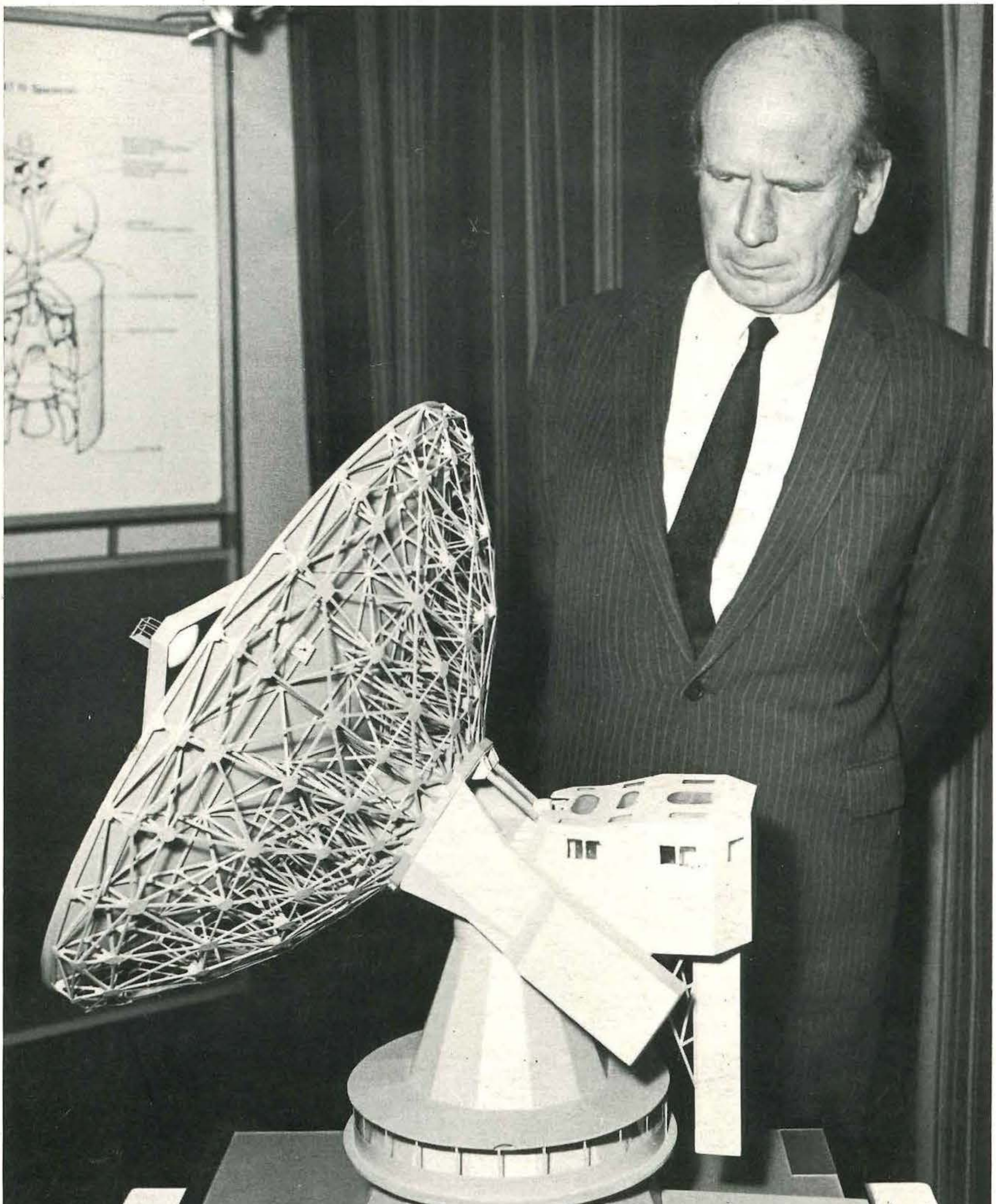
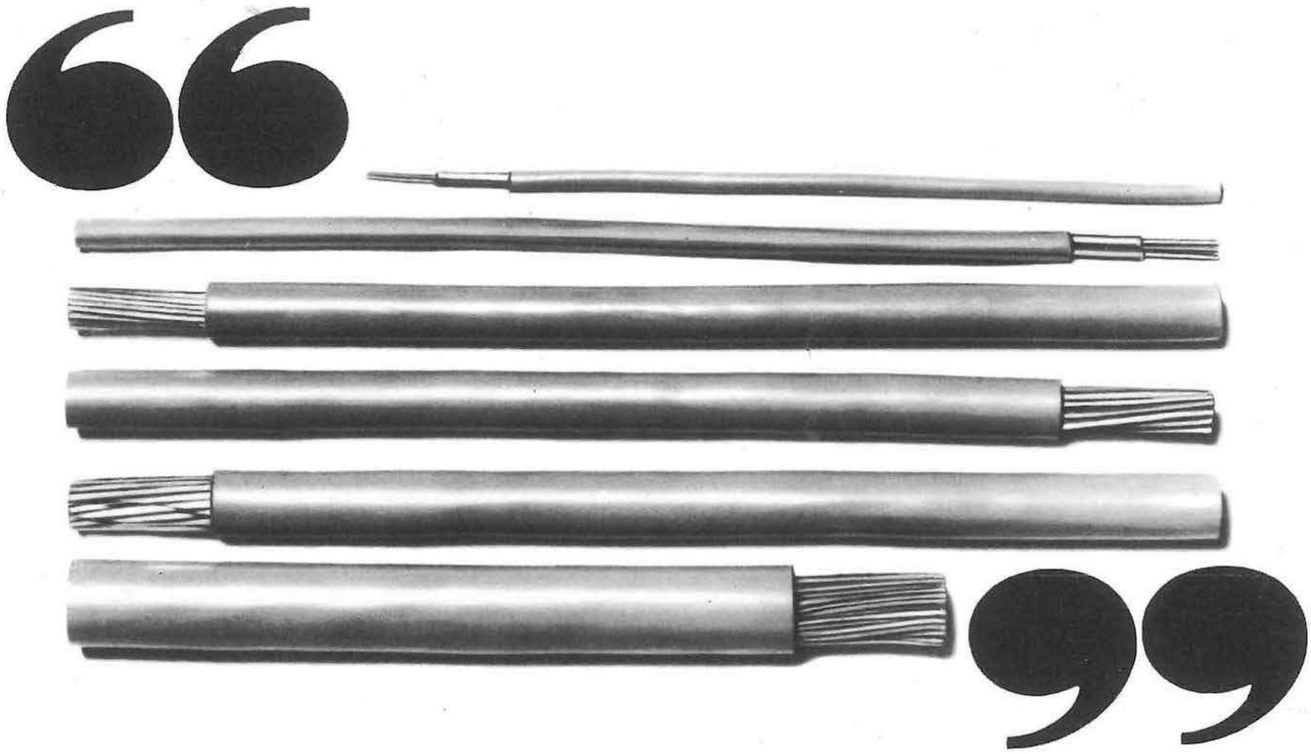
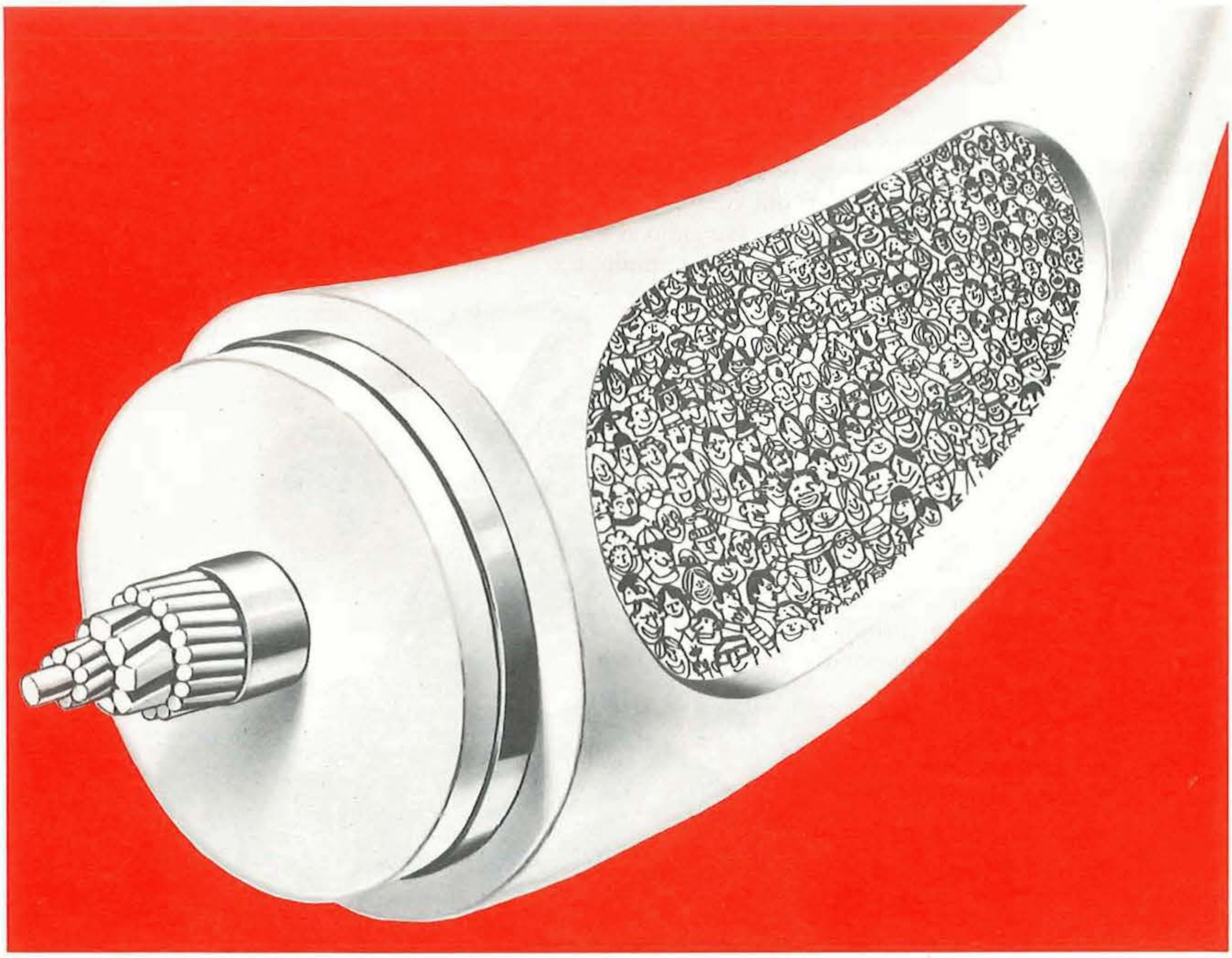
Post Office telecommunications journal

One shilling and sixpence Autumn 1970 Vol. 22. No. 3







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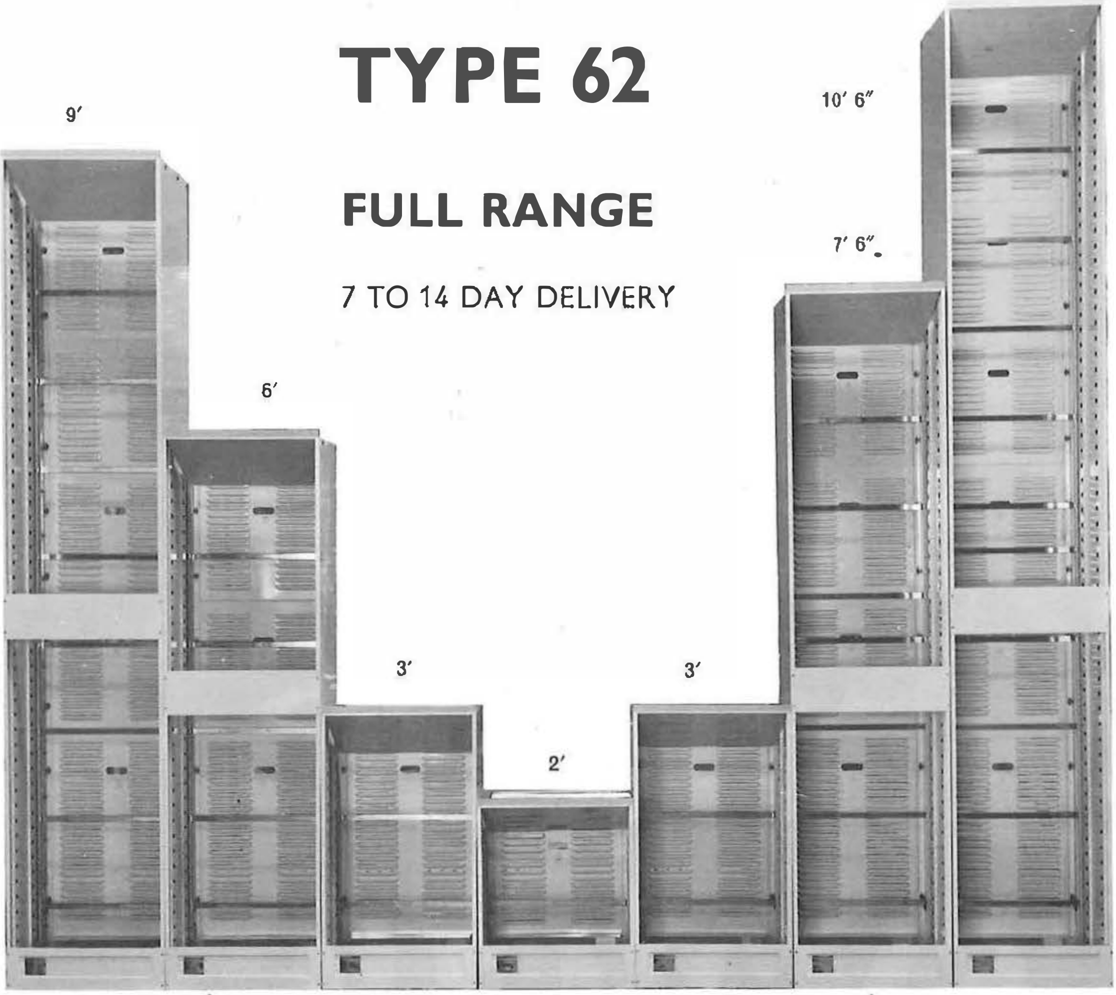

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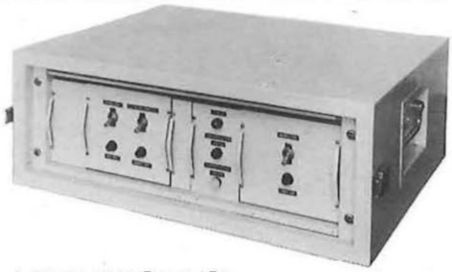

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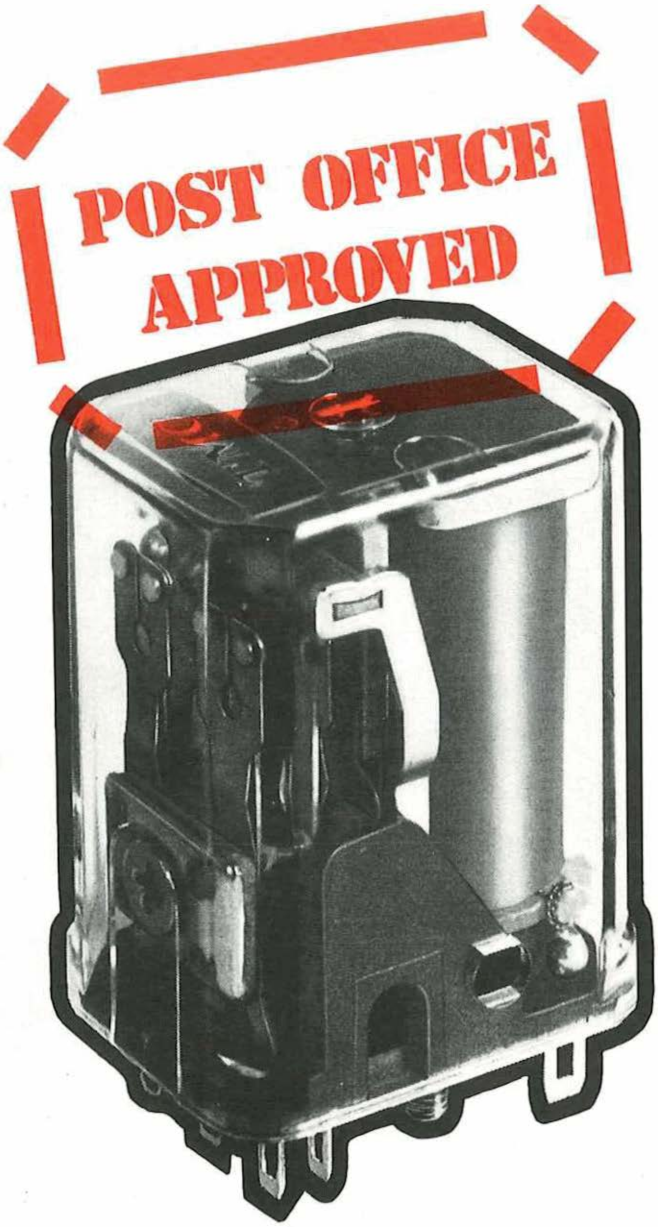

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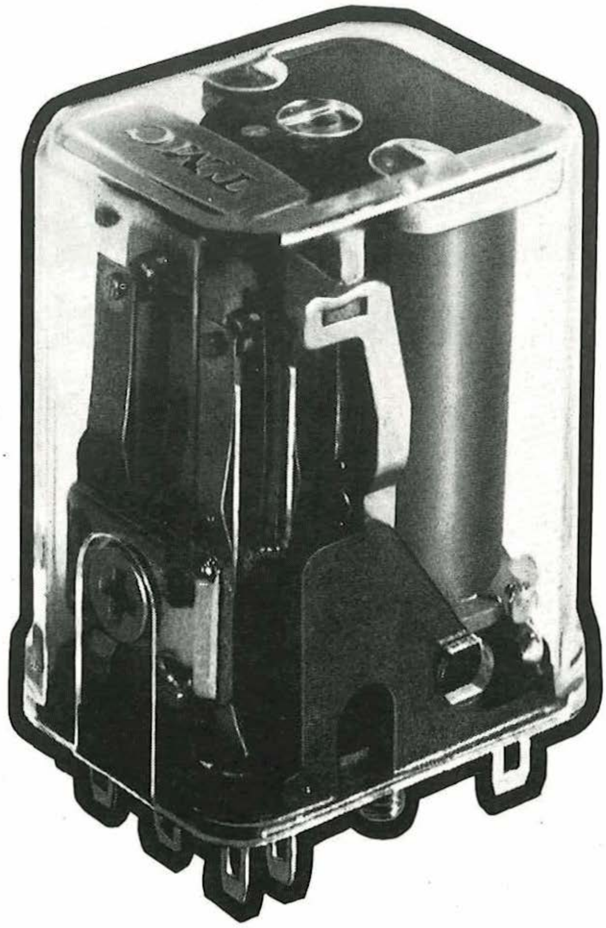

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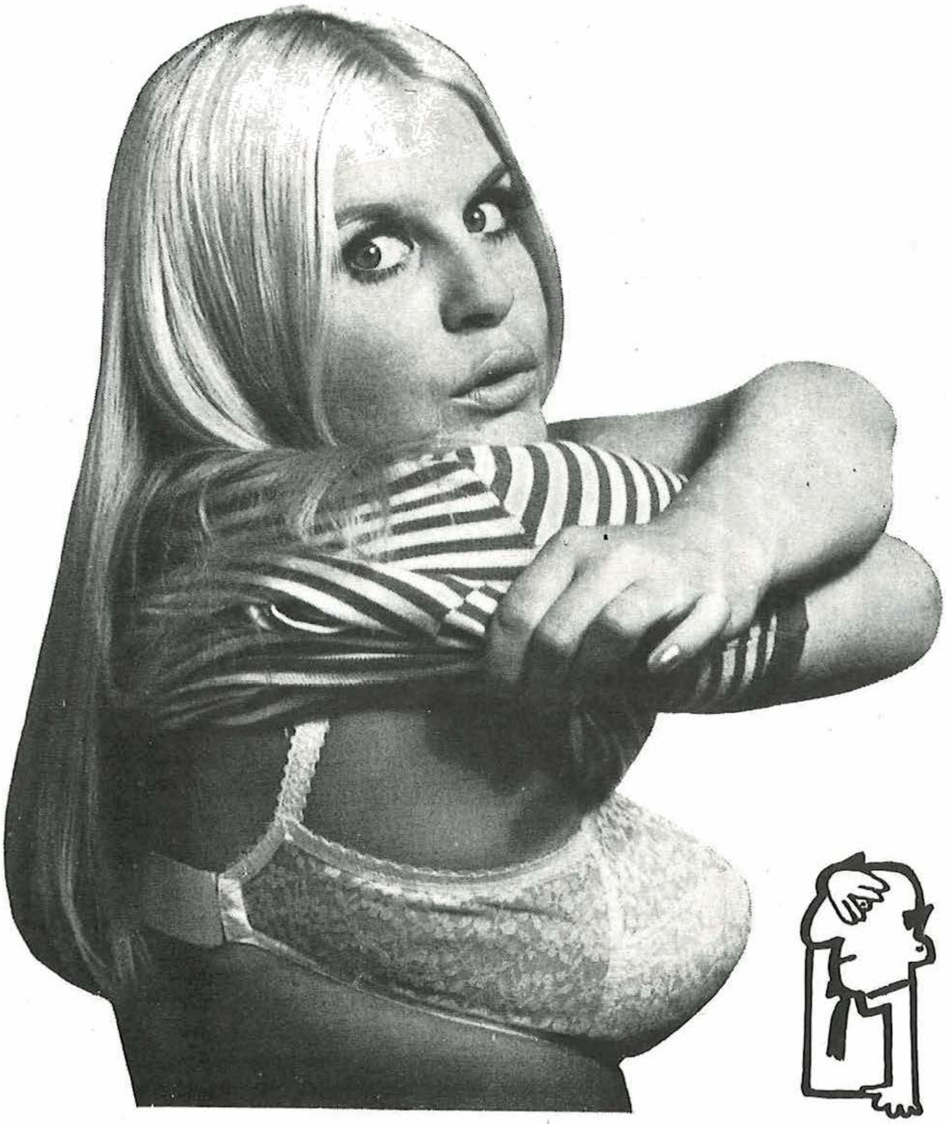

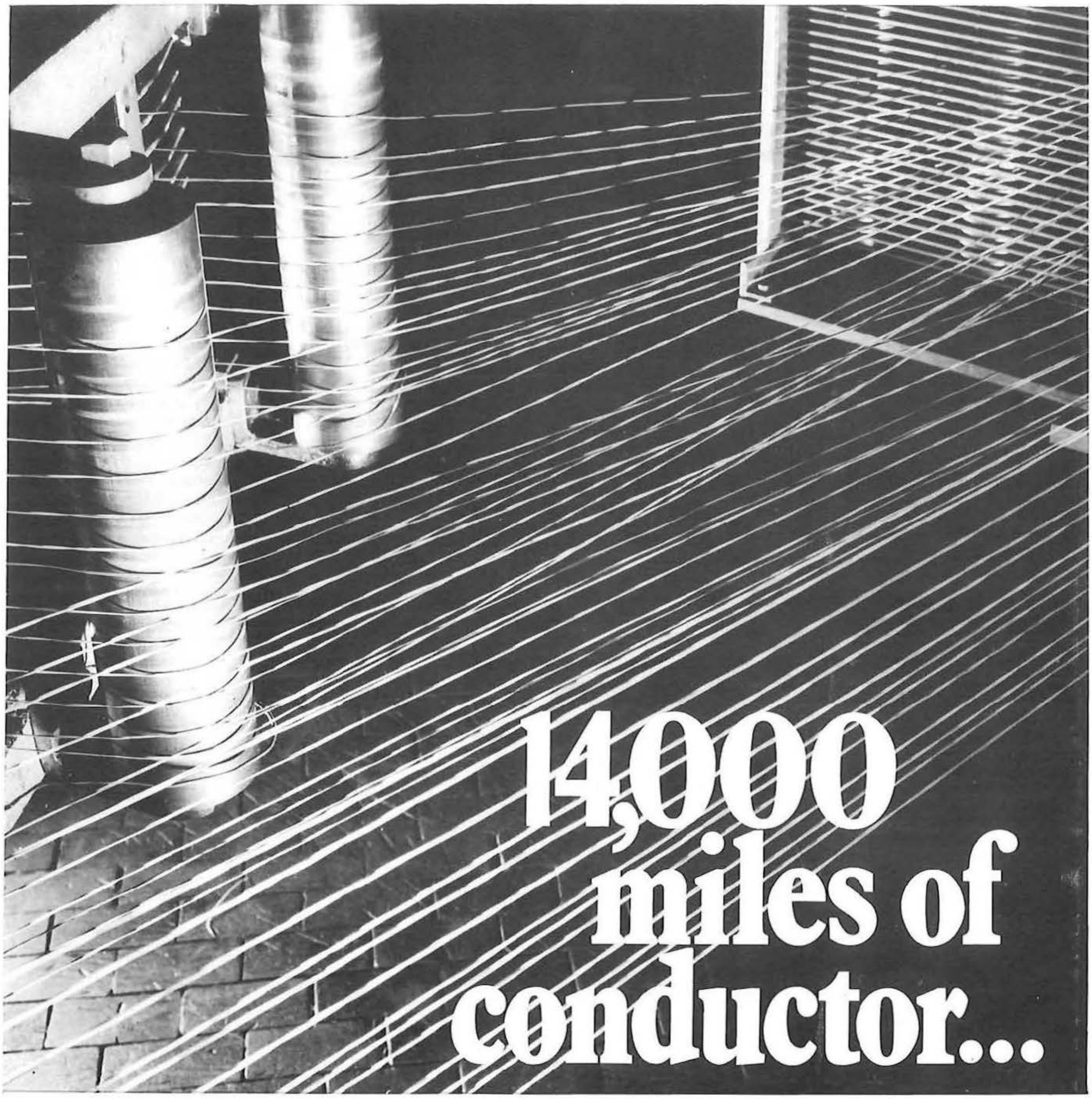

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Post Office telecommunications journal

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

Vol. 22 Autumn 1970 No. 3

On the anniversary of the setting up of the new Post Office corporation Mr. EDWARD FENNESSY, Managing Director, Telecommunications, takes a broad look at . . . .

