Post Office telecommunications journal

Winter 1975/76 Vol. 27 No. 4 Price 12p

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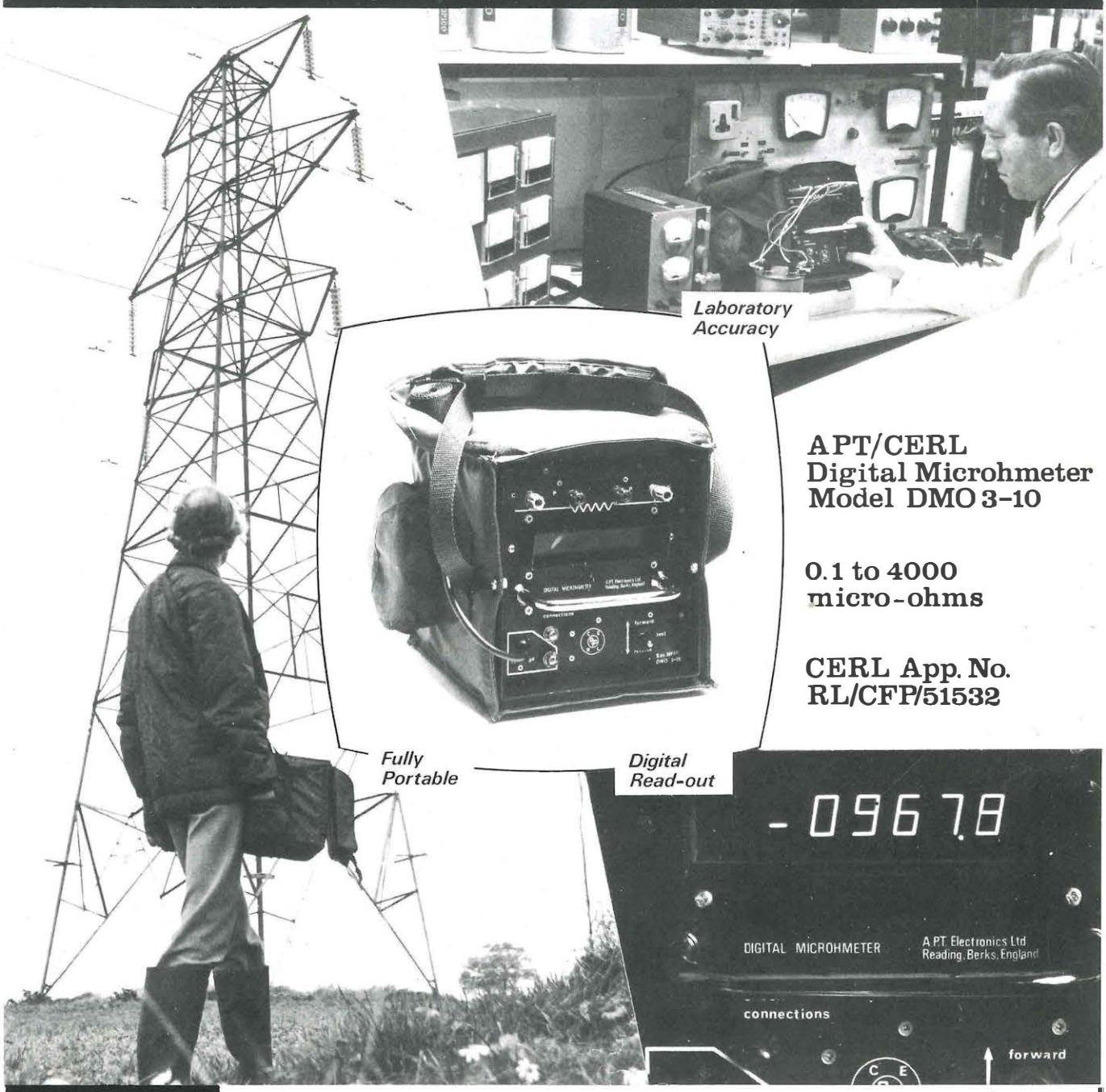

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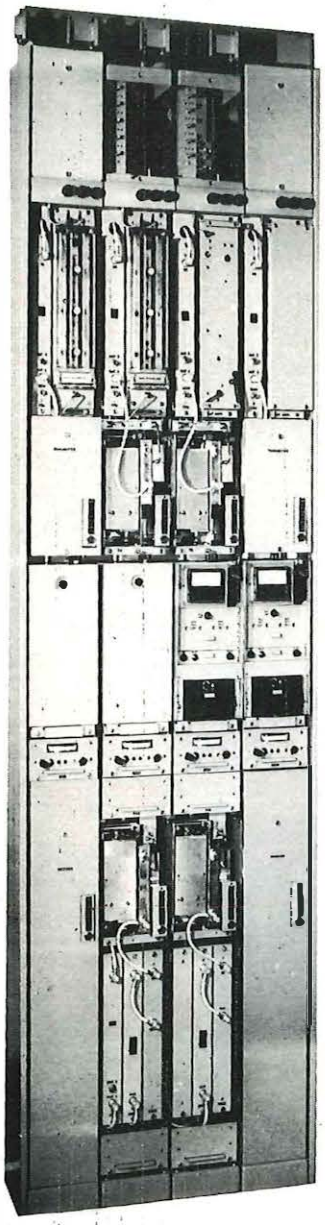

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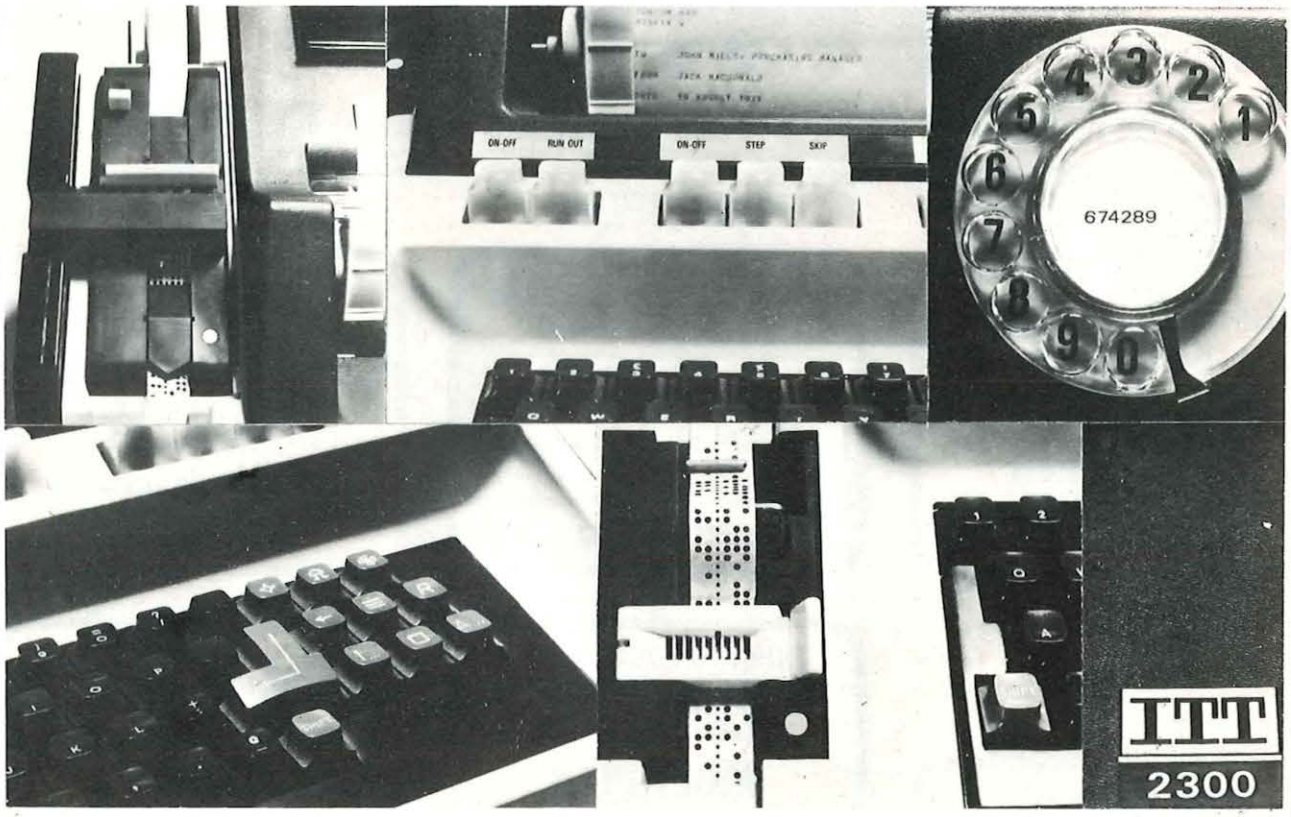

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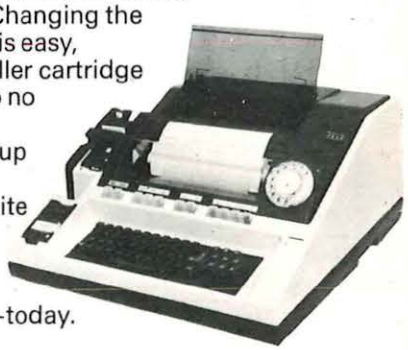

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Speeding vital links

Two recents events demonstrate the Post Office's ability to respond quickly to the need for vital new and improved telecommunications services. First, a programme to install the world's largest international telephone exchange – at Stag Lane in North London – was completed more than a year ahead of the original schedule. Soon after, the first part of a network of offshore microwave radio links to serve North Sea oil and gas production platforms began service little over a year after work started on the project.

The huge complex at Stag Lane was started as a crash programme to meet explosive growth in the international telephone service, and the new exchange will be able to deal with 800,000 calls a day. The work has been done in less than four years, under half the time it normally takes to provide an exchange building and equipment of this size.

The first part of the North Sea offshore network provides Mobil's Beryl platform, 150 km east of the Shetlands, with direct dialling throughout the United Kingdom and to many places abroad. And the Post Office is now in a position to provide the North Sea platforms with a wide range of telecommunications services, including telex, computer data transmission and private circuits.

To maintain highly reliable communications with platforms well out of sight of land, a system known as trans-horizon microwave radio is being used for the first time by the Post Office. (See Telecommunications Journal, Spring 1974). Trans-horizon services based on two new radio stations – one near Fraserburgh and the other on South Shetland – are expected to be able to meet offshore communication needs until well into the 1980s.

A little extra

Despite the biting effects of inflation the price of Telecommunications Journal has remained unchanged for two years. However, increased costs of production have made it increasingly difficult to maintain the high standards that readers expect.

With regret, therefore, it has been decided that the price of the Journal must be increased to 18 pence an issue from the Spring edition this year. At just two pence per month more, we are sure that the Journal remains excellent value for money.

The revised method of deduction from pay for Post Office staff will be announced shortly in the Post Office Gazette. Details of annual postal subscription payments will be announced later.

Post Office telecommunications journal

Winter 75/76 Vol. 27 No. 4

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

Cover: Tiny millimetric oscillators are used in the waveguide transmission systems being developed by the Post Office. Technical Officer Rex Hardy works here on an oscillator he made himself at the new Post Office Research Centre, Martlesham Heath, Suffolk. (See page 15)

The sound way to clean equipment

ST Fletcher and A Jarvis

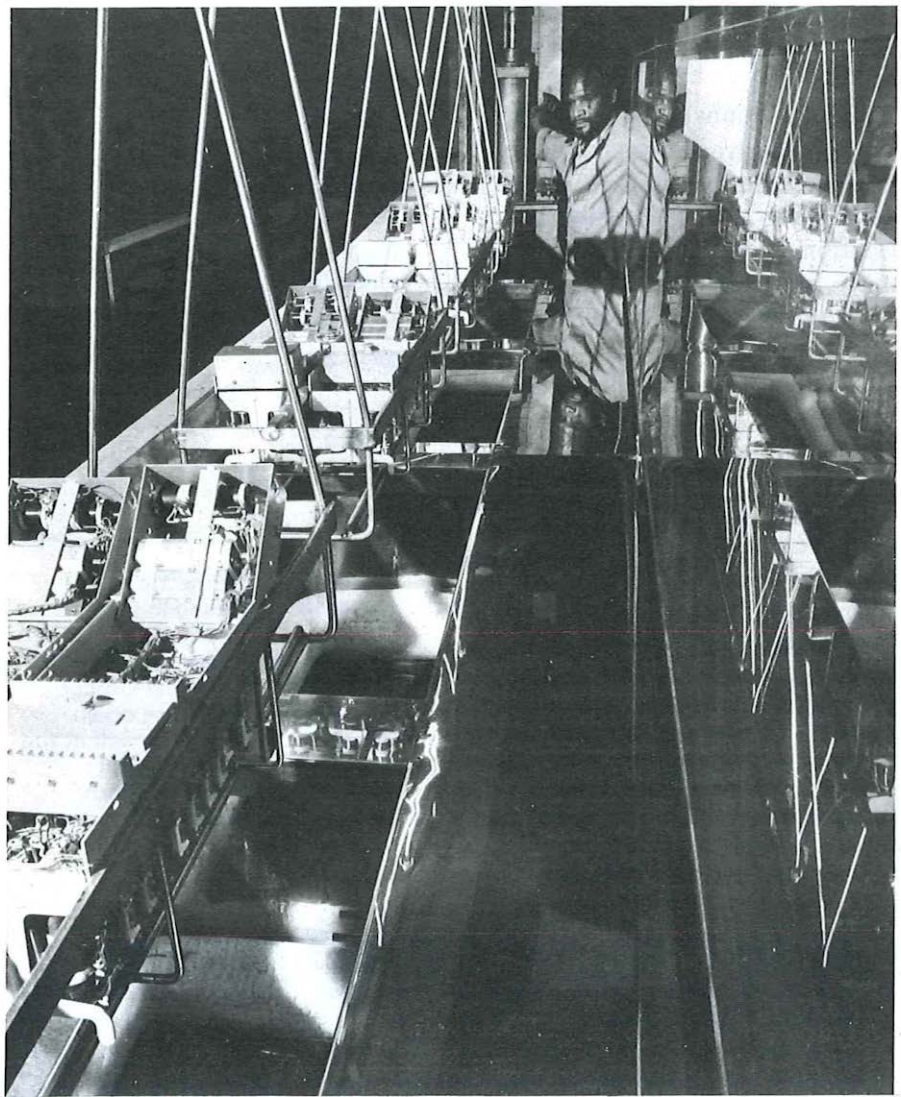
High pitched sound waves which are used to agitate special cleaning solvents form the basis of a technique being used by the Post Office to clean sensitive telecommunications equipment.

IN RECENT years more and more organisations have become aware of the economic advantage of using ultrasonic techniques for metal and plastic welding, drilling, soldering and cleaning. The Post Office is no exception and for some time Factories Division has been using the method which not only cleans complicated items like relay sets, teleprinter units and coin-box assemblies more efficiently but also reduces costs.

It works like this: An electric ultrasonic frequency generator drives a transducer which converts electrical energy into mechanical vibration, thus producing high intensity ultrasonic waves in the surrounding medium. The transducers are attached inside a tank containing the cleaning fluid at a suitable temperature.

The effectiveness of ultrasonic cleaning depends on the phenomenon known as cavitation. Vibrations at ultrasonic frequency cause cavitation – that is, vast numbers of cavities filled with fluid vapour are formed continuously during the low pressure half cycle of the wave as the liquid is stretched. These cavities implode violently as the pressure increases on the following half cycle, causing an intense scrubbing action on anything immersed in the fluid.

Ultrasonic cleaning equipment in action. Relay sets held in special basket-like carriers are lowered into the agitated cleaning solvents.



When an object is placed in the liquid the scrubbing action of the vacuum bubbles will detach dirt, dust, acids and grease from its surface. Grease is dissolved to some extent in the cleaning fluid and other dirt is washed out in solid or liquid form in a series of rinses in the fluid and its vapour.

Choice of fluid depends on the properties of the item to be cleaned. Mouldings from recovered telephone instruments, for instance, can be cleaned adequately in a simple water-based detergent solution, but metal components, often heavily contaminated by oil or grease, require the use of hydrocarbon-based solvents, such as paraffin.

Fluids of these types can, however, cause low insulation or chemical attack if used on items of wired telecommunications equipment such as relays and selectors, or printed circuit boards assembled with electronic components. For these items other fluids are now available.

Certain of these fluids have the valuable property of dissolving oils and greases but not damaging plastics or electronic components such as transistors or integrated circuits, provided they are used in a strictly controlled environment. Their low surface tension, specific heat and latent heat give excellent penetration and draining properties, and little heating is required for efficient cleaning and distillation.

However, the low boiling point (47.6 deg C) and high cost of these fluids require the use of well engineered tanks with complex cooling, pumping, refrigeration and vapour extraction equipment.

Cleaning processes are effective at audio frequencies but the noise would be prohibitive. The choice of operating frequency is therefore usually between 20 kHz and 50 kHz, depending on the strength of the articles to be cleaned. Fragile components may be damaged by the use of too low a frequency as the scrubbing intensity increases inversely with frequency.

Generally, electromechanical items are cleaned at 25 kHz but transistors, integrated circuits and similar electronic equipment should be cleaned at higher frequencies. In practice, a compromise has to be reached, based on development trials.

Washing and rinsing sequences can

be automated by arranging a series of tanks mounted in one frame, each with a specific function. A typical three-tank system is shown in the diagram. The tanks are made of stainless steel and the ultrasonic transducers are mounted on the sides or bottoms of these tanks.

Adjacent tank sides form weirs which automatically regulate the amount of liquid solvent in each tank. When the solvent is heated, evaporation takes place, but the vapours are contained within the tank by cooling coils at the top. These condense the solvent back into the tanks to be recycled.

The cooling medium can be cold tap water in small installations but it is usually necessary to employ a refrigeration system in the large commercial plants to avoid excessive losses of solvent. In multi-tank units the boiling liquid is contained in one tank and the recycled solvent is pumped to the first stage to flow over the weirs through the various stages back to boiling.

Dirt removed by the process is deposited in a sump in the "boiling" stage and is drawn off as the contamination builds up. Filtration elements are frequently incorporated in the solvent circulation, further reducing contamination in the active liquids.

Ultrasonic cleaning can be adapted to flow-line production methods, either in-line or as a separate sub-process. A typical cleaning system would normally comprise pre-cleaning to remove heavy oil and grease deposits; ultrasonic cleaning using fluorocarbon solvent; ultrasonic cleaning using fluorocarbon solvent and detergent; a second ultrasonic cleaning using fluorocarbon solvent and, finally, fluorocarbon vapour rinse to dry off the component.

The main advantages are consistent high quality cleaning, with minimum process rejections and high throughput, economic use of expensive solvents and semi-automatic operation by using automatic loading, unloading and inter-tank transfer equipment which can all be controlled by one operator.

While ultrasonic cleaning plant is expensive the savings in time and labour requirements, and improvements in quality of finish obtained, make it profitable provided it is well engineered and fully utilised.

The Post Office's Factories Division (FACD) has, in fact, been using ultrasonic cleaning methods for many years, mainly with water-based detergent fluids for cleaning telephone mouldings and other solvents for the mechanical parts of telephone dials, teleprinters and other non-wired equipments.

More recently, the Process Development Group has been examining the technical and economic advantages of fluorocarbon solvents for wired equipments such as relay sets, selectors, coinboxes and printed circuit boards.

The first prototype production application, using a small plant, was installed in the Birmingham Factory several years ago, to clean recovered uniselector wiper assemblies before blade replacement. Based on the experience gained, a large plant was installed to clean relay sets and selectors, coinbox sub-assemblies and high-speed relays, as part of organised repair flowlines. The result was improvement in cleaning efficiency, substantial cost savings and reduction of tedious manual cleaning work.

A semi-automatic plant is now in daily use at Birmingham Factory. It cleans two large Strowger relay sets or selectors per operation cycle, or an increased number of smaller relay sets and coinbox sub-assemblies.

Carriers to convey relay sets and other telecommunications equipment were designed in FACD. The plant was made and installed by a specialist contractor but FACD undertook commissioning, process sequence and additional safety engineering.

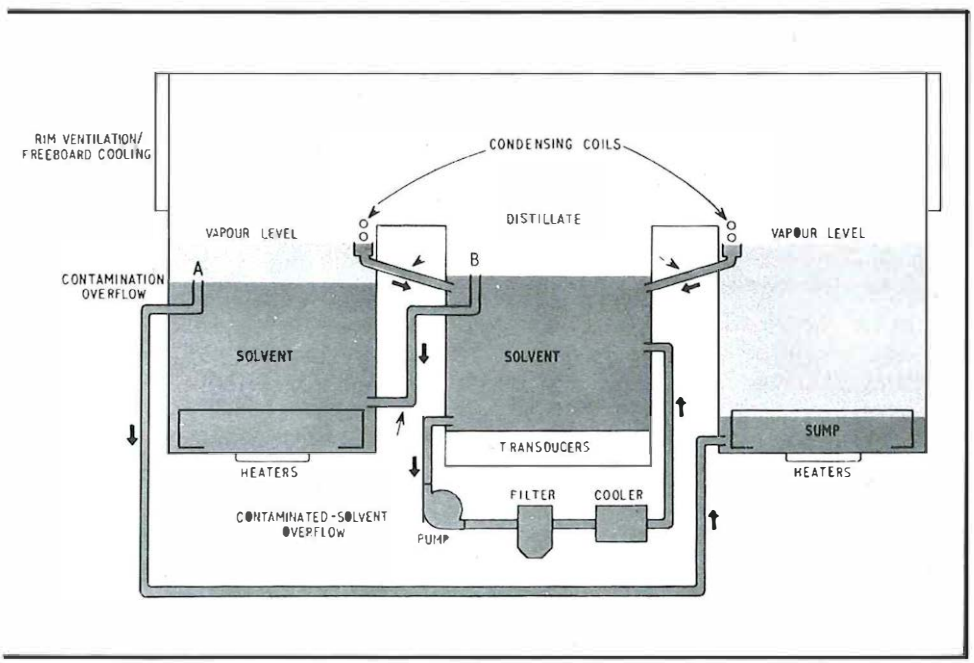
Trials using an additional distillation stage for purification of the solvent while it is circulating in the plant during operation have proved satisfactory, and the plant has been modified for continuous reclamation and re-cycling of pure solvent back to the cleaning stages. This has resulted in further economies in fluid consumption.

