up the computer controlled test equipment that will be used on the 45 MHz UK/Belgium cable.

Below: An operator at the Greenwich works of STC assembles a high-capacity repeater for use in a submarine system.



became evident that under certain conditions, with the then existing single amplifier repeater configuration, signal power could be transferred between the two directions of transmission. This has been avoided in 14 MHz and later systems by the use of twin amplifier repeaters, with one amplifier for each direction of transmission.

Another important consideration in the development of submarine cables is system misalignment, which is caused by very small but cumulativedifferences in the predicted and actual gain characteristics of repeaters and loss characteristics of cable sections. To balance out these small differences electrical circuits – called equalisers – are housed in cases similar to the repeaters and spliced into the cable at regular intervals along its length.

Initial assembly of the equalisers is usually carried out at the cable works, the final circuitry being designed and built at sea as the system is monitored and tested while cable laying progresses. Equalisers for 45 MHz systems, however, need to be more closely spaced, and this would place considerable demands on the cableship design team. As a result, only alternate 45 MHz equalisers will be constructed during the laying operation, the others being completed beforehand.

Misalignment between cable loss and repeater gain can also be caused by sea temperature variations in the part of a system laid in shallow water – that is, the section which rests on the continental shelf. In the shallow-water 45 MHz repeaters, therefore, amplifiers will be used whose gain is controlled by temperature sensing devices housed in the repeater casing.

To enable the repeater performance to be monitored and to aid fault location repeaters for 14 MHz systems have, in fact, one of the most comprehensive supervisory arrangements ever provided, enabling the shore terminal stations to measure gain, noise and signal distortion of each repeater. From experience gained it has been decided that the supervisory arrangements of 45 MHz repeaters can be made less complex, information being provided on gain only.

Shore terminal equipment provides the interface between the submerged plant and the inland telephone network. The 14 MHz shore terminal equipment provides facilities for injecting and extracting the various monitoring and control frequencies and the necessary networks for system equalisation. To ensure that the equipment has a reliability similar to that of the submerged plant it is duplicated on long-distance cables, the working equipment being connected to the system by automatic switching using reed relays.

The most complex parts of the terminal equipment are those for cable power feeding and repeater supervisory monitoring. As mentioned previously, a considerable amount of power must be provided by the terminals for the submerged repeaters and, as the gain of these repeaters is marginally affected by the line current, a very high degree of current stability is required. All high-voltage points are mechanically interlocked to prevent access until the power feeding equipment is made safe.

Equipment for the repeater monitoring must be capable of producing consistent results under many adverse conditions. For systems with a large number of repeaters, therefore, an automatic unit which can monitor the repeaters in any order is provided.

The new 45 MHz terminal equipment follows the same general outline as its 14 MHz predecessor, but the interface with inland plant can be at a greater circuit capacity – 300 circuits compared with 60 circuits. One major difference is that the terminal equalisers are solid-state devices, with no switch contacts in the transmission path. Network losses are controlled by varying currents through semi-conductor devices. It is possible to make these equalisers fully automatic, their operation being controlled by pilot systems passed over the system.

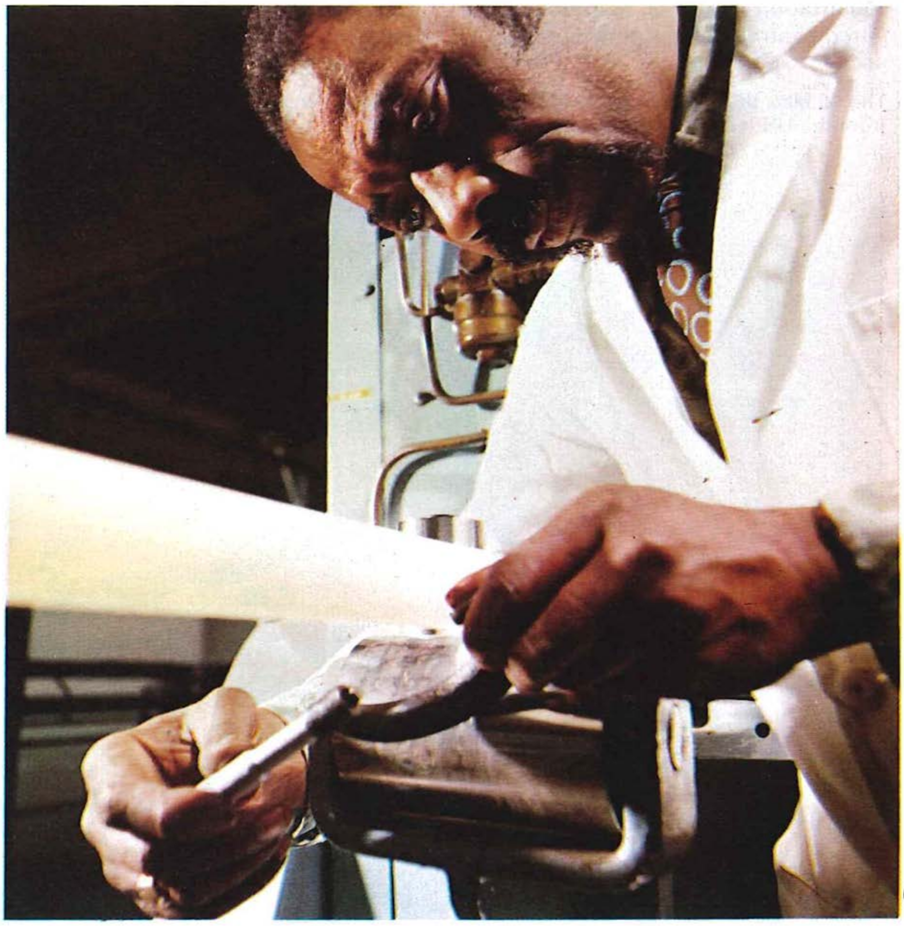
On long haul systems the reed-relay terminal changeover switch referred to earlier is replaced by a solid-state automatic switch which is controlled by a scanning detector that monitors various pilot frequencies. The power feeding equipment has also undergone a number of changes, the most significant being for long-haul systems, where the method of line current control has been changed from transductors – a type of transformer – to a system of pulse width modulation. To cater for a transatlantic system, which would require about 1,000 repeaters, the terminal equipment would have to supply half an ampere dc at a voltage of 18.5 kV.

With the large number of circuits now capable of being carried, system security has to be increased by employing automated surveillance test equipment. This equipment, being provided on the first UK 45 MHz system (to Belgium) replaces the repeater supervisory monitoring equipment and terminal station frequency selective level measuring equipment, and could be used for a general surveillance of all high-frequency systems within a terminal station.

The test equipment is computer controlled and will be identical at both shore terminals. It will be possible for the equipment at one terminal to instruct or interrogate that at the other, and by extending the data control channel the test equipment could be controlled from a remote office. The equipment will normally operate in a continuous surveillance mode in which faults detected will be traced to source and audible and visual indication given at both terminal stations. The surveillance mode can be interrupted for other

Above: A submarine repeater undergoes final assembly in the clean room facility at an STC factory.

Below: During production of a submarine cable, its diameter is measured with a micrometer.



Country and manufacturer	System type	Typical applications	4KHz/3KHz circuit capacity	Normal cable diameter (inches)	Approx. repeater spacing (nautical miles)
UNITED KINGDOM (STC)	5 MHz	UK – Portugal*	480/640	0·99	8
	14 MHz	UK – Canada (CANTAT 2) UK – Spain No. 2	1380/1840 1380/1840	1·47 1·47	6 6
	45 MHz	Spain – Canary Islands (PENCAN 3) UK – Belgium No. 4	4140/5520 3900/5200	1·47 1·47	3 3
FRANCE (CIT)	S 5 (5 MHz)	France – Algiers	480/640	1·0	9
	S 25 (25 MHz)	France – Italy (MARPAL) UK – France 1	2580/3440 2580/3440	1·5 1·5	4 4
USA (BTL)	SF (6 MHz)	USA – Japan (TRANSPAC 2)	630/840	1·5	10
	SG (30 MHz)	USA – France (TAT 6)	3150/4200	1·7	5
JAPAN (NEC FUJITSU)	KS-1200 (13 MHz)	Germany – Sweden	1200/1600	1·0	4
	KS-2700 (36 MHz)	Norway – Denmark	2700/3600	1·5	3

*Laid May 1969

Submarine system types provided and in planning in the period 1970-1977.

routine system measurements, for fault location and out-of-service testing.

During the 1970s advanced transistor technology, improved cable, twin amplifier repeaters and temperature sensitive repeaters have enabled major advances in UK submarine cable systems, resulting in greater circuit capacity. Other advances are reflected in solid-state terminal switching and equalisation networks, as well as computer controlled equipment which is used for surveillance.

This is only part of the story. Other countries have been proceeding with developments best suited to their own particular areas of interest. A 30 MHz system, for example, has been produced in the United States of America which provides 4,000 3 kHz circuits. The first system of this design came into service recently between the USA and France. Called TAT6, it is the largest transatlantic cable laid to date, and a feature of its development has been the American, British and French participation (see the editorial on page 1 of this issue).

Elsewhere, the French have been providing systems in the Mediterranean, and have now developed a 25 MHz system which has a capacity of 3,440 3 kHz circuits. The first system of this type was commissioned between Italy and France at the beginning of this year, and a similar system has also been provided this year between the UK and France as an extension of the TAT 6 cable.

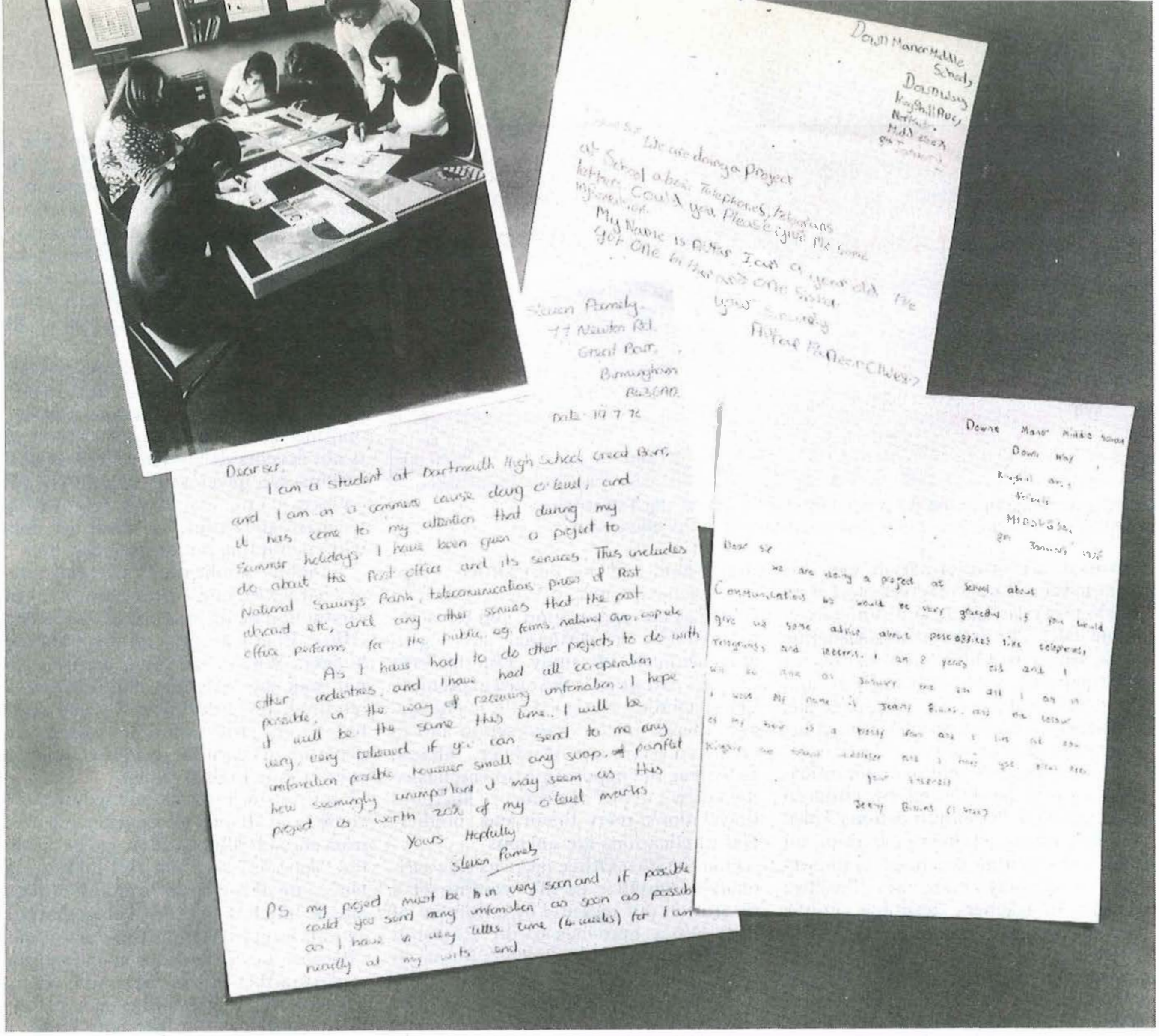
Japan, having developed its own inter-island systems for a number of years, is now moving out of its territorial waters. It has provided a Germany-Sweden 13 MHz system with a capacity of 1,200 4 kHz circuits, and has a contract to provide a 36 MHz system of 2,900 circuits between Denmark and Norway during next year.

Submarine cable systems are developing rapidly, with advances following hard upon one another. The UK and USA are considering 150 MHz systems and the Japanese have a 60 MHz system under development. Fibre optics also offer interesting potential for undersea communications.

Submarine cables, in conjunction with satellite systems, continue to offer viable international communication links. With so much research and effort in different areas, it is difficult to see beyond the next 10 years, but the future undoubtedly promises a great challenge to ingenuity.

The 45 MHz UK/Belgium cable is positioned on bearers in a cable tunnel running from the UK terminal repeater station.

Mr M. J. Ansell is an Executive Engineer in Network Planning Department at Telecommunications Headquarters, responsible for providing submarine system shore terminal equipment.



