Post Office telecommunications journal

Spring 1974 Vol. 26 No. 1 Price 12p

THE SHAPES OF EXPERIENCE

Formica* quality today is the direct result of many years' specialist experience. Now, more than ever, Formica* industrial laminates – paper phenolic and glass epoxy – are used in the majority of British telecommunication industry applications.

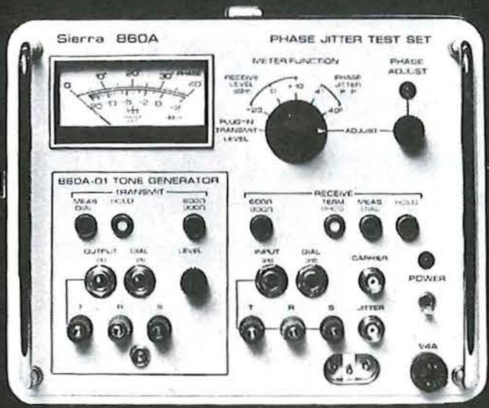
FORMIC

industrial laminat

*Formica is a registered Trade Mark.

Formica Limited, Eldon House, Regent Centre, Gosforth, Newcastle NE3 3PW. Telephone: Gosforth 850171 Telex: 537365 Formica AB N TY

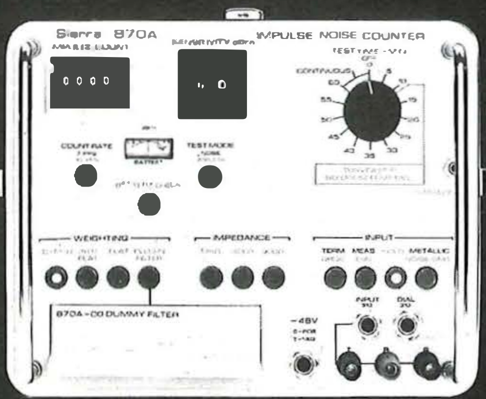
NEW DATA TRANSMISSION TEST SETS.



SIERRA 860A PHASE JITTER TEST SET

SIERRA 860A FOR JITTER

Set the range, tweak the meter. That's all you do to get a fast reading of peak-to-peak phase jitter and tone level. This 8 pound portable also offers dial-and-hold functions and a 1020 Hz plug-in tone generator. The set's designed to meet Bell System standards.



←870A & 860A USED TOGETHER WILL MEASURE PHASE HITS↑

SIERRA 870A IMPULSE NOISE COUNTER

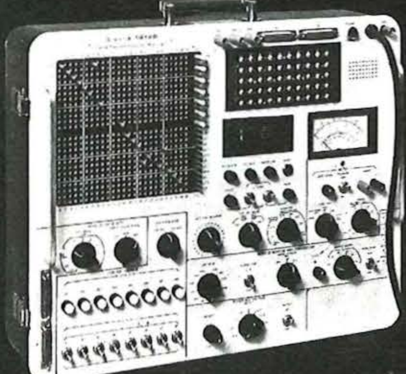
For voice band or wideband data channels . . . a 14 pound battery operated test set that measures noise spikes or levels (metallic or noise-to-ground) with sensitivity of 20 to 99dBrn. Time intervals settable from 9-60 minutes or continuous. Built-in C-message and 3kHz flat filters; optional plug-in weighting filters are available.

SIERRA 920A ERROR TEST SET

SIERRA 920A FOR ERRORS

Measure bit or block error rates in simplex, half duplex and full duplex modes up to 2 megabits per second. EIA compatible; may be customized for non-EIA modems. Bright LED digital error rate readout. Self test capability.

. . . BROUGHT TO YOU BY THE MAKERS OF THE FIELD-PROVEN 1914 SERIES . . .



SIERRA 1914 FOR END-TO-END AND LOOP-AROUND DATA TRANSMISSION TEST.

Test asynchronous and synchronous voice band modems, check and display bit and block errors. Determine error rate margin. Check control signals and associated time delays. Perform in-service tests on modems. Do all this and much more, easily and simply with the lab-featured portable.

Write or call for the full story and a demonstration.

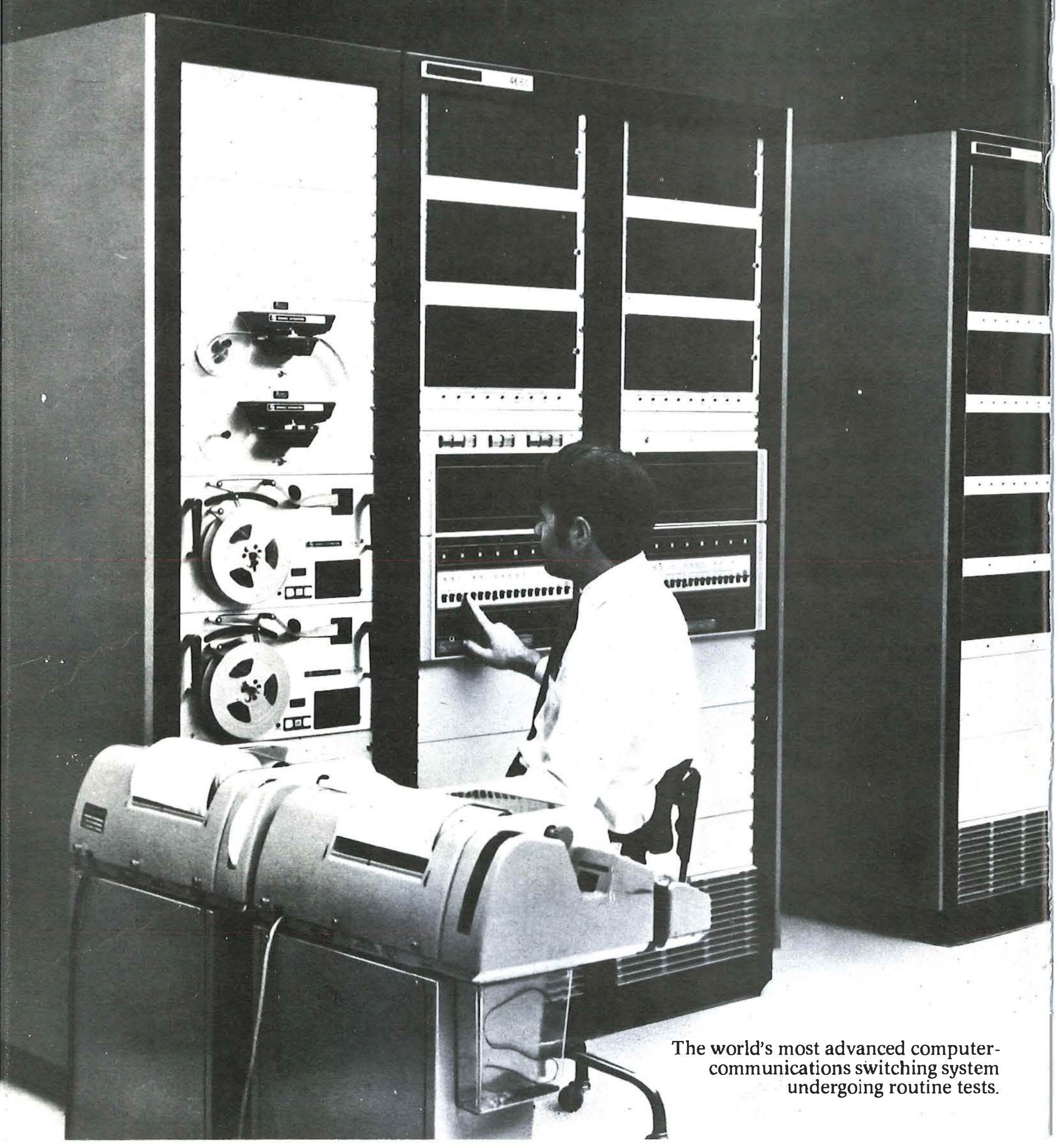
Sierra

Sierra Electronic Operation
3885 Bohannon Drive
Menlo Park, CA 94025
(415) 322-7222/TWX 910-373-1282

PHILCO Ford

U.K. Distributor:–
TONY CHAPMAN ELECTRONICS LTD 3 Cecil Court London Rd Enfield Middlesex Telephone 01-363 6688

Today's telex exchange-SPC; electronic; solid state



The world's most advanced computer-communications switching system undergoing routine tests.

Plessey System 4660

Not so much an exchange as a computer that can take all the requirements of a telex network in its stride. There are no crosspoints in the conventional sense—the signal path is routed through the computer core memory.

Here are some of the things it can do: if an addressed line is busy it can hold the message until it is cleared; it can send a message to a required number of addresses in one operation; it can store messages until low tariff periods commence; it can select alternative/optional routes...

These are merely some of the sophisticated extras System 4660 can offer, but they indicate the advanced technology of its design. The terminal equipment, for example, includes operator consoles with c.r.t. display, print-out or magnetic cassette.

Sizes: systems can range up to 32,000 lines.

Features include: *High traffic capability · Modular design · CCITT compatibility · Economy and low cost · Speed and code conversion · Ease of maintenance · Automatic message accounting · Self diagnosis and fault indication · Space saving · Solid state reliability · Flexibility and speed of installation.*

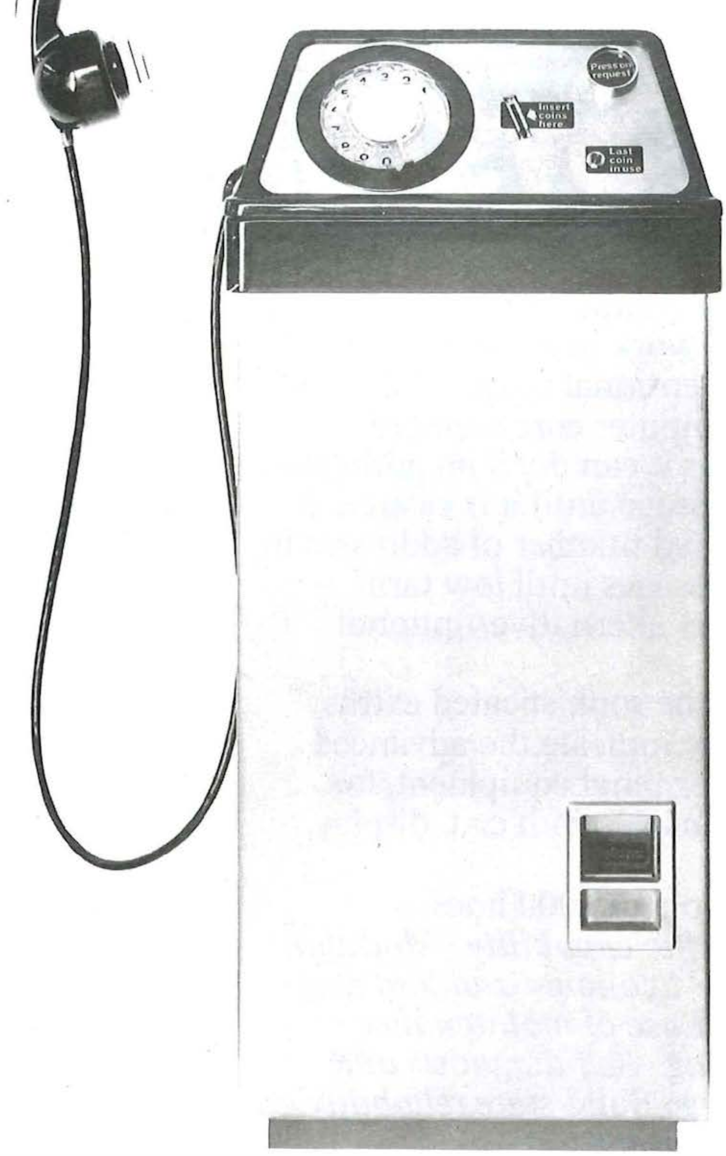
There is a full spares and after sales service.

For further information about System 4660 please write or telephone: Plessey Telecommunications, Major Systems Marketing, Edge Lane, Liverpool, England L7 9NW. Telephone: Liverpool (051) 228 4830. Telex: 62267.

Cordless Switchboard Operator position handling assistance call with CRT Visual Display.

PLESSEY
TELECOMMUNICATIONS

TARIFF FLEXIBILITY



plus IMPREGNABILITY

This new 7000 Series Coin Operated Telephone allows changes in tariff rates by simply altering links in the electronic module.

The modern pleasing design hides a robust and rugged casing able to withstand the most determined attacks.

M.O.S.T. logic circuits monitor and control all functions within the call box.

Modular construction eliminates maintenance.

Associated Automation Limited

A member of the GEC group of companies

Dudden Hill Lane Willesden London England NW10 1DJ
Telephone 01-459 8070 Telegrams Astomation London Telex Number 935210


VARTA

International network grows at record rate

Britain's international telephone service is growing faster than at any time in its history. During the next five years the number of overseas telephone calls handled by the Post Office will more than double – from 60 million a year now to 150 million in 1978.

London is the focal point of Britain's international telecommunications services. Although overseas telephone calls can be dialled direct from many parts of the country, all calls leaving the UK must pass through international switching equipment in the capital. Similarly, all incoming communications first go to London for distribution in the UK.

Until 10 years ago the ordinary trunk telephone network carried international communications between London and the cable, satellite and microwave radio terminals where they left UK territory. This was then the most economic arrangement. Rapid growth of international services, however, has justified the provision of "dedicated" capacity over many of the routes.

To help meet the present rate of growth the Post Office is to spend £9½ million expanding this special network between switching exchanges in London and the coastal and satellite terminals. The network, which in addition to telephone calls handles telex messages, telegrams and computer data, will be increased five-fold – from the present 13,500 circuits to 66,800 circuits in 1978.

The extra circuits on the inland sector are needed primarily to guard against a major failure on any one route. The network is designed so that if any inland route does break down at least 80 per cent of the traffic it carries can be redirected over an alternative link. This safety margin protects vital international communication against delays caused by transmission equipment failure. There must also be sufficient spare capacity on the inland links to permit re-routing of communications in the event of breakdown in a submarine cable or other international route. For example, if one of the cables linking Britain with Germany fails, communications can be re-routed over the UK-Belgium link.

The expansion of the inland network handling international calls is only part of a £115 million drive to improve international telecommunications services. The number of circuits in submarine cables, microwave radio and satellite routes linking Britain with other countries is to be more than doubled.

By 1978 circuits routed over submarine cables will be increased from the present 10,800 to 22,000. Microwave radio systems (Britain's busiest single international link is the microwave "hop" across the English Channel near Dover) will be increased from 2,000 to 5,700 circuits. Satellite circuits will go up from 1,200 to 2,700.

☐ See page seven for an article on a new international switching centre.

Post Office telecommunications journal

Spring 1974 Vol. 26 No.1

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

Cover: Closed-circuit television is an important aid to computer-based systems for road traffic control, currently being developed with Post Office help. The television camera shown provides an operator at a remote control desk with on-the-spot information of traffic conditions at a large intersection in London. (See the next two articles.)

In the West London road traffic control centre at New Scotland Yard a police operator calls up the computer visual display of traffic light operation at a busy junction. In the background is a map of the area controlled by the scheme and television screens which show the state of traffic movement at the most important intersections in the area.

How to beat the jams

WJ Paterson

The Post Office is helping several local authorities to tackle the ever growing problem of road traffic congestion. Computer systems and closed-circuit television, using Post Office communication links, are being developed to control traffic in busy areas.

MOST traffic lights in the United Kingdom are controlled by timing devices that can be adjusted by vehicles approaching the controlled junctions. Vehicles are detected by the familiar rubber bar on the road surface, and more recently by sensors which are buried under the road. These facilities provide fairly flexible and efficient control of individual junctions, particularly where there is a low-to-medium volume of traffic. However, as traffic increases this method of control tends to introduce delays in areas where there is a succession of traffic signals. It has been estimated that queueing at traffic lights accounts for more than 100 million vehicle hours each year in this country alone.

About eight years ago British traffic engineers first considered using computers to co-ordinate the timing of signals in busy areas in the hope that they would offer an improved method of linking signals according to the traffic situation at any given time. Following two successful experiments, in West London and Glasgow, the Department of the Environment (DOE) proved that computerised systems could reduce journey times by up to 10 per cent in a controlled area, and at the same time reduce road accidents and police manpower requirements for traffic duty. Estimated savings to the community provided a good return on capital outlay and running costs.

Currently some 16 local authorities are introducing or planning computerised systems of traffic control. Ultimately more than 30 cities and towns in the UK will have their traffic signals connected to central computers. The Post Office is playing an important role in planning and providing data communication networks for these systems. The links are unusual in that they are probably the largest data networks in the country contained within either a single Telephone Area or, in the case of the two

largest systems, a Telecommunications Region. The number of traffic signals that will be linked to a computer range from about 60 in the smaller towns to more than 1,000 in Greater London.

System philosophy is still in a state of evolution, and the Data Communications Division at Post Office Telecommunications Headquarters, in conjunction with DOE, offers its services on a paid consultancy basis to local authorities who need detailed help in planning their data communication networks. A study was carried out early last year for the County Borough of Northampton, and currently a major contract for Greater Manchester is nearing completion. The latter contract was negotiated with the South East Lancashire and North East Cheshire (SELNEC) Highway Engineering Committee which acts on behalf of the principal local authorities in and around Greater Manchester.

Post Office involvement in road traffic control systems is also attracting worldwide interest. Negotiations are in hand with a Far East administration to carry out a special study this year.

An immediate advantage of using a computer is that it can control a large number of traffic lights. The computer, at a central control point in the area, is linked to the traffic lights by Post Office data circuits. Data terminal equipment is housed in roadside cabinets which contain the complex traffic control equipment. Separate instructions for changing each set of lights at predetermined intervals are stored in the computer. Together these instructions – called fixed-time plans – provide a complete cycle of traffic signal operation in the controlled area, the red and green signals of every set of lights being altered in relation to each other.

In addition to sending computer instructions to the controlled area, it is equally important to receive confirmation from the roadside controllers that instructions are carried out and that signal timings continue to be accurate. Traffic engineers estimate that the ability of a computer to monitor these operations alone can account for a six – seven per cent reduction in journey times through the controlled area.

The usual approach to setting up a computerised system of road traffic control is to start with fixed-time plans, but the system allows other, more flexible signal control methods to be adopted at a later date. As the first step towards increased automation several fixed-time plans are calculated to provide suitable light switching patterns for different times of the day and week. Calculations are based on traffic surveys carried out at all signalled intersections in the area, but allowance can be made for small modifications to the plans by vehicle-actuated detectors in the road.

A more sophisticated method of control is to base the selection of fixed-time plans on information from road traffic detection equipment. A further refinement is to store traffic information on the computer but modify it second-by-second with data from the controlled junctions. The ultimate aim is for the computer to produce unique signal plans which are totally based on the incoming information.

Traffic information is supplied both by vehicle-actuated detectors, which provide axle counts, and special detectors which give information on vehicle speeds, the length of queues and the position of vehicles approaching the controlled junctions – for example whether they are likely to be turning right. Detectors can also be provided to identify public transport and emergency vehicles, such as ambulances.

If the special detectors indicate congestion at a particular junction the computer can prevent further traffic from using the main approach routes. This is achieved by switching on signs not normally illuminated to divert the vehicles to a by-pass route. The technique can be used to operate other traffic control signs, for example to give motorists early warning of full car parks or to restrict exit from car parks to certain busy routes at peak periods. A variety of other signs associated with motorways and high-speed urban roads can also be controlled by the computer. Normally the special detectors are installed irrespective of the type of control system first adopted by a local authority. Initially, therefore, the information they provide may be used only for statistical purposes.

Closed-circuit television (CCTV) provides an additional source of information for road traffic control systems. Cameras at important road junctions and intersections are linked to television screens at the central control. These monitors can give early warning of abnormal situations which cannot be identified by the computer system, such as accidents or adverse weather conditions which may subsequently cause traffic congestion. By detecting the problem on his television screen, the con- ▶

troller can take emergency action by overriding the computer control of traffic signals in the affected area. (A CCTV system planned for the Greater London area is described in an accompanying article.)

The proposed SELNEC system for Greater Manchester, referred to earlier, will connect more than 600 traffic controls to a central computer in Manchester and cover an area of approximately 300 square miles. The area includes many important towns, including Bolton, Oldham, Ashton-under-Lyne, Stockport and Altrincham. The study team has considered all possible data transmission techniques and networks to determine and justify on technical and economic grounds a solution which will minimise the total cost over 15 years allowing for both capital investment and annual running costs of the system.

Networks cannot be considered in isolation from the data terminal equipment which organises the data to be sent over the communication links. An important aspect of the SELNEC study therefore has been visits to manufacturers to discuss currently available equipment and development plans for the future. Manufacturers readily accepted the Post Office in the role of the customer's consultant and have co-operated by providing full details of their equipment specifications.

Road traffic control systems have a built-in fall back system in that traffic lights will continue to operate if the computer link fails, but the requirements of system reliability and ease of maintenance are as vital as for any other major data communication network. The DOE requirement for two computers at the control centre is a measure of the importance placed upon continuous computer control. The data communication system must clearly reflect this high standard of reliability, although without duplicating every component.

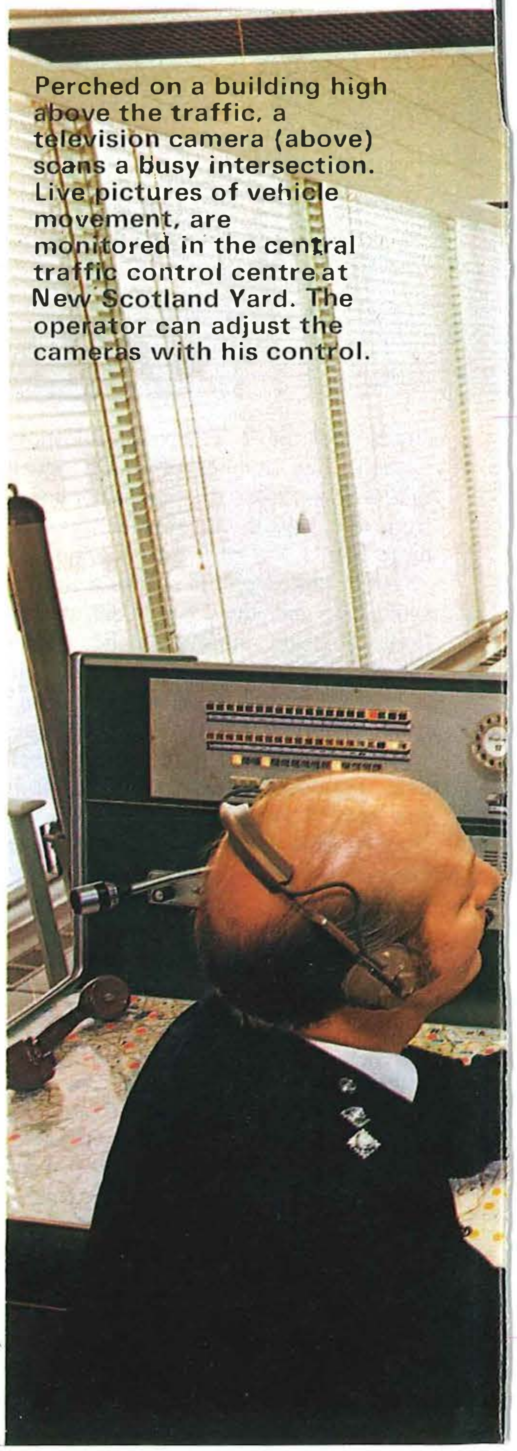
A great deal of attention is being given in the SELNEC study to the appropriate measures for achieving high reliability. The final report will contain general advice and recommendations concerning diagnostic fault procedures and testing aids for the proposed data transmission system.

Experience in the past has proved that this type of work requires the study team to become an integral part of the complete system planning unit, and members of the Post Office have worked alongside local authority staff throughout the exercise. Further consultancy studies are planned for other local authorities who are considering similar road traffic control systems.