Consideration is now being given to the installation of a second and larger plant at the London Factory, initially to replace the manual cleaning methods which precede Switchboards PMBX 2/2, 2/3 and 2/4 and Key and Lamp Unit flowline repairs.

Further plants are in the planning and installation stages for cleaning printed circuit boards after a flow soldering operation, and to remove dust and grease from various electronic units prior to servicing and repair.

Throughout the development and commissioning of these cleaning plants close liaison has been maintained with the suppliers of the fluids, the manufacturers of ultrasonic equipment and the Occupational Hygiene and Organic/Inorganic Materials Testing Groups of Post Office Purchasing and Supply Department, to ensure protection of personnel from any risk to health. Adequate extraction arrangements for the removal of solvent vapour from working areas is of prime importance in the control of the working environment.

A typical three-compartment ultrasonic process plant.
The treatment cycle would normally be to pre-clean the part in boiling liquor, treat it ultrasonically in cool liquor and then a final vapour rinse.



Mr S. T. Fletcher is head of a group responsible for the development of repair and manufacture processes and machine tools in Factories Division of Purchasing and Supply Department.
Mr A. Jarvis is an Executive Engineer in the same group.

Screened information- at the touch of a button

S Fedida

The Post office is beginning a pilot trial of its computer based information system, called Viewdata. The service is designed to enable telephone users at home and in the office to call up information on a variety of subjects for display on their television screens.

THE IDEA of settling into a favourite fireside armchair on a bleak winter night, switching on the television and using a hand-held keypad to summon up on the screen information about next year's summer holiday is a thought to lighten even the darkest evening. And the chances are that a service to provide this data and many other kinds of information could become a reality within the next few years.

The secret is Viewdata – a system developed entirely by the Post Office and which, in the words of Chairman Sir William Ryland, "adds a new dimension to communications". As well as helping to select holidays the system is capable of providing topical information on news, sport, broadcasting programmes, cars, mortgages, insurances and many other topics ranging from what's on at the cinema to the state of the Stock Market.

It may also fulfil the function of a library to supply reference information requiring relatively infrequent updating, such as timetables, directories, recipes and do-it-yourself instructions. Simple sketches, diagrams and maps can also be displayed, while up to seven colours can be used to give added impact to words and drawings.

Basically Viewdata is envisaged as a network of computers that are interconnected and programmed so as to be able to support the variety of information and communications services of interest to people at home and to the professional user in his office. This computer databank is connected to the public telephone network. All the customer needs to gain access to it is a standard television receiver adapted to receive and display the information by way of the telephone.

To obtain information, users switch on the television and then call up the service they require over the telephone. This could eventually be achieved by pressing a button on the hand-held control unit avoiding the need to lift the receiver. Then, at another touch of the button the opening display – an index listing the subjects on which information is available – appears on the television screen. Following simple instructions displayed on the screen, users select the information they want by pressing further buttons on the control unit.

The display is cut off and the call ended, again eventually at the touch of a button. As an alternative to a domestic television, business users could have a purpose-made terminal with built-in controls and telephone. When not in use for Viewdata the telephone can still be used for making and receiving telephone calls.

Basic equipment for a home user of the Viewdata service. Information can be displayed in up to seven colours.

Independent agencies would be responsible for providing the information displayed on Viewdata and would supply it in a form suitable for direct use by the system.

Viewdata is an additional information medium, complementary to existing ones but fulfilling an important need not at present fully satisfied. The concept arose during a study undertaken in the Computer Research Applications Division of the Post Office Research Department on the extension of Viewphone to provide alphanumeric information display facilitics.

It became clear early in the study that the technologies required to support a viable visual information service were in fact at hand and could be

implemented on a nationwide scale within a much shorter time scale than could be envisaged for the Viewphone – and at a considerably reduced cost.

The major impetus in the development of Viewdata was the urge to provide a new and useful service to the public which would at the same time stimulate utilisation of the vast capital investment of the Post Office in telephone plant, a large part of which is relatively little used during evenings and weekends.

Increased use of telephone plant outside peak hours would clearly result in more revenue at little extra cost.

For this reason, from the beginning the design of Viewdata has been based on the premise that it must use the existing telephone switching systems of crossbar, Strowger and electronic, current and proven modes of data transmission, and the totality of the telephone plant in its present form. Only then could it be hoped to introduce Viewdata to the public in a reasonably short time and without the trauma of extensive modifications to operational equipment.

That this latter objective is technically feasible has been demonstrated in the experimental system now running from the Post Office Research Centre at Martlesham Heath. Trouble-free access to it using the public switched telephone network has already been demonstrated from a number of widely spaced geographical locations in the United Kingdom.

More extensive tests of the system are planned during a pilot trial this year and next which will enable the Post Office to determine the range of information to be provided, establish charges for the service and assess the likely demand.

The use of computers for making diverse information available to a variety of users is of course not new. Many information systems based on individual computers, and some on computer networks, have been established during the past decade, and most are successful, albeit in limited and specialised fields.

These have been established mainly for the benefit of the specialised professional and involve considerable outlay in cost. They also involve much training on the part of the customers, in order that they become proficient in their use.

From the start all the component parts of Viewdata were examined to ensure that they would knit together into a viable arrangement capable of meeting user's requirements in the most economical and convenient way. Hardware and software problems were considered together and at all times the foreseeable needs of the users were kept firmly in focus to ensure that the man was not constrained by the machine to adopt unnatural modes of communication and operation.

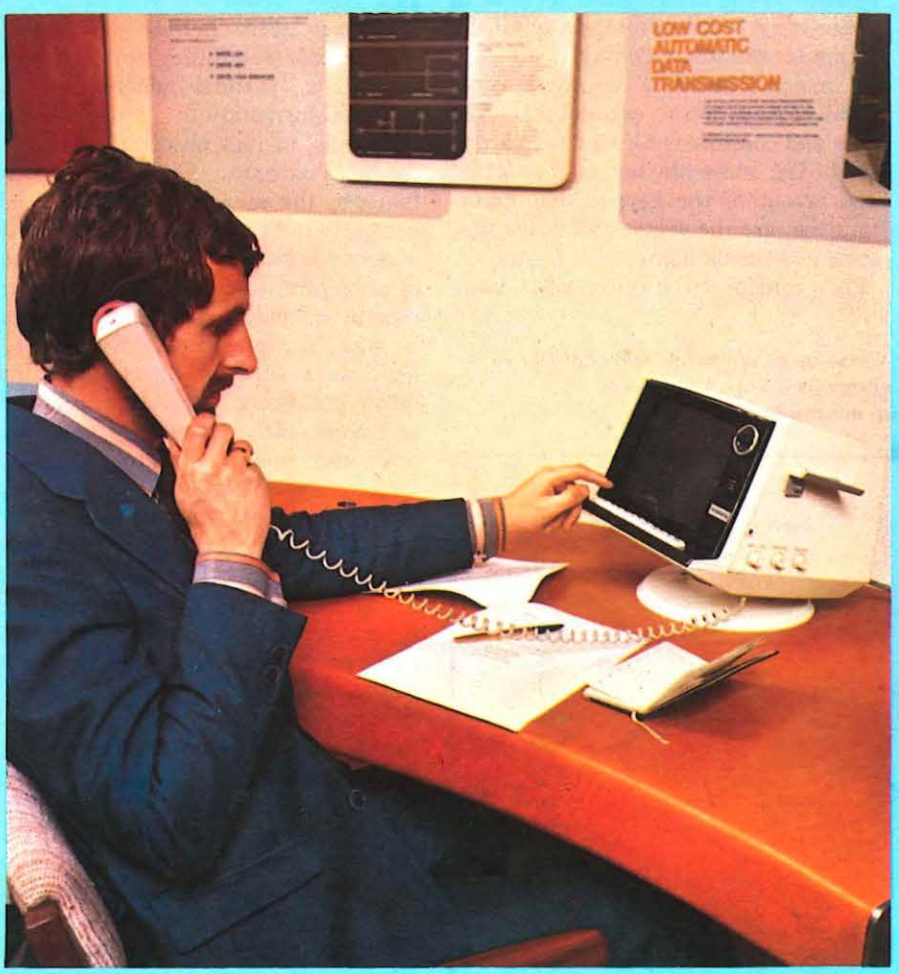
In considering the overall system it was necessary to devote attention to the receiver, the computer, the computer software and protocol – the rules which govern access to and use of a computer – the communication network, the information base and related communications possibilities and ergonomics of system usage. All these aspects, together with their complex interactions, were considered in detail and taken into account in the definition of the initial system, which formed the experimental basis.

The other major departure of Viewdata from earlier attempts at establishing computer based information systems was in the organisation of the information and the design of the computer software and protocol to support such an organisation.

It was obvious from the outset that if Viewdata was to make an impact on the public, the receiver would have to be economically priced, readily available and suitable for use by customers at home. Conventional computer terminals are not suitable on most of these counts, and while visual displays are clearly much more acceptable they are too costly in the form readily available for computer connection and much too daunting for use in the average home.

On the other hand adaption of the domestic television receiver was found to be eminently practicable, and given a sufficient production volume could be done at only a fractional increase in the cost of the receiver.

At about this time also the BBC and IBA were engaged on a study of broadcast teletext information systems, CEEFAX, and ORACLE, and it was soon obvious that Viewdata and teletext were more complementary than competitive. By choosing compatible display formats and character codes for these services, the domestic television receiver became firmly established as ▶



Mr Malcolm Smith of Telecommunications Marketing Department demonstrates a specially designed Viewdata terminal with built-in controls proposed for business users.

the ideal information receiver for use in the home. The small control panel is a feature of Viewdata and further enhancements could include an audio cassette recorder, for accepting several pages at a time from the system, storing them locally and replaying them without having to maintain an open telephone connection to the Viewdata computer for long periods. This could prove particularly useful for such items as recipes or extended lists of stocks and shares.

In order that Viewdata should appeal to the general public it is necessary to provide a broad coverage of information needs and to meet the wide requirements of a potentially diverse user population. This may be done adequately at reasonably low cost, even with fairly small computers, at the same time providing detail to satisfy users.

Current thinking on the information capacity of a local Viewdata centre envisages a data base of the order of 20,000 to 40,000 pages. This is a very large amount of information by any standard, although much market research will need to be carried out to determine the optimum scope and depth of treatment.

The system's appeal is also likely to be greatly enhanced by some of the additional services that could eventually be supported by the system, particularly message services. A calculator service of interest to students and small business users could also be supplied by the system.

It is part of the total system concept that the information structure has been designed to use a small amount of computer processing time. It is essentially a disc-based input/output operation. The interactive services already mentioned thus provide a useful balance to the information services in achieving a better utilisation of all the computer resources available.

A major feature of Viewdata is its detailed attention to ergonomics – the ease and comfort with which it can be used. The most obvious is the design and layout of the keypad but important too, are the access and usage protocol and the dialogue.

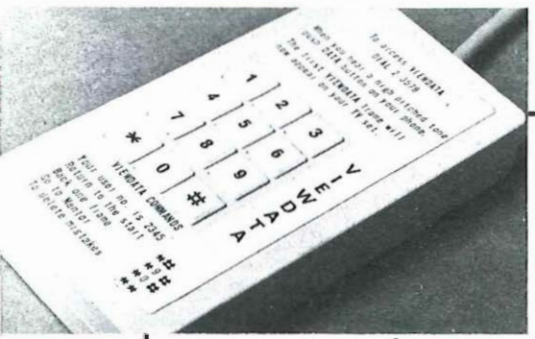
The protocol is the set of rules, procedures and instructions which govern access to and use of a computer. For the professional using a specific computer for a limited range of activities, the protocol presents no long-term problem. Only short-term problems remain, which given the enthusiasm of dedicated computer users is usually solved in time.

This approach is clearly quite unsuitable for the majority of Viewdata users, who cannot or would not submit to the extensive training needed to understand and memorise a conventional computer protocol. Nor would they have the opportunity of practising the protocol often enough for it to become second nature, and consequently tolerable. They would not wish to have to remember every minute detail of it nor, indeed, would they be prepared to consult a manual whenever they needed information.

There is, in fact no computer protocol in Viewdata. The action to be taken by the user seeking information is clearly indicated on the screen. The dialogue is based on a well defined set of principles which include guiding the user by offering him a choice of what is available, providing information a little at a time to avoid confusion, being consistent in all presentations and commands, keeping explanations brief and simple, avoiding computer jargon, and always giving guidance regarding the next action.

The information structure is, in fact, extremely simple for the user. It is based on a tree structure, the top representing a main topic of information and giving access to sub-divisions of the main topic which are classified either on a logical or alphabetic structure. Thus the user is guided gradually to home on the particular item of information he is seeking.

This, then is Viewdata. Of course it is still early days but already the indications are encouraging that a cost effective system which gives every promise of having a considerable impact on the information and communications needs of modern society has been created. This exciting prospect will be subjected to intensive evaluation during the current pilot trial and forthcoming public trial planned to begin late next year which, if successful, should lead to the opening of a public service during the second half of 1978.



Left: Close-up of the hand-held control unit with which Viewdata users call up information.

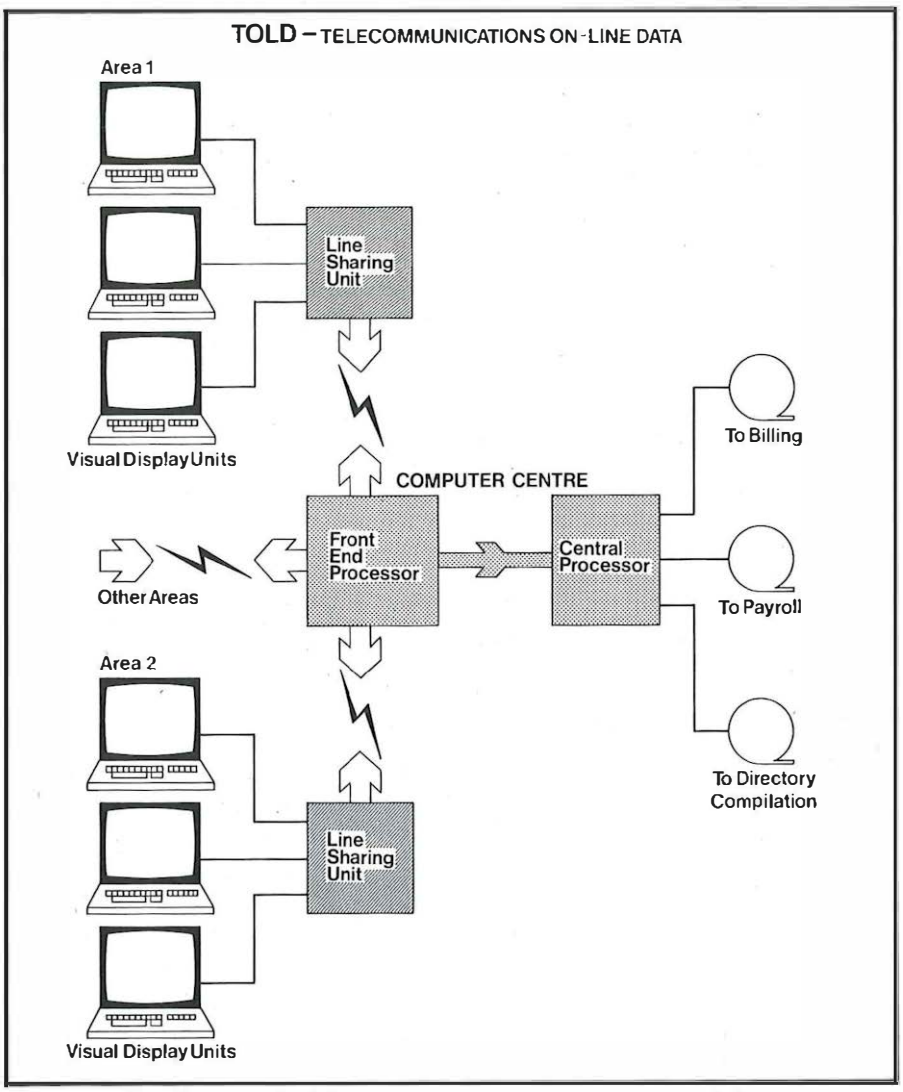
Mr S. Fedida is head of the Computer Applications Division in Post Office Research Department and was the originator of the Viewdata concept.

PO Telecommunications Journal, Winter 75/76

Now it can be TOLD...

LV Reinger

Telecommunications On-Line Data (TOLD) is a new system providing multi-purpose computer terminal facilities in Telephone Area and Regional offices, thus bringing computers one step nearer the staff who use them.



COMPUTERS have been used by the Post Office for many years in the preparation of telephone bills, payroll, telephone directories and stores re-ordering schedules as well as many other jobs essential in the planning and operation of the telephone service.

Most systems so far devised have relied on office staff in Telephone Areas and Regional offices to complete forms with the detailed instructions necessary to update the computer records. These records may require updating weekly, as in the case of payroll where overtime, tax, staff substitution or other details regularly change and affect pay.

There are several Post Office computers, each handling a particular type of output, and about 100 Telecommunications offices sending input. Therefore a large amount of important information has to be despatched quickly and reliably in an extremely tight timetable.

At a computer centre written information on the forms is converted into punched cards which the computer can read quickly. Occasionally, of course, the written information – commonly known as data – may be incorrect, ambiguous or illegible and this leads to the computer questioning the validity of the input or producing worthless results which then have to be corrected manually.

But now a system is to be introduced nationally which brings computers closer to the staff who use them. Known as TOLD, the Telecommunications On-Line Data system, it has been developed especially for the Business and enables data to be collected on-line from local offices with little intermediate preparation of forms and without any punched cards. Instead, a clerk or supervisor can type information on a keyboard and see it appear on an associated visual display unit (VDU) before it is transmitted direct to a TOLD computer.

The system does not affect the way data is processed and output will continue to be provided by the same systems and computers as used at present. TOLD merely replaces the present input arrangements and allows local staff who collect the original data to be in control of its processing.

There are several parts that together comprise the TOLD system. First there are the VDUs, which are situated close to staff in the pay groups, accounts groups and cash groups throughout the office. The VDU has a screen similar to a conventional television set but provides a display of up to 2,000 characters in a format of 25 lines each of 80 characters.

Each VDU is capable of handling all the different types of data collected by computers. Security keys issued to staff each allow access to one particular computer system and each key ensures that only bona fide instructions and data for that one user system are accepted by the TOLD computer.

When the key has been inserted in the VDU the computer normally responds by presenting on the screen a choice of formats available for input. Formats are similar to ordinary paper forms with spaces marked out for clerks to insert data, character by character, using the typewriter-like keyboard. The selected format is presented on the screen and the clerk is ready to transfer data from source documents.

A marker, known as a cursor, which consists of two flashes above and below each character, shows automatically where the next entry should be made. Mistakes can be corrected by moving the cursor by means of another set of keys at the side of the keyboard to the offending item and writing over it. Completion of a screen of data is followed by transmission to the TOLD computer centre which is simply done by pressing a "send" key.

Data is vetted at the centre immediately and if there is an error the screen ▶

of data is returned with the mistake identified. Vetting continues until the data is completely acceptable. It normally takes about five seconds for the computer to respond to any message from a VDU.

Each Telephone Area and Regional office will be equipped with several VDUs – about 15 in large Areas. For most offices all the VDUs will be connected to their TOLD centre by a single telephone circuit. This will be achieved by connecting the machine through a line sharing unit – a device for arranging the VDU signals to use the full data carrying capacity of the circuit. The circuit will be a private wire link and modems will be provided at both ends to convert signals into a form suitable for transmission.

The TOLD system will be controlled from two centres – at Harmondsworth and Leeds – where a mini-computer will handle communications with the VDUs and organise the transfer of data to a main-frame computer for vetting and storage on magnetic discs. Staff at the centres are responsible for loading the computer with magnetic tapes, discs and drums for the operation of the various user systems.

About half the local offices will be connected to each computer centre. Scottish and Northern Ireland offices will be connected to the Harmondsworth centre which can provide a year-round service, including English Bank Holidays.

A new private wire network known as ICON (Inter Computer Centre Network) is being installed to link the centres at Harmondsworth and Leeds to each other and to several other processing computer centres throughout the country. Most data will be sorted daily at both TOLD centres and then transmitted over the appropriate ICON link set up by another mini-computer to the required processing centre. ICON will ensure that processing of most data will be completed at least a day earlier than previously possible.

With the large volume of data passed to the TOLD centres daily, organisational problems are immense. The system is designed to be very reliable but faults on equipment or circuits could prove disastrous if adequate contingency measures were not taken. If a private wire fails data will, in fact, be switched via the public network, although the VDU response may be slightly slower than usual.

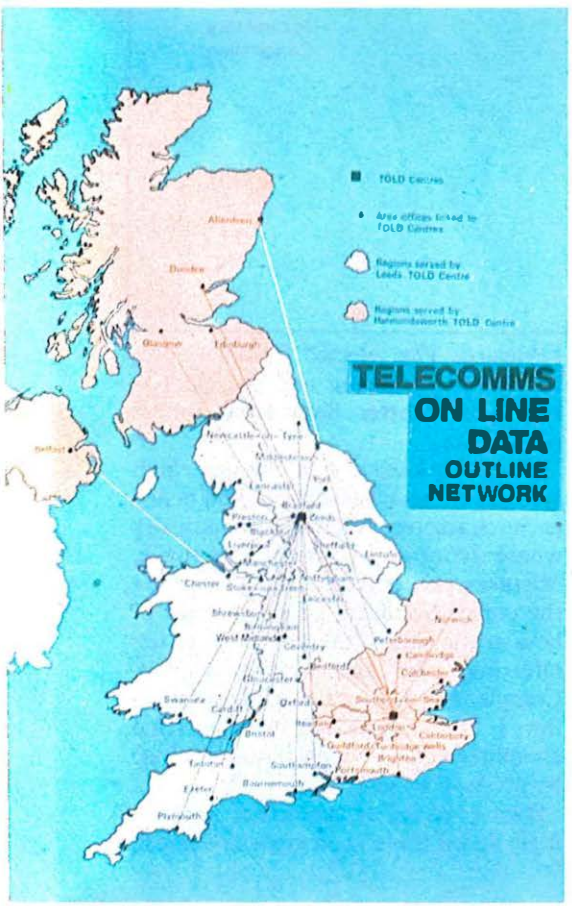
Computer breakdowns will be dealt with by diverting data to similar computers which would otherwise be processing less urgent batch work at the TOLD centres. If necessary, VDU breakdowns will be handled by arranging input on other users' units. Spare maintenance VDUs will be provided to replace a unit withdrawn from service for repair.