The challenge of the seventies

TWELVE months after Vesting Day, with a year's experience as Managing Director, Telecommunications behind me, is perhaps an appropriate moment to take a broad look at the Telecommunications business.

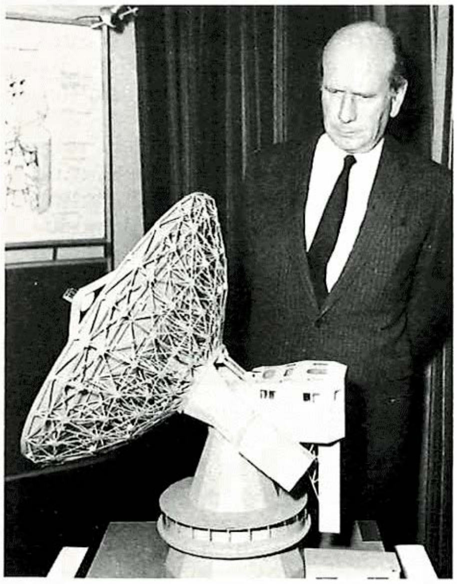
A year is not long to absorb and understand a business that employs nearly a quarter of a million people; that has assets in excess of £2,000 million; that spends over £1 million every day on new plant and buildings; that serves nine million subscribers. Such a vast business is not the subject for hasty judgement.

A managerial approach appropriate to smaller businesses would, on account of the scale of the Telecommunications business, be quite inappropriate. Few companies in Britain employ more people, very few have greater assets and none has a capital expansion programme approaching that of Post Office Telecommunications. Yet people are still more important than capital assets. In attempting to understand our business one has to consider both the 250,000 men and women who work within it and our customers, almost the entire population of the country above the age of ten, who use the telecommunications network. The skill and energy of all who work or have worked in telecommunications has built the system that we know today and these qualities will create the future system. In this respect the Post Office and the public are well served. I have found that there exists within the Post Office a sense of responsibility and public service that I believe is unequalled in Britain. It is vital that this spirit be fostered and encouraged, although at times there may be problems and misunderstandings.

I believe that the vast majority of the public we serve appreciate the high quality of service provided for them at what, by international standards, is a low cost. It is impossible to serve such a vast public without there always being vocal critics who will often damn the whole system because of some limited personal experience. But such failures, annoying as they may be to the person concerned, must be seen against the 10,000 million calls we successfully handle in a year. Such comments, which always command more attention than the praise of satisfied users of the system, must be placed in proper perspective. This does not mean we can be complacent. The task before us is a vast one. During the decade the total telephone system will double in size. A huge new data communications market will develop. New systems of waveguide transmission will become a reality. Video communication will begin to make its impact and many new customer services will become commonplace.

This vast expansion and extension of the telecommunications system must be successfully achieved during a period of very rapid technological development. Microelectronics and, in particular, large-scale integrated circuits offer a revolution in equipment design. Waveguide and light guide techniques offer the opportunity for dramatic reduction in transmission costs while computer techniques will bring to switching a new order of flexibility.

The immense range of technical opportunities that the 70s will bring presents to us one of the most difficult problems. How are we to make the fullest use of this techno-



COVER PICTURE: Mr. Fennessy looks at a model of the new aerial which is to be built at the Post Office earth station at Goonhilly, Cornwall. See next page.

IN THIS ISSUE

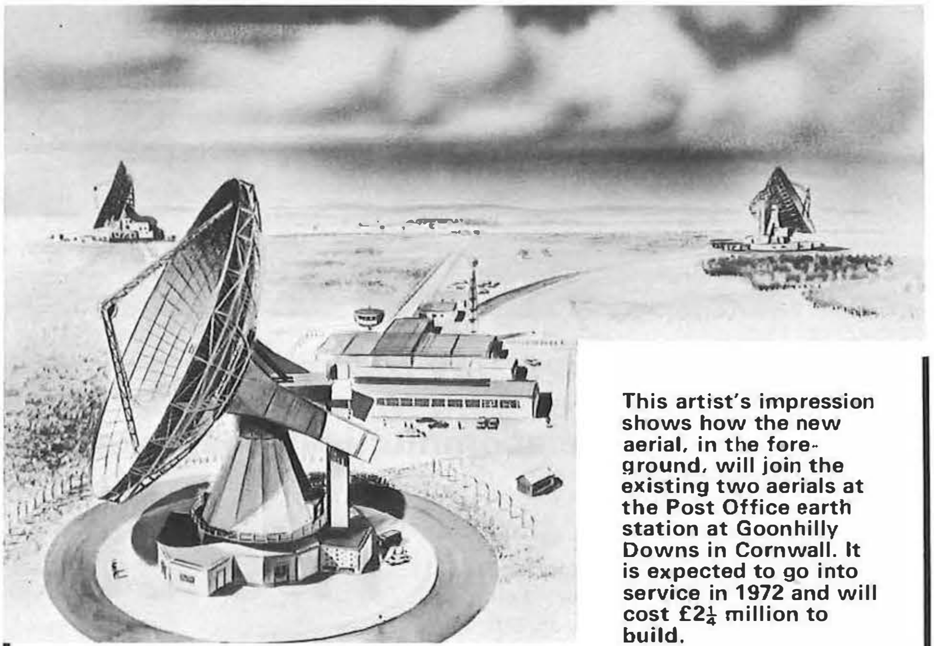
logical opportunity without chaos and confusion? In this we face a unique problem. The great and complex network of exchanges, both Strowger and Crossbar, cannot be replaced overnight by more modern equipment; indeed, not even over the decade. It is a hard, economic fact that the system of today which represents an investment at current values of over £2,000 million must continue to serve for many years to come. Into this vast system we must introduce all the new developments that the next ten years will bring in a way that makes technical, operational and financial sense. This means that as well as thinking about the equipment of the future we must think about the equipment available today.

A decade from now the system will contain large quantities of Strowger and Crossbar, working with the more advanced electronic equipments. We must ensure that we optimise the distribution and usage of the equipment currently available and that we do not lose sight of the realities of the situation—for example, design and development times, production rates and installation rates—when speculating about the equipments which may be available within the next few years.

The communications revolution, and that is what it will be, cannot take place without the most far-sighted view and the most thorough planning. Rash, ill-considered decisions based on inadequate knowledge could produce disastrous consequences. It is, therefore, essential that the work of our Long Range Studies Division and our new Corporate Planning Division should be used as a vital element in all medium and long-term decision making. Nearly all the major technical and operational decisions with which we shall be concerned will be long term in their consequences. We must recognise, understand and act on the opportunities and demands not just of today, but of the future.

As Managing Director of the business, my outstanding responsibility is not merely to see that the immediate problems of today are effectively dealt with but also to see that the massive expenditure of public money for which we are responsible is invested in a way that will ensure that well within this decade Britain has without question the finest telecommunications system in the world. Within the Post Office of today we have all the ingredients required to achieve this objective: these ingredients are money, technology and men and women with the skill and determination to succeed in the public service they perform.

The Post Office corporation could not have assumed responsibility for this great public service at a more challenging time. It is a challenge that all members of our Telecommunications business should find both exciting and demanding.



This artist's impression shows how the new aerial, in the foreground, will join the existing two aerials at the Post Office earth station at Goonhilly Downs in Cornwall. It is expected to go into service in 1972 and will cost £2¼ million to build.

Aerial number three for Goonhilly Downs

THE building of a third satellite communications aerial for the Post Office will make the earth station at Goonhilly Downs, Cornwall, one of the largest and busiest in the world. The new aerial—Goonhilly 3—is expected to go into service early in 1972. It has been specially designed to work with a new generation of satellites, Intelsat IV, which will have a far greater capacity than current satellites and will require different methods of aerial working.

The first Intelsat IV, to be launched into synchronous orbit over the Atlantic next year, will be able to carry up to 5,000 two-way telephone calls or the equivalent in TV transmissions. Even without the development of this satellite, a third aerial would have been needed at Goonhilly to cope with the growth of telecommunications traffic across the Atlantic.

A £2¼ million contract has been placed with Marconi for the building of Goonhilly 3. The 97 ft. diameter dish, with Cassegrain feed system, is larger than the other Goonhilly aerials, and the reflector panels will be made of aluminium instead of stainless steel. The aerial will be mounted on a reinforced concrete tower which will house the bulk of the radio equipment. Its automatic tracking system is entirely electronic.

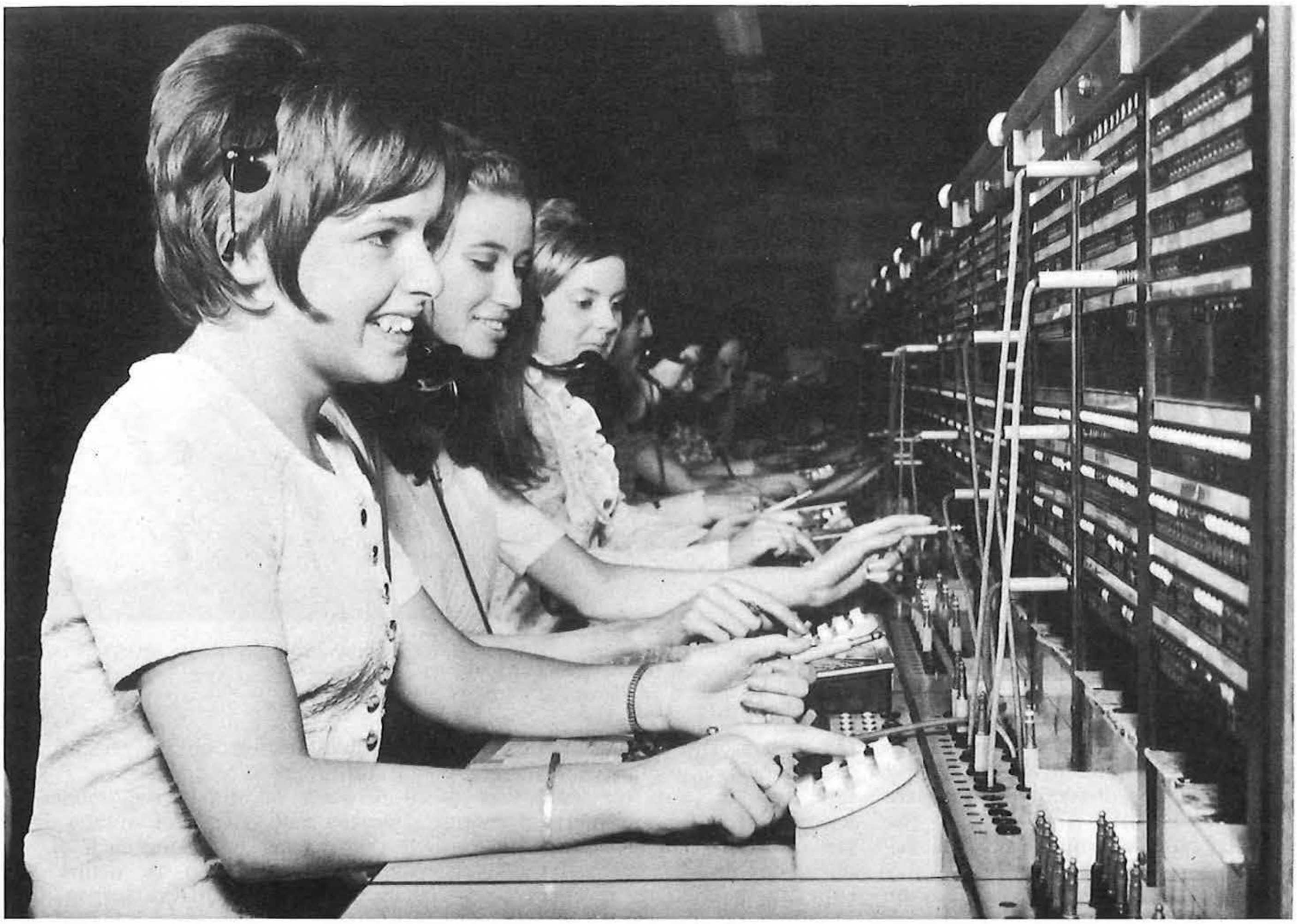
The receiving equipment will cater at first for 400 channels coming from 21 distant earth stations. The capacity of the system can be increased to at least 1,800 telephone circuits, provided on seven transmitted carriers and 33 received carriers.

Wide-band receiving equipment, cooled by gaseous helium to a temperature of 15°K (−258°C), and the high-powered transmitting stages will be housed on the aerial. For reception, frequency converting equipment, intermediate frequency equipment, modulators and demodulators will be installed in an extension of the central building of the earth station. The aerial will be linked to the control building by a single waveguide carrying all the received carriers in the frequency range 3,700–4,200 MHz.

At the central building the wide-band signals will be split into separate paths leading to the individual chains of equipment for each carrier. New strip-line techniques will be used in the branching networks and two-stage frequency converting equipment, greatly reducing the space required.

Four wide-band transmitters will be installed, each with a peak output power of 10 kilowatts in the 6,000 MHz frequency band. Two transmitters will be used for telephony channels with a third for television transmissions, and a fourth as a standby.

● More about satellite communications on other pages of this issue: A picture survey of earth stations of the world—page 15. The crowded spectrum in space—page 25.



Operators at St Albans Exchange using the keysenders.

Push-button dialling for exchange operators

By R. T. FARROW

WITHIN the next three years some 20,000 electronic keysenders (push-button dialling units) will be fitted at every cord-type automanual exchange in the country. They will take the place of conventional and slower rotary telephone dials. Wholly of British design and manufacture, they employ new and advanced techniques and have now enabled the British Post Office to become the technological leaders in this particular. field.

Although keysenders have been used for many years, up to the present time they have been relatively expensive and required considerable apparatus rack space. The new keysender requires no additional apparatus rack space and is economically most attractive since it costs very much less than its electro-mechanical equivalent.

The development of this new technology allows an electronic device to be used with traditional Strowger electro-mechanical equipment. Because the keysender has fewer moving parts it should be less prone to faults. Keying is faster than dialling and the operator is able to remember the number until the keying operation is completed, and no longer requires an intermediate reference to ticket or file as often happens with rotary dialling. It is also consistently more accurate in use.

The rapid introduction of keysenders has been made possible by the Telephone Manufacturing Company—part of the Pye Group—who, three years ago, set up a special design team to pioneer the use of microelectronic techniques in the telecommunications field. As a result they were able to offer the Post Office early last year a fully developed keysender unit which employed the world's first commercial application of custom designed, large-scale metal oxide silicon transistor (MOST) circuits. Just two MOST chips each less than two mm. square, but containing between them the equivalent of about 1,500 transistors, will perform all the functions of storage, sequencing of input and output information and timing . . . all necessary because the number information can be keyed so fast that it has to be stored and then forwarded to the Strowger equipment at a standard rate of 10 pulses per second.

The new keysender is completely self-contained. The keypad replaces the dial on the switchboard keyshelf. It is plug-ended and connects with the sender unit which contains all the electronic components and is fitted below the keyshelf. Installation is completed by connecting the wires from the dial mounting to tags on the sender unit and providing a power supply.

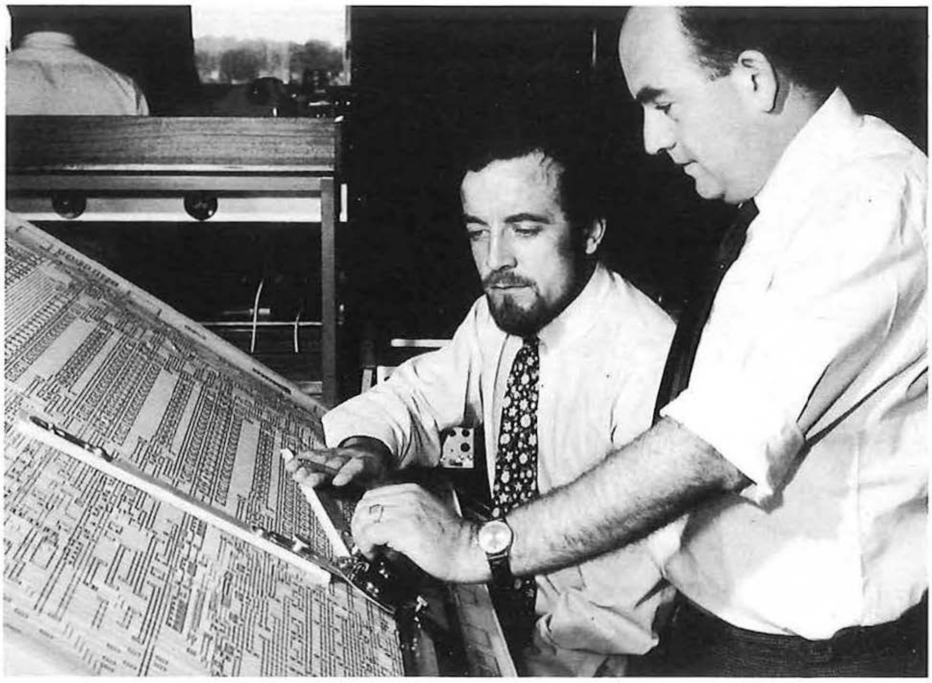
As soon as one of the keys has been depressed the number is translated into binary form and is put into a MOST shift register type store. At the same time, the fact that a store now has information causes the first number in the store to be transferred to the output pulsing circuit and the sender starts to pulse out the digit at standard Strowger speed. As other digit keys are pressed the information is stored and each digit sent out in turn separated by a pause of 800 milliseconds. The sender can store details of up to 16 digits and the operator will normally complete keying well before the sender has completed its work. A supervisory lamp on the keypad indicates that digits remain in the store.

Throughout a year-long trial at St. Albans telephone exchange the keysenders operated satisfactorily. Staff liked them, considered them easier and less tiring to use and there was a marked reduction in noise. No changes were made in operating procedure although operators started to use the time between end of keying and completion of sending to prepare tickets. The trial showed that the overall call-handling time was reduced by two to three seconds.

Whilst the trial was in progress the ergonomic aspects of the keypad were investigated in the Human Factors Research Laboratories at Dollis Hill. Volunteers from a number of London exchanges, with and without keysending experience, took part. Their accuracy and speed were analysed and the effects of varying the key pressures were studied. As a result, changes in key spacings and pressures have been made in the final design. The Dutch PTT were already using a similar keypad which had been life tested to one million operations of each key. It was therefore decided that no further life testing was necessary.

An interesting feature of the keysender development is the method which the Telephone Manufacturing Co. devised to use a number of computer programs to assist in the accurate, quick and economic design of these special circuits. Once the circuit has been designed by an engineer, it is simulated using a special program which will detect errors in design logic. At this stage errors can be easily corrected and once this has been done a physical layout of the circuit is started.

The conversion of the circuit diagram to an integrated circuit design is also carried out by the computer. The whole circuit layout is then displayed on a cathode ray tube and additional circuit functions added by drawing the necessary shapes on the face of the tube with a light pen. When this is completed a further program checks the layout to ensure that it conforms to certain rules such as dimensional tolerances. A magnetic tape output from the computer is used to steer an automatic drawing table to produce a large scale drawing of the circuit layout with all the layers superimposed. This is checked visually to ensure that the various circuit elements are properly interconnected. The same magnetic tape is used to make very accurate drawings of each layer of the circuit. Each drawing is then photographed and repeated exposures made until 374 complete layer drawings appear on one 35mm transparency. The final result is a series of five photographic transparencies—each containing the information for one layer of the circuit repeated 374 times.



Engineers check the computer-produced, large-scale drawing of the MOST circuit which will be used to produce a circuit just 2 mm square.

A minute MOST wafer is tested by an engineer in the Clean Room Laboratory of the TMC Company at Dulwich.

A wafer of silicon two inches in diameter and 1/100th of an inch thick is then processed, using each of the five masks in turn to define the photolithographic processes so that semi-conductor circuits are built up on the silicon. The processed silicon wafers are tested, the wafer is scribed and broken and the individual circuits mounted in a carrier. With the aid of a powerful microscope, gold connecting-wires 1/1000th of an inch thick are used to complete connexions to the various parts of the circuit. The completed circuit is subjected to rigorous quality checks before being sealed in the carrier ready for mounting in the electronic unit.

Deliveries of the keysender will start in January 1971 and the first 400 will be used to compare the fault liability of dials and keysenders in order to evaluate the maintenance requirements.

The close co-operation between the manufacturers, the various Telecommunications Headquarters Departments concerned and the engineering and operating staff at St. Albans exchange, contributed to the successful completion of the trial and will ensure that the benefits of keysender working are realised in the shortest possible time.

THE AUTHOR

Mr. R. T. Farrow is a Senior Telecommunications Superintendent in the Operator Services Equipment Branch of Service Department. He has been concerned with the trial and introduction of the electronic keysender.

A new type of trunk telecommunications system in which radio signals are transmitted through hollow copper tubes buried in the ground is to undergo a full-scale field trial. The tubes, called waveguides, are just 50 mm in diameter, little thicker than a car's exhaust pipe, and are capable of transmitting signals of very short wavelength.

Although loss of signal strength is very low, amplifying stations are needed at intervals. If the waveguide route is fairly straight and level these repeaters may be 20 km or more apart. In built-up areas where the waveguide must bend to avoid pipes and cables already in the ground, there are additional losses and repeater spacing may be 10 km or less.

The field trial equipment will be capable of carrying over 300,000 two-way telephone conversations or 200 television circuits or the equivalent in other forms of traffic. If successful, waveguides could be laid from city to city to provide "super-highways" for telecommunications traffic.

The trial, to be conducted in collaboration with Britain's telecommunications industry, will be over a 30 km stretch between the new Post Office Research Station at Martlesham Heath near Ipswich and Mendlesham Microwave Radio Relay Station. The system will be tested by loading it with simulated or actual traffic of all kinds including high speed data, Viewphone and conference television.

Contracts have been placed with GEC-English Electric (Marconi Research Laboratories) for the development of terminal and repeater equipment and with Plessey (British Telecommunications Research Ltd) for waveguide study. A number of other firms and University College, London, will also be providing support. It is expected that most of the installation work will be completed by the end of 1972, with the trial in 1973-74.

WAVEGUIDES–HIGHWAYS OF COMMUNICATION

By R. W. WHITE

A member of the Martlesham waveguide team wraps insulating material around a section of the experimental waveguide. It is then covered by protective asbestos material, as in the section in the background.

THE general properties and possibilities of waveguides were surveyed in the Autumn 1960 issue of this Journal. That article summarised the position then as follows:

> "Two satisfactory methods of trunk communication—coaxial cable and microwave radio relay systems—are now available for field use and they can readily meet foreseeable traffic requirements for the next few years. A third method, involving millimetre wavelength signals in a high precision circular waveguide, is in the laboratory stages and shows reasonable promise of an ultimate traffic capacity of at least 100 television channels or 100,000 telephone channels. Although many problems have yet to be solved, and little can yet be forecast about its economics, there is no doubt that this is a development of great technical interest and very considerable potential importance in the field of telecommunications."

In the late 1950s many laboratories in various countries were investigating waveguide possibilities. Although that work established the technical feasibility of waveguide systems, it emphasised very clearly the practical difficulties. In particular, the forms of repeater which were feasible at that time were complex, costly and unreliable. The most serious problem was that thermionic valves had to be used and the millimetric wavelength versions of these involved very high cathode-current densities, close tolerances and small clearances, so that it was extremely difficult to achieve good reliability and long life. In addition, the vast traffic capacity which a waveguide can offer was scarcely needed at that time, so around 1960 the work went into abeyance in most organisations.