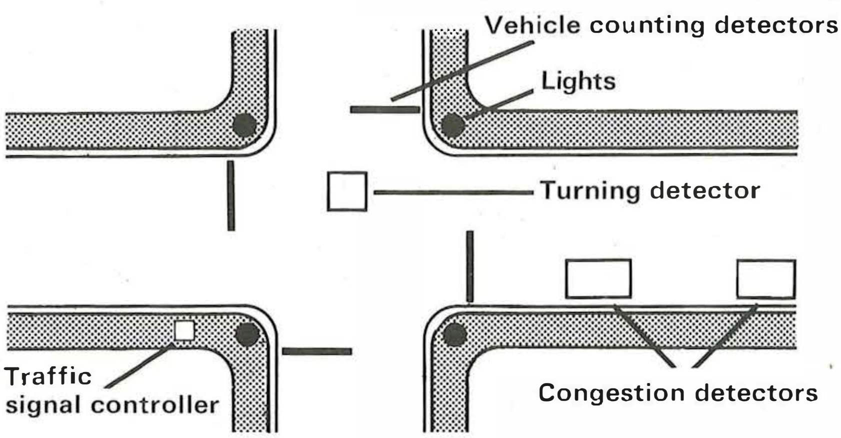
In addition to the consultancy work carried out by staff at Telecommunications Headquarters, regional Datel marketing officers or area sales staff are co-ordinating network requirements in conjunction with specialist engineering officers. Among the Telecommunications Regions involved in this work, London is responsible for the system in Greater London, and Midland Region currently has five systems in an advanced planning stage. Engineering staff in Liverpool Telephone Area are also conducting a consultancy study under the guidance of THQ to advise Liverpool Corporation about sectors of the network which are to be owned by the local authority.

Mr W. J. Paterson is head of the group responsible for data communications consultancy work in Telecommunications Marketing Department, and has been concerned with traffic control systems since 1972.

PO Telecommunications Journal, Spring 1974



Perched on a building high above the traffic, a television camera (above) scans a busy intersection. Live pictures of vehicle movement, are monitored in the central traffic control centre at New Scotland Yard. The operator can adjust the cameras with his control.



An intersection with computer-controlled traffic lights, showing various types of remote device which can be used to detect such problems as congestion and vehicles waiting to turn at a junction.

Keeping an eye on traffic

LS Lunt

MOTORISTS in the Greater London area should encounter progressively fewer traffic jams in the coming years. Following the success of an experiment to control traffic lights by computer in a small part of the capital, the Greater London Council (GLC) has decided to extend the scheme to the whole of London. The experiment has succeeded in cutting down rush-hour journey times in the trial area by six minutes in every hour. In this system two computers at the New Scotland Yard headquarters of the Metropolitan Police receive data on traffic flows from sensors located in the road at or near junctions controlled by traffic lights. The computers use this information to co-ordinate the traffic signals so that congestion on roads in the controlled area is reduced to a minimum. Closed-circuit television (CCTV) cameras at important road junctions provide visual information to an operator in the control centre who can adjust the computer instructions to signals.

The Post Office installed data circuits and a CCTV system for the experiment in a 6¼-mile area of West London (see Telecommunications Journal, Spring 1968), and will provide similar facilities for the new scheme. Called Central Integrated Traffic Control (CITRAC) the scheme will be introduced in stages over a number of years. The first phase covers 45 square miles of central London and involves 300 sets of traffic lights, and will be in operation by 1974/75. The area is bounded by Marylebone Road in the north, Victoria in the west, The Oval in the south and Gardiner's Corner, Aldgate, to the east.

The CCTV system plays an important role in any overall road traffic control scheme. Although the computers can quickly switch traffic signals in accordance with the data supplied, they cannot recognise the causes of variations or stoppages in traffic flow caused by abnormal situations, such as accidents, breakdowns or adverse weather. It is therefore necessary to have visual indication at the control centre of such hold-ups, and this is the main purpose of the CCTV system.

In the West London scheme television cameras are installed on high poles or buildings at the approaches to road junctions and intersections where there is a high rate of traffic flow. Pictures are transmitted to the control centre at New Scotland Yard where they are displayed on the screens of television monitors. An operator at the control centre can adjust the cameras by means of teleshift controls – zoom, focus, pan and tilt – to ▶

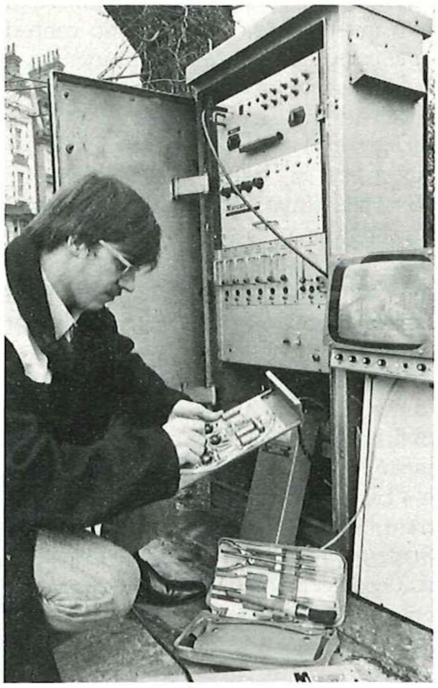
identify the cause of a hold-up. He can then either override the computer or reprogram its instructions to overcome the cause of congestion. Where necessary the operator also advises traffic police of the hold-up, for example to send a crash squad quickly to the scene of an accident.

The CCTV line system being provided by the Post Office for the Greater London scheme differs in some respects from that used in the experimental system. Only eight cameras were needed in the trial area and separate video cables were provided from each camera to the control centre. In the early planning stages of the much more comprehensive CITRAC scheme it was recognised that it would be neither economical nor practical to provide a separate cable for each camera. In the first phase the Post Office has to provide vision circuits for 45 cameras, and in the later phases involving outer London up to 150 more cameras may be required.

It was therefore decided to design a hybrid system consisting of two standard Post Office television line transmission systems, namely video and very high frequency (VHF). The video system provides individual point-to-point CCTV line links, and can give a 625-line picture over a distance of up to 7.5 miles. The VHF line system is designed to accept a number of separate vision signals and transmit them over a single coaxial cable to the control centre.

In practice, for the first phase of the CITRAC scheme, eight areas have been selected in each of which up to nine CCTV cameras may be installed. A telephone exchange approximately at the geographical centre of each area acts as a collecting centre for the television signals. The telephone exchanges used will be Wellbeck, Tower, Temple Bar, Gerrard, Abbey, Belgravia, City and Waterloo. Each camera in a selected area will be linked to a telephone exchange by a video cable over which vision signals can be transmitted in the frequency range 0–6 MHz. By means of VHF translating equipment at the telephone exchange vision signals from each camera in the area will be combined into the frequency band 40–140 MHz and transmitted together with a 140 MHz pilot signal over a single multi-channel VHF link to the control centre.

A Post Office engineer checks a video amplifier in a roadside cabinet which contains the control equipment for a television camera at a road junction.



By using the hybrid system only eight cables will enter the control centre instead of 45 cables that would be necessary for an all-video system. This will avoid congestion in the cable ducts into the centre, which already have to cope with a large number of audio and data cables. The system has a capacity for 72 cameras, although only 45 will be provided initially for the first phase of the scheme. Cameras can therefore be added or relocated in each area, up to a maximum of nine, without needing to provide additional cables between the exchanges and the control centre.

To compensate for transmission loss over the video cables, mains-powered amplifiers will be provided at intervals along the cable routes. These video amplifiers can be installed in telephone exchanges, repeater stations, the customer's premises or in roadside cabinets similar to those used for local telephone distribution. The number of line amplifiers required for the hybrid system is less than would be needed for a wholly video system, and avoids the difficulties in obtaining wayleaves for a large number of roadside cabinets that would be needed to accommodate video line amplifiers.

The special, robust cable generally used for the video links between the cameras and the telephone exchanges can be installed in a variety of footway boxes and manholes and all types of ductway with little risk of it being damaged when in place. The cable contains two pairs of wires, one pair being used to transmit the television signal and the other for camera control signals which are transmitted at voice frequency.

The VHF line network consists of special coaxial cable equipped with amplifiers which are installed at intervals in junction boxes or footway boxes to provide a constant signal to the control centre. The cable is robust and resistant to crushing, and can be installed in a variety of ductways. For added security the cable will be installed in deep-level tunnels wherever possible. Power for the line amplifiers is supplied from the batteries at each telephone exchange. To assist maintenance a monitor outlet is provided at each amplifier and the signal level at that point in the line system can be measured.

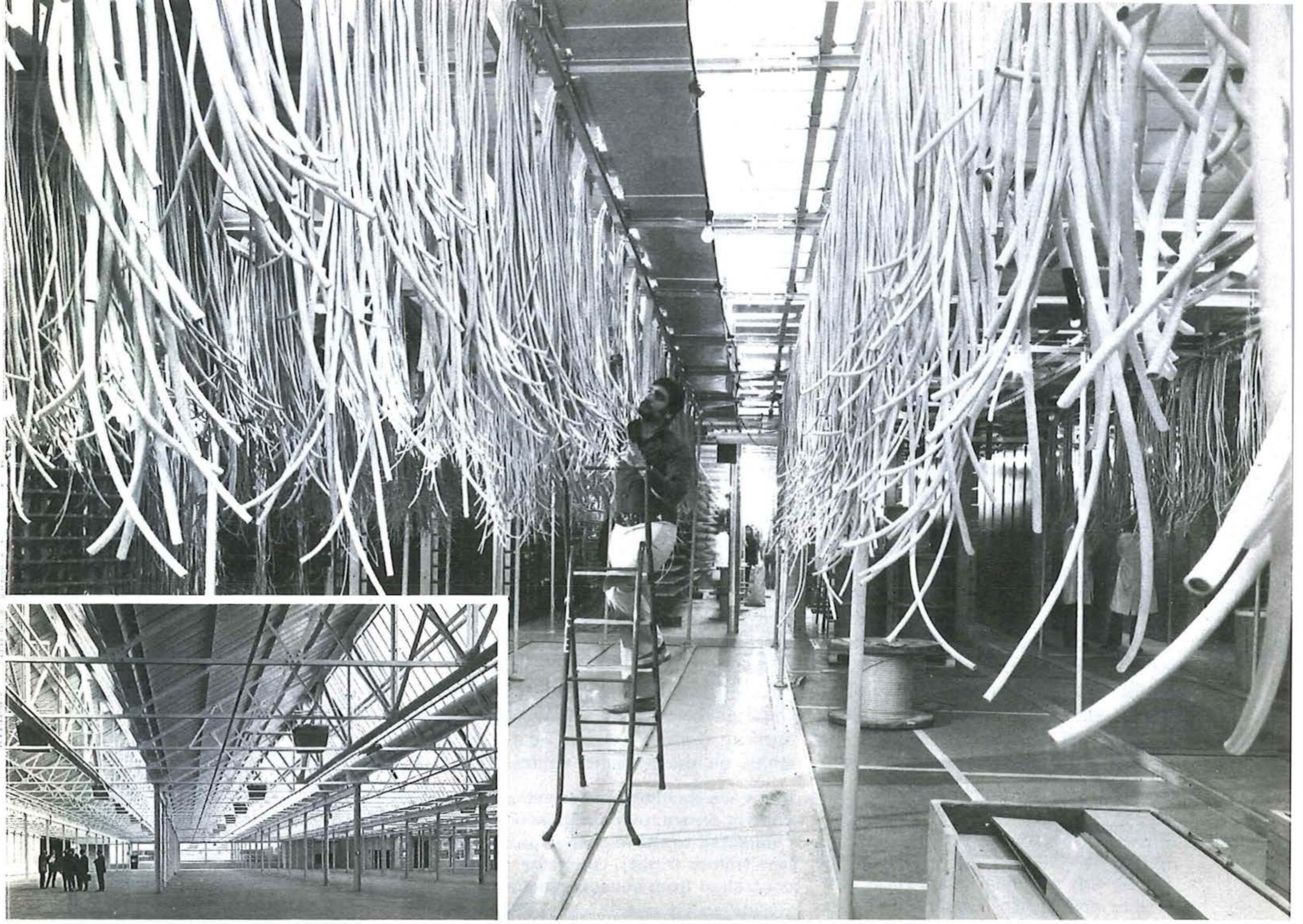
At the control centre each VHF line system is terminated by a receive amplifier which is basically similar to the line amplifiers but is powered from the local alternating current supply. The receive amplifiers also have alarm lamps which indicate that the mains supply is switched on and that the 140 MHz pilot signal is being received.

For the first phase of the scheme there will be eight receive amplifiers. The VHF output from each amplifier will be connected to equipment provided by the GLC which selects the VHF channels required at a particular time from the 45 present and converts them into video signals which can be connected to television monitors. The number of operators and monitors required at the control centre has not yet been decided, but experience in this country and the USA suggests that one operator cannot watch more than six monitors at a time.

The hybrid television transmission system has been designed to provide the required reliability and good quality television pictures. It will be capable of being extended to cater for later phases of CITRAC. The hybrid system is also less expensive to provide than an all-video system and should also be easier to maintain.

It is envisaged that within the next decade many of the larger towns in this country will have computer-controlled traffic lights and television surveillance. There is a need therefore for the Post Office to consider with the Department of the Environment whether adequate traffic surveillance can be achieved with reduced picture quality, requiring a much smaller bandwidth. Some development work is therefore being directed to new CCTV transmission systems with the object of meeting customers' requirements at lower cost.

Mr L. S. Lunt is head of the group in Network Planning Department at Telecommunications Headquarters which is responsible for all aspects of closed-circuit television. The group is currently involved in the planning of the GLC road traffic control scheme.



From a large, empty factory (inset) the Mollison switching centre takes shape at Stag Lane, North London.

Hunt ends at Stag Lane

RW Button

The international telephone service urgently needed a new switching centre. A rapid search was made for a suitable existing building, and the centre is being set up in record time.

THE LARGEST telephone exchange in the world dedicated to international traffic is currently being set up by the Post Office to cater for the rapid increase in calls between the United Kingdom and the rest of the world. The international centre will provide urgently needed switching capacity to augment existing facilities, and has been designed to meet anticipated growth in international calls during the rest of the present decade. The whole £40 million project is being carried out in about half the time normally required to set up a large telephone exchange, and the centre is scheduled to handle its first calls later this year, less than three years since the plan was put into operation.

Last year more than 53 million calls were handled by the Post Office's international telephone service, and forecasts up to 1981 indicate that this traffic will continue to rise at an annual rate approaching 20 per cent. Originally the Post Office planned to install equipment at a large, new international switching complex in central London to meet the more immediate requirements. However, in 1971 it became clear that delays in construction of the building, Mondial House, would prevent completion of the project on schedule, and it was decided to find an alternative location for the equipment.

At the same time plans were being made to provide additional equipment to ensure that customers in Britain and callers dialling into the Post Office network from overseas would be provided with an international service meeting forecast demand over the coming years. It is also vital to have sufficient switching and transmission plant to cater for the transmission systems available between the UK and other administrations, such as the CANTAT 2 transatlantic submarine cable (see Telecommunications Journal, Autumn 1973).

As a result the new international telephone service centre now being set up in record time will house two international switching centres (ISCs) and will be capable of connecting more than 750,000 calls a day. To reduce the time-scales needed to obtain a site, then to plan, construct and equip the centre, a search was made in the Greater London area for an existing building which could be adapted. At the same time offers for the supply and installation of additional switching equipment were sought by international invitation to tender. By June 1972 the lease of a suitable site had been obtained, plans ▶

had been made to divert equipment originally ordered for Mondial House, and a contract was awarded for the additional equipment.

The site chosen for the new centre comprises a complex of buildings on a former airfield at Stag Lane, Edgware, on the outskirts of London. Two large buildings on the site have been adapted to house the two ISCs, and these have been named De Havilland and Mollison from the association of the site with the aircraft industry and the flying pioneers of the early 1930s.

De Havilland ISC has been designed as a "full facility" unit to handle all types of international telephone traffic. It will deal with calls directly dialled by subscribers and with operator-controlled calls. Automatic transit calls – which are routed through intermediate countries to their destinations – may also be set up by, and through, the unit. Plessey 5005T switching equipment originally ordered for Mondial House is being installed in the De Havilland building. Some 3,060 international circuits and about 4,500 circuits in the UK national network will be terminated on the equipment.

Mollison ISC will cater for busy intercontinental and continental telephone routes. As a "limited facility" unit it will handle only outgoing international subscriber dialled (ISD) calls from the UK and incoming calls terminating in this country, neither of which requires the services of a UK operator. The ISC is divided into separate units for outgoing and incoming calls, and these units are further sub-divided into twin units. In effect, therefore, the Mollison ISC consists of four separate switching centres. Interconnection between the twin units allows a limited amount of traffic on one twin to be handled by the other, enabling full access by all incoming circuits to all outgoing circuits.

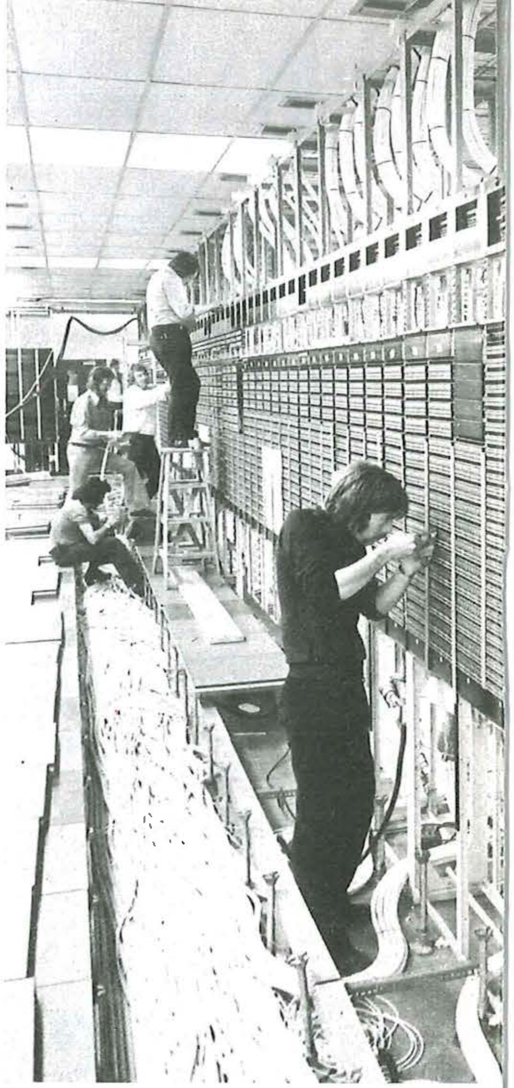
Switching units for the Mollison ISC, ordered as a result of international competitive tendering, are of L. M. Ericsson of Sweden ARM20 crossbar type and have been given the Post Office designation TXK5. By the end of 1976 the centre will have a total of 2,320 intercontinental circuit terminations, for countries such as the USA, Canada and Australia, and 8,520 terminations for countries in Europe. Of the 12,020 national circuit terminations in the Mollison buliding, 6,900 will be for the provinces and London sector switching centres, and the remainder for other exchanges in the London Director area.

A large number of the international circuit terminations at Mollison ISC will use a signalling system (CCITT R2) new to the UK. The system tends to be favoured by European administrations, and is more flexible than the international system presently used by the UK and other countries in Europe.

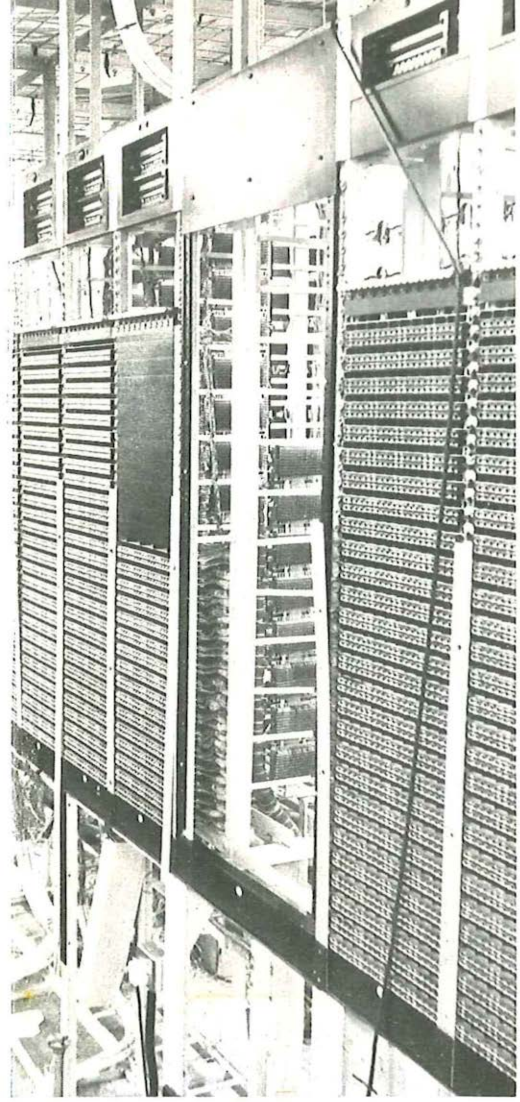
There will be no manual switchrooms at the Stag Lane complex. All calls needing the intervention of a UK operator will be connected to international control centres in London, Leicester and Glasgow. These centres are collecting points for international telephone traffic which has to be manually controlled.

ISD is being extended to many provincial centres and much of this traffic will be routed through Mollison ISC together with a substantial amount of international traffic which passes to and from London.

With Mollison concentrating on the large streams of international traffic, calls for the smaller international routes must be carried by the other UK switching centres. The network associated with the De Havilland ISC augments those of the Faraday and Wood Street ISCs in central London, and carries traffic on these smaller routes and all



In the De Havilland maintenance control centre, test equipment is connected to the exchange on test jack frames (right). Line tests will be controlled from consoles (below).

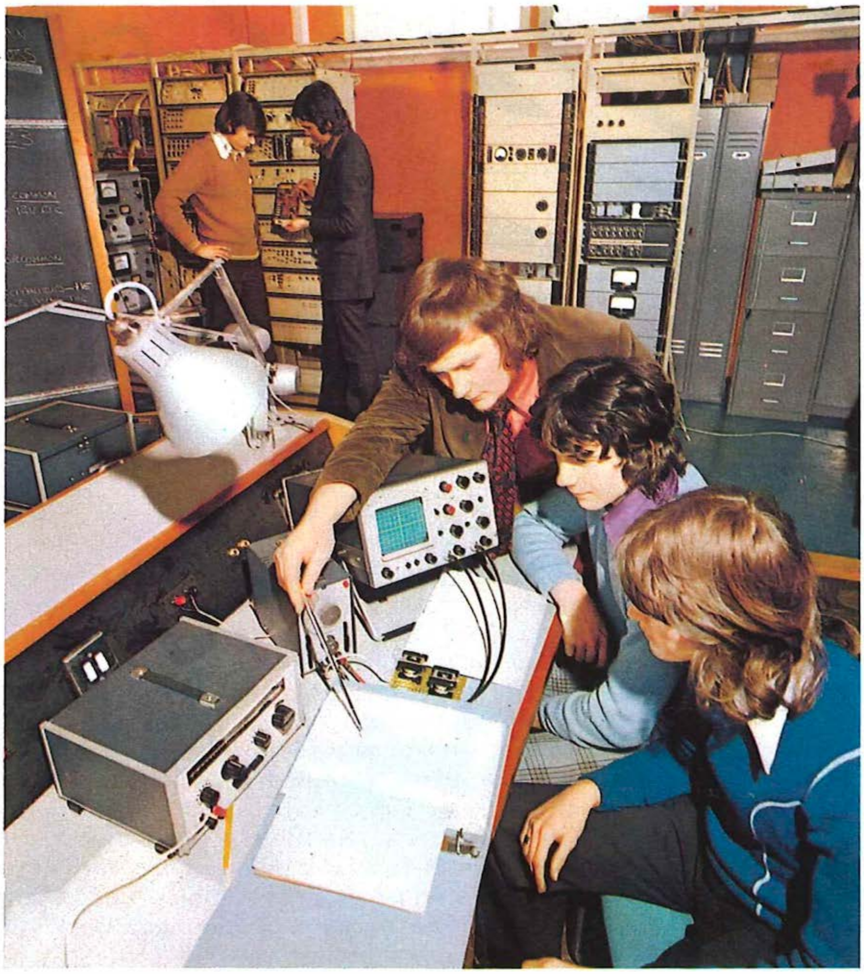


traffic handled by the international operators in this country.

All incoming calls from overseas to Mollison will be switched to the provinces using the national transit network or, where justified by the volume of traffic, direct routes to group switching centres. De Havilland incoming international traffic will be switched in a similar way, but this centre will have additional facilities to cater for provincial traffic via the UK zone centres.

The Stag Lane complex is 10 miles from central London where the national and international networks are concentrated. Cables have been installed to link Stag Lane with the existing international high-frequency (HF) network and these, together with other specially provided line plant, give the new centre access through all UK frontier and coastal stations to the rest of the world by means of satellites and submarine cables. Similar line plant connects Stag Lane to the national HF network, but access to the London Director area is being provided by a large number of pulse code modulation (PCM) systems.