Let us now consider some of the many advantages of TOLD over more traditional data collection methods. First, as data is passed directly between offices and the computer centres, communication is quicker, thus giving extra time for collection of late data without exceeding processing deadlines. Second, as there are no intermediate stages of data preparation, local staff have control and are solely responsible for completeness and accuracy of data being input.

Another advantage of the system is greater accuracy, as data is passed direct to the computer without data conversion. And with special on-line vetting by the computer, errors can be corrected immediately.

Once basic operating procedures are mastered the system is easy to learn. Minor changes to formats are quickly incorporated and, as instructions can be included on the screen, major staff retraining is avoided. The quiet and unobtrusive nature of VDUs make them suitable for office use without providing special accommodation.

The development of TOLD provides an



An operator uses the new style visual display unit (VDU) and associated keyboard to send information to the TOLD computer.

excellent example of how a business can effectively use Post Office data facilities in the management of its computing resources. Several major processing systems have been designed to use TOLD input from its outset. Many other applications are planned to start in the next few years.

Payroll is one of the first systems to use TOLD, weekly input being greatly simplified by the special data checks that are carried out automatically before processing. Experience gained from experimental use of VDUs for payroll input in Southampton Telephone Area (Telecommunications Journal, Autumn 1973), and other trials still running in Oxford, Middlesbrough and West Area in London, has been used in the development of TOLD.

With the introduction of the new Pay and Related Information System (see this page) TOLD will extend the time available for input without affecting the overall turn-round time. About one third of the payroll may be processed earlier than at present.

Another system, which enables telephone bill payments to be ledgered on the billing computer more quickly, is already under trial in two Areas. As a result, fewer unnecessary reminders should be issued to customers and billing queries may be answered much more quickly and reliably.

Compilation of directories has been computerised for some years, but on-line vetting and collection of data by TOLD will considerably reduce the laborious daily checks of input listings. A trial began recently in Oxford Area. By processing locally the films of meter readings and using TOLD to input from the negatives, customers' bills can be sent out with as many as four extra days of dialled call charges included.

It is expected that TOLD will be developed to improve data collection procedures in the customer services and accounting activities of the Telecommunications Business. It opens up new opportunities for the rapid and reliable collection of many types of computer data, and an increasing number of staff will come to regard it as an essential aid in their dealings with computers. The system is a major step towards bringing computers within easy reach "at the touch of a button".

Mr L. V. Reinger is a head of section in Telecommunications Management Services Department and has had overall control of the TOLD project since its inception.

...and PARIS in the summer

RV Franks

An improved computer payroll system known as PARIS will be introduced into the Telecommunications Business in July. It makes full use of the TOLD system described in the preceding article.

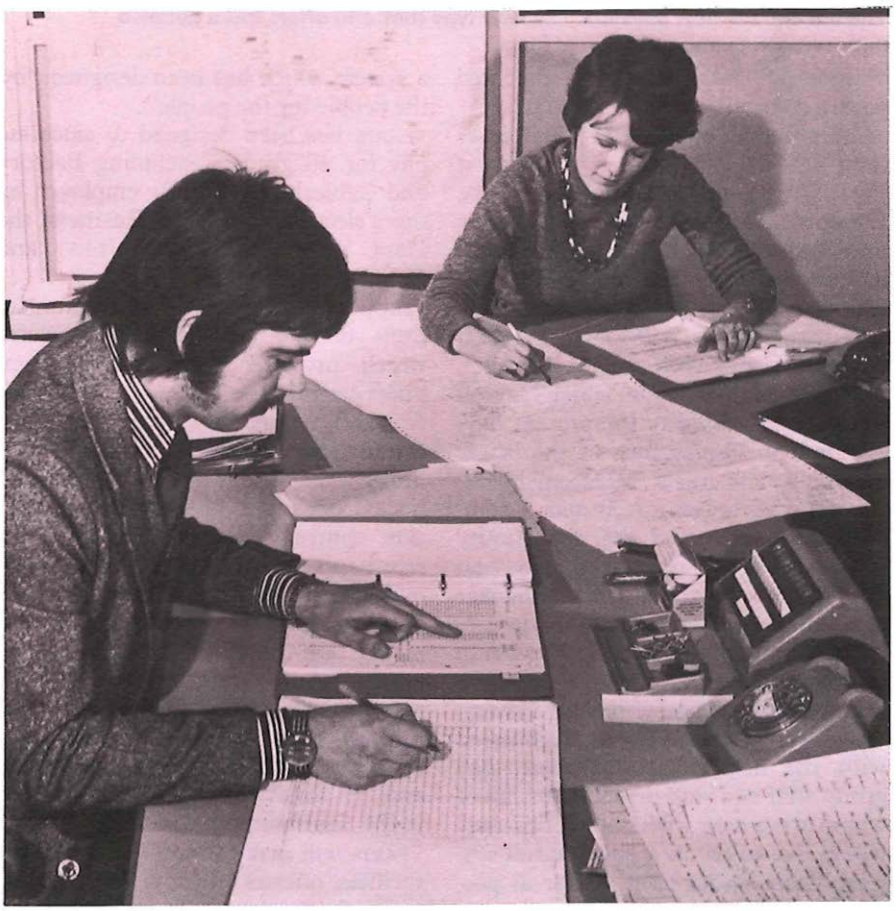
THE COMPLEX task of preparing the payroll for the quarter of a million people who work in Post Office Telecommunications is soon to be performed by a new computerised system. This system – known as the pay and related information system (PARIS) – will be introduced next year and bring with it many new facilities which can be used with payroll.

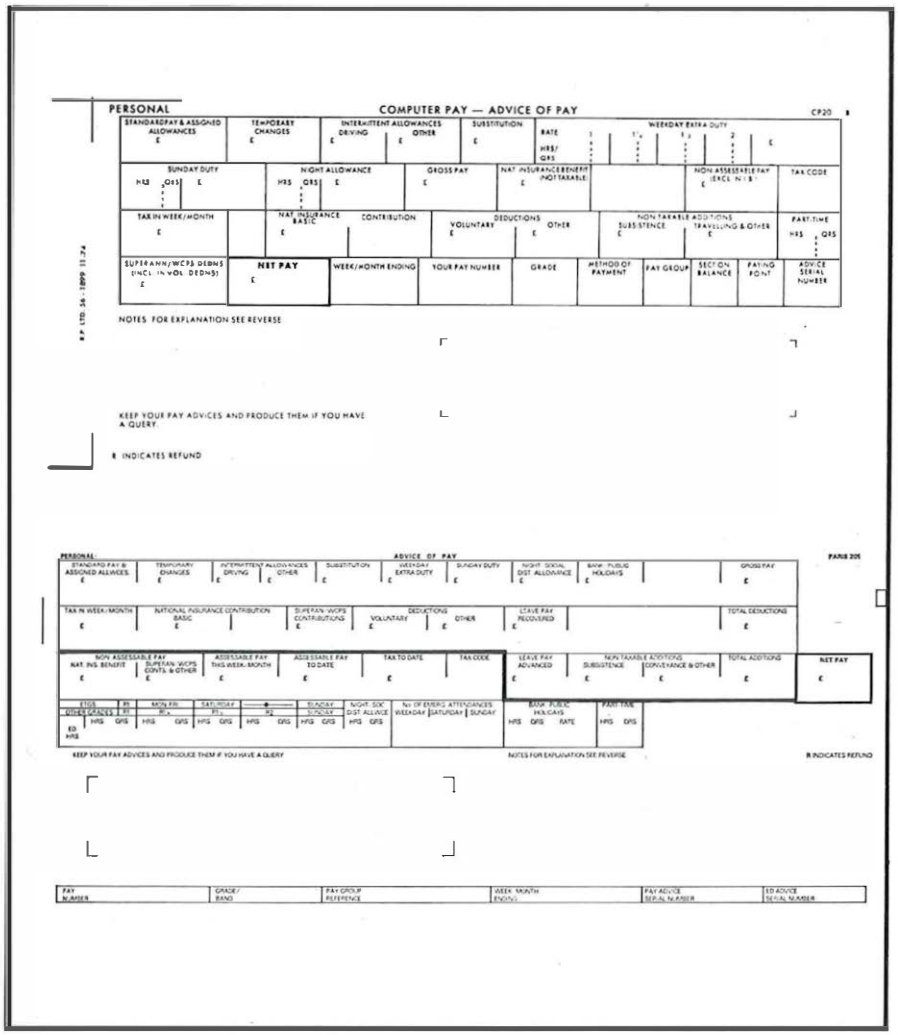
The Post Office Telecommunications payroll involves the issue of more than nine million pay advices to its staff, in a year. These pay advices, however, represent only part (albeit an important part!) of the payroll process, the complexity of which is often underestimated by those who are unfamiliar with it.

The large number of staff employed by the Telecommunications Business and the range of grades (with their various conditions and allowances) represented within it, means that its payroll system must take many variables into account.

Results produced by the payroll system must be absolutely accurate and the whole payroll operation, including the processing of a considerable▶

Executive officers check through the computer printout during trials of the new pay and related information system.





The old and the new payslips: The new type (bottom) offers more detailed information in an easier-to-read form.

volume of data, must be executed within a strictly limited time scale.

Computerisation of payroll started as long ago as 1959 when, in the first Post Office Computer application, the London Electronic Agency for Pay and Statistics (LEAPS) was introduced in London area offices using National Elliott 405 electronic computers. This was superseded in 1969 by a national computerised payroll system using ICL Leo 326 computers on which payroll has been processed to the present day.

Imminent obsolescence of the latter machines and their replacement by the more advanced ICL System 4 computers has presented the opportunity for reviewing computerised pay and designing PARIS which is more efficient and comprehensive than any to date.

Work on PARIS began in 1972 when a report was published setting out the requirements of a new payroll system. These requirements were formulated with the help of management, pay group staff and staff associations, all of whom were asked what facilities they would like to see in a new payroll system. Their wishes have, as far as possible, been incorporated thus making it a system which has been designed "by the people for the people".

PARIS has been designed to calculate pay for all grades (excluding Factory and Cableship) currently employed by the Telecommunications Business, the Data Processing Service (DPS) and Central Headquaters.

Input will utilise the Telecommunications on-line data (TOLD) network, which provides multi-purpose computer terminal facilities to Telephone Area offices and other premises on a common-service basis. Visual display units (VDUs) in pay groups will be connected on-line to a TOLD data collection centre. This method of input represents a significant improvement over the former paper tape (LEAPS) and present punched card input media. On-line input, however, will not be peculiar to PARIS as it is envisaged that it will be used as the input medium for the present system for a short period before conversion to PARIS and has already been successfully used in the Southampton pay group.

PARIS will make the fullest use of the facilities offered by TOLD. The elimination of intermediate punching operations and the introduction of interactive vetting of input on the VDU screen will give a faster input with minimisation of input errors, resulting in a payroll output requiring fewer manual alterations. PARIS will incorporate more sophisticated screen checks than will be available on VDUs for the present system, thus introducing a high degree of flexibility and control into the checking of payroll input.

After acceptance by the TOLD data collection centre, input will be transmitted via an inter-computer on-line network (ICON) to the PARIS computer centres.

A later input cut-off time will be made possible as PARIS will process on a section balance (that is, division of a pay group) basis as opposed to on the pay group basis of the present system. This will mean that pay groups need no longer wait until their last section balance is complete before processing can begin. The input cut-off time can therefore be extended from Monday evening to mid-day Tuesday for many section balances, thus reducing pressure in pay groups and allowing more time for accommodation of late changes – again saving work.

PARIS will contain a facility for the automatic calculation and payment of arrears of standard pay and extra duty caused by retrospective pay revisions: standard pay will also be increased automatically as in the present system. In practical terms this will mean that the laborious task of calculating these arrears manually will be removed from pay group staff and that the arrears will be received by payees at the same time as pay is increased, not some time afterwards.

This facility represents an entirely new concept in payroll computing and it has been made possible by the introduction of a carefully designed historic file (held on the computer) of pay information which will feed off the main payroll system. The use of historical data to produce results of the accuracy required for payment of wages and salaries has presented a challenging task involving the resolution of numerous problems. This pay revision facility (which forms a sub-system) has been designed within the framework of PARIS so that the minimum of special input will be required to make it effective. Despite its complex nature great care has been taken in its design to ensure that it can be easily operated by pay group staff within the normal payroll cycle.

The part of the payroll system closest to most people's hearts is the pay advice. The present pay advice has

been criticised on the grounds that it has no apparent logical order, the net pay figure is difficult to find and it is not sufficiently informative. While these criticisms are, in the main justified, it should be noted that there have been many major payroll changes during the lifetime of the present system, some of which have been quite difficult to accommodate.

The new pay advice will attempt to overcome all the shortcomings of the present pay advice. The layout will have the logical order of build-up to gross pay (first line), deductions (second line), non-taxable additions (third line) and net pay in a prominent position at the end of the third line. PARIS will provide a range of 51 pay advice notes – compared with the 19 of the present system – with amounts and dates where appropriate and, if these should be insufficient, special messages may appear. Cumulative totals used in PAYE calculations will also be shown. Additionally, for salaried payees, a summary will be produced showing each week's extra duty separately.

The benefits of the new pay advice will be to give payees more information in a more logical manner thus reducing the number of queries that need to be dealt with by staff in the various pay groups.

Many other innovations, designed to give a better payroll service, include facilities to transfer payees' records automatically, to produce computer printed documents instead of some which are completed manually at present, to calculate superannuation contributions automatically and improvements in layout and information shown on output documents.

Improved payroll analyses will be produced with a far wider range of analysis codes than at present. Management information required by Telecommunications Pay and Grading Department will be provided by a personnel information from payroll (PIP) sub-system. Extensive audit requirements, both internal and external, have been built into the system giving the security which a payroll system must possess.

Implementation of PARIS is scheduled to begin in July this year and currently exhaustive systems trials are being carried out by Telecommunications Finance Department (TFD) in conjunction with DPS. The system will be introduced in two pay groups in a two-month pilot scheme, running in parallel with the present system. This will provide an opportunity for all interested parties to recognise PARIS as a satisfactory and efficient system. These will be the only offices where the two systems will run concurrently.

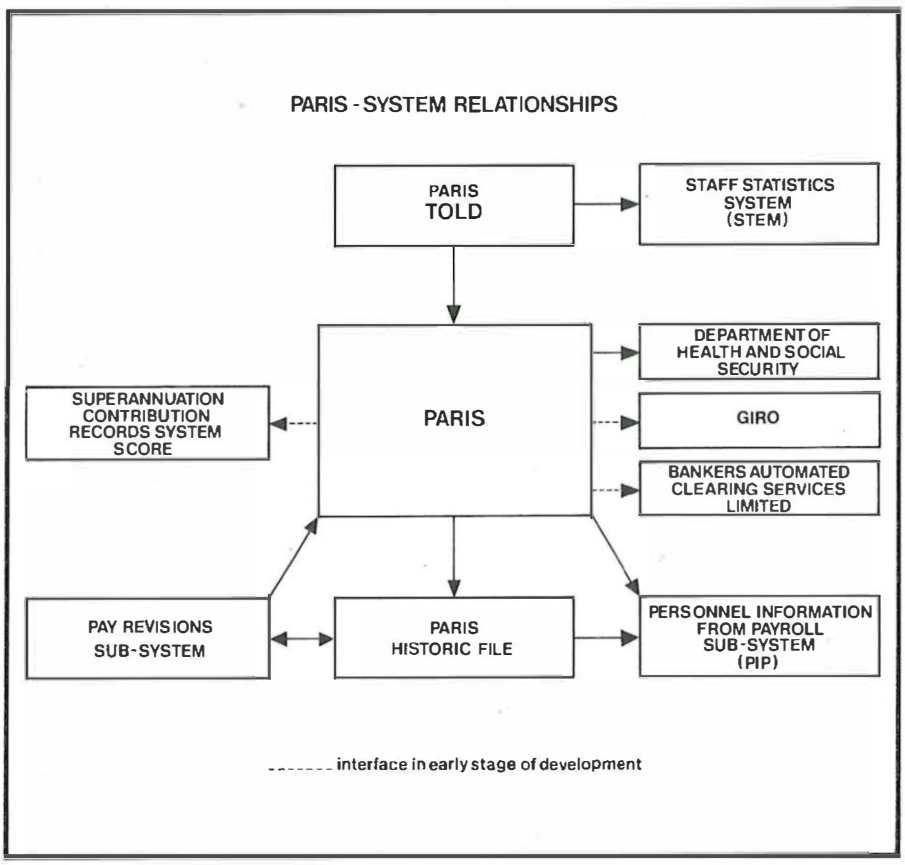
Once the pilot runs have been completed national implementation will begin in October and is scheduled to be completed in December 1977. Implementation will be achieved by a progressive conversion of payroll files from the 326 computers to the System 4 machines using a standard interface assembler. These conversions will be carried out in monthly cycles, in general one pay group per region being converted each month. And as conversion will be from one computer system to another some of the traditional problems associated with conversions from manual to computer systems should be avoided.

The order in which pay groups will be converted will be determined largely by the order of implementation of TOLD, as it is envisaged that pay groups will have had VDUs installed for three months before conversion to PARIS. This will allow pay group staff time to familiarise themselves with the new input medium before learning the new procedures. Training material and courses are being prepared by TFD which is also arranging seminars for management and staff associations interested in the project.

In keeping with the growth in computerisation, both within the Post Office and outside, interfaces between PARIS and various other computer systems are being developed. Perhaps the most significant of these is the interface between PARIS and the staff statistics system (STEM). Some of the data held by STEM is common to PARIS and it is obviously advantageous for STEM to be updated by the relevant input of the PARIS system.

A magnetic tape transfer interface will exist for sending end-of-year returns to the Department of Health and Social Security. Similar interfaces with Giro and the Banks, as well as with other internal Post Office systems, are in the early stages of being developed.

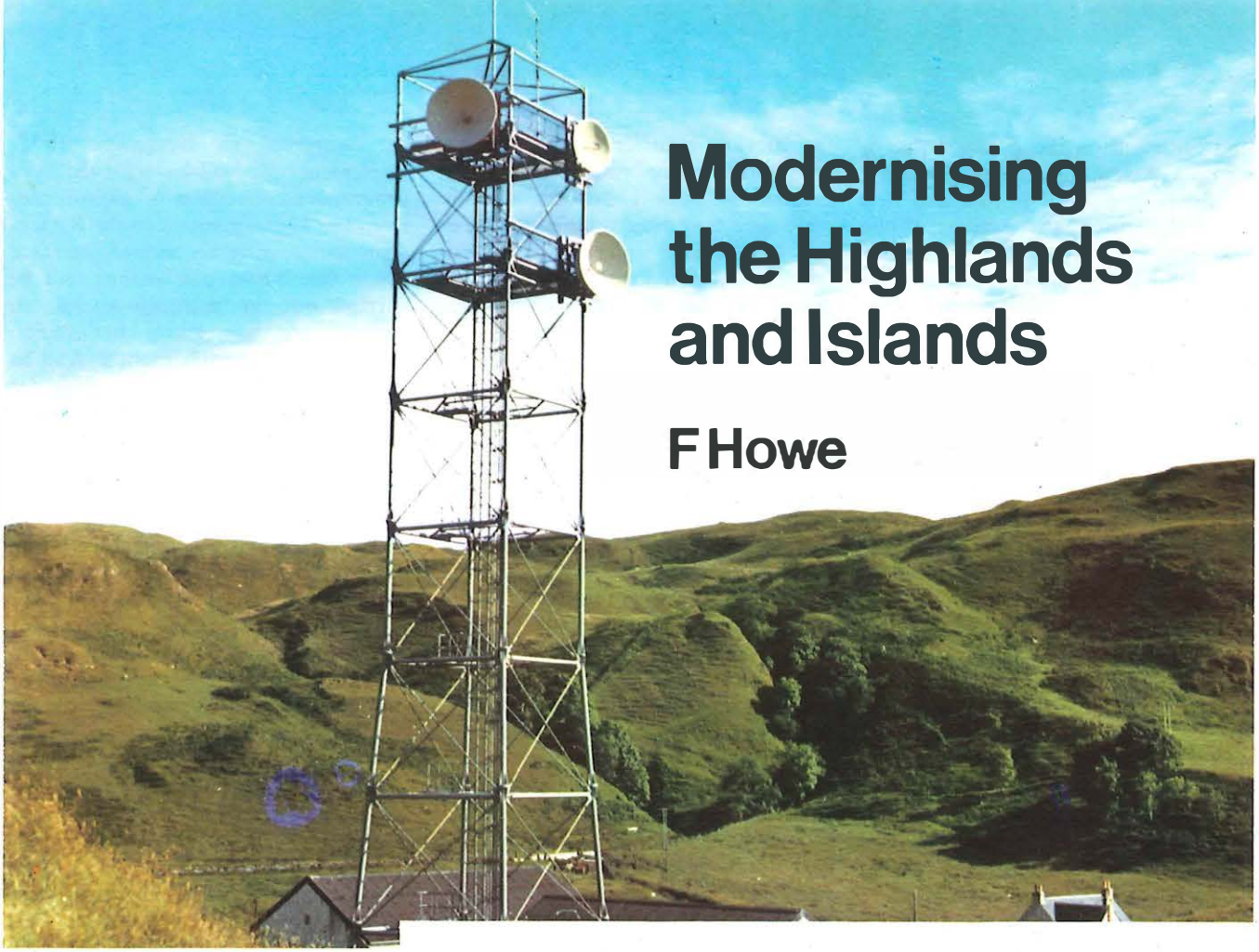
What of the future? Although PARIS will be a more powerful and sophisticated payroll system than any to date the need for change is never far removed from payroll and the rate of change seems to be increasing as time goes on. PARIS, as a robust system, should be capable of accommodating many changes when necessary and enhancements will be made to the system once in operation.



Mr R. V. Franks is a Higher Executive Officer in the PARIS project team in Telecommunications Finance Department. He is an associate member of the British Computer Society.

Modernising the Highlands and Islands

F Howe



Six-channel aerials tower above the radio station at Gallanach Beg. The station serves nearby Oban, with links to Mull and Kingairloch.

Automatic telephone service has been brought to a vast, sparsely populated area of Scotland by an extensive scheme of exchange and lines modernisation.

