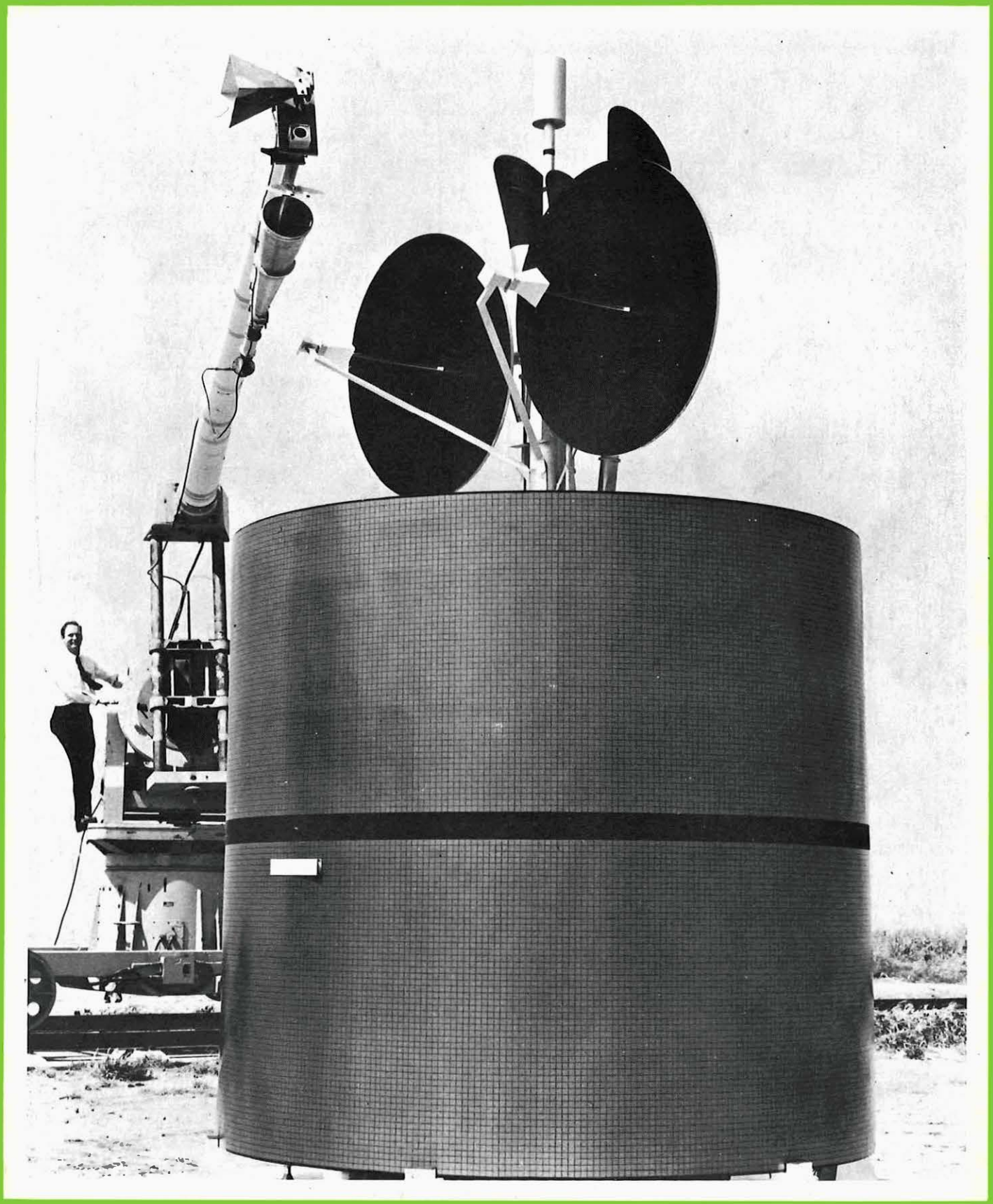
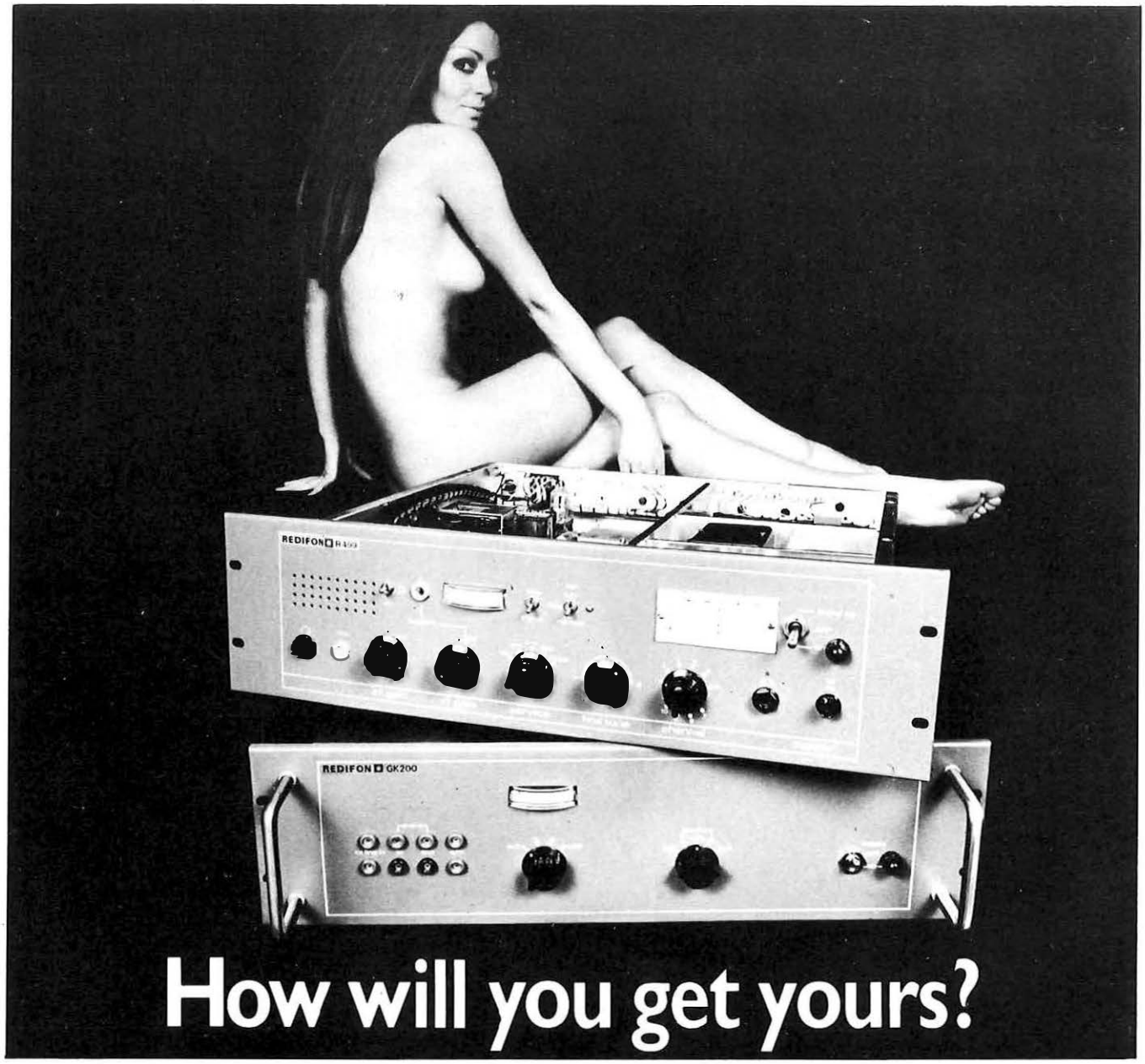
# Post Office telecommunications journal

One shilling and sixpence Spring 1970 Vol. 22. No. 1



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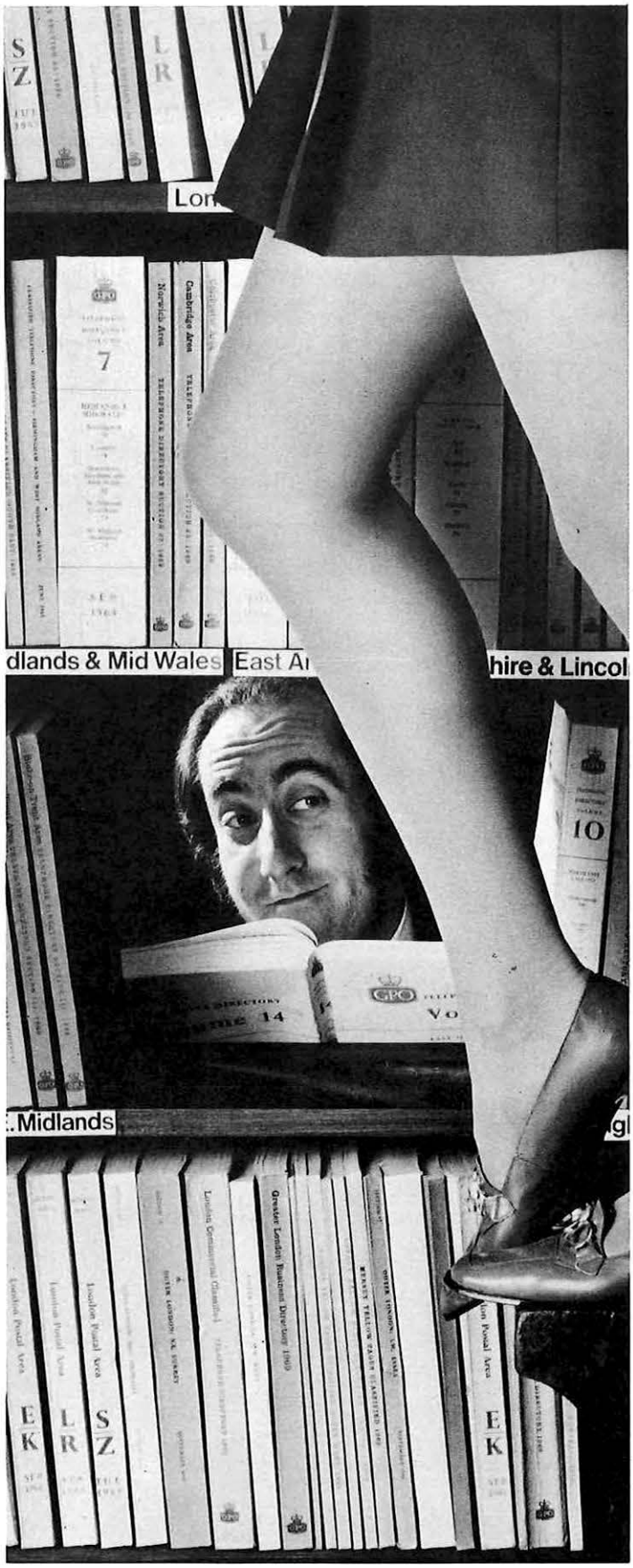


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Post Office telecommunications journal

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

Vol. 22 Spring 1970 No. 1

# Plan for regional boards

NEW guidelines for the Post Office and a plan to broaden the role of regional boards were outlined by Viscount Hall of Cynon Valley, Chairman of the Board, when he spoke at the annual dinner of the Telecommunications Engineering and Manufacturing Association. He said that the new Corporation was developing a number of characteristics and attitudes:

- It will emphasise that the customer is all-important and will give him continuously good, reliable, predictable services at a fair price.
- It will have venturesome drive in the market place. It may make mistakes but this will not stop it acting decisively.
- It will be a business run as a business.
- It will integrate with the local community and with local business to the maximum possible extent.

Lord Hall said that changes would take time to work out. The Board had to look at all its problems in depth so that its decisions were the right ones, and it was determined that they should be right for the very variable characteristics of every part of the country.

"We believe this can be very largely achieved by the setting up of operational boards for the businesses of Posts and Telecommunications in all the regions," said Lord Hall, "and we are about to put the philosophy into experimental practice in a Telecommunications and a Postal region within the next few months."

**Following Lord Hall's speech, the Post Office announced the setting up of regional boards on an experimental basis for the Telecommunications business in Wales and Border Counties and Posts in the North-West.**

**Each is to consist of a Chairman and up to eight members, of whom not more than four will be part-time members from outside the Post Office.**

**Wales and Border Counties region has been re-named Wales and the Marches.**

People of eminent industrial standing and experience, with an overlay of community conscience, would be invited to serve on the boards in a part-time capacity.

"If these boards bring new imagination and verve to our affairs at the customer point of sale, we shall quickly equip the other regions and eventually the headquarters of our various main businesses in the same way," Lord Hall added.

Discussing the challenge of the seventies, Lord Hall said that the predominant characteristics would be growth and change—in crescendo. The growth of exchange connections in the 1940s was over a million; in the 1950s over two million; in the 1960s just under four million. In the 1970s it was expected to be eight million.

The technology adopted had to be right. There would be a host of options and the decisions when to stop researching and begin developing and marketing would be difficult, but the Post Office would act decisively.

Neither at home nor abroad in the export market could the manufacturers or the Post Office afford to be charged in the seventies, as they were justly charged in the sixties, of doing too little, too late, too often.

A modern exchange system for large exchanges was urgently needed and a great deal of work had been put into this in recent years. A decision was very near and he was sure that when taken it would meet the large exchange need for many years.

The Advisory Group on System Definitions would be taking care of the more distant future and Lord Hall said the effective start made by the Group was immensely encouraging and important. It was laying a firm foundation for a future pattern of work which reconciled the individuality of the partners with the thrust of common enterprise.

"My board is determined to raise the Telecommunications services at home and in the export field to an enviable position in the world well before the end of the seventies," said Lord Hall.

Where was the money needed to carry out the programme to come from? The demands being made on national resources were already immense and would grow very fast. Only two years ago the Post Office drew up its £2,000 million programme, but as it rolled forward demand increased from every quarter and costs were rising. Currently the programme stood at £2,500 million and was getting bigger.

"We finance just under half our investment from our resources," said Lord Hall. "This is not enough and puts the programme at risk, so we must put more in the kitty. This is an urgent problem which is now being tackled. Have no doubt we shall find the money to achieve the heritage left us by the GPO and to fulfil our duty to future demand. We will not prejudice essential investment."

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COVER PICTURE: An engineer carries out tests on a full-scale model of the Intelsat IV communications satellite which will be launched next year. Intelsat IV will have a far greater capacity than any of its predecessors—see colour feature centre pages.

# Telecommunications

**Telecommunications 2000 was the title of a symposium held in Amsterdam by the Netherlands PTT to celebrate their two millionth telephone connection. Mr. J. S. WHYTE, Deputy Director of Engineering who heads the Post Office Long Range Studies Division, was invited to give one of four lectures at the symposium and extracts are printed here.**

IN looking towards the future it is important to resist the temptation to suppose that it will merely be a somewhat bigger and slightly improved version of the present. The history of technology in the past 200 years has shown a progressively increasing rate of advance and the steady progress achieved between World War I and World War II has been superseded since then by a period of rapidly accelerating change. Those of us privileged to know what is happening in some of the most advanced laboratories of the world can see no sign that this acceleration is doing other than continuing.

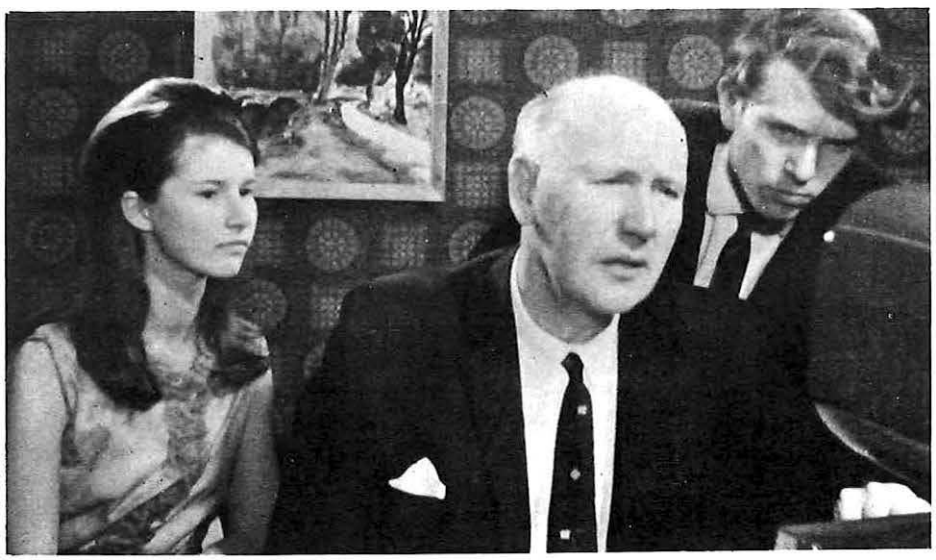
The year 2000 is only 30 years away and if we step back 30 years in time who would, in 1940, have expected the situation in which we now find ourselves? In our homes our carpets and our curtains, and many of our clothes, are made of materials that had not been invented at that time. The world's air speed record, set by a lonely heroic aviator, stood at 400 miles per hour . . . Who amongst you would in 1939 have supposed that by today not only would several men have walked upon the surface of the moon but that you would have watched them take those first historic footsteps from the comfort of your own homes?

The enormous rate of growth of what we may describe as conventional telecommunications will continue until the penetration of at least one telephone line per household has been achieved and a large proportion of the telephone customers throughout the world will be able to call each other without operator assistance. Two particular features of the new era will be the emergence of rapidly growing requirements for man-machine and machine-machine telecommunications and an upsurge in demand for visual communications.

The communication facilities required for use by computers, which we usually call data communications, are already growing spectacularly in several countries. In the United Kingdom data transmission services were first introduced in 1965 and have already grown so that more than 6,000 terminals are in use and the rate of growth continues at about 100% per annum compound. We expect the number of terminals in use to have reached 40,000 within three or four years and they may well reach over 1,000,000 by the end of the century. It is of particular significance that, at a time when computers are becoming more and more dependent on telecommunication facilities to expand the range of their application, certain parts of telecommunication networks are themselves beginning to look more and more like computers in the technologies they employ and in the manner in which they operate. This convergence of computer and telecommunications technology is likely to prove of the utmost significance in the longer term.

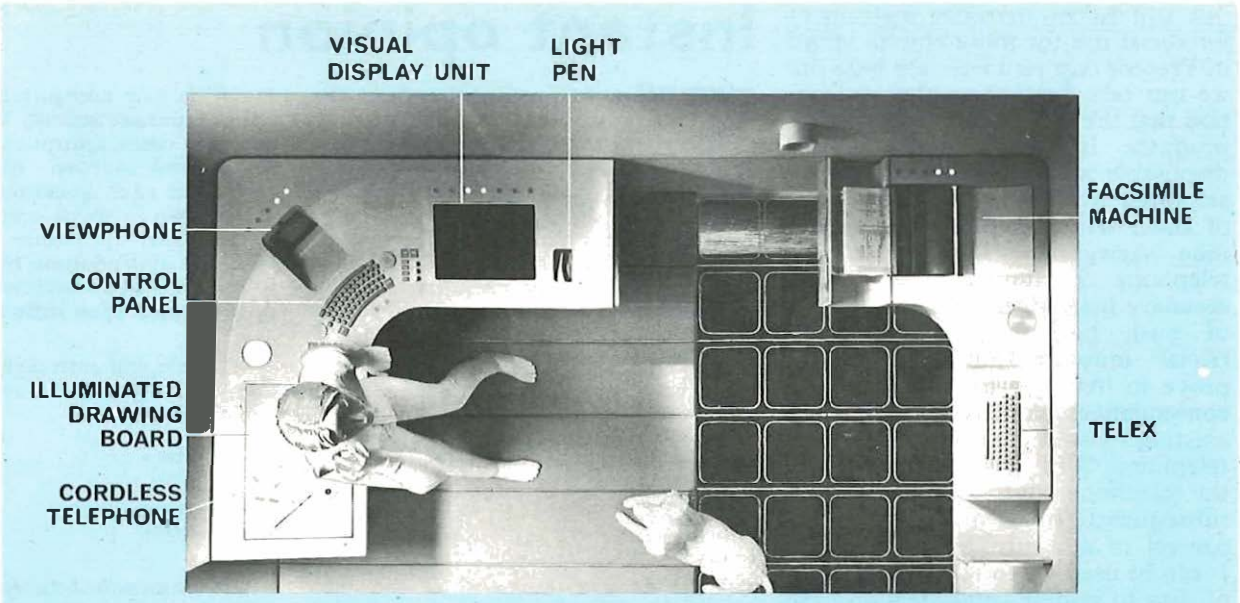
Models of telephone exchanges incorporating stored program control, that is, control of the switching operations by a computer, have already been constructed and hold great promise. We may expect to see this form of control extended so that not only individual telephone exchanges but whole areas of the network are remotely controlled by computers which will be capable of optimising the flow of traffic through the available plant in a dynamic manner. This will have the effect of increasing the efficiency with which the capital investment is used and also protecting the customer from some of the consequences of system faults and localised congestion. One of the outstanding characteristics of telecommunications systems using stored program control is the greater ease (and also speed) with which the administration will be able to modify the facilities that it offers to its customers. This will be of growing importance in the future because as telecommunications becomes ever more pervasive and integrated into the organisation of society it will be necessary for administrations to respond to meet new requirements with a greater degree of freedom than is possible with today's plant . . .

The business man in the future will have many new aids to the more effective conduct of his business.



**FAMILY FINANCIAL PROBLEM IN THE YEAR 2000—and the family go to the Viewphone to get direct visual access to a computer to find the answer. This is a scene from a film made by Dollis Hill research station staff which cleverly simulates services that could be offered to the customer of the future. The young couple want to know the best way to raise money to buy a house—mortgage, insurance policy etc.—and after they have keyed in the data with a push-button telephone the computer prints out the comparative costs on the Viewphone screen. All the parts in the film were played by Dollis Hill staff—the young couple in the picture are in fact newly marrieds—and it was directed by Staff Engineer Mr. F. E. Williams, well known as an amateur film maker.**

2000




**THE OFFICE OF THE FUTURE—We are looking down from the ceiling at a civil engineer working at his home at the end of the century. Facilities that could be at his disposal without leaving his favourite chair are shown. The visual display unit would be connected to a library of microfilm drawings; the light pen used for correcting drawings with an immediate "play back" of the amended version. This display was seen at a recent exhibition.**

Visual display units in his office will enable him to interrogate the computer remotely, calling up numeric and graphical data from the computer files. Being presented to him on demand the information is more up-to-date than present hard copy methods permit and therefore more valuable . . . The remote interrogation of computer-held data bases is only one of the many uses that can be foreseen for image transmission systems. These are really a whole class of services, which include information retrieval services, video conference facilities, audio-visual educational systems and Viewphone. In the British Post Office we have in operation an experimental Confravision system with which our business man of the year 2000 will certainly be familiar . . .

The relatively high cost is likely to rule out the growth of Confravision as a substitute for the telephone so that it may be regarded as a complement, rather than a competitor, to Viewphone. The latter is a telephone system incorporating a television type display of the face of the distant party, but the additional value that it confers by comparison with voice only is the subject of keen debate . . .

In order to provide a Viewphone service the transmission bandwidth required is likely to be of the order ½–1 MHz if analogue transmission is used and of the order 6M bits per second if digital transmission is used. There seem good grounds for suggesting that once such a service has been established many other applications will emerge for this very high bit rate switched capability, and in considering the economic viability of the Viewphone service we should perhaps think of it less as a Viewphone service than as a switched broadband capability. In the business environment the use of Viewphone by itself for facial images may have a limited importance. However, in combination with other devices permitting high definition displays of small static objects, alpha numeric displays of information retrieval from computer stores, as an output device for receiving images derived from remotely accessed microfilm libraries, and for the verification of signatures, it could assume great importance . . .