Below: The Stag Lane complex includes a regional engineering training school. In one classroom an instructor helps students to test an amplifier they have constructed.



Each ISC at Stag Lane has its own maintenance centre and computer installation. The De Havilland computer system, known as International Accounting and Traffic Analysis Equipment (IATAE), will handle accounts for international calls as well as carrying out traffic recording and performance monitoring tasks in the ISC. A more simple computer system in the Mollison ISC will provide facilities for recording information which will be used in the calculation of international traffic accounts.

Both ISCs are served by a common repeater station at Stag Lane. All external lines terminate in this station before they are connected to the ISCs, and it will have an ultimate capacity of more than 17,000 international circuits. A proportion of these circuits will provide direct lines overseas for private renters.

Many parts of the Stag Lane project involve new design principles, practices and methods. Extensive training programmes have been compiled and training is already under way. A regional engineering training school has been incorporated in the Stag Lane complex which, in addition to the main buildings of single-floor construction housing the two ISCs, includes some sub-floor areas and office accommodation which is mainly of two-storey construction.

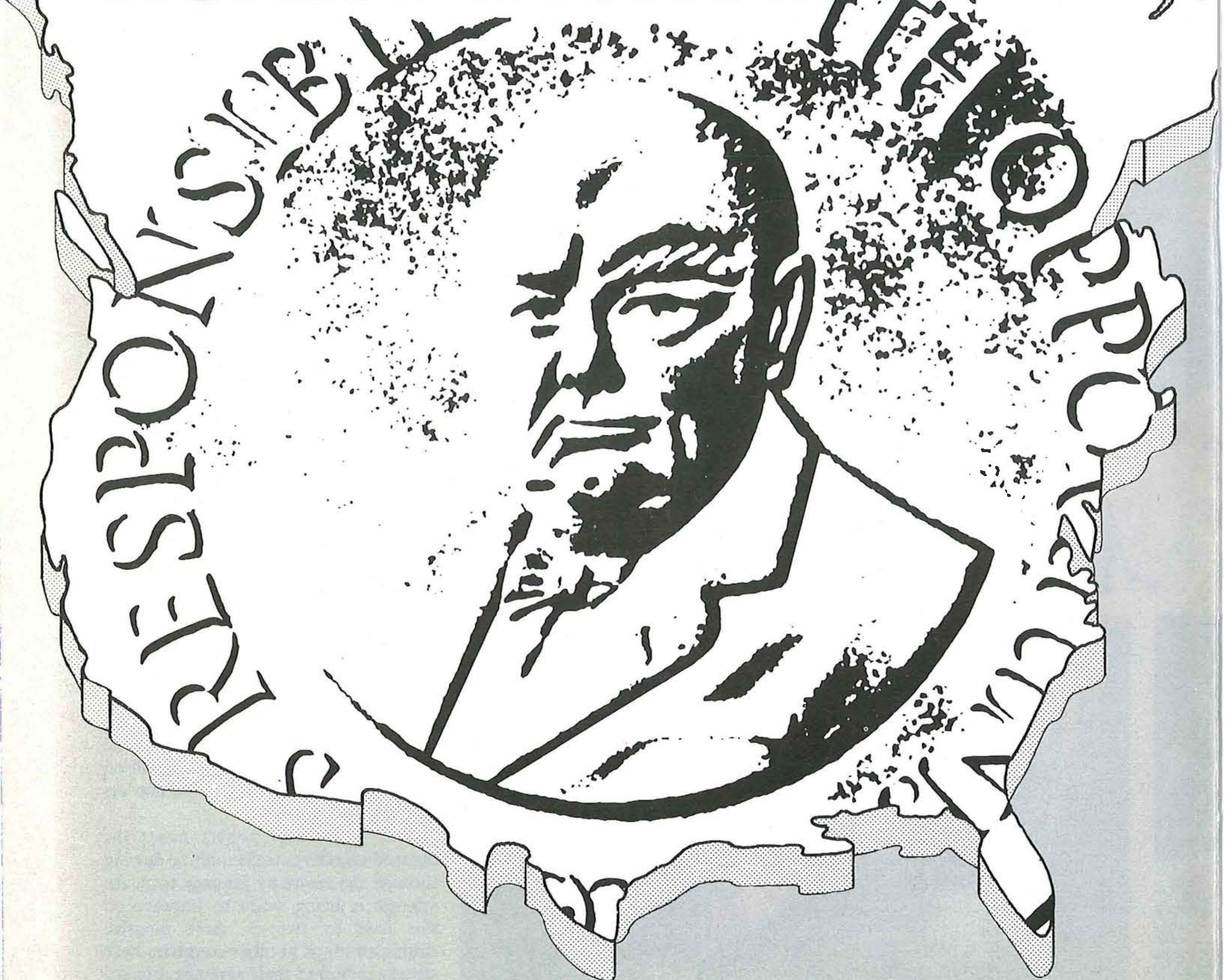
Installation of the De Havilland ISC began in February last year, and testing of the various parts of the switching process is already in progress. Starting this summer it is hoped to connect the circuit termmations at the Mollison switching centre at the rate of not less than 1,000 a month.

If the Stag Lane project meets the planned objectives traffic will be flowing through the centre by January 1975. An attempt is being made to improve on this date by two or three months. Administrations in other countries have already indicated their agreement to co-operate fully with the Post Office to get the Stag Lane international telephone service centre into operation as quickly as possible and thereby achieve a mutual objective of a substantial improvement in the quality of the international telephone service.

Mr R. W. Button was recently appointed to head the new Network Control Division of the Post Office's External Telecommunications Executive. Formerly Deputy Controller of the Project and Works Division in International and Maritime Telecommunications Region, he has been concerned with the Stag Lane oroject from the outset.

PO Telecommunications Journal, Spring 1974

Churchill invades North America



Seven Post Office staff were awarded Churchill Travelling Fellowships last year to study telecommunications in other countries. Three people chose very different aspects of the business in North America and they relate their experiences in the following pages.
(Reports from other Churchill fellows will be included in a future issue of the Journal.)
The fellowships – in the form of financial grants – were awarded by the Winston Churchill Memorial Trust which was established in 1965 to commemorate Britain's famous statesman. The Trust gives men and women from all walks of life the opportunity to travel abroad to widen their knowledge in nominated fields of activity, chosen each year by the Council which manages the Trust. All UK citizens may apply for a fellowship regardless of their age and academic or professional qualifications. Selected applicants spend an average of three months overseas, and are then asked to report on their studies. They also undertake to do whatever they can to ensure that other members of the community will benefit from their experiences. A special medallion is awarded to each person on successful completion of their fellowship. Photographs of the medallions and the authors are shown in these pages.

The country of the Ace salesman

WT Harper

Ted Harper, who is a Sales Superintendent in the Belfast Telephone Area, made use of a Churchill Travelling Fellowship to study marketing aspects of telecommunications in the USA and Canada. During his two-month visit Mr Harper examined sales techniques used by telephone operating companies in the two countries.

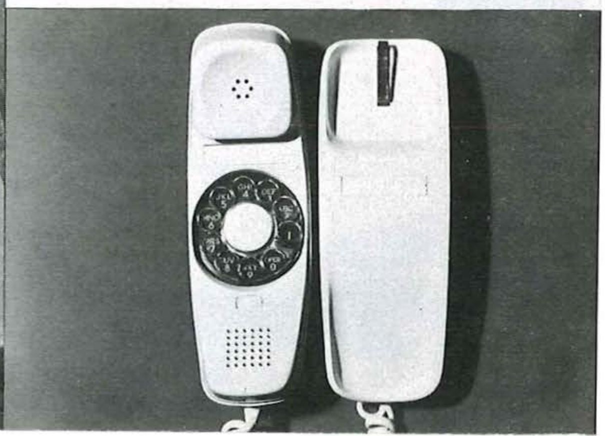
IT IS GENERALLY agreed that the United States of America is the traditional home of the salesman and the telephone. The country has more telephones than Europe, South America, Central America, Mexico and Africa combined, and with demand for basic service largely satisfied (93 per cent penetration of all tenancies has been achieved) the telecommunications business has now moved into the true field of selling.

American Telephone and Telegraph (AT&T) is the parent company of the Bell System, which supplies 82 per cent of the country's telephones. It comprises 21 local operating companies and four others with nationwide responsibilities. Service to the remainder of the country is provided by some 1,800 independent companies, ranging from one in Washington's Puget Sound with only 18 telephones to the largest, General Telephone, which has over 10 million.

In early days, companies vied with one another for customers and it was not unusual for two or three rival concerns to operate in the same area. They came to realise slowly that this destructive competition was neither in their own interests nor that of their subscribers. Consequently, as a result of mergers and take-overs a position was established whereby each company had a franchise to operate within a defined area without encroachment from the others. Today the Bell System generally has the lucrative high-density city areas, while the independent companies are to be found in the suburbs and country. With the rapid expansion of the cities and the movement of industry and commerce to the outskirts, the smaller companies are experiencing a boom which will undoubtedly continue.

Applications for tariff increases must be filed with Public Utilities Commissions, the State Governments dealing with intra-State matters and the Federal Government with inter-State affairs. These regulatory bodies act to protect both the nation's and the public's interests. The applications are carefully considered and due regard is given to the viewpoint of objectors before a decision is made whether to grant a tariff increase partially or in full. The ▶

Left: In the skyscraper-lined Madison Avenue, an operator at the modern switchboard of one of the world's largest advertising agencies.



Below: Modern designs of telephone instrument offered to customers in North America. Units have various dial and push-button arrangements.

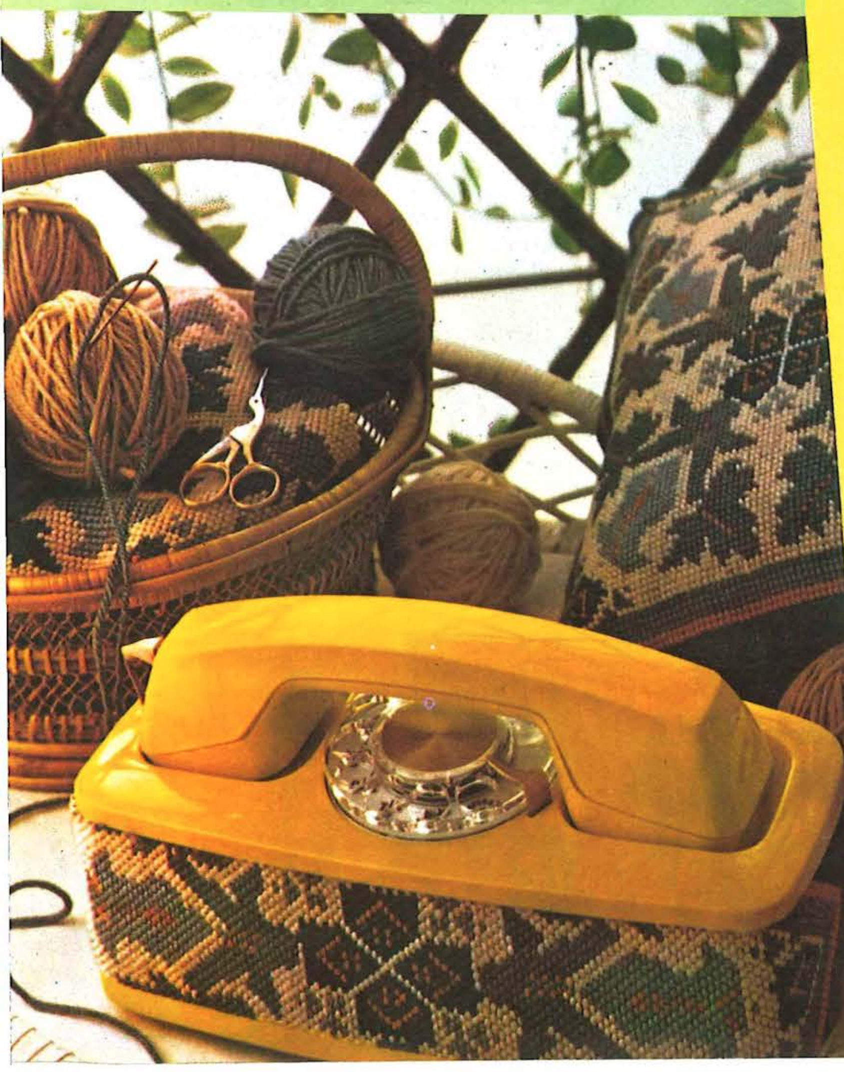
Americans have become conditioned to an inexpensive telephone service and applications are often hotly disputed. As the companies raise all their capital on the open market through the sale of stocks, shares and bonds, problems arise if a reasonable tariff structure cannot be attained. Low profits lead to a shortage of capital from investors.

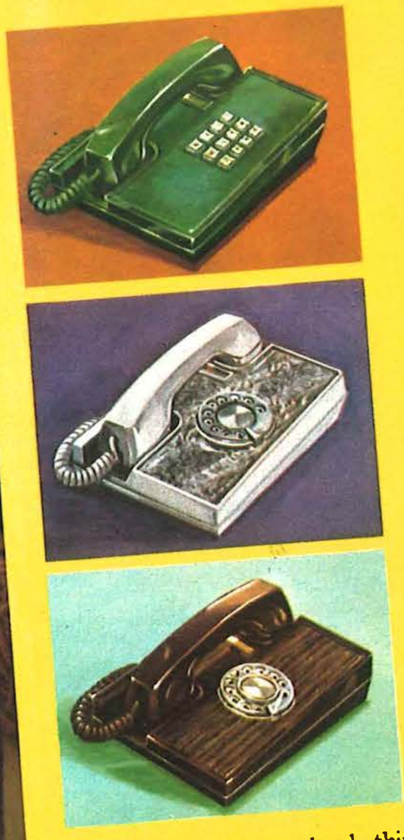
Mainly because of higher living standards and different domestic priorities, the USA "explosion" in demand for telephone service in the 1950s came earlier than in the UK. As a result of the present market penetration, provision of service presents little difficulty. Some delay is still experienced in rapid growth areas, such as Florida and Colorado, because of shortage of underground plant, but most applications are met within two days, and over a month's delay is considered unacceptable.

Common use of poles for electric and telephone services is prevalent in rural areas where up to eight subscribers may share a party line. Present policy is to reduce sharing to a maximum of four subscribers. However, when a subscriber does obtain an exclusive line, he is not asked to share.

An interesting development is taking place in Chicago where an operating company in the Bell System is pioneering a scheme with the local building industry for prewiring all new houses and apartments. The company supplies wiring and one socket for each room and the electrical contractor completes the telephone wiring along with his own. When the tenant moves in, he calls at the local Phoneshop, chooses his instrument and carries it home; no additional charge is made for the sockets. By the time he arrives the line is already connected to the exchange and a test ring is given. This method saves the company the cost of installation and of subsequent internal alterations to the telephone wiring which are known to be very uneconomical.

A vistor calls one of the residents in a block of flats by using a push-button telephone unit in the lobby. The residents can unlock the main entrance by dialling a certain number on the telephones in their flats.





For executives who do things with flair. Classic-plus styling in brown, green or white. Trimmed with brown alligator vinyl, apple-green leather, or silver-... Tone® or rotary dial, of course.

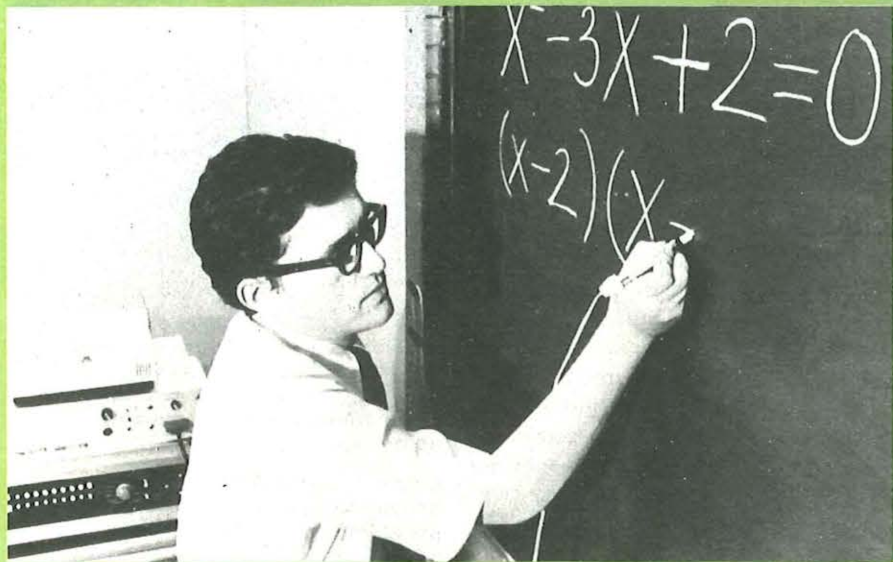
Currently there is strong competition in the provision of terminal equipment. Since 1969 a subscriber in any part of the United States has had the choice of renting apparatus from his local operating company or of obtaining it either by outright purchase or on rental terms through any number of private manufacturers. A number of American firms, as well as Swedish, German and Japanese suppliers, are very active in this field. No prior approval is needed from the operating company, the only requirement being an interconnect device rather similar to a fuse box to protect the network.

At first the operating companies were unprepared for the onslaught into their previously protected markets. Now they must actively pursue orders, and their marketing forces have been expanded and trained in the competitive art of salesmanship. It is widely quoted that today 80 per cent of all orders pursued are brought to a successful conclusion.

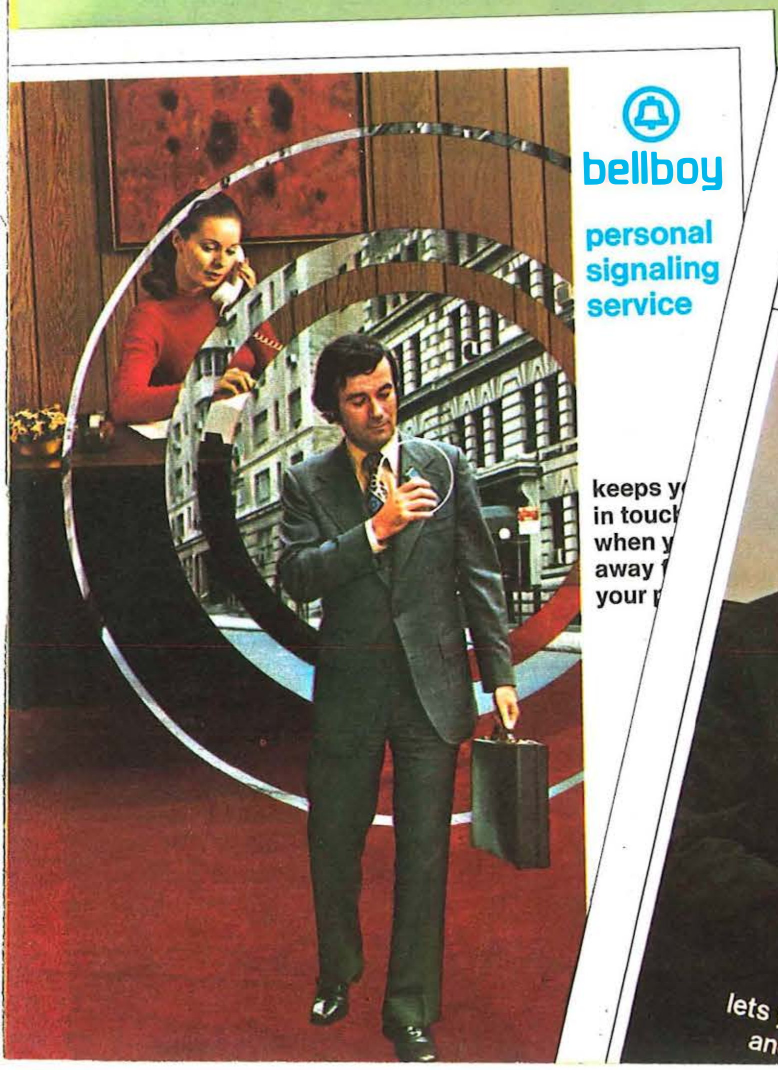
One of the means used to meet competition is a programme of planned calling on subscribers who have three or more exchange lines. In this way the sales representative can find out if the customer is contemplating a change of system and can forestall his competitors. Sometimes a subscriber will, rather mischievously, invite the operating company and private supplier representatives to discuss jointly the advantages and disadvantages of their respective equipment.

Competition has brought a greater customer awareness of the wide choice of facilities available. It has increased pressure on companies to provide as far as possible the exact equipment required, or risk losing customers to a competitor. It has been stated that while this new situation was stimulating and a challenge to sales staff, loss of revenue was presenting serious problems for some operating companies.

There is a wide range of telephones



An experimental "remote blackboard" system has been developed by Bell Laboratories to enable visual instruction to be given to a distant classroom. The algebraic equation shown here is electronically translated into ultrasonic pulses and transmitted over ordinary telephone lines to the classrooms where it is reconverted and displayed on a television monitor or projection screen.



Examples of sales literature produced in North America.

for the home, a variety of keysets for the smaller business, and a multiplicity of switchboards the most sophisticated of which is called Centrex. This is a PABX tailored to the customer's requirements and which has the facility of Direct Dialling In. The switching equipment can be located either on the customer's premises or in the telephone exchange which is called the central office in America.

Blocks of flats have telephone systems for communication between tenants and callers at the front door. The tenant can unlock the door by dialling a certain digit. Picturephone, an expensive facility, is in service in Chicago, and there are city-wide paging systems in a number of places. The view has been expressed that facsimile transmission will make telex obsolescent in the USA in the not too distant future. Facsimile facilities are already available in certain areas at a rent of £35 per month.

The demand for push-button keyphones is increasing. When connected to an electronic exchange keyphones can give additional facilities such as two-button operation to call up to 30 frequently called numbers, subscriber-controlled transfer of calls to any number on the local exchange and also to long-distance, and means by which three people in different parts of the country can be linked on one call.

Among the wide range of outdoor call office structures are some of pedestal type which have three or four booths on one stand. This type has the advantages of lower initial costs, less cleaning and maintenance and better supervision. Having little or no glass the pedestal structure is safer to use and is less prone to vandalism.

The marketing needs of residential customers and small businesses are handled by a telephone company's commercial or clerical division, which also initiates the follow-up action on overdue accounts. Business customers with three or more lines are dealt with by the more skilled marketing division. Residential selling campaigns on premium items are undertaken from time to time and an element of competition is introduced between the sales girls. The winner is given a small award, and this appears to be enjoyed by the staff concerned as well as providing that little extra incentive. In one office a sales representative who won five orders in competition with a private supplier was named an Ace, on reaching 15 he became a Tiger and at 25 he was awarded the Blue Max.

Outdoor sales forces are usually called communications consultants and

Above: Convenient coin-operated telephones for people in wheelchairs have been successfully tested in American hospitals, nursing homes and airports.

Below: As a reward for good behaviour, inmates in many American penal institutions may have a five-minute telephone conversation each month with friends and relatives. The idea was conceived by the American Telephone & Telegraph company.

accounts managers, and in the larger offices specialisation by the type of account is common. One representative may deal with hotels and motels, another with banks and department stores, and a third with Government and local council offices. This enables a representative to become very familiar with the business he is serving, and to give him an even better knowledge he may attend courses run by that industry for their own employees.

The method of preparing and circulating Advice Notes, called Service Orders, varies between companies. The larger offices are moving towards a computerised system called Biscom or Sword. Details of the customer's application are first typed on the keyboard of a computer terminal which has a visual display unit (VDU). When the details have been checked on the VDU, a button is operated and the order is transmitted to the distant computer and the appropriate engineering control centre.

Upon completion of the work, the fitter telephones direct to the sales clerk who calls up the computer to extract the copy from its "pending" file. The copy is displayed on the sales clerk's VDU for updating and closing, and the computer passes the necessary information to the billing, traffic and directory sections. As with the Post Office Customer Rental Records system, the territorial sales clerk receives a record card showing details of the subscriber's installation and rental.

Telephone service for speech purposes is regarded as the basic bread and butter commodity in the USA. In addition to the usual data applications, telephones are also now being used as a means of settling bills and for several kinds of banking business. In Seattle a telephone subscriber calls his bank's computer, identifies himself and by depressing a combination of buttons on his keyphone instructs the bank to debit his account and credit another. Complicated mathematical problems can also be dealt with in this manner and the computer replies using normal speech.