Special service for schools

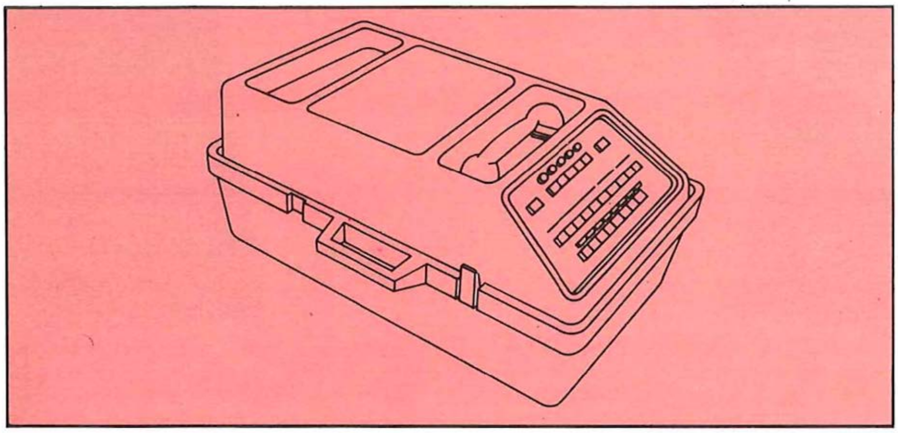
E Frost

IN A BUSY office at Post Office Telecommunications Headquarters, just across the road from St Pauls Cathedral, a telephone rings. At the other end of the line the piping voice of a 10-year-old schoolboy wants to know about "telephones and things because my teacher has asked me to write about them".

The person receiving the call is not surprised – the caller might just as easily have been a young student, a head teacher or even a parent. For the request is typical of the thousands dealt with every year by the Education Service of Telecommunications Marketing Department's Publicity Division.

Pleas for help in learning about the Post Office and telecommunications flood in both by telephone and letter to the Education Service, which sprang from humble beginnings in 1934 when the first wallcharts and leaflets for schools were produced. Since then the service has developed out of all recognition, particularly during the last few years when wide-ranging studies of the Post Office have assumed great importance in the curricula of schools and colleges throughout the country.

This fact, and modern educational development which encourages schoolchildren and students to undertake their own research and to apply direct to



Artist's impression of the teacher's monitoring set for the Telestructor, a portable miniature telephone exchange for use in the classroom.

organisations for information, explains why the service now receives more than 15,000 letters a year, in addition to telephone calls. Pupils at various academic levels seek Post Office information for examinations, such as GCE, CSE and RSA. The subjects include science, technology, commerce, office practice, history, geography and social science.

The Post Office's role in communications cannot be ignored by children undertaking a "communications" project, and young teachers embarking on their first teaching practices frequently ask for display material. Teacher advisors in teachers' resource centres require "schools" items to create Post Office project kits, and museums and children's libraries also need project kits and wallcharts in fulfilling their educational role. Scouts, guides and other youth groups, too, ask for material for their clubrooms.

This live and ever-increasing interest is of mutual benefit to both the educational field and the Post Office. From the teachers' point of view, the Post Office as an organisation, and telecommunications in particular, are legitimate subjects for study. For the Post Office's part there is the need to promote understanding and goodwill, to encourage interest in the organisation and to create an awareness of services offered, as well as the opportunity to emphasise the correct use of equipment. The public relations, recruitment and commercial implications are obvious.

That the Post Office takes its role seriously is implicit in the wording of a resolution put recently by a number of Post Office branches to the Research Department's Human Factors Research Committee: "It is considered that the telephone education of schoolchildren and students is of paramount importance to the future and extensive use of the telephone system". The resolution was strongly endorsed.

The Education Service originates the design, and arranges the production of wallcharts, books and leaflets on the most popular aspects of telecommunications. A knowledge of teaching methods, design and printing processes is essential. The items are colourful and care is taken to ensure that their educational content and presentation are acceptable to teachers for use in the classroom.

Built into these publications are various points the Post Office needs to publicise, such as the importance of correct dialling. Propaganda as such, however, is not acceptable and unsolicited publications are never sent to schools and colleges. This could be resented by teachers and result in waste of stock which could be put to use elsewhere.

"Schools" publications are issued free of charge, financial provision for their production being authorised by the Post Office Board as part of the publicity budget. Where specialist information not met by existing publications is required, the Education Service seeks help from the relevant operational departments whose response and co-operation is highly valued.

Requests for information and material come from all over the country and even from abroad. All those that can be met by the "schools" material and local assistance, are devolved to "schools" duties, one of which is in every Telecommunications Regional public relations office.

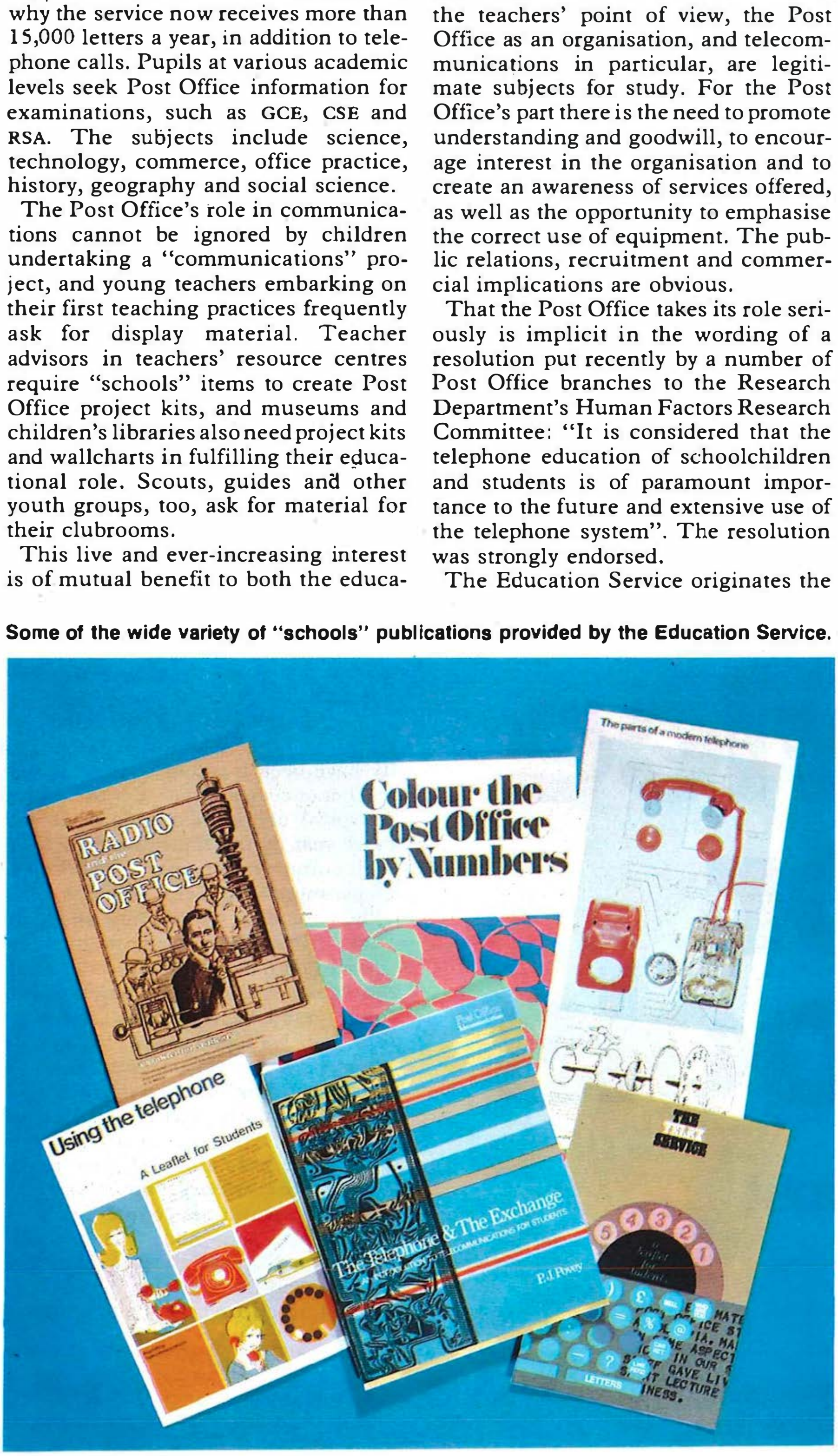
Because of the need for economy, and to ensure that appropriate publications are sent only to those eligible to receive them, authority to distribute stock is restricted to the Regional "schools" duties and Education Service in London. For economic reasons, too, material cannot be distributed for internal use, and response to requests from abroad has to be restricted to the British Family Education Service overseas.

It is an unfortunate fact that "poor customer performance" – misdialled calls and the like – costs the Post Office £30 million every year. In the past the Post Office sold, for a subsidised price, surplus obsolescent equipment for telephone practice purposes. Although it was all that could be spared at the time, this equipment was neither ideal for the purpose nor did it compare favourably with the modern audio-visual equipment used in schools and colleges.

In an effort to remedy the situation, the Education Service and the Inner London Education Authority set up a working party. Engineering, sales, traffic and information staff from the Marketing and Service Departments represented the Post Office, with an Inspector from County Hall and teachers from six schools and two colleges representing the ILEA. Ideas were pooled and as a result of practical experiments undertaken in schools and colleges, the concept of Telestructor was developed.

This equipment is basically a portable

Some of the wide variety of "schools" publications provided by the Education Service.



Young schoolchildren find learning can be fun with the Teleprax two-telephone practice set. Behind is an example of the Education Services' eye-catching wallcharts.

miniature telephone exchange for use in the classroom, which allows realistic simulation without being connected to the public network. It has a teacher's monitoring set, and can produce various types of tone likely to be heard on the telephone. Up to four telephones can be connected to the equipment to provide four-way communication, and additional handsets can be linked to the equipment so that other pupils can listen to the conversation and teacher's instructions.

To allow the teacher ample scope to demonstrate correct telephone techniques, working coinbox equipment can be linked to the Telestructor, and a tape recorder can be attached to play recordings designed to prompt response from the pupils and to record conversations so that progress can be monitored. Design of the Telestructor's electronic circuitry was undertaken by Telecommunications Development Department, and it is hoped that a contract to produce a prototype model will be placed shortly.

A new two-telephone practice set called Teleprax is also being developed, which is basically an updated version of equipment already being sold to schools. It consists of two modern telephones with one speech circuit and it can be used in conjunction with a tape recorder to help improve children's telephone and speech techniques. This equipment is being manufactured by the Post Office in its Factories Division.

It is not only in schools that telephone practice equipment is useful. Firms and organisations such as the Civil Service want this type of equipment for their staff, and already an interest has been expressed in Telestructor. Many teachers have said that the two types of sets would be helpful to them in their efforts to correct both adults' and children's speech impediments.

Another project dear to the heart of the Education Service is the scheme whereby the Post Office sells scrap equipment to schools via an educational agency sponsored by local education authorities. The equipment is used for scientific experiments and for handicraft teaching.

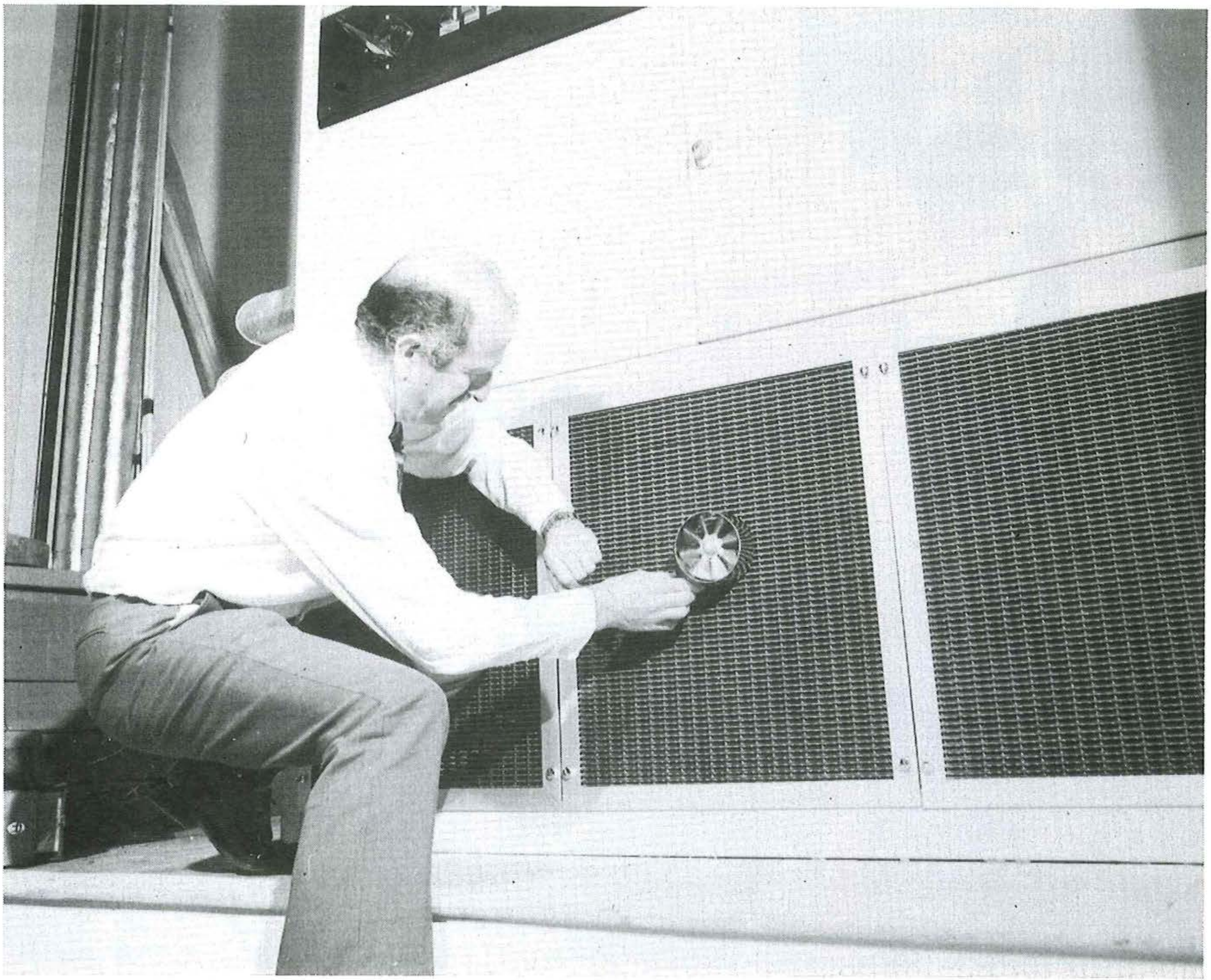
The education service has close liaison with various educational bodies such as the Schools Council. It also supplies on request, reference material to help with schools radio and television programmes. Textbooks are also sent in for checking. But above all else continuity in the provision of help to schools is essential if the service is to be worthwhile.

And it is worth remembering, too, that whenever little Mary writes in for information or young Johnnie wants a few leaflets, the Post Office is dealing with VIPs. Both are potential customers of the future and what they think of the Post Office is vitally important.

As Mr F. G. Phillips, Director of Telecommunications Marketing Department said recently: "This past year has been the roughest and toughest since we took over from the National Telephone Company in 1912. Our image is at an all time low".

The education service is in a prime position to do something about it, and is, in fact, doing so. After all, today's schoolchildren are tomorrow's customers and their goodwill is one of the Post Office's main assets, as without them it has no future.