The situation has changed drastically in recent years owing to very rapid progress in development of microwave solid-state devices. Landmarks in this field were the announcements by Bell Telephone Laboratories in 1967 that they had obtained 20 mW at 88 GHz from a solid-state oscillator, and in 1969 that they had exceeded 100 mW at over 100 GHz. It is important to appreciate that "best yet" powers are generally figures obtained from the finest specimen of a laboratory device under conditions where any attempt to raise the power still further results in breakdown of the device. The power available with reasonable life from a particular type of solid-state device is probably a third or less of the maximum power output achievable just before that device dies; but progress is so rapid that the unique laboratory device of today is generally overtaken by standard commercial products within a few years.

From the time that the Post Office ceased its earlier work on waveguides, a watching brief was kept for new developments which might lead to a more reliable and cheaper form of repeater. By 1966 there were moderate prospects of an all-solid-state repeater, so a contract was placed with University College, London, for investigations into dielectric-lined waveguides and some work was restarted on a very small scale in the Post Office Research Department. By early 1968 it seemed to be well established that satisfactory millimetric-wavelength solid-state devices would be obtainable in due course and Post Office effort on waveguide system research and development was greatly stepped up. The objective was no longer to carry out laboratory investigations of a remotely possible system but to try to get to economically viable operational systems as rapidly as possible. The work was planned with this in view. During 1969 the staff concerned with millimetric waveguides were moved from Dollis Hill to the new Post Office Research Station at Martlesham, where more laboratory space and good field facilities could be provided.

A number of basic parameters had to be decided, initially on a fairly arbitrary basis. Some of these, such as the choice of a single tube for both directions of transmission, the use of digital rather than analogue techniques and exclusive use of solid-state devices for all parts of the terminal and repeater equipment were relatively simple decisions; but others involved compromises between conflicting requirements.

The waveguide internal diameter selected was 50 mm and it was known that this should provide a useful operational frequency band extending over at least 40-90 GHz. Extension to a somewhat lower frequency is practicable if one can accept the increasing attenuation and the complication of rapidly increasing group-delay distortion as the frequency is lowered. If the waveguide is of suitable design and of extremely high precision, the upper frequency limit may be extended to beyond 100 GHz; but the useful upper limit is largely an economic matter of balancing the extra frequency band against increased cost of the waveguide. In 1968 very few millimetric wavelength solid-state devices were commercially available and virtually nothing above 50 GHz. We decided, therefore, that the development of repeater and terminal equipment should be carried out in at least two stages—a first phase using the low-frequency end of the band where some devices were obtainable and a second phase to exploit the higher-frequency part of the band when devices for such frequencies became available at a later date.

More detailed planning resulted in the selection of the frequency band 32-50 GHz for a Phase I system to provide some 16 broadband digital channels, each of 500 MHz bandwidth in each direction. Each of these broadband channels should be capable of carrying digital traffic at rates up to about 500 Mbits/s using fairly sophisticated modulation techniques, or a somewhat lower digit rate with simpler equipment. If it is difficult to visualise a rate of 500 Mbits/s per channel, some impression of its capability may be obtained when one realises that a telegraph system with this bit rate could transmit the complete text of the Bible in a fraction of a second—and the Phase I waveguide should provide 16 of these channels each way! On a basis of approximately 500 Mbits/s per broadband channel, the total traffic capacity available in Phase I will be about 64

A sample length of circular waveguide is tested for attenuation during experiments in the Martlesham laboratories.

television channels (625-line colour) each way, or over 100,000 telephony circuits, or a vast amount of data.

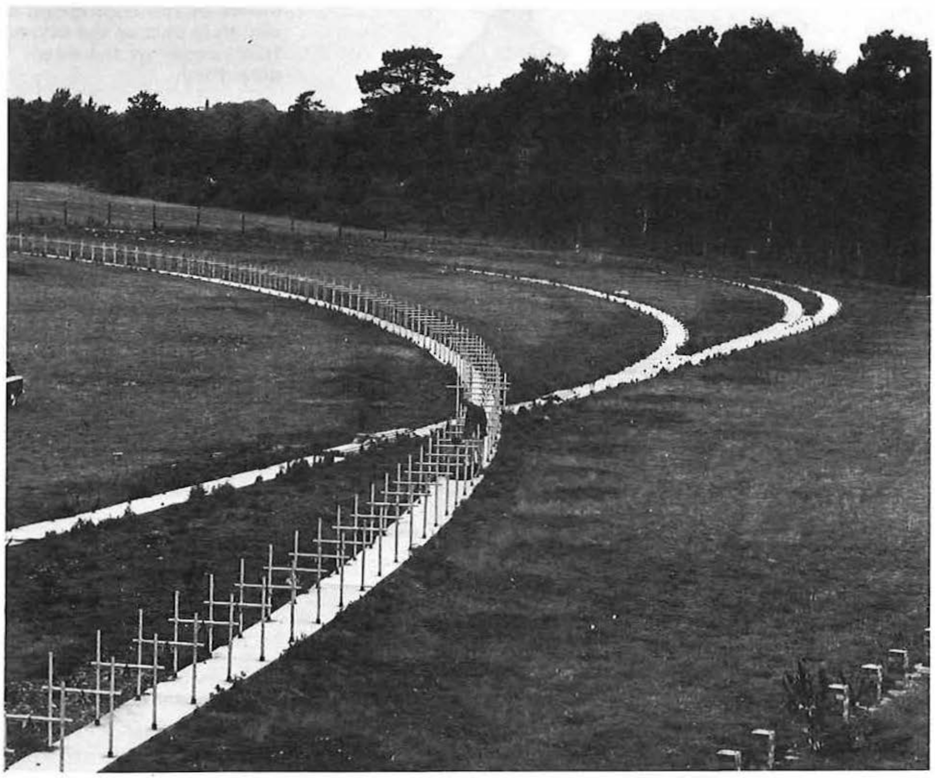
In Phase II we hope to exploit the range 50 to 90 or 100 GHz for even wider and higher-traffic-capacity channels and present plans are on a basis of eight channels each of about 2 Gbits/s capacity in each direction. The addition of Phase II terminal and repeater equipment should approximately treble the overall capacity of the Phase I system.

A plain circular waveguide is impracticable for operational systems as it necessitates mechanical tolerances which are much too stringent. A key factor of waveguide design is the modification of the surface impedance of the internal wall to allow maximum relaxation of mechanical tolerances without excessive additional cost. Two fundamental methods are well established for doing this—lining the inside of the waveguide with a thin dielectric film; or constructing the waveguide in the form of a close-pitch helix of insulated copper wire.

The relative merits of these two forms of waveguide, or of some mixture of the two, are matters of dispute and further investigations are in progress. The ultimate choice must undoubtedly be made largely on economic grounds, but current Post Office work is concentrated largely on the development of a very cheap lightweight helix waveguide intended for use inside an appreciably larger and very strong steel duct.

Each repeater consists fundamentally of a receiver, a regenerator and a transmitter. The receiving equipment follows normal superheterodyne practice, but the intermediate frequency is 1.25 GHz over the bandwidth 500 MHz. After demodulation, the digital signal is regenerated in normal PCM fashion; but, as the regenerator is dealing with pulses of about 4 nanoseconds duration, it necessitates techniques which are close to the limits of existing solid-state device technology. The transmitting end of the repeater can consist of a directly modulated oscillator or may embody a number of alternative and more complex arrangements. At frequencies above 32 GHz, amplifiers are virtually impracticable but it is possible to make a pseudo-amplifier by using a locked oscillator. For example, if the oscillator can be locked satisfactorily to a signal 15 dB below its output level and it can respond adequately to the modulation of that input signal, then it behaves effectively as a 15 dB amplifier.

The site of the new Post Office Research Station at Martlesham has a total area of approximately 100 acres and this has enabled us to provide comprehensive field facilities. A test-bed with small terminal buildings at each end can accommodate runs of waveguide up to approximately 1 km in length. The experimental waveguides are above ground as they approach one building, but at the other end they are below ground level and the building there has a semi-basement laboratory into which waveguides emerge at bench level. In the underground section there is a lined trench with removeable covers for easy access to experimental waveguides; but some steel duct has also been installed so that waveguides can be assessed under more realistic conditions. In the "above-ground" area there are facilities for investigating bends of various radii.



Waveguides, resting on tubular frames, will be laid along these concrete paths which curve in varying radii so that engineers can assess the effect on performance of each type of bend.

An experimental length of waveguide is inserted into an underground duct.

As an essential stage between the work on site at Martlesham and operational systems, a comprehensive Post Office/industry field trial is planned. The route selected will link Martlesham to a microwave station at Mendlesham, the nearest point on the normal microwave radio-relay network. The length of this system, approximately 30 km, will necessitate one repeater station in addition to the two terminal stations. It has been chosen to provide representative samples of varying installation environment, it is close to the Post Office laboratories concerned and it can be used to carry useful traffic between Martlesham and Post Office THQ in London.

The field trial is required to demonstrate:—

- that designs of repeaters and waveguides developed in the laboratory are satisfactory under field conditions;
- that waveguides can be laid efficiently and economically under the wide range of conditions encountered in practice;
- that the techniques proposed for supervision, control, fault finding and fault repair are adequate for practical systems;
- that the estimated costs of operational systems are realistic and predicted economic advantages over advanced cable systems are realisable.

If the results on both technical and economic aspects are satisfactory, the Post Office would then wish to order operational systems; but if this had been purely a PO experiment and industry had not been involved up to that point, considerable delay would then occur during development and testing of production prototypes. Early involvement of UK industry is most important if the time lag between completion of experimental work and the availability of operational systems is to be reduced to a minimum, so the field trial has been planned on a basis of extensive industry participation. Post Office and contractor designed equipment, using as far as practicable differing design approaches, will be installed and tested so that experience can be gained of alternative techniques and an optimum design arrived at for future operational systems.

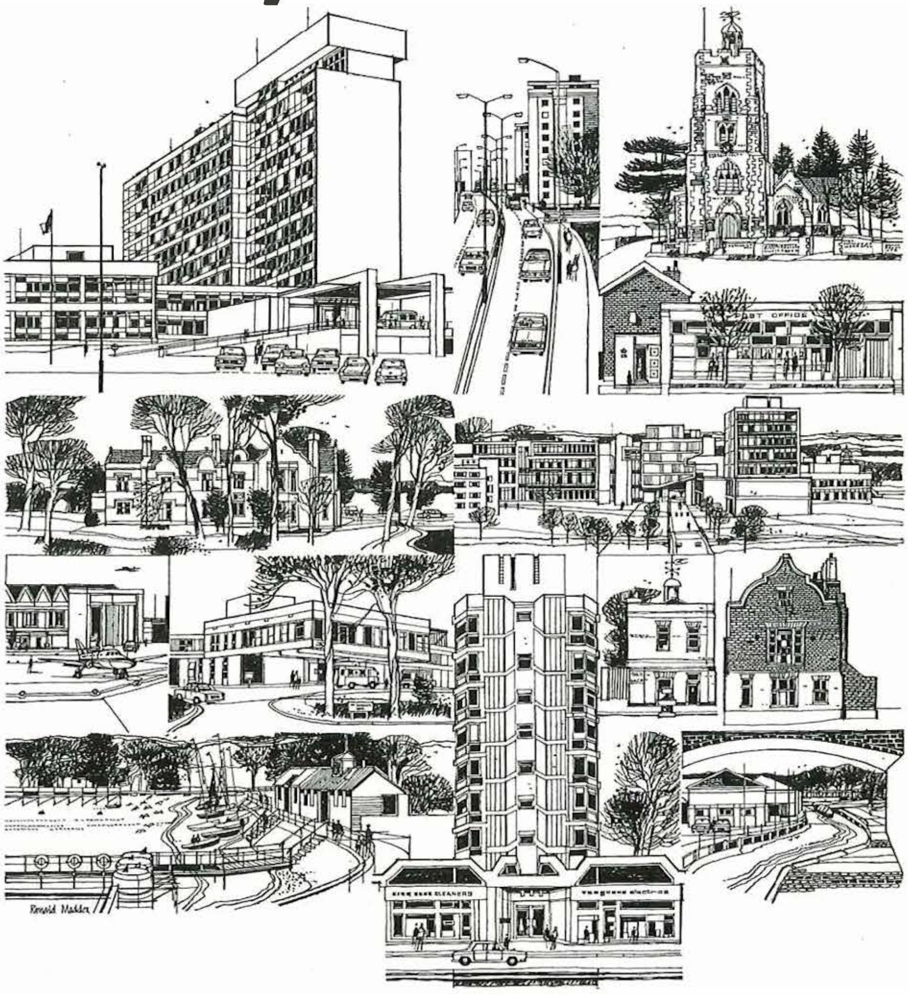
Several major contracts for industry participation in the waveguide field trial have already been placed and others are under consideration. One or more universities will also be providing support in certain areas. The time scale of the project envisages completion of Phase I of the field trial installation and the starting of overall tests early in 1973.

At present, the trunk network relies primarily on microwave radio links and coaxial cables. If we are to achieve a 5:1 or 10:1 increase in traffic capacity within the next decade, any alternative systems which offer good prospects of high traffic capacity and low cost per channel merit serious consideration. Coaxial cable systems can meet the foreseeable increase; but, in the microwave case, the finite width of frequency spectrum available for point-to-point links makes an extremely large increase in traffic capacity impossible. It is mandatory that any new trunk telecommunication system should meet internationally agreed transmission standards and provide adequate reliability. If more than one technique is available which meets these requirements a choice between them must be made predominantly on economic grounds. Accurate estimation of the relative costs of future systems, whether waveguide or coaxial cable, while they are still in the early stages of development is bound to be a difficult process; but present indications are that, where its large capacity can be effectively utilised, a waveguide system should be a strong economic competitor to the most advanced coaxial cable systems presently envisaged.

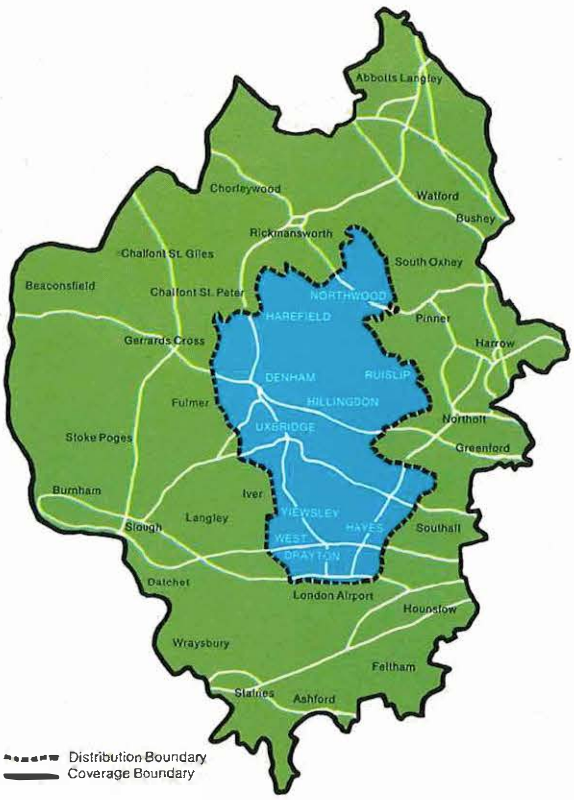
THE AUTHOR

Mr. R. W. White is a Staff Engineer and head of the Millimetric Waveguide Systems Branch of Post Office Research Department. He was awarded the OBE in 1963 for his part in early experimental work on satellite communications. A graduate of Glasgow University, he has been with Research Department since 1939 before which he spent two years in industry with GEC research laboratories.

The numbers that really want



ABOVE: The montage of views of the Hillingdon area which is part of the attractive front cover of the new directory.



LEFT: The Hillingdon directory is distributed within the area bounded by the broken line, but the numbers it contains cover the whole of the area shown on the map.

RIGHT: Some of the "useful numbers" which are included in the directory.

people

By P. A. PANICHELLI

THE recent issue of a telephone directory for the London borough of Hillingdon introduced a new concept in the publication of directories. Normally, a directory is no more than a list OF the subscribers in a particular area. The new idea, reflected in the Hillingdon book, is to provide a more useful list FOR the subscribers by including all those numbers, wherever they are, which research has shown they are likely to want.

With the rapid expansion of the telephone system, the size of directories is growing fast and subdivision of existing directories is unavoidable if the books are not to become unwieldy. However, the traditional methods of dividing directories often produce boundaries between books which cut across communities of interest—there may be considerable telephone traffic between adjoining towns which happen to be separated by a directory boundary. Subscribers tend to be discouraged from using large directories which are sub-divided, and which often contain far more information than they need while not always listing the numbers they really want.

The concept being tried at Hillingdon is aimed both at dealing with the problem of directory growth and the need to provide more effectively the information that customers want. Advice was sought from management consultants and the Post Office itself made detailed studies over a number of years on the selection of contents.

In practice this means listing not only the subscribers who have the book, but also those in a wide surrounding area together with selected numbers from much farther afield. The Hillingdon directory is being distributed to about 55,000 subscribers in the London borough. It lists all their numbers and some 170,000 other subscribers in the surrounding area of about 200 square miles. Also listed are some 900 other numbers from all over London which it is known people in Hillingdon often call; they cover such categories as Animal Clinics, Cinemas, Government Departments, Embassies, Hospitals, Transport and Welfare services. These have been included in their appropriate alphabetical order in the body of the book and separately in the preface to the directory by classifications.

The directory also introduces further changes designed to make it indispensable to customers and to encourage them to keep it readily to hand. At the beginning of the book is the new 16-page sales supplement—the "Green Pages"—now being bound into the front of all alphabetical and combined directories. This gives a brief outline of the many telecommunications facilities available to subscribers, and includes a voucher on which more detailed information can be requested from the Telephone Manager. Apart from the usual service codes for local recorded telephone information, such as Time, Weather, Motoring etc., details are given about the codes to dial to obtain information about weather, motoring conditions etc. in the rest of the country. For example, if one is motoring to Edinburgh or Manchester, it is possible to find from the directory the appropriate number to ring to get information covering road conditions within 50 miles of the destination. Numbers are also shown from which weather forecasts covering 16 areas over the whole of the United Kingdom may be obtained.

Another new feature, introduced with the assistance of the local authority, is a short description of the area, together with full details of the services provided by the various Borough Departments. These include such items as times of opening of libraries and rates offices. British Rail and London Transport provided maps and details of public transport serving the Borough and information from Hospital Groups in the area includes visiting hours at each hospital, bus routes and stations serving them, and the types of cases treated.

A final novel touch is the attractively illustrated cover, carrying a montage of views in the area, and the inclusion of sketches inside the directory.

The Hillingdon directory was also the first in London to be compiled and photoset by computer methods. Entries for the area were selected by the Post Office computer at Leeds from national files of number information, and arranged in alphabetical order. The resulting output was then passed to an HMSO computer at Norwich for editing, and finally went to HMSO Gateshead Press where printing plates were prepared by phototypesetting equipment. The use of these techniques, as advanced as any in the world, is a dramatic step forward in directory production. A film of a new directory is produced at the rate of one page every 4½ minutes; plastic-covered, lightweight printing plates are produced from the negatives and rotary presses can run off 40,000 72-page directory sections, i.e. 2,800,000 pages, in an hour. In the case of the 700-page Hillingdon directory, about 120 working hours after the Leeds computer is instructed to compile a new edition, printing plates for the directory can be ready for printing.*

Because so many new processes were involved, the operation of producing the pilot Hillingdon directory needed very close co-ordination and programming. All activities within the Post Office and HMSO were programmed, using PERT chart techniques, with monthly progress meetings to ensure target dates were met.

What of the future? This must depend on the reactions of the subscribers for whom the new directory was expressly designed. The views of everyone who received a copy of the directory are being sought after they have had an opportunity to use it for about two months. If they find it useful, and an improvement on the traditional approach to directory structure, similar directories will be published to cover the whole of the outer London area within the next two years. The next two to be issued, early in 1971, would be those for the London Boroughs of Ealing and Hounslow. In each case the distribution areas will join up with the distribution boundaries of the adjoining directories, but because the contents cover a much wider area than an individual borough there will be considerable overlap.

The objective is to provide customers with the numbers they really need. While the overriding consideration remains service to the telephone user, more effective directories leading to fewer directory enquiries will mean a significant reduction in operating costs.

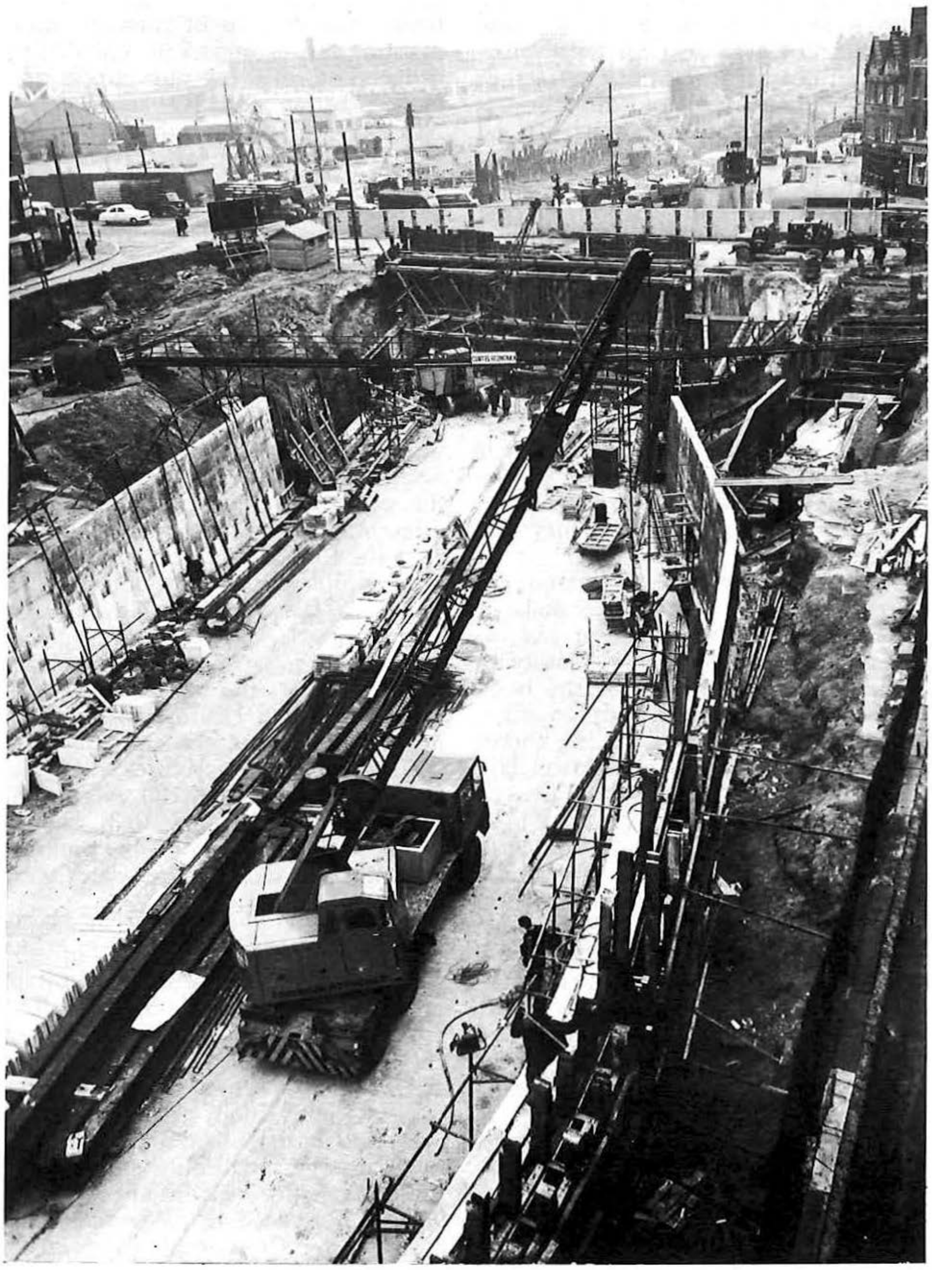
*See *Telecommunications Journal*, Winter 1969.

THE AUTHOR

Miss P. A. Panichelli is a Senior Executive Officer in Service Department with responsibilities for telephone directory planning and development. She joined the Post Office in 1937 as a Clerical Assistant and has since served in numerous Headquarters departments. She was appointed HEO in 1962 and SEO in June last year.