These switched image distribution systems will be the big watershed for the telecommunications network because the demands of, for example, a Viewphone service on transmission capacity multiplies by about 100 those of the purely voice service. If only one per cent of all calls were Viewphone calls it would double the bandwidth requirement in the national transmission network, and if only five per cent of calls were Viewphone calls they would completely dominate the scene. Such massive demands for bandwidth adds stimulus to the current research program directed towards new transmission media, particularly those employing circular waveguides and optical fibres which share the characteristics of providing massive information transmission capacity. May I illustrate this by saying that a circular waveguide system of the type being developed in the British Post Office Research Laboratories and elsewhere could have a transmission capability of about 300,000 telephone channels.

What about the home? How will we fare domestically by the end of the century? We have already mentioned the Viewphone and clearly

**CONFRAVISION—Experimental Post Office studios in London are used to demonstrate how businessmen many miles apart can hold a conference in sound and vision. Monitor screens show the participating groups or drawings and documents in close up.**

this will be an attractive instrument for social use for those able to afford it. Present cost estimates are high but we can take heart from the observation that the real cost of technological products is falling and personal disposable wealth is rising. But there are other devices in prospect—some of them will probably come sooner than Viewphone. The dial on the telephone instrument will almost certainly have given place to a series of push buttons; this apparently trivial innovation may eventually prove to have the most far-reaching consequences immensely broadening existing views of the application of the telephone. With its aid not only can the telephone call be set up but it can subsequently be used for the remote control of apparatus of many sorts. It can be used to send small quantities of data to remote computers and the computer can respond by sending back program-controlled voice responses from a library of pre-recorded words. This opens the door to such possibilities as automatic ordering facilities from small retailers, travelling salesmen, part-time sales agents, and direct from members of the public. Automatic interrogation of credit records, automatic credit transfers and bank account interrogation facilities, automatic reservation schemes for hotels, theatres, airlines and sophisticated information systems in which iteration between the caller and the answering computer is necessary to identify the precise subject on which information is required. It may well be that telephone administrations will provide a variety of public services controlled by computers which will be accessed from push button telephones, with regional computers providing many of the facilities which at the present time have to be provided by an operator.

All manner of surveillance services both for the very young, the very old, and the infirm, fire and burglar alarms are natural extensions of the capability of the communications system. Beyond these one can visualise the means by which home video shopping could be achieved with goods displayed to the housewife on a relatively large viewing screen, her orders sent using a simple keyboard or even by pointing at the screen, automatic packaging and invoicing taking place simultaneously at the warehouse, and automatic debiting of her Giro or banking account. The only step that we cannot eliminate is the delivery of the goods . . .

All this seems technically possible but when, if ever, all these developments will become economically viable is much more difficult to suggest. Further, I think it is legitimate to ask whether the housewife will ever really want this; perhaps, in part, her shopping is a social exercise offering a certain pleasure and satisfaction which would be lost if the family shopping expedition were replaced by the technological *tour de force* that I have outlined . . .

With all these many new services within our technological grasp it is nevertheless important to be realistic. For many of those that I have described the timing is likely to be determined more by economic viability than by technological possibility. A service like Viewphone will involve a vast national investment. The present-day cost of the telephone instrument that you have in the home is about 40 Guilders (£5) but many people do not realise that this is only the tip of a very large iceberg. The capital value of the plant that is provided by the telephone administration for the transmission and switching of your telephone conversation amounts to some 5,000 Guilders (£600) per customer, and in the case of many new services it is this vast cost of the infrastructure needed to sustain them that will have a dominant influence on the cost of the service . . .

This leads me to suggest that we shall not find it possible to develop, and bring into widespread use, all of the many new services that are technically within our grasp. Society therefore will have to make choices and in making these choices one hopes that the dominant consideration will be the contribution that each service can make towards enhancement of human wellbeing and happiness. We know, however, very little about the way in which these new capabilities will influence society and its institutions and its organisations. The power to bring about social change that some of these services possess is probably very great indeed but very little effort is being devoted to the study of this question.

The problems are intellectually difficult but if we let these difficulties dismay us we may find that we have allowed ourselves to drift into a new situation in which the expected benefits of our technological achievements turn out to be hollow triumphs. Mankind has continuing need for truth, beauty and compassion; technology alone is not enough.

# Instant opinion

**THE 1,500 people attending the symposium were able to take part in an opinion poll on questions affecting telecommunications, with an analysis of their answers shown immediately on a large screen. Apparatus normally used for simultaneous translation in the hall was adapted to provide each member of the audience with inputs to a "voting machine"—a computer that calculated percentage scores. The counting of the 1,500 votes, computation of percentages and screen display of the results on each question was managed within two to three seconds.**

**The same questions were put before the symposium began and after it had finished, indicating the extent opinion had been influenced.**

Do you think that the technical equipment now being installed will meet the needs of the next five years?

| | *1st ballot* | *2nd ballot* |
|---|---|---|
| Very probable | 10.8% | 6.3% |
| probable | 41.1% | 51.9% |
| Don't know | 7.4% | 6.2% |
| improbable | 34.3% | 28.2% |
| Very improbable | 6.3% | 7.4% |

What do you think will be the main bottleneck in telecommunications in the next five years?

| | *1st ballot* | *2nd ballot* |
|---|---|---|
| Connecting new subs. | 27.5% | 11.6% |
| Handling traffic growth | 24.8% | 15.6% |
| Data | 32.2% | 55.7% |
| Introducing new services | 11.6% | 11.0% |
| None | 3.8% | 6.0% |

Will the growth of telecommunications facilities make decision taking easier?

| | *1st ballot* | *2nd ballot* |
|---|---|---|
| Very much easier | 16.1% | 10.9% |
| A little easier | 49.2% | 55.0% |
| No change | 21.3% | 16.4% |
| More difficult | 9.2% | 13.1% |
| Very much more difficult | 4.2% | 4.5% |

Do you think that in the future the investment in telecommunications as a fraction of Gross National Product will increase or decrease?

| | *1st ballot* | *2nd ballot* |
|---|---|---|
| Increase greatly | 26.9% | 6.7% |
| Increase slightly | 49.5% | 41.5% |
| No change | 14.3% | 43.8% |
| Decrease slightly | 8.0% | 6.3% |
| Decrease greatly | 1.4% | 1.8% |

Will new and extended telecommunications have a good effect on man's spiritual and moral life?

| | *1st ballot* | *2nd ballot* |
|---|---|---|
| Very probable | 13.1% | 7.6% |
| probable | 28.7% | 32.5% |
| No change | 10.9% | 8.0% |
| improbable | 30.0% | 35.9% |
| Very improbable | 17.4% | 16.0% |

Will the growth of the telecommunication network reduce the load on human memory?

| | *1st ballot* | *2nd ballot* |
|---|---|---|
| Very probable | 15.2% | 9.9% |
| probable | 21.3% | 30.0% |
| Don't know | 7.5% | 3.7% |
| improbable | 35.6% | 42.3% |
| Very improbable | 20.8% | 14.2% |

In the realisation of new telecommunications facilities there will be three groups of problems. Which do you think will be the most important?

| | *1st ballot* | *2nd ballot* |
|---|---|---|
| Technological | 6.8% | 2.3% |
| Economic | 45.5% | 35.2% |
| Sociological | 41.7% | 57.2% |
| Don't know | 5.9% | 5.2% |

Which type of information exchange will need most telecommunications in the year 2000?

| | *1st ballot* | *2nd ballot* |
|---|---|---|
| Man—man | 27.1% | 21.5% |
| Man—machine | 25.0% | 24.3% |
| Machine—machine | 42.0% | 51.4% |
| Don't know | 5.9% | 2.7% |

# Decimals... huge conversion task ahead


Converted coinboxes will look like this. They will have only two slots, for 2p and 10p coins.

THE introduction of decimal currency in Britain early next year will mark the most radical reform in the history of our monetary system. For the Post Office, which handles millions of pounds in the course of a financial year, the implications are enormous. In the two businesses, each now in the throes of conversion, a payroll of more than 400,000 and 250,000 coin-operated machines will have to be changed for decimal working, and that is only part of the task.

While the job is immense the switchover should not be thought of as just one more difficulty to be overcome. It is an opportunity to modernise and improve working practices. Decimalisation will help the gradual adoption of the metric system by British industry over the next 10 years; each reinforces the case for the other. It will be an important aid to productivity, having the considerable advantage that money is treated like ordinary numbers making calculations quicker, easier and less prone to error. Calculating and accounting machines will become more versatile and be able to handle both numbers and money, and because there will be fewer coins cash-handling will be easier.

While the Postal business, with its direct cash dealings with the public at the counter, will be affected to the greater extent, the task within the Telecommunications business is nevertheless huge. Virtually every department will be involved.

To consider the problems and review progress towards full decimalisation the Telecommunications business set-up, early in 1968, a Decimal Currency Liaison Group consisting of representatives from each Telecommunications HQ department. To ensure co-ordination of

By F. W. BURGESS

departmental tasks a network analysis chart has been produced to control the progress of 284 listed events leading to the completion of decimalisation. These cover every aspect of the business and represent a vast amount of work if targets are to be achieved by D Day, February 15, 1971.

The main objectives will be the conversion of tariffs, coinboxes, bills for all services and the training of personnel.

The biggest practical problem is the conversion of the 230,000 coinboxes—about 30,000 prepayment and 200,000 pay-on-answer types—of which 140,000 will be altered and 90,000 replaced with new boxes. The total cost to the Post Office will be around £3 million. At present, prepayment boxes and a few other obsolescent types connected to non-STD exchanges accept pennies, sixpences and shillings, and the pay-on-answer (PA) boxes linked to STD exchanges sixpences and shillings. The PA boxes were designed to operate on a coin value ratio of 1:2:4 and when introduced operated on the 3d piece as well as the sixpence and shilling. The 3d was used to transmit one electrical pulse which allowed one pulse unit, the 6d allows two pulse units and the shilling four. Since a pay-on-answer coinbox call must be set up using the minimum fee of one coin, the smallest coin accepted had to be as closely as possible equal in value to the present 6d. Coinboxes will in fact operate on 2p and 10p coins, a ratio of 1:5. It is believed that this will be a useful combination for already it seems clear that the 10p will be in extensive circulation and there is little doubt that the 2p, once issued, will also be widely used. Charges for many trunk calls are already a combination of these coins and when fixing future charges account will have to be taken of the coins accepted by the modified boxes.

Conversion of the coinboxes will have to be completed as soon as possible after D Day. Detailed plans are now being made in each Telephone Area. As much work as possible is to be done before the end of 1970 so that the minimum of field work will

be outstanding when the 2p coin becomes legal tender on D Day.

Conversions will start 24-hours after D Day, allowing one day for the new coins to circulate, and should be completed in six weeks. Generally, all boxes connected to one exchange will be converted as quickly as possible, then all the exchanges working to the one Group Switching Centre until all the GSCs served by the same Auto Manual Centre have been converted. All exchanges served by the same manual board must be converted as speedily as possible to minimise operator difficulties.

All rentals and charges will have to be converted for D Day. Fortunately, the majority of charges are already expressed in whole £s and present no difficulty. The main problem is the conversion of telephone call charges into decimal. For example, the present unit charge for STD is 2d, and its decimal conversion is 0·833333 recurring. The rounding of this figure up or down by one thousandth of a new penny would affect our revenue by something like £300,000.

Telephone and telex bills are rendered quarterly. For the three months prior to D Day, customers will receive their bills showing the total amount in both £sd and £p. The conversion of the total will be done according to the statutory whole penny table which has to be used for all banking transactions. This means that bills presented for payment at Post Office counters will need no conversion there. The charges for any services provided between the last bill before D Day and the first bill after it which are held on the computers will be converted during the weekend 20-21 February, 1971, allowing five days for tickets made out in £sd to be cleared through the pipeline from switchboards to billing points. Few bills will be sent out that week, and those that are, will have the totals expressed in both £sd and decimal currency.

A leaflet will be enclosed in the dual currency bill explaining that the £sd amount should be paid before D Day and the £p amount after it. Advice will also be given on how to write cheques and Giro transfer forms in decimal currency. Information about changed charges will be published in good time before D Day and the Post Office Guide is being deferred to late 1970 in order to be able to show the decimal tariffs.

Conversion of salaries and weekly wage rates should begin around the middle of this year, by which time claims currently in the pipeline are expected to have been settled. Salaries, which are expressed exactly in £s sterling, will be easily converted as will wage rates where these are in shillings. Difficulties, however, will arise where wage rates, overtime and piece-time rates are in amounts with no exact decimal equivalent. Here, a decision will have to be made on whether to round up or down. To this end discussions will soon be taking place with the Staff Associations. When agreements have been reached new pay scales will be published, probably sometime in the autumn of this year.

Training will be another major task. All staff will have to be made familiar with the decimal system to appreciate the changes in procedure and practice in day-to-day jobs. For example, about 1,000 forms will have to be changed to comply with decimalisation. Fortunately, in the Telecommunications business a general appreciation training will be sufficient for the majority. This will be accomplished, in the main, by the circulation of four-page information leaflets at bimonthly intervals throughout this year. For the few telecommunications staff involved in direct cash dealings with the public, for example at Overseas Telegraph Offices and at counters in Telephone Managers' Offices, practical courses to familiarise them with the actual handling of the new currency will be held. Film strips synchronised with recorded talks on decimalisation may also be made available to Telephone Managers' Offices to help staff understand the new system.

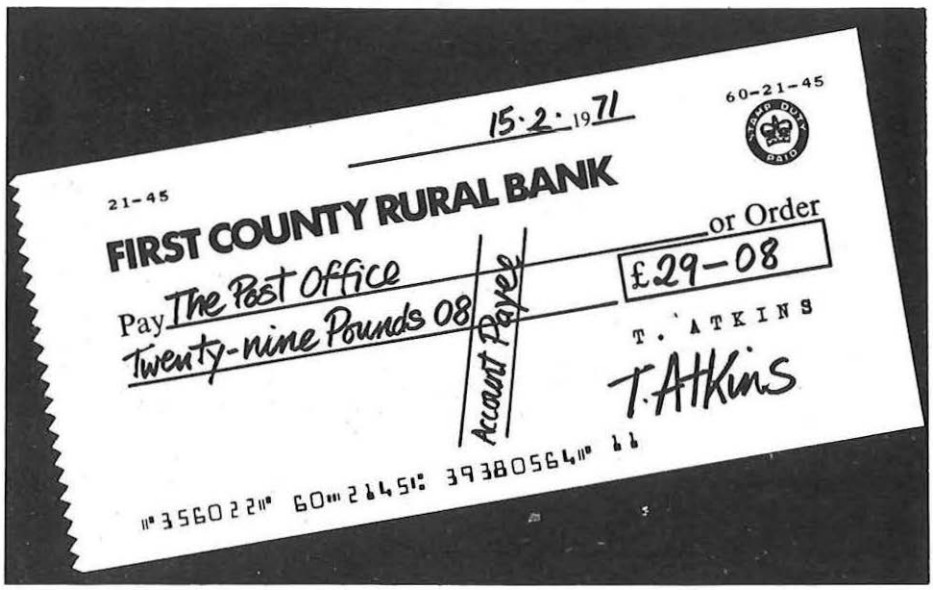
Decimalisation of a business the size of Post Office Telecommunications is such an immense task that it can be achieved satisfactorily only with long and detailed planning. We certainly started planning early enough and, though there will be tremendous pressure on the Telephone Areas to complete the coinbox conversions in the short time allowed, there is no reason why the transition should be anything other than smooth.

Telephone Number NEWCASTLE 59582 Date of bill DEC 70

ANY CALL CHARGES NOT TO HAND WHEN THIS BILL WAS PREPARED WILL BE INCLUDED IN YOUR NEXT BILL.

| | £ | s. | d. |
|---|---|---|---|
| Rental (and other recurring charges) at quarterly rate of 4 0 0 1 DEC to 28 FEB | 4 | 0 | 0 |
| Non recurring charges (statement enclosed) | | | |
| Dialled units to 25 NOV 624 at 2 d. | 5 | 4 | 0 |
| Local calls via operator to hand on 25 NOV | | | 10 |
| Trunk calls via operator to hand on 18 NOV | | | |
| 6 OCT | | | 6 |
| 15 OCT | | 3 | 4 |
| 10 NOV | | 5 | 2 |
| 18 NOV | | 15 | 4 |
| TOTAL | 10 | 9 | 2 |
| (DECIMAL EQUIVALENT | £10.46) | | |

A specimen of the telephone bills that will be produced in the last quarter before D Day, giving the total due in both forms of currency.




This is the way cheques will be written after decimalisation:

**THE AUTHOR**

**Mr. F. W. Burgess** *is a Principal in the Tariffs Division of Telecommunications Headquarters Service Department. He joined the Post Office in 1968 from the Royal Navy.*

# Room for research

**The Post Office is building a magnificent new research centre, shown in the model above, at Martlesham Heath, near Ipswich. It will provide much-needed space for the expansion of research work. The special facilities at Martlesham are expected to make it the finest research centre of its kind.**

By C. F. FLOYD

DOLLIS Hill has been the home of the Post Office research laboratories since the mid-twenties when the Research Branch was founded. The activities of the Research Department, into which the original Research Branch has matured, have expanded rapidly and now involve a staff of some 1,500, of whom about a third are graduate engineers and scientists. The rate of growth is likely to increase because of the rapid and far-reaching advances in telecommunications technology that must be explored and exploited by the Post Office.

It has been apparent for some years that the site at Dollis Hill, where all available land has been used, is not fully adequate for the work of the Research Department. More laboratories are needed to provide research facilities for complex modern studies, such as microelectronics; extensive outdoor areas are needed for field work on an increasing scale. Long underground waveguide installations for broadband transmission experiments, steerable aerials for microwave satellite communication studies, work on multichannel coaxial cable systems all require access to large open spaces that are not to be found in suburban London. The environmental factor is also important. A modern, stimulating, expanding environment is essential to achieve success in the competitive business of recruiting first-class research staff, and such an environment will also have a beneficial effect on the quality of the work that they do.

It was therefore decided to move the Research Station out of London. After many locations had been studied, with the valuable help of the staff representatives, a 98-acre site for a new research centre was selected on the disused RAF airfield at Martlesham Heath, five miles east of Ipswich. Planning began in 1964 in collaboration with the Ministry of Public Building and Works who, in conjunction with Post Office engineers, were to undertake the detailed design. Critical studies were made of many modern laboratories both at home and overseas and various schemes were devised and analysed before the basic design evolved.

Experience at Dollis Hill has shown that a telecommunications research establishment, covering the wide range of engineering and science required by the Post Office, must be flexible in application if it is to operate efficiently. New techniques now appear with alarming rapidity,

and the days when a fixed plan of laboratories and offices could be adapted to meet all new requirements have passed. No laboratory can work efficiently if builders are continually in occupation, altering internal walls and fittings, or constructing clean-air rooms.

It was decided that extensive use should be made of moveable partitioning, erected on large unobstructed floors, so that laboratories could be arranged in a wide variety of sizes and patterns. Further commitments were that all the laboratories and closely associated areas should be air-conditioned and that service connections on laboratory benches, for electricity, gas, etc., should be available anywhere in a variety of room layouts.

Special attention was paid to the problem of eliminating vibration in the laboratory building and the need for "clean-room" facilities for work on micro-electronic devices which are being introduced to an increasing extent in telecommunications techniques.

The aim of the designers has been flexibility of accommodation in an environment that will meet the basic need of Post Office research for many years to come.

Plans have now been produced under the guidance of the MPBW senior architect for Martlesham, Mr. S. Spielrein, based on a schedule of requirements that visualises an establishment approaching 2,000 total staff in the mid-seventies. The buildings are to be grouped together in the south-west quarter of the site and so arranged that further building can be undertaken in the future without encroaching on the northern and eastern parts which have been reserved for field work. An £8 million contract for the main building work has been placed with Mitchell Construction Ltd. of Peterborough with a completion date of October 1972.

The site is roughly square with its west side along the Woodbridge-Felixstowe road, the A1093. The main buildings comprise three closely related blocks, linked at all levels by two lift towers so that it will be possible to move anywhere between buildings under cover. Each of the three blocks is individual in appearance and in function. The main central building, the largest of the three, is the seven-storey laboratory block; the smallest in area is the four-storey administration block to the south-west and the third, on the north-east side and largely single storey, is the research services building.

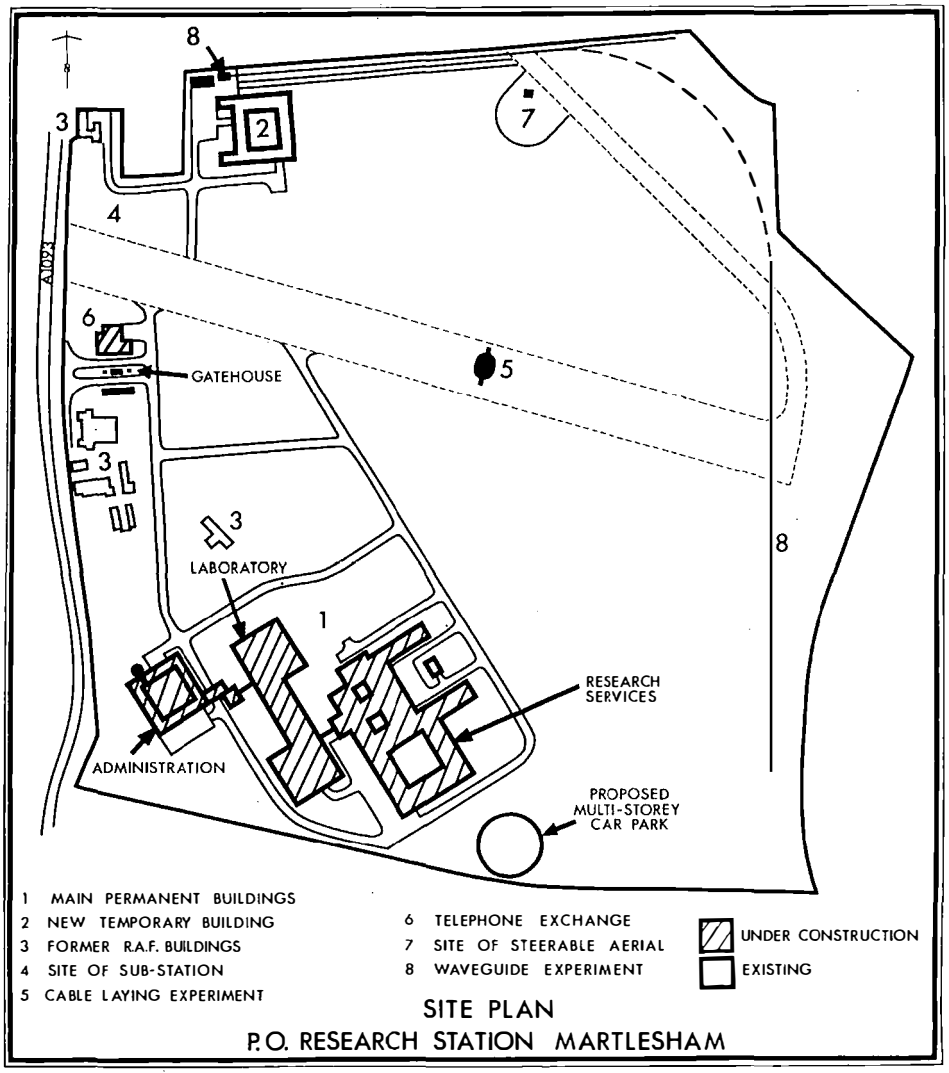
The unusual shape of the laboratory block (shown in the site plan) arises partly from the need for a structure giving efficiency in air-conditioning. Structurally it consists of five similar units each of 150-ft. × 75-ft. in plan size, joined together to give a building which in plan consists of two squares 150-ft. × 150-ft. joined by a link 150-ft. × 75-ft. The overall length is therefore 450-ft. The height above lower ground level is approximately 112-ft. The building will be fully air-conditioned by a dual-duct system in which hot and cold air streams supplied in separate feeder ducts are mixed in controlled proportions to give the desired air temperature to individual parts of each floor.