It is envisaged that this method of carrying out banking business will eventually largely supersede present arrangements. Unfortunately for the local telephone company it is at present on a flat rate tariff, with no charge for local calls, and it is naturally anxious that this new type of traffic should generate additional revenue. A measured rate tariff similar to that applied in this country may be the answer, although this would need to be approved by the Public Utilities Commissions.

Because of the different circumstances, the American approach to marketing varies considerably from that of the telecommunications business in Britain. Many of the recent advances in techniques and facilities in the US were brought about by the full impact of competition. The UK Post Office is in a near monopoly position with a special responsibility to cater fully for the needs of its customers, and we cannot afford to take them for granted.

PO Telecommunications Journal, Spring 1974

Switching to computer control

A No. 1 electronic switching system (ESS) takes shape in a North American telephone exchange. The system has a central control computer which sets up connections through a switching network under the control of sequences of instructions, called programs, stored in an electronic memory.

WB Mills

William Mills spent two months in the USA studying the use of electronic common control switching systems and stored program control of telephone exchanges. Mr Mills is an Executive Engineer in a group at Telecommunications Headquarters responsible for liaison with manufacturers in the development of TXE4 large electronic exchanges.

ANY TELEPHONE switching system processes each call according to one of a number of fixed patterns. In the simplest form of electro-mechanical system these patterns are defined by the wired interconnections between and within the various items of equipment. Any changes required (to introduce new services to customers, for example) might involve wholesale rewiring of a working exchange and such a procedure is clearly expensive and inconvenient and at the worst totally impracticable.

However, with the use of common control equipment, the logical sequence of processing a call may be made very much less dependent on the physical structure of the switching network itself. The comparatively slow operational speed of electro-mechanical equipment limits the extent to which its control can be centralised, but with electronic circuitry the call processing logic for an entire exchange can be concentrated in one or more computers or processors. Changing the way in which calls are handled need involve, in the main, changes to the processor(s) alone. It may be further simplified by arranging that the operation of the processors is controlled by a semi-permanent stored set of instructions or program.

The most widely installed stored program machine in the United States is Western Electric's No. 1 Electronic Switching System (ESS) in service with Bell companies. There are currently some 380 working No. 1 ESS installations, all in large metropolitan areas. The system will accommodate up to 63,000 lines and, in its latest version, will process up to 100,000 calls per hour.

A reed relay switching network is controlled by a pair of stored program processors. The switching network itself contains virtually no intelligence and the processor is responsible for receiving and analysing dialled digits, selecting and setting-up paths, supervising calls in progress, recording billing information and releasing connections. Associated with each call processor are two stores. A ferrite sheet store holds transient information associated with each call in progress as well as a continually updated "map" of the switching network indicating the location of all busy paths. A permanent magnet twistor store holds the main control program, information about all exchange terminations (location on the switching network, class-of-service and so on) and exchange variables (number of switching racks, registers, dial-pulse receivers and so on). In the twistor store, information is held on small magnets attached to metal cards. For small changes to this information the cards are removed from store modules and remagnetised on a special writer provided as a part of the No. 1 ESS equipment. For more extensive changes, such as a complete change of the main program, replacement cards are shipped direct from the manufacturer.

In normal operation of the system one processor controls the entire exchange, but its partner performs identical operations simultaneously. Special circuits monitor the outputs of both ▶

processors. Any disagreement results in suspension of normal call processing and the running of special diagnostic programs designed to isolate the faulty equipment which is then removed from service. Since the processors have overall control they are able to assemble a variety of useful data describing the performance of the exchange. This information is printed out periodically on a teleprinter and parts of it are used as a basis for calculating future equipment requirements.

Since the introduction of No. 1 ESS a number of important new features have been added, including customer dialling of international calls. In the main this has been achieved by changes to the program and only minor alterations to physical equipment, clearly demonstrating the inherent flexibility of the stored program concept.

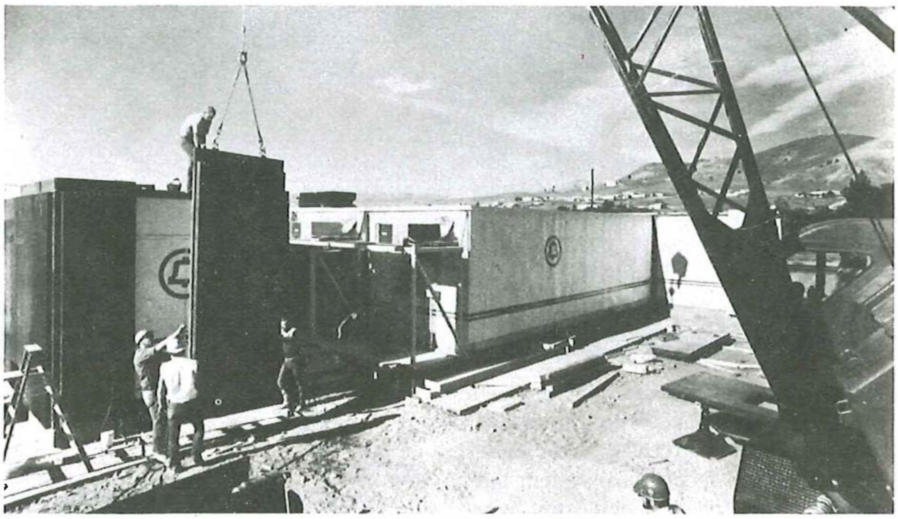
Two other stored program machines (No. 2 ESS and TSPS No. 1) are currently in service with Bell companies and a further two are under development. Several installations of No. 2 ESS, designed as a local exchange for suburban areas, are now operational. This system is similar in concept and overall operation to No. 1 ESS. However, to minimise initial costs (which tend to be high for common control systems) the system security arrangements have been somewhat simplified and more call processing is done outside program control. No. 3 ESS will be a small local exchange system for semi-rural areas and No. 4 ESS a time-division trunk switching system.

TSPS (Traffic Service Position System) No. 1 is a stored program controlled switchboard system designed primarily to speed up handling of calls requiring a degree of operator supervision. For such calls the TSPS machine connects the caller briefly to a free operator while at the same time the call is being set up automatically according to the digits dialled by the customer. The operator may be needed, for example, to record a credit card number or details of special billing required, and this information is keyed into the system by the operator who then releases her position from the call. Subsequent supervision and timing is done by TSPS under program control.

Since the operator consoles merely interface to the central processor they are of simple design and can be located in office accommodation remote from the control. As a result, it is often economically desirable to locate the operator positions in suburban areas where the labour market is less competitive. (See the following article about switchboard operation.)

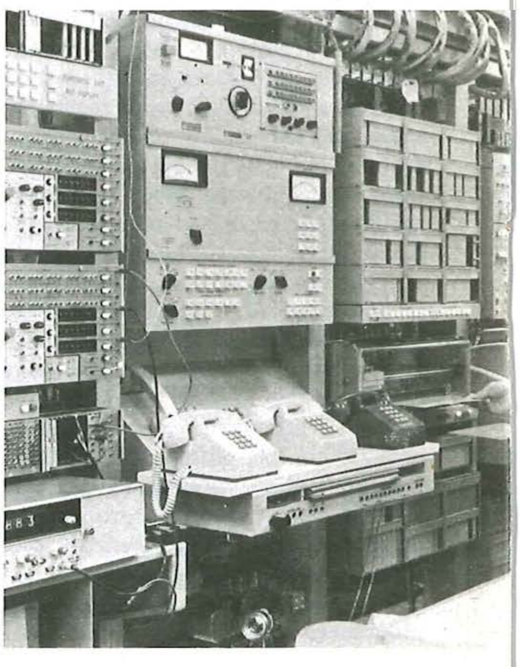
A further TSPS program is now being introduced which will automatically provide customers with details of time and charges immediately after calls have been made from hotel and motel rooms. The program will also make possible more operator dialling of international calls at switchboards outside the large "gateway" exchanges.

Bell is not alone in introducing stored program machines. GTE-AE currently has two No. 1 Electronic Automatic Exchange (EAX) installations in service.This system is designed for a total capacity of



Above: Pre-cast walls are erected around modular units of an electronic switching system (No. 2A ESS) to form a local suburban exchange serving up to 15,000 lines. The equipment is placed on a concrete foundation and can be installed in as little as six weeks.

Below: As services provided by an electronic switching system are changed, or as exchange connections are altered, the program data must also change. Here on a No. 2 ESS maintenance frame, a memory card is remagnetised with data to update the program store.



Crossbar 5A – mobile and modular telephone exchange units – are built, tested and packaged for delivery on specially designed lorry-trailer bays. When completed each unit is picked up by a lorry cab for transportation to its site.

20,000 lines and 79,000 calls per hour. The reed relay switching network is controlled by a duplicated processor. Data on exchange terminations, translations, etc. is stored on a magnetic drum and the main control program on a ferrite core memory. For security reasons, however, the main control program is also duplicated on the drum. Under fault conditions, this copy can be used to reload the core should this be necessary. In a similar manner to ESS No. 1, the EAX periodically produces a variety of system performance figures. GTE-AE is currently developing two stored program machines similar in size and facilities to No. 2 ESS and TSPS No. 1.

Western Electric and GTE-AE are the largest manufacturers of switching equipment in the United States. Western Electric sells exclusively to the operating companies of the Bell System of which it is also a part. Similarly, GTE-AE equipment is purchased by operating companies of the General System of which GTE-AE forms the manufacturing interest. There are, of course, a number of smaller manufacturers whose markets are mainly among the many independent telephone companies in the USA – Stromberg-Carlson, Northern Electric and ITT all have stored program systems under development.

As far as in-service equipment is concerned, the stored program concept is still comparatively new within the independent companies in the USA. However, it is well established in the Bell System and the developments completed since its original inception have demonstrated the operational flexibility which a stored program can bring.

PO Telecommunications Journal, Spring 1974

Computer-controlled Traffic Service Position Systems (TSPS) in the USA help to speed the connection of calls needing operator intervention. The equipment handles most routine details of setting up and recording calls, and very little work is required by the operators, who use simple push-button consoles.

Time off to go shopping

PC Bull

Patricia Bull, a Traffic Efficiency Officer in North Central Telephone Area, London, selected management and staffing techniques of North American exchange switchrooms for her Churchill Fellowship study. She visited five different telephone companies across Canada and the USA during a two-month tour, travelling 14,000 miles.

THE HOURS of duty worked by telephone operators are one of the many aspects of staffing and management in North American exchanges which differ from the methods used in this country. Unlike the separate staffing arrangements made for day and night work at Post Office exchanges, operators in Canada and the USA are employed on duties around the clock. These operators, mostly women, are therefore liable to do day or night work, although their average length of duty is less than eight hours. On my visits to telephone exchanges I saw various types of switchboard, with plug-in and cordless types predominating in Canada. Plug-in boards are similar in operation to those in this country, but the calls are not timed automatically. A calculagraph – similar to a time clock for checking in and out of work – is used by each operator to stamp the start and completion times on the call tickets.

Telephone companies in the USA make wide use of a computer-controlled switchboard system for handling calls that require the intervention of an operator. Called the Traffic Service Position System (TSPS), it is linked to four or five switchrooms which may be located some distance apart in a city area. However, incoming calls are routed via the TSPS equipment to the first available operator at any of the switchrooms.

For most types of call handled by the switchrooms, including transfer charge and personal calls, the customer dials the digit 0 – for connection to the operator – followed by the whole number required. In this way the TSPS sets up the call automatically while the operator asks the customer for any additional information, such as credit card number or details of special billing. The information is ▶

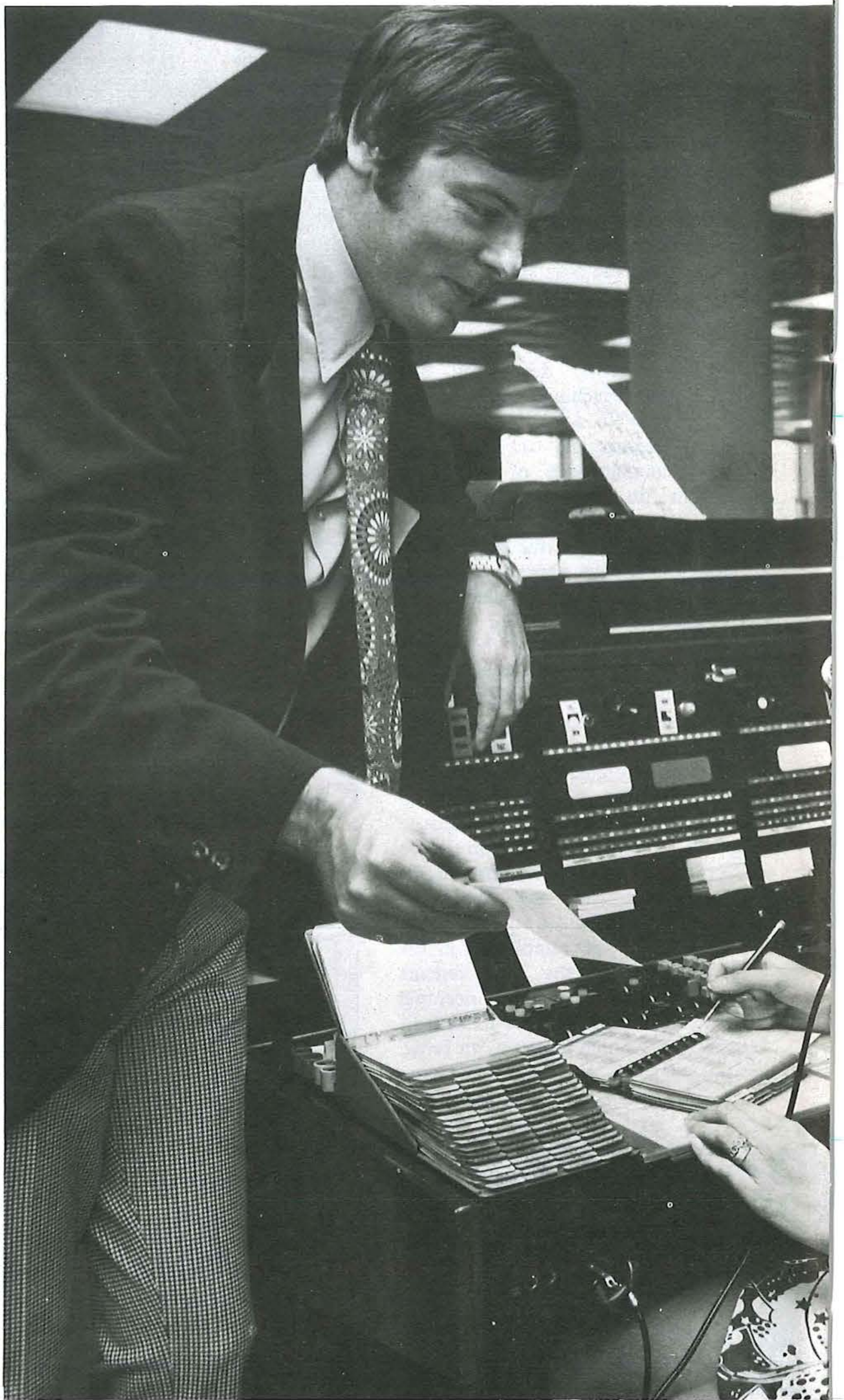
keyed directly on to a computer tape in the system by means of push-button controls on the operator's position. By pressing certain buttons the called or caller's number can also be displayed on a visual display panel in front of the operator.

Subsequent supervision and timing of a call is carried out by the TSPS unit. Very little work is therefore required by the operator, and the average handling time for each call is about 48 seconds. If a call requires further operator intervention, for example where additional payments are needed in a coin box, the line is re-connected to a free position in any of the switchrooms and all the relevant details are shown on the operator's display panel.

Management in the North American exchanges starts at staff levels which are equivalent to the switchroom Divisional Supervisors and Chief Supervisors at Post Office exchanges. The group chief operator – a Divisional Supervisor – is a first-line manager who has two or three supervisors working for her. Her main duties are the development of experienced operators and supervisors, and either initial training of new operators or responsibility for the daily management of the switchroom. The chief operator (Chief Supervisor) is a second-line manager who has overall responsibility for the switchroom. Her work includes training first-line managers and co-ordination of their work.

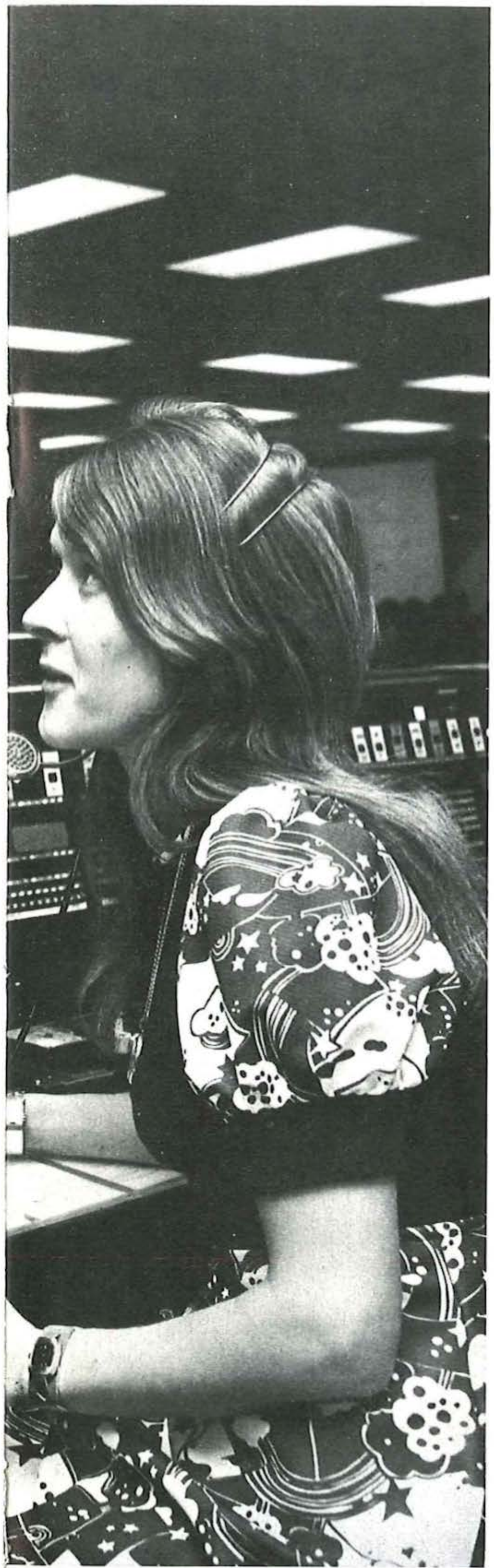
Telephone companies are very budget conscious. In the ordinary exchanges the chief operator of each switchroom assists a traffic manager to prepare detailed long-range plans, covering a period of twelve months or more, for the budgeting and staffing of her unit. Each plan is based initially on a forecast of calls expected each month, and historical data is used as a basis for estimating. The build-up of data is continuous, and two years' figures are at hand for the monthly forecasts, less being needed for weekly or daily forecasts. The methods on which call estimating is based are surprisingly simple but very accurate, usually being within two per cent, and appear to justify the accumulation of the statistics.

In the companies which operate TSPS, long-range planning is carried out using similar data, but the staffing is calculated by a central duty who prepare a schedule for the whole system, breaking it down afterwards for each switchroom. The daily management of switchrooms is also basically controlled from the central duty, and the main aim of the switchroom managers is to maintain the staffing levels required on their switchboards.



The author, formerly a superintendent at London's Shoreditch telephone exchange, is shown an operator's position on a cordless switchboard in Vancouver. "To my dismay, I was put on a switchboard after only an hour's training," she reported.

In conjunction with the long-range plans, all companies maintain short-range plans, and the most recent statistics of calls are used to prepare the staffing figures. A new staffing scheme is drawn up weekly by most companies. Bell Canada and the Manitoba Telephone System, two of Canada's largest telephone companies, use a basic rota of staff which is based on the number of operators required to handle calls on the least busy day of the year. Staff absences and the need for extra duties is then covered by staff from a supple-



mentary rota. In this way the two companies can schedule staff to meet work levels estimated from the latest call statistics. Other companies draw up complete rotas and allow the operators to state their preference for duties each week, with priority of choice being given according to length of service.

The main aim of staff scheduling is to achieve productivity targets, and the number of operators required is calculated using a factor known as the board load. Basically, the board load is the number of calls expected daily divided by the number of calls per hour an operator can handle. This determines the total operator manhours needed, and therefore the number of staff justified.

Achieving the daily board load target, while ensuring that customers get a good service, is an important part of the group chief operator's job. She assesses the current traffic and re-calculates the staffing required two or three times a day. If the traffic is slower than estimated by the staffing schedules, operators superfluous to needs are offered E time – that is, leave without pay – which could be for an hour or two or perhaps the rest of a duty. On the other hand, if the traffic is higher than expected temporary part-time staff are called in from a list of former telephonists who are willing to work odd days.

Operators are willing to take E (Excess) time because generally they can afford to do so and it is convenient for such things as shopping. At times calls to the switchboards slacken for short periods which do not warrant unpaid leave. During these periods some operators are still taken off the boards to help the switchroom achieve its productivity target and to enable the remaining operators to keep working at a steady pace. A list of activities is prepared for staff taken off the boards during these periods, and includes clerical work, checking their call tickets and helping trainees. However, they are often allowed the time to themselves.

Much of the switchroom managers' time is taken up in the development of operators and to encourage a sense of pride and achievement in their work. The managers sit in with each telephonist once a month to observe their work and to carry out checks on their board loads. Results are discussed with the operators and they are given the opportunity to set their own productivity targets. It was interesting to note that at exchanges where individuals checked their own board loads there was very little need for supervision and higher productivity was achieved.

I also spent some time in North America studying recruitment and training methods. Generally a telephone company recruits its telephonists together with other non-management grades at a central recruiting office. The office of the Pacific Telephone and Telegraph company in San Francisco was manned by highly trained interviewers who have a thorough knowledge of all the jobs available. The interviewer decides which job seems most suitable for an applicant who, if agreeing, then undertakes some simple tests. The type of tests depend to a certain extent on the job involved, but tests for telephonists are the same as for clerical officers.

The average length of initial training given to operators is about 10 days, and is carried out in the local exchanges. Programme learning techniques are used and board training is carried out in the switchroom at operator positions which are specially wired up to provide call simulation. From the supervisor's control position, lamp appearances can be made on the training positions to simulate outgoing and incoming signals, and the supervisor can be heard on the trainee's headset in the same way as a customer. This method is more realistic than the use of dummy boards away from the switchroom.

The period of training is considerably shorter than the five weeks normally given to operators in this country, but subscribers' local calls in North America are free and therefore do not require the preparation of call tickets. In addition subscriber transfer and changed number interception (CNI) facilities are not handled at the switchboards. Subscriber transfer is dealt with by private bureaux, using equipment installed by the telephone companies. Customers subscribe to the bureaux for any transfer arrangements they require. The CNI service is handled entirely by directory enquiry operators.

On the other hand North American operators' visible index files, which contain call routing and charging details, are much larger than those used by Post Office operators owing to the vastness of the area covered. Charging for long-distance calls is also complicated because of the many different rates and the different telephone companies which may be involved. For example, a call from Toronto to Vancouver will pass through a network comprising the systems of six different companies. Each company is therefore entitled to a share of the charge, and revenue for these calls is divided following detailed analysis of the call tickets.

The overall efficiency with which telephone exchanges in North America are staffed and managed is impressive. Staffing methods are very effective, even though the continual re-assessment of schedules perhaps seems excessive. Time spent by the supervisors with their telephonists did a great deal for staff morale, and the interest operators took in their own board load targets went a long way to helping to achieve the switchroom productivity aims.

Across the lonely horizon

AEN Wase

To help the urgent production of gas and oil in the North Sea, the Post Office is setting up two radio stations in Scotland. They will use a new technique to beam telephone calls and other communications over the horizon to production rigs at sea.

THE WORLD energy crisis has focused attention on the search for new sources of oil and gas in the North Sea. The Post Office has been quick to recognise and provide for the particular communications needs of the growing number of organisations engaged in exploration drilling activities off Britain's shores. These ventures are now being followed by oil production operations some 100-200 miles from land, and will require permanent and reliable communications services for the next 20 years or so.

The recent announcement that the Post Office is to set up a £5 million communications system for oil and gas production installations operating in the North Sea represents a significant technological advance in meeting the exacting requirements of a specialist customer in an unusually difficult environment. Meanwhile the Post Office has already launched an improvement scheme to expand the present radiotelephone and radioteleprinter services for the exploration drilling rigs and other vessels.