WHEN the Post Office's most northerly telephone exchange, Baltasound on the Shetland island of Unst, switched to automatic working in 1974 it became one end of the longest subscriber trunk dialling link in the United Kingdom. The changeover from manual working meant that, for the first time, lighthouse keepers off the remote Scottish island of Muckle Flugga could dial direct the length of Britain to their colleagues on Alderney in the Channel Islands.

Even more important, however, the opening of Baltasound's small automatic exchange marked the closure of the last manual switchboard in the Shetlands and another major step in Post Office plans for modernising the telephone system in the Highlands and Islands of Scotland. This vast sparsely populated area has only a few small towns and villages and crofting communities. It also includes some 700 islands off the Scottish coast, of which only about 150 are inhabited.

In 1965 when the initial report on modernisation of the Highlands and Islands telephone system was prepared there were still 55 manual exchanges in the area. Many of these were small CBS2, magneto and even country satellite type exchanges which would eventually have been converted to at least U12s, given the availability of such things as mains power and adequate junction provision.

A common situation at that time involved elderly people who had operated switchboards in their own homes, giving long and faithful service on a 24 hours a day basis and who wished to retire. In most cases it was impossible to find younger replacements, which in any case would have meant moving switchboards to other houses. Given adequate notice, these situations could have been met by normal provision of a building housing a single unit U12, but frequently resort had to be made to the hurried provision of a mobile unit automatic exchange (UAX).

The exchanges of various types were parented on larger manual switchboards – for example, at Stornoway and Lerwick – and there was no STD facility at the UAXs. Junctions between the exchanges and, indeed, the main network circuits, were a miscellaneous mixture of systems which had been introduced over the years. The necessarily devious routing of some calls between exchanges situated close to each other, and the variety of transmission and exchange systems meant that transmission difficulties and complaints were not unknown.

Maintaining such a network required engineering staff of high calibre, whose expertise had to cover a wide variety of equipment ranging from subscribers' apparatus, UAXs and manual exchanges to carrier and radio systems. In many instances the staff also had to work in isolated conditions without immediate assistance, and they developed a resourcefulness which was often called upon to solve difficult problems. Operating staff at the manual exchanges played an important part, using their local knowledge to co-operate with the engineers in keeping the service going.

This then was the situation that the Highlands and Islands scheme set out to alter, to bring an efficient automatic telephone service to the area and to cater for growth in the system. The two distinct parts of the scheme were an exchange equipment modernisation programme and a lines modernisation programme.

A total of some 22 group switching centres (GSCs) were proposed in the plan, 19 of these being crossbar (TXK1)

types. The first one came into service in May 1973 at Scourie, and now only two remain to be completed. Auto-manual centres have been provided at some GSCs and STD has been provided at the UAXs. Transit facilities are available at the GSCs and international subscriber dialling will soon become available at some centres.

While a particular GSC was being installed a great deal of direct labour work had to be carried out to convert manual exchanges to UAXs, provide STD at UAXs, and so forth. It was here that the ingenuity of the staff came to the fore. One scheme, for example, enabled UAXs to continue working over junctions already converted for STD to the existing manual board. This enabled work to be done in advance of the GSC being available, and shortened the period necessary between contract acceptance and bringing the GSC into service.

The order of conversion varied. The usual practice was to bring the GSC into service, with a proportion of the UAXs it served being given STD on the day of transfer. The remaining UAXs would then be given STD in the weeks that followed. This allowed a minimum number of staff to be employed simultaneously, and avoided the difficulty of sending staff to a remote location at a time when roads could be snowbound or islands cut off by rough conditions at sea.

Junctions and main network circuits have been provided basically over radio links, some with coaxial system "tails" between the radio station and the repeater stations. The north west area of the Highlands and Islands is linked into the main line network by a long coaxial cable system to Inverness. Other links to the main line network are by existing radio and coaxial links.

Three types of radio system are used in the Highlands and Islands, discounting the old valve-type UHF systems which have almost disappeared from the network. The systems are 300-channel SHF operating in the 4 GHz band and used for junction and main network routes; six-channel UHF operating around 450 MHz and used mainly for junction routes; and single-channel VHF operating around 86 MHz for junctions and customers' lines.

A total of 36 300-channel links were installed by contract for the Highlands and Islands scheme. Radio installation started in October 1970 on a link between Dunoon and Greenock and was finished in May 1973 with the completion of the Dunure (near Ayr) to Campbeltown link. Some 46 towers of two types were erected to mount 6, 8 and 12 foot dishes used on the radio systems.

Propagation difficulties meant that space diversity, needing two aerials for each link at each terminal, had to be introduced on 10 links. Passive reflectors had to be used on four links to ease the problem of siting the radio terminal or to avoid the need to introduce another system. The 300-channel radio equipment provides a one-plus-one system to give one working and one protection channel.

Of the 46 radio stations in the original Highlands and Islands scheme, only two are solely radio stations. Of the others, 31 are joint radio and repeater stations and 13 share the radio and repeater station function with the telephone exchange.

One problem is that many of the radio stations are in parts of the country where the earth resistivity is high and this, coupled with the height above sea level, has meant that elaborate protection arrangements have had to be made to protect personnel, plant and equipment from the effects of possible lightning strikes. Many of the stations have had to be electrically isolated by means of transformers from the pair type and coaxial cables which connect them to the repeater station and telephone exchanges.

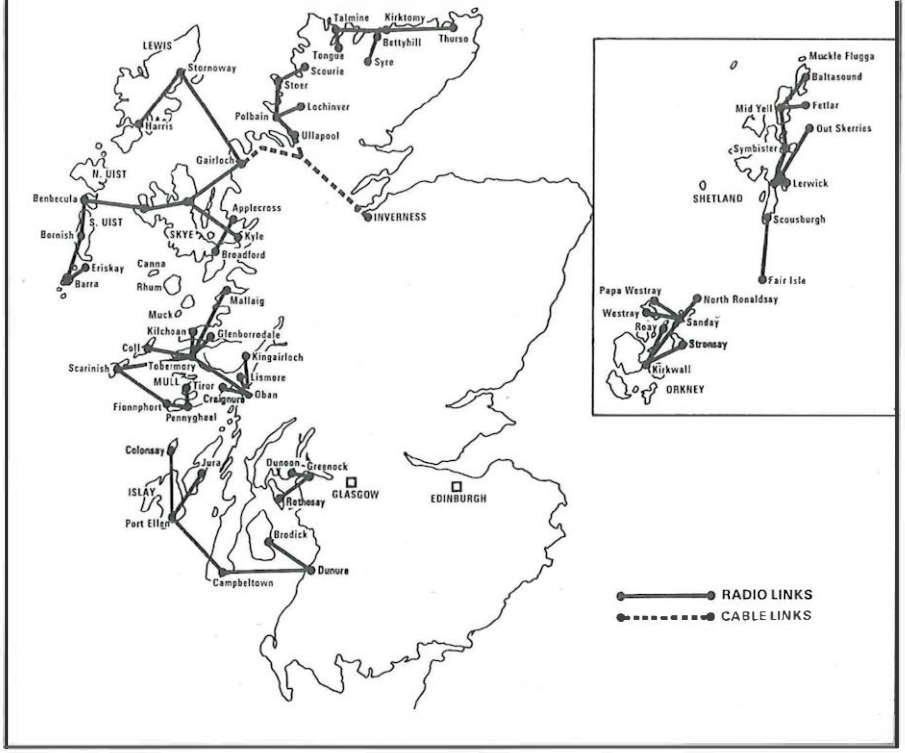
Seven of the six-channel links were provided as part of the original scheme, although this number of links has since been increased. The aerials for these links are similar to UHF television aerials. Separate transmit and receive aerials are used at each station and these are generally pole mounted or mounted on the towers at the 300-channel stations. The radio equipment uses one of 10 available channels in the UHF range, and duplicated radio equipment is provided with automatic changeover in the event of failure.

The single-channel radio links are used where only one or two junctions are required, such as on the islands of Muck, Rhum and Canna, offshore from Mallaig, and in the Shetlands. Other applications for this type of transistorised radio equipment are to connect a customer or call office to the local exchange and to provide a private circuit.

Generally the radio paths were planned from map studies, and building locations, tower sitings and aerial heights derived from these studies. Where doubts existed, the map studies were supplemented by electrical propagation tests. In one case, according to the maps an unobstructed sea path should have existed between the Orkney islands of Sandray and Westray, but when the aerials were being positioned it was noticed that the north end of the island of Eday projected into the path. However, the only effect of the obstruction was slight degradation of the signal, with the bonus of screening both stations from sea reflections.

Installation and commissioning of the radio links and associated coaxial cable systems was completed well in advance of the telephone exchanges they were to serve. Where possible, use was made of these high-grade transmission paths to route circuits between existing manual exchanges. It was surprising how soon word got around about the improvements in transmission quality, and communities that had for a long time accepted the ▶

On a hill high above Greenock a Post Office engineer adjusts an aerial on one of the radio towers which form vital links in the Highlands and Islands telephone network.



The Highlands and Islands telephone network.

existing trunk and junction quality were soon asking for their circuits to be routed over the new radio links.

To date the radio and transmission equipment and power plants have proved very reliable, requiring little attention, and have justified their selection for use in remote and somewhat hostile environments. Maintenance and restoration to service is, in some cases, carried out by part-time staff, often under the guidance of skilled staff elsewhere. The equipment is basically all solid-state and spare panels to replace faulty ones are kept at selected centres. Repair of faulty items of radio and transmission equipment is undertaken at a central repair depot in Edinburgh.

With the new exchange and transmission systems completed and in service transformation in telecommunications to the area has quietly taken place. Complaints about transmission have generally disappeared and system reliability has increased. However, the ingenuity and resourcefulness of staff have been stretched even further than hitherto.

Maintenance officers are now faced with a formidable array of equipment, including subscribers' apparatus and line, UAXs, SAXs, crossbar GSCs, coaxial cable and pulse code modulation systems, microwave, UHF and VHF radio systems, and several signalling systems. In some instances one man is faced with most if not all of these equipments and systems.

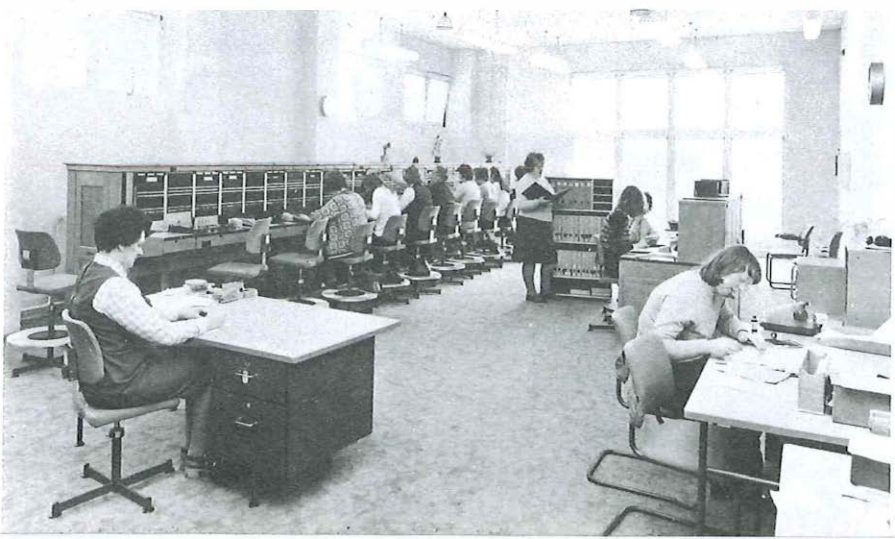
The need for adequately trained and deployed relief staff also poses problems, as does training in general. It is virtually impossible to train staff fully in all aspects of maintaining the diverse equipment because of the sheer number and length of courses and the overall time involved. Some compromise has therefore to be made so that a high level of expertise can be attained.

The aim of the Highlands and Islands scheme was to modernise the system to as high a standard as that enjoyed by the rest of the UK, and the question must be asked as to the extent of its success. Certainly some customers who enjoyed an almost unique personal service did not take too kindly at first to the new "do-it-yourself" telephone but, on the other hand, the ease with which many people are now able to contact distant places must be taken into consideration.

In terms of measurable quality of service – such as the percentage of effective calls, plant defects, and so forth – the Highlands and Islands now enjoy a standard as good as, and often better than, the rest of the UK. However, this is not the whole story. The scheme was conceived without hope of economic return, but in the event it has proved an invaluable asset. Its commercial need is being proved to be of inestimable value to the offshore oil industry and related services and, consequently, to the economy as a whole.

The Highlands and Islands network is not, however, a once-and-for-all static network. The advent of North Sea oil and the resultant service industries has resulted in a rapid growth in trunk traffic in many areas, and the improved service has also stimulated growth. The network is being augmented as required and opportunity is being taken to provide alternative outlets to the main network independent of the long coaxial cable linking the north west with Inverness. Extensions to GSCs have been planned, some are in service and capacity is being added to the radio and transmission systems.

The old and the new . . . Telephone operator Mrs Gilda Thomson, above, at the old manual switchboard at Baltasound in the Shetlands. Following its closure assistance traffic was transferred to the new automanual centre, below, for Lerwick GSC area, which covers the whole of the Shetlands.



Mr F. Howe is a head of group in Service Division of the Scottish Telecommunications Board, responsible for radio and line transmission field maintenance.

Centre of research

Post Office Research has kept Britain in the forefront of world telecommunications, and from its laboratories have come many important developments. Now, in establishing a large purpose-built research complex at Martlesham Heath, Suffolk, the Post Office has provided a modern scientific base for shaping and developing telephone and allied communications for the future.

The new centre, opened by the Queen on 21 November last, replaces buildings at Dollis Hill, London, which for more than half a century was the home of Post Office research. In the following articles MR C. F. FLOYD outlines some of the design features that make Martlesham one of the most advanced centres for telecommunications research in Europe, and explains the major task of moving more than 1,400 research staff from the suburbs of London to the heart of East Anglia.

The author was head of the Division in charge of this move, including planning of the new complex from its inception in 1964. He retired recently from the Post Office after 40 years' service in Research Department, more than half of which was spent as a research engineer on coaxial cable systems, microwave radio systems and satellite aerials.

RESEARCH undertaken at Martlesham is divided into sponsored projects selected to meet the needs of operational units in the Post Office. Most investigations must be customer orientated and are undertaken only if a clear economic advantage is likely to result. The aims, of course, are better service to the public in the long term, reductions in the cost of telephone and allied services and a wider range of facilities available to customers.

Pure research, that is research for its own sake, is not a major concern of the Centre, being regarded as more suitable for university organisations.

The scope of the work at Martlesham is wide, involves many disciplines and, organisationally, it falls into two categories. First there is applied research, covering new materials and their application to devices such as transistors and microtechnology. Techniques have to be developed for producing the devices, and laboratories with special environmental conditions such as a dust-free atmosphere at controlled temperature and humidity are needed for this exacting research.

The second category covers communication system research and advanced development. This explores new methods of transmission, faster and more efficient switching and signalling techniques for the next generation of telephone exchanges and new ideas for telephone services. The main object of all this work is to reduce the cost of telephone service and to increase the range of facilities available to customers.

Work in these two broad categories is mutually interactive. For example, systems research engineers may foresee the need for a new device – perhaps a higher performance transistor that will be essential to the successful development of a projected transmission system likely to be required in the trunk network some time ahead. The appropriate Divisions in Research Department then initiate the necessary research and co-ordinate progress to achieve the target.

A good illustration of this co-operation is in the field of integrated circuit design and fabrication. Planar technology now makes it possible to construct several thousand individual transistors by combining them on a tiny chip of silicon. Work done in this field at Martlesham is having a major impact on concepts of system design.

Component reliability in modern highly concentrated equipment must meet acceptable predictable standards if the cost of maintenance is to be minimised. In the Martlesham laboratories the reasons for component failure are constantly being investigated and exacting automatic methods of accelerated life testing are being established. In due course the knowledge ▶

gained will be made available to benefit the telecommunications industry.

The six-metre diameter steerable aerial that now forms a prominent landmark on the northern edge of the Martlesham site has been built for research in conjunction with radio signals from certain geostationary satellites. It is now collecting data at 20 and 30 GHz from the satellite ATS-6 and will continue experiments with satellites for several years. It will be possible to increase the number of radio telephone channels sent via satellite as a result of such work.

Progress on research in these and other fields cannot, of course, be achieved overnight, and the new buildings at Martlesham have been designed to provide a home for Post Office research and advanced development for 50 years or more ahead. The centre will see many changes in technology, and to meet future needs that at present cannot be defined it was designed with a high degree of flexibility in application and environment.

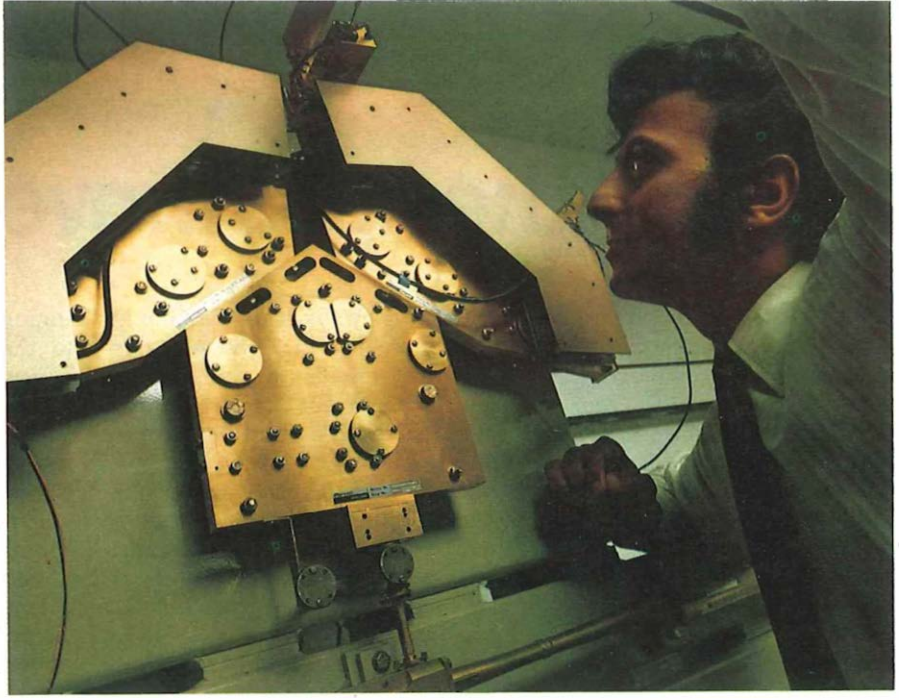
A memorable day at Martlesham Research Centre as the Queen unveils a commemorative plaque, accompanied by Post Office Chairman, Sir William Ryland.

The 6-m diameter steerable aerial at Martlesham, which is used to obtain important data on the propagation characteristics of satellite-earth paths for future communications satellite systems.

An aerial is raised to the top of an experimental microwave radio mast near Martlesham. The equipment is used in tests of radio-relay systems that will have a greater capacity for carrying telephone calls and television pictures.

There are three main buildings, the largest being a seven-floor laboratory block which provides some 400,000 square feet of laboratory accommodation. The second is an administration building with three floors, square in plan, and designed as an inverted truncated pyramid with slender pillars supporting an overhanging top floor. The third main building, mostly single storey, is largely for mechanical engineering, drawing office, workshop and stores accommodation.

The two towers – known as the Radio Tower and Water Tower – are primarily lift towers providing "vertical circulation" between all the floors that run at constant level through the whole complex of buildings. Each tower has several passenger lifts, a five-ton goods lift and many small suites of offices. Covered bridge connections run between the main buildings, maintaining the same floor levels throughout the whole complex..



Post Office experiments on waveguide transmission systems could lead to more than 300, 000 telephone circuits passing down a tube no bigger than a car exhaust. Here work is carried out on part of the terminal equipment of a 14-km waveguide system set up between Martlesham and Wickham Market.

The Radio Tower rises 240 feet above ground level and is cylindrical for the top 100 feet. Its unique feature is a square, two-storey radio laboratory at 140 feet above ground. Higher still, two circular galleries carry microwave aerials, one of which is already in service on the operational link from Martlesham to Mendlesham where it joins the microwave trunk route to London.

In the main laboratory block the aim was to produce a building sufficiently versatile and adaptable to meet the wide range of conditions that are likely to be needed for telecommunications research for many years ahead. To achieve this the basic design concepts were flexibility in the way space would be used, controlled environmental conditions and freedom from mechanical vibration within the building.

To obtain low heat loss from a building the architect should aim at maximum volume for a given surface area. The cube is a practical approximation to the ideal (which is a sphere) and the laboratory block was therefore built as two large cubes linked at all floor levels so as to operate as one large building.

The seven floors of the laboratory block have six-foot high windows around the building with a continuous six-foot wide balcony at each floor level which provides a fire escape and some shielding from the effect of the sun on the floor below. Staffed laboratories and laboratory offices are all situated in the outer belt of each floor, so that everyone has some windowed accommodation.

A corridor of demountable partitions separates the staffed area from the central zone of each floor. The central zones where lighting is entirely artificial, are used for special laboratories that do not require full time staff attendance, such as measurement rooms, computer terminals, local group conference rooms, test rooms and, of course, for housing the switch gear and other service plant.