Miss E. Frost is the Education Officer in Telecommunications Marketing Department and is responsible for all aspects of the Education Service.



At Brighton Kemptown telephone exchange, Assistant Executive Engineer Ted Toms uses an anemometer to check the output velocity of a modular air handling unit.

Modular approach to keeping it cool

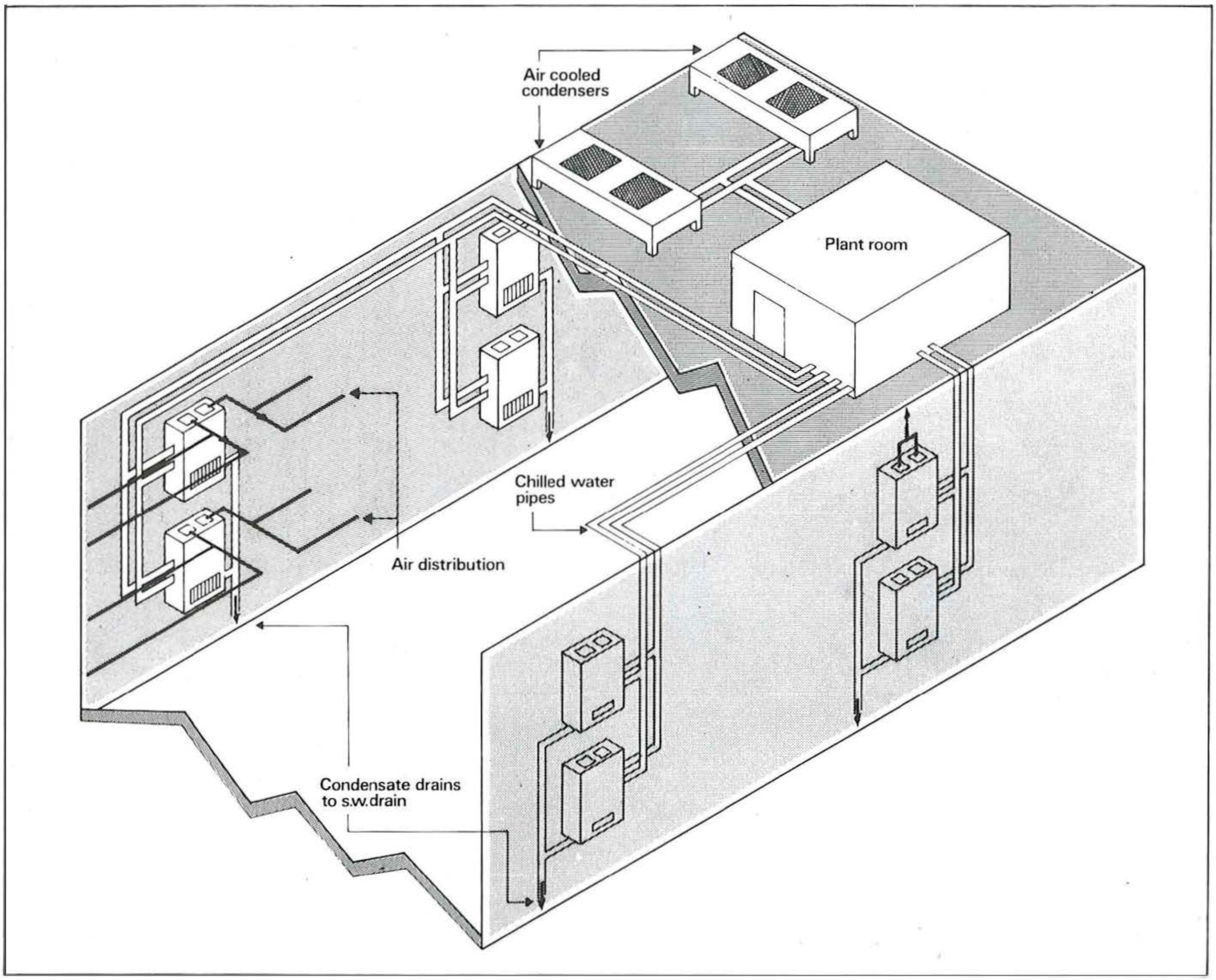
GAL Butler

POST OFFICE development of electronic telephone exchanges with their greater efficiency, lower maintenance costs and less floor space is now continuing apace. Despite all the advantages, however, a few drawbacks remain and one of the most serious is the problem of keeping apparatus – and the staff – at the right temperature.

Basically there are two ways of keeping things cool. The first is passing large volumes of filtered fresh air through the building via ducts and fans, and the second is re-circulating it after it has passed over cooling coils supplied from a refrigeration plant. Both methods are effective but have shortcomings in terms of practicability or cost.

Now, to help overcome these difficulties, a modular approach is being applied. It involves providing localised air distribution systems with air to water heat transfer coils and splitting the air handling plant into four smaller units and only using each as required.

To gain most benefit from the system it has been necessary to design a special air handling unit. This has been standardised in South Eastern Telecommunications Region both in size and



A typical cooling plant layout using eight air handling units.

performance and has a heat removing capacity 0-35 kW. It can handle air volume at between 2-3 cubic metres per second and has an air filtration efficiency of 96 per cent. There is also automatic control of cooling capacity and fresh air volume.

The units are housed in recesses in the side of the building which saves about 38 square metres of floor area and the pipework rises vertically through the building without encroaching on the apparatus area. This accommodation for the units is provided in the initial design of the building and the units are provided as required with the growth of the switching equipment.

Benefits of the modular system include space saving of up to 76 per cent of allocated floor area, flexibility to accommodate any changes in switching equipment planning after building has been completed, minimum outlay on initial plant and easier maintenance and fewer spare parts due to standardisation. There is also the advantage of greater security of the system against plant failure as well as the opportunity for architects to provide an interesting and functional building feature.

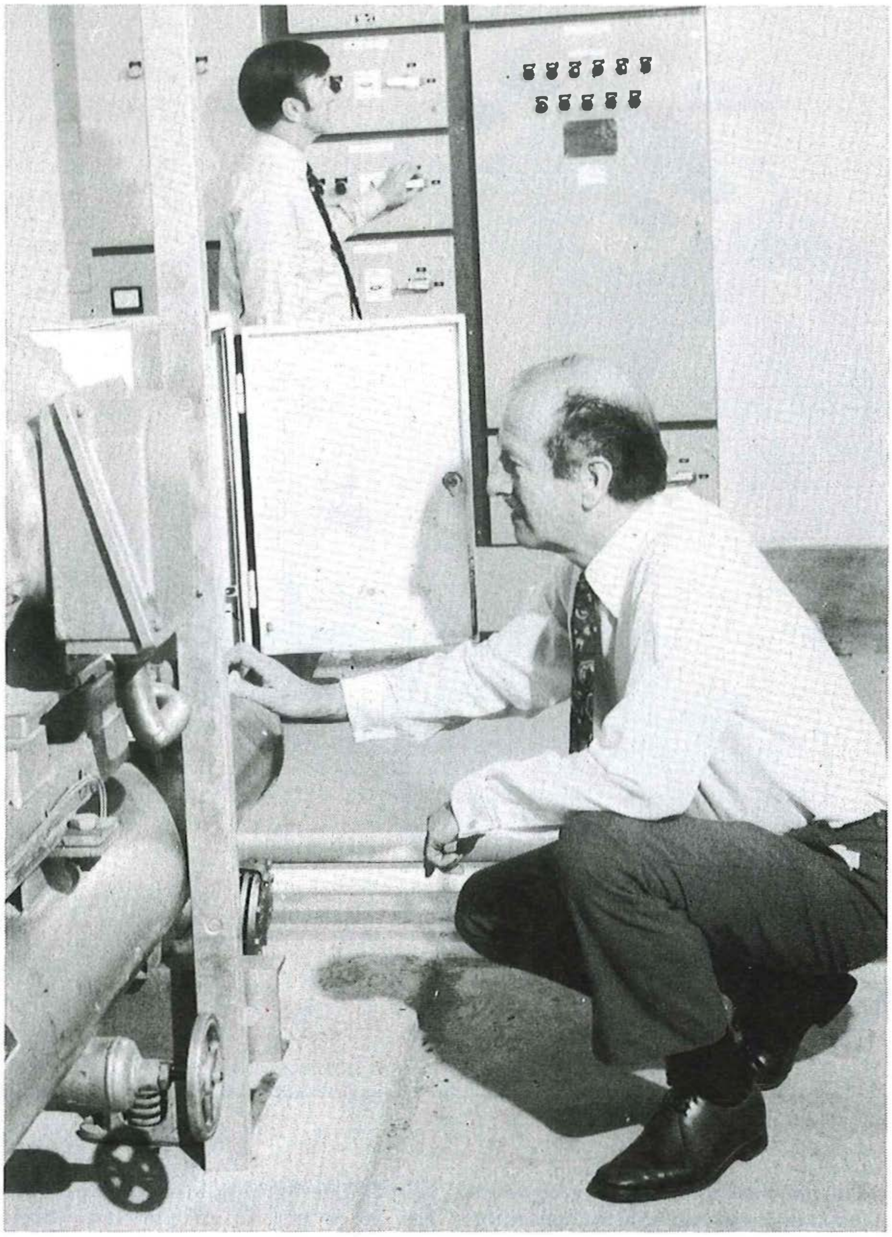
The need to keep the apparatus rooms of exchanges at suitable temperatures has always existed but the development of electronic equipment in recent years has thrown the problem into even sharper focus.

Power consumption of TXE4 equipment exchange, for instance, is about two-and-a-half times that of a Strowger exchange of similar capacity. And furthermore, while the Strowger exchange consumes power mainly when carrying traffic, half the TXE exchange load is continuous. A 10,000 line Strowger equipped exchange dissipating 60 W per sq m requires a floor area of 720 sq m and consumes about 400 kWh of energy per day. A 10,000 line TXE4 exchange dissipating 160 W per sq m would require 480 sq m of floor area and use about 1,000 kWh of energy per day. Already there is equipment in use dissipating 260 W per sq m and it is expected that very much higher loads will be reached with digital systems.

There are of course other sources which generate heat within the building such as the lighting and staff, and there is also heat gain from the sun. Standards of lighting are continuously being raised. The lighting loads for Strowger are 26 W per sq m but have been increased for TXE exchanges to 40 W per sq m. As far as staff are concerned the number working in apparatus areas is small and the problem of heat gains from this source is minimal. It is, however, necessary to ensure that the statutory minimum volume of 4.72 litres per second of fresh air for each person is met.

Heat gain from the sun is essentially a summer problem. Radiant heat falling on a flat roof or wall can approach a value of 1 kW per sq m on a hot day, resulting in a surface temperature up to 30 deg C above air temperature depending upon the reflective characteristics of the surface. Glass will allow radiant heat to pass through with negligible loss but will not pass the resultant low temperature radiation from the heated room surfaces. The heat is thus trapped in the building, and produces the principle known as the "greenhouse effect". Obviously action is needed to avoid buildings becoming huge ovens.

A first step is to look at the design of buildings and consider ways of controlling heat entering them. Fortunately the most economic form of building giving



In the rooftop plant room Ted Toms checks the chilling machine which controls water circulation to the air handling units. In the background the author checks water temperature on the control panel.

the minimum external surface area for the maximum volume is also the most suitable from an environmental point of view. The walls and roof should be constructed to transmit as small amount of heat as possible – this is measured in W per sq m per deg C (known as the U-value) – and the glass area should be kept to a minimum. An ideal building would have a low external surface to volume ratio, a low U-value and no windows.

Until recently many modern buildings seem to have been designed for maximum glass area. The ideal building may not necessarily be ideal from the architect's or staff point of view, but in practice a compromise has to be reached. Buildings with a U-value of about 1 and window area 20 per cent of the wall area are the result.

But once heat has been generated the problem is to remove it. Passing large volumes of filtered fresh air through the building to transfer the heat outside is one way, but to do this successfully there must always be a temperature difference between the supply air and the room air, calculated on a maximum of 4 deg C. Also the outside air may not always be suitable for passing through apparatus areas. It may contain an excessive amount of moisture or large amounts of dust and dirt.

Air used for ventilation purposes has to be filtered before reaching the switching apparatus areas to protect the equipment and to provide clean working conditions. This is usually done by fabric filters capable of trapping particles down to two microns (two thousandths of a millimetre) in size. The filters, however, eventually become blocked and have to be changed. This can be a costly exercise if the frequency of changing is high. Finally, to distribute large volumes of air through the building, large ducts are required and these can produce severe problems of accommodation.

The second method of cooling – recirculating air over refrigerated cooling coils – overcomes these problems but the overall costs of this method are greater because refrigeration plant has to be provided and there is additional electrical power required.

It is normal practice to connect the air handling plant to the essential power supply to maintain air movement during a mains failure. In the second method refrigeration plant is also connected to the essential supply in cases where an excessive temperature rise in the switching equipment would cause damage.

Developments in switching equipment have not only resulted in an increase in the heat dissipated per sq m of floor area but also in the pattern of the 24-hour load curve. Strowger equipment basically consumes power only when carrying traffic, and a typical day to busy hour ratio could be 10:1. Electronic switching equipment, line transmission, radio equipment and AC signalling equipment, however, have a constant load throughout the 24 hours.

In certain installations there may be times during the year when the outside air temperature is low enough to enable heat to be removed without employing refrigeration plant, thus saving energy. In general, however, installations having a continuous load above 100 W per sq m will require cooling plant, and those below that figure can be dealt with simply by using fresh air.

Most systems that provide cooling use air as the working medium, but unfortunately it is not a very good carrier of heat with its low thermal capacity. To achieve the desired thermal effects the system design usually results in catering for the circulation of large quantities of air. Ducts and fans are required to move this air, but because of the accommodation restrictions imposed in apparatus rooms duct sizes have to be kept to a minimum. The smaller the ducts for a given air flow rate, the higher is the energy absorbed by the fan to overcome the friction losses.

Water has a much greater thermal capacity than air and it is cheaper to distribute in terms of both pumping costs and network costs per kW of heat transfer. It is much better, therefore, to provide localised air distribution systems with air to water heat transfer coils rather than central air plants.

Systems designed for cooling apparatus rooms of a standard 610 sq m area have in the past been based on one localised air handling unit per area situated in a plant room of 50 sq m, and it is these that can benefit most from the modular approach.

Mr G. A. L. Butler is an Executive Engineer in South Eastern Telecommunications Region power group responsible for the provision of air cooling plant in the Region.

PO Telecommunications Journal, Autumn 1976

TRANSPORT TRAINING ON THE MOVE

T Stephen and H S James

Work has now begun on a new, purpose built Motor Transport Training Centre for Post Office workshop staff. It is near Stone in Staffordshire and will replace the original training school at Yeading.

A model of the new Motor Transport Training Centre.