USEFUL NUMBERS

Newspapers (continued)	
Sunday Express, 121 Fleet St, EC4	01-353 8000
Sunday Mirror, 33 Holborn, EC1	01-353 0246
Sunday Telegraph, 135 Fleet St, EC4	01-353 4242
Sunday Times, 200 Grays Inn Rd, WC1	01-837 1234
Times, The, Printing Ho Sq, EC4	01-236 2000
POLICE HEADQUARTERS	
City of London (Headquarters & All Depts), 28 Old Jewry, EC2	01-606 8866
Metropolitan, New Scotland Yd, Broadway, SW1	01-230 1212
Essex County	Chelmsford 53131
Herts County, Stanborough Rd, Welwyn Gdn City	Hatfield 63211
Kent County, Sutton Rd	Maidstone 56611
Surrey County, Mount Browne	Guildford 71212
Thames Valley	Kidlington 4343
PLACES OF INTEREST	
All England Lawn Tennis & Croquet Club, Church Rd, Wimbledon, SW19	01-946 2244
British Museum, Bloomsbury, WC1	01-636 1555
British Theatre Museum Association, Leighton Ho, 12 Holland Park Rd, W14	01-937 3052
Commonwealth Institute (Theatre Box Off), Kensington High St, W8	01-937 1857
Cuming Museum, 155 Walworth Rd, SE17	01-703 3324
Earls Court Ltd, Exhibition Bldg, SW5	01-385 1200
Empire Stadium, Wembley Empire Pool, Wembley	01-902 1234
Festival Gardens (London) Ltd, Battersea Park, SW11	01-228 6830
Geffrye Museum, Kingsland Rd, E2	01-739 8368
Imperial War Museum, Lambeth Rd, SE1	01-735 8922
Institute of Geological Sciences, Exhibition Rd, SW7	01-589 9441
Jewish Museum, Woburn Ho, Upper Woburn Pl, WC1	01-387 3081
Keats Memorial House, Wentworth Pl, Keats Gro, NW3	01-435 2062
London Museum, Kensington Palace, W8	01-937 9816
Lords Cricket Ground (Ticket Enquiries only), St John's Wood, NW8	01-289 1615
Museum of British Transport, Triangle Pl, SW4	01-622 3241
National Gallery, Trafalgar Sq, WC2	01-930 7618
National Maritime Museum, Romney Rd, SE10	01-858 4422
National Portrait Gallery, 2 St Martin Pl, WC2	01-930 8511
Post Office Tower, Cleveland St, W1 — General Information	01-636 3133
Administration	01-636 9361
Royal Academy of Arts, Burlington Ho, Piccadilly, W1	01-734 9052
Science Museum, South Kensington, SW7	01-589 6371
Surrey County Cricket Club, Kennington Oval, SE11	01-735 4911
Tate Gallery, Millbank, SW1	01-828 4444
Tower of London, Tower Hill	01-709 0765
Twickenham Rugby & Football Club, Park Fields, South Rd, Hampton	01-979 4827
Victoria & Albert Museum, South Kensington, SW7	01-589 6371
Wallace Collection (Director's Off), Hertford Ho, Manchester Sq, W1	01-935 0687
Wellcome Museum of Medical Science, 183 Euston Rd, NW1	01-387 4688
Wellington Museum, Apsley Ho, 149 Piccadilly, W1	01-499 5676
Wembley Stadium Ltd	01-902 1234
Wesley's Chapel, 49 City Rd, EC1	01-253 2262
White City Stadium (Box Off)	01-743 7220
Zoological Society of London, Public Enquiries, Regents Park, NW1	01-722 3544
POST OFFICE HEADQUARTERS OFFICES	
Central Headquarters, 23 Howland St, W1	01-631 2345
Postal Headquarters, St Martins le Grand, EC1	01-432 1234
Telecommunications Headquarters, 2 Gresham St, EC2	01-432 1234
London Postal Region, King Edward Bldg, King Edward St, EC1	01-432 1234
London Telecommunications Region, Camelford Ho, Albert Embankment, SE1	01-587 6000
National Data Processing Service	01-432 6152
POST OFFICE USERS NATIONAL COUNCIL	
Headquarters, Waterloo Bridge Ho, Waterloo Rd, SE1	01-928 9458
THEATRES, MUSIC HALLS AND CONCERT HALLS	
Abbey Mill Theatre, St Albans	St Albans 67861
Adelphi Theatre, Strand, WC2	01-836 7611
Aldwych Theatre, Aldwych, WC2	01-836 6404
Ambassadors Theatre, West St, WC2	01-836 1171
Apollo Theatre, Shaftesbury Av, W1	01-437 2663
Ashcroft Theatre, Fairfield Halls, Park La, Croydon	01-658 9291
Barn Theatre, Handside La, Welwyn Garden City	Welwyn Garden 24300
Beckenham Theatre Centre, 46 Bromley Rd, Beckenham	01-650 9371
Bishopsgate Foundation and Institute [illegible]	



Thousands of circuits would be put out of action if construction work like this accidentally ripped up a coaxial cable. Mr. J. F. BOAG describes how the Post Office plans to avoid the disruption caused by faults of all kinds by . . .

Protecting the main line

THE capacity of coaxial cable systems has grown tremendously in recent years and will continue to grow. Present generation systems allow a maximum of 16,200 telephone circuits to be packed into one cable sheath, but increased capacity brings with it the problem of ensuring reliability of service.

Despite the great care that is taken to ensure the reliability of transmission plant, faults do occur; plant can also be affected by roadworks carried out by other organisations. And faults on high capacity plant can cause major disruption to the country's communication system.

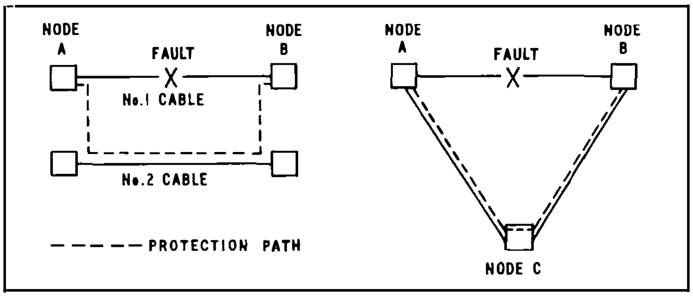
It is to avoid the worst effects of such faults that the Post Office is now installing a protection network which will provide an alternative routing for traffic immediately a breakdown occurs on any of the main line transmission systems anywhere in the country.

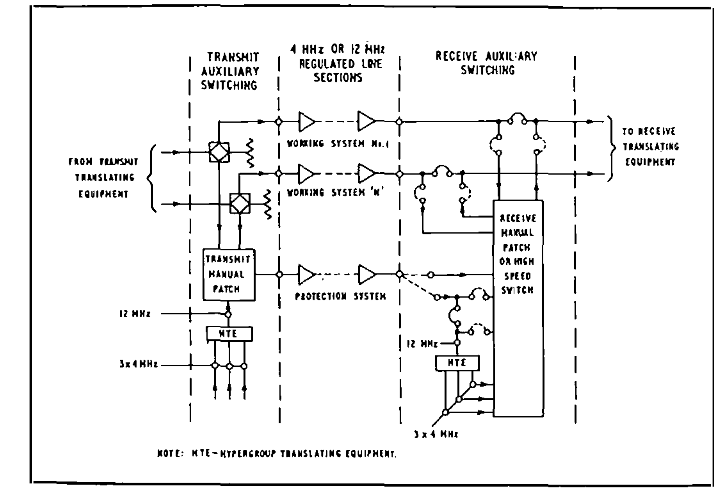
The network—to be known as the Main Line Service Protection Network—will not only provide protection of service. It should also result in improved circuit performance as a result of the better facilities for investigating trouble; better maintenance efficiency because more maintenance work will be done during normal working hours; and the ability to withdraw working transmission systems for modification or modernisation.

Work on the first of the coaxial cable links for the new network started last year and should be finished by 1971. By 1972 manual switching arrangements will be introduced. Until then, *ad hoc* switching facilities are being provided to enable the early links to be brought into use. The remaining links will be completed by 1975 when a network of protection channels amounting to 10 per cent, almost 10,000 miles, of the working coaxial system mileage will be available.

The standby network will also have available to it the radio protection channels which are normally provided as an integral part of microwave radio relay systems—but only when these are not required within the radio system. From 1975 onwards it is hoped that the protection network will be kept at a constant 10 per cent of the working system, a proportion regarded as sufficient to give standby cover for all of the United Kingdom main line network.

At some future date an automatic switching system, perhaps under the





ABOVE: Coaxial systems can be replaced by protection systems in a second cable between the same two points. **ABOVE RIGHT**: The tandem connexion of spare systems in cables or microwave radio relay systems between nodes A and C and between nodes C and B make good a fault between nodes A and B. **RIGHT**: The basic switching arrangement, for one direction of transmission only, adopted for the manual switching phase of the protection network.

control of a computer, will be introduced.

While the actual job of switching from main line to protection circuits will be carried out at the appropriate repeater stations, all switching operations will be controlled by the National Network Co-ordination Centre in London.* The present aim is to reroute circuits within 15 minutes of a cable failure, but as the Protection Network develops and Stage 1 switching is fully implemented it is hoped to bring the reroute time down to five minutes.

The manual switching facilities will allow a faulty coaxial system to be replaced by a spare protection coaxial system within the same cable. If there is a complete cable failure, the affected coaxial systems can only be replaced by protection systems in a second cable between the same two points or by the tandem connexion of spare systems in cables or microwave radio relay systems. Both approaches are used in the protection network, depending on the layout of the main network and the availability of plant.

A fundamental decision to be made in all protection networks is the size of the unit to be switched. The most common units used between nodes in the main network are 12-circuit assemblies called groups, 60-circuit supergroups and 900-circuit hypergroups. Current designs of coaxial cable systems and microwave radio relay systems transmit one to three hypergroup assemblies.

An assembly of one to three hypergroups between two nodes is called a broadband. A broadband path may be formed from one coaxial cable or microwave radio relay system or from two or more such systems connected in tandem. The broadband path within each of these systems is called a regulated line section (RLS). An overall broadband path is therefore made up from one or more RLS.

If a small unit is chosen for switching the switching costs are high, due to the large amount of equipment involved if a major plant failure occurs. On the other hand close control can be exercised on the traffic routes to be replaced under emergency conditions. If a large unit is chosen the switching costs are reduced and under manual switching conditions restoration procedures can be carried out more quickly and effectively, but the control over the selection of the traffic to be restored is less precise.

The basic units chosen for the manual switching stage of the protection network are 4 MHz (960 circuits) and 12 MHz (2,700 circuits) regulated line sections. In addition hypergroup translating equipment will be provided at selected stations to derive three 4 MHz sections from a 12 MHz RLS.

The manual switching facilities are:

- The replacement of 4 MHz and 12 MHz RLSs by protection 4 MHz and 12 MHz RLSs.
- The replacement of 4 MHz RLSs by either a protection 12 MHz RLS or a 4 MHz section derived from hypergroup translating equipment associated with the 12 MHz RLS via switching equipment.
- The tandem connexion of protection RLSs.

All switching will be done on a "fault" or "in service" basis. The essential difference between the two is that, in the latter case, switching is carried out at high speed to avoid noticeable interruption to working services when, say, it is necessary to switch these to protection plant in order to carry out maintenance or other work on the normal plant.

In the basic switching arrangement adopted for one direction of transmission only the signals to the Regulated Line Sections are fed via a hybrid; one output of the hybrid is connected to the normal routing and the second output to the manual patch frame. If it is required to route the signals via the protection network the second output is manually patched to the selected protection link. At the receive end the signals are normally passed to the receiving translating equipment by way of a "U" link arrangement. If a protection link is required to be brought into use the receiving path of the working link is routed by means of "U" links to the receiving manual patch frame, where the protection link may be connected to the receive translating equipment of the working link by means of patch cords or a high speed switch. The "U" link arrangement is situated remote from the receiving patch frame to prevent a potential fault hazard arising from a high concentration of links on one patching frame.

Consideration is now being given to the automatic switching phase. With this, the switching unit may well be the hypergroup. There are at present 430 hypergroup nodes in the main network and considerable study will be required to develop an optimum automatic switching scheme to provide automatic protection to all possible paths.

Already the protection links are improving the service to customers. Links between London and Manchester have been in use for 27 per cent of the time over a 14-week period. The links were used in roughly equal proportions for fault conditions, maintenance purposes and planned works.

The protection network will cost many millions of pounds to provide. However, on the credit side is the increased reliability of our communication links and reduction in loss of revenue due to major failures of plant.

*See "Towards a better service", *Telecommunications Journal*, Autumn 1969.

service

THE AUTHOR

Mr. J. F. Boag is an Assistant Staff Engineer in Network Planning Department and is in charge of the section which deals with High Frequency lines and microwave radio relay systems planning.

THE HIGHLANDS AND

THERE are about 700 islands off the coasts of Scotland of which only 150 are inhabited. And in the whole of the vast territory north and west of Glasgow there are just a few small towns, not one with a population of 10,000, and a multitude of villages and crofting communities. These are the Highlands and Islands of Scotland, remote and scattered and with such natural telecommunications barriers as mountains, lochs and sea.

Providing an efficient telephone service for the area, while at the same time coping with the phenomenal increase in demand in the densely populated parts of the country, has created a unique problem for the Post Office in Scotland.

Inevitably, in the period when capital and equipment were scarce, priority had to be given to the bigger towns and cities, and the Highlands and Islands have fallen behind in the race for modernity. The £6½ million scheme now underway—a complex system of land lines and multi-channel radio links—will give the area's telephone service a completely new look and will bring automatic service and STD to all its subscribers.

The broad problem facing Post Office planners and engineers was to modernise the remotely situated exchanges in Aberdeen and Scotland West Telephone Areas, which between them take in the whole of the Highlands and Islands, and augment and upgrade the trunk and junction network for automatic working and STD.

The plan provides for 18 Group Switching Centres (GSCs), eight with automanual switchboards. These will be connected to the existing Zone Centres and Trunk Switching Centres at Glasgow, Oban and Inverness. There are at present high-frequency cable routes from Inverness to Kirkwall and Lerwick in the Orkneys and Shetlands and from Glasgow to Ayr. An existing submarine cable from Gairloch to Stornoway in the Outer Hebrides will continue to be used, although its capacity will be augmented later by a new radio link.

A new coaxial cable is being provided from Inverness to Ullapool and Gairloch—a major job involving a route of over 120 miles along roads which are gradually being converted from single to double track. Roadworks have so impeded duct laying that temporary measures have had to be adopted, even to the extent of bringing a cableship into Little Loch Broom to lay a length of subaqueous cable.

A major feature of the Highlands and Islands scheme is the building of 56 new radio stations on the islands and in the remote areas along the western and northern edges of the mainland. These will provide multi-channel radio links to extend existing coaxial cable routes to the more remote GSCs and to interconnect the islands with each other and with the mainland.

One of the difficulties of operating a communications system in a territory consisting of islands, mountains and lochs is the maintenance of equipment. Travel is often difficult and staff limited. Equipment must therefore be of high reliability and designed so that units can be changed and shipped to a central depot for specialised maintenance. The two radio systems which are being used have been designed with these requirements in mind, and both will employ solid state devices instead of thermionic valves to improve reliability and reduce power consumption.

The six channel system, for use on the smaller junction routes, will operate on frequencies of about 450

ISLANDS

By R. N. PALMER

MHz. Each station will require one "Yagi" aerial—similar to a BBC 2 TV aerial—mounted on a pole, and will contain main and standby transmitters and receivers, the latter with automatic monitoring and changeover facilities in case of failure.

The 300 channel system will operate in the SHF band at 4 GHz. Main and standby (or "protection channel") transmitters will work on separate frequencies and both will be continuously energised, signals being fed to the two in parallel. The better channel will be selected automatically at the receive end. The frequency translating equipment and filters required for individual speech channels will be provided, sometimes in the radio station building with connexions at audio frequency to the exchange equipment and sometimes in the telephone exchange with high frequency cable from the radio station. The aerials for this system will be 6 ft. or 8 ft. diameter paraboloid dishes and, for "through" stations, two or more of these will be mounted on a tubular steel tower (the new Post Office Tower No. 4A). A smaller tower of 4 ft. cross section (the Post Office Tower No. 6A) will be used for certain terminal stations.

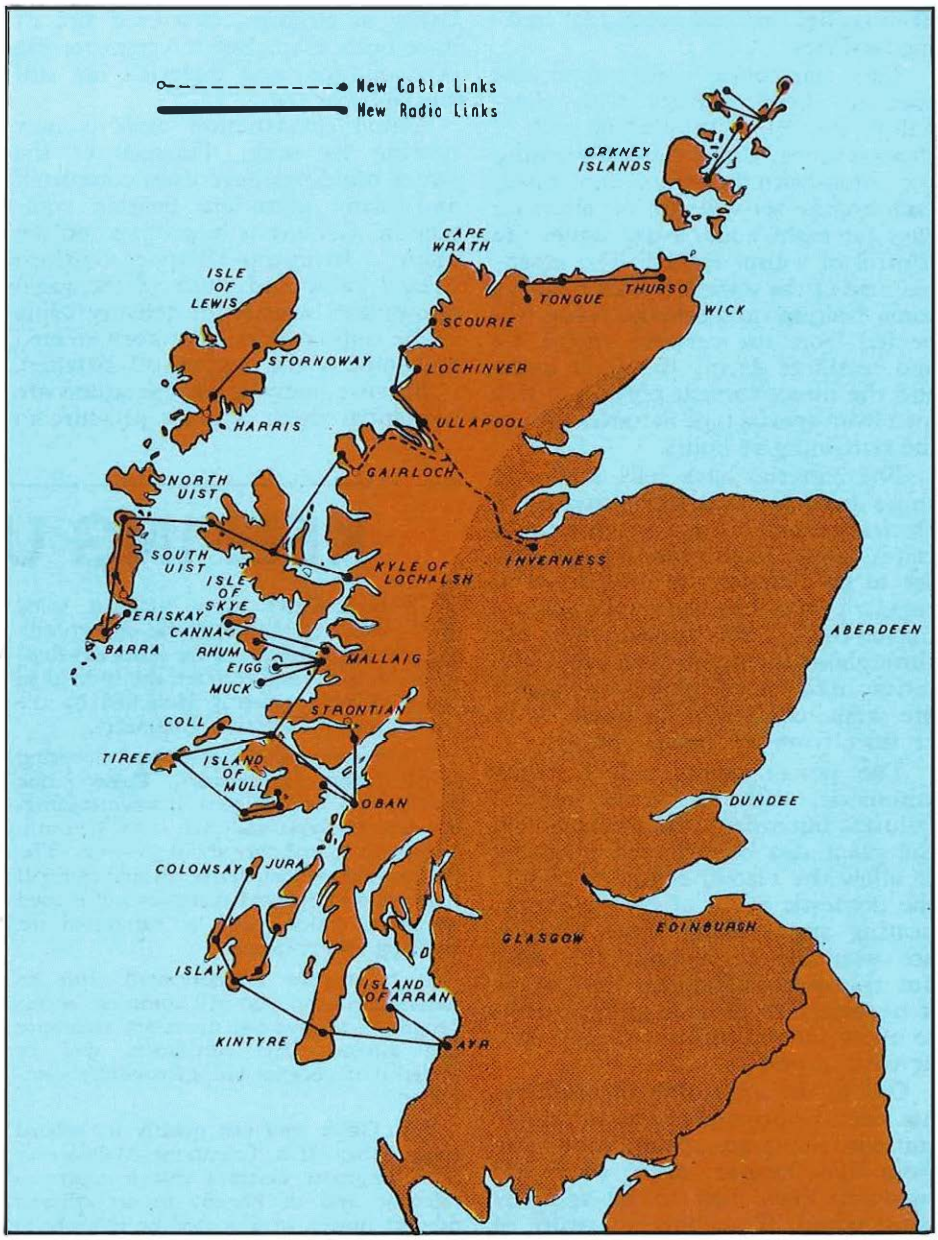
Not all of the radio stations are isolated. In two cases a tower and the GSC exchange are together, with both radio and switching equipment in the same building. In 23 other cases the radio station could be located near enough to centres of telephone development, small though these may be, for it to be economical to place the switching equipment for the minor exchange in the same building as the radio equipment using common power plant.

Maintenance difficulties were also much in mind when planning the switching system. The objective was to provide full automatic service with STD at recognised grades of service and transmission standards. The use of modern electronic techniques would have offered considerable maintenance advantages, but because design priority was being given to larger units this equipment was unlikely to be available in time. Various other systems proposed by manufacturers were examined, but none was suitable.

Most of the exchanges involved are of very small size, and many will need to provide no more than 20 to 40 lines. Even the GSCs are small; some will need an ultimate capacity of only 120 to 150 lines, but their size seemed no sound argument for treating them differently from other GSCs and they will have crossbar equipment (TXK 1). For the minor exchanges there was no alternative but to use existing types of Strowger equipment. Adequate stocks are likely to be available, though much of it will have been in use elsewhere and will be factory reconditioned, sometimes rewired, before it is installed.

At 35 of these minor exchanges the additional trunk and junction requirements can be provided by traditional means, or by a "tail" cable from the terminal radio station. Since no special plant is needed the switching equipment can be housed in the normal type of standard building. For those minor exchanges which are to be combined with radio stations, and for most of the remote stations, buildings have been specially planned. The design and materials take account of extreme weather conditions and in many of the buildings a bed is provided for emergency use, possibly by a stranded maintenance man. Piped water supplies are available at only a few of the stations and provision is made for collecting rainwater in a tank within the building. Drinking water must be carried to the sites.

Power supply also produced problems for in some areas no public supply is even in prospect. Thirteen stations are affected in this way and a power plant has had to be specially



LEFT: The section of the Inverness-Ullapool-Gairloch cable laid under Little Loch Broom is pulled ashore from the Motor Vessel Warlight by crewmen of the Post Office Cableship Ariel. The Warlight was temporarily adapted for the cable laying operation. Too big to get close to the shores of the sea loch, Ariel lay off as a floating headquarters.

RIGHT: The unshaded portion of the map shows the islands and parts of the mainland served by the Highlands and Islands scheme. Not shown are the Shetland Islands which come within the scheme and existing links from Stornoway to Gairloch and Inverness to the Orkneys and Shetlands.

LEFT: Even this trenching machine has difficulty negotiating rough Highland moorland during the laying of the Inverness-Ullapool-Gairloch coaxial cable. This stretch was laid across the moor to keep it safely away from extensive roadworks that were going on nearby. RIGHT: Field staff manoeuvre the cable in the open moorland trench.

designed to provide for both telecommunications equipment and the heating, lighting and occasional cooking facilities.

Two air-cooled and especially silenced diesel engines with alternators are being installed at each of these stations. Under normal working conditions with the station unmanned, each engine set will run on alternate days for eight hours a day under the control of a time switch. The essential load of the station, which includes some heating on a storage basis, will be fed from the running engine set and rectifiers during the eight hours and the direct current portion of this load from special type batteries during the remaining 16 hours.

The batteries have cells similar to those used for traction purposes in electric trucks or cars. This type of cell is being used because the batteries are to be charged and discharged in regular cycle—charged by the engines during the day and discharged by use throughout the night. Normally, batteries used in telephone exchanges are kept constantly charged by a rectifier from the mains supply.

The power plants will be fully automatic, with alarms to indicate failures, but when a station is staffed the plant can be switched manually to allow the second engine to supply the domestic needs of extra lighting, heating and cooking. Fuel supplies are available throughout the area, but transport difficulties have made it necessary to provide storage tanks to allow for replenishment only once or twice a year.

One of the most difficult problems has been to provide access to remote stations. Some are up to a mile away from the nearest main road and roadways have had to be specially constructed. Travelling to many of the islands has often to be by small boat although more recently, with the laying of airstrips, chartered aircraft have been used. But the transporting of equipment and materials has still had to be by sea.

Actual construction work is now nearing its peak. Thirteen of the larger buildings have been completed and many more are nearing completion. Cabling is in progress on the main Inverness-Ullapool-Gairloch coaxial cable and some of the radio equipment is ready for delivery. Nine of the radio towers have been erected and some of the engine sets installed.

Because many of the operations are sequential there is great pressure to get building work done as early as possible in the good weather so as to permit the remaining operations to be completed before the following winter. Indeed, such delays as have occurred so far have been mainly due to bad weather, high winds having particularly affected aerial construction work.

THE AUTHOR

Mr. R. N. Palmer is Project Manager for the whole of the Highlands and Islands scheme. In the Post Office since 1924, he has served for varying spells at Guildford, Leicester, Nottingham, Peterborough and in Wales. He moved to Scotland in 1961 on promotion to Regional Engineer.

KEEPING UP TO DATE

ENGINEERS who qualified some years ago are given the opportunity to keep abreast of the latest developments in their field through the Individual Study Service recently launched by the Institution of Electrical Engineers.

Three correspondence courses covering Field Effect Transistors, Pulse Code Modulation and Digital Instrumentation are now available and each is divided into 15 lessons spread over about 30 weeks. The lessons include instructive reading material together with worked examples and graded questions which must be submitted for marking and criticism.