The gross floor area of the laboratory block is approximately 400,000 sq. ft., with approximately one fifth of this occupied by air-handling plant, corridors and stairways. Floors are relatively free from fixed obstructions such as pillars and shafts, and moveable partition walls rising from floor to ceiling can be erected almost anywhere on a grid pattern that is based on a 40-in. module. A high standard of lighting will be provided and the system is designed so that partitions can be erected without alteration to the fluorescent light fittings or the air grilles attached to them. Laboratory services, such as electric power, gas, water, waste pipes and internal cabling are also being provided on a grid system so that feeds to benches are readily available without additional engineering work.

It is important to the work of the research department that vibrations generated anywhere in the laboratory building should not be transmitted through the structure to cause interference elsewhere. To this end, the laboratory floors will consist of isolated sectionalised concrete slabs resting on resilient pads on the supporting steel beams. For refined acoustic research a specially designed suite containing two anechoic chambers and a reverberant room is being built as an adjunct to the main building. Special "clean rooms" for micro-electronic research are housed on the ground floor where building stability will be optimum.

All floors of the laboratory building will have continuous six-foot-high fixed windows round the periphery, partially shaded from direct sunlight by balconies round the entire building at each floor level. The balconies also provide emergency escape routes, and give easy access for window cleaning and maintenance to the outer fabric of the building.

Although small internal stairways are being provided between floors, the main access is by the ten passenger lifts and two 5-ton goods lifts in the two external lift towers. A two-storey




SITE PLAN
P.O. RESEARCH STATION MARTLESHAM

radio laboratory with an aerial platform—at 215-ft. above lower-ground level—forms the upper part of the south-west lift tower. A water tank is supported by the other tower. Many small offices are also included in these towers.

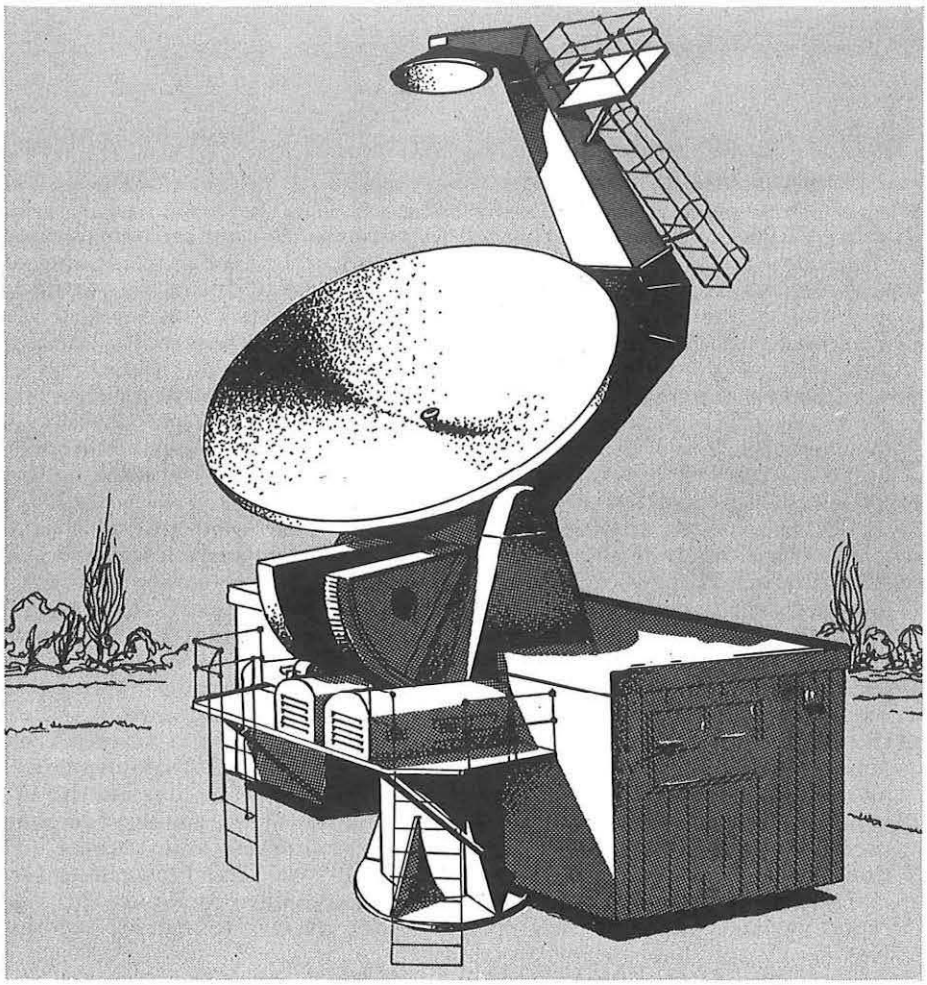
A research centre of the size and technological importance of Martlesham is likely to attract even more international interest towards Post Office telecommunications research and there will certainly be a demand for international conferences to be held there. Appropriate facilities have therefore been included in the design of the administration block. There will be two lecture theatres, with seating capacities of 450 and 50 respectively, and simultaneous translation facilities to audiences are envisaged. Also in the lower part of the administration building are an exhibition gallery, conference rooms and a Confravision studio by which meetings can be held between remote places over closed-circuit television.

The comprehensive technical library will have space for study, microfilm reading and copying facilities. Book collections grow at an alarming rate and ample stack room is needed for book storage. The library, which will occupy the equivalent of two storeys, and the main lecture theatre below it, form the core of the administration building, the natural slope of the terrain contributing to the design of the sloping floor of the theatre. Offices are grouped around the periphery of each floor, with Directorate rooms on the second floor projecting beyond the floors below. The top floor, projecting still further on all four sides, is devoted to welfare; the restaurant, kitchens and games rooms occupy this floor, which has a small central courtyard with roof lights in the library below. The whole administration building is a truncated inverted pyramid, joined at each floor level by bridges to the radio tower. These floor levels then continue into the laboratory building.

The social side of life has not been forgotten and the administration building is so designed that it can be used for social and community activities that will be an essential part of the corporate life of Research Department.

The third main unit of the research centre is the research services block to house a total staff approaching 500 people. It has a two-storey office element, cruciform in plan and grouped around the base of the water tower, to be occupied by engineers and drawing offices. Beyond this are single-storey workshops, part being air-conditioned for high-performance machinery, as well as stores, loading bays and transport facilities.

Other plans include a double carriageway road improvement to be made in the vicinity of the research station approach to give safer entry for traffic. A new telephone exchange, a type TXE2 installation having 2,000 line capacity, is being built alongside the entrance gatehouse to serve the new establishment. The Eastern Electricity Board is erecting a substation some yards to the north of this entrance to supply electric power to the research department.



**An artist's impression of the steerable aerial to be built at Martlesham for studies on satellite communication systems.**

The Martlesham site has been used by the Post Office for field work since 1967 in a joint experiment with University College, London, on waveguide transmission. The first permanent transfer of staff from Dollis Hill was made in 1968, using refurbished RAF buildings. Since then a single-storey temporary laboratory building to house about 100 people has been erected in the north-west part of the site and remaining RAF buildings have been converted to provide laboratories, offices, workshops, a canteen and welfare rooms. Nearly 200 of the staff from Dollis Hill have already moved from London to form the advance party headquartered at Martlesham. The remainder will transfer in carefully phased moves after the main buildings open towards the end of 1972.

Because of the field space available it has been possible to begin several large-scale experiments—notably waveguide transmission, tests on submarine cable laying gear under simulated conditions within the protection of a large air-house, a new steerable microwave aerial for experiments with satellites and microwave radio propagation at high frequencies. None of these could have been undertaken fully within the confines of Dollis Hill.

Close ties have already been established with Universities and neighbouring technical colleges, especially with the University of Essex at Colchester, only 25 miles from Martlesham, where the Post Office is supporting a chair of Telecommunications Systems Engineering. This should ensure a source of high-grade recruits for Research Department and be valuable to the Post Office as a whole.

The long-term prospects for the new research centre are dazzling. For the first time the Post Office will have available adequate research facilities, comparable with the best in the world, and with space to build for several generations ahead.


**THE AUTHOR**

**Mr. C. F. Floyd** *is the head of the Research Department's Move and Personnel Division. He is the overall planning officer for the Martlesham project and is assisted by a small, concentrated team.*

# THE POST OFFICE HELPS PEOPLE TO HEAR

SEVERAL million hearing-aids have been manufactured for the National Health Service since its inception in the late 1940s. The aids have made life more bearable for the hundreds of thousands of partially deaf people throughout the United Kingdom. It is a commendable record to which the Post Office has contributed a great deal.

Helping the deaf has been one of the lesser known activities of our telecommunications business for more than 20 years. Post Office work in this field began in 1943 when a number of senior officials sat on the Medical Research Council's Electro-acoustics Committee which was set up at the request of the Ministry of Health—then in the process of planning the National Health Service—to advise on the design, performance and application of electro-acoustic equipment used in the investigation and alleviation of deafness.

This Committee produced the report which included the main performance requirements of the first National Health Service hearing-aids. This target performance was decided only after much work by staff at the Post Office Research Station in London who built the first Speech Transmission System for tests on the partially deaf. The latest development of this system is described later.

Research Branch also built the prototypes of the first National Health Service hearing-aids of which 45,000 were later manufactured and distributed when the National Health Act came into force. Because time was short, these aids incorporated the same components as the prototypes and many had to be imported from the United States.

To save dollars it was necessary to develop British manufactured replacements. With its expertise in the development of similar components for telephones, and because of its contact with suitable manufacturers, the Post Office took over this role in 1948. Research Branch continued with its work and subsequently the purchasing of hearing-aids on behalf of the Ministry of Health was undertaken by Contracts Department who invited tenders and awarded contracts to specifications, drawings and diagrams produced by Subscribers Apparatus Branch. The Test and Inspections Branch also assumed responsibility for quality and used methods of inspection and acceptance for aids and components similar to those used for other Post Office items.

The roles of Contracts Department and Inspections Branch have now been taken over by the Contracts and Control Divisions of Purchasing and Supply Department and the work of Subscribers Apparatus Branch by Telecommunications Development Department where a special group, consisting of one Executive Engineer and two Assistant Executive Engineers, are wholly employed on this work.

Throughout the 20 odd years of hearing-aid development Post Office staff have produced 18 different designs. Their latest is an experimental behind-the-ear aid for school children over seven years old, and another, which will become the National Health Service's new standard body-worn hearing-aid, is currently being developed.

By G. R. PARR

*The author began his career in the Post Office as a Youth-in-Training in the Factories Department. He has since served in the London Line Tests and Inspection Department and on promotion to Assistant Engineer with the Engineering Department. Three years ago he joined the group working on hearing-aids development and design.*

# New hope for 120,000 deaf

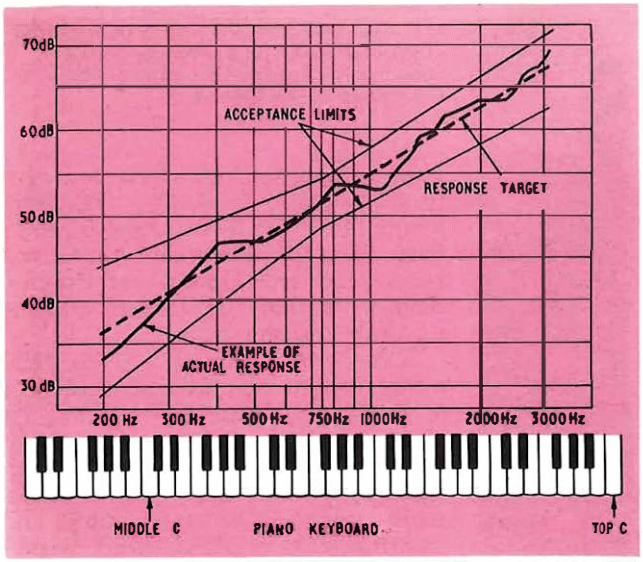
**The author examines a "patient" who has a hearing-aid with the new STS equipment. On the "patient's" left hand is the volume control which she can adjust to hear the spoken word or tape recordings more clearly. In the centre is the master control unit which records the frequency response.**

OVER 600,000 people in the United Kingdom suffer from varying degrees of deafness. For the majority, the handicap can be largely overcome by using the standard hearing-aid supplied through the National Health Service. For something like 20 per cent of those afflicted, however, the standard hearing-aid has varied greatly in its usefulness largely because of the severity or type of deafness. To some the aid has given no assistance.

Now there is more hope for these people due to a new tool for the assessment of deafness designed by the Telecommunications Development Group responsible for hearing-aid design and development.

The new equipment is a development of the Speech Transmission System (STS) first provided by the Post Office in 1945 for the evaluation of deafness and to provide a means of assessing the hearing-aid requirements of the partially deaf.

It differs from its predecessors in that it is portable, contains its own




**A typical response of a standard hearing aid. The air to air gain, the difference between the volume coming from the amplifier and that which entered the microphone, is shown in decibels. The piano keyboard, related to the speechband 200-3,000 Hz gives an indication of the frequency range over which the hearing-aid responds.**

battery supply and uses different transducers. Early models used high-quality microphones and earphones necessitating the conversion of the ideal response obtained from these into a target response for a practical hearing-aid. In the new model, actual hearing-aid microphones and earphones will be used. With these, corrections will be minimal and, in addition, the subject should feel more at ease with the familiar components. A major achievement has been to make the new equipment compact and portable by the use of transistors.

As a result it could, in the long term at least, be made available to clinics, hospitals and other appropriate centres throughout the country. Existing equipment, because of its bulk, has had to be limited to a few Research Centres.

The new equipment will provide some scores of variations to the frequency response within the bandwidth 300 to 3,500 Hz which is similar to the speechband for telephone transmission.

Contrary to general belief, simple amplification of sound may not in itself be sufficient to enable the deaf to hear. In some cases it is the variations in the frequency-response of the aid within the 300 to 3,500 Hz bandwidth which allow a partially deaf person to hear the spoken word intelligibly. Difficulties arise, however, in that the variations required differ from person to person, depending on the type and degree of deafness.

Fortunately, the variations provided by the standard hearing-aid equipment are sufficient to enable the majority of those afflicted to hear reasonably well. It is when the standard aid proves inadequate that the STS should be valuable in that, by a series of tests, the frequency characteristic requirements of a particular person can be arrived at.

The STS consists of a master control unit with earphone attachments for both patient and operator, a tape recorder and a control box by which the patient can control the volume of the recordings or the spoken word. Variations of the volume control are fed back to the master control unit to allow the operator to note the volume changes made by the patient.

The tape recorder is added to provide specially prepared, phonetically balanced, single-syllable word lists on tapes. The tapes have been prepared by trained speech-testers skilled in speaking at controlled levels. By this means possible errors in results due to variations in the normal speaking voice are reduced to a minimum.

As the patient listens to the recordings he selects the most suitable loudness of listening level.

The patient then verbally repeats the recorded words as they sound to him. Depending on the accuracy of the patient's replies the operator can then, if necessary, adjust the settings on the master control unit to alter its response in an attempt to provide the patient with a clearer understanding of the recorded words. At the conclusion of the tests the operator, by noting the final settings of the controls, can observe what departure from the normal hearing-aid response has taken place. For research purposes the variations can be plotted on prepared graphs used in conjunction with the STS.

Using these results, the most suitable hearing-aid available could be selected and advice given on the settings of the controls most likely to give the best results.

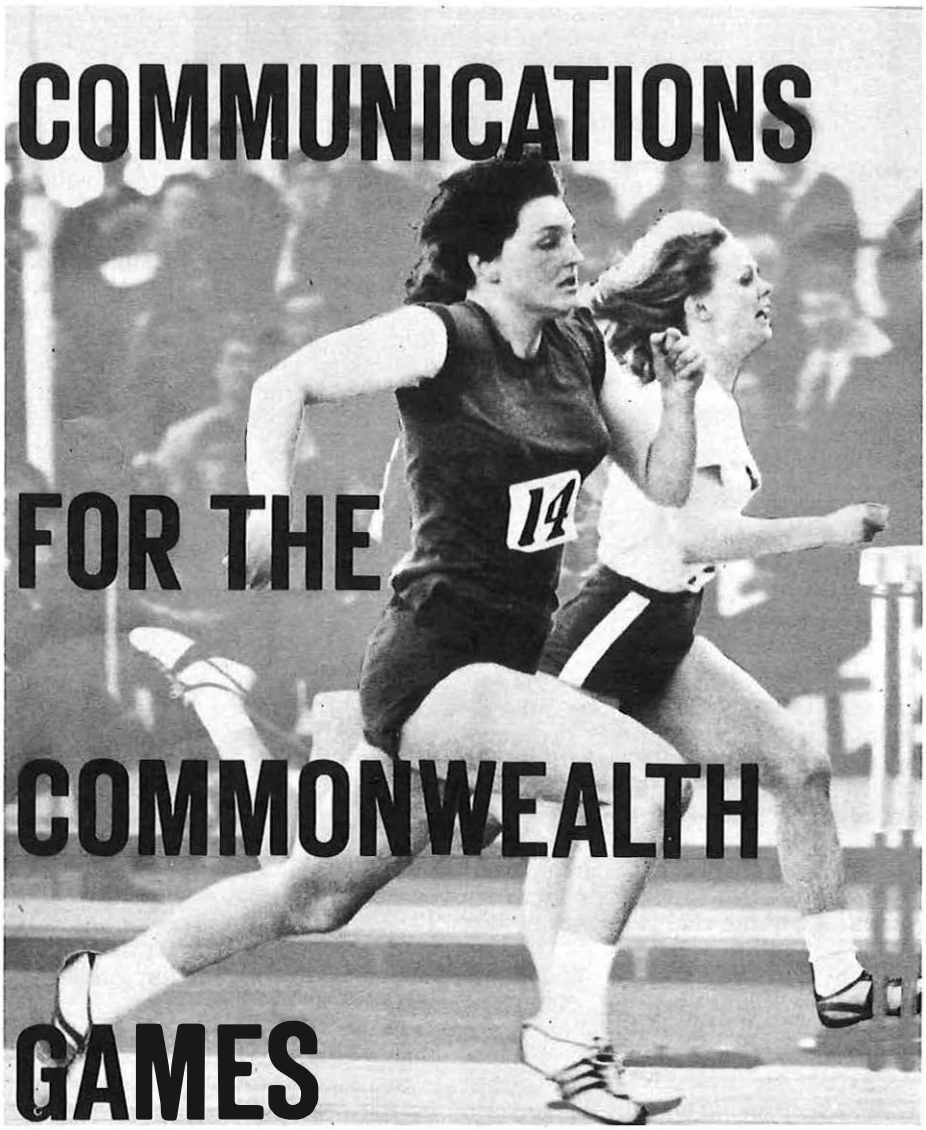
A prototype has now been completed and is to be considered by the Department of Health and Social Security Advisory Group on Audiology and Acoustic Technology and on their recommendations will depend the future use of the new STS.

The design and development group envisage the STS being used initially by research groups for the scientific investigation of the alleviation of deafness. They hope, in turn, to get a feedback of information which could be used for statistical and analytical evaluation for guidance to future hearing-aid design.

In the long term the group hope that a simplified version of the STS —in its present form it is thought to be too complex for routine use—can be developed and made available for general use throughout the country. In this simplified form it might be used for tests prior to the fitting of hearing-aids in much the same way as opticians use "master frames" to help a patient select spectacle lenses.

**In the foreground is one of the last aids to use electronic valves requiring large batteries. Beside it the small transistorised hearing-aid, with its battery, now in general use.**

# COMMUNICATIONS FOR THE COMMONWEALTH GAMES




*Left:* In action—Olympic sprinter Maureen Tranter (No. 14), a telephonist at Wolverhampton exchange, and a possible for England's team for the Commonwealth Games.

By W. N. LANG and W. S. ROSS

AFTER two and a half years Post Office staff in Scotland are approaching the final run-in to providing communications facilities for the 9th British Commonwealth Games to be held in Edinburgh from July 16 to 25 this year.

The job is unique. It is the biggest single task of its kind ever undertaken by the British Post Office and it will be the first time that a Commonwealth Games has had world coverage in 625-line colour television. There was an exceptionally high standard of communications at both the Tokyo and Mexico City Olympics, and Scotland has been under an obligation to provide facilities which will match or exceed them in sophistication, speed, accuracy and coverage. It is confidently predicted that this obligation will be met.

Staff from the Telecommunications Directorate HQ, Edinburgh Telephone Manager's Office and the city's Head Postmaster's Office, who constitute the Games' Communications Committee set up in February 1967, have had responsibilities in addition to normal Post Office services. Not only have they had to provide a large number of PBXs, exchange lines, extensions, telex and inland and overseas telegraph facilities and postal services, they have had to arrange all internal communications for administration, sports organisation and ceremonial purposes.

This has meant the setting up of a fast inter-venue results network, a job never before tackled by the Post Office, to cater for the vast world-wide dissemination of results required by the Press and television; providing five closed-circuit TV systems, mobile radio networks, and designing and drawing-up specifications for electronic scoreboards and the first underwater loudspeaker system ever used in this country. Underwater microphones will eliminate echo and allow teams giving displays to music to hear the beat clearly.

The Post Office is also producing a Games telephone directory, a special Games design on the cover of the 1970 Edinburgh Area directory and booklets describing the facilities for issue to competitors, Press and visitors. Special Greetings Telegram forms for sending to medal winners have been designed and there will be a recorded Games Information Service which will keep visitors up-to-date with events.

The Results Service will use telephone and telegraph links and four of the closed-circuit TV systems. Its main requirement is accuracy and speed and the aim is to have information in a Results Centre within three minutes of ratification and transmitted over the network within a further 10 minutes—times which are likely to be bettered in practice. Official reporters will phone results to the Results Centre where they will be recorded at a suite of key and lamp positions. After checking they will be put on tape and fed into the Press Association's sports results network and, at the same time, into a local results telegraph network covering Games Headquarters, Games Village, sports venues, press agencies, BBC and ITV and a Main Press Centre. Teleprinters on this local network are being provided, maintained and staffed by British Olivetti. During the period of the Games well over one million photocopies of the results will be distributed to press correspondents and officials.

The three closed-circuit TV systems installed at the Meadowbank Sports Centre, the main venue, will speed up the collection, ratification and announcement of the athletics and cycling results. Document transmitters will carry a picture of each result to a row of TV receivers in front of the scoreboard operators, public address announcer, athletics controller and athletics recorders, enabling results to be flashed on the scoreboard and announced immediately they are available.

As far as telephone service was concerned, the first big job was to estimate the extra traffic likely to be generated over the public network. To distribute the load, it was planned to serve each venue from several neighbouring exchanges in the director area while the bulk of the 120 press public lines would be terminated on a manual board as trunk subscribers.

Early estimates of local traffic established that the six Edinburgh director exchanges and the telex exchange serving the main venues would be inadequate to meet demand. Exchange extensions were therefore redesigned and reprogrammed to provide the additional facilities. A major problem was an uncertainty over the location of some venues. For example, ten different buildings were

surveyed before the Main Press Centre venue was finally chosen only in October of last year.