WITH a fleet of more than 70,000 vehicles, ranging from the familiar small postal and engineering vans to huge articulated lorries, special units for erecting telegraph poles and even an ex-army DUKW for ferrying staff and supplies to a remote, flood-bound radio station, the Post Office naturally places great importance on maintaining these assets in top class condition.

The basic requirements to achieve this are modern, well equipped workshops – there are about 650 spread throughout the country – together with skilled mechanics able to cope with the wide range of problems created by a fleet covering hundreds of millions of miles a year. But skilled mechanics are not easy to find, and with rapid increases in technology training is vital. For the past 30 years, in fact, the Post Office has organised its own specialised training programmes to ensure that its high standards are maintained.

In 1949 the first, somewhat primitive training school was set up on the Central Repair Depot site at Yeading, Middlesex, and despite various extensions and even the introduction of mobile courses in three converted motor coaches the situation soon became unsatisfactory. The final blow came in the late 1960s with the Department of the Environment's refusal to sanction any further substantial extensions at Yeading because of a proposed ring road which would pass through the site.

Thus the search began for a "new home" but it was not until early in 1973 that there were any significant developments. Then the Operational Programming Department at Telecommunications Headquarters bought ▶

a site at Badnall Wharf, a wartime railway siding for loading locally manufactured ammunition about 2 km west of THQ's Technical Training College (TTC) at Stone, Staffs. Originally it had been planned to transfer all Motor Transport (MT) training to Stone with just a few of the noisier courses to be held at Badnall Wharf. Later, however, it became clear that to split the training school into separate sites would reduce flexibility and efficiency and create other administrative problems. Finally it was agreed that all MT training should be undertaken at Badnall Wharf.

Plans were agreed with staff, an architect prepared a fully detailed scheme, tendering was quickly completed and building got underway this summer. Work should be completed by the end of 1977 and the school will become an integral part of the Stone TTC administered from the main site.

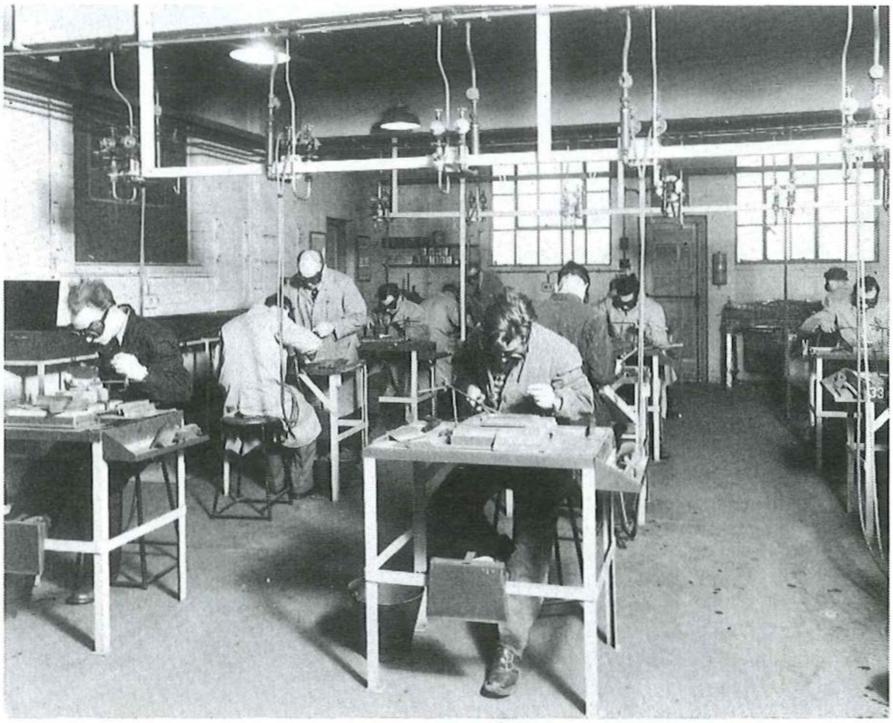
Pleasantly situated in a wooded area the new school is designed to accommodate 150 students. The building comprises two linked blocks, each surrounding a landscaped courtyard. The smaller block contains all the administrative and instructional staff offices together with a staff lounge /dining room and kitchen; the larger block houses the remaining demonstration rooms, tea bar, toilets, locker rooms, first aid room and boiler room. There is flexibility in classroom sizes and, for the first time, each instructor will have individual office space.

The floor area will be about 5,200 square metres compared with about 2,000 sq m at Yeading. The building will be single storey apart from the lecture rooms which will be on the first floor. These are located as far away as possible from the main Stafford-Crewe railway line which runs adjacent to the south-western boundary of the site.

When the site was cleared one building was allowed to remain as it was particularly well constructed to give protection from war-time air attack. This will act as a sound deflector between the railway line and the lecture rooms and is suitable for diesel engine training rooms. These will be specially sound insulated to keep out railway noise, and noise transfer between adjacent rooms.

This building will also house the heavy goods vehicle and vehicle mechanical aids garages and provide space for a motor transport workshop. This will be controlled by Midland Telecommunications Region who will maintain all vehicles belonging to the Stone training complex. Body repair practice rooms, and other potentially noisy areas are located at the outer end of a wing in the new building to minimise the effect on other courses.

A wide variety of courses, covering everything from electrical fault diagnosis and oxy-acetylene gas welding to driving instruction and diesel equipment maintenance, is provided. The high ceiling of the vehicle mechanical aid room will, for the first time, enable complete courses to be carried out under cover. Many rooms are provided with double doors for access from outside and this also enables power braked motive units and electric vehicles to be brought into the demonstration rooms when required.



Workshop staff in one of the classrooms at Yeading.

Provision is made for the safe handling of heavy equipment and demonstration rooms can be designated for particular courses which eliminates time wasted in moving equipment from room to room.

The arc and gas welding rooms will be ventilated by forced air systems, heated air being blown into the room and fumes extracted. The diesel engine rooms will also be force ventilated to remove heat and diesel oil fumes from the engines. Offices, lecture and demonstration rooms will be ventilated by a natural cross flow of air between opening windows on opposite sides. Heating will mainly be by hot water radiators, and the forced ventilation air will be pre-heated.

A tea bar to accommodate 70 students at a time will be provided at the school, but students will be housed and take their meals at Howard Hall, Stone, and will be carried to and from Badnall Wharf by two coaches. Although there are no female motor transport staff at present up to 20 women can be catered for by the use of moveable partitions to alter the number of personal lockers (out of a total provision of 168) accessible only to the female toilets.

All of this, of course, is very different from the facilities at Yeading, where the first course was run in 1949 when 18 students from London and the Home Counties travelled daily for workshop tool training. Later the same year a gas welding course for 12 students was added and by the following year 18 students were attending a four-week electrical course.

Next, students from other Regions began arriving and they were housed in local lodgings. These were difficult to find in an area where there was competition from workers employed on construction jobs at Heathrow Airport and where many housewives preferred going out to work to taking in students.

Because of this an old hospital building and a building next to the Central Repair Depot at Yeading were converted to house 52 students and provide them with recreational rooms. These hostels were brought into use in late 1951 under the supervision of a resident warden and his deputy. A canteen provided all meals for both resident students and daily visitors to the depot.

By the mid 1960s, although the hostel accommodation had been extended to cater for 66 students, the need for a bigger centre to cope with the increase in training requirements became urgent. The situation was alleviated by the introduction of the mobile courses in the converted coaches – but these only partially solved the problem.

The failure to get permission for further extensions led to the quest for a new site and the result is the new complex at Badnall Wharf – one of the finest motor transport training schools anywhere in the country.

Mr T. Stephen is head of the motor transport vocational and technical training group in Telecommunications Personnel Department.
Mr H. S. James is principal of the Motor Transport Technical Training College at Yeading.

Optical fibres light way to new era

RW Berry

IT IS now nearly 10 years since the Post Office decided to set up a special research division to study optical fibre transmission – the system which will enable telephone conversations, television pictures and computer data to be carried along hair-thin strands of glass fibre. Over the years there has been a continuing improvement in the understanding of the manufacturing processes necessary to produce efficient and reliable devices and fibres and also in the understanding of the performance requirements of each of these components. This ensures that they can be associated efficiently with the appropriate electronic circuitry to provide viable systems.

In the last two years or so this understanding has enabled components of sufficiently high quality to be produced and used in research establishments in various parts of the world to construct laboratory systems for assessment of overall feasibility. During that time the Post Office together with industry has developed the system to such an extent that the threshold of a new era in communications has been reached.

Although some further development remains to be done there is hope that optical fibres could be used in the telephone network by the early 1980s. First steps towards this will be in the form of feasibility trials by the Post Office and Standard Telephones and Cables Ltd.

The Post Office trial will be over 5 km and 7 km links connecting Martlesham Research Centre via Kesgrave to Ipswich and will be capable of carrying 120 telephone circuits at 8 Mbit/s. The cable will be manufactured by British Insulated Callender Cables Ltd using Corning fibres and will be installed by Post Office staff. The associated equipment, of Post Office design, will be located only at the named places.

The STC trial will be over a 9 km route between Hitchin and Stevenage in Hertfordshire. The system will be installed during 1977 and will be capable of carrying 1,920 simultaneous telephone conversations at 140 Mbit/s. The duct route will be provided by the Post Office while STC will produce the terminal equipment, optical cable and the regenerators which will be placed at about 3 km intervals.

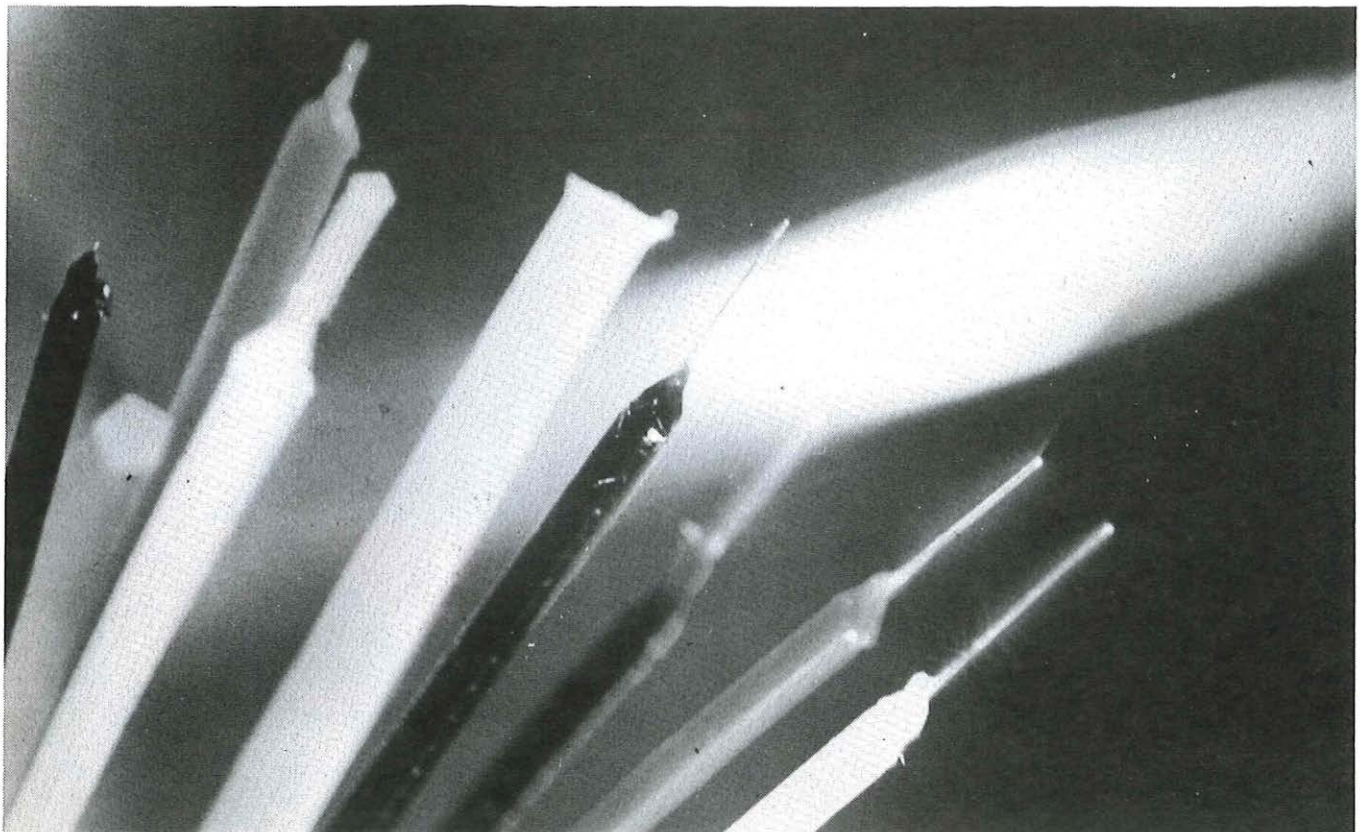
Basically, optical fibres have four main advantages over traditional metal coaxial and balanced pair cables. The fibres themselves are made of materials abundantly distributed over the earth. Fibre systems have potentially much greater capacity, have greater distances between regenerators, and fibre cables, because of their small size, are easier to install.

But how do optical fibre systems actually work ?

At either end of a long fibre is connected a transmitter or a receiver. The transmitter converts electrical signals – normal telephone calls, for instance – into pulses of laser light. This light then travels through the glass fibres and into the receiving terminal. There the light is converted back into the conventional electrical signals.

In the present stage of development, it is strongly preferred to use separate fibres for each direction of transmission. Each intermediate repeater needed on the longer distance optical fibre systems will be similar to that for coaxial cable systems, but with the addition of an avalanche photo-diode at the input and a laser or light-emitting-diode (LED) at the output. These optical repeaters can be sited if necessary in footway boxes. Because an optical fibre is a non-

Part of an eight-fibre cable, showing seven of the fibres and the central core.

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conductor of electricity, power must be fed to the intermediate repeaters over separate conductors which may be in the same cable as, or in a separate cable from, that containing the fibres.

The simplest optical fibres operate on the principle of the "total internal reflection of light". Each fibre consists of a fine glass rod cladded with a glass layer of lower refractive index. The inner core acts as a "light pipe" which traps rays of light travelling along it at angles not too far from parallel to the axis. The rays thus zig-zag down the fibre until they feed into the receiving terminal.

Three basic types of optical fibre are being studied at the Post Office Research Centre at Martlesham. The one known as the monomode, which has a very small core diameter, offers potentially the widest bandwidth, or the highest capacity. For example, 28,000 or more telephone calls might eventually be carried digitally by one monomode fibre over 10 km repeater spacings.

A large core fibre, on the other hand, is capable of carrying up to about 120 conversations over 10 km spacings. A fibre of intermediate capacity has a graded refractive index between the core axis and the cladding. This third type of fibre may become widely used in 140 Mbit/s systems carrying up to about 2,000 telephone calls per fibre.