Since 1965, when companies started to prospect off-shore, the Post Office has been providing the communications needs of the drilling rigs, supply ships and, more recently, the pipelaying barges. Traffic is handled through Post Office coast radio stations at Humber, Stonehaven and Cullercoats. Because the normal maritime channels would have been seriously overloaded by the heavy new demand, extra radioteleprinter and radiotelephone facilities have been made available for the exclusive use of the new industry. The radioteleprinter circuits are leased on an exclusive basis between individual rigs and the shore, using forward error correction – a system which detects and corrects errors caused by atmospheric noise and interference from other sources in the selected MF radio (2-4 MHz) band. The radiotelephone channels, also leased for exclusive use by the drilling rigs, are connected into the on-shore public telephone network via the radio stations. However, rigs have to share access to the limited number of channels dedicated to them.

Increased piping ashore of gas and oil has brought with it new demands from pipe-laying vessels and ancillary craft for communications services to the shore. These have been accommodated partly on the special radiotelephone channels and on the recently opened ship-shore radioteleprinter service that provides access to the public network.

There has also been increased activity in the waters east of Aberdeen and around the Shetlands which has added to the demand for services in the more northern fields. Extra circuits have been provided exclusively for rigs and service vessels by the Stonehaven and Wick coast radio stations, which cover northern waters from the Firth of Forth round to Cape Wrath on the north-west tip of Scotland. The improvement scheme includes a new communications station on the island of Unst in the Shetlands, remotely controlled from Wick Radio station 200 miles away on the mainland. Rigs tend to make radiotelephone calls of longer duration than ordinary shipping, and the new project will ease the pressure on the public network.

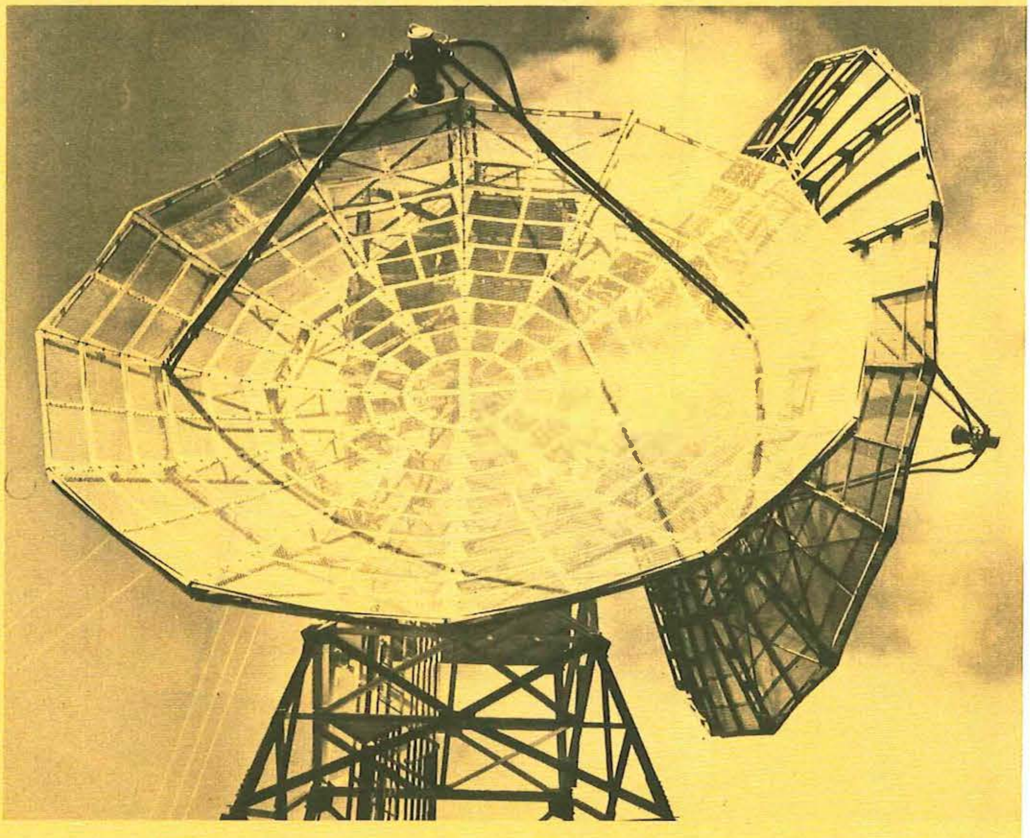
As a result of the improvements there will be a total of 80 radioteleprinter circuits and four radiotelephone channels exclusively for rig communications.

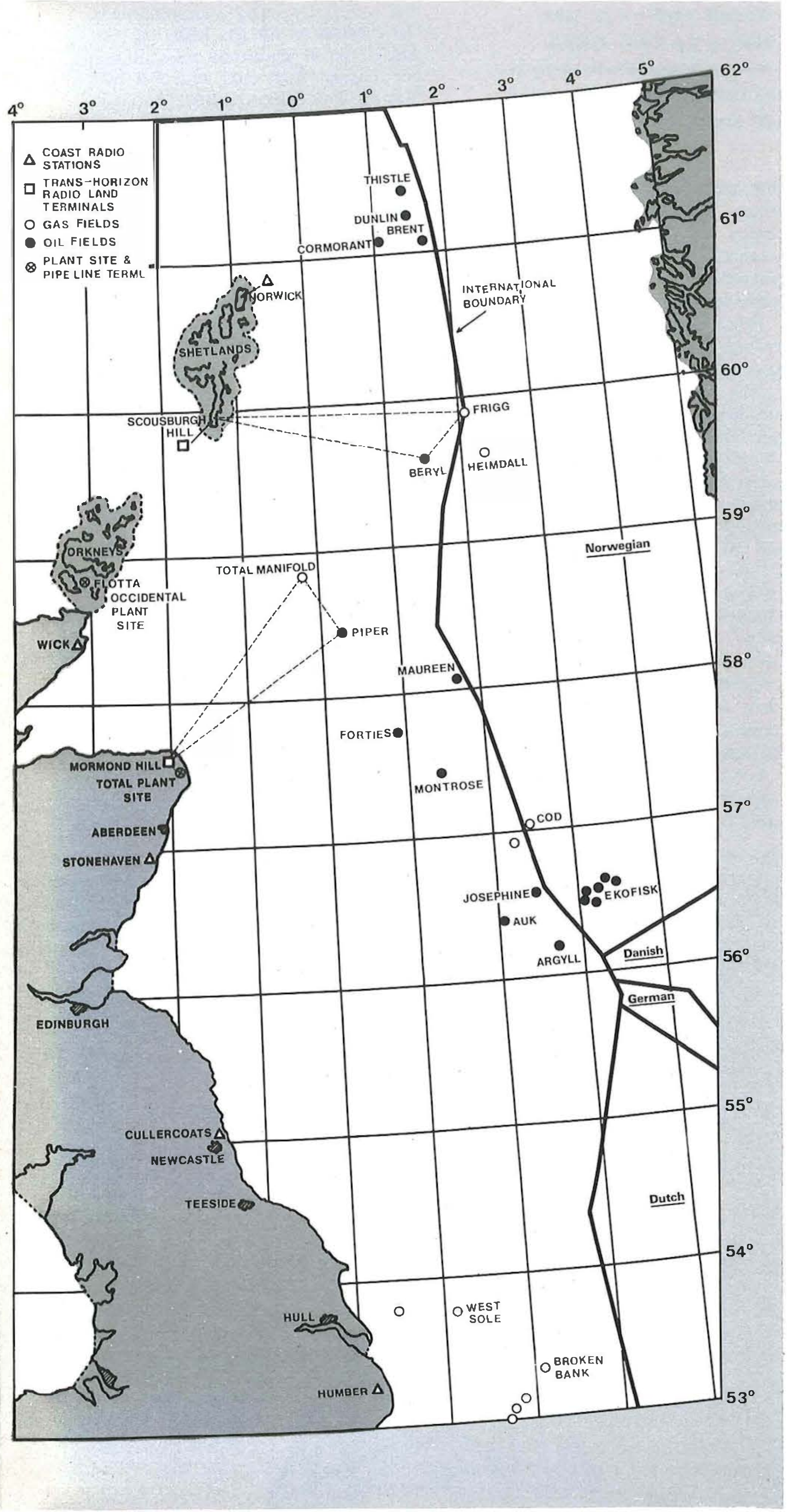
In contrast to the gas fields off East Anglia, the oil production areas are well out of sight from land and it is here that the Post Office proposes to introduce a radio communications technique which it has never used before. The technique, known as trans-horizon radio (tropospheric scatter), is to beam high-power microwave radio signals into the layer of atmosphere above the earth's surface. The signals are scattered by atmospheric turbulence so that a small but still usable signal reaches the receiving aerials. The scarcity of radio frequencies that can be made available for trans-horizon systems from land dictates the use of common carrier (shared) radio systems to "master" production platforms off-shore. Each "master" platform will relay signals to other production platforms in their locality by conventional line of sight microwave radio systems.

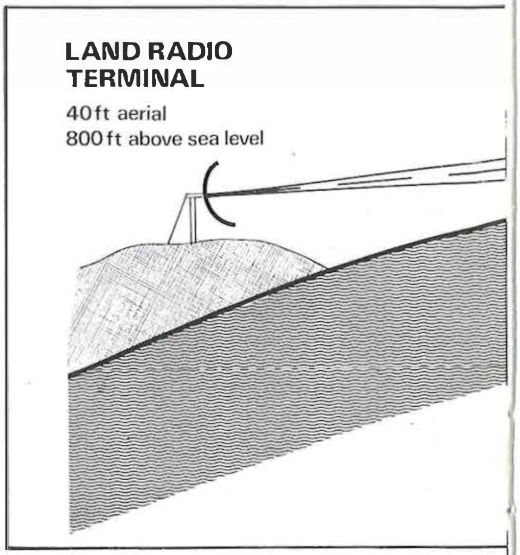
The Post Office is establishing two trans-horizon radio land terminals, one in South Shetland (Scousburgh) and the other in North-East Scotland (Mormond Hill) near Aberdeen. Both sites are strategically placed for providing radio links to serve oil fields production areas in the North Sea and Atlantic areas West of Shetland. (See the map on the next page.)

Commencement of services is planned for October 1975 to the deep water platforms now in construction for the ▶

The tropospheric scatter aerials seen here are in operation in South America.



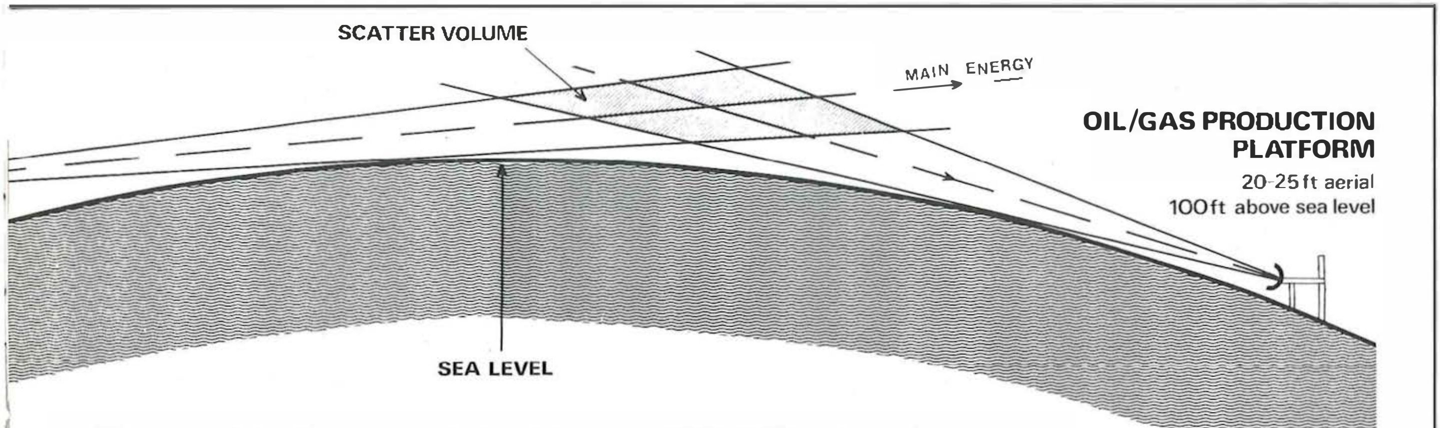




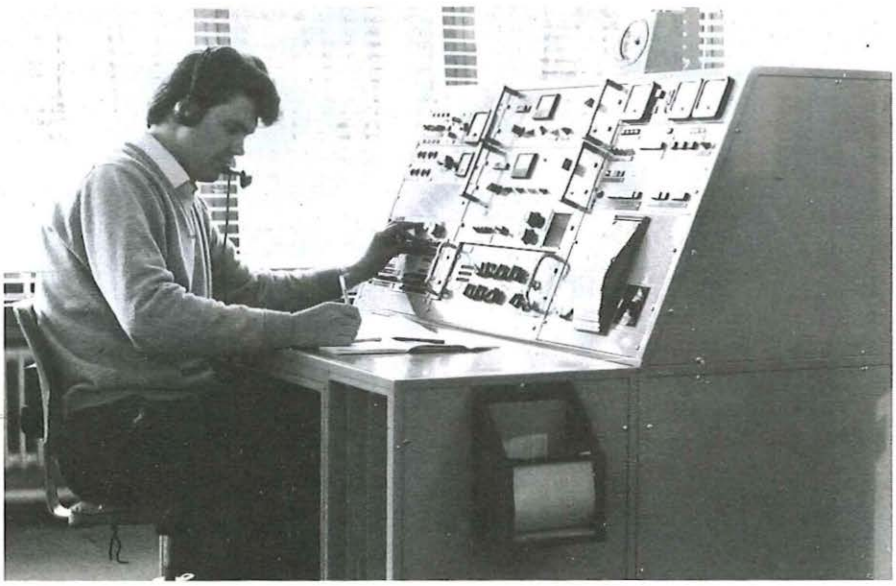
Total, Mobil and Occidental groups of companies. The Post Office will communicate from Shetlands alternately to either the Total Frigg platform or to the Mobil Beryl platform, and both platforms will be linked by line of sight radio to carry through-communications circuits to the other company's installation. The Mormond Hill terminal will also communicate alternately to either the Total pipe-line manifold platform or to the Occidental Piper platform, with the off-shore terminals similarly linked by line of sight radio.

Reliable communications in terms of continuity of service is particularly important in production operations and is essential for pipe-line transport to shore. Confident availability for Data/telemetry circuits is particularly necessary for off-shore production operations and a target transmission performance is proposed for a North Sea trans-horizon radio path of not less than 99.98 per cent service availability during the worst month of the year. This represents about nine minutes during the worst month when the specified performance standard may not be met. The Post Office proposals are for a system based on alternate routing of a trans-horizon radio path from land to off-shore terminals separated by 20-30 miles, which are linked by a robust line of sight system. This network arrangement is designed to limit the possible loss of service continuity to a shorter period and to guard against equipment failure.

Trans-horizon radio transmission losses (exceeding 200 dB) are of the same order as for a satellite radio system. The latter has the advantage that the radio path loss is almost constant, whereas trans-horizon radio propagation is subject to extreme variations necessitating the use of diversity arrangements employing as many as four radio paths



Microwave radio signals normally travel between aerials in "line of sight". In the trans-horizon system the microwave signals are scattered in the troposphere above the earth's surface and a "deflected" signal is picked up by the receiving aerial.



Radio stations at present operating to the North Sea have a special console for contacting drilling rigs. Seen here is the console at Stonehaven.

to realise satisfactory service continuity.

Propagation is characterised by rapid fading which has to be catered for by system configuration and equipment techniques to achieve reliable communications. System transmission performance during the greater part of a year is normally comparable with that attained by line of sight radio systems (except for a slight relaxation of circuit noise standards) but some degradation may be experienced for short periods during some months of the year. To provide good quality service with circuits of high reliability in the difficult North Sea environment Post Office systems will use quadruple diversity (space/polarisation). That is, there will be two transmitting aerials fed from separate transmitters, one transmitting a vertically polarised beam and the other a horizontally polarised beam. Two aerials separated (spaced) by some 20 ft edge to edge are needed for reception and each receives the two differently polarised signals which are detected in two separate receivers. In practice transmit and receive aerials are combined so that each complete trans-horizon radio terminal comprises two aerials, two transmitters and four receivers to achieve four independent radio paths.

Each Post Office trans-horizon radio system will have capacity for 72 telephone channels, but this may be increased to 132 where traffic demands. The land terminals will connect into the UK communications network to provide circuits to company premises for communications by telephone, teleprinter and data/telemetry transmission up to 2,400 bit/s. In addition, access to the international telex and telephone networks will make it possible to send a telex message almost anywhere in the world and to make world-wide telephone calls from a North Sea platform 200 miles from the mainland.

Dish aerials up to 60 ft diameter will be installed at the land radio terminals, but off-shore the constraints imposed by platform design will limit the aerials to 25-30 ft diameter. Transmitter output power of 1-2 kW will be used for both land and off-shore terminals.

Line of sight microwave radio links, using 1-2 W transmitter output power between off-shore platforms separated by up to 30 miles, will require dish aerials up to 12 ft diameter mounted up to some 285 ft above mean sea level, with dual space diversity for good system reliability. On almost all off-shore platforms a radio tower will be needed to carry dish aerials for local over-sea links to inter-connect platforms within an off-shore production area network.

Accommodating the large aerials structures needed on an off-shore production platform for microwave radio communications, both to land and to nearby platforms, presents mechanical design problems of considerable magnitude in the hostile North Sea environment.

A Post Office Task Force, set up last year, is collaborating with Government Posts and Telecommunications staff in planning the development of UK-off-shore communications networks to serve the oil and gas production installations of this nationally vital new industry. Many novel problems in frequency management and network control are being encountered and we are as yet only on the threshold of a long period in the development of a new and sophisticated communications medium to serve the industry's needs over the next 30 years.

Mr A. E. N. **Wase**, MBE, is Deputy Controller of the Post Office North Sea Task Force in the International and Maritime Telecommunications Region.

PO Telecommunications Journal, Spring 1974

Hello— the echo

AK Jefferis

An echo effect can make telephone conversations by satellite difficult because of the thousands of miles speech has to travel. Experiments being held to find improved methods of overcoming the problem are described in this article.

THE SATELLITES which carry a large proportion of Britain's intercontinental telephone traffic are in orbits 22,000 miles above the Equator at which height they appear to remain stationary relative to the earth. Since radio waves travel at 186,000 miles a second (the speed of light) it takes about a quarter of a second for information transmitted from one country to be received via the satellite in another country. The delay is generally of little concern for services such as telegraphy or television transmission but can be important for telephony.

In the first place delay can cause confusion in the flow of conversation. The two parties may start talking at the same time but may not immediately realise this and, furthermore, each may think he was the first to start. With the quarter-second delay of one satellite hop this effect is not serious and frequently goes unnoticed, but it probably would become troublesome if a circuit were routed via two satellites, for example between the United Kingdom and New Zealand.

Echo is a more serious problem. International lines and national trunk lines are four-wire systems in which separate pairs of wires are used for each direction of transmission. Local lines are two-wire systems, and the receive and transmit signals traverse the same wires. A four-wire circuit is connected to a two-wire circuit using a device called a hybrid, which is located in a switching centre. (See the diagrams on the opposite page.)

In ideal conditions the hybrid prevents signals coming in on the receive side from being sent back on the transmit side. In practice, because the characteristics of two-wire lines vary considerably, the degree of suppression of signals between receive and transmit sides of the four-wire circuit is less than perfect, and this gives rise to an echo at the speaker's end of the circuit.

For short distances the echo of the speech arrives back at the distant end so soon after the speech is uttered that it is hardly noticed, simply adding to the side-tone effect which normally occurs in the telephone handset. However, for circuits greater than about 1,000 miles and for all satellite circuits, delay between the speech and its echo can be very disturbing to the talker. Indeed with the half-second "round trip" delay occurring in a satellite circuit most people find it almost impossible to talk clearly if they are hearing a delayed echo of their own speech.

For long circuits carried by both cable and satellite the effects of echo must obviously be eliminated or at least greatly reduced. This is done today by means of an echo suppressor in the international switching centre. The top diagram opposite shows how this device works. While the distant party, A, is talking and B is listening an echo suppressor at the B end of the connection detects the presence of speech on the incoming part of the four-wire line. The suppressor then disconnects the return path so that any echo signal leaking across the hybrid cannot return to A.

If this was all the echo suppressor did then B would not be able to interrupt. The device therefore has a "break-in" facility, which compares the relative strengths of the incoming speech and the signal on the outgoing line, which may be either A's echo or speech from B. If the B signal is much weaker than the A signal it is assumed to be only echo, but if it is comparable with or greater than the A signal it is assumed to be speech from B's telephone and the return path is restored to let the speech through. At the same time, of course, the suppressor lets through any echo, but this is minimised by reducing the strength of A's speech signal in the receive path. Another echo suppressor at the distant end of the connection controls the echo of B's speech.

Various "operate" and "hangover" delays are included in the detection circuits to prevent false operation. Nevertheless mistakes can still occur,

is cancelled

especially when the delay over the circuits is quite large. As a result, occasional clipping of the initial syllables of speech, brief spells of echo and reduced volume speech may occur.

The echo suppressors in use today are a great improvement on earlier models but it is recognised that their performance still leaves room for improvement. Work is in progress in a number of laboratories around the world to develop a completely new kind of echo control device known as an echo canceller. The bottom diagram (right) shows how the device works.

First, assuming that only A is speaking, very rapid samples are made of the incoming speech from A and these are stored in the echo canceller. At any given instant the store contains 260 speech samples taken over the preceding 1/30th of a second.

At the start of the conversation some of the incoming speech from A will be returned as echo. Samples are therefore also taken on the return path of the line at the same rate as those for the incoming speech, and these are fed into the processing section of the echo canceller together with the stored samples of incoming speech. By comparing the two sets of samples the characteristic of the echo path is rapidly calculated and used to produce a close replica of the echo from any incoming signal.

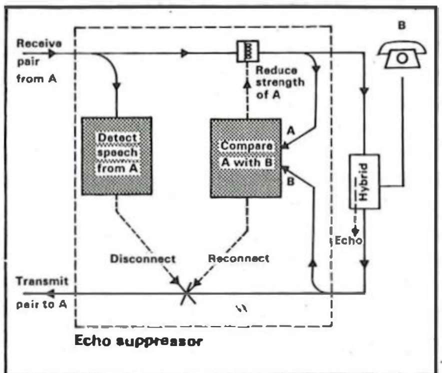
The process of calculation is repeated until, within a second or so, a really accurate replica is produced. The replica is then subtracted from any signal on the transmit path to leave it free, or almost free, of echo. If B speaks, even though A may be speaking at the same time, only the echo signals are subtracted and B's speech signals are sent over the line unaffected.

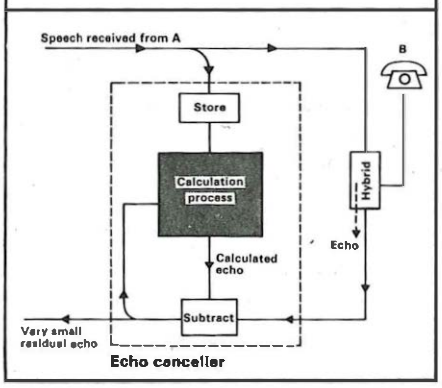
The first calculation of the echo path characteristic may take a second or so at the start of conversation before it is really accurate. During the conversation, all the time that A only is talking, the residual echo on the return path is continually sampled and used to apply small corrections to the calculation process and so maintain a high degree of echo cancellation throughout the call. Echo cancellers at each end of the connection remain in operation until the call is completed.

This fundamentally different approach to echo control avoids the problems which arise with conventional echo suppressors, and appears capable of rendering long-distance circuits almost completely free of the effects of echo. Unfortunately the simplified account of the echo canceller given in this article belies its true complexity. The experimental models available at present would be far too large and expensive for use in every international circuit in normal service. However, the fundamental principles have been proved to work in the laboratory, and to some extent in the field, and future development effort will concentrate on reducing the equipment to a size and cost which is acceptable for normal service.

Two echo cancellers have been built under the research and development programme of INTELSAT (International Telecommunications Satellite Organisation), the 83 nation organisation in which the UK Post Office is the second largest member. A pair of experimental cancellers were also designed and built by COMSAT – the Communications Satellite Corporation, which acts as manager for the INTELSAT member countries – and have been given a field trial in a circuit between London and New York.