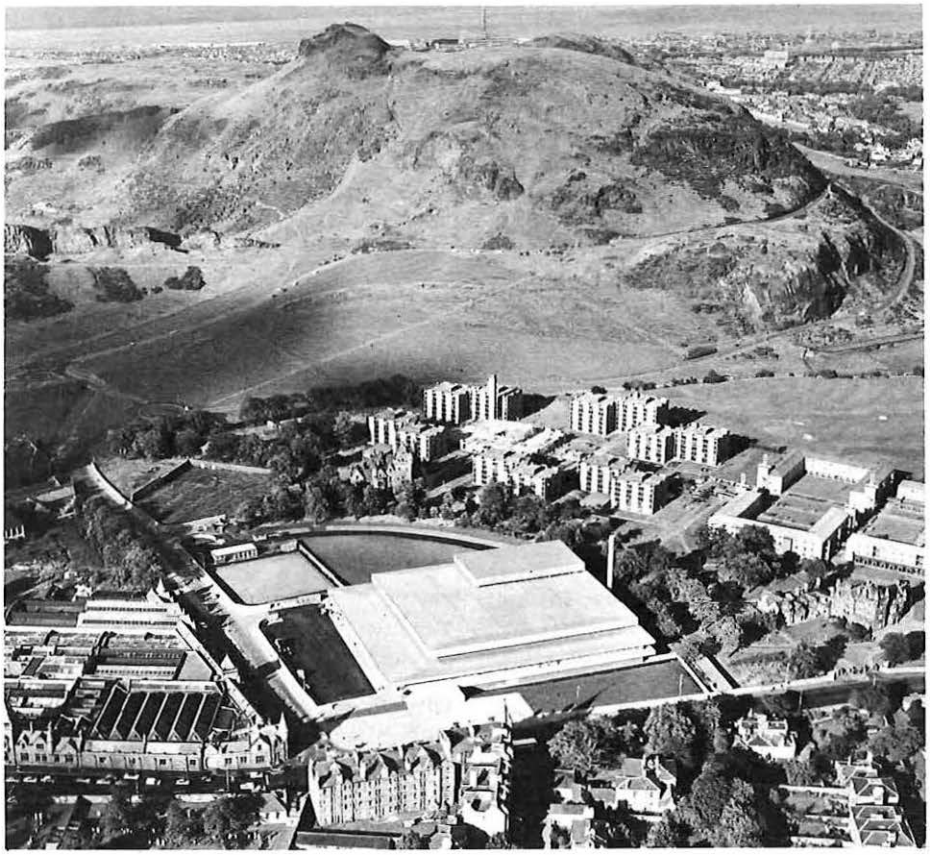
Trunk estimating was more difficult. As well as 1,800 competitors and officials the Games are expected to attract 1,000 press and TV people and around 200,000 visitors. Assessments were made for the Edinburgh area and the circuit provision estimates adjusted. Each Telephone Area had to take a closer look at their trunk traffic estimates since the Games will undoubtedly generate a large increase in visitors throughout Scotland. Overall, more than 6,400 extra junction and trunk circuits are being provided. This is being achieved, in the main, by bringing forward the circuits provision programme for 1970-71.

To meet this huge increase the planned Extension 2 to the city's Woodcroft trunk exchange was redesigned. A £60,000 bulk order for over 2,000 relay sets and selectors was also made to augment the local network. Fortunately, ample manual board positions are available in the city's three trunk exchanges and an additional special suite of nine positions will be available in time for the Games. Some redistribution of loads was necessary to shift the surplus to the trunk exchanges serving the main venues.

At the same time as these plans were being made to strengthen the basic network, negotiations began to establish the requirements of the press, TV and radio and the facilities needed at the administrative offices and various venues. Immediately it was obvious that in all of the venues the Games requirements would vastly outweigh the capacity of any existing or proposed permanent installation. These were therefore disregarded and temporary installations planned to cover all purposes. Venues are anything up to five miles apart and scattered throughout the city and had not only to be equipped for their own particular purpose but interconnected.

The main communications complex is at the Meadowbank Sports Centre which will house the athletics, cycling, wrestling, fencing and badminton events; the BBC Control Centre, a 10,000 sq. ft. area in the main stand; the Results Centre; offices for seven major press agencies each requiring its own private telephones, telex and telegraph installations and a Press Centre. Within two miles is the Swimming Pool, the Games Village, the Main Press Centre set up in a former printing works, Games Headquarters established in a former city hotel, the Main Ticket Office housed in a shop in the city centre and Leith Town Hall which will take the weightlifting events. Five miles away is Murrayfield Ice Rink which will house the boxing events and the Balgreen Rinks which will stage the bowling competitions.


**Operators at the Games Headquarters switchboard at the city's Rose Street trunk exchange.**



**Dominated by Arthur's Seat, Edinburgh's famous landmark in Holyrood Park, are the modern buildings of the Games Village. The flat-roofed building is the new Royal Commonwealth Swimming Pool. To the left of the Pool are the old buildings which will house the Main Press Centre.**

Extensive ducting and cabling has been provided throughout the whole Meadowbank Sports Centre to cater for all communications requirements. A 2-position PMBX 4 will cater for general administration and will link up five 4+18 keyboards and a 2+10 Keymaster system being installed for the control of the individual sports. A special electronic scoreboard has been designed and provided by Edinburgh Telephone Area staff for the fencing finals. For the road races communications will be based on a system of fixed telephone installations at control points, linked by omnibus circuits back to the start and finish points and will be backed by the mobile radio telephone system.

Massive arrangements have been made to meet the needs of the press. At the Main Press Centre a PMBX 4

switchboard with 10 exchange lines, four inter-venue lines and 40 extensions is being installed together with a suite of 32 automatic and manual call office telephones. Large inland and overseas telegraph offices will be provided with 14 telex and private wire circuits and there will be off-line tape-punching facilities for reporters wishing to prepare their own tapes. To meet private press orders capacity has been provided for 75 telephones, 20 telex circuits and six 4-wire picture transmission circuits. A public address system is being installed to call correspondents to a suite of incoming call telephones.

About half the 700 press seats at the various venues will be wired for privately ordered telephones and at the Meadowbank Sports Centre 280 press seats will have a system of telephone receivers which will allow the broadcasting of items of special interest to reporters. Each venue will also have its own Press Centre. Already more than 150 telephones have been ordered for these Centres—a figure likely to jump substantially before the July opening. Thirty teleprinters are being provided at the Meadowbank Sports Centre and a fully equipped telegraph office with two telex machines at Murrayfield Ice Rink. For the 200 still, colour and cine photographers a total of 25 4-wire picture transmission circuits will be available at the Main Press Centre, Meadowbank Sports Centre and Murrayfield Ice Rink for mobile picture transmitters.

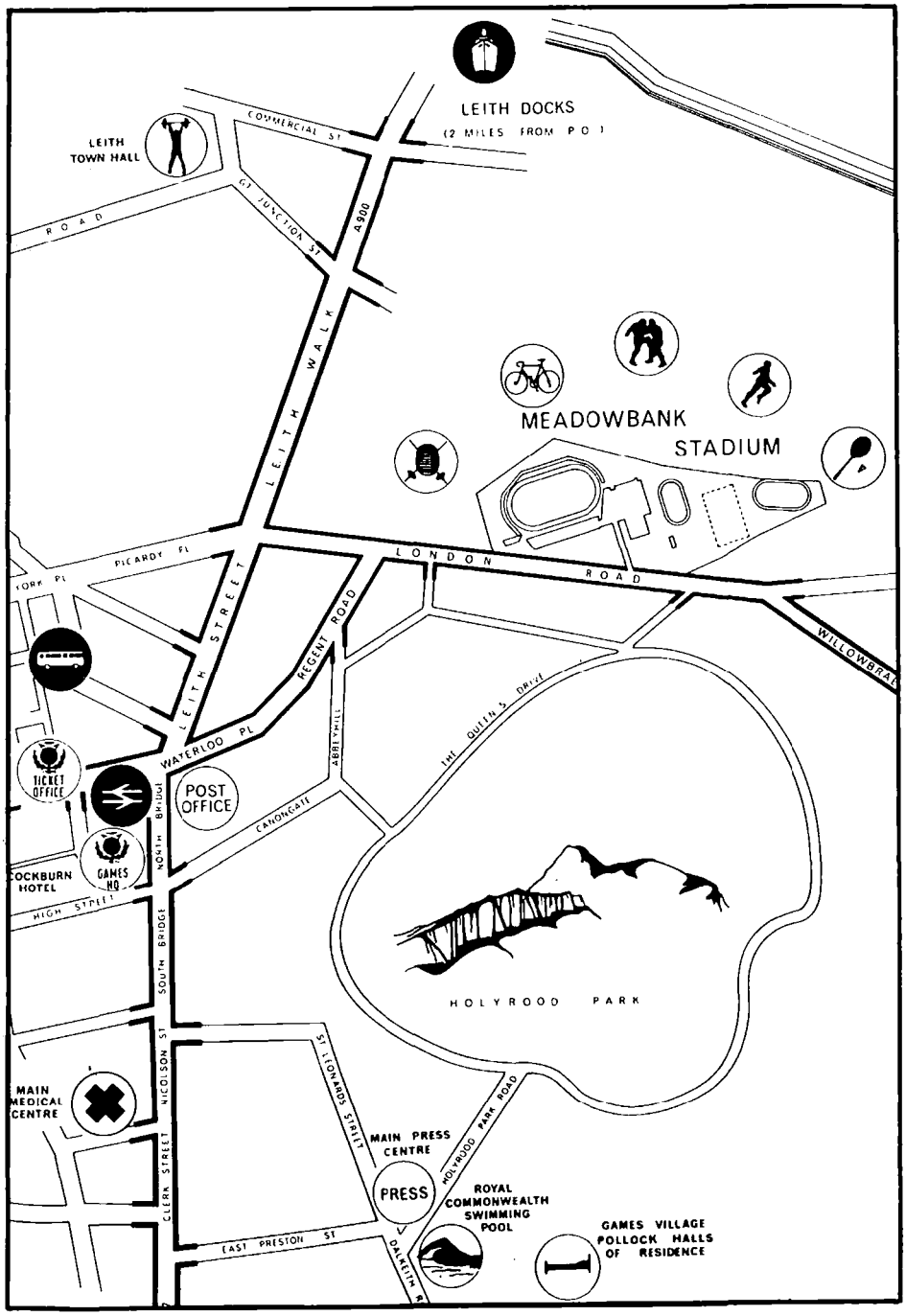
Since ITV are giving live coverage only to the opening and closing ceremonies and filming the remainder, their requirements are limited to video music and control links between the Meadowbank arena and their Edinburgh studio.

BBC on the other hand, with world-wide commitments, will have a lavishly equipped Control Centre and will be providing live radio and TV coverage of all sports. BBC will provide the TV micro-wave links between venues and their Centre. The Post Office will provide the main links, four video channels to London and two to the Kirk o'Shotts TV switching centre and 260 music and control circuits between the BBC centre, the venues and the BBC studios in Edinburgh, Glasgow and London. At Meadowbank all Post Office circuits will terminate in the Control Centre, the BBC wiring from this point to the commentary positions. At the other venues TV circuits will be terminated at the BBC mobile control units but all radio circuits will be taken to the commentary positions where a large number of Lamp-calling telephones will also be provided.

Service between Games Headquarters and the venues is given by Post Office staffed manual switchboards linked by an integrated private wire network to the Headquarters switchboard situated at the Rose Street trunk exchange about a mile away from the Headquarters building—an economic proposition because a 200-pair cable was available between the two points.

Throughout the 10-day event the Post Office will require to staff 17 switchboards, three special Games Post Offices, six telegraph offices and find attendants for seven suites of call offices. In addition, a special engineering maintenance control is being set up at Meadowbank Sports Centre to deal with any faults on the communications installations—both Post Office and non-Post Office. Arrangements are being made to organise loans of staff to augment the Edinburgh complement.

With only a short time left before the July opening pressure to get installations completed and working is building up to a peak. If all the plans are brought to their successful completion then not only will the Post Office have provided for the largest and most unique customer yet, it should do so with a negligible complaint rate.




**The locations of the Games centres. Outside this area is Murrayfield Ice Rink and the Balgreen Rinks which will house the boxing and bowling events.**

## THE AUTHORS

**Mr. W. N. Lang**, *is Controller Service for Scotland and in this capacity is chairman of the Commonwealth Games Communications Committee.*

**Mr. W. S. Ross**, *an STS in THQ Scotland, is full-time secretary of the Communications Committee and is responsible for co-ordinating the work of providing all communications requirements.*

# Latest Datel service twenty times faster

By D. R. MILLARD
and N. G. SMITH

THE Post Office is introducing this year a new high-speed data transmission service over which it would be possible to transmit the whole of the Bible in about sixteen minutes. The service will be known as Datel 48K because the basic facilities offered are for the simultaneous bothway transmission of binary data at a speed of 48,000 binary digits per second, twenty times as fast as any existing Post Office service.

The maximum data transmission speeds provided by the existing Datel services using Post Office modems are up to 1,200 binary digits per second (bit/s) over the public switched telephone network, and 2,400 bit/s over four-wire Post Office private telephone circuits. However, the ever increasing use of data processing techniques and computers, and the growing need to transmit computer information quickly from one point to another, has given rise to the need for a high-speed transmission service.

The Post Office is not only introducing a point-to-point Datel 48K service, providing private circuits for the exclusive use of specific customers, but is setting up at the same time a manually switched trial network. Initially, the trial network will operate between London, Birmingham and Manchester, and customers will be able to book time as they need it. If successful, the trial could lead to a regular service to cater for the needs of customers requiring only occasional or short duration 48 kbit/s connections and for whom the renting of full-time or part-time Post Office private circuits would involve excessive expense.

A major purpose of the trial is to give manufacturers the incentive to develop 48 kbit/s terminal equipment compatible with Post Office equipment. In all of the currently provided Datel services the facilities are provided jointly by the Post Office (transmission arrangements) and private suppliers (data terminal equipment). The successful functioning of the service therefore depends on good interworking between the Post Office and privately supplied equipment, and also upon the exact specification of requirements at the junction, or "interface", between these equipments. The use of the Datel 48K transmission facility, and in economic terms the measure of its success, depends upon the availability of data terminal equipment to interface with it. At the present time very little standard equipment exists and a significant amount of development work by data terminal equipment manufacturers will be required. To assist this development, manufacturers have been offered the use of the trial network free of charge for a period of six months.

The trial will also enable the Post Office to gain experience of the problems of transmitting 48 kbit/s data. Other benefits which could

**The manual switchboard at Telephone House, Birmingham, specially developed for the Datel 48K trial. Other switchboards are in London and Manchester.**

accrue from the trial are a boost in the use of Datel 48K facilities due to a more general availability of suitable data terminal equipment, and some indication of the traffic patterns generated by customers when transmitting at these high speeds. The latter could provide useful design information on which to base more advanced switched networks of the future.

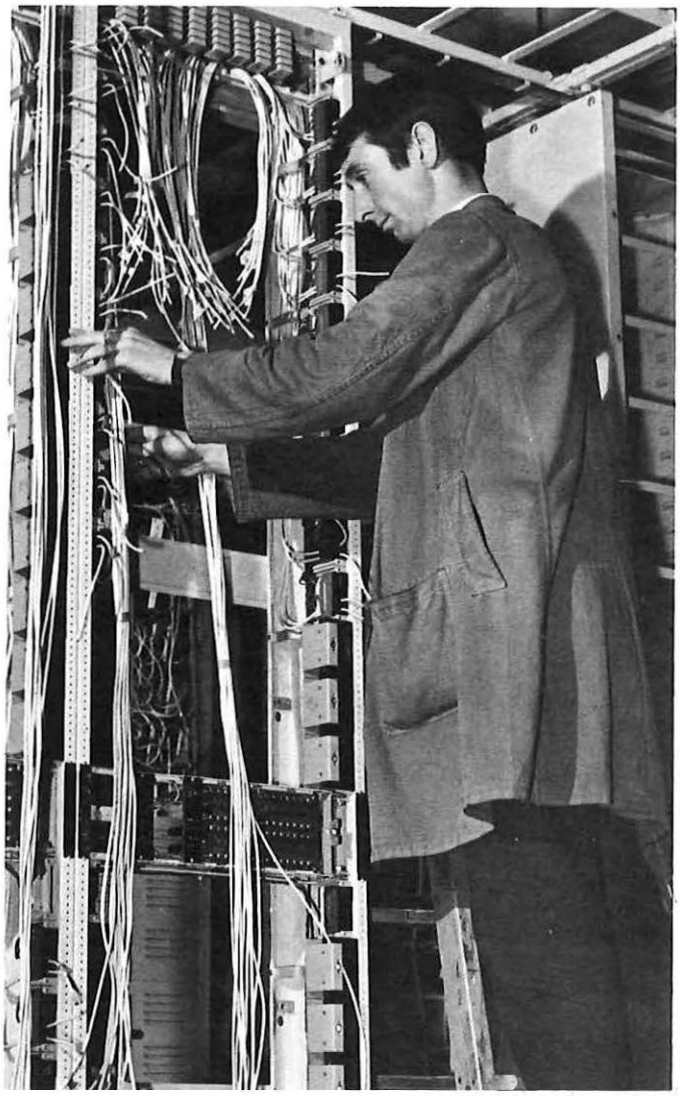
The purpose of this article is to describe briefly the manually switched trial network and the Datel modems. The specially developed manual switchboard and the switchboard operating procedures will be described in the next issue of the *Journal*.

Although a few customers are already using privately owned modems operating at 40·8 kbit/s on Post Office private circuits, little definite information is available regarding likely traffic patterns and customer usage for a switched network. It is thought, for instance, that call durations could vary between about one minute and two hours, and because of the various unknown factors involved, the planning of the trial network has been restricted to a relatively simple system requiring minimum development and production effort. However, it was decided that all aspects of the installations for the trial would be fully engineered and particular attention has been paid to the provision of a reliable service with full standby arrangements for the main network. Datel Test Centre facilities have also been provided.

The facilities offered to customers during the trial are for duplex (simultaneous bothway) transmission of 48 kbit/s isochronous binary data using Post Office modems, with an optional simultaneous speech circuit. Tentative rentals and tariffs have been prepared, and during the trial customers will receive dummy bills to enable them to assess the charges which would have been incurred on a fully charged service. A condition for participation in the free trial, however, is that customers will provide feedback to the Post Office on specific engineering and traffic matters.

Transmission of data at 48 kbit/s is not possible over normal speech-type circuits, particularly where bandwidth is restricted by loaded cables and multi-channel telephony equipment. On the main network, group links for the transmission of 12 telephone channels have a bandwidth of 48 kHz and cover the frequency range of 60-108 kHz. Arrangements can be made for these group links to have characteristics which are suitable for 48 kbit/s data transmission. An equipment known as the Datel Modem No. 9 has been developed which converts the data signal into a suitable form for transmission over the group links. While this arrangement solves the main network transmission problem the difficulty remains of how to convey the data signal between customers' premises and the repeater stations where the group link is normally terminated. One way would be to use special cables such as Cable Polythene Quad No. 4. This is an expensive solution and the alternative is to use the normal telephone exchange subscribers distribution cables.

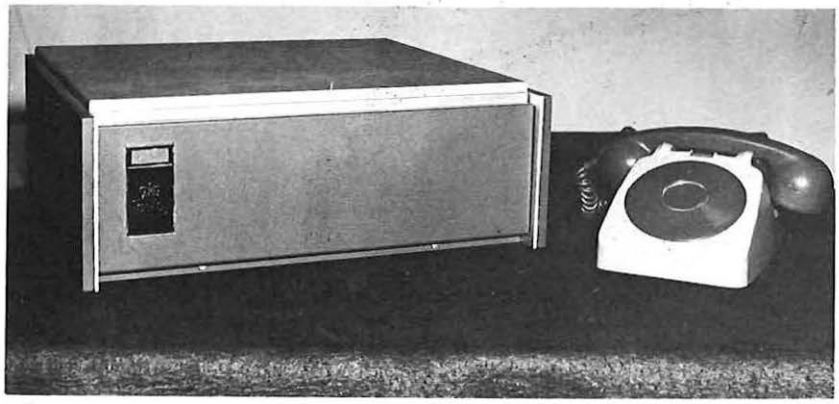
In order to make use of local distribution cable pairs, the 48 kbit/s data signal generated at the customers' premises is transmitted to line through an equipment known as Datel Modem No. 8. This equipment converts the signals from the customers' data terminal into a suitable

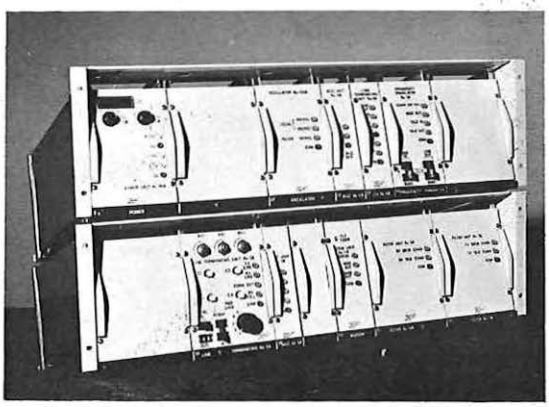


**Installation work in progress at the Birmingham HF terminal.**

*Below LEFT:*
**Datel Modem No. 8 which will be installed in the customer's premises.**

*Below RIGHT:*
**Datel Modem No. 9 for installation in a repeater station standard rack.**





electrical form for transmission over normal local telephone distribution cables. The action of an encoder in the modem ensures that the data signal contains many transitions, i.e. changes from binary 1 to binary 0 and vice versa. This makes it possible for the very low frequencies and any d.c component in the data signal to be suppressed without any great penalty. The encoded data with its d.c. component removed is referred to as a "suppressed d.c. binary" (sdcb) baseband signal.

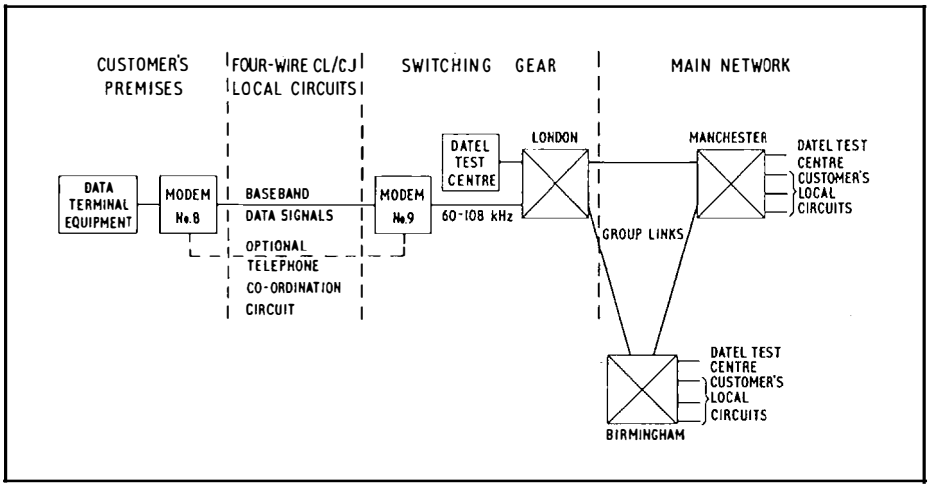
The Datel Modem No. 9 accepts the data signal from the local distribution cable and changes the frequencies making up the signal to those suitable for the telephone group link. For the technically minded the signal produced is a vestigial sideband, amplitude modulated, suppressed carrier signal. The carrier frequency used in the modulator is 100 kHz. At the receiver information about the carrier frequency used at the modulator is required to recover the original data signal. Arrangements are therefore included in the modem for the carrier to be injected into the line signal at a power level equal to about $\frac{1}{10}$ of the total power transmitted. The suppression of the d.c. component in the Datel Modem No. 8 assists the functioning of the receiver in the Datel Modem No. 9 and could be done at the input of the modulator in the Datel Modem No. 9. For convenience it is included in the Datel Modem No. 8 and allows the modems to be transformer coupled to lines. It may also help later in the design of junction transmission facilities.