A major cost factor in competitive cable systems is that of the repeaters or regenerators, which have to be installed at about every kilometre on a high-capacity coaxial cable system. With optical fibres far fewer repeaters would be needed because the signals are not absorbed as much as in other cables. Indeed, researchers envisage optical fibre cables needing repeaters only at 5 to 10 km spacings.

As far as flexibility is concerned, the optical fibre again scores over the conventional coaxial cable – being much lighter and easier to handle. A commonly used cable composed of eight copper coaxial pairs measures about 5 cm in diameter, whereas a cable made of say, 20 to 100 glass fibres, would have only a 1 cm diameter.

In preparing a fibre, great care has to be taken to ensure that the materials are of the purest quality. If they are not, then the light beams will be attenuated excessively by absorption and scattering or either.

To overcome this problem, Post Office research staff use a special preparation technique before actually turning the glass into rods and then stretching or

Top left: in a laboratory at Martlesham, an optical fibre transmission test is carried out using a drum of cable.

Inset: Accuracy of fibre alignment in an optical coupler is inspected. The coupler is used for linking devices to the fibre.

Left: Plastic coated optical fibre is inspected by an STL engineer, prior to assembly into completed cable.

Lasers undergo life testing to measure their reliability for optical fibre transmission.

"drawing" them into fibres. The glass is made from high purity silica, boron oxide and sodium carbonate powders. The mixed powders are heated in a special crucible to a temperature of about 1,100 deg C. It takes about ten grams of pure glass to make 1 km of fibre.

During production, the fibre is given a thin plastic coating to protect it against surface damage. Further protection is then provided by a fine polymer tube extruded over the coated fibre. This plastic tube isolates the fibre mechanically from the strains that may occur during subsequent handling, cabling and cable laying processes.

Work on optical systems at Martlesham covers most aspects of optical cable transmission, including the fibre materials and fabrication technology, the devices needed to interface between fibres and conventional electronic circuits, and the optical transmission system as a whole.

The coupling of fibres to sending and receiving devices, for instance, must be done in a way that ensures low optical losses while not impairing the reliability of the devices. Couplers have been developed which make use of miniature aspherical plastic lenses of focal lengths which permit the devices to be enclosed in hermetically sealed encapsulations having suitable optical windows. A semi-reflecting 45 deg mirror can be incorporated to allow system tests to be made without disconnecting the fibre from the device.

This jig, developed at the Post Office Research Centre, is being used to joint two experimental lengths of fibre cable under field conditions.

A laboratory 8 Mbit/s system was developed in the Research Centre during the past year to transmit 120 telephone channels over a 4 to 5 km length of fibre. This system used a semiconductor (gallium arsenide) light-emitting-diode operating at the infra-red wave-length of about 900 nanometres together with large-core multimode fibre having an attenuation of about 7 dB/km. A silicon photo-diode detector was used, and the resulting electrical signal was regenerated by conventional solid-state electronic circuits. Repeater spacings of about 10 km will be possible when fibre with 3 dB/km attenuation becomes available in cable.

The preparation of the very pure glasses needed for low-loss fibres, and the drawing of fibres from such materials by the double-crucible technique is in hand and fibre of 11 dB/km attenuation has been produced and protected by a strong polymeric over-sheath in kilometre lengths. Studies of the factors that affect the reliability of semiconductor lasers require sophisticated techniques such as transmission and scanning electron microscopy, infra-red emission spectroscopy and X-ray topography.

World-wide activity in the field was illustrated at the first European Conference on Optical Fibre Communication held in London last year.

But what are the longer term prospects of fibre optic communication?

The high optical "carrier" frequency (approximately 300,000 GHz) of the system suggests a wider range of possibilities for the use of the theoretical bandwidth than has so far been seriously considered. For example, several optical carriers, each carrying its own independent group, or supergroup or hypergroup of telephone circuits, could be transmitted over the same fibre.

At the other end of the range, demonstrations of the adequacy of analogue transmission at relatively low frequencies (eg, 6 MHz for colour television) even with present devices, suggest that developments leading to high-power, high-linearity send devices, and to overall linear operation with reduced noise levels, will enable optical systems to take their place as competitors in the full spectrum of line transmission systems, both analogue and digital.

Mr R. W. Berry is head of the repeater and systems development group in the Optical Communications Systems Division of Post Office Research Department.

PO Telecommunications Journal, Autumn 1976

Mini-computer aids exchange testing

SP Grimes

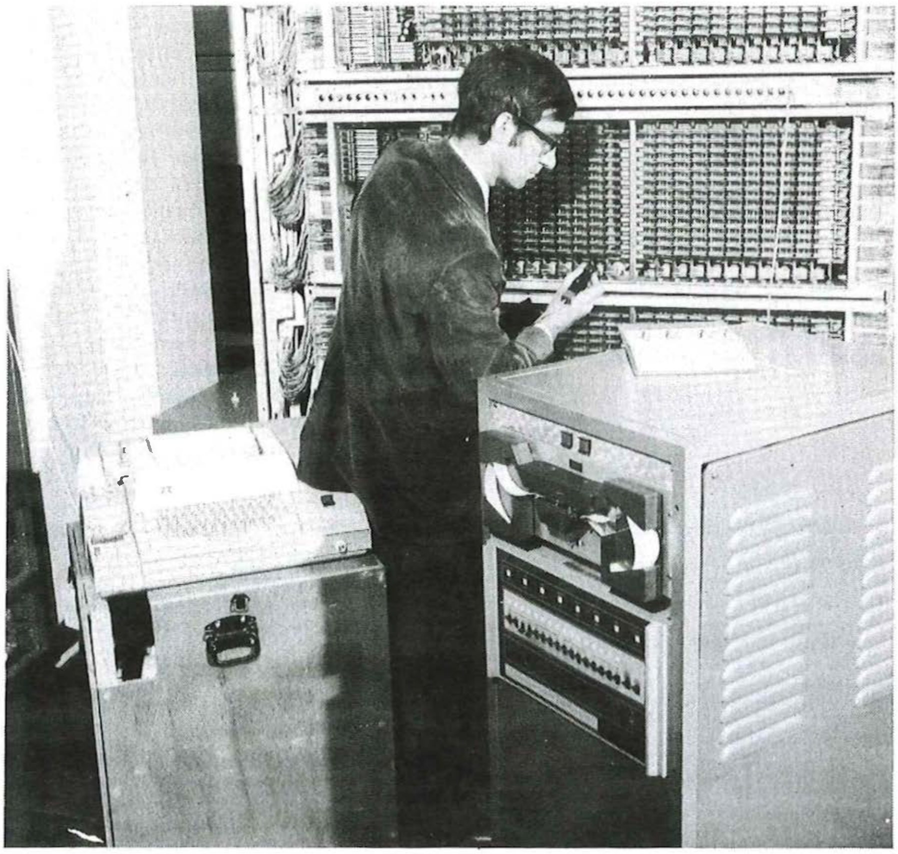
The feasibility of using a transportable mini-computer to simplify and improve commissioning and acceptance testing of large telephone exchanges of the crossbar type has been proved in an operational trial.

REDUCTIONS in size and cost of computers has led to their wider use in the field of automatic testing of telephone exchanges. Standard Telephones and Cables Ltd, in collaboration with the Post Office, have developed Computer Based Installation Testing (COBIT) for testing TXK3 common control crossbar exchanges.

These telephone exchanges serve mainly in Director areas – the large multi-exchange centres like London and Birmingham – and normally have a capacity of about 10,000 lines and comprise functional units for the switching and control of calls.

The size and design of present-day exchange systems means that shipment and installation of a completely assembled telephone exchange is not practicable. Before equipment is released from a contractor's factory, therefore, individual items, such as completed equipment frames, are tested to agreed standards after which they are moved to site, assembled and interconnected to form units and, eventually, a complete exchange.

A member of the STC COBIT development team checks a fault during installation of Bexleyheath TXK 3 crossbar exchange by using the fault dictionary.



Specific functions and interconnections of equipment are tested by the contractor at various stages of installation and current practice for the TXK3 system is that the equipment frames, which contain the relays and crossbar switches, are mounted in the exchange and then each self-contained circuit is tested using simple manual test sets. The main purpose of these tests is to eliminate most faults remaining in the equipment after it has left the factory, been transported to site and erected on to the equipment racks. The later, more comprehensive, system testing is therefore made easier. In practice the use of manual test sets tends to be slow, tedious and not as effective as intended.

Once the frames of equipment have been inter-connected to form the switching and control functional units these are tested with semi-automatic test sets for their particular function. The tests are intended to prove the cabling and the interworking of items of equipment.

When connection between the functional units has been completed the exchange is system tested in two ways. For the first test a call is passed through every available path between the switching and control units to prove connections between them and their interworking capability. For the second test calls are set up to specified items of equipment to prove their ability to deal sequentially with simultaneously arriving calls. Before accepting the exchange the Post Office carries out its own multiple call sample test to prove that the exchange meets certain specified requirements and that it will give satisfactory service to customers.

With so many testing processes involved, it was felt that if the functional unit part of the testing could be fully automated and arranged so that every item within the functional unit would be tested, then the manual tests and some of the system tests could be eliminated.

With a view to COBIT application to other systems later, the TXK3 system was chosen by the manufacturer as being the most suitable for a development test bed. COBIT consists of a mini-computer, a high-speed tape reader, interface unit and simulators. The simulators can represent any part of the exchange that may be necessary and are under the control of the computer via the interface. A teleprinter is used for putting information into the computer about the configuration and size of the exchange being tested. It also prints all details of faults encountered and the confirmation that a test has been successfully completed.

The five types of unit shown in Fig 1 are those to which the method has been applied. There are other circuits interconnecting these units and also con-

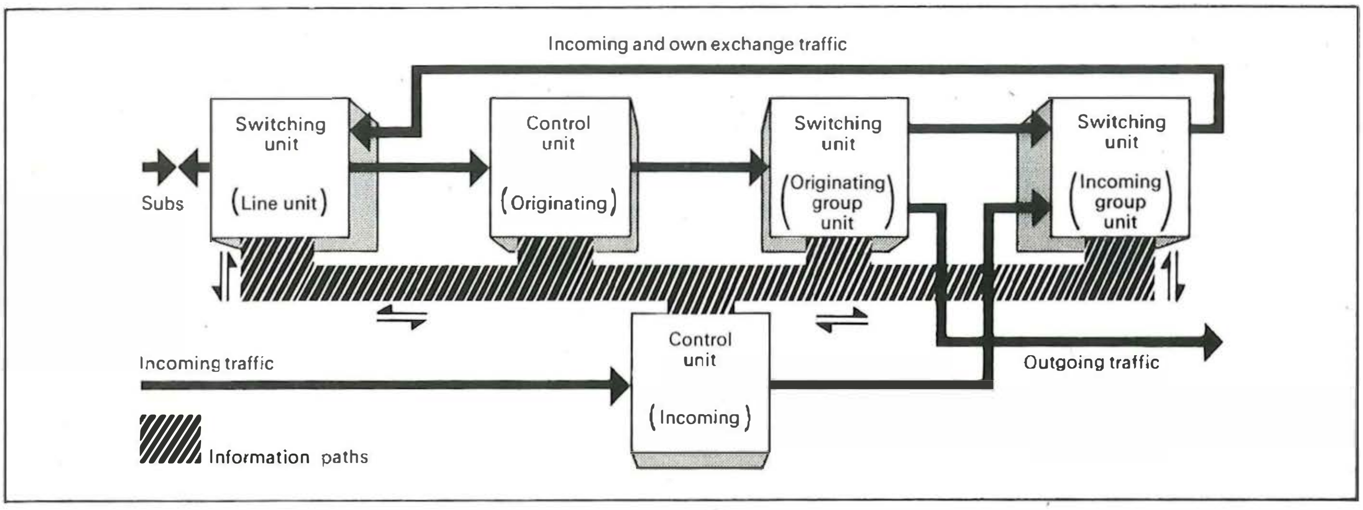


Fig 1: The five types of unit in a TXK 3 exchange to which COBIT testing has been applied.

necting them to incoming and outgoing lines but it is not economical for COBIT to gain access to these circuits. A cheaper, purpose-built automatic test set has been developed for this purpose.

In the early stages of its development COBIT was designed for testing TXK3 control units only and is used in place of the manual tests at some sites. At a suitable stage of installation a temporary connection frame is taken to site and made ready for the arrival of COBIT. The points at which this frame is connected have been chosen so as to keep the number of interconnections to a minimum. The use of a connection frame enables the COBIT equipment to be speedily connected, via plugs and sockets, to the units under test.

At the start of testing, a data preparation tape is fed into the computer which generates a questionnaire via the teleprinter asking for details of the exchange to be tested. The test engineer supplies the required information using the teleprinter. This information and the data supplied by an agreed programme test tape, which is standard for all TXK3 exchanges, defines the tests to be applied to the particular unit.

The computer then begins the test by sending a series of calls via each register in turn. The registers, as the central items of the control unit, use all other circuits of the unit in controlling the processing and switching of calls. The simulators replace the line units, group units and conditions normally expected from both the subscriber and junction terminations.

If a fault is encountered the identity of the equipment under test and a fault number are printed by the teleprinter. The test engineer may then refer to a manual known as a fault dictionary which will give details of the components under test and possible causes of the fault. When it is thought the fault has been cleared the test sequence that failed is re-run. This procedure may be repeated any number of times. All test sequences must have been applied successfully and in their correct order before the computer gives confirmation that the equipment is satisfactory.

Experience gained from the control unit tests showed that there was no technical reason why COBIT should not be extended to other equipment. However to make more efficient use of the computer it was realised the order of installation and testing at the exchange sites would have to be much more closely defined.

A new commissioning procedure based upon the full use of COBIT, both on control and switching equipment, was evolved. This is called multifunction COBIT and this system has been used in an operational field trial in South East London. There were three main objectives of this trial. The first was to prove the effectiveness of testing the switching units. The COBIT tests had to be good enough to replace the manual tests and also some of the system tests which involved setting up many individual calls.

The second aim was to prove that COBIT could operate on a time sharing basis and test two units under the control of two test engineers. The high speed of working of the computer, compared with that of a TXK3 exchange, allows two sets of simulators to be controlled at the same time. The programs have been devised so that any switching unit may be tested with any control unit. This keeps the number of simulators required on site to a minimum. The third objective was to prove the new commissioning procedure which was intended to gain efficient use of the computer and to reduce testing time.

The testing of the control unit under multifunction COBIT is identical with the COBIT control unit testing already described. The only changes required to the program were those necessary to allow a control and switching unit to be tested simultaneously.