Staff from the Post Office's Research and Telecommunications Development ▶





Departments, International and Maritime Telecommunications Region and International Telephones co-operated with their opposite numbers in the American Telephone and Telegraph Company and with COMSAT engineers to carry out the trial. One echo canceller was installed in the Faraday International Switching Centre, London, and the other was installed in New York. A comparison was made between customers' views of the performance of a circuit equipped with echo cancellers and of a circuit with conventional echo suppressors.

During the trial period, which lasted from January until the end of April 1973, a team of three interviewers asked customers whose calls to the USA had been connected over the test circuits whether any difficulty in talking or hearing had been experienced and what their opinion was of the quality of the connection. The results of these interviews were analysed statistically by the Post Office Research Department.

The results showed that with the echo canceller circuit fewer customers reported having difficulty when the caller was in London and the called customer in New York, although the number of calls in this category was not sufficient to satisfy the statistician completely that the favourable result might not have been given by chance. For customers outside London and outside New York the effects of other circuit imperfections generally made it difficult to detect the differences between the echo canceller and the echo suppressor with any confidence, although for one category – a London customer calling a customer outside New York – the echo canceller circuit appeared to perform worse than the echo suppressor circuit. The reason for this is not known at present, and indicates an area to be probed in the next development stage.

In addition to the interviews made in the UK opinions were also collected in the USA and trials are now being conducted between other pairs of countries. It seems likely that, taking all the results into account, a number of aspects of the echo canceller design will need to be investigated and modifications implemented. However, the ultimate benefit of using this type of device in long-distance international circuits will justify pursuing the development to a conclusion over the next few years.

Mr A. K. Jefferis is head of a section in the Space Communications Systems Division at Telecommunications Headquarters which deals with overall systems planning.

PO Telecommunications Journal, Spring 1974

SERVICE FOR THE AA

FE Elliott

A FIVE-YEAR communications project in which Post Office staff throughout the country have played a part was completed when the new national headquarters of the Automobile Association were officially opened by Her Majesty the Queen. The multi-storey building at Basingstoke, Hants, has a large communications centre which provides a wide range of telephone facilities for the 1,400 staff at the headquarters. The centre also houses the nerve centre of a streamlined telegraph system linking AA offices throughout the country, as well as those in Dublin and Jersey.

The AA relies heavily on fast efficient communications to maintain its many services to more than five million members, and the private automatic exchange installed at the new headquarters alone handles 2,000 calls every working day. The Plessey PB 8000 crossbar equipment has 88 exchange lines which provide staff with direct access to the public network and intercommunication between 660 extensions, all of which are equipped with push-button telephones (keyphones).

Twelve exchange lines have facilities for direct dialling-in which enables 100 extensions to be connected directly to incoming exchange line calls. By dialling a special code incorporating the extension number, a caller can by-pass the headquarters switchboard. Private circuits in the telephone system provide direct links between the building and AA regional headquarters at Teddington, Bristol, Halesowen and Cheadle Hulme. The modern, cordless switchboard, with positions for four operators and a supervisor, handles most incoming exchange line traffic and calls on the private circuit links with the regional offices.

The telephone system at Basingstoke also incorporates a teledictation facility for headquarters staff. By dialling a certain code on their keyphones staff are automatically connected to central tape recording units. They then simply dictate their messages on to the recorders so that the tapes can be transcribed by the headquarters typing centre.

Although the size of the telephone system is more than sufficient to meet present needs, the PABX capacity can be extended to 147 exchange lines and 1,200 extensions. Post Office staff in the Guildford Telephone Area determined the size of the system required following detailed traffic checks at the former, world-famous headquarters of the AA in Leicester Square, London, and two other AA departments in Stoke-on-Trent and North London which have moved to Basingstoke. The Post Office was also responsible for acceptance testing of the system and is maintaining the equipment. A teleprinter linked to the exchange equipment in the communications centre helps Post Office engineers to locate trouble by automatically printing out details of faults.

Computer-controlled, automatic data exchange (ADX) equipment in the communications centre switches telegraph messages at high speed between 44 offices of the AA throughout the country. The ADX is connected by Post Office telegraph lines to teleprinters in each office, and all messages first arrive at Basingstoke before being automatically re-routed to their destination.

The ADX can handle 3,000 messages an hour. It replaces a slower, torn-tape relay system at the former headquarters in Leicester Square. In the old system a message transmitted from a branch office was produced on punched paper tape at the control centre in London. An operator in the control centre then had to tear off the strip of tape containing the message and load it into an automatic transmitter connected to a teleprinter at the addressee's office.

In the new telegraph system operators use special codes to route messages through the ADX to their destination. Wrongly formed messages or those bearing an invalid code are rejected by the ADX and automatically referred back to the originator. Details of incorrect messages are also printed out on a teleprinter in the communications centre.

When several messages for one office arrive at Basingstoke at the same time they are stored in the ADX and retransmitted immediately the line becomes free. Faulty lines can be closed by a supervisor and test messages sent over the lines. At night the ADX continues to operate while unattended.

The multi-storey headquarters building comprises a base of two large ground floors, called the podium, on top of which stands a 16-storey tower block. About 25 miles of telephone cable have been installed throughout the building, and this job took longer than any other Post Office task because it could not be completed until the whole building had been finished. However, it was essential that the cables were provided as each floor became available.

External cables from Basingstoke telephone exchange and from the nearby AA central stores department are terminated, together with the building's internal cables, on a main distribution frame. The frame is housed in the communications centre which occupies the lower ground floor of the podium.

Internal cables from the distribution frame are routed to the various floors through a shaft which rises the full height of the building. These heavy multi-wired cables had to be installed in the shaft by lowering them from each floor. Great care was needed to ensure that the cables were not dropped and damaged, and they were firmly anchored in the shaft after final installation. Separate cables run from the shaft into a grid of ducting under each floor and are brought out from the ducting at points where telephones are required. Special terminating sockets which fit into the floor are used to connect the cables to the telephone extensions.

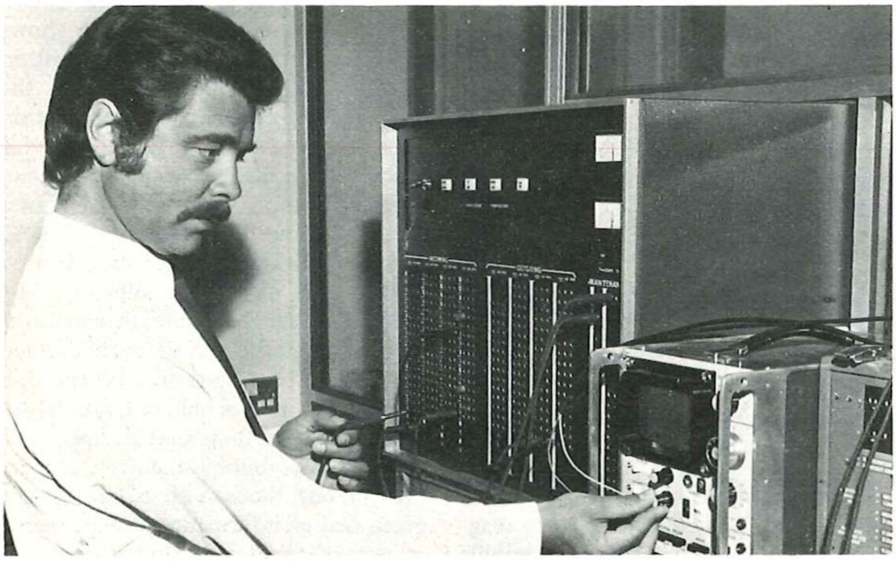
Cabling of the upper ground floor of the podium was a major task. The 40,000 sq ft area was to become an open-plan office for the AA's membership administration department which deals with some 100,000 telephone enquiries a year. As the department required a large number of telephones, which might need to be relocated from time to time, cables were installed in the under-floor ducting to 914 separate points where terminating sockets could be provided. It is estimated that about 14 miles of cable was used for this floor alone and – although 914 telephones will never be required at one time – it is now possible to provide service anywhere on the floor without having to use surface wiring or install extra cables.

In addition to the work involved in setting up the communications systems at the new AA headquarters, the Post Office provided a number of interim telephone and telegraph facilities. The telephone facilities enabled AA staff to be relocated in stages over a three-and-a-half-year period.

At an early stage in the project the central stores department of the AA moved from Stoke-on-Trent into its new, permanent location – an enormous warehouse half-a-mile from the Basingstoke headquarters site. This department supplies equipment and goods to more than 200 AA outlets throughout Britain, and to meet its immediate communication needs the Post Office installed a private automatic branch exchange in the building. Subsequently, the telephone extensions on this PABX were re-wired and connected directly to the crossbar exchange in the headquarters building.

Installation of the telegraph lines for the automatic message switching system also called for careful planning to ensure that the AA's vital telegraph communications network would not be disrupted during the changeover from their existing system. The Post Office therefore provided separate telegraph lines so that two lines existed in each office – one from London and the other from Basingstoke.

The many and varied communications facilities provided for the AA in its new national headquarters required a great deal of planning, co-ordination and liaison between all the interests involved. The success of the telephone and telegraph systems, and the various interim facilities provided, resulted from the high degree of teamwork achieved between the AA, equipment suppliers, building contractors and the many Post Office personnel who were connected with the project.



Above: A check is carried out on the automatic data exchange equipment which switches telegraph messages between AA offices.

Below: Robin Hughes, Post Office maintenance officer for the telephone system, tests part of the crossbar exchange equipment.

Mr F. E. Elliott is in charge of the special services group in Guildford Telephone Area, and is the Post Office company representative responsible for liaison with the Automobile Association.

A million bits of data in one square inch

RD Enoch

A new technology enables tiny bubbles of magnetism to be used in the development of computer memory devices which can store vast amounts of information in a very small area. The Post Office Research Department at Dollis Hill is studying the technology and possible applications – for example computer controlled telephone exchanges.

IT IS WELL known that computers and computer-like devices have filing systems, called memories, for storing instructions and data. The information is stored in binary form and each character – a letter, numeral or punctuation mark – is represented by a sequence of "ones" and "zeros". Since the mid 1950s wide use has been made of magnetic discs and drums in which binary information is stored by magnetic-surface recording in much the same way that sound is stored on a tape recorder.

The main difference between these memories and normal recording tapes is that the magnetic film is coated on to an aluminium disc or drum instead of a plastic base. The memories also differ in that the read/write head is not in contact with the magnetic film but is "flown" just above the surface of the coated disc or drum, which is rotated at up to 6,000 revolutions per minute.

Disc and drum memories provide inexpensive, large-capacity storage of information which can be located in moderately short times and quickly transferred to other units of a computer. Present types represent considerable achievements in the fields of electrical engineering and of precision mechanical engineering. For example, a disc file system announced recently has a storage capacity of 800 million binary digits (Mbits), an access time of one-fiftieth of a second and a data transfer rate of about 7 Mbits per second. Such a system could store the names, addresses and telephone numbers of three million telephone subscribers.

While the performance of these disc and drum memories is impressive, they are bulky and have moving parts. Additionally, the magnetic coating must be protected from dust particles which otherwise could lead to failure. Not surprisingly, therefore, work is in progress in research laboratories throughout the world to find a solid-state replacement for these memories. One of the many candidate technologies which is emerging is that of magnetic bubbles. The name magnetic bubbles was given to the technology by research workers at the Bell Telephone Laboratories in America who have been responsible for a considerable amount of work on this subject since they introduced it in 1967.

A magnetic bubble is a cylindrical region of reverse magnetisation which can be formed in certain, special magnetic materials. Figure 1 shows a schematic diagram of a magnetic bubble.

The bubble has a south magnetic pole distributed over its upper surface and a north magnetic pole distributed over its lower surface; the state of the surrounding magnetic material is opposite to that of the bubble. The bubble material is unusual in that its magnetisation can lie only along an axis which is perpendicular to the surface, and the material is only weakly magnetic.

An important requirement for the formation of magnetic bubbles is a suitable magnetic field which has to be applied perpendicular to the surface of the bubble material, as shown in Figure 1. The field maintains the bubble at a constant diameter. If this field is gradually increased, the bubble diameter decreases until at a critical diameter the bubble collapses. If, on the other hand, the applied field is reduced, the bubble diameter increases until, at a certain value of the applied field, the bubble becomes unstable and changes into a sausage-shaped region of reverse magnetisation. Thus the magnetic bubble is only stable at certain values of the applied field. This stability range is important when considering the operating characteristics of a memory device.

Magnetic bubbles are useful because a binary "one" can be represented by the presence of a bubble and a "zero" by the absence of a bubble (a no-bubble). In addition, bubbles are extremely mobile and can be moved about the bubble material at high speeds. Binary information – a sequence of bubbles and no-bubbles – is stored in a tiny device called a shift register. Figure 2 shows part of a widely-used T-bar shift register.

Designed like an open sandwich, the shift register consists of a base of a thin layer of a synthetic crystalline material, which is typically one-fifth of one-thousandth of an inch thick. A register circuit of a repeated pattern of Ts and bars is fabricated on this base from a coating of a nickel-iron alloy. Usually called permalloy, the circuit material is easy to magnetise and demagnetise and the Ts and bars fabricated on the thin base are themselves only one-hundredth of one-thousandth of an inch thick.

As a typical bubble diameter is one-fifth of one thousandth of an inch, a great deal of information can be stored in a very small area. For example, a million binary digits could be stored in an area measuring only one square inch. In addition to endless loops of Ts and bars for storing information, the shift register incorporates a seed bubble from which new bubbles can be formed to input information, an erase function for removing old information, and a detector past which the sequence of stored bubbles is moved to obtain a read-out of

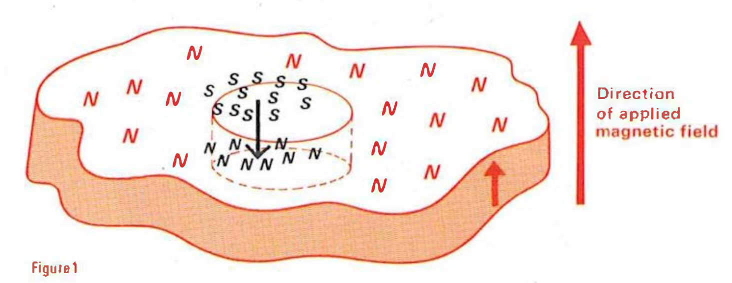


Figure 1

the information. The similarity to conventional magnetic recording is therefore apparent.

Most of the circuit operations can be described by approximating the properties of a magnetic bubble to those of a simple button magnet, magnetised as shown in Figure 1. In addition, bubble devices make use of three other well-known magnetic phenomena, namely that unlike magnetic poles attract one another, that a long bar of a magnetically-soft material is easy to magnetise along, but not across its axis, and that the electrical resistance of the material changes when the material is magnetised.

First consider the way in which bubbles can be moved. As well as the constant, perpendicular bias field which maintains the bubble at the required diameter, there is a rotating in-plane field for creating a system of travelling magnetic poles in the permalloy T-bar circuit. For example, consider the effect of the in-plane field on the permalloy pattern when the field shown in Figure 2 is in position 1. In this position north poles are induced in the Ts in the regions marked 1. (South poles are induced in the regions marked 3 but do not contribute to the working of the device.)

The bars are only slightly magnetised because their long axes are at right angles to the applied field. When the field rotates through 90 degrees to position 2, north poles are induced in the regions marked 2 on the Ts and disappear from the first regions. Further rotation of the field leads to north poles appearing successively in regions 3 and 4 of the pattern. Now consider the situation in which a magnetic bubble is under region 1 with the in-plane field in position 1. The south pole of the bubble is attracted to the north pole of the T. When the direction of the in-plane field rotates to position 2, the bubble is attracted to the centre of the T by the north pole induced there. As the field rotates, therefore, the bubble follows the north poles induced on the Ts and bars. In practice, sequences of bubbles are stored in the endless loops of Ts and bars which together make up the shift register circuit.

As mentioned earlier, new bubbles can be created from a seed bubble. A bubble generator is shown in Figure 3. The basis of generator action is that it is possible to produce new bubbles from a stretched, sausage-shaped region of reverse magnetisation.

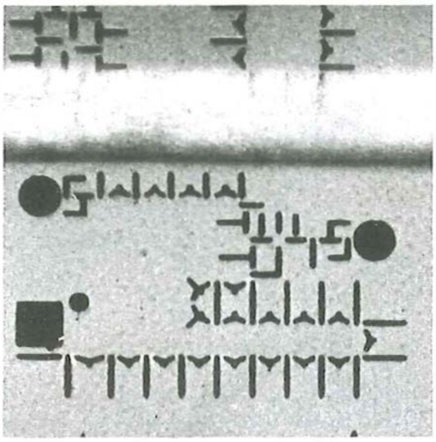
The seed bubble is trapped under a circular permalloy element. When the in-plane field rotates from position 1 to position 2 the bubble experiences attraction to two north poles, one on the generator and the other on the bar A, and is stretched between them. In position 3 the "bubble" is stretched even further (as shown) between the two north pole regions until at some point between position 3 and 4 the central part of the distorted bubble severs, leading to the formation of a new bubble which moves off to the right along a T-bar track.

Unwanted bubbles can be erased by using a generator working backwards, so that the bubbles are fused with a seed bubble. Alternatively, the bubble can be collapsed in a region of the circuit where the bias field is momentarily increased by the magnetic field from a current-carrying conductor loop.

Magnetic bubbles are detected by using the change in electrical resistivity which accompanies a change in direction of the magnetisation of permalloy. The magnetic field from a bubble changes the state of magnetisation of a permalloy resistor which leads to a change in its resistance.

Using the circuit elements described so far – the generator, propagation track, eraser and detector – it should be straightforward to fabricate a bubble memory which has a storage capacity and data transfer rate comparable to that of a small drum memory but with a much faster access time. However, the development of bubble memories on a commercial scale is being delayed by a number of problems. For example, it would be desirable to have a material in which bubbles could be moved ten times faster than in present materials. Additionally, an improvement in the quality of the bubble material and of the permalloy overlay structure would enable larger areas of material to be used.

Magnetic bubble technology, like any other new technology, has its share of exciting successes and bedevilling problems. Its widespread use is likely if the current problems can be solved, but it has to catch up with drum and disc memory technologies which are still being steadily improved.



An experimental Y-bar circuit produced at Dollis Hill. The square and small circle is a bubble generator, and the larger circles are bubble erasers. A human hair at the top indicates the magnification.

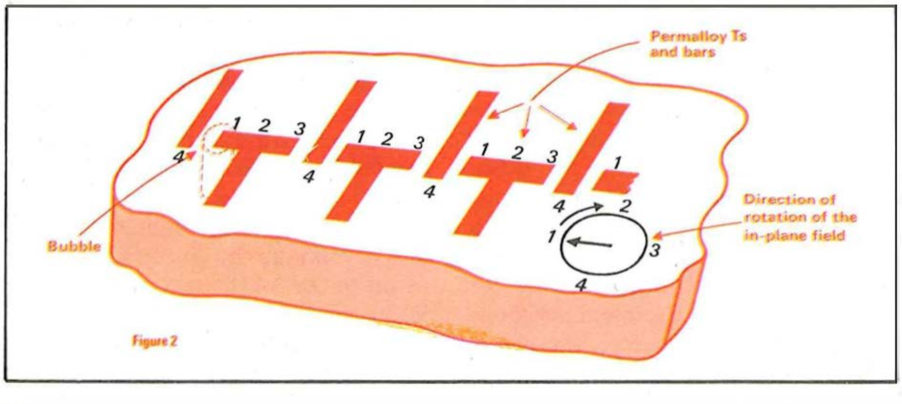


Figure 2

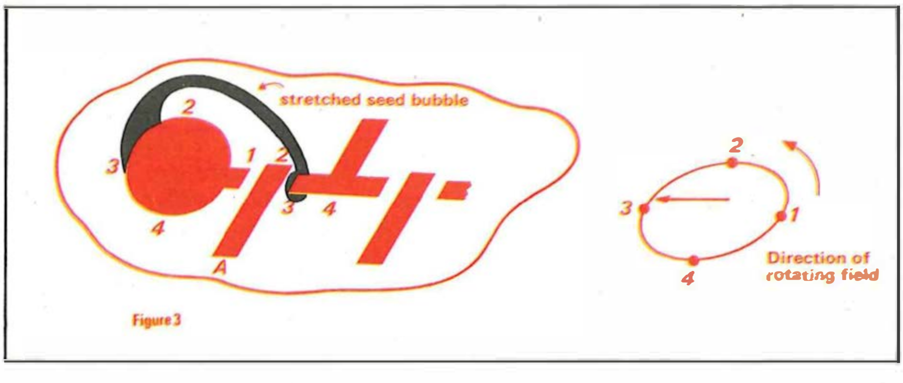


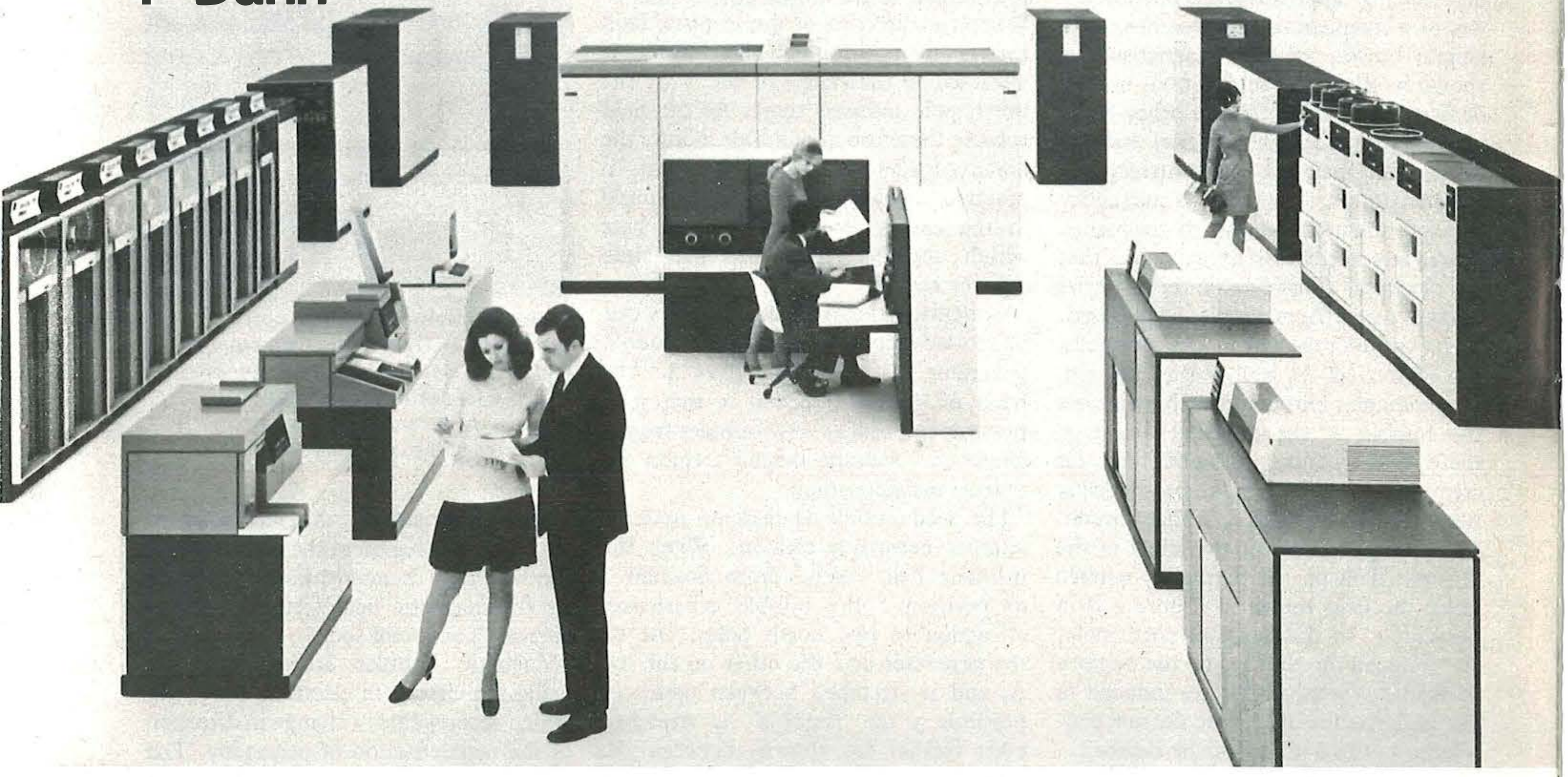
Figure 3

Dr R. D. Enoch is head of a section in the Materials Division at Post Office Research Department, Dollis Hill, specialising in magnetic materials and devices.