Each student is associated with an individual tutor who will comment on his progress and give any necessary assistance and advice. IEE certificates will be awarded if courses are successfully completed.

Post Office staff can qualify for official sponsorship. If a Telephone Manager or Staff Engineer certifies that a course is relevant and of benefit to an officer's present duties, or any that he is likely to undertake in the next year or two, the Post Office will pay the full costs and allow a student a half-day off each week for the duration of the course. Alternatively, an officer studying in his own time can qualify for 80 per cent of the minimum course fee and 50 per cent of the cost of text books if his TM or SE can confirm that he has the necessary academic ability to profit from a course and is likely to make use of the knowledge in the future. Normally, fees are £25 per subject for IEE members and £35 for non-members.

Courses start at a level approximating to the final year of a modern three-year degree course in electrical/electronic engineering and students are expected to prepare in advance by studying recommended reading matter and by refreshing their background mathematical knowledge at the standard required.

Applications from Post Office staff should be made through local Training Officers who can obtain the necessary registration forms from the Education Officer, The Institution of Electrical Engineers, Savoy Place, London, W.C.2.

Earth stations of the world

By B. A. LOWE

With the building of a third aerial at the Post Office earth station at Goonhilly Downs—see our cover picture and page two—it is an appropriate time to look at the kind of aerials used in other countries. This article is based on observations made by the author during a round-the-world tour in which he visited a number of earth station installations.

BEFORE dealing with earth stations in use in other parts of the world it is useful to review the salient features of the two existing aerials at Goonhilly.

The No. 1 aerial was built in 1961-62 to enable the Post Office to take part with the ATT Company of America and the French PTT in experiments in satellite communications which provided the foundation on which the present global system is based. It is probable that few, if any, of those present on the night of the first transmissions on 10 July, 1962, expected that a commercial service would be in operation just three years later.

The Goonhilly aerial differed from the aerials used by the other two countries in being a paraboloid dish designed to withstand local weather conditions without protection. The American and French stations both used identical horn reflector aerials designed for use under a protective radome. The advantages of the Goonhilly design were clearly demonstrated when the other stations had to operate in heavy rain or snow and frequently had to be withdrawn from operation because of the resulting increase in noise.

It is significant that present practice throughout the world is to build dish aerials designed to operate without a radome.

The No. 1 aerial provided the first satellite circuits to be used for commercial traffic when it began operating in July, 1965, through the Early Bird satellite, and since July last year after being extensively re-equipped, has been working to the Indian Ocean Intelsat 3 to provide circuits to Australia, Bahrain, Hong Kong, Indonesia, Japan and Kuwait. In readiness for participation in the global system the No. 2 aerial was completed in 1968 and now operates via the Atlantic Ocean Intelsat 3 to Canada, Iran, Lebanon, Morocco and the USA.

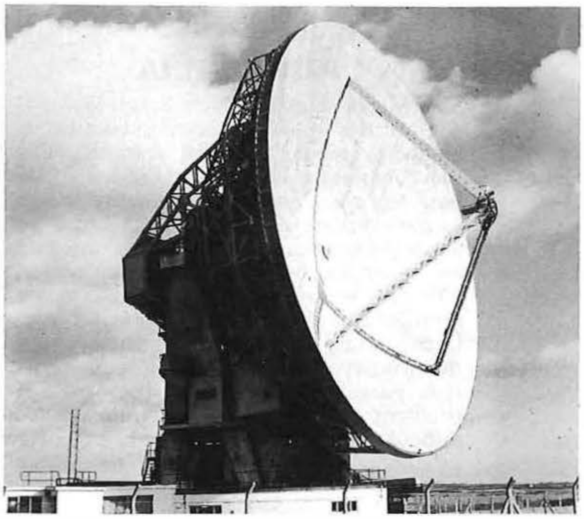
The main difference between the two aerials is that whereas the No. 1 aerial has a primary feed located at the focus of the main reflector, where it is relatively inaccessible, the No. 2 aerial employs a Cassegrain feed system in which a sub-reflector at the focus, is interposed between the primary feed and the main reflector. The primary feed itself protrudes through, and lies along, the axis of the main reflector with the result that it is more accessible and that simpler and shorter waveguide runs between the high power transmitters and the feed, and between the feed and the receiver, are possible. The Cassegrain arrangement also results in a saving of transmitter power and an improvement in receiver sensitivity.

Other significant differences relate to the diameter of the main reflector, the material used for the support structure, and the total weight of and the amount of equipment space provided on the moving parts of the aerial structure. The No. 1 aerial has an 85 ft. diameter reflector, a support structure of steel and reinforced concrete, and the moving part of the structure weighs about 1,200 tons. By comparison, the No. 2 aerial has a reflector which is 90 ft. in diameter and a support structure entirely of steel. The moving part of the structure weighs approximately 940 tons and has about three times the amount of equipment accommodation as is available on the No. 1 aerial.

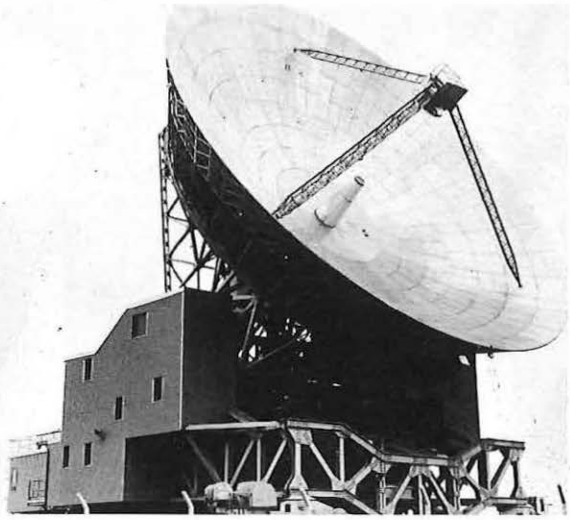
It is the structural features of the Goonhilly aerials which provide the most striking differences between them and the aerials used elsewhere, and which give the impression that the others are smaller even though the reflector diameters are often greater. The Goonhilly aerials are exceptional too, in that they use steel and stainless steel for the main reflectors whereas all others use aluminium.

The present Goonhilly aerials were special designs but the new aerial will be the standard design offered by the contractor concerned. As present designs use aluminium reflectors and offer much less equipment accommodation on the aerial itself the new aerial will bear a much closer resemblance to stations overseas than to its sisters at Goonhilly.

Mr. Lowe takes readers on a colour tour of the world—see over.



Goonhilly aerial 1



Goonhilly aerial 2

Paumalu

UNITED STATES OF AMERICA

Four identical aerials at Etam, West Virginia, Paumalu, Hawaii, Jamesburg, California and Cayey, Puerto Rico were built in 1967-68 in readiness for the global system. They have 97 ft. diameter aluminium reflectors with backing structures of the same material. At Etam the aerial is fitted with de-icing equipment—heating elements behind the reflector with a power loading of 480 kW. This is the station to which Goonhilly No. 2 worked until May of this year by which time the link carried over 200 telephony circuits some of which were extended for permanent use by other European countries.

Etam, Jamesburg and Cayey were designed as single aerial stations, having the aerial base structure adjoining the main equipment building. This compact layout, with all equipment under one roof, greatly facilitates the rapid investigation and handling of equipment failures. The equipment layout takes account of the possibility that a second aerial may be built at some future date, though such an aerial would have to be at a greater distance from the equipment than the original one.

The Paumalu station, in addition to the 97 ft. aerial, also has an 85 ft. diameter aerial built in 1966 and a 42 ft. transportable casshorn aerial now used for command, telemetry and monitoring.

Fucino

ITALY

The main aerial on the Italian station at Fucino is similar to the Etam and Paumalu aerials and is, in fact, an earlier version of the same design. The site also contains a 42 ft. aerial used for command and telemetry purposes in connection with the Intelsat satellites. The main aerial has electrical heating elements installed behind the reflector to keep it free from snow and ice. These are thermostatically controlled and constitute a power supply load of 240 kW.

Moree

AUSTRALIA

The Moree station in New South Wales is one of the most interesting because it embodies several unusual features. The most important of these is the use of an hour angle/declination mount in preference to the elevation-over-azimuth mount used at all other stations. The two mounts can be regarded as being essentially similar but whereas in the elevation-over-azimuth arrangement the primary axis is vertical, in the hour angle/declination arrangement the primary axis is set at an angle such that it is parallel to the axis of the earth. A problem with this type of mount is the difficulty of providing satisfactory accommodation for those items of equipment which have to be located on the aerial itself. At Moree such equipment is housed

Earth stations of the world (contd.)

Mr. Lowe continues (from the previous page) his tour of the world's earth stations. The main point to emerge from the survey is the remarkable degree of uniformity in the main features of aerial design. For example, all stations employ paraboloid reflectors with Cassegrain feed systems and do not use radomes. While there is slightly less agreement about the size of the aerials, designs for this generation have centred on 90 ft. and 97 ft. diameter reflectors. There is a tendency now, though not universal, towards even larger diameter reflectors and one or two aerials completed at the end of 1969 have had diameters of 100 ft.

Sriracha

Ibaraki

ı a feed cone, to which access is difficult, ıd inside which working conditions are ·amped and made more difficult because ηuipment is subjected to movement about ɔth axes. This together with the fact that ıe hour angle/declination mount has no articular advantages over the azimuth/ evation mount for the type of satellite rbits at present envisaged, makes it ılikely to be used elsewhere.

Also interesting is the building of the ıtenna and mount on top of a four-storey uilding with the equipment, which needs › be close to the aerial, installed on the top oor. Another feature is the use of a omputer to monitor the state of the quipment and effect changeover to stand-y facilities or whatever other action that ıay be necessary. This system was not perational at the time of the author's isit and it is not possible to assess the ıccess or otherwise of the arrangement.

THAILAND

The station at Sriracha is very different from the other designs. The aerial has a "do it yourself" look about it but performance is well up to standard. It has a 97 ft. diameter reflector of aluminium and a backing structure of steel. The whole structure is supported by four sets of bogies which move round a circular track when azimuth movement is required. Low noise amplifiers and associated cryogenic equipment are housed in the feed cone—a hollow truncated cone shaped structure about 8 ft. in diameter at its base—on the front side of the aerial reflector. It is accessible at most elevation angles and provides acceptable though cramped working conditions at the operating elevation. But working conditions would become very difficult at elevations above about 30 degrees.

JAPAN

The earth stations at Ibaraki and Yamaguchi are similar to one another. One of the main differences is that at the newer station Yamaguchi, completed in 1969 and which operates to Goonhilly No. 1, the transmitters are housed in the base of the aerial tower instead of in a high-level cabin on the moving part of the aerial as at Ibaraki. In addition the use of waveguide rather than coaxial cables to provide the inter-connexion between the main equipment building and the aerial allowed the up-converters and down-converters to be housed in the central building instead of on the aerial. The Japanese aerials are of the near field Cassegrain type and use horn reflector feeds in which the axis of the horn is coincident with the elevation axis of the antenna. This arrangement enables the low noise amplifiers to be installed in a normal and accessible position such that the attitude of neither the amplifiers nor the cabin changes with the elevation of the aerial. Both the aerials have 90 ft. diameter aluminium reflectors but have steel backing structures. The aerials are driven hydraulically.

OPEN DAY AT YAMAGUCHI

Mr. B. A. Lowe, the author, plants a tree in the grounds of the Yamaguchi earth station to mark his visit which coincided with an Open Day. Mr. Lowe's round-the-world tour, which lasted for about seven weeks, was undertaken with a view to helping space communications in the Post Office by learning how other people in this field had solved their various problems and how their stations differed from Goonhilly. Mr. Lowe is an Assistant Staff Engineer in the Earth Station Planning and Provision Branch of Telecommunications Development Department, and his work includes technical assistance to overseas administrations. He was concerned at Headquarters with work relating to the building of the first Goonhilly aerial and subsequently was controller of the early experiments there.

New exchanges for old

By R. C. KYME

At Highclere, near Newbury, a new TXE2 electronic exchange (left) stands beside the small UAX13 exchange building. The electronic equipment will shortly replace the 25-year-old UAX13.

In the current financial year the Post Office will be placing orders for 258 complete new telephone exchanges costing some £32 million. About £19 million of this will provide for replacement of existing exchanges, and this figure is likely to increase substantially in the years to come. Why, when and how do we replace exchanges?

THE most obvious reason for replacing any article is that it is worn out; but it is not always easy to define what we mean by "worn out". There is no doubt about an electric light bulb which fails, but it may be more difficult to decide when to discard a suit of clothes; after all you can go on patching until little of the original cloth remains. A similar state of affairs occurs with a telephone exchange, and before deciding on replacement we ought to ask the questions:—

- Is the service which it is providing acceptable to the customers and to ourselves?
- If above-average maintenance effort is being expended to provide an acceptable service, is it economically right to continue in this way or should we actually save money in the long run by providing a new exchange?
- If the service is not acceptable should we further increase maintenance effort or should we replace the equipment?

Some years ago certain exchanges which failed to provide a satisfactory service were identified, and it was decided that they should be replaced as capital became available. These were exchanges originally installed more than 30 years ago and with particular unsatisfactory features: for instance single contact relays. An appreciable capital sum has now been allocated for these replacements in the current financial year.

Replacement on economic grounds is simple to justify in theory but is more difficult in practice. The cost of keeping an exchange in service—maintenance labour, materials, running costs, the value of the equipment if recovered and, if applicable, the cost of foregoing new facilities such as STD—has to be balanced against the annual charges which would be incurred by installing and running a new exchange. These costs include depreciation, interest on capital, maintenance and other running expenses. To ensure at least the minimum return required from capital investment the yearly savings from a new exchange expressed as a percentage of the capital expended must equal the required return—currently 10 per cent.

A lack of operational facilities provides an important reason for replacing an exchange, and although the enormous quantity and longevity of existing plant discourages rapid change, this factor will no doubt play an increasingly important part in the future. Manual exchanges are still being replaced by automatic exchanges more than 40 years after the decision to provide an automatic service was taken. UAX7s had to be replaced before the subscribers they served could have STD, but in 1968 there were still 78 left. Strowger exchanges which are being extended with considerable quantities of new Strowger equipment are, by modern standards, lacking in speed, flexibility in providing new facilities and prodigal of maintenance effort. They will have to be replaced, but it is no mean task to replace £700 million worth of equipment which is still being added to at the rate of about £90 million a year.

By far the most common reason for replacing an exchange is that it cannot be extended to cater for growth, either because of design limitations, or because the building is not large enough and cannot be extended. A typical example of design limitation is the UAX13 with a capacity of 600 numbers which can, exceptionally grow to 700, but no further.

Building and site limitation is often a troublesome category, particularly in towns where sites are difficult to acquire and where there are heavy penalties, in increased cabling costs, for building the new exchange away from its most economic position. By replacing old equipment with new, sufficient space can sometimes be saved to permit an exchange to continue to occupy a building which otherwise would have proved to be inadequate, but this is unlikely to be a reason for replacing a complete exchange.

For completeness it is necessary to mention two reasons for replacing an exchange which fortunately do not occur very often. The first is catastrophe, such as fire, and the second is the need to make the space occupied by an exchange building available for some other purpose: for instance a new road.

The timing of many replacements is determined by the lack of capacity in the existing exchange for connecting new customers or for handling increasing traffic. Even with favourable conditions all the way, it takes about seven years to plan, find and buy a site, erect a building and install and bring into use a medium-size exchange. Planning many years ahead is therefore vital if a new exchange is to be ready by the time the capacity of the old one is exhausted.

An exchange can be replaced in the same building, extended if necessary. Unless the site is very badly placed in relation to the cable network this is the most economic course. Many of the larger local exchanges installed in the last 10 years have had their equipment arranged in units, so that equipment of similar age is grouped together to facilitate replacement. This should prove valuable when changing to a new system such as crossbar or electronic. If it is impossible to install the new exchange alongside the old, a new site must be found as close as possible to the centre of the cable network—the practical centre. Cables feeding the old exchange must have parallel connexion to the new one, with means for disconnecting the old and connecting the new in the few minutes allowed for changeover.

Little difficulty need arise when the replacing exchange can be completely installed before the old one is taken out of service. Neither has there been any trouble in the past, with Strowger equipment, even when there was room to install only a part of the new exchange. This new portion could be brought into service, the corresponding part of the old exchange taken out, and more new equipment installed in its place. With the advent of crossbar and, very shortly, large electronic exchanges the problems involved in a staged turn-round are considerable and would generally necessitate provision of extra equipment to enable old and new systems to work together during the turn-round.

The average life of the collection of equipment forming an exchange is at present about 30 years, although this life is likely to be considerably reduced as a result of a review that is being carried out this year. The high growth rate which started in the earlier 1960s means that much of the equipment, even in an old exchange, can be almost new. The temptation, in such cases, to replace only the old equipment in the exchange with the modern Strowger equivalent is considerable. When a complete exchange is replaced there is again temptation to re-use, somewhere else, the newer recovered equipment. The longer we go on the more equipment there is to replace, and the problem will get worse when it becomes possible to offer facilities like push-button telephones and viewphone to customers.

When to replace exchanges which are still able to provide service is one of the most difficult questions the Post Office has to answer. An increase in the replacement programme will require vast investment and manufacturing resources, and greatly enlarge our provision for depreciation by "writing off" switching equipment in a shorter time.

Mr. R. G. Lewis, Clerk of Works, inspects new crossbar equipment at Holborn exchange, London. On the left is some of the Strowger equipment which is to be replaced.

THE AUTHOR

Mr. R. C. Kyme joined the Post Office in Reading in 1937 and moved to the Engineering Department in London in 1945. He has served in the Oxford area, Guernsey and South West Region, and is now Assistant Staff Engineer in Operational Programming Department responsible for system planning and economics for the local exchange network.

£50 million for data transmission

THE explosion in demand for data transmission facilities created a heavy responsibility which the Post Office was taking very seriously, Mr. Edward Fennessy, Managing Director Telecommunications, said in London recently.

He was speaking at a prize-giving ceremony in the national "Dial-a-Computer" competition to which the Post Office contributed six modems, exchange lines and up to £300 worth of telephone calls.

The number of Post Office data terminals was at present doubling each year, said Mr. Fennessy. It was expected that there would be 50,000 terminals by 1973 and half a million 10 years later.

The demands of data transmission had not been envisaged when telephone exchanges designed for speech use were being developed.

Existing telecommunication networks were able to carry data, but the Post Office was facing problems created by its volume and characteristics. Time-sharing computer bureaux often called for a hundred or more lines to be concentrated at one point, and data calls were usually 10 times longer than the normal telephone call.

Very sophisticated methods of transmitting data were going to be needed to cope with the expected demand, calling for a completely new concept of the network required. A number of major studies were now being carried out in advance of the decisions that had to be taken, Mr. Fennessy added.

Out of the £2,700 million capital investment programme for the next five years, £50 million had been earmarked for data links.

"We intend to provide in this country within the decade the finest data transmission service in the world," said Mr. Fennessy.

● The "Dial-a-computer" competition, for the most original ideas for using a computer time-sharing service, was organised by the New Scientist and GEIS Ltd. The winners received free computer time. Mr. Dale Clark, managing director of GEIS Ltd. which provided the computer, spoke at the ceremony in praise of Post Office data transmission facilities.

Direct Dialling In

By H. F. EDWARDS and D. W. GATTING

Britain's business houses could get a better incoming telephone service and make substantial savings in operating costs by using Direct Dialling In, a system of routing a firm's incoming telephone traffic so that callers can dial direct to any extension, bypassing the switchboard operator.

PRIVATE Automatic Branch Exchanges (PABXs) have existed for many years. They have enabled extension users to call each other, dial direct to the public network, make and receive calls to and from extensions on other PABXs where suitable private circuits are provided—all without involving an operator at the installation's switchboard.

The only type of call left is the incoming call, the answering and connecting of which forms the greater part of the PABX operator's work. To make the PABX even more efficient and effective a logical development would be to remove incoming calls from the switchboard and enable callers to dial direct from the public network to extensions. It is this step which is achieved with Direct Dialling In (DDI).

The principal virtue of the system is that by bypassing busy and sometimes overburdened PABX operators it reduces the dependence on a human link which has always been the weakest in the chain of events which lead to a telephone connexion. With the consequent reduction in the number of operators and switchboard positions required DDI thereby provides a more efficient and economic telephone service for industry and commerce.

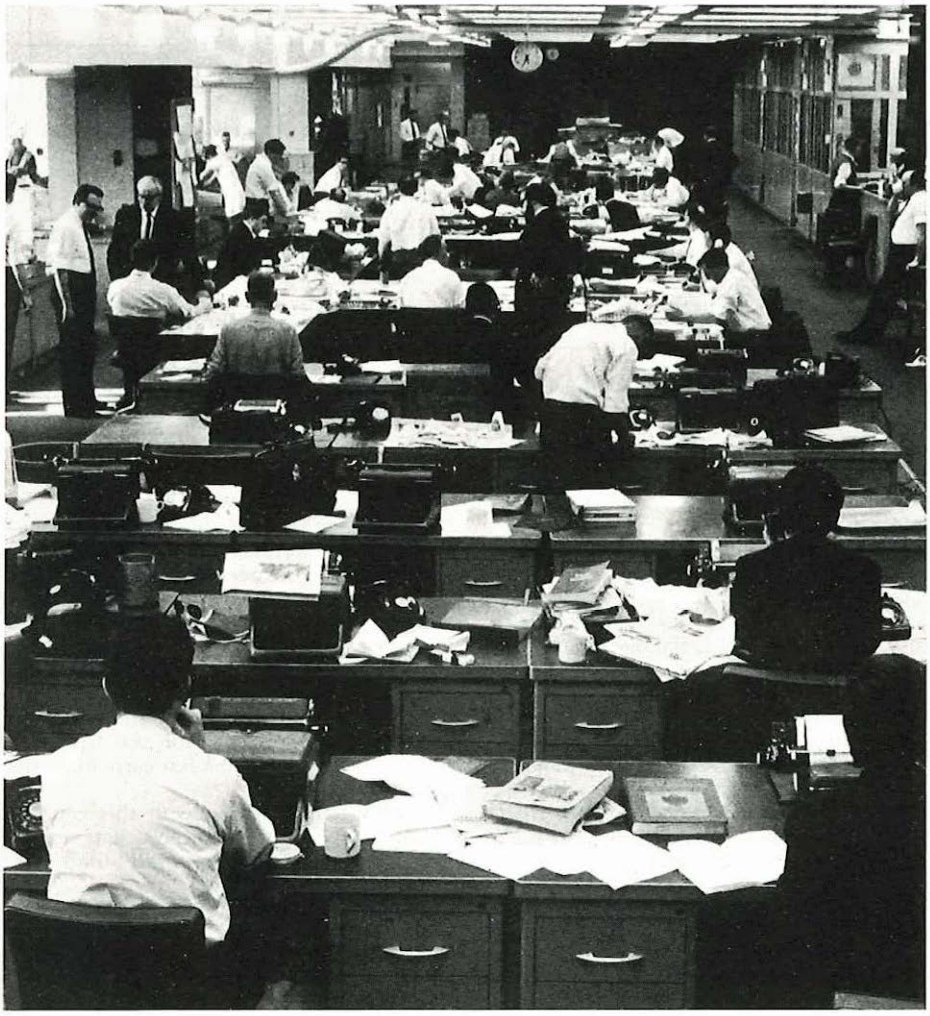
Independence of the operator is taken a step further where a PABX 4 is used. An automatic transfer facility on this type of installation enables a DDI call to be transferred from one extension to another. Simply by depressing a button on the telephone handset, the user of a wrongly called extension can hold the caller, dial the proper extension, explain the situation to a colleague without the original caller hearing the conversation, and then complete the connexion by replacing the receiver.

DDI could have been provided by giving callers access to individual extensions by dialling the PABX public exchange number followed by the extension number, a procedure known as "Final-Selector Through-Dialling" or "Additive Dialling". Because of the technical problems involved, the need to develop new equipment and modify existing plant, all at great expense, this method was not adopted. Moreover it would have led to very long numbers having to be dialled.

Consequently, other methods are being used to provide the facility. The simplest is for each DDI extension to occupy a number in the exchange numbering range. This brings nearer the date when the exchange will become exhausted because whole blocks of numbers, hundreds or thousands depending on the size of the PABX, must be allocated irrespective of whether or not all the numbers are taken up by DDI extensions. Unfortunately, this is the most economic way at the moment of giving the facility on the non-director exchanges that serve towns outside the six large conurbations of London, Birmingham, Edinburgh, Glasgow, Liverpool and Manchester.

A second method is to form a separate exchange unit to provide DDI numbers and to carry incoming traffic only; outgoing calls continue to go by way of the main exchange. This is often a satisfactory method in London and the five provincial director areas where DDI extension numbers are used in conjunction with a three-digit exchange code different from that used for normal lines in the area.