Similar principles to those used in the control unit testing have been used to test the switching units. Calls are passed through the switching units to test the interworking and the cabling between the frames of equipment that form the units. The majority of the facilities of the units are tested. Tests are also made to prove that no faults exist which would affect the ability of the units to deal with calls arriving simultaneously.

The trial has, so far, shown that software controlled testing can be effectively applied to non software controlled exchanges. COBIT will be introduced as a standard method for commissioning and acceptance testing of TXK 3 exchanges.

The advantages offered by a computer controlled testing procedure include systematic functional testing applied to functional units rather than a complete telephone exchange. This, together with the use of the fault dictionary, makes for rapid localisation and clearance of faults.

It is also a fact that the use of a computer results in smaller test equipment compared with an equivalent "all hardware" system, and computer control provides a high degree of flexibility to accommodate exchange system and facility changes. Other advantages are that automatic testing greatly reduces running time and automatic control ensures that all test sequences are carried out correctly, thus reducing operator dependency and increasing confidence in the results.

With new designs of telephone exchange using software control it will be possible to replace, temporarily, the operational software with acceptance testing software. Effectively such exchanges would functionally test themselves. Some foreign systems already successfully use this principle and it is a facility that could be used eventually with System X, the Post Office's switching system of the future.

Mr S. P. Grimes is an Assistant Executive Engineer in Telecommunications Development Department responsible for the specification of exchange commissioning procedures.

Getting through to the customer

At a time of general economic recession, Post Office Telecommunications last year achieved continued growth in its services, as well as a return to profit. Here Mr F. G. Phillips, Director of Marketing, outlines the strategies employed to stimulate both increased use of the telephone network and a greater awareness of the facilities it offers.

The year 1975/76 was the toughest our Business has ever experienced. Demand was down, cessations were up; following the previous year's heavy loss, charges were raised twice during the year, and the media constantly emphasised how expensive our services were becoming.

Despite the hostile environment, we still achieved a net growth of five per cent for the telephone service, eight per cent for telex and 16 per cent for Datel, and a record overall trading surplus.

A massive marketing effort was mounted in all Telecommunications Regions and Telephone Areas, supported by a series of national campaigns.

We spent £500,000 on three television campaigns to stimulate use of the telephone, for both inland and international calls, by stressing value for money. Other national campaigns promoted the telex service, PABXs, trimphones, and the introduction of Keyphones.

Regions and Areas conducted campaigns in their own territories using local press advertisements, mailshots, posters on our vehicles, displays in post offices and shops, and mobile exhibitions in caravans specially equipped for the purpose. Sales of at least 20,000 telephone connections and 30,000 other items were attributed directly to this activity.

Considering the adverse economic climate in which these selling campaigns were conducted, the results achieved were remarkable, and seem to me to indicate the public's growing awareness of the social value of the telephone, which augurs well for telecommunications in the UK.

But one feature of our service, in which we share a common experience with most other telephone administrations, is its relatively low usage in the home – about two calls a day. We are working on the problem of how to stimulate more calls.

Because we have evidence that the public think call charges are higher than they really are, we have concentrated, in our television campaigns, on the actual rates of evening and weekend calls with the slogan "Across the country for 10p", and recent research shows a high level of public awareness of cheap rates.

New products and services are being developed for the future which are designed both to promote more use of the telephone network and to make it easier for the public to make and receive calls. Some of these have already been described in Post Office Telecommunications Journal, and others will be the subject of future articles as they develop.

There is an exciting future for users of telephone and allied services, and the prospects for this future have been made brighter and more certain by the return of the Telecommunications Business to economic health during 1975/76, a situation which I am sure will be continued.

THE YEAR IN FIGURES

A review of Post Office Telecommunications progress in the year 1975-76

	Result	% Growth over 74-75	Result	% Growth over 73-74	Result	% Growth over 72-73
Telephone services						
Size of system						
Total working connections	13,230,442	4·2	*12,698,642	6·7	11,903,627	8·7
Total working stations	21,064,661	3·4	20,389,129	6·5	19,136,847	8·7
Call office connections	77,221	0·6	76,787	0·2	76,600	0·4
Shared service connections	1,918,402	−8·9	2,104,586	0·8	2,087,950	2·9
% of connections on auto exchanges	99·9	0	99·9	0·3	99·6	0·4
Growth of system						
Net demand for connections	1,166,089	−10·5	1,302,714	−3·9	1,355,540	−5·3
New supply of connections	1,272,180	−5·7	1,348,744	−7·4	1,456,524	2·5
Waiting list	47,307	−53·8	102,415	−6·6	109,610	−45·2
Penetration						
Stations per 1,000 population	376	3·6	363	6·1	342	8·9
Traffic (in millions)						
Inland effective calls, trunk calls	2,356	1·9	2,313	8·2	2,138	10·0
Inland effective calls, local calls	13,736	1·6	13,523	6·4	12,707	9·6
Continental: outward calls	34·34	16·1	*29·58	23·7	23·90	13·4
Inter-continental: outward calls	9·10	37·6	*6·61	26·7	5·21	22·2
Telephone usage						
Calls per connection	1,245	−3·5	1,290	−0·9	1,302	0·7
Calls per head of population	288	1·6	283	6·8	265	9·1
Exchanges						
Local manual	3	−76·9	13	−56·7	30	−37·5
Local automatic	6,260	0·3	*6,242	*0·4	6,215	1·2
Local electronic	Not yet Available		*586	*19·1	*4·92	*31·9
Local mixed strowger/electronic	Not yet Available		3	—	—	—
Local crossbar	Not yet Available		*310	*35·4	*229	*54·7
Local mixed strowger/crossbar	Not yet Available		4	−20	5	—
Automanual and trunk	Not yet Available		*374	*0·8	*371	2·7
Telex service						
Total working lines	59,421	9·0	54,493	10·7	49,220	13·7
Metered units (thousands)	403,283	4·0	*387,661	6·6	363,481	−1·4
External originating traffic (thousands)	47,250	10·8	42,637	12·1	38,028	15·6
Telegraph service						
Inland Telegrams (thousands)	4,230	−31·8	6,200	−14·5	7,252	−0·7
External Telegrams:						
UK originating (thousands)	5,891	−16·5	*7,056	−5·4	7,461	5·8
UK terminating (thousands)	5,833	−11·9	6,622	−5·4	6,997	3·3
UK transit (thousands)	4,833	−8·9	*5,304	−2·5	5,438	1·2
Telecommunication staff						
(Part timers count as half)						
Total	237,693	−3·8	247,205	2·1	242,086	0·8
Engineering technical grades ø	108,871	−0·4	109,308	1·3	107,892	2·2
Telephone operating force (incl. supervisors)	43,094	−13·8	49,982	1·7	49,155	−2·88
Clerical staff	29,502	−3·8	30,678	5·4	29,120	1·8
Other staff	56,226	−1·8	57,237	2·4	55,919	1·0

ø Note change of title

*Amended figure

The network dedicated to overseas calls

G Cottam

THE ENORMOUS growth in international communications over the past few years is reflected in the fact that there is now capacity for more than 25,000 speech circuits between the United Kingdom and the rest of the world via submarine cables, microwave radio and satellites. At the end of the Second World War total capacity was about 500 circuits.

Currently the need for overseas plant is growing annually at about 15-20 per cent compared with about 10 per cent for inland services. Calls to and from the overseas network are routed through international switching centres (ISCs) in London. These centres are linked to repeater stations – referred to collectively as frontier stations – from where submarine cables, telecommunications satellites or microwave radio extend the circuits to ISCs throughout the world.

Responsibility for operating this overseas network rests with the Post Office's External Telecommunications Executive (ETE). The planning and provision of plant needed to collect and distribute the traffic to and from the inland exchanges and the line plant to link the ISCs to the frontier stations is however undertaken by the Network Planning Department at Telecommunications Headquarters as part of its overall responsibility for the main HF network. The international requirements are therefore fully integrated with plans for the national requirements.

The planning results in capacity from the ISCs to the frontier stations being assigned for the dedicated use of ETE. The unit of capacity used by ETE depends on the estimated growth and varies from a 12 channel group to a 900 channel hypergroup.

For links between adjacent countries in continental Europe, the frontier station may be just one of a number of intermediate stations on a coaxial cable or microwave radio route. Because of the geographically insular position of the United Kingdom there is usually either a change of line plant or multiplexing or both at the frontier station.

In the case of submarine systems the capacity is incompatible with inland line plant and with the microwave radio link it is the multiplexing arrangements on each side of the English Channel which are incompatible. The UK equipment provides for the assembly of the hypergroup from 15 60-channel supergroups while the continental equipment requires an extra translation stage, the mastergroup (five supergroups) for the subsequent assembly of a 900-channel supermastergroup. The highest common factor in the two multiplexing hierarchies is the supergroup. Another type of frontier station is the satellite earth station at which a variety of assemblies of supergroups and groups are used.

In 1977 the first submarine cable system of a new generation is expected to be commissioned which will have a capacity of 65 supergroups assembled in 13 mastergroups. Equipment has been developed for use at the UK terminal of this and future systems to enable mastergroups to be extended to the ISCs. This equipment is designed to overcome problems of compatibility between UK and continental multiplexing hierarchies. The possibility of a future need to extend supermastergroups is being studied to see how incompatibilities with the national network can be minimised.

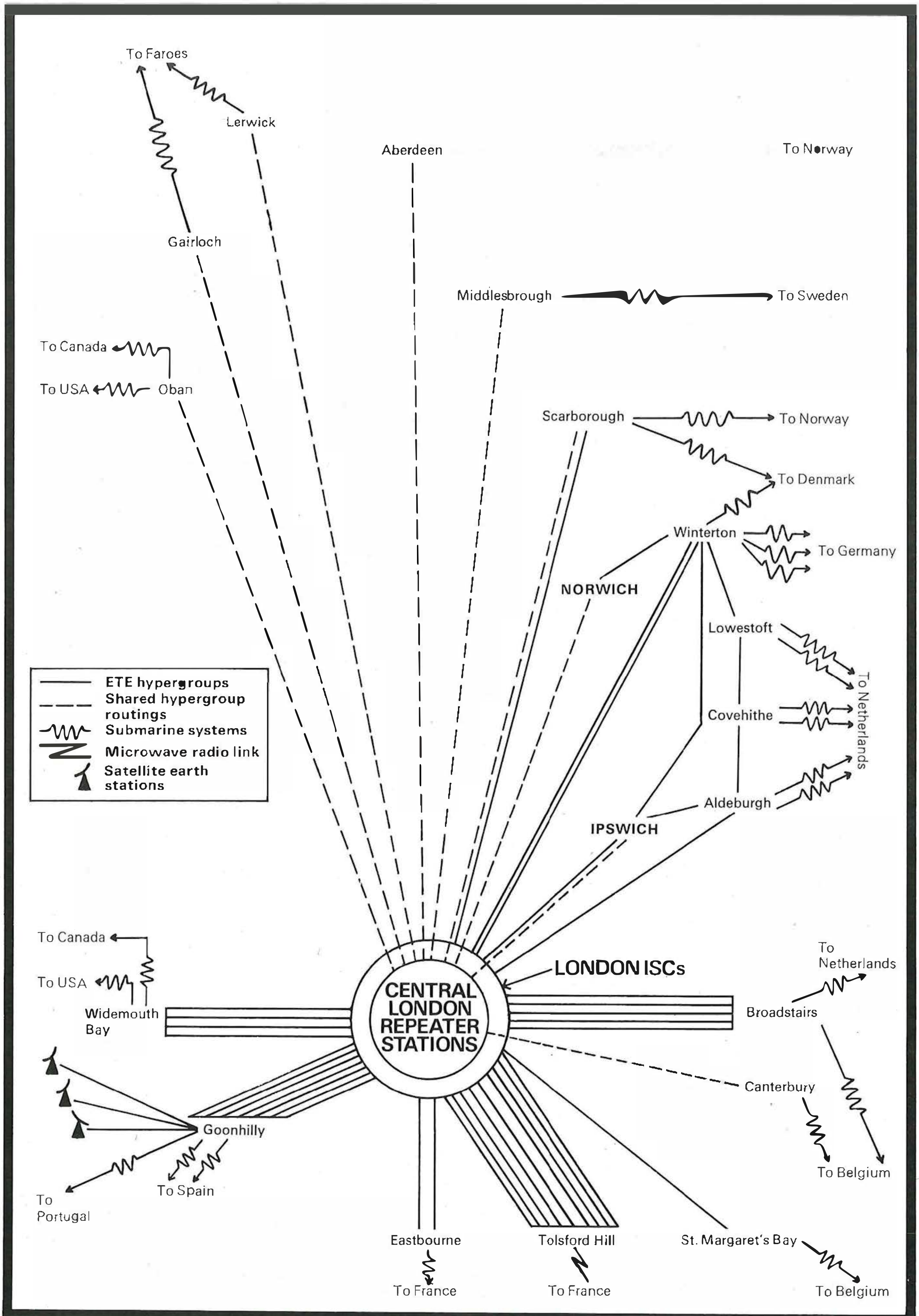
It is planned to reorganise that part of the network reserved for restoring service if a fault occurs in the UK national section. This is presently carried out on a supergroup basis but by 1978 hypergroup restoration will be employed. This will greatly reduce the number of individual operations – that is, patching – needed to re-route circuits when a fault occurs as well as lost service time. The equipment being provided for this purpose incorporates a hypergroup patching frame and high-speed switching facilities.

These arrangements will enable the return to normal routing after a fault has been cleared without affecting traffic carried at the time. It will also enable circuits to be diverted before planned engineering work and a return to normal routing on completion of the work without affecting traffic. No change is proposed for the international section which will continue to be restored at supergroup level.

At present a dedicated network of 41 hypergroups has been built up linking frontier stations to the ISCs in London. To allow the distribution of the capacity of the hyergroups between the ISCs there are six hypergroup ties. There are also nine hypergroup ties between the ISCs and central London repeater stations for national access circuits, international private circuits and for those frontier station routes which are served by hypergroups that areshared with inland circuits.

Some of the capacity of the long-haul hypergroups and the ties between ICSs is for the protection of the network and is terminated on supergroup patching frames at the ISCs and, in part, at the frontier stations. As a result, most failures in the UK network can be made good by supergroup patching between the ISC and the frontier station. The effect on service of a failure in the international section is minimised by patching at supergroup level between the ISCs of two or more administrations. For example the loss of a Frankfurt-London supergroup can be made good by using spare London-Amsterdam and Amsterdam-Frankfurt links.

By close co-operation between administrations in a particular region, such as countries bordering on the North Sea, it has been possible to establish a network of restoration supergroup links, which, by pre-planned action, enable rapid restoration of service to be



The international network – United Kingdom inland routings.

achieved when service over a submarine cable has been interrupted.

Before 1960, with the exception of the microwave route to France, frontier station capacities did not exceed 30 groups and these could be handled by carrier cables, usually provided on two different routes. When the repeater station chosen for a new submarine system also served a Group Switching Centre (GSC), advantage could often be taken of existing HF routes provided for national circuits to route the international circuits.