PO Telecommunications Journal, Spring 1974

The problem-solving machine

F Dunn



A LARGE, powerful computer has been purchased by the Post Office as a further step in providing a nationwide service for staff who need ready access to computers in their day-to-day work. In particular, the high processing speed and large data storage capacity of the new machine are needed to assist research and development work in support of the programme for modernising the telephone system in this country. Computer-based studies of telephone traffic and exchange designs are important stages in system development which is planned, ultimately, to lead to the introduction of System X – a total system of electronic exchanges for the 1980s.

In recent years there has been a continually growing demand throughout the telecommunications business for data processing facilities covering a variety of tasks. Computers have been provided as knowledge of their advantages has been acquired and as suitable computer techniques and facilities have been developed. Use has also been made of commercial computer bureaux to carry out work beyond the capability of the Post Office machines.

Direct access to the computers from terminal equipment in telecommunications offices started in 1967, and now nearly 200 remote terminals exist throughout the business. The stage has been reached where direct access is available to all staff needing this facility in Telecommunications Headquarters (THQ), as well as every Regional office and more than half the 62 General Managers' offices in Telephone Areas.

The new computer, an IBM 370/168, is now being installed in the Post Office computer centre operated by the Data Processing Service (DPS) at Harmondsworth, Middlesex, and will be ready for service in June. It will take over the work of five existing Post Office computers. Six times more powerful than all the machines it is replacing, the new computer will also enable Post Office work currently being performed by the commercial bureaux at a cost in excess of £½ million per year to be done in-house, and provide extra facilities for the whole of the telecommunications business. Overall, therefore, the IBM is expected to reduce costs by about £1 million a year in addition to the benefits achieved by the various projects using the computer.

Large, repetitive computer-based jobs, such as the preparation of telephone bills, staff payroll and telephone directory compilation, will not be handled by the new installation. It is intended primarily for the individual who has a particular problem to solve in which the calculations are either beyond human capability or where time and expense can be saved by using a computer. Normally the definition of a problem and its conversion into computer language – known as programming – is carried out by the man with the problem, but the computer will also hold a number of ready-prepared programs which are available on request.

Research and development staff need computers to undertake the extensive calculations which their work involves. If their studies are not to be held up and their trains of thought broken a very fast response from the machine is required. In many instances the engineer or scientist has constant access to the computer, feeding information in and receiving answers throughout the time he is devoting to the problem.

A major task of the IBM computer will be in support of simulation studies carried out in the Telecommunications Development Department. Simulation is a technique used for exploring the potential call carrying capacity of a proposed design of telephone exchange. As it is not possible to test traffic design principles on a working model, the computer itself is programmed to behave like the exchange. Data which simulates telephone traffic is then fed into the computer "model" to examine the efficiency of the proposed design. Any necessary amendments can be carried out to enable the equipment eventually provided to be closely aligned with the rate and pattern of calls forecast for that particular exchange.

Simulation work involves direct access to the computer while an exchange "model" is being produced, followed by long computer runs carrying out the calculation of its operation. Computers can process data very quickly and it is therefore possible to compress the testing period into a very short time.

The IBM computer can process data up to 50 times faster than those currently used and it also has the capacity to simulate much bigger exchanges. Large exchange systems – such as TXE4 with up to 40,000 lines – have had to be broken down into sections for simulation on the present machines. While this method is useful for examining individual sections of the proposed design, they cannot be tested interactively with calls passing through the whole exchange.

An important use of the new computer by Regional offices will be in ensuring that telephone exchange equipment is provided in the most economic manner. Computer programs have been developed by the Post Office which enable a design engineer to feed in exchange characteristics, such as the number of telephone lines and rate of calls, and to receive statements from the computer of the quantities of equipment required.

In Telephone Areas the use of computers is still in its infancy. However, programs are being developed for their use, and facilities exist for the calculation of discounted cash flows, the analysis of overtime manhour expenditure and stores listing for Private Automatic Branch Exchanges. Areas are also making use of computers for other tasks involving lengthy calculations, such as investment appraisal, financial reviews, and critical path methods.

Various methods are being provided for feeding information to and receiving results from the Harmondsworth computer, and their use will depend largely on the task and amount of data involved. Users will have direct links with the computer by means of teletype terminals, which have a keyboard for typing in and transmitting information and a printer on which results are fed back.

Where large quantities of data are input to the computer, use will be made of punching and reader equipment associated with the teletype terminals. Data is first punched on to paper tape which is then fed into the reader for transmission to the computer at a speed higher than can be achieved on the keyboard. This method reduces the time, and therefore the costs, of occupying the computer and the Harmondsworth link.

When very large amounts of data need to be input, users will write their information on forms from which it can be prepared for computer input at a DPS data conversion centre. The users' teletype terminal printers operate at 10 characters per second and are too slow for handling the processed data, so results will be output on to line printers at Harmondsworth which operate at a speed of 1,000 lines – or 120,000 characters – per minute. To reduce turn-round time where possible, remote batch terminals are being provided at Telecommunications buildings in central London, Dollis Hill, Martlesham and Ipswich where there are large numbers of computer users. These terminals are equipped with high-speed terminal facilities for receiving and transmitting information over fast links with the computer, and they can therefore handle large batches of data for many users who work nearby.

Some existing equipment aiding research and development work will also be able to take advantage of the new installation. For example, storage tubes, which store and display graphical information, will be connected to the computer. The storage tubes are used by Research Department in mathematical studies where graphical output is useful, such as in the study of transistor performance characteristics.

The communications network designed for linking terminals and other equipment with Harmondsworth computer centre consists of a combination of telephone lines, private and Dataplex circuits. The teletype and high-speed terminals are connected to telephone exchanges at Martlesham, Manchester and London by means of Datel services which allow computer data to be transmitted over the public switched network. These exchanges are linked to the Harmondsworth computer centre by using Dataplex facilities which enable a number of calls to be transmitted simultaneously at local call rates over special circuits. Other equipment will use private wires direct to Harmondsworth.

The IBM installation at Harmondsworth is a very large and powerful machine. Its main store can hold three million characters (3 Megabytes) of data to which access can be gained by the processing unit at a speed approaching one-tenth of a millionth of a second (80 nanoseconds). The computer also has a store of fixed discs – like records – which can hold 11 Megabytes of data not immediately required. Information on the fixed discs is transferred into the main store when needed for processing, in blocks of 4,000 characters in five milli-seconds. A further 800 Megabytes of data can be stored on replaceable discs to which access can be gained in an average time of 30 milli-seconds.

Terminal users' files of information will normally be held on the replaceable discs and transferred progressively to the faster access storage devices when processing is being performed. Infrequently used files will be held on magnetic tape and transferred to the disc files by the computer operator when requested by a user. In this way the work of up to 3,000 users can be held in the computer equipment.

The computer can handle work from 100 terminals simultaneously, and at the same time carry out other work as a background operation. The combination of large store and high speed enables the extensive calculations required for exchange simulation studies to be carried out. However, this work requires so much of the computer's capacity that it will normally be run at night when it will not be competing with work from the terminals.

Commissioning and running of the Harmondsworth computer is the responsibility of DPS but Post Office Telecommunications, as the major user, has to specify its requirements and then plan and implement the transfer of work. A project team has been set up to control implementation and take the major decisions. The team will report to a Scientific Computer Services Steering Committee, which is chaired by Management Services Department and has representatives from DPS and user interests in the telecommunications business.

The primary objective of the project team will be to get work transferred quickly from the commercial computer bureaux to the IBM installation. This will be followed by the need to transfer work currently being handled on the Post Office machines which are being replaced. These tasks involve arranging for the work of the 3,000 users throughout the business to be converted from existing computer programs to those which will run on the new machine.

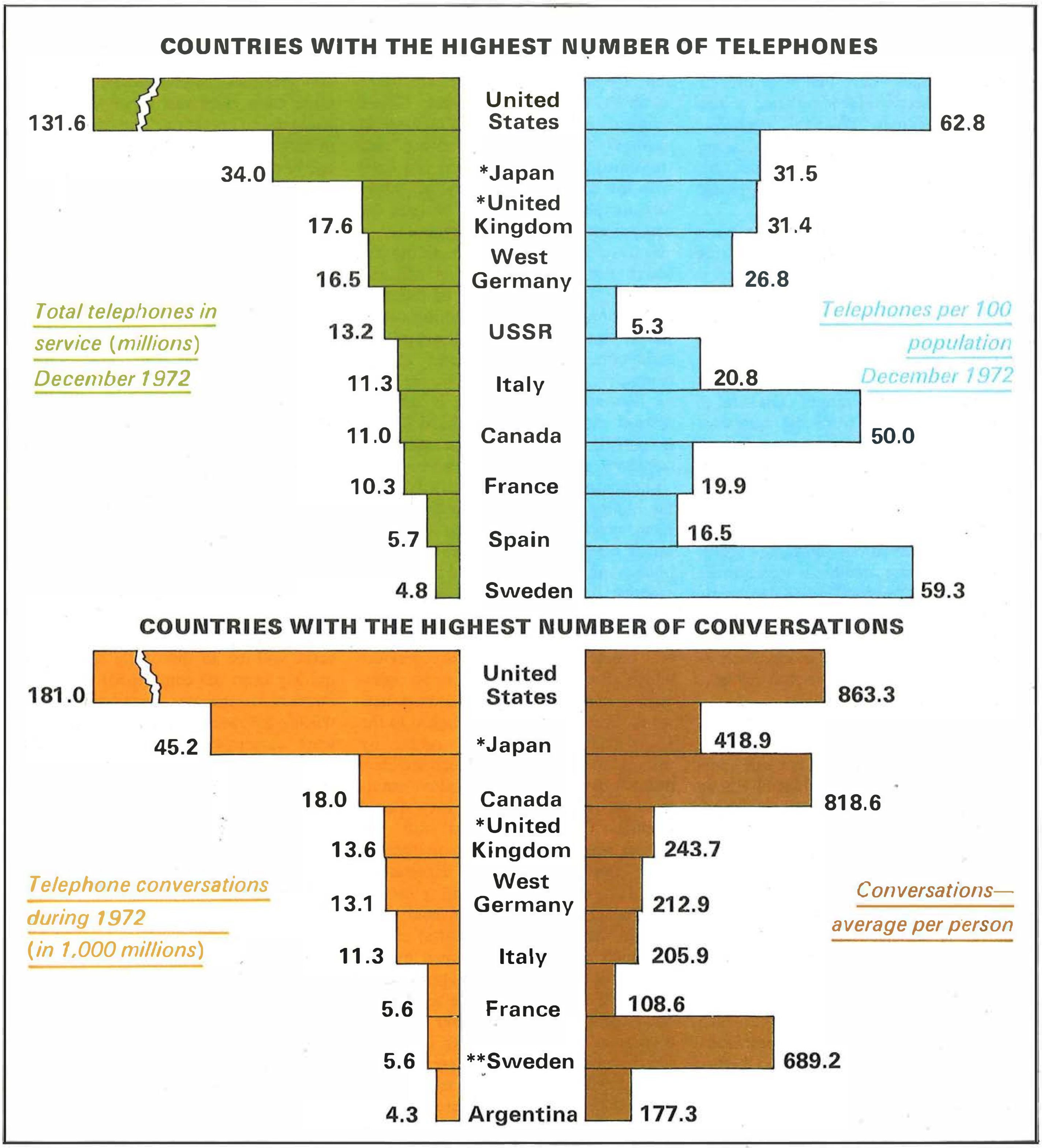
The whole exercise is an example of co-operative effort throughout Post Office Telecommunications. Many experts are working together to implement the new computer configuration, and users will be co-operating to achieve the maximum economy for the Post Office.

Mr F. Dunn is head of the section in Telecommunications Management Services Department responsible for the control of computer projects and co-ordination of the transfer of work to the new computer.

PO Telecommunications Journal, Spring 1974

Telephones around the world

We show here our annual international comparison of telecommunications statistics. The figures indicate, for example, the importance of the telephone in the USA, Canada and Sweden – by far the leading countries in both ownership and use of the telephone when compared with the size of the population. The source of the figures is the American Telephone and Telegraph Company and the International Telecommunications Union.



*Figures quoted are as at 31 March 1972 and 31 March 1973

**Relates to the year July 1972 to June 1973

UK figures include Hull Corporation Telephone System

MISCELLANY

Ahead of schedule

CANTAT 2, the submarine telephone cable linking Britain and Canada, was formally handed over to the Post Office by the manufacturers nearly a month ahead of schedule. Due to come into service this Spring, the cable will carry up to 1,840 telephone conversations at once – more than the combined capacity of all the other transatlantic telephone cables. (See Telecommunications Journal Autumn 1973).

The new cable is being provided jointly by the Post Office and the Canadian Overseas Telecommunications Corporation. It will carry public telephone calls, telex messages, telegrams and computer data between the UK and Canada. In addition, 19 European telecommunication authorities have already purchased or leased circuits in the cable to provide communications with both Canada and the United States.

Converted

Britain's telex links with Taiwan and Jordan have been converted to automatic working as part of a Post Office programme to automate its international telex services. Telex users can now set up their own calls to the two countries without using an international operator.

The Post Office currently has automatic telex links with the 28 European countries capable of accepting automatic service, including all Common Market countries. A further 34 countries beyond Europe also have automatic service with Britain.

A new manual telex service enables British users to make calls for the first time to the Iraqi towns of Baghdad and Basrah. Previously, telecommunication between Britain and Iraq was only by telephone and telegram.

Direct to Spain

Telephone users in Britain who have access to International Subscriber Dialling can now dial their own calls direct to Spain. This brings to 18 the number of countries to which the ISD facility has been extended. With the addition of five million telephones in Spain, there are more than 295 million telephones in Europe, Canada and the USA which can be dialled from Britain.

Aerial power

The satellite earth station at Goonhilly Downs, Cornwall, which carries more than half the telephone calls between Britain and countries beyond Europe, is to operate full-time off its own power supply. Mains electricity will be used only as a standby.

The change is aimed at improving the already high reliability of the station and reducing the risk of interruptions to intercontinental telecommunications. The risk comes from minor fluctuations in the mains supply. Sudden and tiny surges in voltage lasting less than one-fiftieth of a second, which might damage sensitive transmission equipment in each of the station's three aerials cause protection systems to stop transmission.

New plant will provide power for the dish aerials and their control complex, and heat given off by the generating equipment will be harnessed to provide domestic heating and water heating for the earth station's control building. The Post Office hopes to place contracts for the necessary diesel generating equipment and control gear this summer, and the station is expected to be fully independent of mains electricity by Autumn 1975.

THE ELECTRIC WORKSHOP

Repair engineers in London have begun a two-year trial of an electric-powered van. The trial will show whether vehicles operated by powerful batteries are suitable and economic for the stop-go sort of driving normally required.
Post Office Telecommunications, with 50,000 vehicles on the road, is Britain's biggest commercial fleet operator. Most of the vehicles are used as mobile telephone workshops, and the average distance covered daily is only about 25 miles – less than for the average car owner. One of the limiting factors of electric vehicles – their short range – will therefore be less of a drawback than for some other operators. The vehicle being tested has a range of between 35 and 40 miles on a single charge and a top speed of about 30 miles per hour. It is made by Harbilt and powered by two conventional 72-volt batteries.

Data team

To find out how computer users could benefit from digital data transmission services being planned by the Post Office, a cost-benefit analysis team has been set up by the Data Communications Division of Post Office Telecommunications. The team will seek to identify the impact on customers' data processing activities of new facilities which future transmission services could offer.

The Post Office has given Pliener Associates Ltd – specialists in the design and implementation of on-line data-processing and communication systems – a contract for consultancy services.

Network grows

Nearly a million new exchange lines were added to Britain's telephone network in 1973. The number of exchange connections in service rose to 11,647,000, an increase of more than nine per cent compared with the end of the previous year. At the end of last year some 8,596,000 residential lines were in service, a growth rate over the year of 10.6 per cent. The number of business lines in service passed three million for the first time.

In the same period more than 19,000 trunk telephone circuits were added to the network, bringing the number in service to more than 140,000. The trunk network now carries more than 2,000 million telephone calls a year. In the last three months of 1973 a record 541 million trunk calls were made, of which 88 per cent were dialled direct by customers using Subscriber Trunk Dialling.

Computer link

The Post Office is now operating an International Datel 600 service with New Zealand which enables computers in the two countries to 'talk' to each other over ordinary telephone circuits at rates up to 1,200 binary digits per second (bit/s). Other countries linked to the UK by the service are Australia, Bahrain, Belgium, Canada, Denmark, Dubhai, Finland, France, German Federal Republic, Hong Kong, Netherlands, Norway, Singapore, Spain, Sweden, Switzerland and the USA.

International Datel 600 provides alternate bothway transmission of data. The ▶

charge for the service to New Zealand is £1.40 per minute with a three minute minimum. Main users of the service are expected to be shipping agents and banks.

Appointments

Mr K. C. Grover, Head of Business Planning at Post Office Telecommunications Headquarters, is to become Chairman of the Scottish Telecommunications Board. Mr Grover, Chairman of the Editorial Board of Telecommunications Journal, will succeed Mr H. J. Revell who is retiring in June after 40 years' service with the Post Office.

Mr. N. Gandon has been appointed Director of North East Telecommunications Region. Deputy Director, Training, of Post Office Telecommunications since 1969, he succeeds Mr H. S. Holmes.

Mr. K. S. Nash is the new Director of the Post Office's Central Financial Planning Department. Formerly financial advisor to the External Telecommunications services, he has taken over from Mr N. F. Holman, who has retired.

Educational study

The development of education in Britain up to the 21st century and its impact on telecommunication services is the subject of a major study commissioned by the Long Range Studies Division of Post Office Telecommunications. During the study, which covers the period 1983-2003, a team of leading educationists will forecast the likely form of education Britain will have in the year 2000.

A wide range of educational services will be examined with emphasis on the use of telecommunications, particularly in relation to close-circuit television and computers in education. The study seeks to establish patterns of communication in education, matching its likely future needs with the services likely to be available from an advancing telecommunications technology.

Lasting a year, the study is being undertaken by the Council for Educational technology, The Department of Education and Science will also be consulted.

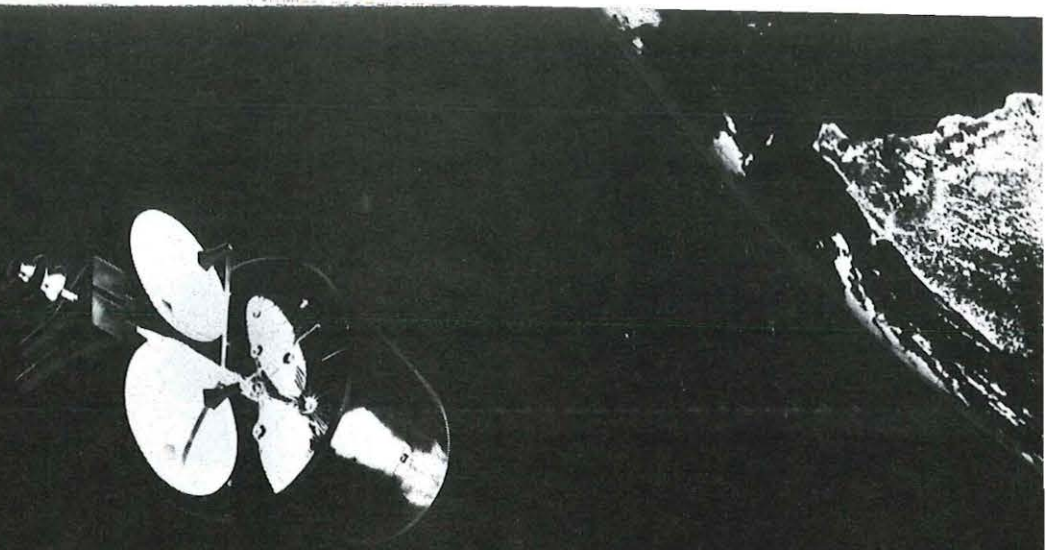
The study is one of a series commissioned by the Long Range Studies Division. Others look at the future of the economy, leisure, transport, health services, and the urban environment.

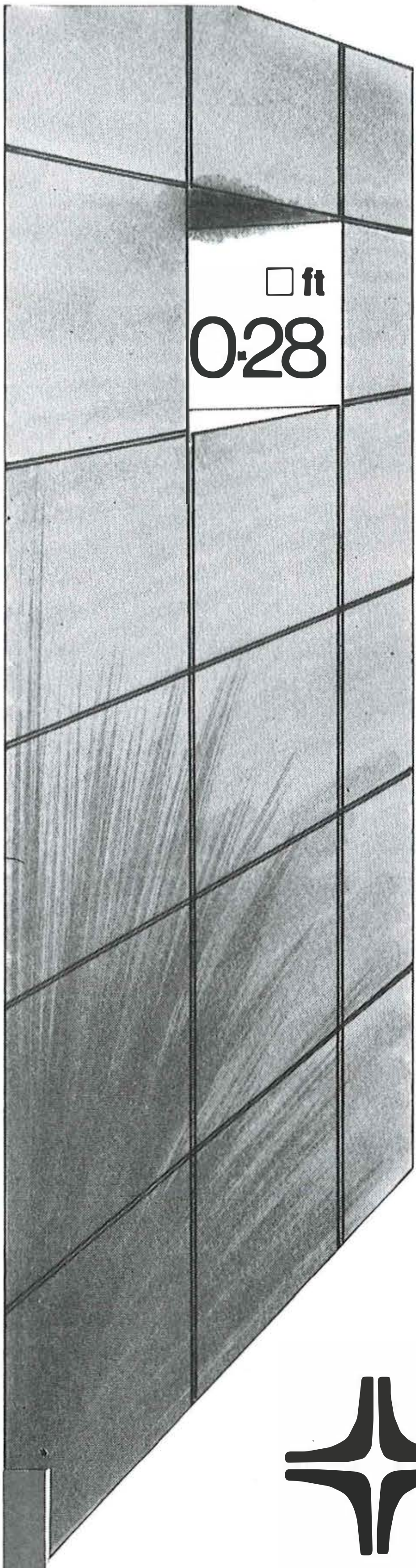
Children's London, an information service on things to do recorded by disc jockey Ed Stewart, received its two millionth telephone call recently. Miss Anne Durrant, a telephonist at Colindale exchange and Miss North West Phones, here presents a golden trimphone to Ed Stewart.

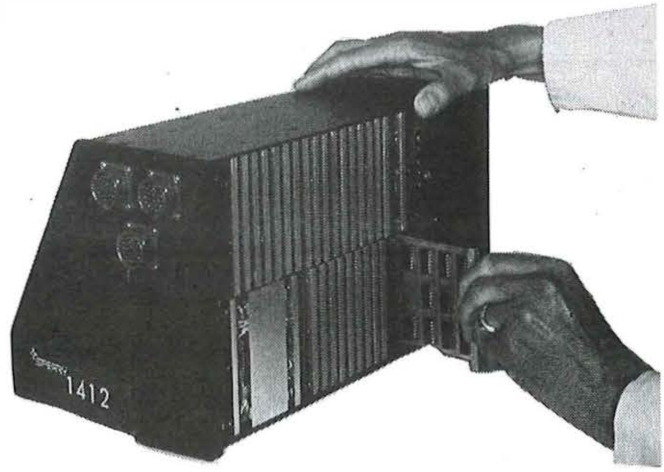
Faster service

A new international telephone control centre has been opened at Leicester as part of a £1m Post Office project to provide a speedier service for people making operator-controlled international calls from outside London. Initially the centre will serve 150,000 customers – including 35,000 business users – in Leicester, Hinckley and Loughborough. During the next few years its call-handling capacity will be stepped-up to provide an improved service for the whole of the Midlands and East Anglia.

The Leicester centre is the second of three being provided by the Post Office. The first, serving the South-East, opened at Brighton last year. The third, planned for Glasgow, will serve Scotland, Northern Ireland and the North of England.







PLUG-IN A COMPUTER

- ☐ **RUGGED** ☐ **INEXPENSIVE**
- ☐ **4K MEMORY** ☐ **SMALL VOLUME**
- ☐ **12/24 BIT PRECISION**
- ☐ **47 POWERFUL INSTRUCTIONS**
- ☐ **LOW POWER CONSUMPTION**

☐ For many applications there is only one choice of digital processor that can meet difficult specifications. The Sperry 1412 has been especially developed as a hard working small computer for use in adverse industrial and military environments.