The method of trunking known as "Alpha-Beta" working, sometimes used in Director Areas to provide more numbers in an existing exchange building, can also be applied for DDI. Although the DDI (Beta) code is different from the main (Alpha) exchange code, the public exchange directors "translate" the DDI code so that it is routed to the



The huge newsroom of the "Daily Mirror" which was the first company to get direct dialling in. Outside callers can reach the reporters and sub-editors direct on any of the hundreds of telephones . . . a boon in the daily newspaper race against the clock.

ADVANTAGES

1. With the exception of small PABX installations there are savings in operating staff and switchboard positions.
2. There is a faster and less frustrating service on incoming calls. You get the person or department you want directly.
3. Because DDI calls are completed automatically, without the intervention of the PABX operator, there is an additional degree of privacy.
4. The timing and the metering of calls to DDI extensions starts only when the extension answers and not, as happens without DDI, when the PABX operator answers. The number of complaints to the Post Office arising from ineffective time paid for on calls to PABXs resulting from slow time to answer from extensions would be reduced.
5. The introduction of DDI should result in a reduction of personal calls handled in the public exchange by allowing subscribers to call an extension without being charged if it is unattended.

DISADVANTAGES

1. On the provision of DDI there are minor differences in facilities available on calls connected via the operator and those dialled direct to the extension. Some of the personal service given by PABX operators is lost, but this may be compensated if a good answering service is given by the extension users.
2. When extensions are engaged, unattended, or delay answering the proportion of ineffective call time will rise and this cost will be borne by the Post Office.
3. DDI may mean that there is a less efficient use made of public exchange numbering capacity and/or exchange codes. In addition, some switching equipment may have to be provided in that part of the exchange which is selected to give the DDI access.

main exchange and they then add an extra digit which switches calls to a previously unused level in the main exchange from which they are extended to the Beta unit.

To take an actual example, British Petroleum is on the 628 exchange (Alpha) but its DDI numbers are all on the Beta code 920. The latter when dialled is translated into the 628 routing plus the extra digit, in this case 1, to step the call to the previously unused level 1 in the main exchange. If the digits 6xxx, 7xxx or 8xxx are dialled after 920 they give access to up to 3,000 DDI extensions on BP's very large PABX at Brittanic House. (Dialling 1xxx, 2xxx etc. gives access to other companies' PABX extensions). In fact for the loss of those 1,000 numbers on the unused level in the main exchange up to 10,000 DDI extensions, the maximum of any four-digit numbering scheme, can be provided.

At present there are sufficient spare codes in each of the five provincial Director Areas to cater for any demand for DDI that is likely to

A British Petroleum executive uses the automatic transfer facility to pass a call to a colleague on one of the 9,000 push-button telephones installed at the company's London headquarters. BP was the second firm to be supplied with DDI.

occur. In London there are enough for some years, but an increased use of DDI will advance the date when a rearrangement of the London Director Area numbering scheme will be needed.

For outside callers who do not know the DDI number of the person required, access to the PABX operator can be given in one of two ways. Either the PABX can retain the original published number, completely different from the DDI numbers, or it may be given a separate number within the DDI range. The main disadvantage of the former method is the necessity to split the exchange lines to the PABX into two separate groups—one for DDI extensions, the other for the PABX operator. Because traffic between the two groups fluctuates, the total number of circuits which have to be provided is higher than with the alternative method. If a separate DDI number is allocated all traffic goes over the same exchange line group and any change in the proportion of DDI and incoming switchboard traffic does not affect the number of circuits required or the grade of service.

The biggest DDI concentration ever likely to occur in this country is the complex of PABXs which is being set up for Government Departments in and around Whitehall. A tandem exchange is being provided which will not only cater for intercommunication between the PBXs over private wires, but will also act as the focal point for switching DDI calls from the public network to the 60,000 extensions in the first two phases of the scheme.

Direct Dialling In is being used at an increasing number of mainly large installations, such as the Daily Mirror, British Petroleum and the Bank of England, where around 1,000 and sometimes several thousand extensions have to be provided. It now seems likely, however, that some customers with around 200 or 300 extensions would like the service, and that it may be possible to provide it at a moderate cost, probably by concentrating this traffic on certain specialised exchanges. It is now being used by a number of Post Office departments and Telephone Managers' Offices of this size.

DDI is primarily of value to organisations where the number of the required extension is known to the caller or can be made known on letter heading or by other publicity. To get the greatest advantage from DDI this is vital. DDI numbers are not shown in Post Office telephone directories because they would occupy a large amount of space, especially if duties as well as names were shown, a necessary inclusion if information was to be of much use. Moreover, the mass of detail would make it difficult for casual callers who might be tempted to try numbers almost at random, instead of calling the one published number that the PABX operator will still answer. But when DDI is conscientiously publicised it is possible for organisations to get more than half their incoming calls dialled directly into the extensions, giving them substantial savings.

Little would be gained by installing DDI if a high proportion of calls were still routed to the switchboard, for example because the nature of a business needed the operator to establish which extension was wanted. And with the smaller PABXs it is unlikely that DDI would effect operating staff economies to an extent which justified its introduction.

Provision of DDI needs careful planning well in advance of the required date to allow the public exchange equipment to be designed to cater for it. At present it is very difficult to forecast demand as the facility is not yet widely known. Eventually, it is hoped that sales forecasting may include estimates of potential DDI customers in the same way that it provides for large PBX demands. It would then be possible to plan an exchange in such a way that DDI could be given at fairly short notice in contrast with the present situation where the first customer sometimes has to wait for a considerable period until an extension of equipment is completed.

THE AUTHORS

Mr. H. F. **Edwards** is a CTS in Market Research Division of Marketing Department. He has been dealing for nearly 10 years with the traffic aspects of the design of PBXs and their operation. **Mr. D. W. Gatting** is an STS in the Facilities and Traffic Engineering Division of Telecommunications Development Department with responsibilities for determining the requirements of customers' apparatus.

Computers in the Post Office

By J. J. SMITH

The Board has reviewed the arrangements for computing work in the Businesses, apart from the use of computers for the direct control of telecommunications and postal equipment and traffic.

It has decided that computers for processing commercial and management data, and for scientific and technical computation, shall be provided and operated as a corporate service. This Data Processing Service will come into operation on 1 April, 1970, and have two principal components: the National Data Processing Service (NDPS) working for customers outside the Post Office, and the Post Office Data Processing Service (PODP) working for Telecommunications and for Posts and Giro.

The Post Office Gazette announcement of the reorganisation of the National Data Processing Service.

THE bringing together of Post Office interests in the field of electronic data processing will yield many advantages in terms of the planning and co-ordination of resources to meet the considerable expansion of Post Office computing activity over the next decade and beyond.

Plans exist for the expansion of existing systems and for the development of new systems, both "in-house" and commercial, which will keep the Post Office in step with the fast advancing technology which is a constant feature of the computer scene. It will be the job of the new corporate organisation to put these plans into effect and to ensure that the computing skills required for this task are developed and deployed to the best advantage. Above all, is the aim to see that the Telecommunications and Postal businesses are able to introduce and use computer aids speedily and effectively.

Already, DPS resources add up to a formidable display of computer hardware and "know-how": computers on the ground total 20, with a capital value of £8 million and a computing power of seven Atlas machines. Total staff number 3,000 and includes over 850 systems analysts and computer programmers.

Before looking at possible future commitments for the new Data Processing Service it is worth outlining the build up of computing activity within the Post Office. Modern computing may be said to have started in the Post Office in 1958 with the installation of two Elliott magnetic-tape computers for payroll work. These machines are due to be relieved of their load by the end of 1970 after 12 years of Post Office computing. This first excursion into data processing paved the way for the large modern computer centres in London, Derby, Edinburgh and Portsmouth.

These were the centres that provided the computing power for the many projects which were planned, programmed and implemented during the 1960s. Equipped with ICL 326 machines, they are processing volumes of data which are large even by Post Office standards. Accounts for more than seven million telephone subscribers are being handled at the four centres, and 32 million bills a year processed and printed. Three additional machines are due to be installed this year, including one in a new centre in Bristol. Ultimately, all seven machines will be fully occupied in producing bills, ledgers, subsequent payment reminders and follow up notes, in total involving the use of 70 different computer programs.

A stores control system has been set up and involved the control of receipts, issues, provision and accounting for 40,000 stock items valued at £90 million, mainly in the Telecommunications business. This system provides for automatic stock replacement, and the periodic recalculation of stock levels. The new comprehensive payroll system will also run on these machines and will eventually calculate pay for some 300,000 staff, catering for gradings, allowances, overtime rates, voluntary deductions and so on.

For the Postal business high-speed data transmission equipment has been in use between Chesterfield and the London Kensington computer centre since 1966 to record the serial number details of some 800,000 paid postal orders every day. A total of 10 million characters per day are received over the data-link and filed in serial number order on magnetic tape. A vehicle scheduling scheme which produces timetables for the Central London fleet of mail vans has been in use since 1967. This fleet has some 500 vehicles stationed at five garages and performing about 30,000 time-critical trips and covering about 250,000 miles a week.

At the new Leeds computer centre, opened last year, some full scale and some pilot Post Office projects are being processed on the latest ICL System 4 machine. These include a Telecommunications Number Information System which compiles, maintains and processes the records of telephone directory entries for the directory enquiry service and for the computer controlled composition and printing of telephone directories. A Broadcast Receiving Licence scheme is also being run on this machine; this scheme when fully implemented will maintain and update records of licence holders throughout the country.

A large Post Office computer complex in Bootle serves the National Giro Service which was planned and introduced as a computer based service from the outset. A particular feature of this system is the use of a wide range of very advanced peripheral devices. These include optical character readers, a system for the direct keying of input data from 142 keyboards onto magnetic tapes, and equipment for the direct recording of data from magnetic tape onto microfilm records.

At the new London Computer

A bank of magnetic tapes at the Leeds Computer Centre.

Centre, opened in 1969 and equipped with one ICL 4-70 computer and two ICL Spectra 70/45 machines, two major telecommunications projects are being developed and implemented. These will give users immediate access by means of visual display units to computer-held records for trunk forecasting, trunk line allocation and routing, and for local line planning and control. Both are on-line, real-time systems, i.e. there is direct access to the computer through a keyboard input and the computer immediately processes the information and gives an answer.

It has been a Post Office policy that all staff concerned with research and development should have access to a computer. The R & D machines installed at Gresham Street and Dollis Hill provide facilities for a wide range of work which includes, for example, the design of submarine cable systems, research into solid-state and semi-conductor circuits, design of telephone exchanges and speech analysis for new methods of transmission. More recently terminals have been provided in all Telecommunications Regional headquarters and some areas as an aid to exchange designers and to provide for *ad hoc* computational work. By means of these time-sharing terminals a number of offices can have access to the computer at the same time.

On the commercial side of Post Office computing, NDPS has been engaged in a variety of large and small scale computer projects. Large projects include the design and operation of an on-line real-time system to control the documentation and clearance of incoming air cargo at London's Heathrow Airport. Known as LACES —London Airport Cargo Electronic-data-processing Scheme—it will provide HM Customs and Excise, some 16 major airlines and the many shipping and forwarding agents operating at the airport, with a round-the-clock seven days-a-week computer service.

NDPS has also been retained by two large groups of Trustee Savings Banks to operate on-line real-time computer based banking systems in the North West and in the Midlands and North East of England. When fully operational, these systems will process about 43 million transactions a year for nearly five million TSB account holders. Another major commercial assignment involved the provision, at very short notice, of the fully equipped computer centre at St. Albans for the Cadbury-Schweppes organisation. Contracts have also been obtained for numerous smaller jobs including a system which will provide a complete accounting scheme for the National Federation of Builders and Plumbers Merchants.

As to the future, the Management Services Department of THQ has outlined a 10-year plan for computer applications in the Telecommunications business. A highlight of this plan is the development of a Customer Services System which will bring together many of the existing systems and combine them with new ones to provide and process all the information involved in the provision of telecommunications service for customers.

This system will provide computer facilities for consulting plant records, issuing of advice notes, preparing directory information, billing and updating of plant records. It will integrate with existing systems and initiate the necessary action making known any contingency which might delay service. Staff will have access to it through video terminals, for putting in data and receiving information relating to provision of service, account queries and service complaints. Other inputs to the system will be through specially developed devices interfacing with telecommunications network plant, e.g. automatic traffic recorders and call failure detection equipment. Because of its intimate involvement in operational work, the system will need to be

Location of Post Office Computer Centres.

Operators at the Leeds Computer Centre transfer telephone directory information on to punched cards which are later fed into the computer.

"fail soft" in design, i.e. protection would be provided to prevent a sudden and complete failure.

A report on Computer Aids to Post Management indicates that the Postal business also will move progressively towards the development of an integrated management information system, with existing and proposed systems being evaluated both on their own merits and for their contribution to the overall system. NDPS also plans to develop and expand its commercial services. The London Airport Centre has capacity for additional computers, and has been designated as a NDPS West London Headquarters. Further centres are planned to meet existing and forecast demand in the fast expanding computer services bureau market.

Clearly the Data Processing Service has a heavy task in hand, both in maintaining and expanding existing services and in developing and implementing the new projects demanded by the Telecommunications and the Posts and Giro businesses and by NDPS commercial customers. Its first and most urgent task is to fulfil the "corporate" function of the new organisation by taking into account the plans and requirements of both the PODP and NDPS and developing resources to meet them. The execution of this plan will be the major task for DPS during the years ahead as this new and rapidly expanding business takes its place alongside, and in support of, the traditional and long established Posts and Telecommunications businesses of the Post Office.

THE AUTHOR

Mr. J. J. Smith joined the former Central Organisation and Methods Branch in 1962 from HQ Sales Division and was responsible for the project to transfer the checking and summarising of postmasters' accounts onto a computer. He is now a CEO in the Sales and Marketing Branch of NDPS.

THE 'INSTANT' COMPUTER CENTRE

Operators change the discs at the St. Albans Computer Centre.

A FULLY operational computer centre has been set up in only two months by NDPS for the Cadbury Schweppes food, drinks and confectionery group. Normally, an installation of this type would take from 12 to 18 months to complete.

The high speed operation was made possible because NDPS rearranged work at their Bootle centre so that an ICL 4-70 computer providing reserve capacity there could be quickly moved to a new Cadbury Schweppes computer block at St. Albans, Hertfordshire.

NDPS got formal approval to move their reserve computer in April this year. Immediately they arranged for transfer of the equipment and the provision of additional plant by ICL. Installation at St. Albans began on 6 May and by the beginning of July the centre was fully tested and ready to go into operation. The swiftness of the operation was helped by the close co-operation of Cadbury Schweppes, ICL, and other equipment and building contractors.

Total value of the installation is £850,000 and it includes, in addition to the ICL 4-70 central processor, a core store of 262 kilobytes, 12 120-kilobyte magnetic tape units and 12 replaceable disc stores.

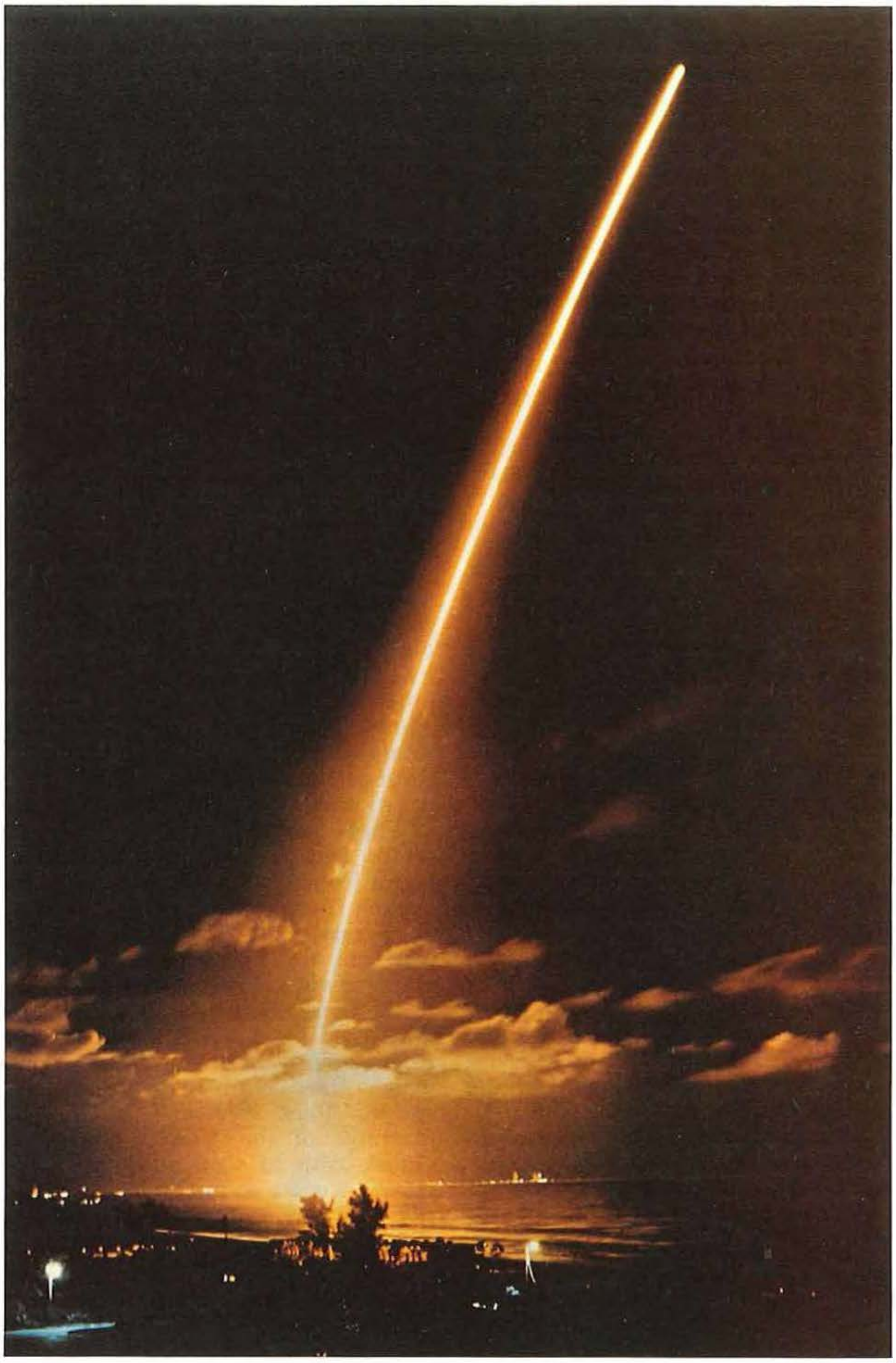
On these machines NDPS, who have a £3-million, seven-year contract to operate the St. Albans centre, will run programs designed by Cadbury Schweppes for the group's sales ledger, invoicing, marketing and sales statistics, and file maintenance. There are more than 200 individual programs of which 150 will be run daily.

During the first year of live operation—all programs are required to be operational by January 1971, to meet the decimalisation deadline—the computer will process 146,000 customers accounts, and produce 13,000 invoices a day and 74,000 statements a month in addition to extensive management information and statistical work.

The St. Albans centre is the first dedicated NDPS complex in the commercial field.

The crowded spectrum in space

By J. K. S. JOWETT



Another communications satellite rockets into space just before dawn from a launching pad at Cape Kennedy, USA. All types of spacecraft make use of radio frequency transmissions, and an important international conference next year will review their needs for the use of the radio frequency spectrum. Of particular interest to the Post Office and to other participants in the INTELSAT global network is the amount of new spectrum to be made available for communication satellites. Today's network of INTELSAT III satellites—one is being launched in our picture—provides for commercial telephone, telegraph, data and television-relay communications between about 40 large earth stations around the world. This situation has been reached within only eight years of the launching of the experimental satellite TELSTAR. It is clearly essential therefore to allow for the expansion of such services in the future and next year's frequency conference will set the pattern for large-scale future developments.

A MAJOR international conference is to be convened in June of next year under the auspices of the International Telecommunications Union in Geneva. It is to be known officially as the World Administrative Radio Conference (Space Telecommunications), or WARC(ST) for short, and is the successor to the important Extraordinary Administrative Radio Conference of 1963 which made history in allocating extensive frequency bands for the newly developing space communications services.

The developments that followed that Conference have more than confirmed the wisdom of the decisions then taken. The Conference was, in fact, an excellent example of successful international collaboration in a rapidly expanding field of technology. Without it, no integrated commercial development of frequency bands for communication satellites would have been possible and INTELSAT, the international satellite communications consortium in which the British Post Office plays a major role, could scarcely have commenced operations.

In the field of long-distance radio communications—which now includes that of satellite communications—progress has always been very dependent upon the reaching of international agreements, not only as to the precise frequency bands to be allocated but also as to procedural, technical and regulatory rules governing the operation of the different services. Now, seven years later, the need arises to review the 1963 provisions for space communications and, in particular, to provide for the growing number of new space radio services foreseen in the next decade.

One main interest of the Post Office centres on the protection of its present forms of satellite communications service via INTELSAT and the provision of adequate further spectrum space for similar services which can be foreseen in the future. In 1963, over 2,000 MHz of frequency space were allocated for communication satellite services, although almost all of this was to be shared with terrestrial services using line-of-sight radio relay links.

This is a large amount of frequency spectrum and, furthermore, it can be used several times over by different systems using satellites sufficiently separated in the geo-stationary satellite orbit. Nevertheless, it is already widely accepted that additional frequency bands for some future types of satellite system must be provided for at next year's Conference.

It is not, however, merely the allocation of new or extended frequency bands for space radiocommunications which will engage the attention of the Conference. The technical conditions under which existing frequency bands are shared between space and terrestrial radio services will also come up for review, based on the findings and recommendations of the ITU's International Consultative Committee on Radiocommunications (the CCIR). The determination of these technical limits has been one of the most complex tasks that Administrations participating in the CCIR have ever had to face. The problem has been to fix limits which will ensure freedom from interference between the two types of service yet, at the same time, allow the maximum scope for free development of space and terrestrial services to meet the present and expected demands.

The developments of recent years have owed much to the outstandingly successful technical work carried out through the CCIR. It will now be for the WARC (ST) to consider the latest recommendations of this body, and to determine in what way further formal changes and additions should be made to the Radio Regulations in order to facilitate the development of both space and terrestrial radiocommunication services. There is also the possibility that, to permit the introduction of new satellite communication services employing the higher satellite powers which are now achievable, more provision should be made for frequency bands to be exclusively allocated to such services. These and many associated technical, procedural and administrative questions concerning all forms of radiocommunications in space will provide a full agenda and call for determined efforts if the Conference is to conclude its work in the six weeks which have been allotted.

Of especial interest are the types of space service which may in future become possible, such as satellite broadcasting and satellite systems for communication to ships and to aircraft. Virtually no provision was made for these at the 1963 Conference which was largely concerned with long-distance communication satellite services and various forms of space-research service. Communications needed for space research, manned spacecraft, meteorology and telemetry of all kinds also have grown since 1963. These growing requirements will demand substantial revision of the regulations and, in some cases, of the frequency bands to be set aside. While many of these requirements are no longer the concern of the Post Office they have to be studied closely by Government Departments and other users, and in particular by the Ministry of Posts and Telecommunications which has overall responsibility for this country's preparations for the Conference.

These preparations are now well under way in Britain as in other countries and technical interest is at present focused upon a joint meeting of several CCIR Study Groups arranged for February, 1971. This meeting will prepare technical recommendations relating to the work of the WARC (ST). Again, the Ministry is responsible overall for contributions which this country makes to the special Joint Meeting, as to all meetings of the CCIR. The Post Office, with its very substantial expertise in space and radio communications, is playing an effective part in the preparations for this meeting.

The interests of the Post Office are not, of course, limited to space radio services. Of particular concern is the preservation of its interests in terrestrial communications, and it is necessary to ensure that the technical criteria for frequency sharing are such that they do not seriously inhibit the development of the inland microwave radio-relay network by the development of space systems. Likewise full allowance must be made for the expected development of new terrestrial networks at frequencies above 10 GHz. The balance of interests between the terrestrial network developments and necessary expansion of space communications is a delicate one which demands careful preparatory work by Administrations participating within the CCIR.

One other subject which latterly has been receiving considerable technical study concerns the practical minimum spacing between satellites in the geo-stationary satellite orbit. This, of course, is not to suggest the possibility of collisions between satellites! The problem is one of potentially excessive interference between the signals received by or transmitted from satellites sharing the same frequency band. Present indications are that an angular separation of a few degrees (i.e. a spacing in geo-stationary orbit of perhaps a thousand miles or more) will be needed to avoid such interference and the problem is currently receiving the close study of an International Working Party of the CCIR. The Post Office has made special studies in this particular field and, since it holds the Chairmanship of this Working Party, is to host its second meeting in London during October 1970. The report of that meeting will then be submitted to the Joint Meeting of CCIR Study Groups to be held in February 1971. It is expected that both the technical factors and procedural means for controlling interference between satellites will be major subjects for debate and decision at the 1971 Space Frequency Conference.