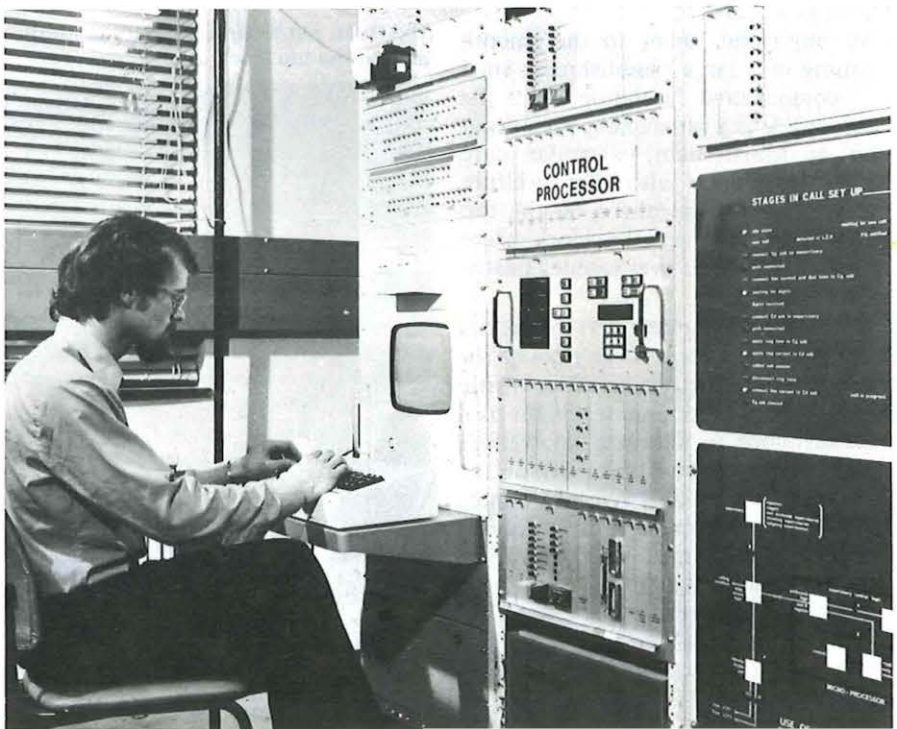
All rooms in the main laboratory block are formed by demountable partitions that can be readily assembled without structural alterations on a two-metre wide matrix. As a result, room sizes can be re-arranged to suit project requirements. There is full air-conditioning with air heating and humidifying using a dual duct system.

Services – gas, water, chilled water, electricity, drains, telephones – are easily accessible both from feeders around the outer wall and from a carefully planned floor matrix that will match a variety of laboratory bench positions. All the heavy services plant, such as air-conditioning machinery, heating boilers and refrigeration plant, is in rooms at lower ground floor level on mountings isolated from the building foundations.

Laboratory floor slabs are sectionalised and mounted on neoprene cushions to minimise the transmission ▶

Below: A technician at the Research Centre measures an acoustic horn which will be used for testing transmitters in telephone handsets. Made of pure copper, each horn is produced by an electroforming technique to very close tolerances.

Below: This model processor-controlled telephone exchange is used in the switching research programme to provide information for advanced, computer-based microelectronic system development.



of vibrations to the steel building framework, which is itself sectionalised to suppress vibration along the main structure. The dual duct air conditioning system allows all rooms to be heated and ventilated by an adjustable ratio of cold to hot air, so that if a particular experiment produces an excess amount of waste heat the proportion of cold air supplied through the ceiling grilles can be increased as circumstances may require.

Successful research, however, is not achieved only as a result of laboratory experiments. It should be borne of inspiration, nurtured by reading, discussion and exchange of information, often at international meetings and conferences. The air-conditioned administration block has been designed with this very much in mind. It is especially suitable for technical demonstrations and conferences both within Research Department and for wider audiences.

A 450-seat lecture theatre now dedicated the "John Bray Lecture Theatre" in honour of the first Director at Martlesham, is complete with projection facilities, electronic aids, a stage and translation booths. It opens off a large reception hall with its exhibition gallery overhead. A small, octagonal lecture theatre with 50 seats, two conference rooms – and, later, a Confravision studio – are situated nearby on the same ground floor.

On the floor above is a large technical library of unusual design. It is on three levels, each successively stepped outwards beyond the one below, the uppermost providing a study area. This is the main technical and scientific library for the Post Office and its size and general standard of appointment reflect its importance both to the Research Department and the Post Office as a whole.

An important factor in the smooth running of a large establishment sited in comparative isolation in the countryside is a satisfactory restaurant and at Martlesham particular care has been taken with this welfare facility. The restaurant is on the top floor of the administration block where it commands views over wooded heathland.

A cafeteria, waitress service, coffee lounge and bar form three sides of the square, the kitchen being offset within the square. The remainder of the restaurant floor is allocated to welfare rooms for use by all members of the Research Centre. This gives the opportunity for social clubs to meet during off-duty hours with nearby restaurant facilities readily available.

Making the right move

THE Post Office Research department – part of Telecommunications Headquarters – had grown over the past 50 years at Dollis Hill from a small experimental unit working in huts in open hilly country north-west of London to a staff of 1,450 in 1968 working in laboratories surrounded by densely populated London suburbs. For much research this crowded situation became intolerable and early in the 1960s plans were started to set up a new research complex well away from London.

An exhaustive search for a suitable site was launched. Vacated airfields offered promise and Martlesham Heath, near Ipswich in Suffolk, was finally chosen. It is not far from London by rail or road, is in an area of East Anglia in which the development of high technological industry is being encouraged, is close to well established small historic towns where the Arts flourish and is in an area full of attractive pursuits and sports.

The first research group of a dozen men moved to rehabilitated RAF buildings on the site at Martlesham Heath early in 1968 to start extensive field experiments on transmission in circular waveguide. Since then a steady build-up of staff has been maintained, most being moved from London, but an increasing number (at present some 300) have been recruited locally.

It was foreseen that the success of this large, complicated move would depend primarily on staff reactions. The maintenence of staff morale depended to a large extent on the degree of acceptance by wives and families in changing from life in London suburbs to the countryside in Suffolk, finding new schools for children, making new friends and "putting down new roots".

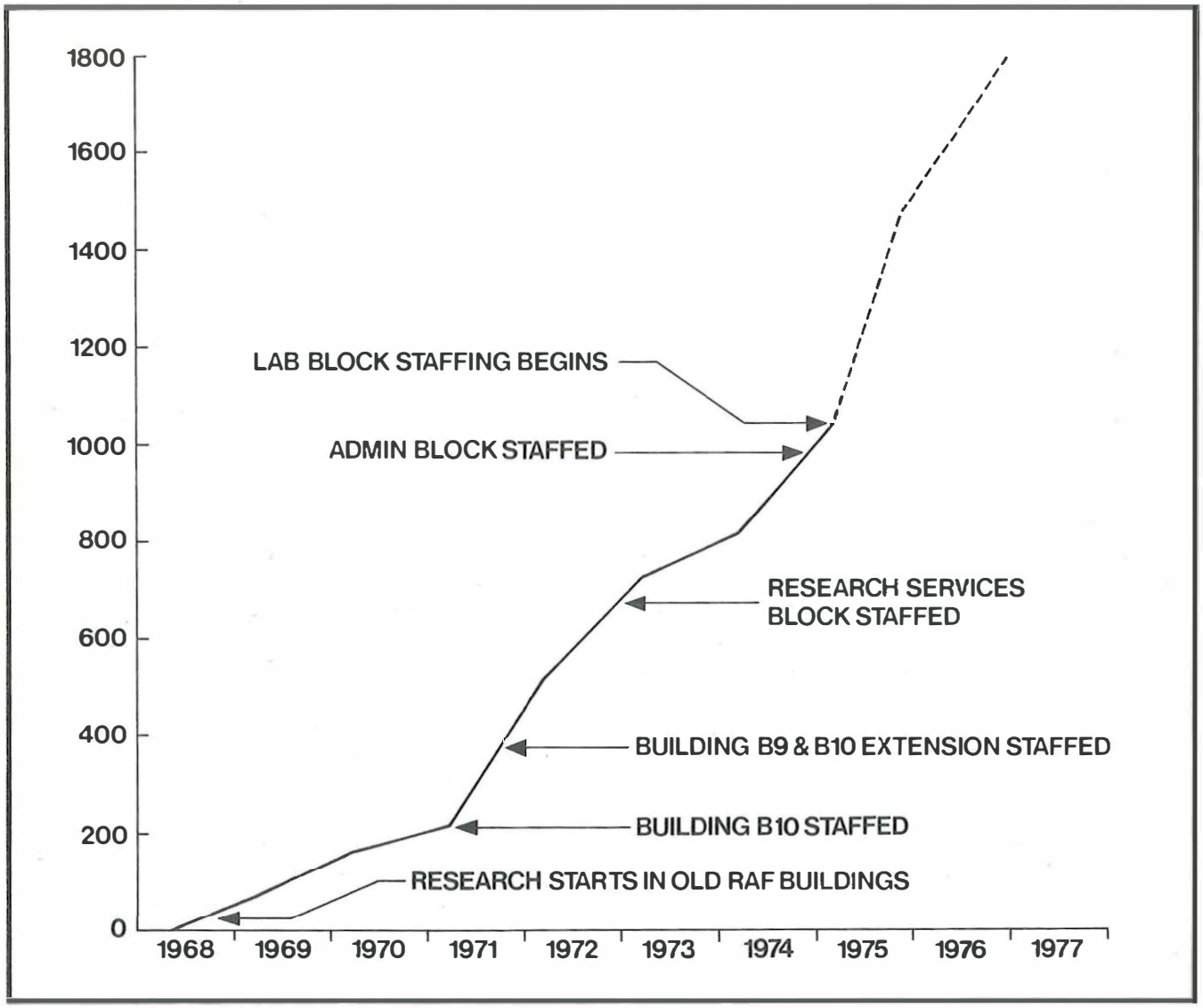
There was always the possibility, at least in the early days of the move, of meeting with some local resentment because the arrival of hundreds of outsiders in the quiet town and village communities of East Suffolk must be a cause for local alarm. However social disturbance is only alarming if it is too concentrated.

So the move into Suffolk was spread over a number of years, by starting it in 1968 well in advance of the main buildings. East Suffolk gradually became aware of the new research establishment that was growing up and had accepted its presence before the main buildings were started.

The basic management organisation in Research Department that had responsibility for the move was most important. A joint management/staff side working party known as the Move Committee was established in 1964 at the start of planning to co-ordinate views on all aspects of the buildings required, and to discuss the problems of moving. Sub-committees were set up to deal with laboratory accommodation design details, with educational matters in East Suffolk, with welfare and to explain financial matters to staff moving from London.

Authoritative booklets on "Removal Expenses" and "Education in East Suffolk" were written by these Sub-committees for general issue to all staff in Research Department, and

The three-tier technical library at Martlesham, which incorporates a spacious study area at the top level.



Build-up of Research Department staff at Martlesham.

every effort was made to keep staff well informed on progress. Regular newsletters were issued by the Move Committee. An Information Room was opened at Dollis Hill where house agents could display advertisements; maps and guide books were on loan for consultation.

The vagaries of the housing market caused difficulty in the early years. House building in East Anglia was almost at a standstill and builders were looking for work. Research Department staff gave careful attention to public relations, giving talks and lectures and explaining the work of its Department to schools and local societies.

An opportunity arose to buy a number of houses built by the Department of the Environment for service personnel in a village close to Martlesham Heath. It was decided that the Post Office should purchase these for use as "staging post" houses so that they could be let temporarily to staff looking for a permanent home. When the move is completed the houses will be returned to the open market.

There was also a demand, relatively high at first – but diminishing as the move progressed – for local authority properties. The Move Committee was able to help here, and an effective relationship has been maintained with the Local Housing Authority to supply the needs of staff.

Schooling has caused a few problems because families had to move their children from the numerous schools in the Home Counties to conditions less favourable in East Suffolk, However, increasing demand for places in all age groups is helping to stimulate new school provision in the Ipswich area which will help establish families and new arrivals.

Apart from the social limitations already explained because of families with housing and school problems, there was a limit to the rate at which staff could be received into the Martlesham laboratories and workshops. Every research group needs its own conditions and facilities and the aim at all times was to minimise discontinuity in the laboratory work.

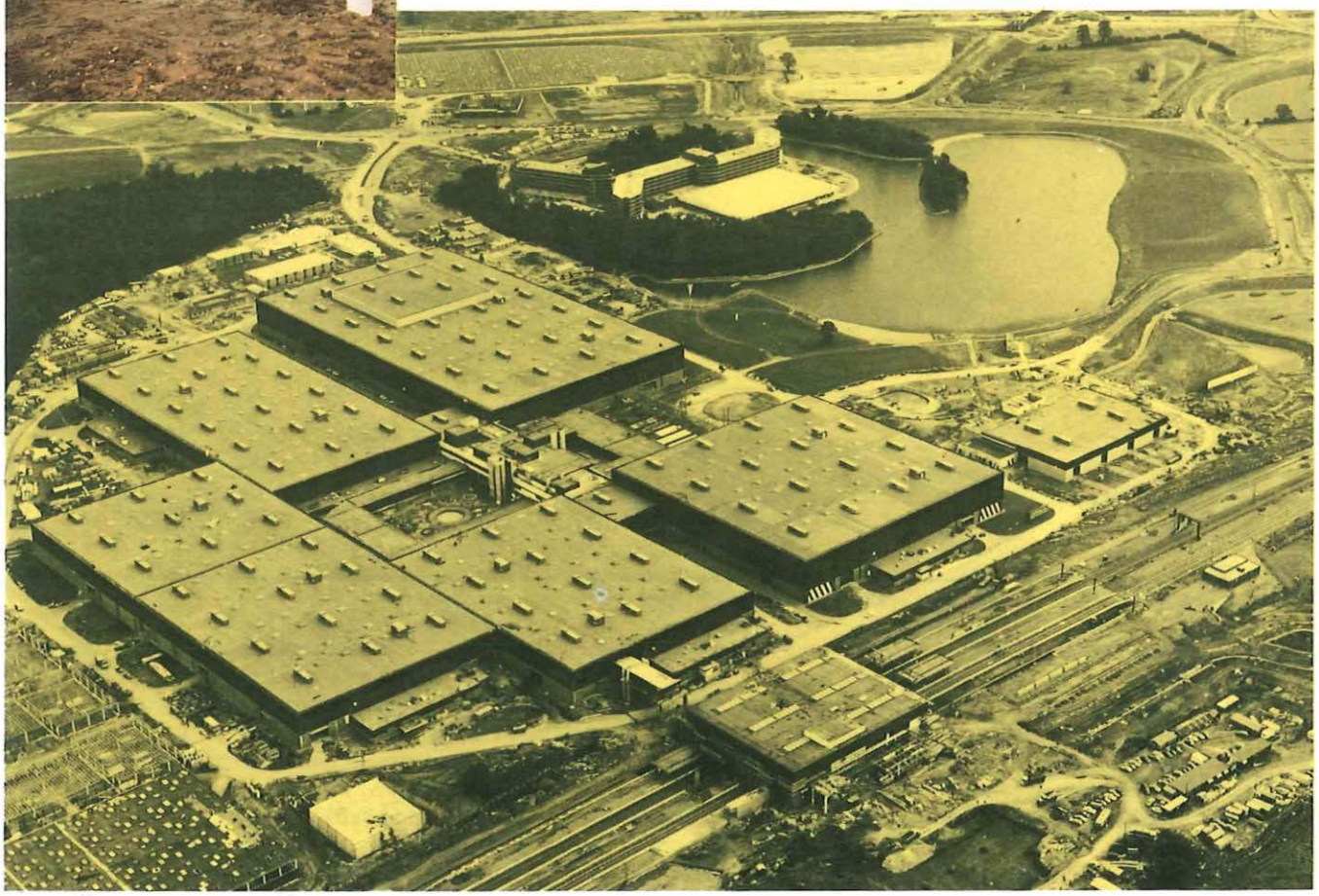
In some Divisions, small sections or groups could be moved as individual units, and these were easy to organise and settled in quickly. Others needed special environments, clean rooms and elaborate laboratory installations such as computers. These presented many planning problems, and considerable skill and experience had to be acquired before the more complicated group movements could be undertaken.

However, the move continues and should be completed by the end of 1976. Eventually Martlesham will have a staff of 1,800. This will include 850 research engineers and scientists, 550 technicians, 80 draughtsmen, 80 trainees, 150 administrative staff and 90 general support staff. Of the 850 engineers and scientists, 600 are graduates with degrees or the equivalent.

Good connections at the national showplace

SSP Marklew

The exhibition halls, conference rooms, hotels and many other facilities which form Britain's prestigious new National Exhibition Centre are served by a wide range of telecommunications services planned and provided by the Post Office.



An aerial view of the National Exhibition Centre showing the halls, hotels by the lakeside and the new railway station.

IN 1969 when it was first proposed to build a major 300-acre National Exhibition Centre on green belt farmland near Birmingham, the Post Office found itself with a daunting task. The new centre, described by former Prime Minister Edward Heath when building work began in 1973 as "a showplace worthy of the best that Britain can offer", was in an area where telecommunications forecasts had shown a zero growth rate.

But almost overnight all that changed and suddenly the Post Office was faced with having to provide telephone, telex and Datel services for hotels, conference halls, restaurants, banks, shops, workshops, railways, taxis, housing, police, fire, AA and RAC, television, press, radio, contractors, and private and public coinboxes.

The site for the centre was chosen for several reasons. There are, of course, an enormous number of manufacturing and exporting industries in the West Midlands, and the road and rail links between Birmingham and all other parts of the country are second to none. Indeed, there are motorways all around the area and the new five-platform International Rail Station on the main Euston line runs along the western boundary of the site. Almost as close is Birmingham Airport which already operates a full range of scheduled services to many major continental destinations.

The site itself, which opened with its first exhibition in February, contains six halls – one being the biggest in Europe – providing almost one million square feet of exhibition space. As well as these halls there is a central core – called the Piazza – of administration and catering buildings together with offices and shops. There are two hotels, a cinema and the more usual facilities of banqueting suite and res-

taurant. Car parks will cater for 15,000 cars and 200 coaches and an internal transport system will carry visitors around the site. The appearance of the whole place is enhanced by a lake and thoughtful use of existing trees.

Obviously the first job facing Birmingham Telephone Area was to forecast telecommunications requirements. In 1970 the City Architect published a report which gave a detailed appraisal of the site and the huge scale of the operation meant that Area staff had to look elsewhere for comparisons. As a result information on other European exhibition centres was sought through Telecommunications Headquarters.

The response was interesting but of limited use because on the Continent the public are generally excluded from trade exhibitions. Information was also sought from London Telecommunications Region about Earls Court and Olympia – both of which, incidentally, would easily fit into the new centre. Visits were made to London and a healthy dialogue has continued between the staff in Birmingham and London's South Central Telephone Area as work on the site has progressed.

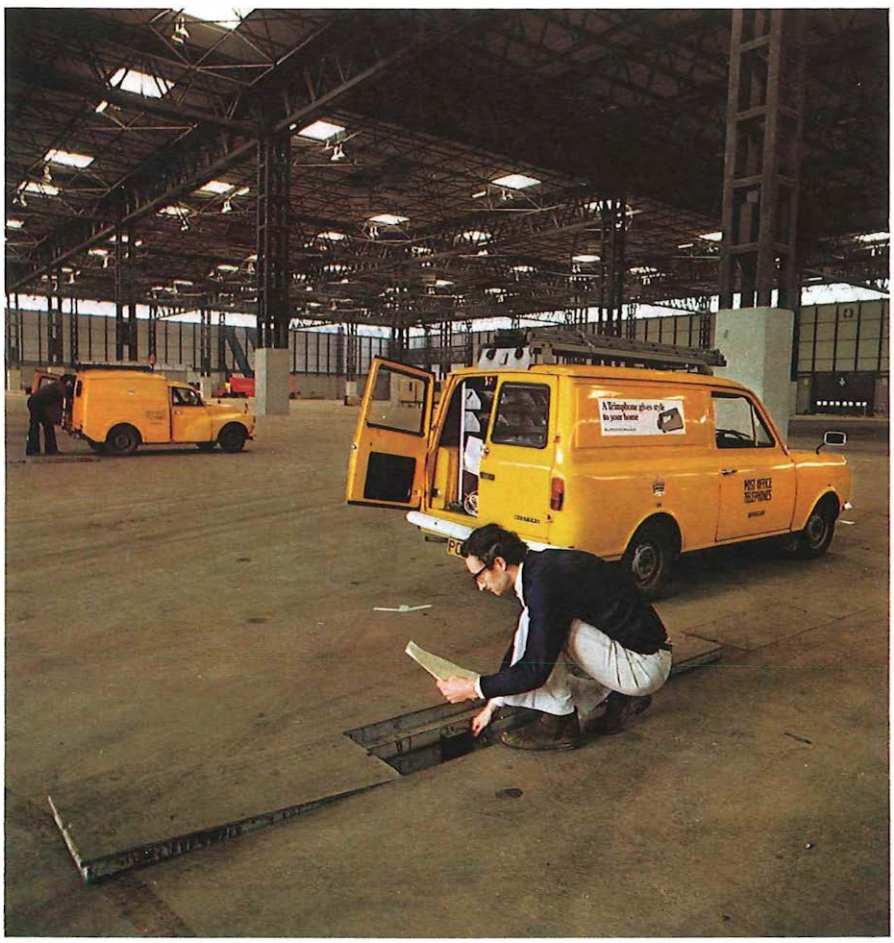
One of the first steps was to complete a sales forecast based on the information culled from London together with details obtained from the City of Birmingham and National Exhibition Centre (NEC) consultants. Lengthy discussions were held and Birmingham sales staff were able to offer many constructive suggestions about the likely communications needs of such a huge site. It was vital that these meetings took place as early as possible so that Post Office planning could proceed.

Planning a public exchange service was highly complex. Nearby Director exchanges at Sheldon, Marston Green, Solihull and Chelmsley were considered. There was also the suggestion that service be given by a new exchange to be provided specifically for the NEC though there would not be time to find a new site and erect a building.

After cost studies it was decided to provide by contract a new 2,400 line Strowger Director exchange (code 780) in Chelmsley building. The existing crossbar exchange at Chelmsley though new, had been designed for mainly residential traffic and was considered unlikely to cope with the higher calling rate expected from the NEC. Work on the new 780 exchange began in January 1974.

To get from Chelmsley Exchange to the NEC site access point meant the ▶

Telephone connections are checked in a service tunnel which runs underneath the exhibition halls.



Technicians at work in an exhibition hall shortly before the centre opened. In the foreground a connection is tested at a distribution box.

provision of 2,900 metres of duct, mostly three-way, and 3,800 metres of cabling containing 2,400 pairs. From the access point to the NEC main distribution frame (MDF) needed a further 2,000 metres of duct and cable. Extensive roadworks outside the site provided a particular problem and, as a result, cabling had to be delayed for about three months.

The entire 2,400 lines at the new exchange are cabled to the NEC. Of these 1,780 lines are allocated for exhibition purposes including 2–10 PBX groups and renters' coinbox lines. Some 420 lines are allocated for permanent use for shops, banks, public coinboxes and so forth, while the rest will serve PABXs for the NEC Company and the hotels.

Altogether there will be about 1,500 extensions, and one of the main features of the whole system is the underfloor distribution. It is the first time this technique has been used in Midland Telecommunications Region on such a major undertaking.