Initially, the Network will comprise three fully interconnected switching centres which will be located in London, Birmingham and Manchester. The specially developed manual switchboards are sited in auto manual centres at each switching centre and the associated transmission equipment, including the Datel Modems No. 9, is installed in nearby repeater stations. The transmission path between the centres is provided by a 60-108 kHz group link which is routed in a through-supergroup to minimise transmission distortion. In addition to the main group link a dedicated standby has been provided between each centre. In exceptional circumstances it may be desirable to establish a connection indirectly through the third switching centre. To cater for tandem connections of this type a facility which comprises back to back Datel Modems Nos. 8 and 9 has been provided at each switching centre and is cabled to the switchboard. It is known as a link circuit.

The basic equipment at the customers' premises consists of the Data Terminal Equipment and the Post Office Datel Modem No. 8. Data transmission between the customers' terminal and the local switching centre is provided by normal telephone distribution or junction cable plant, and for this reason the location of participants in the trial has been restricted initially to within a nominal $1\frac{1}{2}$ miles radius of the switching centres. At the repeater station the data channel together with the telephone channel, if provided, are frequency translated into the 60-108 kHz band for transmission to the switchboard and then over a group link to the distant switching centre. Amplifiers are provided in the repeater station in the connections to the switchboard to raise the switching level and thereby reduce the effect of noise interference which might be introduced in the switchroom. The repeater station equipment includes spare modems and amplifiers for maintenance replacement purposes. The Datel Test Centre is provided with a Datel Modem No. 8 and all equipment necessary to enable tests to be made to customers and also to the Datel Test Centres associated with the other switching centres.

The planning and provision of this relatively small network has involved, either directly or indirectly, many departments of THQ including Network Planning, Telecomms Development, Service, Marketing, Telecomms Finance and Purchasing and Supply and also the Staff Associations and the engineering and service divisions of the London, Midland and North Western Telecommunications Regions.

The initial planning and development has been largely completed, but a considerable effort will now be required to make effective use of the trial period from both the Post Office and customers point of view.




**An outline of the Datel 48K network.**


**THE AUTHORS**

**Mr. D. R. Millard** *is an Executive Engineer in the Data Systems Planning Branch of the Network Planning Department. He joined the Post Office in 1937 and spent a number of years in Radio Branch at Headquarters and Dollis Hill.*

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# First direct cable to Spain

THE Post Office is to lay a new submarine cable between Goonhilly in Cornwall and Bilbao. It will be the first direct cable between Spain and the UK and will pave the way for the introduction of International Subscriber Dialling between the two countries.

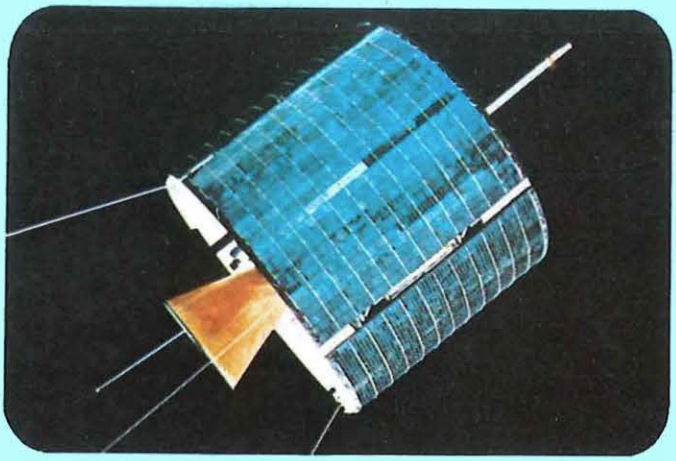
The cable, 477 nautical miles in length, will be laid by a Post Office cable ship. It will be capable of carrying 640 high-quality (3 kHz) conversations. A total of 51 transistorised repeaters will be laid at equal intervals along the cable. Ready for Service date is scheduled for 1 September this year.

The contract for the manufacture of the Post Office designed cable has been placed with Standard Telephones and Cables Ltd. and is worth a total of £2.5 million. The Post Office's contribution will be just over £2 million.

The Post Office has also purchased from the American Telephone and Telegraph Co., (AT&T) rights in 116 telephone circuits in the new USA-Spain submarine cable (TAT 5) to be used in conjunction with circuits in the UK-Portugal cable in which AT&T have purchased rights from the Post Office.

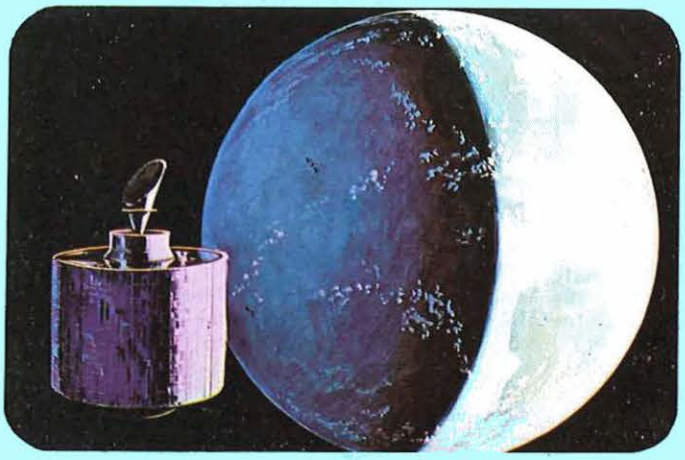
The two cable landing points in Spain and Portugal will be connected by a microwave system extension of TAT 5. Completion of TAT 5 enables these circuits to be brought into use to provide for the growth in demand until the new high-capacity Intelsat IV satellite comes into service over the Atlantic, scheduled for early next year.

# 5,000-LINE EXCHANGE FLOATING IN SPACE

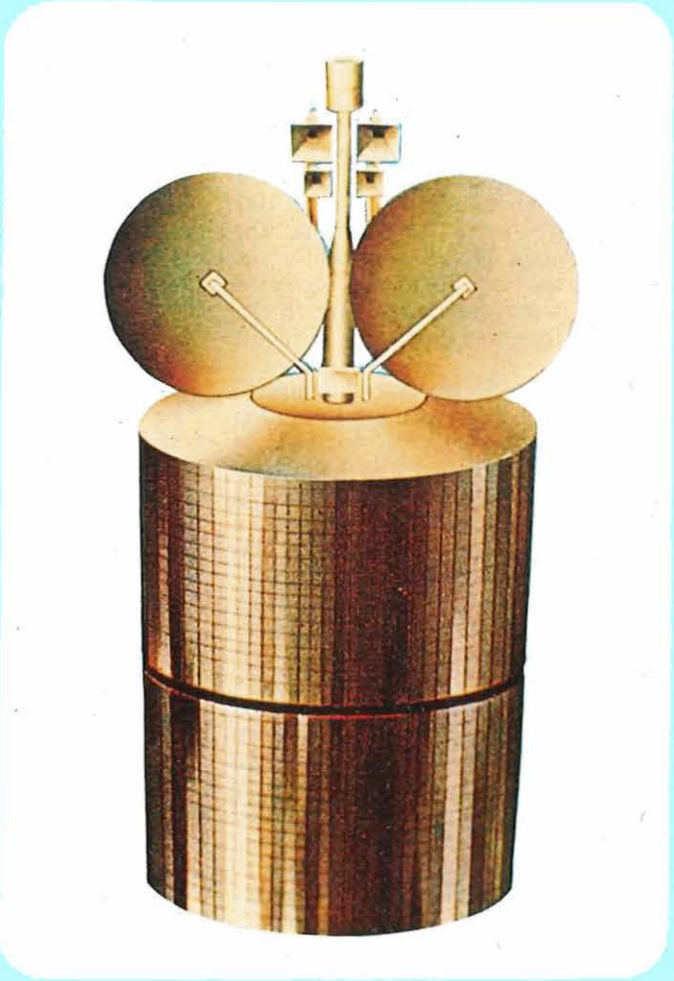


INTELSAT I (EARLY BIRD)—1965
Coverage: N. Atlantic area
Diameter: 28.4 inches
Solar drum height: 23.25 inches
Weight: 150 lb at liftoff
85 lb in orbit

INTELSAT II—1967
Coverage: Atlantic and Pacific basins
Diameter: 56 inches
Solar drum height: 26.5 inches
Weight: 357 lb at lift-off
192 lb in orbit



INTELSAT III—1968
Coverage: global system
Diameter: 56 inches
Overall height: 78 inches
Weight: 632 lb at lift-off
322 lb in orbit



INTELSAT IV—1971
Coverage: global system
Diameter: 93.5 inches
Solar drum height: 111 inches
Overall height: 17 ft 6 inches
Weight: 2,452 lb at lift-off
1,075 lb in orbit

INTELSAT IV, the largest civil communications satellite in size and capacity, will be launched into space early next year. It is the latest in the line of such satellites which have revolutionised telecommunications around the world. To work to it, the Post Office is to build a third tracking aerial at the Earth Station at Goonhilly Downs in Cornwall.

Intelsat IV will have a capacity far greater than any of the communications satellites now in operation. It has been designed to carry more than 5,000 two-way telephone calls or transmit 12 simultaneous colour TV broadcasts or any equivalent combination of different kinds of transmissions.

Four Intelsat IV satellites are currently being built and four more are on order. The first—scheduled launching date January 1971—will be put into synchronous orbit 22,300 miles above the Atlantic Ocean and subsequent launchings will eventually provide two Intelsat IVs for the Atlantic and Pacific regions and one for the Indian Ocean, plus spares in orbit. The first five should all be launched within the next three years.

A unique feature of the new satellites will be an ability to focus part of the total capacity into two spot beams and point them at selected areas, providing a stronger signal and thus more channel capacity for areas of heaviest communications traffic. For trans-Atlantic transmission the beams could be aimed at Western Europe and the Eastern United States.

This is made possible by having two steerable dish antennae on the satellite which can be controlled on command from earth. Two other antennae will be carried on the satellite to provide communications coverage outside the areas encompassed by the spot beams. Electronic switching will enable ground controllers to adjust the amount of power going into each of the two antenna systems.

The Post Office's Goonhilly 3 aerial is to be built to keep in step with Intelsat IV advances which require different methods of aerial working from those used for the current Intelsat III satellites. It will also help to cope with the rapid expansion of traffic across the Atlantic—now increasing so fast that even without Intelsat IV a third aerial would still have been needed at Goonhilly.

The alternative was to take an existing aerial out of commission and refurbish it for working to Intelsat IV. This would take from one to three months, and with such a huge demand for service and earning potential currently estimated at about £100 a minute, such a step could not be contemplated.

Later, the existing Goonhilly aerials will be refurbished one at a time for working to the Indian Ocean Intelsat IV and the second Atlantic satellite. Until then the existing aerials will continue working to the Intelsat III satellites.

The Intelsat IVs are being built for the International Telecommunications Satellite Consortium (Intelsat), of which the Post Office is a major partner, by the Hughes Aircraft Company of America in collaboration with the British Aircraft Corporation and Ferranti Ltd. in Britain and with other European aerospace companies.

**Standing beside a model of Intelsat IV, and emphasising the size of the biggest civil telecommunications satellite in the world, are some of the international team who are playing a part in the construction and launching of the first operational model. A dozen companies in ten different countries, including Britain, are participating in the making of the Intelsat IV series of satellites.**

**A City broker presses the push-button remote control unit on the desk in his office to select one of the 20 television channels available to show the latest Stock Exchange prices. This service is only one aspect of a huge private communications system which the Post Office has provided for the new Stock Exchange. More than 6,000 telephones have been fitted and a "paging" system has been provided so that members can be called to the phone quickly. An article dealing with these aspects of Stock Exchange communications will appear in a subsequent issue.**

# TV service for brokers

By P. C. CRANMER and J. C. JESSIMAN

THE Post Office has set up one of the first television networks in the world capable of transmitting 20 TV pictures simultaneously over one coaxial cable. Installed and commissioned by London Telecommunications Region, it links the new 27-storey London Stock Exchange, which opened in February, to over 200 of its members' offices within the City. At the touch of a button, brokers can flash onto a TV set in their offices up-to-date prices of more than 700 stocks and shares and the latest news and information on such matters as commodities and exchange rates.

At the heart of the system is a computer, installed nearly a mile from the Stock Exchange building, which provides the memory store for the constantly fluctuating market prices. On average, £125 million changes hands every day in some 25,000 transactions involving nearly 10,000 stocks and shares which continuously change in value.

Previously, to keep in touch with these fluctuations, brokers had to contact specialist "jobbers" on the floor of the Stock Exchange. Now information is fed to the computer from eight keyboards on the Exchange floor. Television links from the computer back to the Stock Exchange allow the keyboard operators to check the accuracy of this information

**An engineer lines up the equipment which routes the TV signals.**

**Receiving equipment is commissioned in an office building.**

before it is passed to one of the computer's 20 memory stores. These 20 sets of information are then transmitted simultaneously to members' offices where each TV receiver has a remotely-controlled 20-channel selector so that members can select any of the pictures at will.

The Post Office task was to provide all the inter-computer connections. The job was unique in that a 20-channel operation had never been attempted before. Previously, seven channels had been the maximum. LTR, in fact, took only 12 months to instal and commission this TV system.

Distribution of the 20 channels to the 200 subscribers could have been accomplished in several ways. Twenty separate low-grade, high frequency cables, each carrying a single channel would have provided the simplest solution. A single high-grade, high frequency cable carrying a 20-channel carrier system was the most sophisticated answer. Extensive studies by Telecommunications Headquarters showed that single cable working was the most economic. It also occupied the least duct space, a vital consideration in the congested City of London area. Because insufficient time was available to design special equipment, proprietary equipment which could be adapted to meet the requirements was used.

To enable the use of standard receivers, modulators providing a normal broadcast signal were required. These employ restricted double sideband (vestigial) transmission and assemble the 20 complete TV pictures into separate 8·5 MHz channels in the frequency band 45-220 MHz. An 8·5 MHz spacing is satisfactory for the Stock Exchange network because vision only, and no sound signals, has to be transmitted. The TV pictures are produced by the use of character generators associated with the computer which convert the digital information from the computer to Alpha/Numerical form for display on normal TV receivers. The synchronising and blanking signals to operate the receivers are also inserted by this equipment.

A coaxial cable of 0·620 inches diameter has been developed for the closed-circuit TV system for London schools capable of carrying the 45-220 MHz bandwidth. It had the disadvantage that it used solid polythene insulation, making it difficult to bend or joint. As a result, large sweeping bends had to be employed and the joints, made by an injection moulding process which required considerable skill, took four hours to complete.

The proprietary amplifiers used were installed at 500-yard intervals. Unsuitable for damp locations, they resulted in the system being designed in a way which allowed all amplifiers to be installed in subscribers' premises. This introduced considerable legal difficulties in negotiating "wayleaves" for their installation in safe but accessible sites. Each installation comprises a tandem amplifier to feed the next section, a terminal amplifier for local distribution and a mains unit supplying 13 volts direct current for the amplifiers.

A maintenance engineer adjusts Post Office sending equipment.

Many problems arose during commissioning. Parking permits had to be obtained daily from the City of London police, but the bulky test equipment still had to be carried by hand from site to site. In addition, the amplifiers, although provided with switched equalisation, had to be supplemented by "tailor made" equalisers fitted at frequent intervals. The communication that was essential between commissioning engineers was provided over the TV cable by modifying the "Carrier Telephones" that had been designed by LTR for use on the Educational TV network.

The main headaches, however, were caused by delay in completing the accommodation for the Post Office to house the 20 modulators and associated sending equipment. To overcome this setback, which was beyond Post Office control, all the equipment was pre-wired by City Area and the tested racks installed when the accommodation was available. Unavoidable delays in the construction of new manholes hindered cabling progress and the final commissioning time as a result was reduced from 16 to eight weeks. Despite this, the system was operational by the end of June last year—the target date. Following completion of system tests in conjunction with the computer programming, it was fully operational for the opening of the new Exchange building in February.

Many local extensions of the scheme are anticipated. Already, over 20 orders have been received from firms within the City of London who are anxious to participate. Extensions outside the City have also been requested, but these will require the development of waterproof amplifiers suitable for manhole mounting.

Stock Exchanges in other cities may also be interested and could be served by data links from the main London computer. Data to Alpha/Numerical translators would then feed a network similar to that in London.


**THE AUTHORS**

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**Mr. J. C. Jessiman** *joined the Post Office in Bristol in 1952. For the last 18 months he has been an AEE in the London Telecommunications Region Headquarters Group responsible for closed-circuit TV installation and commissioning.*

# THE COMPUTER EXCHANGE

By A. C. COLE

**"The development of the technique of traffic simulation by computer in recent years has revolutionised traffic engineering and has come, fortunately, at a time when switching techniques are becoming more and more complicated"**

THE problem of determining the amount of traffic which a telephone exchange can handle at the given grade of service is of fundamental importance. Upon its solution depends the correct dimensioning of the telecommunications network which is vital to economic operations coupled with good service. It is also a major factor in the design of new systems of switching.

In most applications the problem is too complex to be solved by mathematical analysis alone. Although, in principle, it is possible to visualise a set of equations which express the probabilities of the exchange being in certain states (i.e. with a certain number of calls in progress using specific paths, and with the probabilities of new calls arising and of calls in progress clearing down) in reality the number of equations would quickly become too large for the analyst to enumerate, let alone solve, even with the aid of the largest digital computer in existence.

In the past traffic engineers have had to rely upon basic traffic theory supported by empirical studies of the behaviour of traffic in practice, and the latter are rarely satisfactory. However, the development of the technique of traffic simulation by computer in recent years has revolutionised traffic engineering and has come, fortunately, at a time when switching techniques are becoming more and more complicated.

For certain types of systems, e.g. the Strowger system, it is possible to split the exchange into a number of small blocks or units whose traffic capacities can be determined separately and then can be used to determine the traffic capacity of the whole. Most new and developing exchange systems, however, use a method of selection in which the switches of several serially arranged switching stages are seized only if a path can be set up from the calling inlet (e.g. the caller or incoming junction) to an outlet of the objective group (called subscriber or outgoing junction). Even the smallest block which can then be considered is too large for solution by mathematical methods so far available.

By computer simulation of a switching system we mean the writing of a computer program which firstly describes the logical structure of the network, and then generates sequences of random numbers representing the instants of time when calls arrive and the holding times of the various pieces of equipment in the system under study. By applying one to the other the operation of the system in practice is simulated, and the ability of the system to carry traffic at various levels of loading can be measured.

To simulate a switching system therefore a number of activities are necessary. The system must be studied to determine which features of its topology and methods of functioning are relevant to the problem. Then the operation of the part of the switching network to be studied must be transformed into a computer program. For this purpose it must be broken down into a number of separate events which are assumed to be instantaneous in time, for example, the initiation of a call, the seizure of a register, and so on. For each of these actions a section of computer program must be written which describes logically the functions to be simulated. In general, the more details considered necessary the greater the storage capacity required in the digital computer and the slower the execution time of the resultant programs. For example, the program which simulates the Strowger grading described later required 3,000 words of computer storage and processes one call every 30 milliseconds, whereas a program which has been written to simulate the main feature of the TXE No. 4 electronic exchange systems requires some 30,000 words and processes one call about 700 milliseconds.

To be able to execute an event-by-event simulation, a schedule of future events must be compiled by the computer as it goes along. This is a list which contains the times at which future events are to occur, and, for each event, a sub-list of any parameters which have been preselected to be associated with that event. Thus, if the event is the release of a call, information must be stored identifying the paths through the exchange made busy by the call so that they may be set free at the correct time. Such a list of events is called a "directory". Furthermore, it must be possible for the computer to manipulate the list so that new entries may be made and used entries deleted, and to re-arrange the list to ensure that events are dealt with in the proper order.

The concept of time is inherent in such simulations. Accordingly, there

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 8 | 9 | 24 | 25 | 32 | 33 | 36 | 37 | 39 | 40 |
| 7 | 10 | 23 | | | | | | | |
| 6 | 11 | 22 | 26 | 31 | | | | | |
| 5 | 12 | 21 | | | | | | | |
| 4 | 13 | 20 | 27 | 30 | 34 | 35 | 38 | | |
| 3 | 14 | 19 | | | | | | | |
| 2 | 15 | 18 | 28 | 29 | | | | | |
| 1 | 16 | 17 | | | | | | | |

Fig 1a O'dell grading: availability (k) = 10, groups (g) = 8, trunks (N) = 40.

| VALUE OF GROUP | VALUE OF CHOICE 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 8 | 9 | 24 | 25 | 32 | 33 | 36 | 37 | 39 | 40 |
| 7 | 7 | 10 | 23 | 25 | 32 | 33 | 36 | 37 | 39 | 40 |
| 6 | 6 | 11 | 22 | 26 | 31 | 33 | 36 | 37 | 39 | 40 |
| 5 | 5 | 12 | 21 | 26 | 31 | 33 | 36 | 37 | 39 | 40 |
| 4 | 4 | 13 | 20 | 27 | 30 | 34 | 35 | 38 | 39 | 40 |
| 3 | 3 | 14 | 19 | 27 | 30 | 34 | 35 | 38 | 39 | 40 |
| 2 | 2 | 15 | 18 | 28 | 29 | 34 | 35 | 38 | 39 | 40 |
| 1 | 1 | 16 | 17 | 28 | 29 | 34 | 35 | 38 | 39 | 40 |

Fig 1b Contents of the array ENTRY [1:8, 1:10]

| | |
|---|---|
| 1 | 0 |
| 2 | 1 |
| 3 | 1 |
| | |
| | |
| 39 | 1 |
| 40 | 0 |

Fig 1c Contents of the array TRUNKS [1:40]

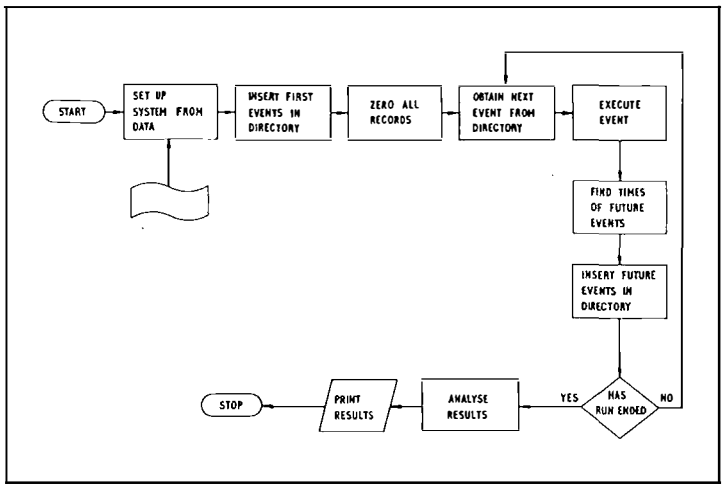



Fig 2a Flow chart showing a simulation in outline.

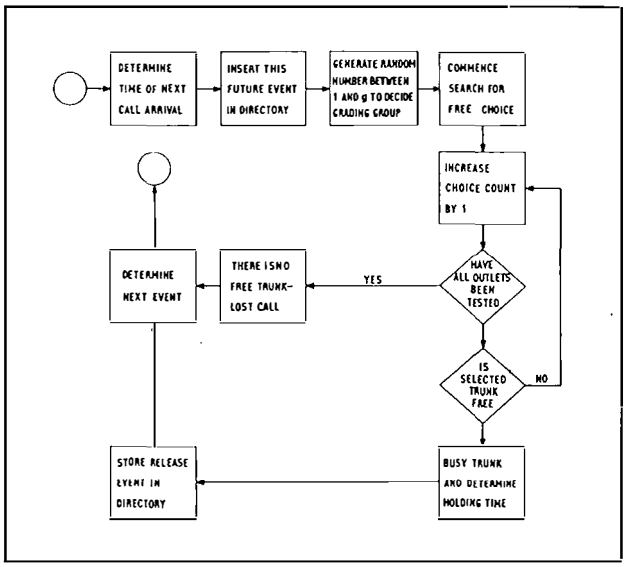



Fig 2b The sequence of logical steps in setting up a call.

must be a "clock" stored in the computer which records the passage of time. The clock can function in one of two ways. Firstly, time can be advanced in unit steps in exactly the same way as a pulse-operated electric clock; in this case, each time the clock moves forward the list of future events is searched and all those whose time of execution is current are performed. Secondly, the clock can be made to move forward to the time at which a given event is scheduled to occur; then all events having this time will be performed by the computer. Both techniques have advantages depending on the characteristics of the simulated models.