In many cases the chosen terminal for a submarine system was not a GSC and no HF network outlet existed. The plant provided was determined by the ultimate capacity of the frontier station and inland network considerations.

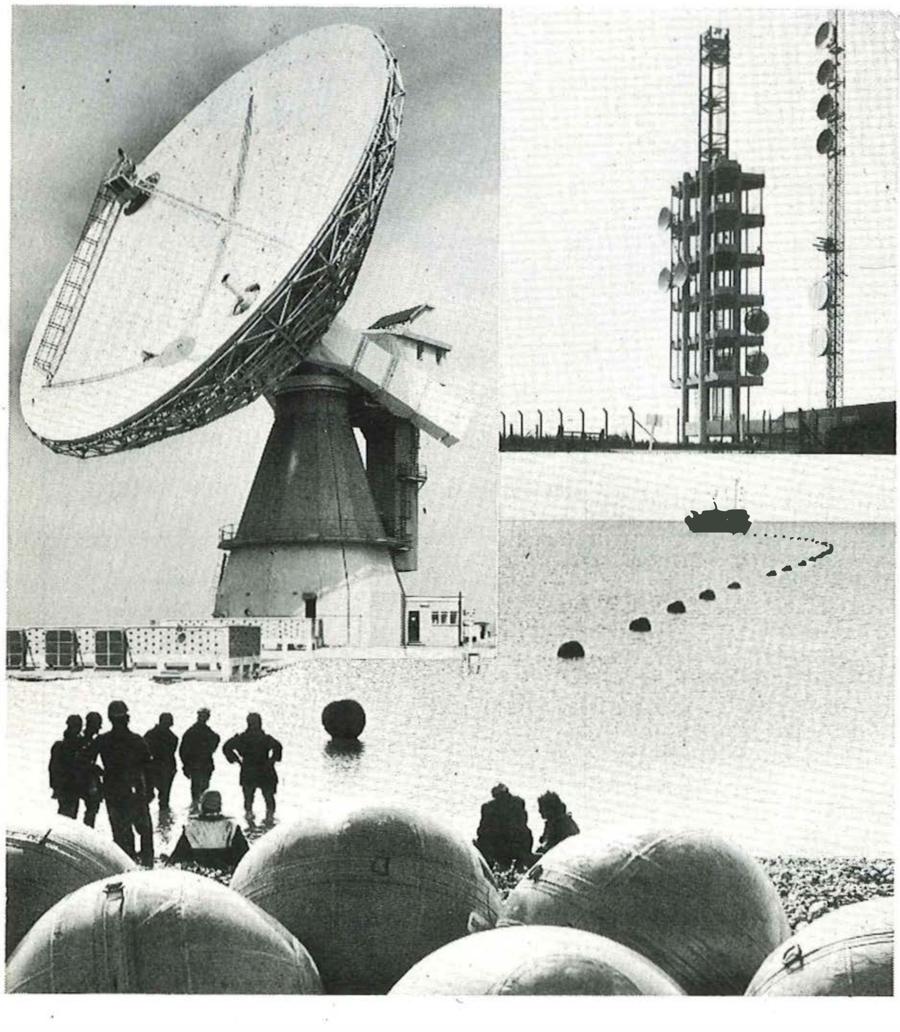
In the early 1960s four 120-circuit submarine systems were provided to new repeater stations in East Anglia. These stations were linked via the two existing stations to the main HF network at Ipswich by small-bore coaxial cable. The cables were equipped with systems to enable a network of hypergroups to be set up. These hypergroups were used exclusively for international circuits which were extended from Ipswich and Norwich to London on line capacity providing geographical diversity of routing and spare capacity to enable a degree of service restoration to be achieved.

With the introduction of satellite communication in the mid 1960s it became necessary to link Goonhilly earth station to the HF network and, taking foreseen growth of this facility into account, it was decided to provide a microwave radio outlet to Plymouth. This was equipped with two channels which could be used for 960-circuit telephony or television and with protection channel switching facilities. The telephony channel was extended permanently to Faraday international repeater station coaxial tie. This was the first hypergroup linking a frontier station to an international repeater station for the dedicated use of international circuits.

At about the same time the capacity of the UK-France microwave link was being expanded and arrangements were made with the French PTT to enable service to be protected against interruption of the submarine systems between St. Margaret's Bay and Escalles, by providing restoration facilities for two supergroups via the microwave link with France. This was an important decision which prepared the way for more ambitious agreements on service protection that were to follow.

Between 1968 and 1971 five submarine systems of eight supergroups capacity were laid using repeater stations at Covehithe for the Netherlands, Scarborough for Norway, Goonhilly for Spain and Portugal, and Lerwick for the Faroes. The stations at Scarborough and Lerwick were already GSCs served by the HF network, thus enabling international circuits to share the outlet capacity with national circuits.

Circuits from the United Kingdom are extended via satellite, microwave radio and submarine cable to International Switching Centres throughout the world.



Since 1971 seven submarine cable systems of 21 to 23 supergroup capacity have been laid, including the second between UK and Canada (CANTAT 2) with the UK terminal at Widemouth Bay, Cornwall. In the early life of this system when circuit demands are low the system will be exploited mainly for 4kHz spaced channels. As demand increases, however, it is planned to change over to 3kHz channels.

This changeover will increase the effective capacity of the cable by 33 per cent to 1,840 channels. It also increases the mean speech power by a similar amount and provision is made for this in the design of the submarine system.

On the inland systems used to extend the capacity to London the extra speech power could overload the systems and so some capacity has to be left spare.

A further factor which affects system power loading is the number of multichannel voice frequency (MCVF) telegraph bearer circuits which are carried on international supergroups. Inland system design is based on one MCVF bearer per supergroup and as, on average, international supergroups carry more than five per supergroup, an additional allowance must be made for this in the calculation of supergroups to be left unused.

It can be seen therefore that as submarine, satellite or microwave system capacity of a frontier station increases the point is reached, even allowing for routing diversity in the UK network, when one or more of the routings can be served more economically by direct hypergroups to the ISCs rather than by sharing the capacity of hypergroups used for inland circuits. The cost comparison is between the provision of multiplexing and through-connecting equipment at a number of intermediate stations to achieve a high line plant utilisation factor and the provision of more line plant which may take longer to utilise fully.

It will be apparent therefore that, as the demand for capacity increases, so does the quantity and cost of intermediate station equipment. The time taken to fully utilise line plant decreases however.

It is for this reason that plans for 1980 envisage an increase in the size of the network to be provided for the overseas service to 100 hypergroups.

Mr G. Cottam is head of International Transmission Network Planning in the External Telecommunications Executive of the Post Office.

PO Telecommunications Journal, Autumn 1976


Going Digital?
Overloaded Audio Cables?
Pye TMC 30-Channel
PCM slots in.

MISCELLANY

Packets by trunk

TRUNK switching has successfully been brought into operation on the Post Office's Experimental Packet-Switched Service. All users linked to the service through its three packet-switching exchanges in London, Manchester and Glasgow, may now exchange data with each other. Previously, data interchange was possible only between users on the same exchange.

Europe's first packet-switched system for public service, the experiment is being staged by the Post Office in co-operation with the computing and computerising industries. EPSS enables data to be sent in the form of self addressed blocks or packages, and customers can choose between packet or character-mode operation.

Packet operation is suitable for "intelligent" terminals. Data is transmitted and received in packets, each comprising a header with an address code, the data package containing up to 2,040 bits, and an error-checking code. Character-mode working is suitable for "simple" terminals, and data – transmitted serially using a 10- or 11-unit character structure, is assembled into packets at the exchange before being sent through the network.

At present 42 terminals are connected to the service – 22 being packet terminals working at data rates of 2,400, 4,800 or 48,000 bit/s. The other 20 are asynchronous character terminals transmitting at 110 or 300 bit/s and linked to their local packet-switching exchange over the public telephone network.

The three exchanges use Ferranti Argus 700E computers for switching the packets. When fully in operation, the service will use 13 of these computers – three each in Glasgow and Manchester and seven in London. One will be for overall system supervision.

New President

PROFESSOR James Merriman, Senior Director of Development, Post Office Telecommunications, has succeeded Professor R. C. G. Williams as President of the Institution of Electrical and Electronics Technician Engineers. Membership of the IEETE, the largest professional body for technicians and technician engineers increased during last year by nearly 1,000 to 18,000.

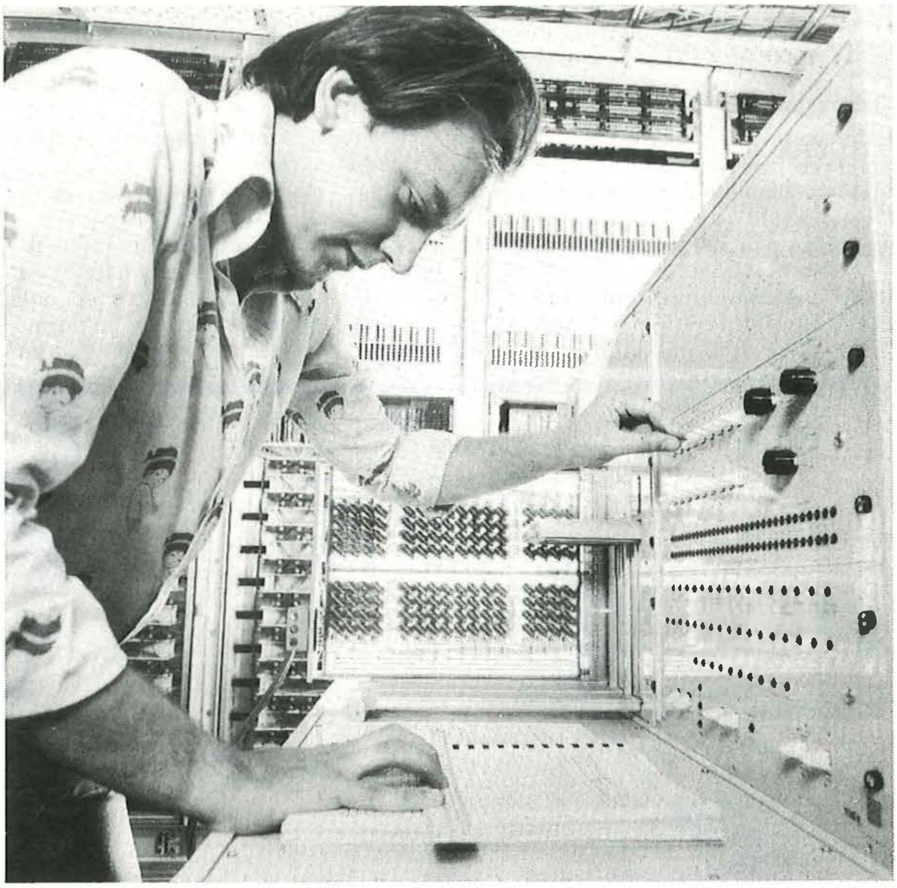
Desk-to-desk dialling

BRITAIN'S first international desk-to-desk dialling service has gone into operation with the Royal Dutch-Shell group of companies.

The service, which cuts out office operator intervention, is the result of close co-operation between Shell and the Telecommunications Divisions of the British and Dutch Post Offices. The oil company has been provided with 24 special private phone circuits which reduce the connection time between its offices in London and The Hague by up to 25 per cent.

London staff can automatically get through to The Hague by dialling a two-figure code, which picks up one of 12 outgoing circuits followed by the required extension number.

Previously they had to dial a two figure code to reach the distant Shell operator, who dialled a further four digits to put the London call through. The scheme may be extended to Shell offices in Rotterdam, Pernis, Amsterdam, Rijswijk.



As part of a £330 million programme to modernise public telephone exchanges, London will have its first TXE4 exchange operating at Perivale next year. The electronic exchange – with an initial capacity of 10,000 lines – will serve numbers on the 997 code.

Advantages of the TXE4 system are greater reliability, easier maintenance, enhanced speech quality and less floor space occupied. By the end of 1977 it is planned that 40 TXE4s will be in service.

Work on Perivale's new £2 million exchange started more than two years ago and the picture shows technical officer John Reed using a matrix tester as part of the joint acceptance tests being carried out with Standard Telephones and Cables Ltd.

Celtic Sea search

THE Post Office is helping the search for oil in the British sector of the Celtic Sea with a new radio service which offers exclusive radio-teleprinter links with the mainland.

To provide the new facilities the Post Office has installed more than £100,000 worth of extra equipment at Ilfracombe radio station, North Devon.

A semi-submersible exploration rig drilling 40 miles south west of Milford Haven is linked with the company's base office in Pembroke Dock. It also shares a radio-telephone service connecting it to the international telephone network.

Up to 15 rigs will have their own exclusive teleprinter link to the mainland and an automatic error-correcting system will ensure reliable communications in all but the worst conditions.

Contracts

Marconi Systems Ltd – £6 million at present prices for the first aerial system at the Post Office's new satellite earth station at Madley. The contract includes a 32 m (105 ft) diameter dish aerial, aerial building, roadways, broad-band transmitters and receivers, ground communications equipment and central and supervisory equipment.

The first of three new aerial systems planned for the station by the early eighties, the new aerial is due to come into service early in 1978. It will work to a satellite over the Indian Ocean, handling all satellite communications between the UK and the eastern hemisphere up to the early 1980s.

The new aerial takes over the work of Aerial One at Goonhilly Down, the Post Office's earth station in Cornwall.

Pye TMC Ltd – £420,000 for 1,000 Datel modems and 250 control units.

The contract calls for short-term delivery up to January 1977.

The modems – type 2B – are of Post Office design and developed by Pye TMC under contract. The modems provide error-free performance over unconditioned telephone lines at speeds up to 200 bauds and may be used successfully at speeds up to 300 bauds with suitable data terminals.

GEC Telecommunications Ltd. – for digital multiplex equipment for the Post Office to be used in conjunction with the 120 Mbit/s digital line systems. These new digital systems, the first in Europe, will form part of the first phase of the digital network which will ultimately cover the greater part of the United Kingdom.

More platform links

A £2 million project has been launched by the Post Office to put ten more North Sea oil/gas platforms on the telephone. (See map below). The ten platforms, located 160 km (100 miles) to 240 km (150 miles) north-east of the Shetlands, will be progressively linked to Britain's telecommunications network – and to the rest of the world – from next summer, when new radio communication equipment starts coming into service.