To carry traffic to and from Chelmsley 780 exchange into the Post Office network, 14 new pulse code modulation systems (each having a maximum capacity of 24 circuits) and 114 audio cable pairs have been provided. In addition a 308 pair spur from a junction cable will be fed into the site to cater for the expected demand for private circuits.

At the NEC site the cable pairs from Chelmsley are split. To shorten the routing the hotel pairs are fed to a cabinet and the main group go to the NEC main distribution frame. Also connected to the MDF are more than 200 separate cables feeding out to distribution points all over the site.

The distribution cables to the exhibition halls terminate at cross connection boxes in the service tunnels running under each hall. At six-metre intervals service trenches (about 300 mm wide and deep) run off at right angles from the top of the tunnels and distribution cables are taken from the cross-connection boxes by way of a plastic capped groove in the side of the trench to distribution boxes which are placed every 10–15 metres along it.

Each distribution box has 12 jacks to which are connected the pairs in the distribution cables. By fixing corresponding plugs to the exhibition telephone the connection will be made by plugging-in. This a special arrangement of Installation Division to meet the exhibition need of rapid provision and recovery.

The exchange lines at Chelmsley MDF allocated for exhibition purposes are permanently jumpered to cable pairs at the NEC. At the NEC MDF these pairs – and thus the exchange line numbers – are permanently jumpered to a patching field-equipment which uses a variety of jacks to provide great flexibility and enable incoming and outgoing exchange lines to be made available at any point in any of the exhibition halls without jumpering changes.

The number of exchange lines fed to any distribution box is normally four but may easily be varied between zero and 12 at the patching field at the MDF. In the event of excessive demand at any point extra lines would be achieved by feeding from adjacent boxes or by running extra cable from a connection box in the tunnels.

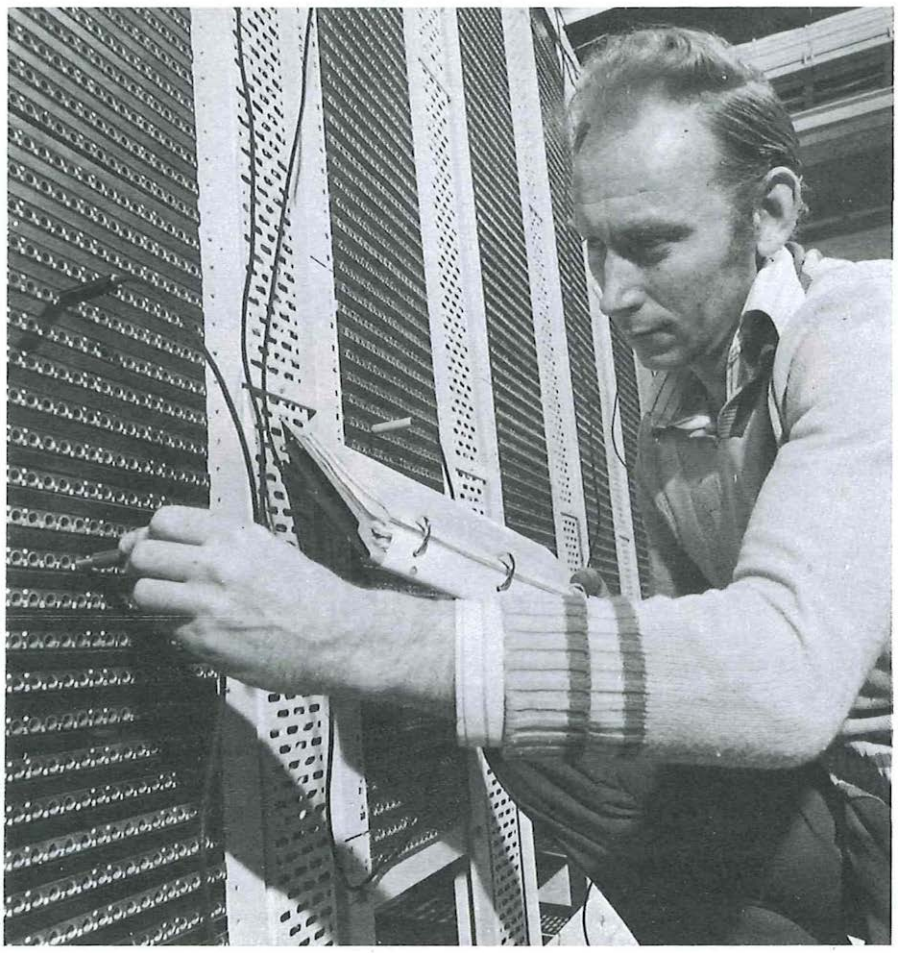
A refinement to simplify the work of allocating exchange numbers to particular exhibition stands is the use of films on which are marked the distribution box positions in each hall. By placing the film over a print to the same scale of the exhibition layout, stands, distribution points – and therefore telephone numbers – can be easily related so that re-arrangement work on the patching field at the MDF can be minimised.

In all 67,000 metres of distribution cable of various sizes and 9,500 jacks at the distribution points were used in the exhibition halls.

At both the NEC and the International Railway Station the public call offices will require adequate distribution of foreign language call office instructions and in selected places public directories in addition to those for Birmingham Telephone Area will be provided.

Co-ordination of the work involved several committees and groups with THQ, MTR, LTR/SC all co-operating. MTR had exchange (780) planning responsibility and all Divisions in the Area took part. The heaviest burden fell on Installation Division Customer Works Group (South), but sales staff and Internal and External Planning and Works staff have also been very busy in what has been one of the most prestigious jobs ever in the Region.

An adjustment is made on the special patching field which allows great flexibility in the use of exchange lines at the NEC.



Mr S. S. P. Marklew is a Deputy General Manager in Birmingham Telephone Area and is responsible for provision of service at the National Exhibition Centre.

Creating an area of safety

VG Bedford

AS THE employer of the largest workforce in Britain the Post Office plays a leading role in industrial safety. The protection of its staff at work has, in fact, always been of major concern and, in 1964, a completely new centralised organisation was set up in London to strengthen even further safety standards throughout the Telecommunications and Postal Businesses. This was followed three years later by the introduction of a newspaper designed to create greater safety awareness among the large number of staff in engineering grades.

One result of these concerted efforts was the winning, in 1969, of the coveted Sir George Earle Trophy. But although the Post Office as a whole may have got to grips with safety problems, Guildford Telephone Area had the worst accident rate in South Eastern Telecommunications Region (SETR) – and the safety record of the Region itself rated only moderately in comparison with other Regions. It was clear that something had to be done, and as a first step the SETR Personnel Controller issued a 10-point guide to Areas for the setting up of Safety Liaison duties.

9.00: The author, right, starts a typical day of safety liaison duties with a visit to a telephone engineering centre. Here he discusses a check being carried out on gas testing equipment.

Guildford Telephone Area alone is spread over 750 square miles and includes Aldershot, Basingstoke, Camberley, Dorking, Farnborough, Farnham, Haslemere and Woking. Staff, including administrative, clerical, engineering and operating grades, total more than 2,700 with engineers accounting for about half of this number. In Guildford Area, therefore, it was decided to appoint two part-time Safety Liaison Officers, one to cover the engineering grades and the other to cover remaining staff.

Since their introduction more than five years ago, the role of the Area Safety Liaison Officer has undergone considerable development. Today he is an adviser to Area management and a vital link between the Post Office's centralised safety organisation and the staff. In order to fulfil this role it is vital that he retains the confidence of the staff and is regarded as a friend rather than an inspector.

For a number of years the safety activities within the Area were presided over by one committee under the chairmanship of an engineering Head of Division. The committee was too big and covered too broad a field for many of its members, with the result that it lost much of its effectiveness.

In 1973 it was decided to establish two committees as part of the local joint consultive and negotiating machinery. Each committee is chaired by a Head of Division, one representing engineering grades, the other covering all other grades. Each committee with its appropriate Area Safety Liaison Officer has between eight and 10 members representing staff, and all levels of management.

The two committees hold meetings at quarterly intervals, the engineering committee changing its venue from time to time and frequently making a tour of inspection of the local exchange or telephone engineering centre as part of the meeting.

Accident statistics and reviews figure prominently on the agenda, as do project reports and the report from the Area Safety Liaison Officer. The minutes are circulated and put on display throughout the Area and most members of the committee leave the meetings with assignments for the next quarter. An important feature of the work of these committees has been the strong representation of management which has given considerable strength to the activities of the Area Safety Liaison Officer.

Much attention has been given to accident investigation and as the result of a number of studies, and issue of local instructions, a considerable improvement has been achieved both with the thoroughness of the investigation and the contents of the report. All engineering supervising officers hold a Duty Safety File which contains details of accident investigation procedures and requirements together with a copy of the Engineering Safety Guide, Gas Precautions handbook, Propane Plumbing handbook and the Highway Code.

Once the investigation has been completed the report is seen by the Area Safety Liaison Officer and the management of the Division concerned. In ▶

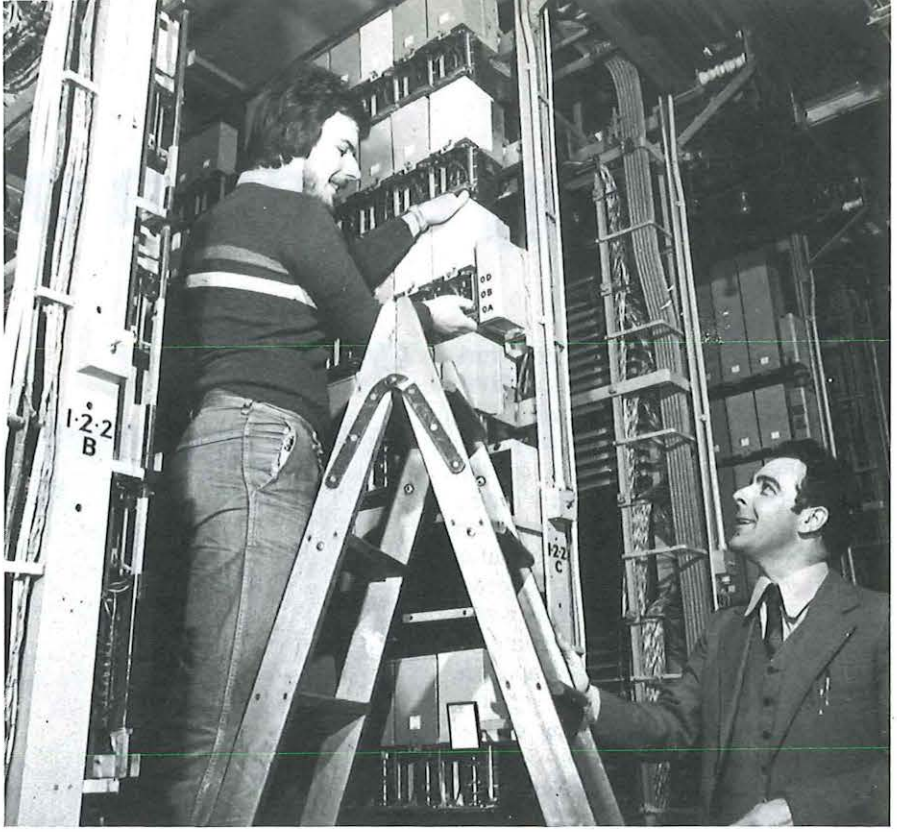
the case of serious accidents the Divisional Head will nominate the investigating officer because the immediate supervising officer could be indirectly involved. In the case of these accidents it has also been found worthwhile to appoint a collating officer who will be divorced from the pressures of the investigation and who will be able to take a detached look at the way the investigation is going. This also ensures that nothing is overlooked.

The principal aim of accident prevention is to place the individual into a safe system of working, using safe working methods, and aids provided for a given task. It is also important to develop the same safe working habits at home – after all climbing a ladder at home is the same as climbing a ladder at work. Through education and persuasion a man can be convinced that accidents do not always happen to other people. He can be persuaded to accept his responsibilities as safety officer for his family.

The role of the first line supervising officer is all important in the accident prevention field. He will ensure that safety procedures are observed, that the appropriate equipment is subjected to the necessary safety tests and that his staff are safety conscious. His fundamental role is to promote safety and health matters within his area of responsibility, but it is recognised that he must be given the knowledge, skill and backing to fulfil this obligation.

The link between the Area Safety Committee, line management and the individual is the Area Safety Liaison Officer. His is not a passive role, but demands initiative and leadership. The Safety Liaison Officer's responsibilities fall into three main categories. First, he is an adviser to management. His experience, knowledge and judgment contribute to the formulation of management decisions affecting safety. Next, he is consultant to the line management, and helps solve safety problems, advises on interpretation of standards and regulations and makes recommendations for safety improvements. Third, as a co-ordinator of the Area safety programme and organisation he provides enthusiasm and guidance to keep that organisation active and productive.

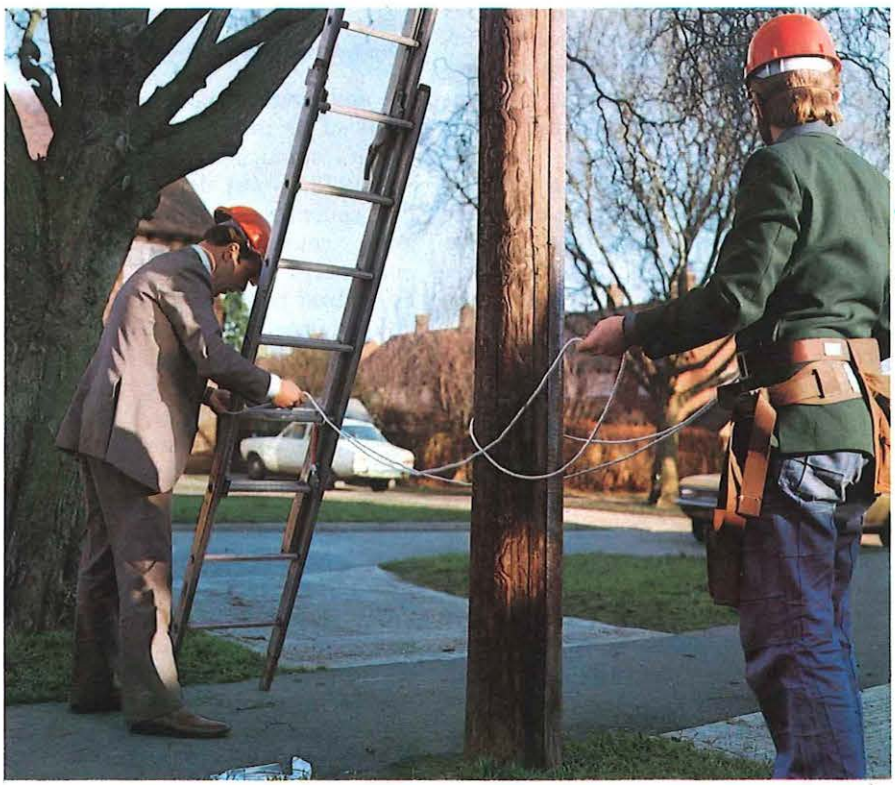
Publicity is invaluable to a safety programme and to be effective it requires imagination, sparkle, punch and a human touch to provide a favourable reaction. Safety notice boards have been placed at strategic points throughout the Area and the local supervising officer is charged with ensuring that the programmed publicity is on display.



10.15 am: A few words of friendly advice on ladder safety during a call at Guildford telephone exchange.

The programme is controlled by the Area Safety Liaison Officer who arranges for a revised display at fortnightly intervals, some posters being used on a number of occasions. With these notice boards there are 55 points in the Area at which a message can be displayed within 24 hours if necessary. This has been a real boon to both supervisors and staff, particularly those who do not meet daily.

As personal contact is the best form of communication much thought and effort goes into staging the various safety projects which take place about twice a year. The main objective is to involve the staff and their supervising officers and to establish a safety rap-

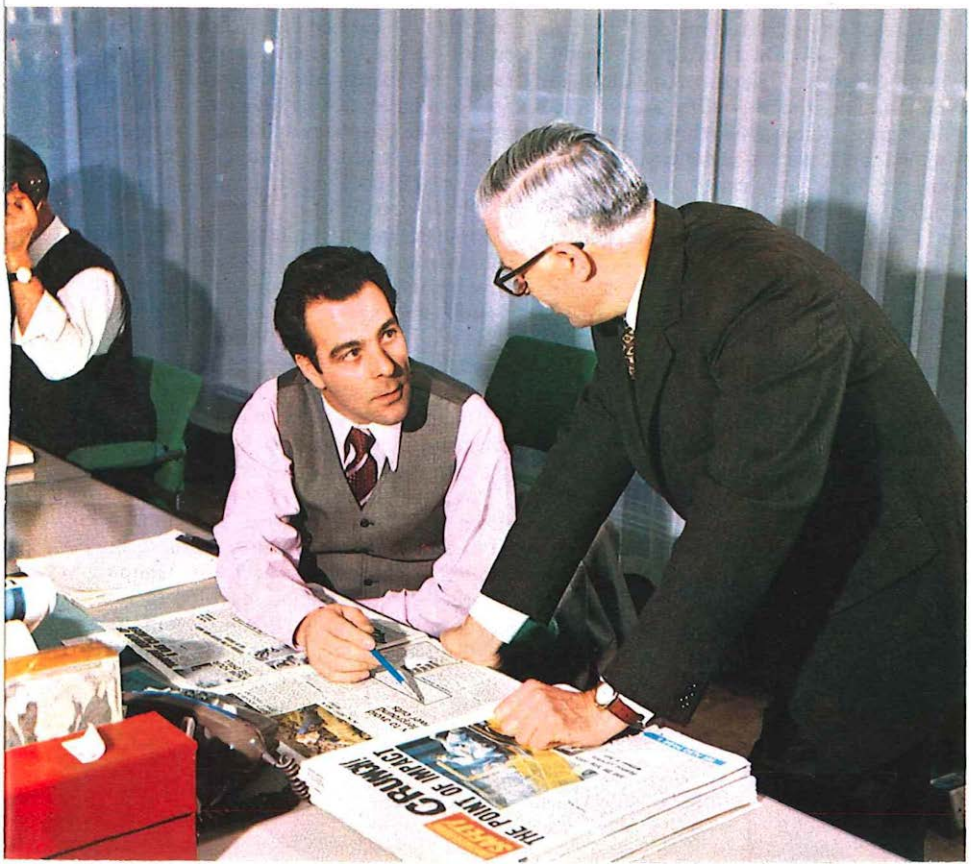


11.15 am: Out on the road, the author ensures that a technician is safely equipped for working on a pole.

12.30 pm: Still in the field, Mr Bedford exchanges safety views with an engineer working at a roadside cabinet.

port between staff and management. By carefully selecting the time and location much benefit can be derived with the minimum of interruption to normal working. Each project has thrown up a number of queries and problems and the Area Safety Liaison Officer ensures that there is a proposal to follow up.

3.00 pm: Back in the office, Mr Bedford discusses an item in "Engineering Safety" with his head of section.



At telephone engineering centres an inspector's staff are assembled with their tools and vehicles. These are inspected by members of the Safety Committee and various points are discussed with the staff as the inspection continues. Following tea in the local canteen a seminar follows, and usually a useful discussion ensues that results in a better understanding all round of safety problems and procedures.

A great deal of safety effort is aimed at staff working externally. This has involved equipping the Regional exhibition caravan with various safety displays, and each Area Safety Liaison Officer, under the direction of the Regional Safety Officer contributing one theme. The exhibition has already visited the main depots in Guildford Area and although not all comments from visitors were favourable, people were able to "get grievances off their chests".

During one three-week period the Area Safety Liaison Officer was detached from all other responsibilities and embarked on a "safety aids" project, which involved visiting staff in the field to check on the holding, condition and use of safety aids. Both internal and external staff were seen during the course of 120 visits and 15 major items were discovered that required attention.

Another useful project was to arrange for a safety shoe manufacturer's representative to tour the Area with a display van. This resulted in the sale of an additional 54 pairs of protective footwear. A cassette film recorder has also been used to great advantage, being a valuable aid to special publicity campaigns, for example in showing correct lifting techniques.

This of course is only a brief outline of the safety activity going on within one Telephone Area. All such work is closely supported in each Region by the Regional Safety Officer and at Telecommunications Headquarters by the Safety Services Branch. Although the Post Office is already one of the leaders in the field of health and safety there is still much to be done before everyone realises and believes that the practice of safety is a basic ingredient in improving the quality of life.

Mr V. G. Bedford is an Assistant Executive Engineer in Guildford Telephone Area with responsibility for engineering safety liaison.

Book reviews

A co-operative venture

Handbook of Data Communications
Authors from Post Office Telecommunications Marketing Department
NCC Publications £8.50

COMPUTING is increasingly exploiting, and fast becoming dependent upon, telecommunications services; it is therefore appropriate, that a book on the subject of data communications should be prepared and published as a co-operative venture by the Telecommunications Marketing Department of the Post Office and the National Computing Centre.

This co-operation reflects several years of experience in running training courses aimed at telling commercial and industrial data processing specialists about the opportunities, practices and problems that are afforded by the available public telecommunications services. The authors clearly have this kind of reader in mind for the Handbook is concerned with current, rather than future techniques, with practical rather than theoretical considerations and with typical rather than exhaustive examples.

The first chapter, on the origins and nature of data communications, is general and sets out some basic terms and concepts as well as carefully defining them. Chapter 2 gives a highly-compressed outline of the essential features of the switched telephone system, showing the routing and transmission plans currently used. Chapter 3 extends the basic concepts of the introductory chapter to include the idea of channel capacity, but is disappointing because the opportunity is missed of explaining the influence on channel capacity of non-ideal transmission features.

Chapter 4, on transmission and modulation systems, deals briefly with the characteristics of telephone circuits and switched connections, beginning with a simplified treatment of loss, loading of cables, amplification and modulation.

Data terminals are the subject of Chapter 5. After a general review of terminal equipments, keyboard machines, visual display units and remote batch terminals are described and this leads into a chapter on line control, a detailed, step-by-step treatment of the need for bit and character synchronization and the means for obtaining these in start-stop and synchronous systems. Message and block synchronization using the control characters of the International Alphabet No. 5 is also explained.

Chapter 7, the Communications Interface, describes and explains the V-series interchange circuits recommended by the CCITT for inter-connecting modems and data terminal or automatic calling equipment. A lengthy chapter, on data errors, gives examples (derived from CCITT documents) of error rates and error distributions on typical leased telephone-type circuits and switched telephone connections. It goes on to consider error control systems in practical terms.