The switching network consists of a number of switching stages with groups of paths or trunks between each stage. In many problems the interest arises in knowing whether or not a given path is busy or free, that is, the path is a two-state device and its state can conveniently be represented in the computer by using either one "word" or one bit of a word to represent the path, and writing into it a 1 or 0 to indicate the condition, busy or free.

Thus, in determining the efficiency of a grading of the type commonly used in our Strowger exchanges we have to be able to store the states of occupation of the trunks of that grading. Fig. 1a is the conventional way of representing an O'dell grading, currently used in Strowger, with availability (k)=10, groups (g)=8, and trunks (N)=40. A call which is offered to group 3 may hunt over trunks 3, 14, 19, 27, 30, 34, 35, 38, 39 and 40 in search of a free one. If now we store in the computer a two-dimensional array of numbers (called ENTRY) as shown in Fig. 1b we can find the sequence of trunks to be tested by reference to it. The contents of this array must not be changed during a run since it is a computer representation of the physical make up of the system. We shall also require a second array of 40 words, (called TRUNKS) Fig. 1c, in which the states of the trunks can be stored. The contents of this array will change during the course of the simulation since it represents the conditions of the trunks, busy or free. At the start of the simulation all the trunks in the grading will be free so that all the locations of the array TRUNKS will contain 1's or 0's according to which has been chosen to represent the free state. To study the behaviour of the grading when offered traffic, we must look at the array TRUNKS at randomly chosen instants of time which represent the times of arrival of calls. This is done by generating a sequence of random numbers which represent the time intervals between successive calls.

The way in which the simulation works is for the computer to make an initial reference to the directory to find which section of program is to be executed first. During this operation new entries may be added to the directory by the computer. For example, if this section is for the initiation of a call demand, the time of the next arrival will be generated and information will be stored in the directory to show that at the time of the next arrival the section of program now being dealt with is to be entered once more. When execution is complete reference will be once more made to the directory to decide what shall be done next. This process will continue until the run is completed. Fig 2a shows in outline a flow chart for a simulation and Fig. 2b shows in greater detail the sequence of logical steps in setting up a call in the grading of Fig. 1.

During the course of the run statistics are accumulated, and when the prescribed time has elapsed and the run ends they are printed out. An example of the information to be obtained from a simulation study in the grading of Fig. 1 is shown in Fig. 3. Since a simulation is by its very nature an experiment, there is no such thing as an exact result and the results must be subjected to statistical interpretation.

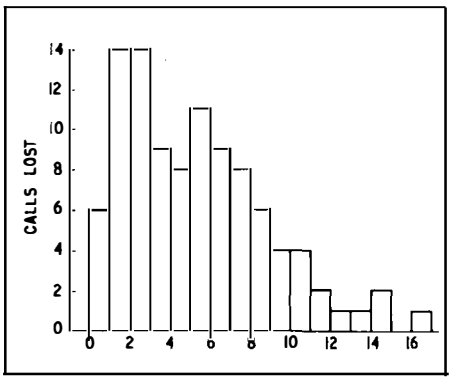
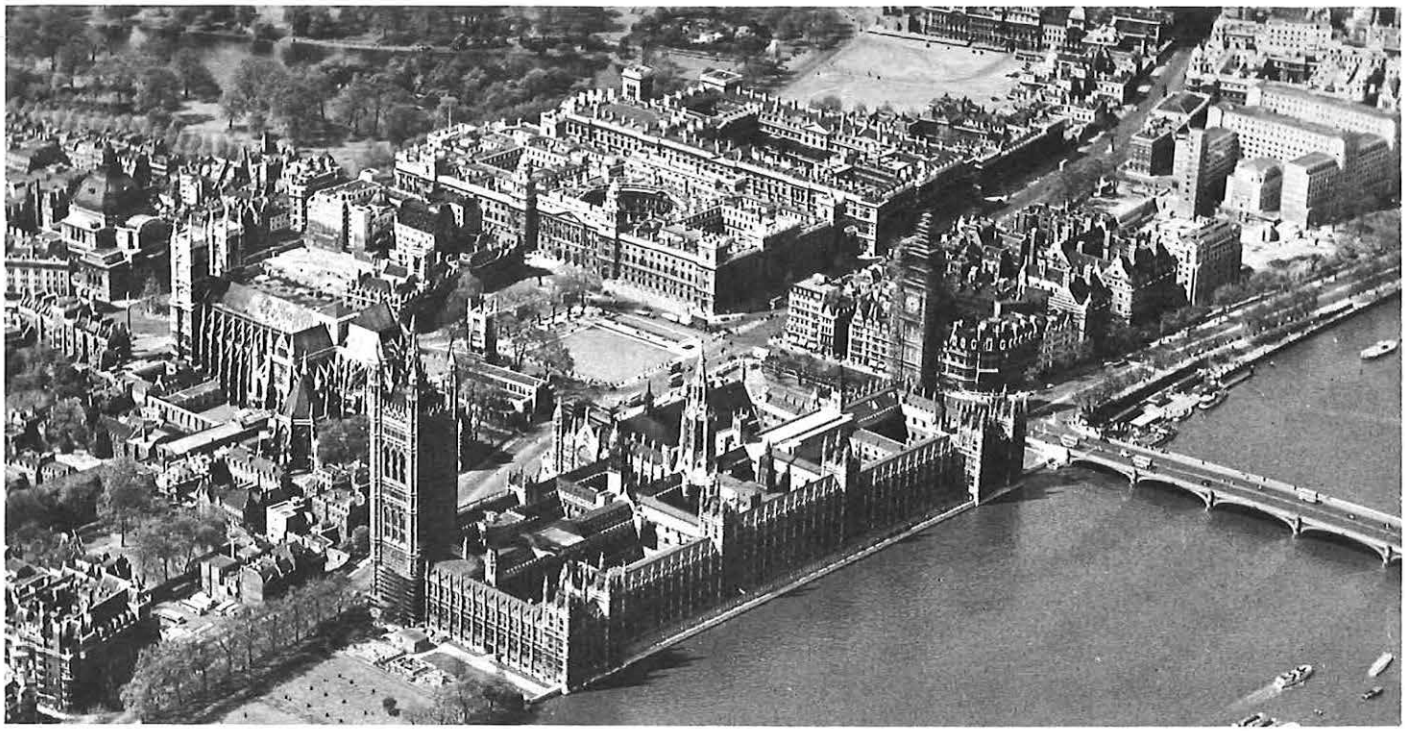



Fig 3 An example of the information obtained from a simulation study—the number of calls lost in each simulated hour. Mean number of calls lost = 4.8.

Computer simulation is a powerful aid in the evaluation of switching networks, but it is also demanding in the time required by the traffic engineer to analyse the system, to write and develop the program and to interpret and evaluate the results of the simulation. For example, a proposal for the Cordless Switchboard System No. 2 which is being examined at the present time required some six man-months for writing and developing the program. In addition to its value in the assessment of the traffic capacity of a switching network, simulation is of great assistance in the study of the behaviour of networks under fault conditions, e.g. the failure of part of the sectionalised control of a TXE 4 system or the removal of an early choice trunk in a grading. It can also be used as an aid to efficient design of new switching systems as in the optimisation of matrix sizes and of the number of switching stages.


THE AUTHOR

**Mr. A. C. Cole** *leads the traffic theory section in THQ Development Department. He joined the Post Office as a Clerical Officer in 1938 and for the last 15 years has worked on traffic problems.*



# New telephone network for Whitehall area

By P. J. HAVILLE

THE Post Office has embarked on a massive reorganisation scheme of the telephone network in Whitehall to meet the greatly increased demands expected over the next twenty years. The new network of private automatic branch telephone exchanges (PABXs) will link Government offices in the Whitehall area with one another, with Government offices elsewhere and with the Houses of Parliament. The replacement of the present largely manually-operated system will take several years to complete, and is one of the largest modernisation projects of its kind to be carried out in the United Kingdom.

Since the war telephone usage in Whitehall has rocketed. At the Palace of Westminster, for instance, the average number of calls on a day when the Lords and Commons are in session rose from 6,051 in 1957 to 13,134 a day in 1967—more than double in ten years. At this rate of increase, the existing telephone service, already heavily over-burdened, would not be able to cope beyond 1972.

The new PABXs will be connected to a central automatic tandem exchange enabling any telephone extension in the Whitehall scheme to be connected to any other by dialling or keying not more than seven digits. A caller from any telephone outside the network, if he knows the extension number, will be able to dial it directly without having to contact a switchboard operator. The Government's telephone bill will be less than it would be if the present system were continued, whilst the users will have a faster and more reliable service.

The scheme will be split between two stages of which the first, covering about 30,000 telephone extensions, will be completed by about 1973 and will cost between £2 million and £3 million. The first four PABXs, serving 10,000 extensions, will use modern but conventional electro-mechanical equipment with dial telephones. Subsequent exchanges in the first stage will in the main be crossbar type with keyphones—push-button telephones. Some keyphones are already used in this country in association with private branch exchanges belonging to large firms. The Whitehall system, however, will introduce for the first time the 12-button keyphone. In addition to the ten push buttons for numerals this has two in reserve for additional facilities should they be needed later.

The replacement of the manual exchange at the Palace of Westminster will enable a number of facilities to be introduced. MPs absent from their offices—as they are likely to be most of the time the House is sitting—will be able to divert their calls to a central enquiry desk, and a lamp on each Member's telephone will tell him when a call had been received in his absence. The message can then be picked up by the Member.

The project began in 1964 when a joint Study Group from Post Office Headquarters and London Telecommunications Region was set up to plan an extension of the Ministry of Defence PABX at Whitehall Gardens, and went on to examine the requirements for the introduction of what is now known as the Whitehall Government CBX (Central Branch Exchange) scheme. The basic aim was to design a more flexible system of communications than that given by the mostly manually operated PBX network in the Whitehall area. The new system would be one which could cope readily with the rapid growth and the frequent changes in the locations of

staff and accommodation in the Whitehall area.

Most of the major Departments of State, whose telephones amount to 90 per cent of all those in and around Whitehall, lie within approximately 1,000 yards of Big Ben and, together with the Prime Minister's Office and the Palace of Westminster, form the major part of the Central Government of the United Kingdom. The 34,000 PBX extensions in service in this area today are dependent upon the services of 600 Post Office operators and the annual charge made by the Post Office to the Civil Service in respect of operator services exceeds £¾m. The 45 major PBXs are interconnected by a criss-cross maze of private wires that has grown up over the years and which lends itself to considerable pruning and rationalisation. In all, more than 1,000 private wires are connected to the departmental PBXs, excluding the MOD network.

The burden of the Study Group's report then was to recommend the gradual replacement of the largely manual telephone system in an area with a radius of about 1,000 yards from Big Ben by an integrated automatic system consisting of some 15 PABX4 installations connected to a private wire (PW) and direct dialling in (DDI) tandem exchange. It was predicted that this would reduce the total annual bill to the Exchequer by about one fifth, due mainly to savings in the number of telephonists employed. Each PABX would be planned to serve all departments in one building or, more usually, a group of buildings within a defined area, so that as departments moved between buildings and areas they would receive service from the appropriate PABX. Thus, each of the PABXs could be looked at as a CBX, a central branch exchange.

Following customer acceptance of the scheme it was launched operationally under the title of LTR Project 42 in South Central Area where the Telephone Manager, Mr. G. E. Brett, is the Project Manager. The Project Team consists of 12 members representing Area, Regional and THQ interests.

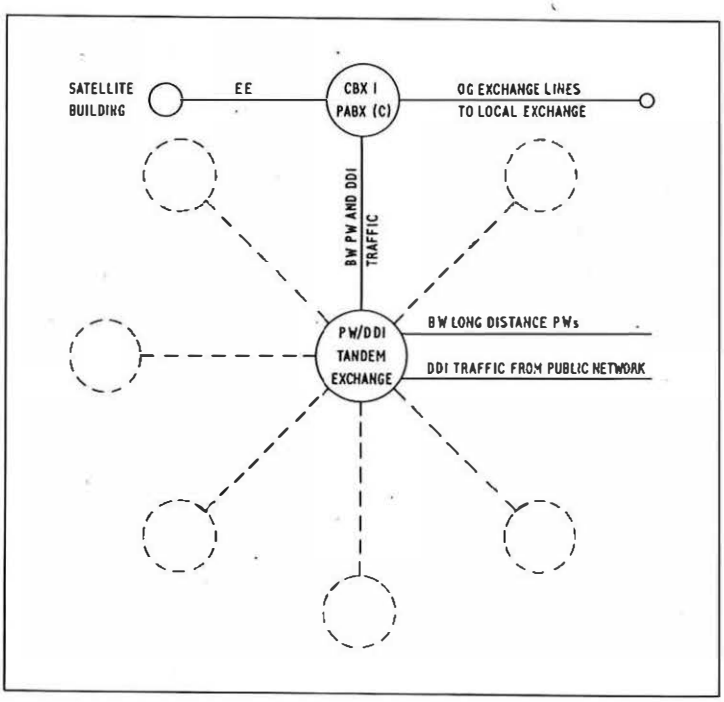
The first task was to map all the departmentally-occupied buildings in the area, whether they were Crown-owned or leased, and having done this to divide the area into portions suitable for the individual CBXs. For planning purposes a penetration of one PBX extension per 100 square feet of net clerical working space was used, which today gives a potential of 73,000 PBX extensions expected to be in service in the 80 buildings by the mid 1980s. Negotiations were opened with the Ministry of Public Building and Works to get more than 100,000 square feet of accommodation set aside for CBX purposes. To add to MPBW problems, as much of the space as possible was to be above ground in receipt of direct natural light; where below ground accommodation was unavoidable this was to be made as pleasant as possible for the staff who would have to work there. With so many competing claims for accommodation in such a densely populated area we were fortunate indeed to obtain wholehearted support and, except for some accommodation required at the Northern end of Whitehall, we have been allocated all we need.

The first CBX to go into service will be a small one opening with 1,200 extensions and serving Employment and Productivity and a section of the Foreign and Commonwealth Office in the St. James's Square area. The first phase of the PW/DDI tandem exchange, to be known as Horseferry Tandem, will open at the same time in mid-1972 and a few months later the Palace of Westminster PABX will be brought into service. The latter is not a CBX as it serves no other user, but it will be integrated into the CBX scheme via Horseferry Tandem.

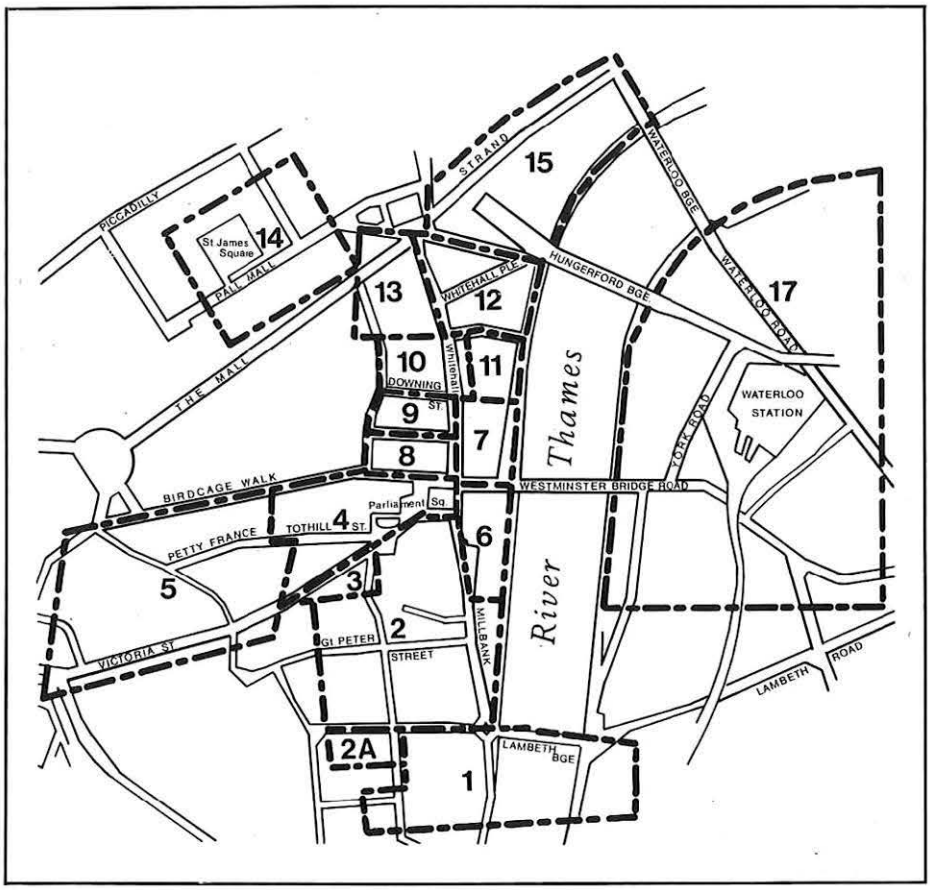
In several instances the operators' consoles and the automatic equipment will be separated in different buildings. At the Palace of Westminster, for instance, where there are severe accommodation limitations, consoles will be installed in the present manual switchroom on the third floor of the Palace while the automatic equipment will be housed below ground about 600 yards away behind Parliament Square. At this same below-ground site we shall be able to install the

**Engineers check on the cable layout at the Palace of Westminster where installation work on part of the Whitehall scheme has already started.**

**A diagram outlining the CBX system.**



**A prototype of the push-button telephone being supplied by the Plessey Telecommunications Group.**




**This diagram shows the 17 different areas into which Whitehall has been divided to facilitate the introduction of the new network. Some PABXs have been grouped together in one location outside the area they serve.**

| *Area* | *Present Main Users* | *Potential Extensions* | *Location of PABX* |
|---|---|---|---|
| **1** | Mintech. MPBW | 6,840 | Cleland House |
| **2** | Home Office | 7,290 | Marsham Street |
| **2A** | Min. of Ag. | 1,530 | Gt. Westminster House |
| **3** | Board of Trade | 2,230 | Victoria Street |
| **4** | Min. of Housing & Local Govt. Dept. Health & Social Security | 3,840 | Broad Sanctuary |
| **5** | Min. of Housing & Local Govt. | 6,580 | Marsham Street |
| **6** | House of Commons | 2,500 | Broad Sanctuary |
| **7** | Foreign & Commonwealth Office | 4,700 | Bridge Street |
| **8** | Treasury | 5,220 | Broad Sanctuary |
| **9** | Foreign & Commonwealth Office | 4,620 | Broad Sanctuary |
| **10** | Cabinet Office | 1,080 | Admiralty Citadel |
| **11** | Min. of Defence | 4,120 | Whitehall Gardens |
| **12** | Min. of Defence | 8,100 | Admiralty Citadel |
| **13** | Min. of Defence | 4,520 | Admiralty Citadel |
| **14** | Dept. Employment & Productivity | 1,780 | Almack House |
| **15** | Mintech. Board of Trade | 3,620 | Adelphi |
| **17** | COI. Min. Posts & Telecomms | 4,480 | Waterloo Bridge House |

automatic equipment for two CBX Areas in addition to that for the Palace of Westminster and, in turn, the consoles serving these areas will be 300 yards away in the Treasury building.

"Hold for enquiry" and transfer of calls facilities will be provided within each PABX and the PW tandem exchange will allow extension to extension dialling between the CBX areas over distances of up to 1¼ miles. Other special facilities can be introduced as need is determined; for instance, the Civil Service Department (CSD) is considering the pros and cons of a centralised dictation system, a facility that does not yet appeal to all Departments.

The rearrangement of the private circuit network on to the tandem exchange is a mammoth task. Each of the 1,000 private wires must be considered individually, first with the customer to confirm requirements and secondly from a line plant and standardisation point of view. Eventually, there will probably be 700 private circuits from the tandem exchange to destinations outside the CBX Area, and a rather greater number of circuits connecting the CBXs to the PW tandem exchange. A sub-committee of the parent Project Team is dealing with the rearrangement of the private wire network and will have its hands full until well into 1971.

Until 1973 a special installation force of 19 men, growing to 40, will concentrate on the introduction of the first CBX installations, including the Palace of Westminster PABX where a complete rewiring of the internal distribution was started during the Easter recess 1969. All told, phase one of the scheme will involve the rewiring or new provision of 30,000 stations (i.e. PBX extensions plus ancillary extensions) and an additional 12,000 automatic stations existing will also be provided with DDI and connection to the PW tandem exchange.

The second stage of the scheme, which will not be completed until after 1974, covers a further 30,000 extensions. A high-level study involving the Post Office, the Ministry of Technology, the Board of Trade, and telecommunications manufacturers, will be taking a close look at a wide variety of automation techniques and shaping them to meet the Whitehall communications requirements from the mid-1970s onwards.

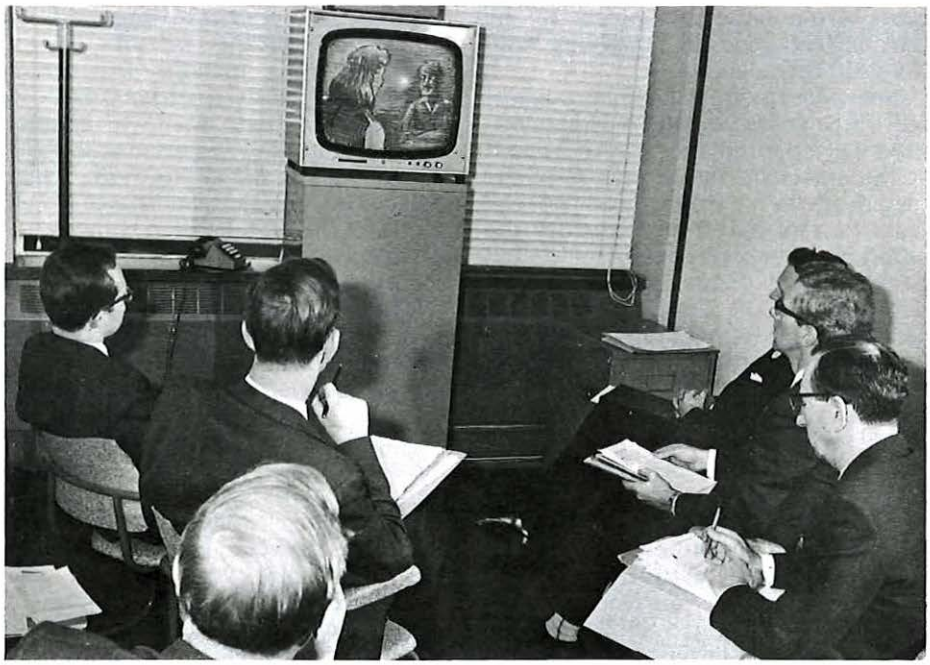

**THE AUTHOR**

**Mr. P. J. Haville** *is Senior Sales Superintendent LTR South Central Area and has been Operational Planning Officer to the CBX Project since 1967. He joined the Post Office in 1941 and served as a Postal and Telegraph Officer and a Clerical Officer before appointment to Sales Superintendent in 1961.*

**The Post Office Appointments Centre has achieved rewarding results since it was set up in 1968 with the aim of . . .**

# Selecting the right man for the job

By R. T. MAYNE



**TOP: A TV camera takes a peep at a practice interview during a training course in selection techniques. BELOW: A group of Post Office staff who will be serving on selection boards watch a video tape playback of the scene before a discussion on interviewing techniques.**

AN increasing number of the best young brains in the country are being attracted to a career in the Post Office. It is a welcome trend, as the human needs of our expanding and complex businesses become more demanding, and there have been some rewarding results since the Post Office Appointments Centre was established two years ago. In 1968 recruitment of graduate management and professional staff was well up on the previous year and in 1969 was the best ever recorded, matching the growth of Post Office activities.