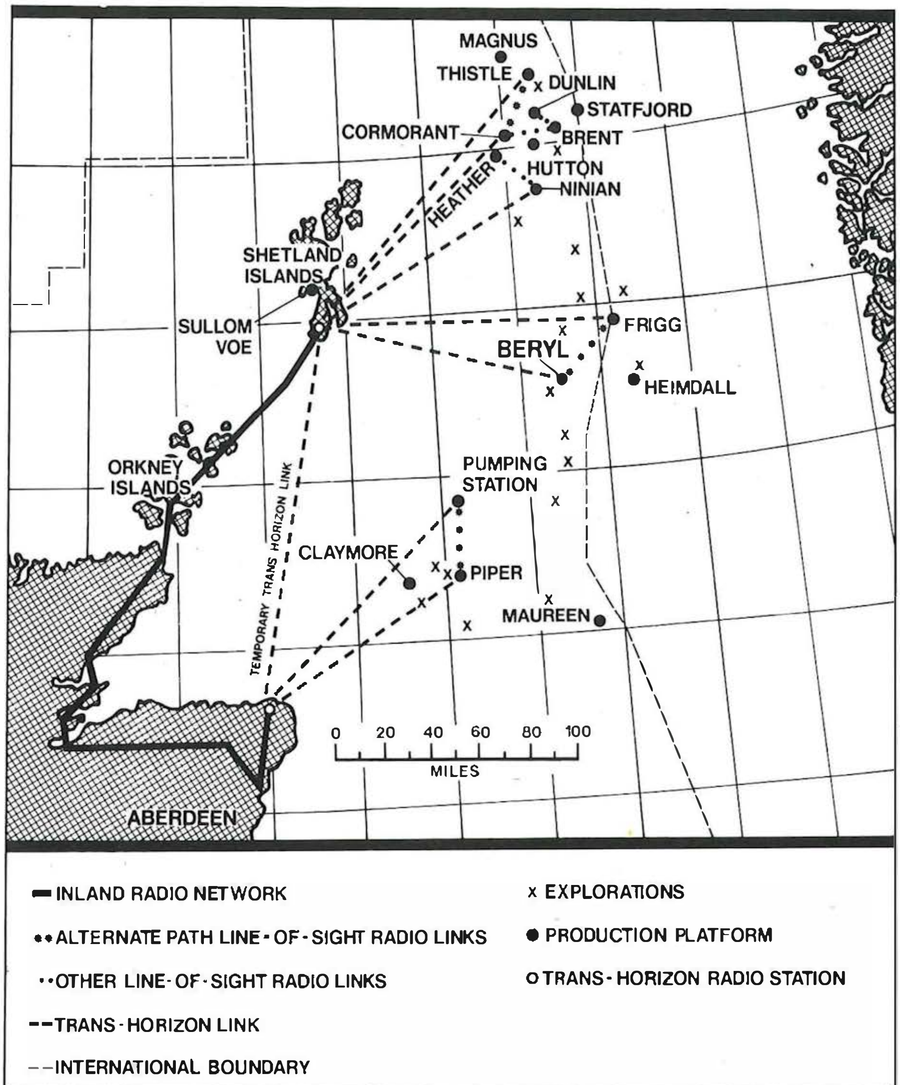
This project is the second phase of the Post Office's multi-million pound programme for providing reliable high-quality telecommunication services for Britain's oil and gas installations.

Already the Post Office has spent about £3 million in getting the first of the North Sea services working – to Mobil Oil's Beryl platform 150 km (95 miles) east of the Shetlands.

Under its programme to provide the North Sea platforms with high-quality world-wide telecommunications services, the Post Office, in collaboration with the oil industry, is setting up a network of off-shore microwave radio links to extend Britain's mainland telecommunications system.

This offshore network is connected to Britain's inland network through two new radio stations on shore, using an advanced radio transmission system of high reliability – known as trans-horizon microwave radio – to meet the exacting demands of high-performance communication across many miles of open sea. These two radio stations are strategically sited to serve almost the entire British sector of the northern North Sea gas and oil fields.

In the second phase of the programme, two new shore terminals are to be built on South Shetland.



Viewdata trial grows

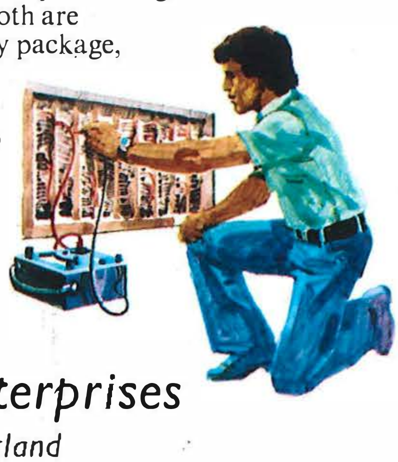
VIEWDATA, the Post Office's system for presenting telephoned information on television screens is continuing to attract more and more organisations to take part in the pilot trial launched at the beginning of the year.

The trial is the first step towards a public service which could start within three years. The massive support for the trial will enable the Post Office to determine the range of information to be provided, consider charges and assess likely demand.

Television receiver firms taking part

Lifetime concern: just a part of the Plessey package

Since installing Europe's first automatic exchange, Plessey has been involved in several generations of technology. But the company prefers to think in terms of generations of *customers* . . . putting the emphasis on long-term service.
Plessey supports installation, commissioning, maintenance . . . then assists in the further development of the system as needs increase and technology advances. Plessey customers have the best possible support in their planning for the future. Lifetime concern from Plessey is as tangible a benefit as good hardware. And both are components of the Plessey package, which covers every stage of telecommunications planning, supply, staffing, maintenance and continued development.



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include GEC, ITT Consumer Products UK, Mullard, Philips Electrical, Pye, Rank Radio International, and Thorn Electrical Industries while those providing information include the Financial Times, the Westminster Press Group, Reuters and Extel. Magazine and book interests include the British Printing Corporation, W. H. Smith, and the International Publishing Corporation.

Other interests represented in the trial include travel, education and careers.

Post Office Telecommunications are also providing a wide range of information – from details of its inland and international telephone, telex and data-transmission services to classifed directory information. There will also be a Viewdata directory, listing participants in the pilot trial and giving the numbers of the "pages" in the Viewdata store on which their information is contained.

Seven new systems

SEVEN high-capacity digital transmission systems – each capable of carrying 1,680 telephone calls simultaneously – are due to come into service by the end of the year. They are the first working systems in the country and they will link Birmingham, Coventry, Northampton, Leicester, Walsall, Wolverhampton, Stoke and Stafford.

The Post Office plans to use the new digital techniques to link Britain's main population centres as part of its programme for introducing the all-electronic telephone exchange systems planned for the 1980s.

Digital transmission systems carry telephone speech signals which are converted from continuous electric waves into streams of electric impulses. They are converted back into speech waves at their destination. Apart from telephone calls the systems carry services, such as television, computer data and facsimile.

Service starts

A NEW coast radio station has opened at Start Point, Devon, to provide full national and international telephone and telegram services for inland shipping in the English Channel between East Cornwall and West Dorset.

The station is part of the Post Office's £116,000 programme to improve shipping communications, and will be controlled from Land's End coast station. It fills the gap between areas covered by the VHF services provided directly from Land's End and Niton, Isle of Wight, and will broadcast messages, weather forecasts and gale warnings along with its parent station.

Messages world-wide

ONE of the world's largest private telegraph systems has been brought into operation by the Post Office for the world-wide Japanese trading firm Mitsui and Co. Called MITPOL – Mitsui Post Office London – the system, which took two years to design and install, can handle 20,000 messages a day.

The system is based on a Post Office message-switching computer which is the focal point of more than 40 private circuits linked to other Mitsui offices throughout the world. All messages switched by the computer are stored for three days after transmission and can be retrieved at any time at all throughout that period.

The message-switching system is directly linked to Mitsui's own computer in Tokyo, which also works to a computer in New York. The new centre is also directly linked to Britain's public telex network, which can help maintain the service if faults develop in the private network.

Call for papers

A CALL for papers on such subjects as lay-out problems, practical circuit and system design, tolerance problems, microwave circuits, microwave integrated circuits, antenna design, design automation and optimisation techniques is being made by the organisers of a conference on Computer Aided Design of Electronic and Microwave Circuits and Systems.

The conference is to be held between 12 and 14 July 1977 at the University of Hull. Papers should reach the conference Secretariat, Department of Electronic Engineering, The University, Hull, HU6 7RX, by 15 December.

Publication and Price:
The Journal is published in January, April, July and October, price 18p per issue. The biennial postal subscription is £3.00 (£2.00 for one year) or life subscription of £6 for retired Post Office staff.

Contributions:
The Editorial Board will be glad to consider articles of general interest in the telecommunications field from all sources. 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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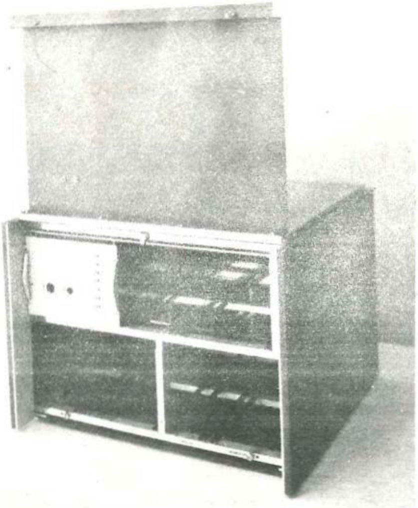
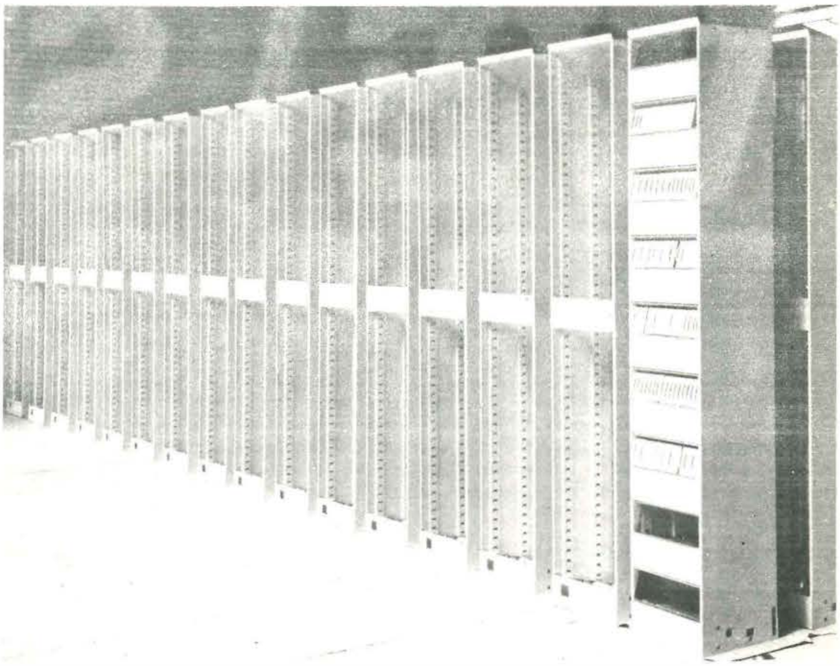


P.O. Modem



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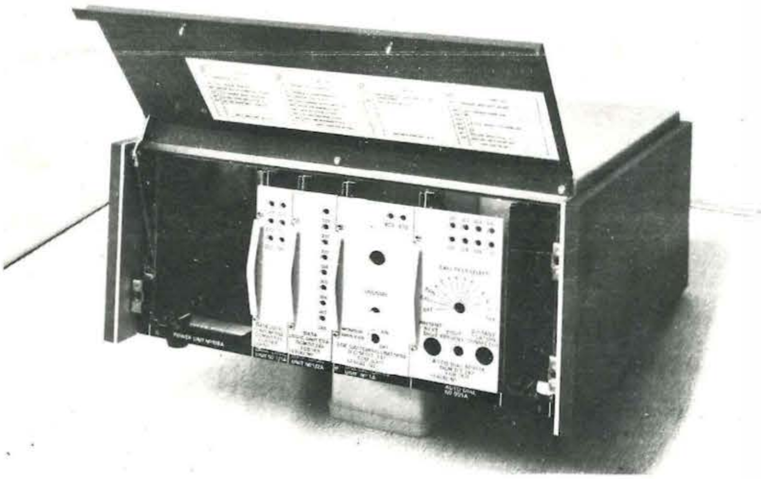
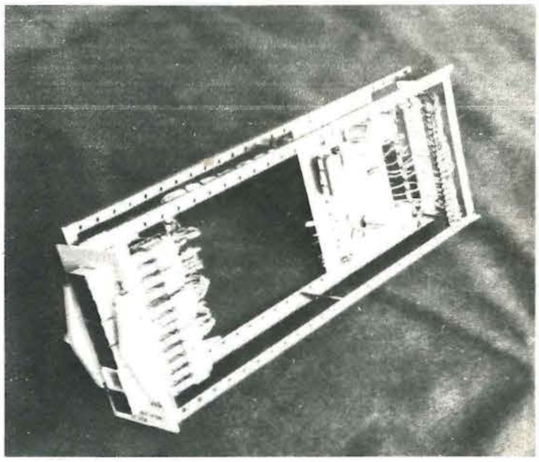
IMMEDIATE QUOTATIONS AND TECHNICAL SERVICE

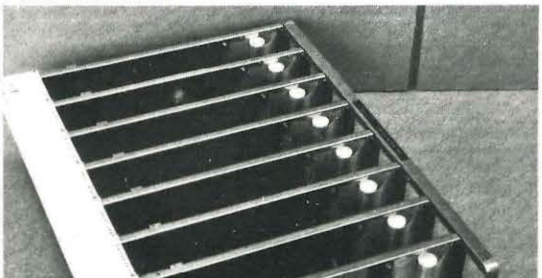


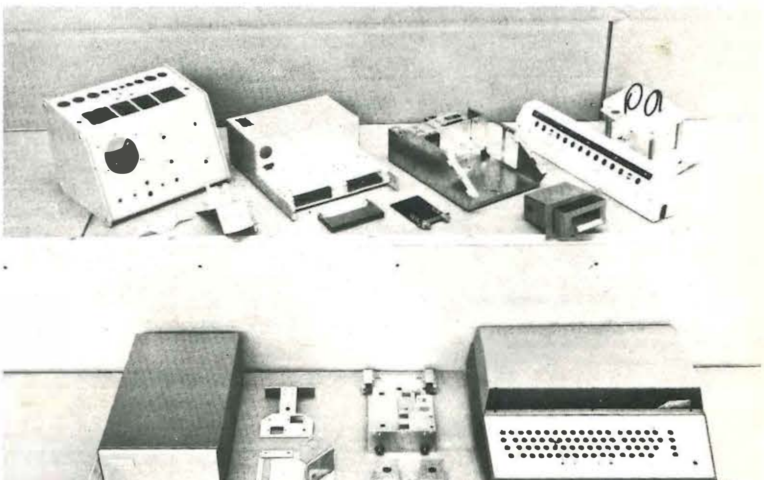


P.O. No. 62 "Jack in" Unit

P.O. Audio Shelf

Typical P.O. Modem





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