The preparations for the 1971 WARC (ST) and for the related CCIR meetings are taking place in a national situation which differs considerably from that applying at the time of the 1963 Conference. On that earlier occasion, the Post Office had to act both as an operating organisation making extensive use of the radio-frequency spectrum and also as the Government Department responsible for regulating such use in all its applications. The situation today is that the Ministry of Posts and Telecommunications undertakes this latter role, while the corporation is concerned as a major operating organisation having specific commercial objectives. Even so, the Post Office has a large stake in the questions to be resolved at the WARC (ST), arising not only from its investment in the INTELSAT global system but also from its plan for the development of terrestrial radio communications. These interests are being closely watched in the preparations now being made.

TEST OF MARITIME SATELLITE SYSTEM

The Post Office is taking part with a number of other organisations in tests of a ship-to-shore satellite communications system. The Cunard vessel Atlantic Causeway has been equipped for two-way communication through the satellite.

It will be linked with a mobile station at the Post Office radio station at Burnham-on-Sea.

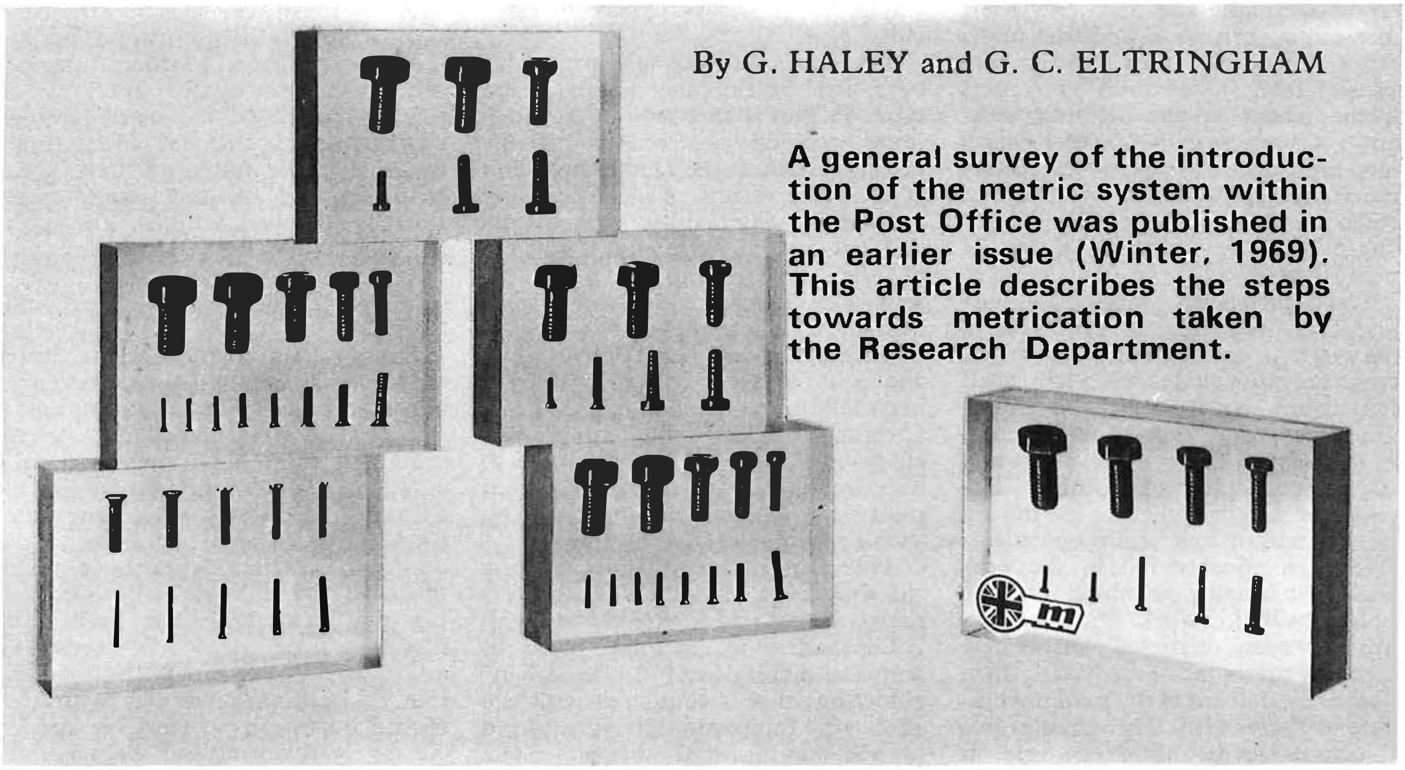
The tests cover radiotelephony, teleprinter, data and facsimile transmissions.

The ATS-3 Application Technology Satellite is being used with the co-operation of NASA—the American space administration.

THE AUTHOR

Mr. J. K. S. Jowett is Deputy Director Engineering in charge of the Space Systems Division of the Telecommunications Development Department. He has represented the Post Office at a number of International Conferences and for a period of five years attended the bi-monthly meetings of the Technical Sub-Committee of INTELSAT in Washington.

Research department goes metric



By G. HALEY and G. C. ELTRINGHAM

A general survey of the introduction of the metric system within the Post Office was published in an earlier issue (Winter, 1969). This article describes the steps towards metrication taken by the Research Department.

A training aid compares a range of 49 Imperial size screw threads (left) which can be covered with only nine metric sizes (right).

THE Post Office Research Department has already made considerable progress towards the introduction of the metric system. The transfer of about 200 staff to the new research centre at Martlesham, Essex, has fortuitously provided the opportunity for an interesting pilot scheme, and the staff there are working solely in metric units.

The need for early consideration of conversion problems arose from the requirements of the mechanical engineering workshop which is part of the Services Section of the Research Department. The workshop and a drawing office providing mechanical engineering design functions have a total staff of about 170.

A very wide range of machine tools is used and it is essential to maintain a policy of regular machine tool replacement, not only to replace worn out machines but also to exploit the ever improving range of machines that become available. About three years ago, when careful consideration was being given to future policy in relation to machine tool acquisition, it became apparent that metrication was a factor that would also have to be considered. Machine tools were then becoming available with metric dimensions on their controls and, since with careful use and maintenance they can be expected to last 15-20 years, it was clear that it would be advantageous to restrict all purchases of new tools to those capable of working in metric dimensions.

The products of the Research Department workshop are almost invariably manufactured for use in experimental laboratory work—e.g. for models and prototype equipment—rather than general release to the Post Office. It was clear, therefore, that components made entirely to metric dimensions would be acceptable to the Research Department earlier than in the Post Office generally. At the time this factor was being considered, a target date for the move to Martlesham was set for 1973. This date falls conveniently within the time-table produced by the British Standards Institution for the conversion of the engineering industry to the metric system, and it was decided that the Department should become metric as each Branch transferred to Martlesham. This decision provided a positive "metrication date", enabling the necessary new plant for Martlesham to be provisioned for metric working.

To enable the necessary information, co-ordination and training to be effective a metrication Steering Group has been set-up with representatives from engineering and scientific research teams, training, drawing office, stores and workshop control. This Steering Group has a purely advisory function and operates by encouraging research personnel to adopt the metric

The mechanical engineering workshop at Dollis Hill.

system at an appropriate time.

For most engineers and scientists—and particularly those working in telecommunications—the metric system is already a well known alternative method of units and it has not been surprising to find that most, if not all, of the units used in the research laboratories can be converted to the metric system without difficulty. In particular, Research Reports now employ SI units—an internationally agreed metric system (See Telecommunications Journal Winter 1969)—as their primary system of measurement.

The Martlesham mechanical engineering workshop is required to carry out a considerable amount of work on waveguides of very small dimensions and associated components for microwave development, so the machinery for the workshop has been selected accordingly. The workshop was brought into use during the Autumn of 1969 and no problems have been encountered in the purchase of metrically calibrated machine tools to suit this work. Output capacity has been restricted deliberately to ensure that some of the Martlesham work is carried out at the parent workshop at Dollis Hill. This enables two objectives to be obtained—first, it restricts the possibility of non-metric work being carried out in the Martlesham workshop, and second, it enables a certain amount of metric work to be manufactured in the workshop at Dollis Hill so that additional experience is gained in metric working.

The staff in the Martlesham workshop have not encountered any major problems in working in decimal dimensions; in this special type of precision engineering, with which the staff is very familiar, decimal/inch working has been commonplace for many years, and a certain amount of metric dimensioning has always, of course, been a feature of Dollis Hill workshops. An interesting point has been one of terminology—the "thou" (thousandth of an inch) has no convenient alternative in the metric system, but the "thou" is a very convenient and necessary dimension and it now seems that the metric counterpart—locally at least—will be "the 100th", i.e. 100th of a millimetre.

The only significant problems encountered have been those of supply. Initially there was considerable difficulty in obtaining drills, cutting tools and taps, but the situation has now largely improved and current deficiencies are almost entirely in raw materials. In many cases Imperial sized material is still being used, but this represents an inconvenience rather than a major difficulty.

As far as the design and drawing office world is concerned, the use of metric dimensions is clearly much more convenient than the Imperial system. Probably our greatest current difficulty in mechanical drawing office practice is to obtain suitable text books, and, one might also add, to limit the enthusiasm of the Dollis Hill drawing office staff to use metric on every occasion (although this point can hardly be classified as a "difficulty"!)

The stores facilities at Martlesham bear little resemblance to the usual type of Post Office stores, as most items stocked are related to the research work of the Department and consist of a variety of electronic and mechanical engineering components and engineering raw materials. One of the more mundane but most important items in the stores is, of course, a comprehensive range of fastening devices, (e.g. screws, nuts and bolts) and it is here that we have been able to realise one of the major advantages which the nation will enjoy as a result of metrication, viz, the opportunity to benefit from reduced stockholdings and costs by "variety reduction".

This point is illustrated in a training aid which is used. One side shows a range of 49 screw threads between 10BA and ½ in. diameter used in Imperial dimensioned mechanical engineering; this is compared with the ISO (the International Organisation for Standardisation) metric coarse screw threads which enables the same size range to be covered with only nine diameters of fasteners. This represents in itself a major reduction of items but it must be remembered that the saving is multiplied by a very wide range of lengths, materials, finishes and head details that are inherent in fastener provisioning. Many engineers have been concerned that the ISO metric coarse thread is not an adequate replacement for the complete range of Imperial system, but our experience to date does not support this somewhat pessimistic view.

Stores transactions at Martlesham are carried out in metric units only and completed dockets are processed at Dollis Hill Accounts Duty without undue difficulty. To gain experience in the main stores at Dollis Hill, tallycards in Imperial units are being amended to metric units as materials or items are delivered in the latter units. This means that there will be a natural transition to a substantially "metric stores" as the various supply industries convert in their planned time scales. As the cable industry has already converted to metric and is now supplying cable and wire in these units, all cable tallycards have been amended and current issues from stores are in metric lengths. Transport log sheets now have the equivalent values of "kilometres" and "litres" stated in brackets after "miles" and "gallons".

Supporters of metrication have made many claims of the national benefits which will be experienced; we have certainly gained in "variety reduction" and can foresee that calculations in the internationally agreed SI units are clearly easier once the procedures become familiar. The opponents of metrication have made much of the difficulties of training, but our experience has been that relatively little training is necessary, and that the real human problem is that of becoming familiar with the metric dimensions of everyday things. As far as scientific and engineering personnel are concerned, the majority are familiar with metric units because of their basic training and studies and few problems have been encountered. Telecommunications engineers are in a very fortunate situation in that calculations are readily performed in SI and some of the more abstract aspects of electrical theory benefit from the elimination of multiple and complex conversion factors.

THE AUTHORS

Mr. G. Haley is a Staff Engineer and Mr. G. C. Eltringham a Senior Executive Engineer. They are Division Leader and Group Leader respectively in the Services Section of the Research Department which includes electrical, mechanical and production engineering, photographic and drawing office and accommodation services.

The workshop at Martlesham.

OPERATION AIRLIFT

A TITBIT of information picked up at a conference was the start of a unique operation by the British Post Office. It resulted in 25 tons of exchange equipment being flown round the world from Sydney, Australia, for installation as a relief unit at the new International Switching Centre at Wood Street in London.

The emergency move was made because the main Wood Street centre could not be brought into service by its planned target date of June, 1970. With international telephone traffic continuing to rise rapidly urgent action was necessary to relieve the overloaded Faraday International Exchange.

External Telecommunications Executive learned in February that a new gateway exchange had been opened in Sydney and an existing crossbar international exchange taken out of service. A staff member picked up the information at a Commonwealth Communications Conference.

Numerous telex messages were exchanged between London and the Overseas Telecommunications Commission of Australia OTC(A), and by early March the information indicated that the equipment would be available and was likely to be suitable. A week later Mr. K. A. Hannant, Head of External Telecommunications Services (ETS), Mr. D. R. B. Ellis, Controller Planning ETS and Mr. C. J. Maurer of Telecommunications Development Department, flew to Sydney. . . Mr. Hannant to negotiate purchase of the equipment, Mr. Ellis and Mr. Maurer to check on its serviceability and technical suitability. Negotiations with BOAC were begun and other arrangements made.

Subsequently, Mr. R. H. Hollands, an Assistant Executive Engineer in ETS and the Clerk of Works to be responsible for re-installation of the equipment in London, was flown to Sydney to supervise dismantling and packing. OTC(A) had agreed to carry out this work and to deliver to Sydney Airport.

In Sydney at the same time was Mr. B. Muir, an Executive Engineer from Services Department THQ, who was checking on possible technical problems. Details of the modifications and internal connexions which would be required to integrate the equipment into the international network in London were worked out with the Australians and arrangements made for the transfer of all available diagrams, drawings, specifications etc.

Air freighting presented BOAC with one of the biggest single cargo consignments they had ever been asked to handle. A plan to fly it in one load on a Boeing 707 had to be changed because it would have interfered with cargo facilities used by regular customers of BOACs Sydney-London route. Instead, the load was divided into two parts, each forming half of the cargo of successive air freighter flights.

By 19 May the two consignments had landed in London . . . just four days before the Spring Bank Holiday. Because of the nature of the cargo, and to avoid having it lying in warehouses over the holiday, discussions were immediately started to speed the equipment through customs. On 20 May, after seven hours of negotiation between Post Office and Customs representatives, clearance was finally given. Within minutes Purchasing and Supply Department lorries, which had been standing by throughout the day, moved in to start a three-day operation to get the equipment to Wood Street.

The entire operation had taken only 12 weeks.

The unusual problems encountered in packing and transporting the equipment and in reinstalling it at Wood Street are described by Mr. Ellis in the following article.

Exchange unit flown in

By D. R. B. ELLIS

THE exchange which was taken out of service by the Overseas Telecommunications Commission in Australia and is now being reinstalled in London is of the 5005T crossbar type. It provides facilities for a four-wire switching block with 120 CCITT No. 5 inter-continental circuits and 138 (75 incoming and 63 outgoing) four-wire loop-dialling national circuits through 26 crossbar racks, four test racks, two multi-frequency generator racks and an intermediate distribution frame.

The weight of the equipment with packing was approximately 25 tons. BOAC use a pallet-loading system, each pallet being 10 ft. 5 in. by 7 ft.

A rack on its way to the fifth floor apparatus room at Wood Street. To avoid damage to the equipment, ropes were used to guide it clear of the apparatus entrance platforms on the lower floors.

Packing completed, the equipment is stored in a Sydney warehouse before despatch to London.

Attaching the steel framework which was used to hoist the equipment to the apparatus room at Wood Street.

4 in. and capable of taking a package 7 ft. high. By removing the cable trough from the top of each crossbar rack its height was reduced to 10 ft. 1 in. which allowed it to fit on a pallet located across the aircraft fuselage. To have crated each rack individually would have exceeded the fuselage width, so it was decided to sandwich each rack between timber and hardboard frames bound with steel tapes.

Each rack was first enclosed in a heat-sealed plastic sleeve, with bags of silica gel to exclude moisture. The timber frame beneath the rack had lateral supports to give rigidity and to enable handling at all stages of the journey by forked-lift trucks.

Two racks were stowed, one on top of the other, on each pallet and the remaining space taken up with the 80 boxes of shiploose items. Each crossbar rack was packed with its shelf equipment in position, opposite front and rear shelves being bolted together to prevent movement. Two strips of plastic foam were fitted between each crossbar switch and the shelf door to cushion the mechanism against vibration or shock during the journey.

A complex hoisting operation was required to shift the equipment to the fifth floor apparatus room at Wood Street. With each rack weighing about 15 cwt. it was necessary to avoid any stresses which would distort the rack framework during manoeuvres which first changed the rack from face-down to an end-down position and then to its normal upright position. At no time could the rack be allowed to rest on its end without protection being given to the V-section on which the shelf connexion-strips are fitted. An ingenious solution to the problem was developed.

After removing the steel tapes and the top timber and hardboard frame, two timbers were fitted to the channels on each end of the rack frame, the whole being held together by a steel framework lifting gear. Four rings were fitted to one end of this gear to take the hoist chains; to the other end were fitted four large castors to allow the rack to be wheeled from the fifth floor entrance to the apparatus room.

Still in the face-down position, in which it had rested since leaving Sydney, each rack was taken by lorry from the store to below the apparatus hoist where, using the hoist, it was rotated into the end-down position and lowered on to two stands while the remaining wood and hardboard frame was removed. After re-assembling the steel lifting framework, the rack was hoisted to the fifth floor, two ropes being used to guide it clear of the apparatus entrance platform on each of the lower floors.

When in the apparatus room a bogie of the standard type used for rack-handling was fitted to the collar at the centre of each steel cross-frame and the rack was jacked-up to clear the floor. Because the lifting points were offset from the centre, the rack rotated under gravitational force to the upright position when it became possible to remove the castors and wheel the rack to its permanent position. After lowering the jacks, the bogies and the timber and steel framework were removed.

Inspection of the racks revealed that their long journey had been completed with only minor damage—four small plastic fanning strips associated with the crossbar shelf tagblocks were broken.

By the end of June all ironwork construction, comprising the erection of the intermediate distribution frame, the provision of overhead ironwork and the refitting of the cable troughs, was complete and ready for cabling to commence. It is planned to complete installation, testing and commissioning to enable outgoing service to open by the end of this year, incoming service following during the ensuing two months after circuit modifications.

Of the 120 CCITT No. 5 terminations, 60 will be used for the provision of International Subscriber Dialling service from London subscribers to the USA, 50 for incoming service from USA and 10 for the termination of tie-circuits to Faraday to give access to manual board services. Allowing for the use of 10 existing CCITT No. 5 terminations at Faraday for the distant end of the tie-circuits, there will be a net gain of 100 inter-continental circuits, and by having transferred much of the USA traffic from Faraday, CCITT No. 5 terminations there will be made available to provide additional inter-continental circuits to other parts of the world.

THE AUTHOR

Mr. D. R. B. Ellis joined the Post Office as a youth-in-training in 1935. He moved to the Engineer-in-Chief's office in London in 1947 and for some years was concerned with progressing telephone exchange equipment works. In 1969 he joined ETE and is now Controller (Planning) of External Telecommunications Services.

BOOK REVIEWS

Principles of Pulse Code Modulation by K. W. Cattermole (Iliffe) 95s.

The author is now Professor of Telecommunication Systems at the University of Essex but he credits his experience of pcm to 10 years' work at Standard Telecommunications Laboratories. He states the aim of the book as giving an account of the major principles of pcm with particular reference to analogue/digital conversion for telephony. This is illustrated by the division of the book, following an introductory chapter on general principles and history, into three main chapters dealing with sampling, quantising and coding respectively.

The first chapter puts the development of pcm in perspective with the early work on telegraphy and the evolution of information theory leading to the realisation of the first commercial pcm junction system, the Bell T1.

Chapter 2 deals with the theory of sampling both from the point of view of a modulation process and by considering the properties of the waveform which is sampled. Band limitation by imperfect filters, energy transfer and time-division multiplexing are considered in this chapter. Chapter 3 deals with quantising, particularly with non-uniform quantising as applied to telephone transmission. Idle channel noise is also considered and there is a section on differential quantising techniques of which delta modulation is the most important class. There is an extensive section on the quality of quantised speech in which substantial reference is made to the work done in the Post Office Research Department by Mr. D. L. Richards and his colleagues.

The final and most extensive chapter in the book is a detailed treatment of coding and encoders. In addition to discussion of the techniques which have now become established in production equipment, there is some treatment of the solid-state domain encoder (DOFIC) and the equilibrium encoder. This chapter concludes with an examination of the requirements for code translation with particular reference to the choice of codes for line transmission systems. The mathematical and statistical basis of the subject is summarised in the appendices which include also treatment of low-disparity codes with which the author was particularly associated at one time. The book concludes with a selected but extensive bibliography of the subject with references up to 1966.

This is a valuable and informative work in which theoretical principles and practical implications are well combined whilst the author has clearly a keen interest in establishing the historical perspective and priorities. No doubt this interest has been stimulated by his opportunities for discussion at STL with the inventor of pcm Mr. A. H. Reeves.

The reader will look forward to the sequel planned by the author dealing with digital topics such as synchronising, regeneration and switching, which complement the study of pcm itself.

The present book does not set out to be a practical handbook or to describe any particular system or equipment. At the time the book was written standards were in the process of evolving and for that reason some of the treatment is inconclusive. Perhaps by the time the sequel appears world standards for the encoding and transmission of telephony will have been set, together with standards for the encoding and for transmission of a range of non-telephony signals.

Signal Processing, Modulation and Noise by J. A. Betts (English Universities Press) 42s, paper-bound.

Dr. Betts, of the Department of Electronics, University of Southampton, prefaces his book with the remark that, except for one chapter, it is intended for the under-graduate student meeting telecommunications for the first time. The main part of the book consists of eight chapters dealing with analogue and digital modulation and with noise. This is followed by three appendices setting out theoretical support for the first part of the book and including Fourier analysis, convolution integral, statistical communication theory and spectral analysis.

The chapter offered as post-graduate standard is that dealing with analogue-to-digital conversion which deals with pulse-code modulation and delta modulation. This is an excellent but concise treatment of the subject which will be of interest not only as a post-graduate text but also to engineers and technologists working in this field. One rather doubtful point, on page 170, is the statement that companded delta modulation obviates a problem of matching coder and encoder which is a feature of pcm. In fact, the problem is reduced to matching a pair of similar networks but cannot be said to be obviated.

There are a few references to practical communication systems which seem to show the author on a little less familiar ground than in his theoretical treatment. For example, on pages 17 and 18 the frequency-division multiplex allocations for the 12-channel basic groups and supergroups do not represent common practice. On page 101, describing the LINCOMPEX system, the term "compandor" is used where "compressor" is clearly intended. There are a few misprints in the footnote references.

Apart from these minor points the book amply fulfils the author's aim of writing an undergraduate text and, in addition to the special merits of the chapter on pcm and delta modulation, the theoretical proofs and demonstrations given in the other sections and the appendices will form a useful reference text for research and development engineers working in the transmission fields. The book includes an adequate index, a good selection of tutorial exercises with answers and a selection of footnote references to specialised articles which appeared in the technical literature up to 1967. **MBW**

Measurement of Transistor Parameters by R. Paul (Iliffe) 90s.

Measurement remains a key part of both science and engineering, not the least so in telecommunications. There are several purposes contributing to its importance. At one extreme the performance of a system needs to be checked against the designer's objectives; at the other there is the component whose performance is far from precisely predictable from the knowledge available of the materials and processing used to make it.

The transistor has proved an example of the second extreme; the measurement of its properties, type by type as they have been developed and put into large scale production, has in consequence received a great deal of attention. Recent types, capable of amplifying signals of very large bandwidth, have shown up the inadequacy of existing measurement techniques for obtaining, with sufficient accuracy, the important data about the performance under likely conditions of use of the devices in, particularly, analogue or near-linear applications. The inadequacy arises for several reasons. Some of the attempts at comprehensive characterisation have been restricted to singling out parts of the transistor behaviour which could be closely associated with predictions based on the main physical mechanisms at work in the device, leaving the lesser effects to be accounted for separately. This approach, of very considerable value educationally and to the device designer, is of little value to the user unless it results in a neat and reasonably accurate answer—which unfortunately it has not, with recent types. So there is little to adopt other than the "black box" approach, which ignores the particular design or any expectations, and concentrates entirely on what parameters of the three-terminal device to measure and the best methods for doing so.

The English translation of this book from East Germany is an excellent summary of the subject up to 1968 (when it was written) and should prove of very considerable value for some years to come. It opens with a fairly lengthy statement on the parameters of interest, followed by a chapter on the rather mundane but essential subject of static properties. About one half of the book is then devoted to the small signal (a.c.) parameters; the text and figures are good and there is a steady build up of a complete picture of both objectives and techniques for reaching them. Work from many countries is included and a very balanced view is generally taken. Finally the large signal, pulse or switching, properties are looked at (the appropriate words often enough because oscilloscope displays have the key role). These properties rarely need to be measured to quite the same degree of accuracy as the small signal parameters, but because a great deal of the design of digital integrated circuits depends on them, they deserve the attention they get.