The Appointments Centre was set up early in 1968, in preparation for the Post Office change from a Civil Service Department to a Public Corporation, to take over graduate and A-level (and Scottish equivalent) open recruitment from the Civil Service Commission. At the same time an entry for graduates was opened which has provided, for the first time, entrants to telecommunications management outside the engineering and policy making areas of work.

The Appointments Centre itself undertakes graduate recruitment nationally and also the selection of A-level school-leavers, Higher National Diploma candidates etc., from the London commuter area; selection units in the Regions have taken on the non-graduate entry work outside London. This arrangement is working well, making the most of local contacts with schools and technical colleges, but preserving the convenience for universities and other degree-awarding establishments of one central point of contact with the Post Office.

A great deal of effort has been put into developing good relations with universities and schools. Prior to 1968 the Civil Service Commission visits to universities had helped to make the Post Office known, but as only one amongst the many Government departments. The student who really wanted a career in Government Service probably felt drawn towards one of the "Whitehall" departments rather than to the Post Office. On the other hand, students with the preference and aptitude for management or professional work in a public utility service did not always recognise that the Post Office could provide plenty of scope for their talents.

The work of the Civil Service Commission was supplemented by our own Research Department who had organised independent visits to selected universities and colleges of technology, securing a good intake of graduates for their own field of work and a small but useful number of people for other jobs, particularly in engineering development. These activities, however, were on too small a scale to present fully the whole range of opportunities for graduates.

As early as possible the new plans for graduate recruitment were put to the universities and colleges and, starting in December, 1967, a series of presentations were made to University Appointments Officers to describe the activites of the Post Office, the variety of work to be done, the good career prospects and the large number of graduates required. The campaign bore fruit rapidly. During the January to March 1969 season of interviews at universities the Post Office visiting staff interviewed nearly 2,000 students.

Post Office regional staff have

always had good relations with schools and technical colleges: first, in regard to recruitment of school leavers and secondly, in giving information about career opportunities in postal and telecommunications work to people choosing subjects for further study at school or university.

To supplement these liaison efforts Appointments Centre staff have visited technical colleges and a selection of schools with the particular aim of stimulating interest in the Post Office University Studentship Scheme; the entry to Assistant Executive Engineer and some other posts by people with Higher National Diplomas; and applications from high grade A-level people for all junior management posts from schools known to be particularly good in supplying staff for Post Office needs.

Selection methods have been adopted which are among the most modern used anywhere in the country, based at the outset on the principles of the "Method II" system used by the Civil Service Selection Board for the administrative class of the Home Civil Service. This system has since been described by the Davies Committee, set up by the Government following a recommendation of the Fulton Committee on the Civil Service, as "a selection system to which the Public Service can point with pride."

The selection methods in use incorporate the technique of successive interviews. That is, the candidate has separate interviews with two assessors. Almost always, one of the interviewers is a member of the Appointments Centre Staff, or of the Regional Headquarters selection unit, who is particularly interested in the candidate's personal qualities and has a broad knowledge of job opportunities. The other interviewer is from an operational branch and concerns himself mainly with the candidate's intellectual qualities, aptitudes and skills in relation to the particular job applied for. The applicant's strengths and weaknesses are systematically analysed in the informal atmosphere of the "person to person" interview.

In all selections now, the assessors' opinions are supported by evidence of performance in a series of objective tests. This process varies for different types of entry, from a single day of cognitive and aptitude tests supporting the interviews for A-level entry, to a two-day procedure which includes group exercises and a complex written problem for general management graduate entrants.

Throughout, the assessors look not only for competence to do the general type of work for which the candidate has applied, but also for special aptitudes and preferences as a basis for recommending assignment to particular working groups. There is also sufficient flexibility for the good candidate who has applied for an unsuitable entry (in terms of level or type of work) to be offered another kind of post where he can find the job satisfaction he needs to develop quickly.

These methods are more searching than those used hitherto and are also much more demanding on the assessors who need training and practice before taking part. Training courses in interviewing techniques were conducted in the early stages by two well-known consultant psychologists who specialise in personnel selection. Now, however, the Centre has its own Psychological Services Branch providing expert training in interview techniques for the Appointments Centre and for senior staff from other departments who are required to interview applicants for jobs.

The training includes instruction on how to phrase questions, how to give the candidate scope to express himself fully, how to pick a man for a job because of his ability rather than because he fits a familiar image. Much use is made of television video tape recordings of demonstration and practice interviewing sessions.

The first graduate selections were made in February, 1968, for posts as Assistant Postal Controller Class II and in the National Data Processing Service. These were followed by Executive Engineer, Scientific Officer and Telecommunications Management selections which started three months later. Selections for the Executive Officer entry started in March of that year and for the Assistant Executive Engineer grade in June. Telecommunications Traffic Superintendent selections had at first to be organised in two separate stages, in February and September of 1968, because Civil Service requirements then did not permit continuous recruitment for this entry.

Overall, results to date are encouraging. In 1968, 209 graduates were recruited at the main entry level and 783 people for posts as Assistant Executive Engineer, Assistant Experimental Officer, Executive Officer and Telecommunications Traffic Superintendent. In 1969 the numbers accepting posts up to the year end were 325 and 909 respectively.

The Centre is also assisting the Postal and Telecommunications businesses in internal "special" selections when required. In 1968 and 1969 the selections of Post Office staff for university first degree scholarship awards were carried out and tests were conducted as part of the selection procedure for Telephone Manager and Deputy Telephone Manager posts.

The Post Office can now look forward to getting a fair share of the talent coming out of the universities, technical colleges and schools. However, close contacts with educational establishments—the sources of supply—need to be maintained and extended to include more of the academic as well as the careers guidance staff. Interchange of ideas with recruitment units in other large industries must continue. Further improvements are needed to reduce to the absolute minimum the time delays between enquiry and interview and between interview and starting work. The selection methods will be further refined and improved as a result of validation research and feedback of information about job performance and career progress of entrants.


**THE AUTHOR**

**Mr. R. T. Mayne** *joined the Post Office as a graduate entrant in 1946. He has worked in traffic engineering, local and trunk systems planning, engineering management in two Telephone Areas, engineering recruitment and university studentship selections. He is now a Personnel Controller and Deputy Head of the Post Office Appointments Centre.*


**A member of the Appointments Centre staff (left) has an "ice-breaking" discussion with young graduates to help put them at ease before a selection board.**

# AUTOMATIC TELEX GOES WORLD-WIDE

**An entirely new system has been developed for the automatic switching and recording of intercontinental telex calls. Introduced first to Canada and New Zealand it has been extended to the USA and to Australia.**

By S. G. TINWORTH

ALMOST all the United Kingdom's inland and European telex traffic is directly dialled by the subscriber and the charging done by pulse metering in a similar way to STD telephone calls. For various reasons it was difficult to extend telex working on this principle to countries far outside Europe. Such calls had either to be connected manually at the International Telex Switchboard in London, or switched automatically using teleprinters to record details from which charging tickets could be prepared manually.

The breakthrough has come, however, with Intercontinental Telex Automatic Ticketing (ITAT), a completely new method which associates automatic switching with the punching on paper tape, at the time the call is made, of all details necessary to prepare customer call statements by subsequent computer processing.

ITAT has certain advantages over pulse metering. For instance, it readily accommodates a set minimum charge, a desirable feature if uneconomically short duration telex calls are to be discouraged. It is capable of pricing calls over telex radio routes, where the charging depends on the opportunities available on the error-corrected radio path for the efficient transmission of each individual character. Moreover, ITAT lends itself readily to the computer production of individually printed subscribers' call statements, a monthly account for the settlement of charges with the distant Administration and various traffic statistics and records necessary for the operation and planning of the system.

There are, of course, a few drawbacks. Perhaps the major one is that the system requires precise operation by the subscriber making the call, and repeat attempts were an early headache. The subscriber must first dial a 3-digit code which routes the call via conventional step-by-step selectors to the ITAT equipment. A reference/time group is then printed on his machine followed by his Answerback Code and an instruction KEY+ emphasising to the operator that the remainder of the operation is keyed and not dialled as before. Secondly, and this is a completely different procedure as far as the subscriber is concerned, he depresses the Figure Shift key on the teleprinter keyboard once. Thirdly, he immediately keys the two or three digit Destination Code followed by the digits of the distant telex number. Finally, he indicates that selection has been completed by the operation of the +key. No other keys must be depressed, including the space bar or non-printing characters, otherwise the call will fail, equipment will have been used unnecessarily and recording and processing of an abortive attempt will take place.

A ticketing machine in Fleet Building, London, is unloaded.

The setting up and recording of an effective call is now described in relation to the equipment in use in Fleet Building, although later this year similar equipment will be introduced at St. Botolph's House on the other side of the City of London to extend ITAT to more countries.

The dialling code 207 will route a call to the ITAT equipment and an Access Relay Set will be seized. The incoming call is then extended to a Control Relay Set, distribution being on a cyclic basis. Associated with each Control Relay Set is a Ticketing Machine consisting of a Perforator 5D and a motor-driven tape winder. On reaching the Perforator a pair of carriage return characters are transmitted from the Control Relay Set which will be punched on the paper tape and when read by the computer later will be recognised as an entry separation instruction used to separate "Heads" of call attempts and "Tails." The carriage return characters are followed by a Letter Shift/Line Feed "Head Marker" combination, also punched on the tape and recognisable by the computer which will expect a Head record to follow it. These non-printing characters have also positioned the subscriber's machine.

There follows a two letter code identifying the Access Relay Set, a two letter code for the Control Relay Set then the 24 hour clock time. The computer will match this four letter reference code with an identical code on the Tail record which will follow later for the same call. The reference code followed by the time is also printed on the

subscriber's machine. The time will be examined by the computer to check the duration in the Tail and to back-date the previous day's calls. The Control Relay Set then transmits back to the subscriber a "Who Are You" signal (not punched) which triggers off the Answerback mechanism within the subscriber's teleprinter and causes the 20 character Answerback signal to be punched on the paper tape which firmly establishes the identity of the calling machine. The reperforator is then held whilst the signal KEY+ is printed on the subscriber's machine. The subscriber will then depress the figure shift key, key the digits and follow with the + sign as already described.

These characters, comprising the selection sequence, are all punched on the paper tape as they are forwarded to the Register waiting to route the call. The selection sequence will be examined by the computer to determine the charge when processing takes place later. The keying operation is quicker and less fatiguing than dialling over which it has certain technical advantages and can be used directly to produce the 5-track punched tape.

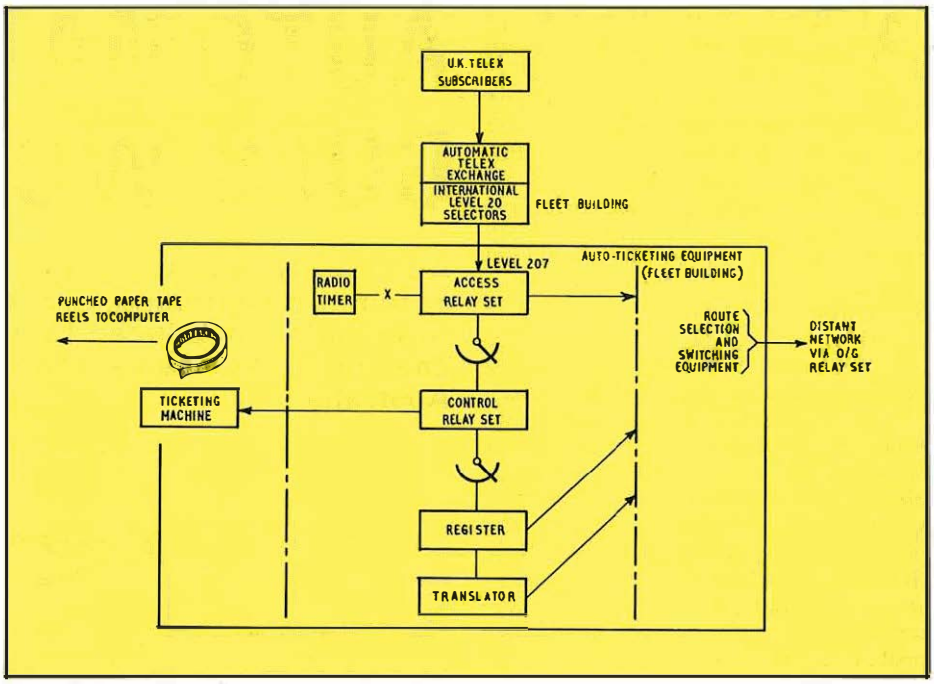
When it has enough information the Register, with a Translator, causes the call to be switched to the appropriate route, whereupon a route code letter is punched in the paper tape so that the computer can produce International Accounts and Call Statistics sub-listed under route headings. The route code completes the Head record and the reperforator signs it off with another pair of entry separation characters. The call is then released from the Control Relay Set and its reperforator, but the Access Relay Set, which is held throughout the call, remembers the Control used.

At the end of the call the Access Relay Set which has been timing the call, stores the time, searches for the Control Relay Set and when its reperforator is free causes an entry separation combination to be punched on the paper tape followed by a Line Feed/Letter Shift combination which the computer will recognise as a "Tail Marker." The same reference code will then be punched on the tape (because the same equipment is in use) as the original Head, although the calling teleprinter has now cleared. Immediately following this is the actual 24 hour clock time. The Access Relay Set will then cause the elapsed duration to be punched on the paper tape in a self-checking letter code and in figures. Not only does the computer check one against the other but it applies an integrity formula using the times punched in the Head and Tail. The elapsed time completes the Tail record which has a fixed length of 25 characters which assists the computer to identify it; complete Head records are always longer than this.

To effect equipment savings each reperforator can accept up to four Head records with outstanding Tails. Based on an average holding time of say three minutes a call this would allow each reperforator to deal with calls at more than one a minute in the busiest period. When the service is available over an error-corrected radio route the telex radio terminal equipment will pass back pulses indicating to the equipment controlling transmission whether to repeat the last few characters sent or to go on to the next few. On an ITAT call these pulses will be returned to a Radio Timer associated with the Access Relay Set which will calculate the elapsed time from the pulses accepting further characters.

Just before the tapes are unloaded each weekday a key is operated on each ticketing machine which inserts a Tape Identifying Test Call. The computer reads a date from this call and dates all the calls on it accordingly. The tapes are then unloaded and sent to the Computer Centre at Charles House where they are vetted and processed to produce a daily magnetic tape. These five tapes are read during a weekly main computer process during which each call attempt (consisting of a Head coupled with its Tail) passes through an Answerback program which, by matching the Answerback punched on the tape with its counterpart on an up-to-date computer Answerback file, produces a telex number and a TMO "Billing Code" for each call attempt.

The computer then proceeds to charge each call individually by reference to the distant network (punched in the Head selection sequence) the duration (in the Tail) and the appropriate charging particulars which are maintained in a computer "International Account File." This file also accumulates week by week the figures necessary to produce the monthly International Account. At the end of the weekly "Run" individual subscribers' call statements are produced in telex number order within TMO groups to which they are despatched weekly for inclusion on the subscriber's telex account.




A diagram of the ITAT system showing the various stages of the operation.

An operator makes a test call through the ITAT equipment. In the background the banks of auto-ticketing equipment which record the calls.

**THE AUTHOR**

**Mr. S. G. Tinworth** is a Senior Telecommunications Superintendent in the Telegraph Operations Division of ETE and has been a member of the development team responsible for the computer billing of intercontinental telex calls.

# Miscellany

## HONOUR FOR MR. RYLAND

**Mr. A. W. C. Ryland, CB, Deputy Chairman and Chief Executive of the Post Office, has been awarded the City and Guilds of London Institute's Insignia Award in Technology (Honoris Causa) in recognition of eminence achieved in the field of telecommunications with the Post Office.**

**Mr. Ryland has been private secretary to two Postmasters General and is a former Director of Inland Telecommunications. He was awarded the CB in 1965 and in the same year was appointed Deputy Director General (Telecommunications). In 1967, with Corporation status looming, the title became Managing Director: Telecommunications. On formation of the Post Office Board Mr. Ryland became Deputy Chairman and Chief Executive.**

## Contracts

**Telephone Network:** Over £4½ million worth of high speed 5005 crossbar equipment for 11 new telephone exchanges is to be made and installed by Plessey Telecommunications Group. More than half the equipment—about 500 racks—is for a new North West London Sector Switching Centre (SSC). It will route calls both in and out of the area from all parts of Britain and switch calls to a new International Switching Centre currently being installed in London. The new SSC will have over 2,000 incoming circuits and more than 2,500 outgoing. Plessey will also equip four new Group Switching Centres at Abingdon in Berkshire, Boston Ridge and Winsover in Lincolnshire and Stornoway in Scotland and will install Crossbar exchanges with capacities ranging from 1,500 to 4,000 lines in London, Wiltshire, Glamorgan, Kent, Essex and Yorkshire.

As part of other contracts worth over £600,000 Plesseys will provide equipment for extensions of Group Switching Centres at Sunderland, Brighton Hove and Worthing and a major extension at Rotherham telephone exchange.

Standard Telephone and Cables are to supply Strowger and Crossbar equipment worth £4 million. Step-by-step installations will include Maidstone, Norwich, Melton Mowbray and South Harrow exchanges. Crossbar projects will be at London, Ballymoney, Rusholme, Cardiff and Shrewsbury.

**Vehicles:** 2,240 Commer vans for use as engineering utility vehicles have been ordered from Rootes Motors Ltd. Deliveries were scheduled to begin in February and should be completed by February, 1971

**Data transmission:** To meet growing demand for Datel services GEC-AEI Telecommunications Ltd. is to provide further data transmission equipment worth over £375,000.

# World's first PCM exchange a success

THE Pulse Code Modulation tandem exchange at Empress, London, the first of its kind in the world, has shown after more than a year's operation that PCM switching of speech channels is not only feasible but can be achieved with improved reliability

The experimental digital exchange was installed for field trials in September, 1968, and has operated successfully on live traffic ever since. It handles 3,000 calls a day and nearly one million connections have been completed. Indications are that the equipment will lead to a considerable improvement over the existing electromechanical exchanges, the number of calls lost being less than 0.1 per cent.

Connected to the tandem exchange are three London director exchanges employing routes of between two and six miles. Direct junctions also exist between each pair of these exchanges and the traffic is shared between the direct junctions and the tandem exchange. The trial demonstrates the feasibility of switching Pulse Code Modulated signals on junctions between conventional Strowger exchanges.

Maintenance appears to offer no serious problems; the majority of failures so far encountered have been detected by the automatic testers used to monitor continuously the control logic and the transmission path. Virtually the whole exchange is tested every few minutes, day and night, giving a printed record of the few failures found.

The exchange contains approximately 7,000 silicon integrated circuits with a failure rate of 0.02 per cent per 1,000 hours. The introduction of large-scale integrated circuits into future designs will increase reliability still further.

# A HOT LINE TO THE MOON

**Mr. C. J. Gill with his certificate which depicts an astronaut walking on the moon's surface. Mr. Gill, who retired in December as Director External Telecommunications after 43 years' service with the Post Office, spent much of his career in international telecommunications.**

THE British Post Office has been honoured by NASA, America's National Aeronautical and Space Administration, for the part it played in the landing of the first men on the moon. NASA Communication Division Award certificates have been presented to Mr. James Gill, former Director of External Telecommunications, and two ET staff who have worked closely with NASA—Mr. Charles Mitchell and Mr. John Crowther.

For the moon landing, the Post Office provided and operated communication circuits by way of land line, submarine cable and communications satellite routes. These circuits, carrying speech, vision, high-speed data and telegraph signals, played a big part in the world-wide network linking the manned capsules in space with the flight control centre at Houston, Texas.

Two similar NASA awards have previously been received by the Post Office—for assistance in the 1965-66 Gemini manned space missions, and for support in the Apollo 8 first manned orbit of the moon.

● Medallions containing metal flown round the moon have been presented to 22 Post Office men at Electra House, London. The awards were made in recognition of the work they do on behalf of NASA—helping to maintain communications for the American space flights.

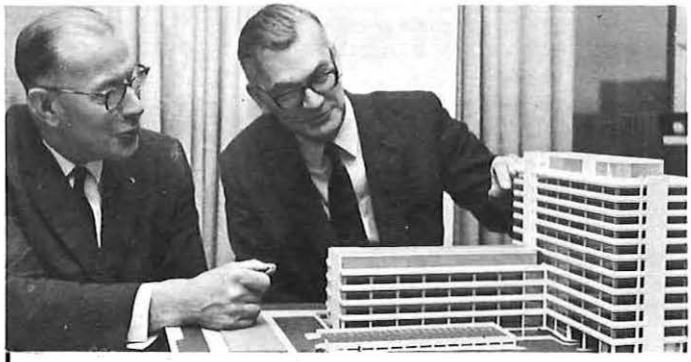
## New Directors

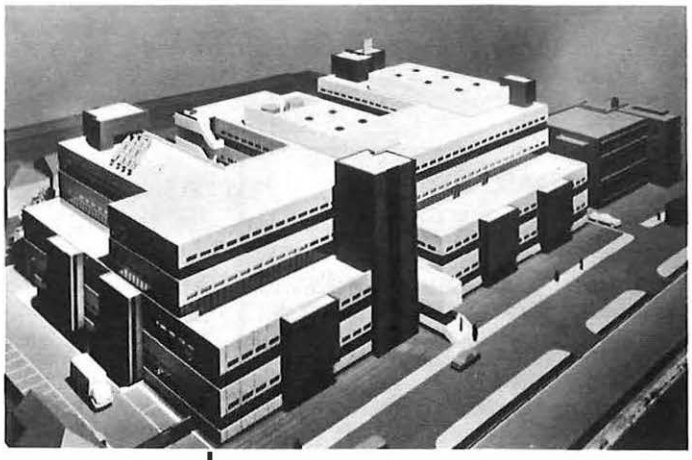
**Mr. James Hodgson** is the new Director of External Telecommunications. He succeeds Mr. C. J. Gill who retired on 24 December. Mr. Hodgson entered the Civil Service in 1950 and was Private Secretary to the Assistant Postmaster General 1953-55 and to the Director General 1955-56. In 1965 he was appointed head of the Operations Branch of the Inland Telecommunications Department and in 1967 became Vice Director of the External Telecommunications Executive.

**Mr. John Thompson,** Deputy Regional Director London Telecommunications Region since December 1967, has been appointed Director, South-Eastern Telecommunications Region. He joined the Post Office in Scotland in 1936 and moved to London 10 years later. Promoted Assistant Secretary in 1963, Mr. Thompson worked on satellite communications until his appointment with LTR. Mr. Thompson served on the Editorial Board of *Telecommunications Journal* until his recent appointment.

## Faraday Lecture

A special presentation of the Faraday Lecture for London staff is being given at the Central Hall, Westminster, on 28 April at 6 p.m. Ticket arrangements have been announced in the P. O. Gazette. In an article on the lectures, which are being given by Professor James Merriman (*Telecommunications Journal*, Winter 1969), a printing error extended the life span of Michael Faraday. The lectures, given under the auspices of the Institution of Electrical Engineers, were introduced in 1924 to pay tribute to the memory of the eminent physicist.