Step-by-step explanations are given of parity-check and cyclic-code error-detection and an introduction to simple error-correcting codes. The chapter ends with a consideration of the various time delays which, with block size and line error rate, limit the data throughput actually achieved.

Chapter 9 distinguishes between concentrators and multiplexers; describing polling (as used in the extensive multipoint bank networks), FDM and TDM (bit and character interleaving) and gives some examples of the cost calculations relevant to the choice of one or other line-sharing technique. It is followed by a chapter on the evolution of switched networks, where the instructions on handling and routing data have to be transmitted to various switching points. The form of these instructions and the way they are handled characterize circuit-switched, message-switched and packet-switched networks. And the basic properties of each are reviewed. There is also a brief account of the Post Office Experimental Packet-Switched service.

The final chapters of the book describe the Post Office Datel Services and review the complementary facilities available in some other countries and internationally. The book contains four appendices (binary notation and International Alphabets), a glossary and a short bibliography.

It succeeds in providing an introductory bridge between the specialisms of computing and telecommunications and covers a wide range of topics, necessarily selectively and superficially. It should, however, provide a basis and inspiration for more detailed study and the bibliography of selected books and articles will provide a useful guide for further reading.

Martlesham Heath
Gordon Kinsey
Terence Dalton Limited, £4.80

The transfer of the Post Office Research Department from Dollis Hill, London to its new site at Martlesham Heath near Ipswich will have inspired many questions on the history of the site and its occupants. This book describes the transition of the wind-swept heath first from an experimental and testing station, then as an operational fighter station during the 1939–45 war and later as an experimental flying base again until the RAF moved in 1963.

The author is a native of the area and has been able to supplement his presentation of RFC and RAF history with recollections and photographs preserved by many people who served at the Station and still live nearby.

Apart from the particular associations, the book provides a valuable and often entertaining account of the small details of service life. It is a well-illustrated book that provides much information about many well-known and not so well-known types and models of aircraft that featured in the history of Martlesham Heath.

Elements of Transistor Pulse Circuits
(second edition 1974)
T. D. Towers, MBE MA BSc. CEng. MIERE
Butterworth & Co. (Publishers) Ltd., £3.50

The author has been associated with the manufacture of transistors for many years and is well known as a contributor on transistor applications to "Wireless World". This book is based on a series of articles in that publication and is aimed at engineers and others interested in the broad design basis and the usage of transistor pulse circuitry using discrete components.

Many of the applications described would nowadays be carried out without involving circuit design by selecting from the wide range of functional integrated circuits now available and catalogued. Moreover, most of the diagrams and examples feature germanium transistors rather than silicon so that the book reflects its first edition (1965) environment.

However, much contemporary electronic equipment uses discrete component pulse circuitry while large systems, such as electronic exchanges, will be in production and in operational use with discrete components for many years to come. Moreover, an understanding of circuit elements will help in the understanding of complex integrated circuits. The book provides a general treatment which remains of value.

There are introductory chapters, on transistor and diode properties and characteristics and on basic circuitry, while a later chapter considers waveform shaping. There are four chapters devoted to families of multi-vibrators, "pumps" and "triggers" and a chapter each on blocking oscillators and gates. Later chapters deal with

counters, timers and timebases. The treatment is descriptive with little mathematical content.

The first appendix contains a few problems for the student to consider, other appendices include a short bibliography and a table of transistor characteristics.

The book will be of value to the student of electronics and to the maintenance technician as well as being of interest to the amateur.

Telephony and Telegraphy A: An Introduction to Instruments and Exchanges (Step by Step and Common Control)
Sydney F. Smith, BSc(Eng), CEng, MIEE
Oxford University Press,
Paper covers £2.20 Boards £4.95

The author is a switching systems development engineer employed by Standard Telephones & Cables Ltd. and has been lecturing for some years in this field. His book is intended specifically to cover the syllabus of the City & Guilds of London Institute examination in "Telephony and Telegraphy A". It does not, therefore, set out to describe any one system in full detail but is organised as a course book, either as support to a programme of lectures or as a complete text for private study.

The first edition (1969) concentrated on the Strowger system used in the UK but this edition has been updated, particularly by including a broader treatment of switching systems and the principal features of common control (crossbar) systems. There is however, no reference to reed relay systems.

There are nine main chapters to the book, each divided into sections covering principles and practical aspects and concluding with self-teaching notes and exercises. A summary of answers to the exercises is given at the end of the book.

Chapters 1 and 2 describe the elements of telephone instruments, the electro-mechanical teleprinter and various types of relay while chapter 3 is devoted to signalling, in subscribers' and junctions circuits and in telegraphy. A short chapter follows, outlining general principles of switching and this explains the functions that have to be performed by manual and automatic exchanges, with an introduction to Strowger and crossbar switching.

Chapters 5 and 6 give a substantial basic treatment of the 200-type Strowger system, beginning with basic mechanisms, trunking principles and continuing with circuit elements and some typical complete circuits. A chapter on traffic and trunking follows (with particular reference to Strowger application) and the book concludes with chapters on distribution frames and power plant.

The book adequately covers the current syllabus of "Telephony & Telegraphy A" and can be recommended as a student's text. It is well written and exceptionally well illustrated with many neat and clear sketches and diagrams. Considerable care has been taken with the arrangement and presentation and the book is generally attractive and easy to read.

The SEMICON International Transistor Data Manual 1974 Edition
Semicon Indexes Limited, 2 Denmark Street, Wokingham, Berkshire RG11 2BB, £8.80

Radio Valve and Semi-conductor Data 10th Edition
A. M. Ball
Newnes-Butterworths, £2

These are new editions of well-established reference books. The Semicon manual has 230 pages of alpha-numeric listings of transistors (some 18,000 types) plus a substitution guide, a list of CV numbers and drawings of outlines and terminations.

A. M. Ball's book is arranged as a comparative guide, classified under types (eg rectifiers, silicon NPN transistors, thyristors etc) and sub-divided by manufacturer; it lists characteristics of 1000 valves and 9800 semi-conductors.

Either book, covering many JEDEC and PRO-ELECTRON series of devices, will be a valuable source of reference for designers, maintenance technicians and the experimenter.

Microwave Mobile Communications
Edited by William C. Jakes Jnr
Wiley-Interscience, £15.50

The time is opportune for a book on microwave mobile communications and this volume of more than 600 pages contains a vast amount of relevant information. The book is edited by William C. Jakes, director of the Radio Transmission Laboratory at Bell Telephone Laboratories (BTL), and comprises material presented by himself and four of his colleagues in BTL based on their work in this field over the past decade.

This highly technical work is not one for the general reader but will undoubtedly be of value to research workers and system design engineers engaged in the development or planning of mobile radio systems. Not without justification, Dr Jakes remarks in his introduction that the reader should have a background of radio communication and some familiarity with statistical communication theory.

While the book is claimed to explore in detail what is known about mobile radio at frequencies from VHF to the upper microwave range, the main emphasis is on high capacity systems operating at frequencies around 1 GHz. The subject is treated in two parts. The first part – of three chapters – covers basic phenomena and aerials, while the second part – of four chapters – deals with modulation, diversity and coverage.

The most difficult problem in microwave radio communications with a vehicle moving in a built-up area is the rapid and extreme variations of received signal which result from multipath interference due to reflection of the radio waves by buildings etc. The nature of this problem is tackled in the first chapter, which gives a comprehensive statistical analysis of the fading and other properties of the received signal, based on a mathematical model of the multipath process, and discusses means of simulating these effects.

The highly mathematical treatment may deter some readers, but those prepared to study the chapter will find a helpful explanation of the electromagnetic environment and its effects on the operation of land mobile systems. This provides necessary background for a proper understanding of the system design aspects considered in later chapters.

The second chapter covers more familiar aspects of radio propagation relevant to the prediction of average signal levels, path losses and estimates of coverage area. Aerial performance and the use of directivity for both mobile and base stations, together with polarisation and diversity effects, are discussed in the third chapter, which completes the first part of the book.

The second part opens with an analytical review of the different forms of modulation and multiplexing, including digital modulation, and compares their merits for mobile communications. The next two chapters examine in detail the principles and techniques of diversity reception which is of particular relevance at microwave frequencies in combating the effects of multipath interference. The final chapter is devoted to considerations of layout and organisation of high capacity mobile radio systems, and discusses the sub-division of large service areas, methods of radio frequency channel allocation, and traffic handling.

The text progresses logically and the book as a whole is well presented and liberally illustrated with clearly drawn figures. Each chapter begins with a synopsis, covering one or two pages, forming a helpful guide to what follows. This is a commendable feature that could with advantage be adopted more widely.

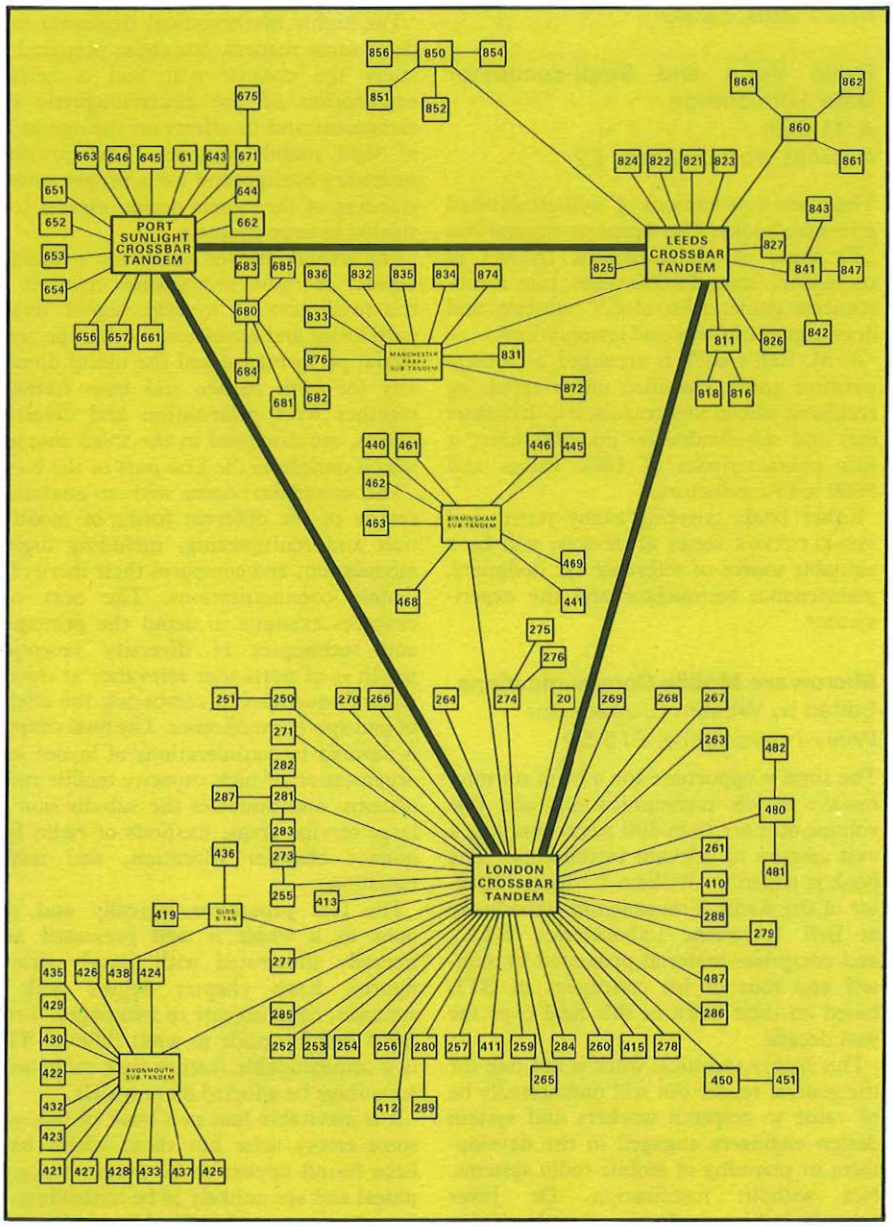
It is inevitable that in a book of this sort some errors arise but those which have been found appear to be purely typographical and are unlikely to be misleading. It is perhaps a pity that SI abbreviations are not used as this would make the text and particularly the figures easier to follow. The use of w, for the baseband filter cut off frequency as in chapter 4, can lead to confusion; similarly one would expect signal strength to be in terms of w/m^2 or v/m rather than in dBm as on page 125.

Despite these minor criticisms, the book is a welcome addition to text books on mobile radio matters. Although primarily a book for the specialist it can also serve as a useful reference for the less expert reader.

MBW

Biggest in Britain

Nationwide locations in the giant Unilever organisation have been linked by the largest private telecommunications network in the country.



The Unilever telecommunications network, showing links between the PABXs (numbered) at various locations and the main tandem and sub-tandem switching centres.

THE OPENING of Britain's largest private telecommunications network by Unilever, in October last, marked the culmination of more than 10 years' intensive study, planning and development effort to which the Post Office has made major contributions. The network links 135 private automatic branch exchanges at the group's premises throughout England, Scotland and Wales, and in addition to telephone calls it gives total integration of all other forms of communication used by modern business.

Plans for the network really began, following the report in 1964 of a study group set up to look at the telecommunications needs of Unilever's widespread and diverse interests in this country. The group found that existing communications, although quite comprehensive, were inadequate – mainly because of the growth of independent services by Unilever companies with locations in different parts of the country.

These developments were uncontrolled and commissioned without an awareness of the needs and facilities of other companies within the group. For example, Unilever's Thames-side and Merseyside units communicated with each other by way of half-a-dozen independent routes.

Among the study group's main recommendations, therefore, was that existing telephone arrangements should be developed and brought under central control, and that a consultancy service should be set up under a specialist manager to draw together and co-ordinate all aspects of Unilever's private telephone, telegraph and data transmission services.

Following acceptance of these recommendations, development was aimed at providing fully integrated, efficient and cost effective communications. Working closely with Post Office Telecommunications, a network design was evolved over several years. The result is, in many respects, a private subscriber trunk dialling and communications network, nationwide in extent, which currently reaches some 30,000 telephone extensions at 177 separate Unilever offices, factories, distribution and computer centres.

Post Office staff at Telecommunications Headquarters and in the Regions have been closely involved in different aspects of the design, development, commissioning and servicing of the network. The system, extending many thousands of circuit miles, uses more than 800 private trunk and junction circuits supplied by the Post Office, who also provided 95 of the PABXs in the system.

At the heart of the network is a "delta" configuration of three main tandem or transit network centres – in London, Leeds and Port Sunlight, Wirral – which employ four-wire switching. The main telecommunications highways between these common control crossbar switching centres are Post Office wideband (multicircuit) links known as supergroups, each with a capacity of 60 telephone channels.

This triangulated transit network of high-grade circuits also affords alternative routing of calls and enhances the viability and capability of the network to handle traffic. Initially, 48 circuits are being used on the London–Leeds and London–Port Sunlight

links, and 24 circuits are in service between Leeds and Port Sunlight. The spare capacity will help to cater for future growth of the network.

Each tandem switching centre serves a number of local PABXs at Unilever locations, either by direct connection or through an intermediate sub-tandem switching unit. At present 70 of the 135 PABXs in the network are directly connected by private speech circuits to their main tandem centre, the number of links varying from a single circuit to 75 circuits.

In addition to connection to the private network, each PABX is linked through its local telephone exchange to the public telephone system. Such calls, cannot, of course, be extended over the private network to other Unilever locations.

Links between the three main tandem centres and the 16 sub-tandem units in the network use Post Office wideband groups, each capable of providing 12 telephone channels. Overall, a total of four supergroups and 17 groups are in service, and another eight supergroups and groups are in the planning stage for implementation in the next two years.

The entire network, including privately purchased equipment, is being maintained by the Post Office, and its future management will be handled by the North Eastern Telecommunications Region. An innovation for the Post Office was the setting up of a fault reference centre in Leeds to cover network maintenance and surveillance, and to deal with faults anywhere on the network interconnecting all PABXs and tandems. Purely local faults continue to be handled by local Post Office fault reporting centres.

Setting up of the fault reference centre is a further extension of Post Office arrangements covering overall maintenance responsibilities for territorially large and complex private circuit networks by means of private circuit network controls and network service liaison officers. These concepts provide, among other things, a single responsible point for Post Office liaison with the individual customer on overall network maintenance service and network problems, combined with continued delegation of responsibility for local equipments to the individual Telephone Areas concerned.

Owing to the size and complexity of the Unilever network and its analogy to STD, the fault reference centre was added to support the network liaison officer at Leeds on a day-to-day basis,

(Turn to page 30)

Formula for efficiency

MR T. W. BAKER, Telecommunications Manager of Unilever Ltd, outlines some important factors in the planning and development of his company's new private network:

"IN THE past 10 years our main objective has been to provide Unilever with the most suitable, convenient, efficient and cost effective communications. At any one point in time it would be reasonable to say our goal had been achieved. But the telecommunications business is changing, companies are constantly reshaping themselves and new technologies allow managements to have much more information than before. All this means that telecommunications services must respond to this new environment and, therefore, our main objective is a continuing one.

"To satisfy the needs of management both now and in the future it is essential to ensure that whatever information is required, irrespective of its source, it is available when and where the manager needs it. This means we must provide desk to desk and desk to data processing facilities, and we must ensure adequate services at all times.

"The Unilever private network was therefore redesigned to meet these needs, and during the last few years the Post Office, manufacturers and my own department have worked towards the introduction into the network of new switching equipment and facilities which will enable us to meet these objectives.

"The crystal ball we gazed into four or five years ago to help us decide our planning parameters was decidedly murky. If we looked again today we might see things a little more clearly. Within Unilever, and undoubtedly in other large companies, studies are in hand to determine the company's communications needs. What should we communicate? How should we communicate?

"To answer the first question we have to identify the needs of the business – where the information is to be transmitted from one company or unit to another. In its widest sense it is the information that enables management to plan, control and optimise quality of its decisions.

"Answering the second question is to make sure all available communication media are known and understood and to explore how we are motivated to communicate: What makes us choose in different circumstances and how modern developments could change this choice.

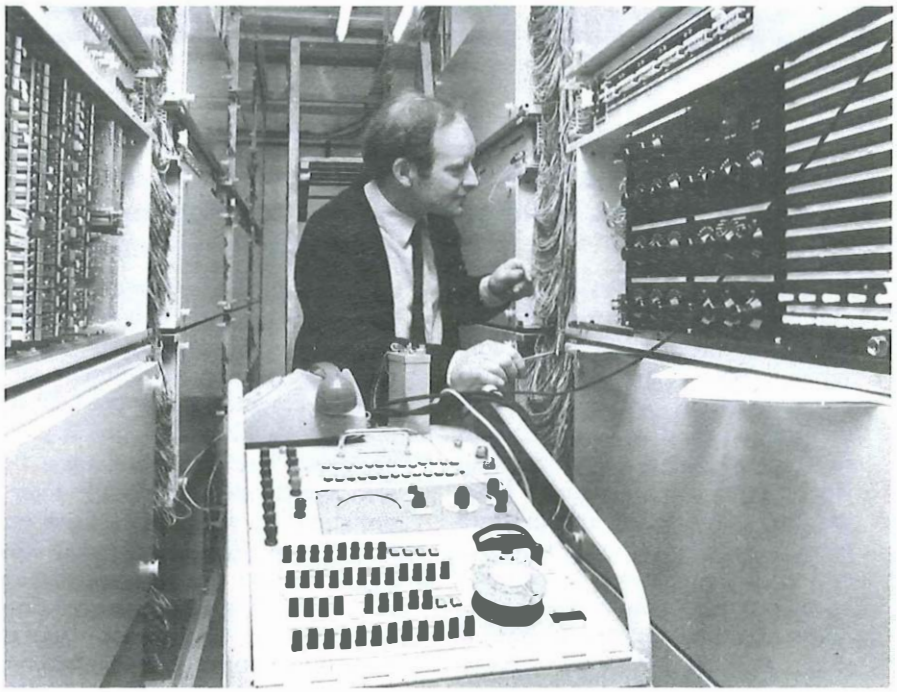
"The crystal ball, therefore, must be seen a little clearer, but the interpretation of what we believe we have seen requires a measure of imagination and the will to provide services in advance of their requirement. And so, after much preparation, an investment of £750,000 for new switching equipment and facilities was approved by Unilever in 1972 and, as a result, we believe the group has the largest integrated private communications system for a business house in the world.

"As data modems increase in sophistication and become more tolerable of communication channels, there is a growing case for integration of data communications and telephony in the switched mode. For certain batch, remote job entry applications of computers it is equally possible to provide a through (non-switched) circuit utilising wideband channels, and high-quality end links.

"However, the desk to data processing function is obviously the way a manager will link with his decision-making aids. The modes of operation will be many and varied and will include interrogation and response, data input and retrieval from strategically located data banks or to time sharing computer bureaux.

"During the three-year planning and implementation period many departments of the Post Office have contributed with contractors and Unilever Telecommunications in resolving policy, design and service problems that large networks bring with them.

"It is hoped that each time this type of activity is pursued, something gets written into the record. For our part, we believe the establishment of the fault reporting centre facility with an overall network service liaison officer for private networks is a major step forward."



A check is carried out on a wiring block at the London main tandem switching centre in Unilever's private network.

and was set up in advance of the opening of the Unilever network. The requisite fault reporting and network surveillance facilities have also been agreed between the Post Office and Unilever.

Introduction of the network has allowed Unilever to achieve a long-standing requirement of a universal numbering system and comprehensive directory, providing abbreviated dialling of internal calls between distant locations throughout the country. In addition, there are private lines between the group's two head offices in London and Rotterdam.

Apart from telephone calls, the network is being used to convey written and graphical information by facsimile transmission between terminals installed at key locations. Data is also transmitted between the group's computer centres and remote terminals, either over switched connections or specially provided point-to-point circuits.

Looking to the future, Unilever plans to link the new network with a similar private network proposed for its Netherlands companies, thus providing direct desk-to-desk dialling between company establishments in the two countries. The feasibilty of connecting the UK network to Unilever's head offices in Germany, France and Belgium is also under discussion. Beyond speech and data, the Unilever telecommunications group is examining the prospects for visual telecommunications conference facilities between its offices situated in London and in the Netherlands.

Another internal service which the Unilever network offers potential for exploiting is the group's computer based typing and word-processing system in which the typist uses a visual display unit (VDU) and associated keyboard equipment.