The book concentrates on the widespread bipolar transistor; the later-developed Metal-Oxide-Semiconductor transistor was only just beginning to assume practical importance in 1968. But the foundations provided by the book need not be altered greatly to accommodate a chapter or two on this newer type of transistor which has so much potential in telecommunications applications. **JRT**

Miscellany

NEW PRICE FOR THE JOURNAL

THE PRICE of Post Office Telecommunications Journal has remained unchanged since 1952. This has been possible because a steady increase in the number of readers and advertising pages has, until recently, offset increased production costs.

It has now become necessary to review the price of the Journal, and a small increase will operate from the Winter issue. Not all the recent increases in costs are to be passed to the reader and the new price will be 1s 9d for the Winter issue and 9p after the introduction of decimalisation.

All the many recent improvements in the production of the journal will be maintained and even at the new price it is still remarkable value for money.

Details of the revised method of deduction from pay for Post Office staff will be announced shortly in Post Office Gazette. An announcement about the annual subscription rate will be made later.

BIRTHDAY HONOURS

SEVEN TELECOMMUNICATIONS people received awards in the Queen's Birthday Honours. They are:—

OBE—Mr. John Breckenridge, assistant controller of contracts, Purchasing and Supply Department. From 1967 to 1969 he established manufacturing costs of equipment and negotiated prices based on his estimates saving the Post Office millions of pounds. Mr. Joseph Holt, staff engineer THQ Network Planning Department, who has been responsible for the overall planning of shallow water and transoceanic systems and has been an adviser to many overseas governments.

MBE—Mr. Matthew Johnston, engineer-in-charge at Baldock Radio Station, who established Baldock's high frequency telephone service to ships and Mr. Leonard Hayward, a chief telecommunications superintendent in THQ Operational Programming Department, who gets a services award, holds the rank of Lieutenant Commander RNVR.

BEM—Miss Olive Hopkins, retired supervisor, who worked for 29 years at Uckfield exchange, Sussex, and Mr. Aneurin Jones, a technical officer at Cardiff TMO, who set up an emergency telephone service when the Lluest Wen dam threatened to break and flood the Rhondda Valley earlier this year.

Royal Victorian Medal (silver)—Mr. John Birchenough, telephonist in the Court Post Office, Buckingham Palace.

Reading exchange is left holding the baby

ABOVE: Party time at the nursery and helpers make sure the "goodies" don't run out.

BELOW: Fun on the chute for the youngsters as mum works next door in the exchange.

YOUNG MOTHERS can now work as telephone operators at Reading trunk exchange content that their infants are playing happily next door . . . in the first day nursery ever provided by the Post Office.

The nursery is an experiment aimed at boosting local recruitment campaigns for telephonists in an area where there is a lot of competition for female staff.

About £10,000 has been spent on converting and equipping a four-bedroom detached house into a nursery where up to 30 children can play, or rest, and take their meals.

The house has a garden with a grassed play area and sandpit. Climbing bars and other play equipment have been installed in a large garage to which the children can go in wet weather. There are swings, tricycles, games, drawing aids and television.

The nursery, managed for the Post Office by local day-nursery operators, is open six days a week from 7.45 a.m. to 6.15 p.m. and has a staff of five. Mothers contribute towards the cost of looking after their children.

STOCK EXCHANGE

THE "paging" system at the London stock exchange operates with 4,000 channels and not 600 channels as described in an article in the Summer issue of the Journal. A signal which calls a wanted person is set up by depressing a button on a special pad in the broker's office.

NEW DIRECTOR

MR. J. E. GOLOTHAN, Deputy Regional Director (Planning) London Telecommunications Region, has been appointed Director Telecommunications Eastern Region.

Mr. Golothan joined the Post Office in 1937 as an Assistant Traffic Superintendent. In 1947 he became Senior Executive Officer in Central Organisation and Methods Branch. He was promoted to Principal in 1956 and to Assistant Secretary in 1966. He was appointed a Deputy Regional Director in LTR in June of last year.

For the past 2½ years Mr. Golothan has been a member of the Editorial Board of the Telecommunications Journal.

DANISH CLOCK

THE BRITISH Post Office Speaking Clock Mark III is now being used to provide a similar service in Denmark. The Clock was selected by the Copenhagen Telephone Company after they had looked at various types of announcing machines available in Germany and the United States.

The Mark III was designed at the Post Office Research Station, Dollis Hill. The time announcements are recorded on a cylindrical band of magnetically-loaded neoprene and the time-keeping is governed by a crystal-controlled oscillator.

The clock now in service in Copenhagen follows closely the Dollis Hill design with modifications to suit their 24 hour system.

The intricate task of recording the Danish time announcements on the correct portions of the cylinder from a master tape supplied by the Danish Administration was undertaken by Mr. A. D. Sinclair, an Assistant Executive Engineer in Telecommunications Development Department and Experimental Officer Mr. W. H. Bird of Research Department.

The Mark III has also been supplied to the Eire Post Office to provide a time service in the Dublin area.

SOCIETY PROGRAMME

THE Postal and Telecommunications Society has arranged its 1970-71 winter programme as follows: 10 November, 1970—Public Relations in the Post Office by K. J. Ley, Chief Press Officer and Deputy Director Public Relations; 5 January, 1971—Philately by J. R. Boxter, Head of Counter Services Division and Secretary to the Stamp Advisory Committee; 10 February, 1971—Marketing Research in the Post Office by H. W. Jose, THQ/MkD; 10 March, 1971—The Highlands and Islands of Scotland (Telecommunications) by D. E. Cridlan, THQ/NPD.

Most meetings are intended to give members an insight into developments within the Post Office and others are on topics of general interest. Visits are arranged throughout the year to enable members to keep in touch with the activities of Departments outside their contact and also with private industry. Persons interested in joining the Society can do so through a local agent or the Secretary, telephone 01–452 8060 extension 333.

CHANNEL LINK

A NEW submarine cable is to be laid between Britain and the Channel Islands. It will run from Bournemouth to L'Ancresse Bay, Guernsey, and will be extended to Jersey by a microwave radio link through the new radio tower at St. Peter Port.

The new link will provide 1,380 circuits, compared with the existing 720, to cope with the great increase in traffic which occurs between the Islands and the mainland during the busy summer holiday months when there can be well over a quarter million calls a month.

The cable will use the most advanced transistorised submersible repeaters and will replace the existing Dartmouth-Guernsey and Guernsey-Jersey cables laid in 1938.

Cable laying will be carried out around the end of next year and circuits should be in operation in time to carry the 1972 summer traffic.

Five-city Confravision

CONFERENCE BY television between businessmen hundreds of miles apart will become a reality in Britain next year. The Post Office is setting up studios in London, Manchester, Glasgow, Birmingham and Bristol to provide the service, known as Confravision and believed to be the first of its kind in the world.

It is the first major step towards a possible national, and international, visual-conference service using two-way television to exchange ideas and information between small groups of people many miles apart.

Leaders of the business world will be invited to try the service next year, initially at a nominal fee. Once it has been tried out by customers it will be offered on a fully commercial basis. The Post Office will then be able to show how the cost for studio time compares with the cost of sending senior business executives long distances to attend working conferences.

The five-city trial links have been based on knowledge gained from experimental studios at Telecommunications headquarters in Gresham Street in the City of London and the Post Office Research Station in North West London. These have been used for internal conferences and have also been available to large business concerns who have helped to assess the possible scope of the service.

Of the studios to be set up next year London will have two, a new one in the West End and the existing one in the City, with one studio in each of the other cities. Confravision customers will be able to conduct conferences in privacy between any two studios.

Each studio will have two cameras, one covering a conference table seating up to five people and one pointing vertically down at a desk to show charts, plans or objects. Two 25-inch television screens will be installed, one showing the picture being transmitted from the home studio and the other covering the distant end. Customers will be able to operate controls themselves to show people at the desk or displays from the other camera. They will be high-quality 625-line black and white pictures although colour for the documents is a possibility for the future.

The Confravision centres will be connected over existing channels by microwave links.

VISITING PROFESSOR

DR. J. R. TILLMAN, Deputy Director of Research in charge of the Materials and Devices Division of the Post Office Research Department at Dollis Hill, London, has been appointed visiting professor in the Department of Electrical and Electronic Engineering of the City University, London. The appointment is for three years with effect from September.

Personnel work is reorganised

Mr. W. Kirkpatrick.

Mr. R. Davies.

PERSONNEL WORK at Telecommunications Headquarters in London is to be split between two departments. The new look is aimed at strengthening and improving the organisation.

Telecommunications Personnel Department will handle recruitment and promotion policy, management development, appointments and training and a new Pay and Grading Department will deal with pay and conditions of service, grading, industrial relations, welfare, health, discipline, safety and catering.

Mr. William A. Kirkpatrick, who was Director Telecommunications Personnel, becomes Director Telecommunications Pay and Grading Department and Mr. Raymond Davies, an Assistant Secretary in Central Headquarters Central Services Department, Director Telecommunications Personnel.

Mr. Kirkpatrick (51) joined the Civil Service in 1936 and transferred to the Post Office in 1956. In 1963 he was appointed Assistant Secretary in the Establishments and Organisation Department and became Director Telecommunications Personnel in 1969.

Mr. Davies (51) joined the Post Office as an Executive Officer in 1938 and first moved into personnel work in 1954 as a Principal involved in telecommunications recruitment and appointments. He was promoted Assistant Secretary in 1965.

BUSINESS SUMMARY

BUSINESSMEN calling the Financial Times Industrial Ordinary Share Index telephone information service provided by the Post Office have been getting an additional three-minute business news summary since 20 July.

The summary, like the Index, is updated four times a day from Monday to Friday—morning, lunchtime, mid-afternoon and late afternoon. From 10 p.m. until the following morning during the week, the summaries are replaced by a short featurette carrying a report of a topical business subject as well as details of the following day's principal business meetings. At weekends similar featurettes are available and occasionally there is a recorded interview with a leading business personality on some topical subject.

A special news team has been set up by the Financial Times to keep the service up to date and a direct line has been installed between the newspaper's office and the Post Office recording centre at Judd Street to ensure that the news is available to telephone callers within minutes of its being prepared.

IPOEE ESSAY

THE INSTITUTION of Post Office Electrical Engineers is offering a first prize of six guineas and four prizes of three guineas in the 1970–71 Essay Competition. Five certificates of merit will also be awarded. The subject is engineering activities in the Post Office and although technical accuracy is essential a high technical content is not absolutely necessary for an award. All staff up to and including Technical Officers can enter. For full details write to The Secretary, Institution of Post Office Electrical Engineers, Telecommunications Headquarters, 2–12 Gresham Street, London EC2 7AG.

BITS AND PULSES

BRITAIN'S TELEX service grew by 12.8 per cent in the 12 months to 31 May when there were an estimated 29,730 working lines compared with 26,350 a year earlier. In the three months to 30 June this year 360 million trunk calls (75 per cent dialled direct) were made in the United Kingdom, an increase of more than 12 per cent over the same period of 1969.

—010—

Mr. George Millington, formerly of the Marconi Company, has been appointed consultant to the Directorate of Radio Technology of the Ministry of Post and Telecommunications. Mr. Millington has a world-wide reputation and has made many contributions to the study of radio wave propagation phenomena.

—010—

Mr. Alan Wolstencroft, CB, has been appointed Secretary of the Post Office in succession to Mr. M. O. Tinniswood who has become Director Personnel at the BBC.

—010—

A feasibility study of the storage and handling of cables is to be carried out by consulting engineers, Sir William Halcrow & Partners for Telecommunications Headquarters Submarine Branch. The study, at the Submarine Cable Depot, Southampton, will cover the method of storing the latest type of cable pans (containers) and of loading them into a cable ship of new design which is to be built for the Post Office. The engineers' report, due to be submitted at the end of this year, will comment on the design of the new pans and advise on the specialised lifting gear required. A full pan weighs about 80 tons and has to be swung out on a reach of up to 60 ft. during the loading operation.

—010—

More than a million telephone calls were made to the motoring information service's 37 centres in the 12 months ending 30 June. Over 800,000 of the calls were made during the six months from October to March. The service reports on traffic congestion and other general road conditions.

—010—

Only 102 of the United Kingdom's 6,130 telephone exchanges are now manually operated. Automatic telephone service is available to 98.52 per cent of all exchange connexions. This compares with about 57 per cent of connexions in 1940, 68.3 per cent in 1950 and 79.9 per cent in 1960.

PREFAB MANHOLE FOR 60 MHz TRIAL

A LARGE prefabricated concrete manhole is manoeuvred into position during work on the trial route for the Post Office's new 60 MHz coaxial cable system which will have the largest capacity in the world (97,200 circuits). The manhole is one of three types to be tested as housings for the systems repeaters. The others are a "silo", a cylindrical tank based on the concept of an agricultural container, and a silicon-aluminium alloy box. Each will be dedicated solely to the new cable—just one of a number of safeguards to ensure that the high capacity cables will have maximum protection. The trial route will run for about four miles near Hungerford. An article on the 60 MHz system appeared in the Summer 1970 issue.

MORE LINES

An increase of more than 380,000 telephone exchange lines during the first six months of this year took the total number working in the United Kingdom to 8,723,361.

Of this total 86.6 per cent were on STD compared with 84.8 per cent at the beginning of the year.

£39.5 MILLION PROFIT IN SIX MONTHS

The last GPO Report

THE books were closed on the "old" Post Office with the publication of the Report and Accounts for the GPO's last six months as a Government Department. In the period covered, from 1 April, 1969 to 30 September, 1969, the Telecommunications business made a profit of £39.5 million.

Demand for new exchange connexions was substantially higher—33 per cent—than in the same period of the previous year. Residential demand increased by 37 per cent and business demand by 16 per cent.

The number of telephones in use increased from 12.9 million to 13.4 million in the six months. Some 470,000 new exchange connexions were provided, exceeding the record rate of supply in 1968-69, and the total in use increased by 260,000 to 8.2 million.

Compared with the period April to September, 1968, customers made many more calls:—

Local calls	10 per cent up
Trunk calls	12 per cent up
Continental calls	18 per cent up
Intercontinental calls	40 per cent up

The proportion of trunk calls dialled by the customers (STD) increased from 70 to 72 per cent. The number dialled in the cheap rate periods increased by 41 per cent. Some 60 per cent of outward Continental traffic was directly dialled.

Despite the exceptionally high growth in business in the period, 47 per cent of all orders were dealt with under the appointment scheme on a day agreed with the customer and most of these were completed within two weeks. More than 55 per cent of the remainder were completed within a period of four weeks.

Some customers had to wait for telephone service until equipment was available. Despite the exceptionally high demand, however, the waiting list was reduced by 4,500 to 83,000 and the average time orders were on the waiting list was reduced from 6½ months to 4½ months.

STD service was extended to 277 more exchanges, serving 430,000 subscribers. At the end of September 1969, the service was available to 84 per cent of subscribers. A further 27 manual exchanges were converted to automatic working leaving 111 still to be converted. Fewer exchanges were converted than expected mainly because of continuing delays in the supply of equipment.

Construction of 147 new buildings and extensions, including 132 telephone exchanges was started; 153 buildings were completed, including 139 telephone exchanges. However, the provision of buildings to meet growth of the service was still hampered by the difficulty of acquiring suitable sites.

Contractors completed the installation of equipment at 282 new exchanges and extensions to existing exchanges. Nevertheless, at the end of September, 1969, nearly 80 per cent of exchange equipment contracts were subject to delay. The average delay was eight months.

About 5,000 long distance and 32,000 shorter-distance circuits were provided between exchanges, representing growths of 8 and 5 per cent in their respective parts of the trunk network. Some 392,000 cable pairs were added to the network connecting subscribers' premises to telephone exchanges.

This growth of 3.3 per cent was similar to that achieved during the same period of the previous year.

During the six months some 155 million calls were made to the various recorded telephone information services, including 128 million to the Speaking Clock.

The Telex service continued to expand at an annual rate of more than 14 per cent, bringing the total number of Telex subscribers at the end of September, 1969 to 27,000. There were 6,600 data transmission terminals in Britain at the end of September—more than double the number 12 months earlier.

The first Report and Accounts of the new corporation will include figures for the whole of the financial year, so that continuity is maintained with the reports published in the previous years.

Telecommunications Statistics

(Figures rounded to nearest thousand)

	Quarter ended March, 1970	Quarter ended Dec., 1969*	Quarter ended March, 1969
TELEGRAPH SERVICE			
Inland telegrams (incl. Press, Service and Irish Republic)	1,836,000	2,059,000	1,883,000
Greetings telegrams	481,000	534,000	469,000
External telegrams:			
Originating U.K. messages	1,788,000	1,863,000	1,481,000
Terminating U.K. messages	1,693,000	1,764,000	1,456,000
Transit messages	1,577,000	1,605,000	1,266,000
TELEPHONE SERVICE			
Inland			
Net demand	337,000	284,000	241,000
Connexions supplied...	293,000	278,000	240,000
Outstanding applications	293,000	248,000	224,000
Total working connexions	8,551,000	8,342,000	7,868,000
Shared service connexions (Bus. and Res.)	1,564,000	1,517,000	1,442,000
Total effective inland trunk calls	342,974,000	336,952,000	311,697,000
Effective cheap rate trunk calls	81,216,000	80,784,000	69,581,000
External			
Continental: Outward	3,090,000	3,024,000	*2,611,000
Inter-Continental: Outward	†437,000	409,000	*335,000
TELEX SERVICE			
Inland			
Total working lines	29,000	28,000	26,000
Metered units (incl. Service)	76,598,000	52,473,000	77,146,000
Manual calls from automatic exchanges (incl. Service and Irish Republic)	†41,000	40,000	34,000
External			
Originating (U.K. and Irish Republic)	5,475,000	5,180,000	4,604,000

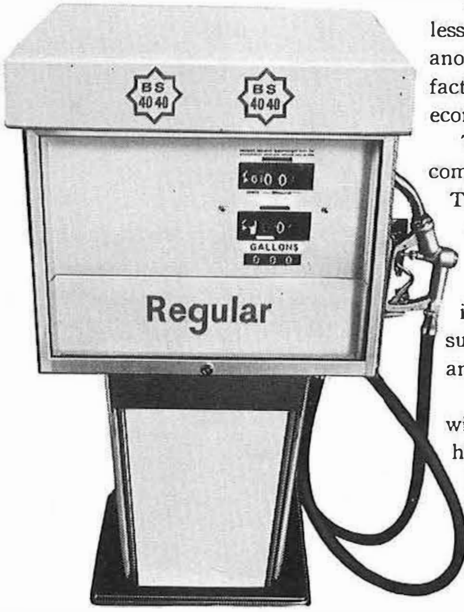
**Figures amended.* †*Provisional.*

Publication and Price. The *Journal* is published in January, April, July and October, price 1s. 6d. (1s. 9d. from January 1971).

Contributions. The Editorial Board will be glad to consider articles of general interest within the telecommunications field. No guarantee of publication can be given. The ideal length of such articles would be 750, 1,500 or 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.

The Big Meany. The Bedford HA costs only £529 and runs on two star petrol.



The Bedford HA van costs less to buy and costs less to run. The 6 cwt. costs only £529. For another £18 you have a choice of 6 attractive factory-finished colours, inside and out. Real economy of initial cost.

The 6 cwt. and 8 cwt. Bedford HA's have a low-compression engine and an economy choke carburettor. These engine design features mean maximum m.p.g. from low-cost commercial petrols. That's real running economy.

With 70 cubic feet of load space, the HA is ideal for modern delivery work. Real job suitability. And, with its nippy easy parking, it's an ideal traffic vehicle.

Like every Bedford, the HA is backed by a nationwide spares and service network that is fast, and highly-skilled.

Prices: 6 cwt.–£529 (illustrated above) and 8 cwt –£556 (inclusive of heater, screen clean and driver's seat belt). Hinged passenger seat, sun visor and seat belt–£11.0.0.

For best budgeting choose a low-cost Bedford HA. More than 100,000 already have.

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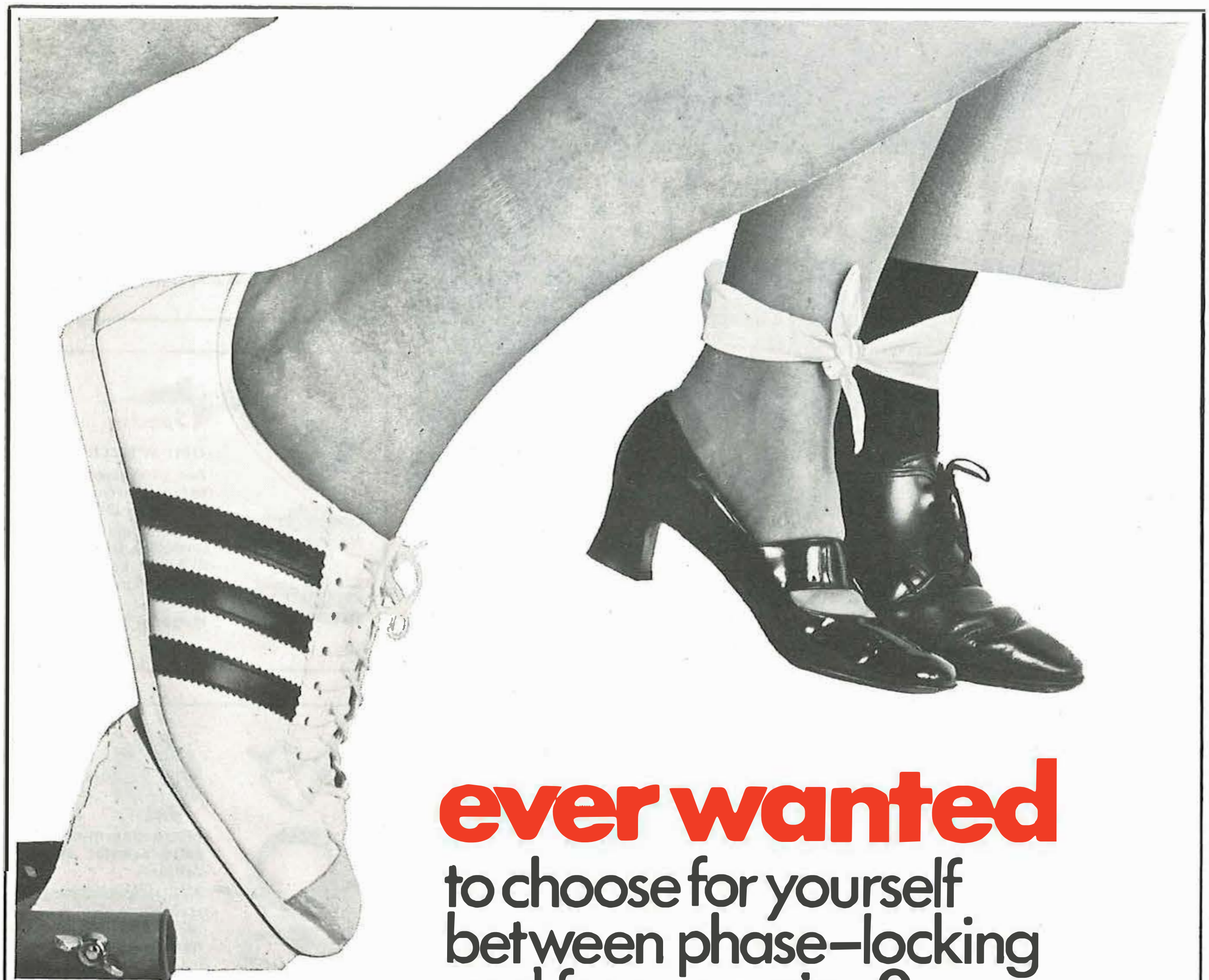
top value in light vans



The Post Office Telecommunications Journal is printed by BKT Printers Ltd., London and Tonbridge, and is published quarterly in January, April, July and October by the Post Office.

The Dash Mounted Westminster has created a lot of talk

(the reasons are simple)

This front mounted solid-state radiotelephone operates in the VHF band from 25–174 MHz. Both AM and FM versions are available.

The transmitter power output of the series ranges from 5–15 watts (AM 5–8 watts; FM 12–15 watts) with 1–10 channels. Various other features include anti-flutter squelch, and an illuminated channel indicator.

The units have been designed as a 'family' and much of the circuitary is common to both base stations and mobiles.

The equipment meets all relevant specifications, including P.O. specification W6770, and is in use in many P.O. radiotelephone systems throughout the U.K. Rugged all-weatherproof universal versions are also available.

> **The W30AM**
>
> *The W30AM is an extension of the Westminster range and being one of the most powerful VHF radiotelephones available in this country it will overcome problems of reception from vehicles in weak signal areas. 10-channel capability with solid-state switching.*

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