The 1412 is already proving its worth in several applications and is the principal module in the SCAMP (Sperry Computer Aided Message Processor) System.

If you have a requirement for a small (0.28 cu.ft.) high quality computer with a 4K memory, 12/24 bit word length and powerful instruction repertoire, *ask Ray Hazell for a quotation.*

SPERRY
GYROSCOPE

BRACKNELL BERKSHIRE ENGLAND RG12 1QL
TELEPHONE BRACKNELL (0344)3222 TELEX 848129

Publication and Price:
The Journal is published in January, April, July and October, price 12p per issue. The annual postal subscription is 80p – reduced to 48p for retired staff.

Advertisements:
Communications, advertisement copy, etc., should be addressed to Sawell Publications Ltd, 127 Stanstead Road, LONDON SE23 1JE. Telephone: 01-699 6792. No official responsibility is accepted for any of the private or trade advertisements included in this publication.

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

Correspondence:
Communications should be addressed to the Editor, Post Office Telecommunications Journal, Public Relations Department, Post Office Central Headquarters, 23 Howland St., LONDON W1P 6HQ. Telephone: 01-631 2191 (editorial), 2193 (sales). Remittances should be made payable to "The Post Office" and should be crossed "& Co.". The Giro account number is 535-1006.

Get your **Telecommunications Journal** regularly

Complete the form or photocopy and send to
TELECOMMUNICATIONS JOURNAL
Public Relations Department,
Post Office Central Headquarters,
23 Howland St., LONDON, W1P 6HQ.

(If you do not work for the Post Office send your subscription to the same address. Details of the annual postal subscription are given above.)

I wish to subscribe to the Post Office Telecommunications Journal and authorise deduction of the subscription from my salary or wages. (Four issues a year at 12p per issue.)

Name__________ Grade__________

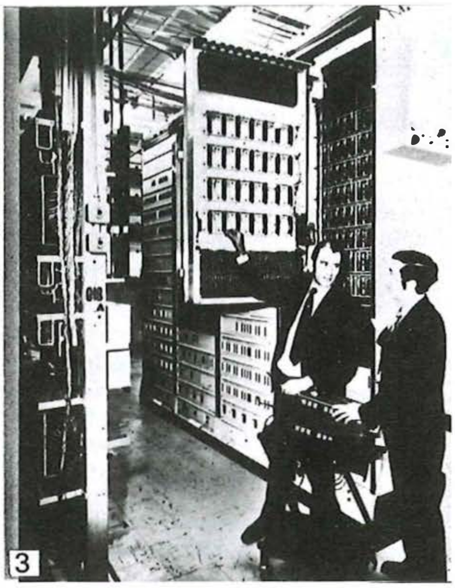
Signature__________ Date__________

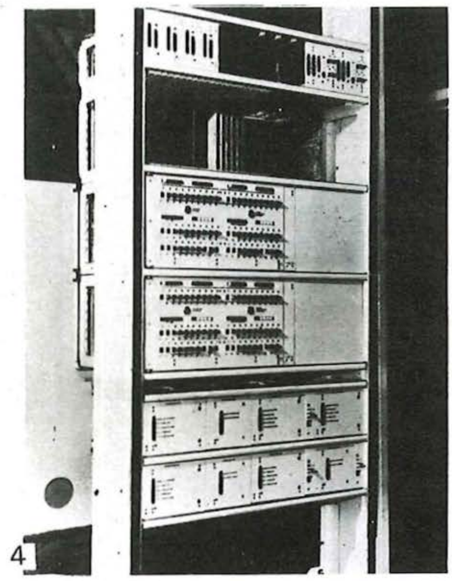
Duty Reference__________ Pay Group__________

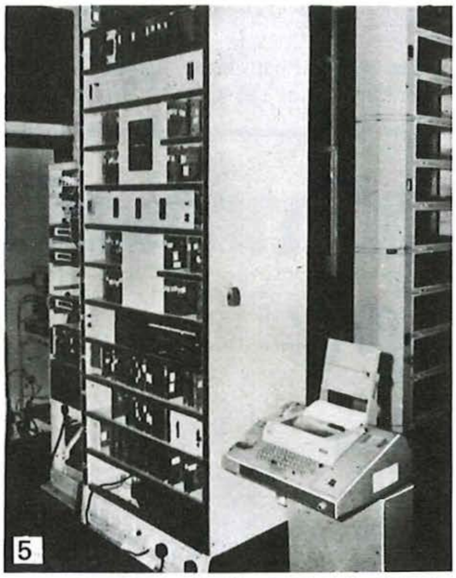
Office Address__________

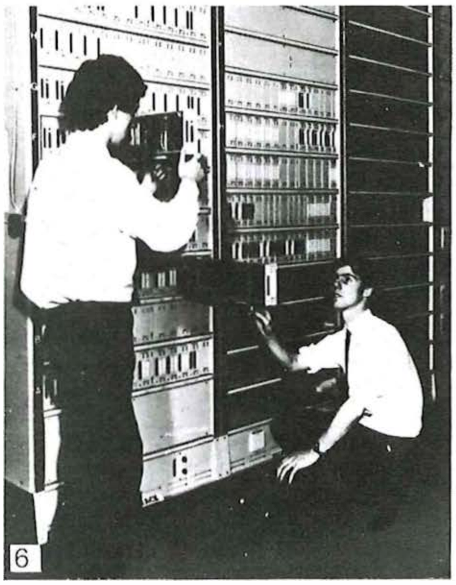
GEC Stored Program Co
Signallin

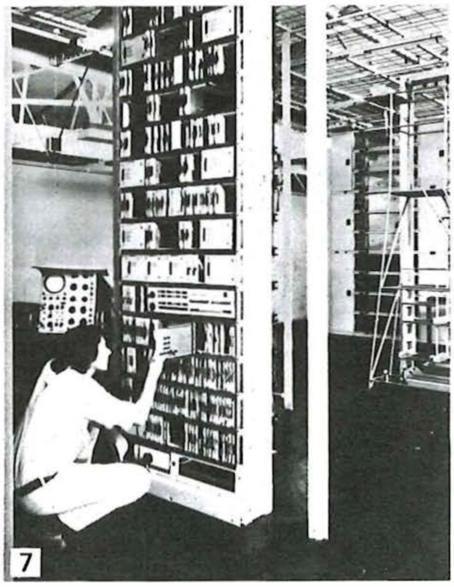

2


3


4


5


6


7

GEC SPC Developed

GEC's ten-year investment in Stored Program Control techniques has an outstanding record of achievement.

The Mark I processor, designed primarily for call-establishment, or register, functions was installed in Belgravia exchange, London in 1966, followed in 1968 by a MK IB.

The experience of 5 years successful operation in public service was incorporated into the Mark IC design which is now in quantity production for, and is operating with:

Strowger Systems.

Electromechanical register translators are being replaced in nearly 100 Director exchanges in the U.K.

Crossbar Systems.

Seven new Sector Switching Centres – huge exchanges that will decentralize London's trunk traffic – are each being equipped with 30 MK IC processors.

Motor-Uniselector Systems.

The first SPC for telecommunications to be exported from the United Kingdom is now operating in Johannesburg in South Africa's STD network.

The MK II processors, which complement the MK I, are more powerful and more versatile real-time multiprocessor computers capable of handling all exchange control functions including network management, exchange misoperation and fault diagnosis.

A MK II A processor was installed in the Post Office ISC at Wood Street, London, in 1969 and carried out 'phase A' test, followed by a MK IIB design for 'phase B' tests, of the new CCITT Signalling System No. 6.

A MK IIB processor has been ordered by the South African Post Office for the main control functions of a large truck exchange.

In 1973, ten years after development started and after an 18 month evaluation of available designs, the UK Post Office has chosen an evolved GEC MK IIB processor, the MK IIBL, to fulfil the control functions for future designs of telephone exchanges for the British network.

This is one of the vitally important decisions affecting switching system concept and design that will have a major influence on telecommunications networks of the future.

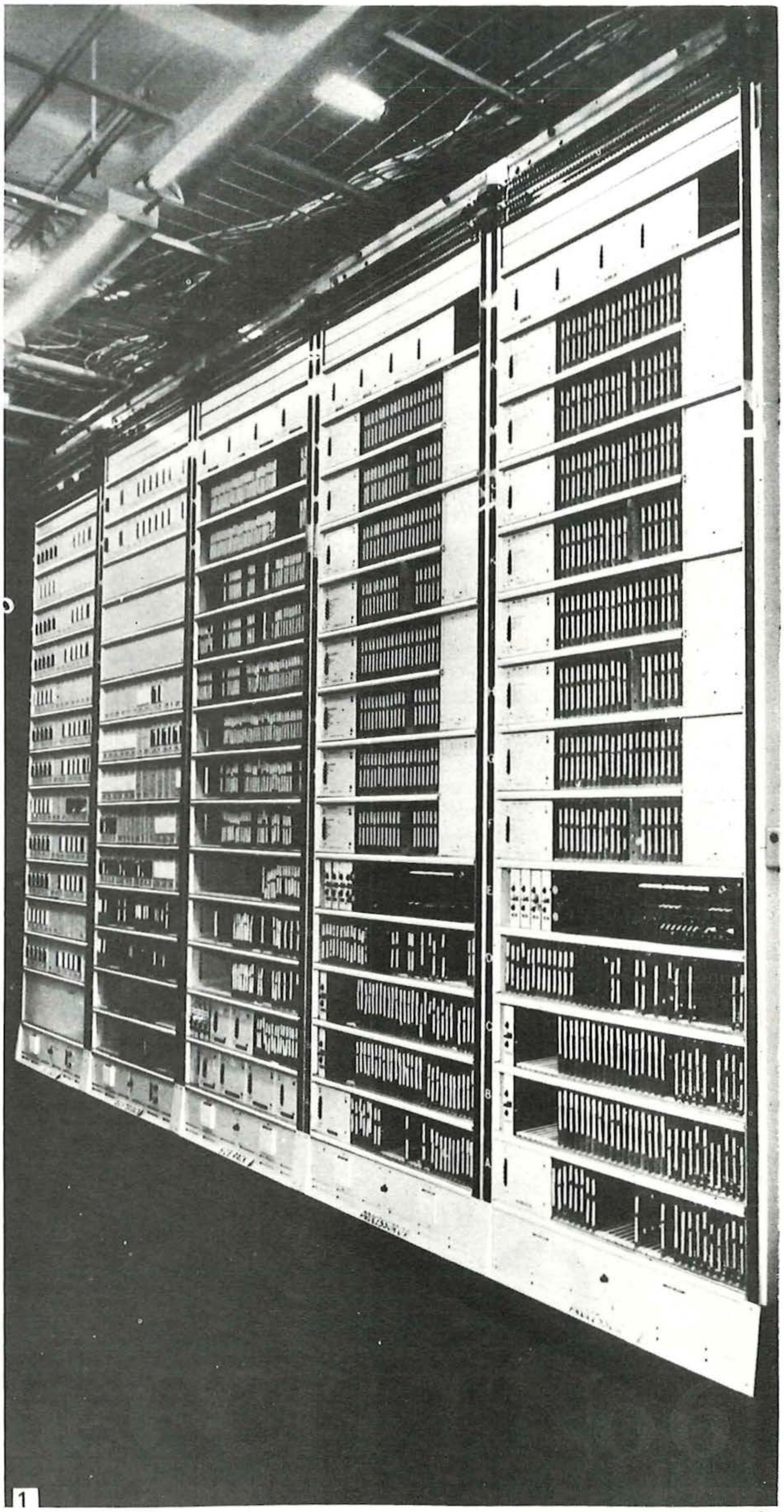
ntrol and the CCITT No 6
g System
on solid foundations

GEC Stored Program Control installed in the Post Office International Switching Centre at Wood Street, London, successfully controlled the equipment that formed the U.K. terminal of the international field trial of the new and advanced CCITT Signalling System No. 6.

Under contracts awarded by the UK Post Office, GEC Telecommunications Limited developed and supplied all the control and interface equipment, including an adaptation of the GEC MK II B real-time multi-processor, for the U.K. contribution.

Key to photographs.

1. MK IIB processor installed in UK Post Office International Switching Centre, Wood Street, London.
2. MK IC – East Sector Switching Centre, London.
3. MK IC – Johannesburg Central Exchange, South Africa.
4. MK IP (two off) – next generation of MK I range.
5. MK IIA – Wood Street, London. CCITT No. 6 Trials.
6. MK IIB – Wood Street, London. CCITT No. 6 Trials.
7. MK IIB – Extended version for S. African Post Office.



1

Telephone Switching Systems. Microwave and Line Transmission. Multiplex. V.F. Telegraphy. Data Modems. Private Telephone Systems. Telephones. Total Systems Capability.

GEC

GEC Telecommunications Limited
Telephone Switching Group,
Coventry, England.

A Management Company of The General Electric Company of England.

GE7

How Giro helps you keep track of your money

When you are paid through Giro you get frequent, free statements which tell you all you want to know about the money in your account. Just look...

STATEMENT OF ACCOUNT

Number 80 245 2743 31JAN74

National Giro
Bootle
Lancs

CO 520170
Serial 7

Summary

previous balance	24JAN74	£52.17
total debits		49.93
total credits		126.48
current balance	31JAN74	£128.72

MR J ENGLISH
4 TOWN SQUARE
FAIRFAX
FA4 2AB

Transactions

			£
		DEBITS	
26JAN	S 2143211	BLDG SOC	19.37
28JAN	S 1769281	HAM UDC	4.00
28JAN	S 3172962	LIFE INS CO	5.00
28JAN	T 1031234	GAS BD	11.50
30JAN	G 000016	GIROCHEQUE	10.00
	FEES		0.06
31JAN		CREDITS	
D SELF			5.25
T 4286237	SALARY		121.23

A Automatic debit transfer
D Deposit
I Inpayment
P Payment
S Standing order
T Giro transfer for further information see overleaf

2 11 8024522743 001

You have no sums to do, the *Summary* gives you the figures that matter straight away. How much was in your account (previous balance) before making the payments shown on this statement, the total of payments made, which includes any cash drawings and fees (total debits), the money you have received (total credits), and the amount in your account when the statement was prepared (current balance).

All your payments by Giro transfer are clearly identified by names, so you can see straightaway who you have paid and how much.

Money you have received is shown separately. And there are many advantages in having your salary paid this way. As well as helping to keep track of your money it means you enjoy the special privileges and terms offered to Post Office staff.

A Great Deal in British Banking

Giro

National Giro

Ask for an application form at your pay office or post this coupon (no stamp needed).

To Miss Pat Christian Freepost National Giro Centre
Bootle G1R 0AA
Please send me an explanatory leaflet and application form for a SALARY-THROUGH-GIRO account.

Name..

Address..

....

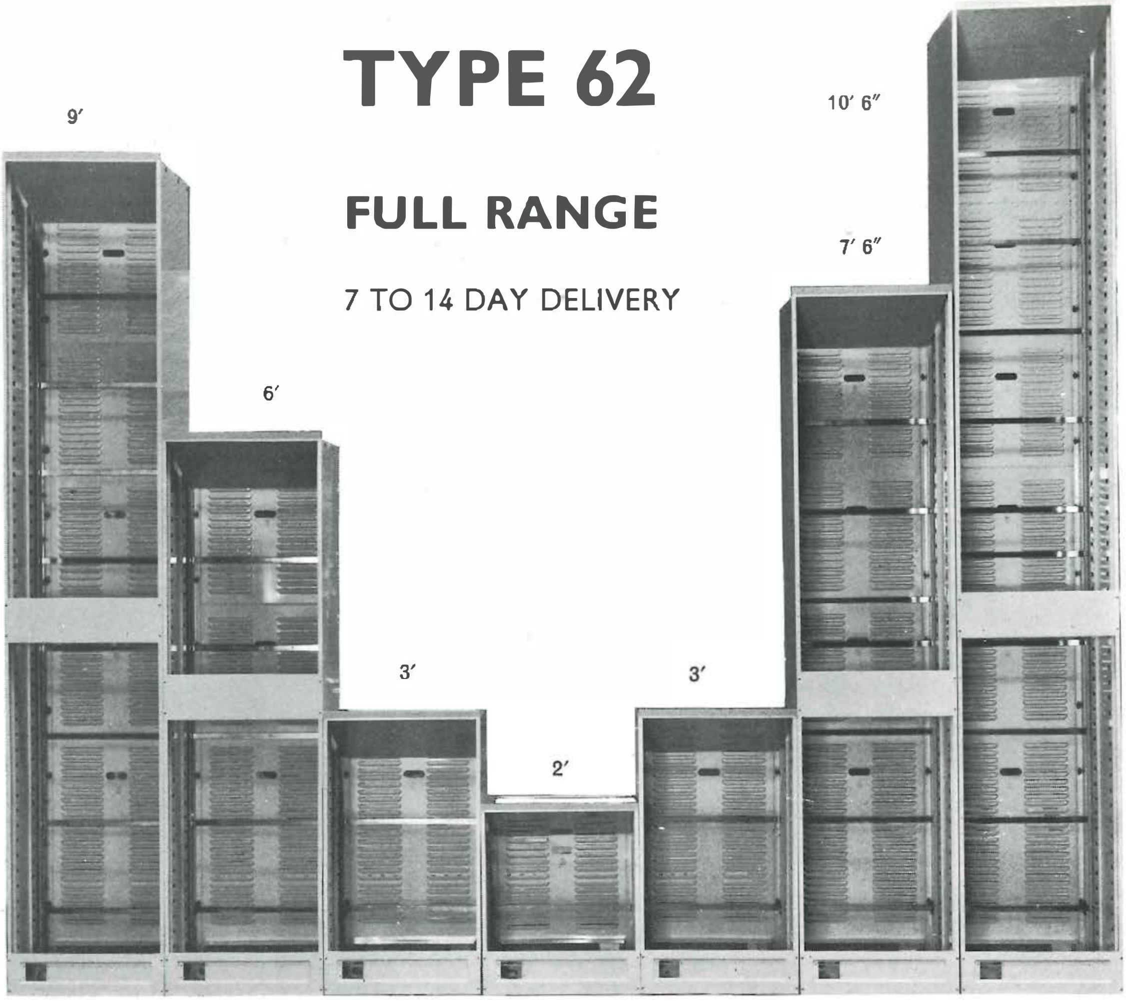
....

....Postcode.................... T.C. 2

TYPE 62

FULL RANGE

7 TO 14 DAY DELIVERY



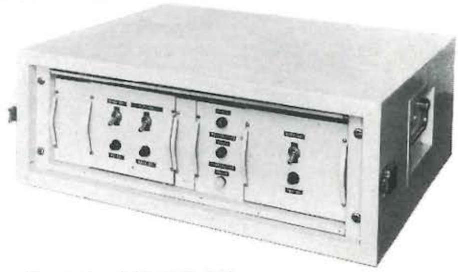
HIGH PRECISION MECHANICS

FOR INSTRUMENT ELECTRONIC AND AUTOMATION INDUSTRIES

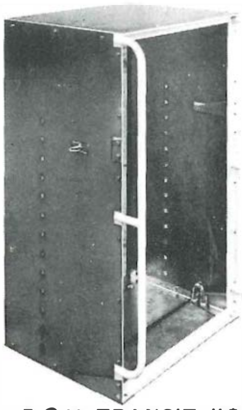
TELECOMMUNICATIONS MECHANICS

P.O. APPROVED

IMMEDIATE QUOTATIONS AND TECHNICAL SERVICE

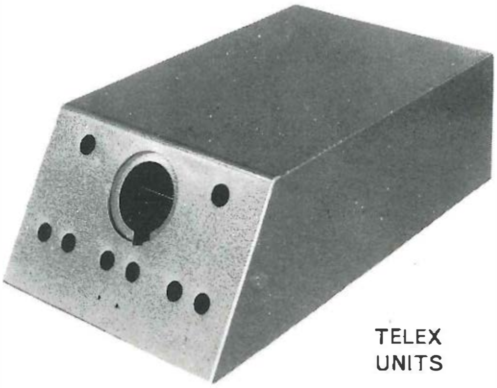


SHELF ASSEMBLIES



P.C.M. TRANSIT JIG

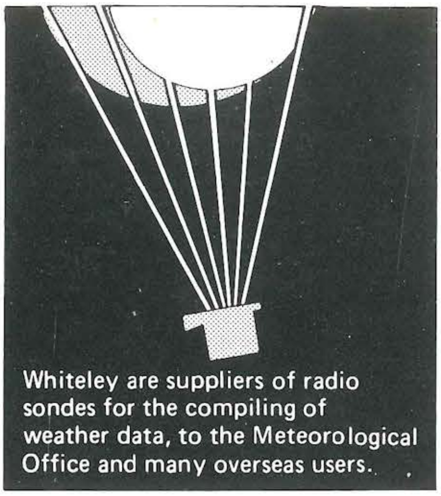
DATEL MODEM

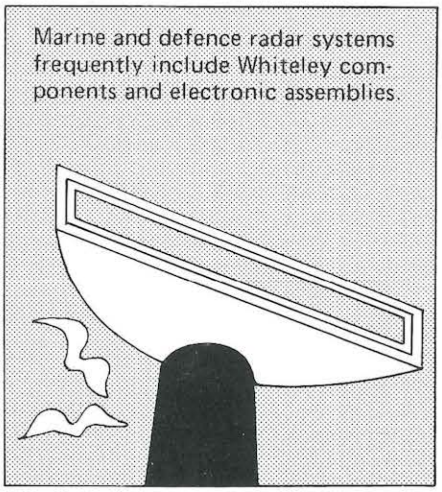


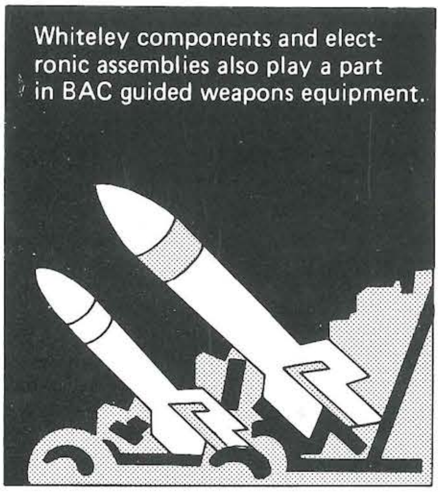
TELEX UNITS

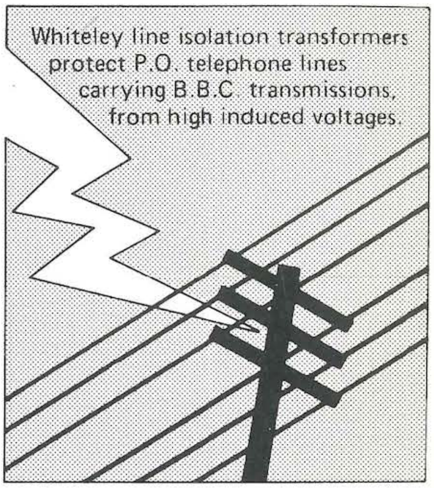
CRAY ELECTRONICS LTD

THAMES ROAD, CRAYFORD, KENT
TELEPHONE: CRAYFORD 29251









Variety is the spice of Whiteley!

Whiteley is one company you **can't** pin down to a stereotyped product range. One company that prefers to keep lively by applying its many skills to a wide variety of contracts. Cabinets, switchboards, acoustic hoods? Whiteley make them. Complete systems for public address or telecommunications? Whiteley make them. Components or subassemblies, transformers, amplifiers, test sets? Whiteley make them. Think of us as specialist suppliers to the electronics industry. We grew up with it. Giving the Whiteley touch to any item they needed from us. Today, the three Whiteley factories serve an impressive list of customers . . . the Post Office, Ministry of Defence, Government bodies, British Rail, BAC, the C.E.G.B., and many top names in industry. You could reap the same benefits by adding **your** name to the list . . . adding Whiteley to your manufacturing resources. Here is a company at your service, with the whole spectrum of facilities from design through to assembly. Ready to offer any or all of them, as you need. A company to keep in touch with.

Whiteley Electrical Radio Co. Ltd.,
Mansfield, Notts. England. Tel: Mansfield 24762
London Office: 109 Kingsway, W.C.2. Tel: 01-405 3074

ELECTRONIC & ELECTRICAL DESIGN
PRODUCTION CAPABILITY
CABINET MAKING
SHEET METAL FORMING/FINISHING
PLASTICS MOULDING
ENCAPSULATION

Call on the Whiteley skills