All typed characters are displayed on the VDU screen and corrections can be made simply by pressing an erase button and inserting the right characters. The typist's unit is linked by data transmission facilities to a small computer which controls the operation of remote automatic typewriters to produce the final copy.

Work is retained on magnetic discs in a file store linked to the computer, and standard letters and documents can be instantly retrieved and displayed on the VDU for amendment as necessary. When alterations have been completed the typist stores the job back in the computer, which then allocates it to a typewriter.

At present the word-processing system is in use only at Unilever's London office. When other locations in Britain are equipped with similar systems it will be possible, by means of data transmission techniques, to make use of the new network so that letters, memos, reports and so forth prepared at one location can be typed out at their destination. This would be done by the originating computer transmitting the material over the network to the receiving computer.

MISCELLANY

Madley goes ahead

The go-ahead has been given for the building of the new Post Office satellite earth station on an 80-acre site near the village of Madley in Herefordshire. Following planning permission, the Post Office has announced a contract for the first phase of the project, excluding the aerials and associated telecommunications equipment.

Ultimately, the earth station will have up to six aerials, but the Post Office is limiting the first phase to the construction of three single-storey buildings and other site development work needed for up to three earth terminals.

Initially one aerial will be built and equipped but two more aerials will probably be needed towards the end of the decade to meet growth in services between Britain and countries served by satellites over the Atlantic Ocean. The second stage of building and site development will not begin until the 1980s.

When in service in early 1978, the first aerial will work to a satellite over the Indian Ocean.

13 million telephones

The number of telephone installations in Britain now exceeds 13 million. Post Office figures show that at the end of October last 13,010,000 people were on the telephone – 662,300 more than at the same time in the previous year.

The number of telephone instruments in use at 31 October was 20,807,000, an increase of nearly one million over the 12-month period. Of these, more than 11 million were at private addresses and the remainder on business premises.

Honour

The first woman to become Director of a Post Office Telecommunications Region has been honoured by her old university. Miss Ena Knight, Director of the Eastern Telecommunications Region, has received the honorary degree of Doctor of Science at the City University in London.

For the diary

A conference on "Communications Equipment and Systems" will be held as an integral part of the Communications '76 international exhibition in the Metropole Convention Centre, Brighton, 8–11 June.

The conference is being organised by the Institution of Electrical Engineers, and will include sessions based on fixed radio communications, mobile radio communications, and civil, public and private telecommunications.

Registration forms and programme details for the conference are available from the IEE Conference Department, Savoy Place, London WC2R 0BL.

The venue of another international exhibition and conference this year, Communication '76, has been changed to West Germany. Originally planned to be held in Rotterdam, the show will now take place at the Gruga Messe Halls in Essen, 7–10 September.

The Essen exhibition will include equipment and services for telecommunications administrations and also private systems. These will cover speech, data and facsimile, as well as audio-visual and broadcasting equipment. Communication '76 is being supported by the German PTT and is organised by Montan Ausstellungs GmbH.

Datel to South Africa

Directly-dialled data transmission services between Britain and South Africa have been started by the Post Office. Using International Datel 200 or 600, computer users are now able to send data to South Africa on a directly-dialled call – the first intercontinental Datel service to be sent over the international subscriber-dialled network. Calls can be dialled direct to the South African towns which are available on ISD from the UK.

Two new services

Two new ex-directory services are being offered by the Post Office in addition to the existing full ex-directory service. With the new services, customers will be able to arrange – free of charge – for their number to be listed in special records used by directory-enquiry operators and given

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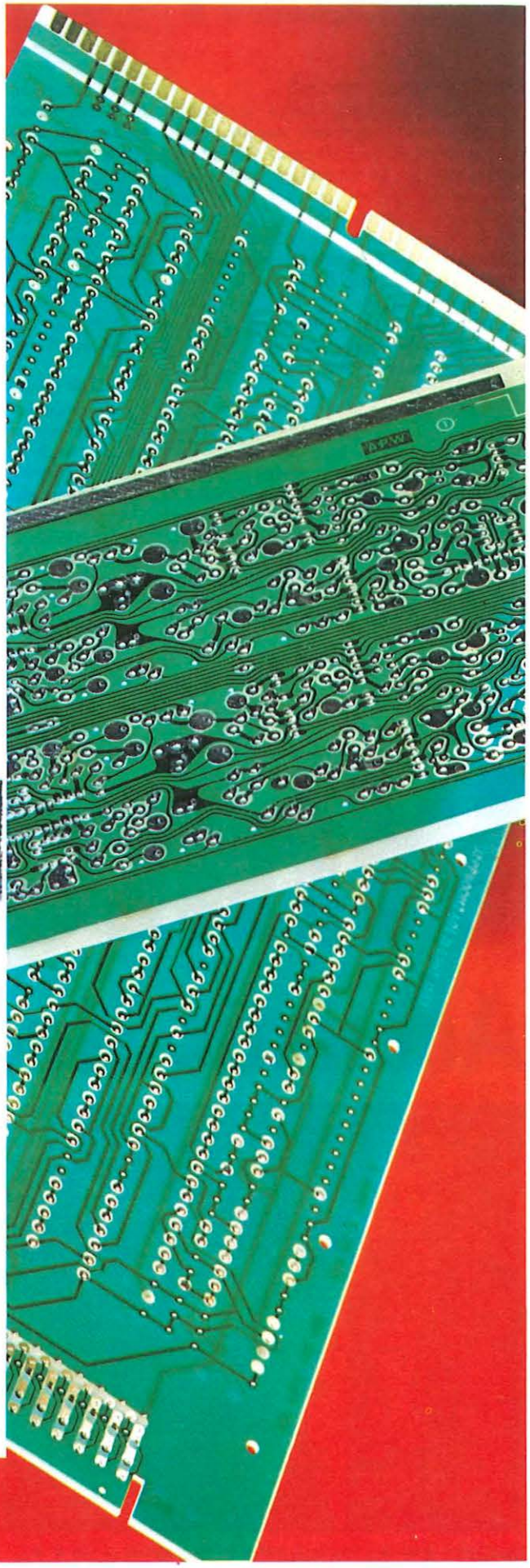

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to callers on request. This is intended to meet the needs of customers who do not want their names, addresses and telephone numbers to be listed in public telephone directories but wish the number to be given to callers who quote their name and address to the operator.

Alternatively, for a charge, ex-directory customers can obtain a "call-filtering" service. The local operator dealing with enquiries about ex-directory numbers would give customers the choice of accepting or refusing calls from strangers, who would first have to identify themselves.

Under the full ex-directory service operators will not put through calls to people opting for this service and numbers will not be disclosed. Callers who insist there is an emergency will be advised by the operator to go to the police.

Appointments

Mr A. J. Barker has been appointed Director of South Eastern Telecommunications Region. Head of the Grading Division in Telecommunications Pay and Grading Department for the past two years, he was formerly General Manager at Brighton and South Eastern Regional Planning Controller.

Mr M. Morris has been appointed Director of Post Office Telecommunications Management Services. A principal private secretary to three Postmasters General, he has also worked both at Telecommunications Headquarters and in the External Telecommunications Executive, and more recently was Deputy Director of Finance and Personnel in the London Telecommunications Region.

ISD extensions

Finland and Cyprus can now be dialled direct from Britain as part of a Post Office drive to extend international dialling. Customers who dial their own calls will normally find it quicker and cheaper than using the operator.

These extensions of ISD bring to 26 the number of countries which can be dialled direct from the UK. Some 60 per cent of British telephone users now have ISD facilities, enabling them to dial direct to 250 million telephones throughout the world. The addition of Finland and Cyprus puts another 1½ million telephones at their fingertips.

Cheaper data

A cheaper way of sending data between Britain and Canada has been introduced by the Post Office and the Canadian Telecommunications Corporation. Cost reductions are made possible by taking data signals from different customers in Britain and Canada and combining them for transmission accross the Atlantic. The new service could mean savings for British customers of up to 10 per cent on rates for existing data transmission services over leased circuits.

The service provides point-to-point data transmission between Britain and Canada at various data rates. For asynchronous transmission, the available rates are 50, 75, 110, 134.5, 150, 200, 300, 600 and 1,200 bit/s. Initially, synchronous transmission is possible at 2,400 bit/s at the start; other rates will be available later. At present, data transmission between Britain and Canada is by International Datel or private leased circuits.

Metric directories

Britain's first metric telephone directory – for Sutton, Surrey – has been distributed and during the next two years the rest of the country's 154 telephone directories will also go metric in size.

The change to a metric format enables the Post Office to fit an extra 30 entries on each page. Volumes can be kept slimmer and the need to split directories into two or more volumes – considered when a directory exceeds 1,000 pages – can be deferred longer.

The Post Office first announced its intention to change telephone books to the A4 size in July 1973, to give plenty of time for directory users and suppliers of furniture, office equipment and materials associated with telephone directories to prepare for the change.

Contracts

Marconi Communication Systems Ltd – More than £1 million worth of pulse code modulation equipment. The order covers the supply of 24-channel PCM systems for use in the South Eastern and North Eastern Telecommunications Regions and Northern Ireland. It also includes the supply of a quantity of equipment designed to protect PCM line systems from high induced voltages, such as those caused by lightning.

Standard Telephones & Cables Ltd – £25 million, awarded by the Spanish National Telephone Company for a high-capacity undersea telecommunications link, called PENCAN-3, running 750 nautical miles between Chipiona on the Spanish mainland and San Cristobal in the Canary Islands. The system has a bandwidth of 45 MHZ and a capacity of 5,520 circuits.

First for telegrams

For the first time the Post Office has provided a First Day of Issue service on the introduction of a new greetings telegram design. Similar to the service for new stamp issues, the occasion was the addition on 2 February of a "Coming of Age" design to the current range of greetings telegram forms. The First Day of Issue impression was carried on the inside cover.

The whole series of greeting telegrams – for weddings, birthdays, 21st birthdays, births and all-purpose greetings is gradually being redesigned, and the First Day of Issue service may also be provided with these designs as they are introduced.

Publication and Price:
The Journal is published in January, April, July and October, price 12p per issue. The annual postal subscription is 80p – 48p (or life subscription of £4) for retired Post Office staff.

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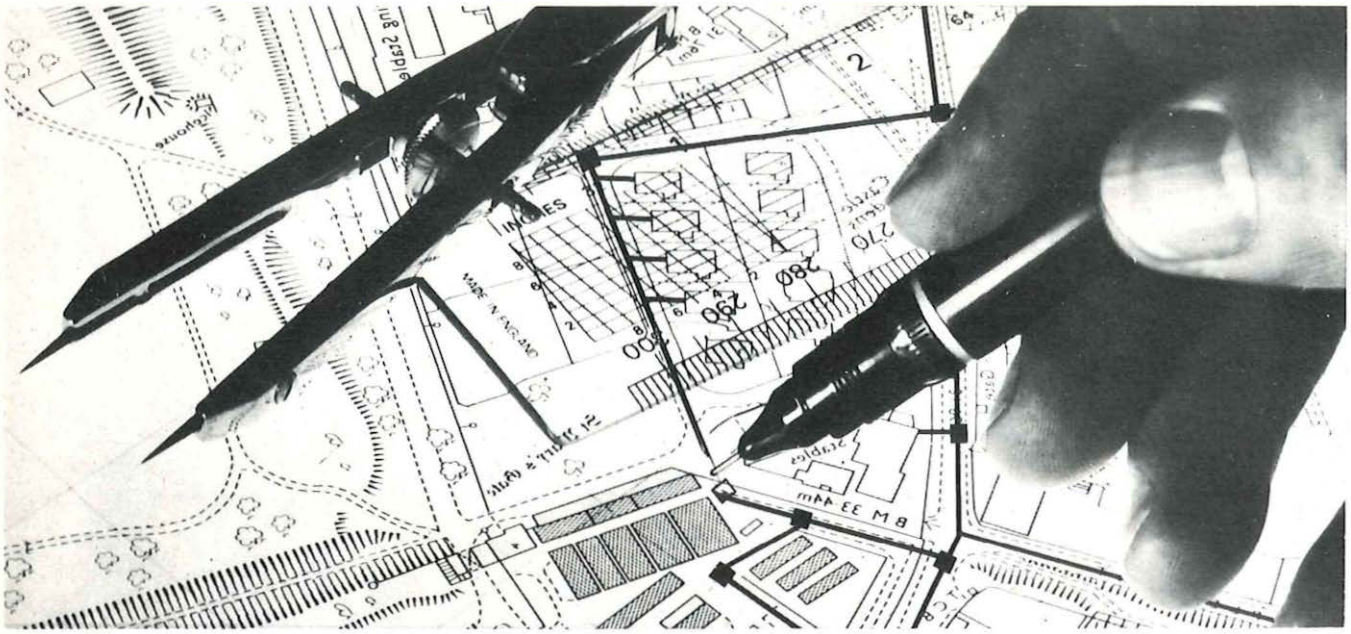
Contributions:
The Editorial Board will be glad to consider articles of general interest in the telecommunications field from all sources. No guarantee of publication can be given. The ideal length of such articles is between 1,000 and 2,000 words. The views of contributors are not necessarily those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

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.



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Transparencies are available of most maps at published scales. These include copies of 1:1250 and 1:2500 maps and up-to-date surveyors' master survey drawings, 1:10,000 and six-inch maps (not showing contour lines). 1:25,000 and smaller scale transparencies are made from outline editions and do not show contours.

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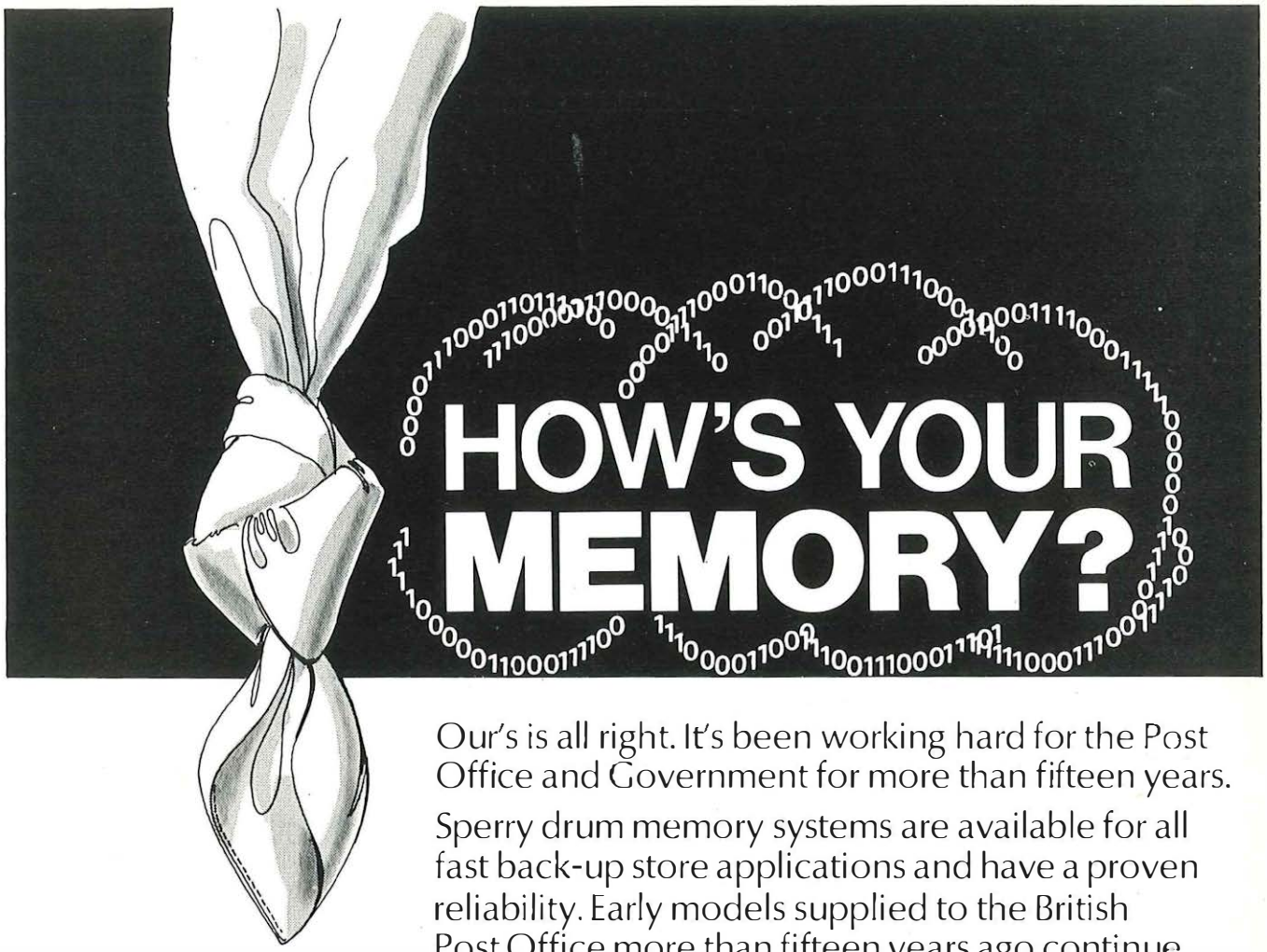

Our's is all right. It's been working hard for the Post Office and Government for more than fifteen years.

Sperry drum memory systems are available for all fast back-up store applications and have a proven reliability. Early models supplied to the British Post Office more than fifteen years ago continue to give excellent service. Current models incorporate the latest storage techniques and provide bulk data storage for computers and message switching, telecommunications and similar data processing systems. For example, Sperry memory stores together with our 1412 mini-computers are the principal modules in the SCAMP (Sperry Computer Aided Message Processor) System.

For more information about Sperry memory systems contact David McNaught. Bracknell 3222.

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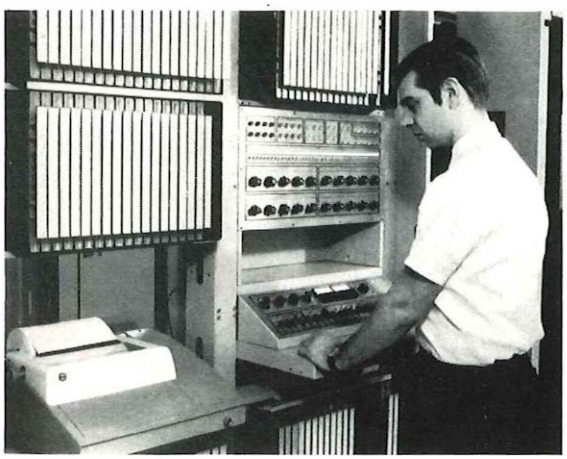
Stored program for the small



Since 1970 telephone administrations have found our C1-EAX with stored program control provides reliability and profitability for small or remote exchanges. They also like the GTE know-how that gives them a design that can now be expanded up to 7200 or more lines/trunks without disturbance to the system in service.

By mid-1975 orders had been received for 231,700 lines at 134 sites. There were 120,780 lines in service at 94 sites.

Here are some of the forward-looking administrations that have ordered or installed this modern high-speed exchange.

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British Columbia Telephone Company
Canadian National Telecommunications
Community Telephone Company of Ontario
Hydro-Quebec
Island Telephone Company
Manitoba Telephone System
Maritime Telegraph & Telephone Company Ltd.
Montreal Urban Community
Newfoundland Telephone Company
Okanagan Telephone Company
Quebec Telephone
Saskatchewan Telecommunications
Telephone du Nord de Quebec Inc.

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Compania Dominicana de Teléfonos C. por A.

REPUBLIC OF MEXICO

Telefonica Nacional, S.A.

UNITED STATES

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General Telephone Company of Florida
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General Telephone Company of Indiana
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General Telephone Company of Pennsylvania
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SPC know-how.

control designed exchange.

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General Telephone Company of Upstate New York

General Telephone Company of Wisconsin

Hancock (New York) Telephone Company

Hawaiian Telephone Company

Lincoln (Nebraska) Telephone & Telegraph Company

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Plessey Pentex electronic telephone exchanges

Plessey Telecommunications has been developing and manufacturing exchange systems and subscriber equipment for nearly 70 years. The Company's policy of continual development has resulted in a new generation of exchanges – the PENTEX family – designed to meet the complete requirements of telephone administrations. PENTEX has been in production since 1966 and the performance, flexibility and reliability of this advanced system has been fully proved in service – in more than 500 installations, large and small, in many parts of the world.

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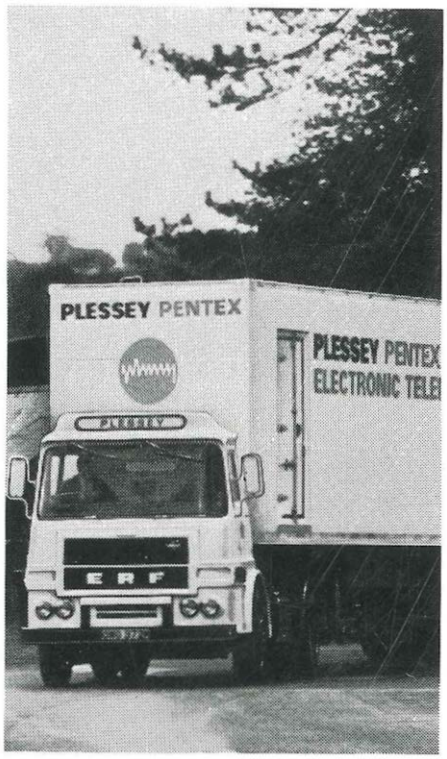
Although Pentex provides new services and facilities, together with the enhanced reliability and versatility provided by the latest solid-state control circuitry and reed-switching, it is also completely compatible with all types of existing electromechanical exchanges and, more importantly, with any foreseeable form of exchange development. Thus, Pentex is making an important contribution to the modernisation and the extension of national networks in many parts of the world.

The Pentex range provides efficient, cost-effective answers to almost any exchange requirement – from the smallest end exchange to main exchanges with 20,000 lines or more. The family also includes 2-wire and 4-wire tandem exchanges, containerised exchanges designed for fast installation and fast extension when additional capacity is needed, and small exchanges from 50 to 500 lines. This versatility and flexibility is due, in large part, to modular design and common technology and construction practice. Pentex exchanges are available at short delivery – meeting specific traffic and facility requirements. Additional facilities can be quickly and economically installed at any time with little or no interruption to traffic.



Pentex exchanges are operating throughout the world with maintenance costs far lower than those of electromechanical systems and with a figure of reliability setting new standards for telephone administrations.

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