**ABOVE: Mr. E. Weaver, Director of London Telecommunications Region (left), and his Deputy Director Planning, Mr. J. E. Golothan, look at the model of the East sector switching centre being built at Ilford, Essex. RIGHT: A model of the South West SSC at Kingston, Surrey.**

ATTRACTIVE model buildings of some of the new sector switching centres planned for London are being featured in exhibitions and shop window displays which explain to the public the reasons for the introduction of all-figure numbering and the benefits it will bring.

All figure numbering has made it possible to house trunk switching centres away from the congested central areas of London where land is scarce and expensive. Seven sector switching centres are planned for sites on the outskirts. They will handle trunk calls in and out of their sector, and the buildings will also include auto-manual exchanges for calls that need operator assistance and tandem exchanges to handle calls within the sector.

Building is already under way for three of the switching centres and all seven should be operational by 1976. By then the sector switching centres and those remaining in central London will be handling between them about five million trunk calls a day.

# 'Dial America' service

THE world's first major inter-continental dialled telephone service opened on 1 March between London and New York City. It is available to 2½ million customers in London who will be able to dial their own calls direct to a similar number of subscribers in New York at a cost of 10s a minute. Some New Yorkers will also be able to dial direct to London and other main centres in the UK.

To dial New York from London the code will be 010 1 212 (010 is the International Subscriber Dialling code; 1 the country code for America; 212 the area code for New York), followed by the New York City subscriber's exchange and number.

Britain-USA International Subscriber Dialling will be extended gradually to other cities in the UK and to other parts of the USA during the next two years. At the same time the Post Office hopes to introduce the first ISD services to Canada, initially to Montreal and Toronto.

About 40 per cent of all calls from Britain to USA are made from London telephones to New York City numbers. About 3,000 calls are made from the UK to the USA every working day. Until the "Dial America" service opened ISD operated to seven European countries.

With new charges for transatlantic calls and other international telecommunications services also introduced on 1 March there will be overall savings of £5 million a year for UK customers.

## CABLES USED IN OCEAN RESEARCH

**THE Post Office's Undersea Cable Systems Branch is helping Liverpool University's Department of Oceanography with important research work on the movements of water in the Irish Sea. Digital recorders are being linked to submarine telephone cables at Post Office Repeater Stations at Port Erin, Isle of Man, Portpatrick in Scotland and Donaghadee in Northern Ireland. This equipment will record water movements by measuring water-induced voltages on the submarine cable.**

**The research should provide a better understanding of storm movements in an ocean area. This is essential to projects for the dispersal of pollutants. It will also help the fishery industry by providing data relevant to the movements of fish shoals.**

**The Liverpool University programme is being led by Mr. P. Hughes, a former Post Office technical officer.**

## HONOURS

MR. GILBERT JACKSON (59), Regional Engineer Wales and Border Counties, was awarded the OBE in the New Year's honours. Mr. Jackson was chairman of the special Post Office committee set up to provide the telecommunications network for the Investiture of the Prince of Wales at Caernarvon last July.

Mr. Jackson, who has worked in London and the Midlands Region, was appointed Regional Engineer in Cardiff in 1962.

Other telecommunications staff honoured are:

**MBE**—Mr. W. H. Slater, assistant executive engineer, TMO City Area, London; Mr. S. Marsden, senior executive engineer, Dollis Hill Research Station.

**BEM**—Mr. A. A. Barnes, technical officer, Silverthorne telephone exchange, Chingford, Essex; Mr. R. J. Williams, mechanic-in-charge, Post Office workshop, Caernarvon; Miss Bessie Paterson, telephonist, North Uist, Outer Hebrides.

## CREDIT CARDS

A NEW international telephone credit card scheme controlled by computer was launched on 1 January by the CCITT, the 137-nation International Consultative Committee for Telephones and Telegraphs. It will enable businessmen and tourists abroad to make credit calls home from even more countries than was previously possible.

To take advantage of the new arrangements the Post Office has transferred production and control of its credit cards to the National Data Processing Service's Derby Computer Centre.

Details of 165,000 credit card holders have been fed into the computer.

## BOOK REVIEWS

**Colour Television Volume 2 by P. S. Carnt and G. B. Townshend.** 276 pages. Published by Iliffe Books Ltd., Price 75/–

Volume 2 deals with PAL and SECAM and some other colour television systems, mainly from the point of view of the broadcast receiver engineer, and complements Volume 1 which dealt with the NTSC system. The book deals fully with the systems' standards and the relevant coding and decoding techniques; the information given is an essential basis for consideration of modern television networks. The book gives an authoritative account of these systems (with a summary of NTSC parameters) and will be a valuable reference and source book to all professional engineers engaged in this field. Attention has already been drawn by another reviewer, however, to the unfamiliar usage of the words 'chroma' and 'chrominance'.

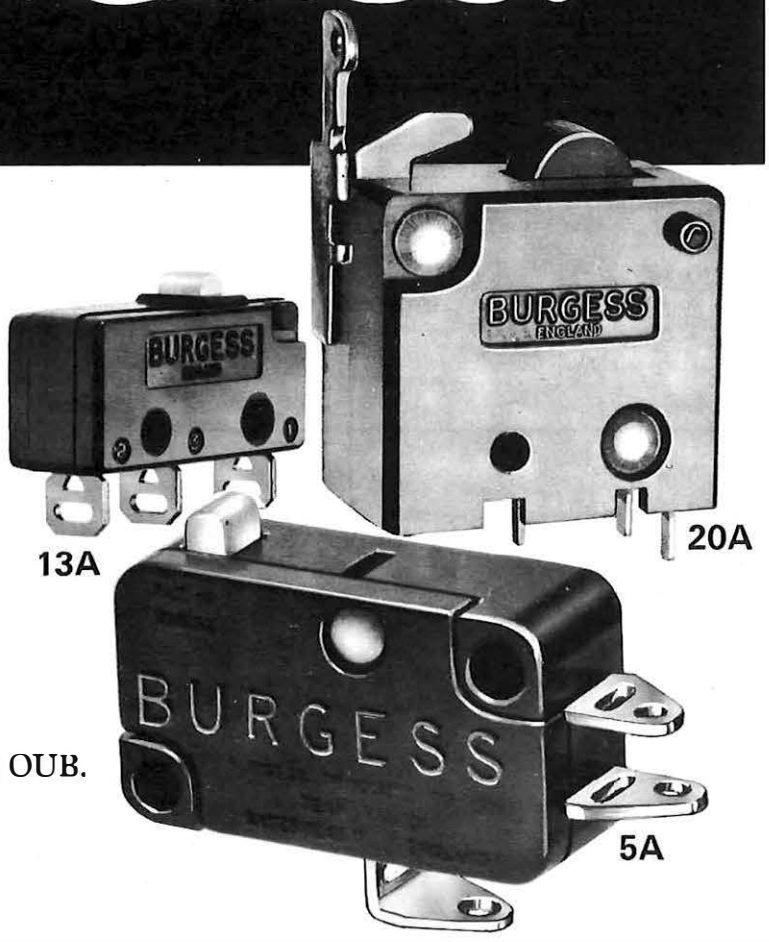
**Questions and Answers on Transistors, (3rd Edition) by Clement Brown** 96* pages. Published by Butterworth & Co. (Publishers) Ltd., Price 10/–

This useful little book, by the Editor of 'Hi-Fi Sound', will be of interest to the student or technician as well as to the general reader who wants to understand a little about transistors and some of their applications.

*Pages 87-90 were omitted from the review copy.

**M.B.W.**

# Burgess reliable micro switches.




Approved Burgess Micro Switches and Micro Switch assemblies include P O ref 5A, 5A-3, 5A-4, 13A, 13A-2, 16A, 16A-1, 19A, 19A-1, Gravity Switches 20A, 20B, 20C.

BURGESS

Burgess Micro Switch Company Limited,
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Telephone 0632—877171. Telex 53229.
London Office: Eastbury House,
Albert Embankment, SE1.
Telephone 01 735 7871. Telex 25553.

# Telecommunications Statistics

*(Figures rounded to nearest thousand)*

| | Quarter ended Sept., 1969 | Quarter ended June, 1969 | Quarter ended Sept., 1968 |
|---|---|---|---|
| TELEGRAPH SERVICE | | | |
| Inland telegrams (incl. Press, Service and Irish Republic) | 2,335,000 | 2,088,000 | 2,482,000 |
| Greetings telegrams | 658,000 | 584,000 | 683,000 |
| External telegrams: | | | |
| Originating U.K. messages | 1,948,000 | 1,834,000 | 1,903,000 |
| Terminating U.K. messages | 1,805,000 | 1,709,000 | 1,934,000* |
| Transit messages | 1,670,000 | 1,604,000 | 1,589,000 |
| TELEPHONE SERVICE | | | |
| *Inland* | | | |
| Net demand | 248,000 | 236,000 | 188,000 |
| Connections supplied | 236,000 | 235,000 | 180,000 |
| Outstanding applications | 242,000 | 228,000 | 242,000 |
| Total working connections | 8,157,000 | 8,017,000 | 7,599,000* |
| Shared service connections (Bus. and Res.) | 1,481,000 | 1,461,000 | 1,409,000 |
| Total effective inland trunk calls | 332,674,000 | 320,354,000 | 299,836,000 |
| Effective cheap rate trunk calls | 83,562,000 | 77,021,000 | 71,137,000 |
| *External* | | | |
| Continental: Outward | 3,640,000 | 3,351,000 | 2,950,000* |
| Inter-Continental: Outward | 363,000 | 365,000* | 298,000* |
| TELEX SERVICE | | | |
| *Inland* | | | |
| Total working lines | 28,000 | 27,000 | 24,000* |
| Metered units (incl. Service) | 63,707,000 | 65,727,000* | 59,259,000 |
| Manual calls from automatic exchanges (incl. Service and Irish Republic) | 39,000 | 35,000 | 28,000 |
| *External* | | | |
| Originating (U.K. and Irish Republic) | 4,821,000 | 4,659,000 | 4,103,000 |

** Amended figures*

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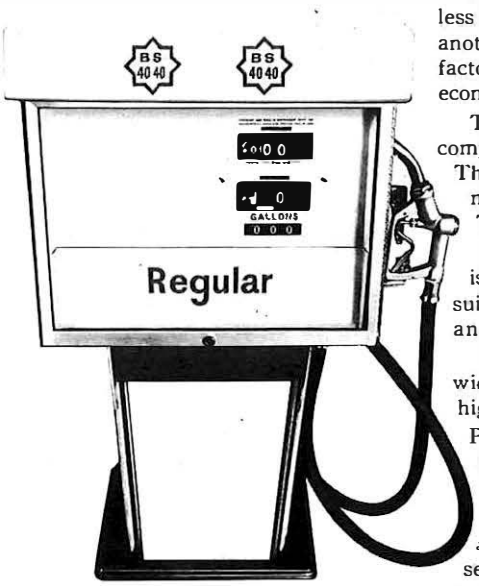
**Contributions.** The Editorial Board will be glad to consider articles of general interest within the telecommunications field. No guarantee of publication can be given. The ideal length of such articles would be 750, 1,500 or 2,000 words. The views of contributors are not necessarily those of the 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 Big Meany.
# The Bedford HA costs only £445 and runs on two star petrol.




The Bedford HA van costs less to buy and costs less to run. The 6 cwt. costs only £445. For another £12 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 nation-wide spares and service network that is fast, and highly-skilled.

Prices: 6 cwt.–£445 (illustrated above) and 8 cwt.–£470 (inclusive of screen clean and driver's seat belt).

Rear seat kits from only £16.10.0., Heater £11.10.0. plus fitting charge. Hinged passenger seat, sun visor and seat belt–£10.0.0.

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

**Bedford**
**top value in light vans**

# 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.*

**rely on PYE**

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THE QUEEN'S AWARD TO INDUSTRY 1966

**Pye Telecommunications Ltd** Newmarket Road, Cambridge Tel: Cambridge (0223) 61222 Telex: 81166

# ever wanted to scale things down to your size? with GEC open-wire systems, you can!

**If your longing is for a small-scale carrier telephone network using open-wire line systems, remember that GEC can supply just that—for as few as three high quality speech circuits, in a compact integral unit complete with carrier frequency generating, translating, channel signalling, regulating and line amplifying equipment, and if you wish four duplex VF telegraph channels.**

The 3-circuit system (Type 30L3A) has a line output in the band 3.16 to 31.11 kHz, and the 12-circuit system (Type 150L12A), which can be operated over the same pair, has a line output in the band 36 to 143 kHz. In addition, a physical circuit (300 — 2700 Hz) can be operated over the same pair.

The systems comply with CCITT recommendations so that several 3-circuit systems can operate over the same pole route, and several 12-circuit systems can be operated over parallel pairs on the same pole route, in each case with minimum crosstalk.

**3-CIRCUIT – TYPE 30L3A**
**12-CIRCUIT – TYPE 150L12A**

G.E.C.

## Takes telecommunications into tomorrow

GEC-AEI TELECOMMUNICATIONS LTD, OF COVENTRY, ENGLAND.

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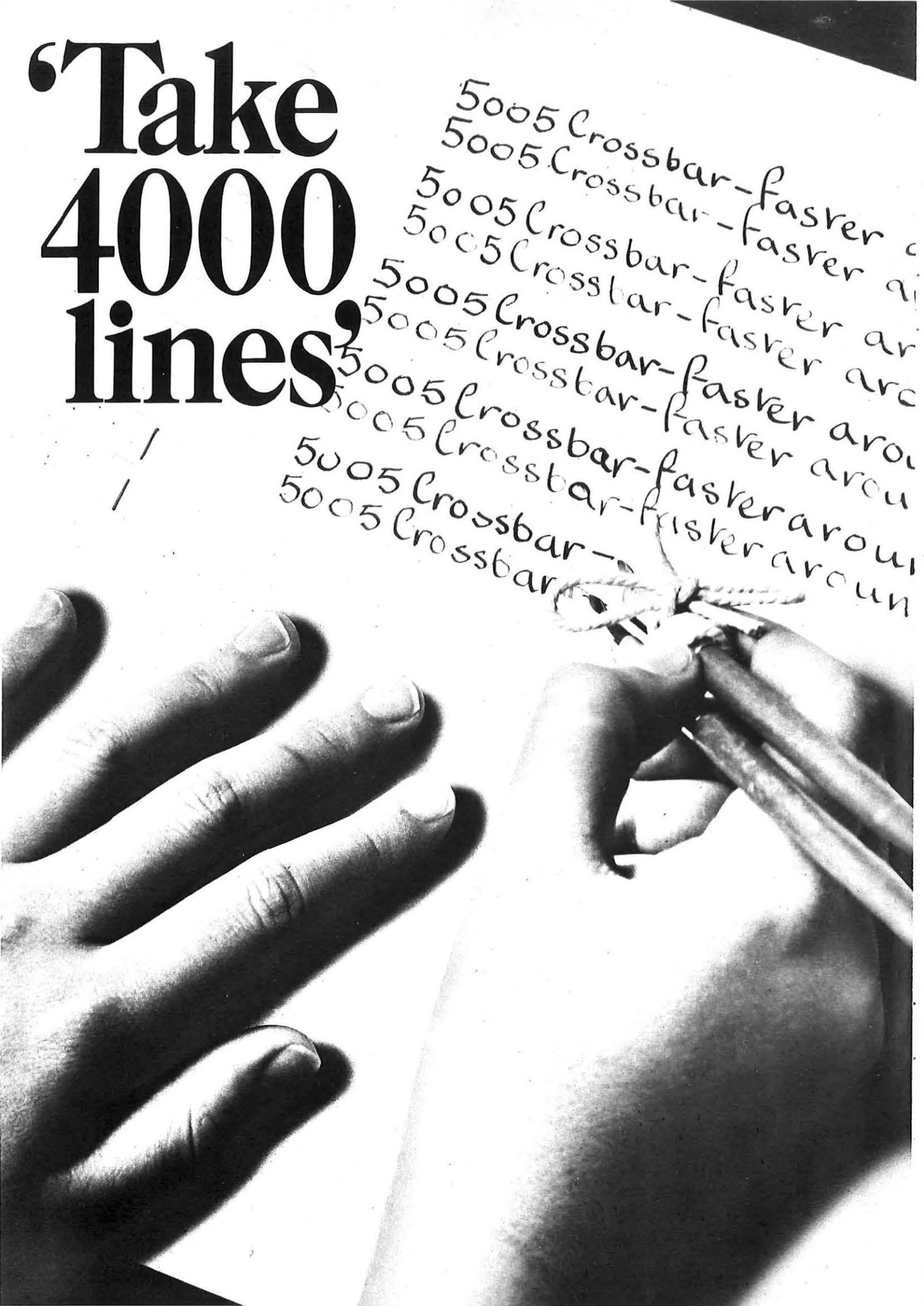
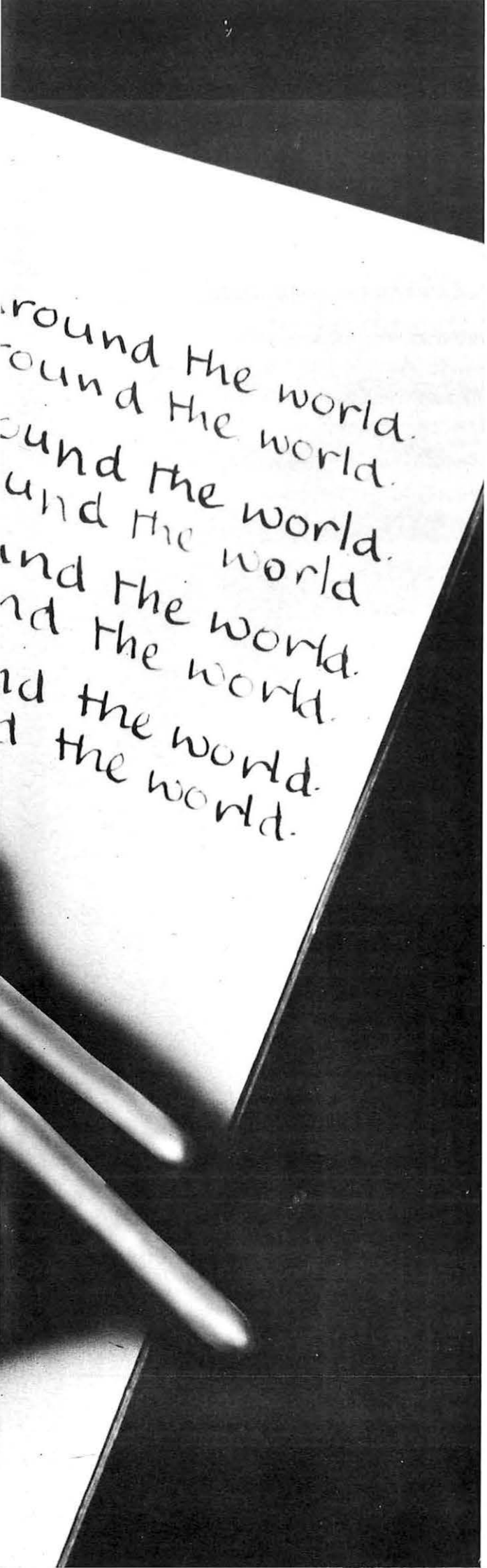
IB/46

# ‘Take 4000 lines’






Take 4000 lines, and up. This is the scale of telephone exchange capacity which is now best handled by 5005 Crossbar.

Crossbar?

Crossbar is the internationally used name for a type of telephone switching rapidly replacing the older 'Strowger' electro-mechanical system that has been at work for over 50 years.

5005?

Plessey telecommunications engineers were first in the UK to see the need for this kind of equipment, 20 years ago, and developed 5005 Crossbar in anticipation of an exploding demand.

Crossbar is now a basic system in the current Post Office expansion programme.

As you might expect crossbar is more versatile, needs less maintenance than the equipment it replaces and it is compatible with electronic systems. It is also compatible with international switching systems and Plessey has installed several major crossbar switching centres at key points throughout the world.

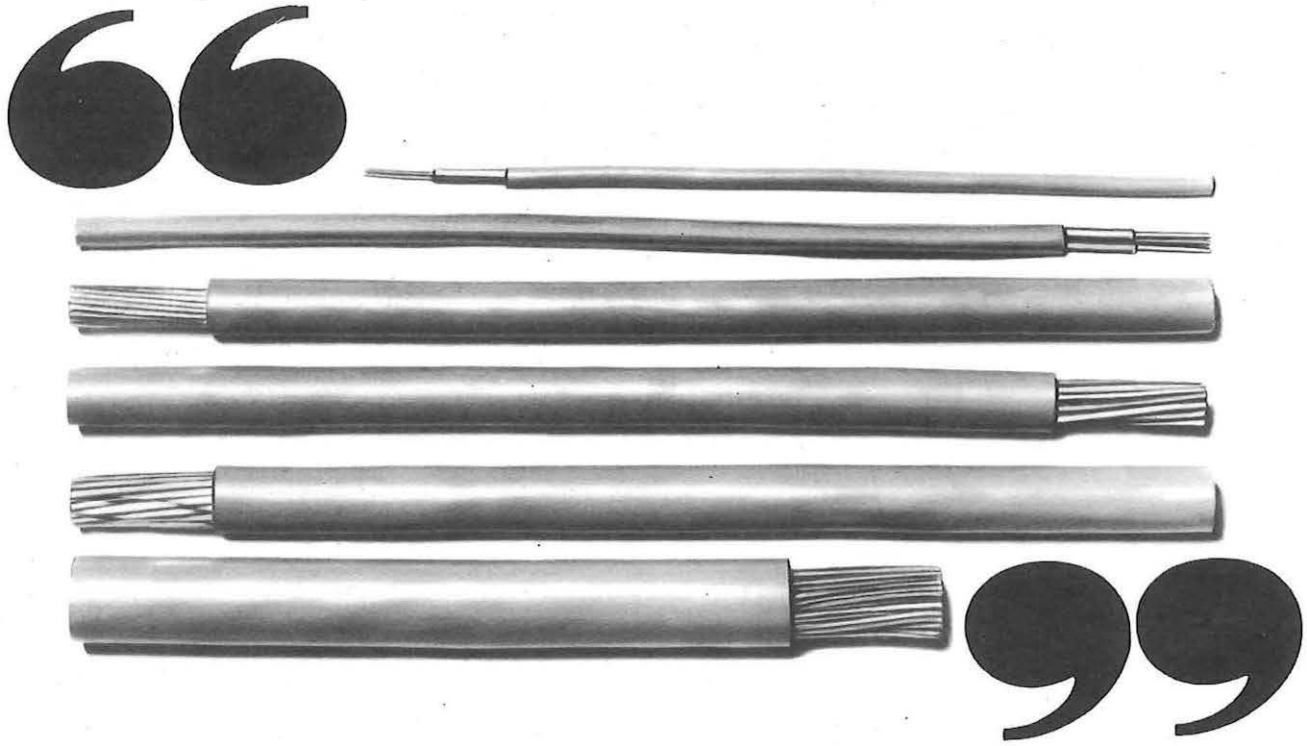
The early Plessey lead in British crossbar is complemented by the first production electronic exchange in Europe (by Plessey) and, for that matter, by the first UK automatic Strowger exchange, at Epsom in 1912 (by Plessey). UK telephone history involves only these three systems. To claim a first in each is no accident. It reflects a planned process of research, development and production to meet predicted needs, a pattern which Plessey is rather good at.

This is why Plessey is a major international force in telecommunications.

Please write for further information on the Plessey 5005 Crossbar system.

The Plessey Company Limited,
Telecommunications Group, Edge Lane,
Liverpool L7 9NW, England.
Telephone: 051-228 4830 Telex: 62267

**PLESSEY**
**Telecommunications**



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Internal telephone communication systems call for the same degree of reliability as for national networks. Pirelli General manufactures a range of multipair and multi-way internal telephone cables which are stocked for immediate delivery.
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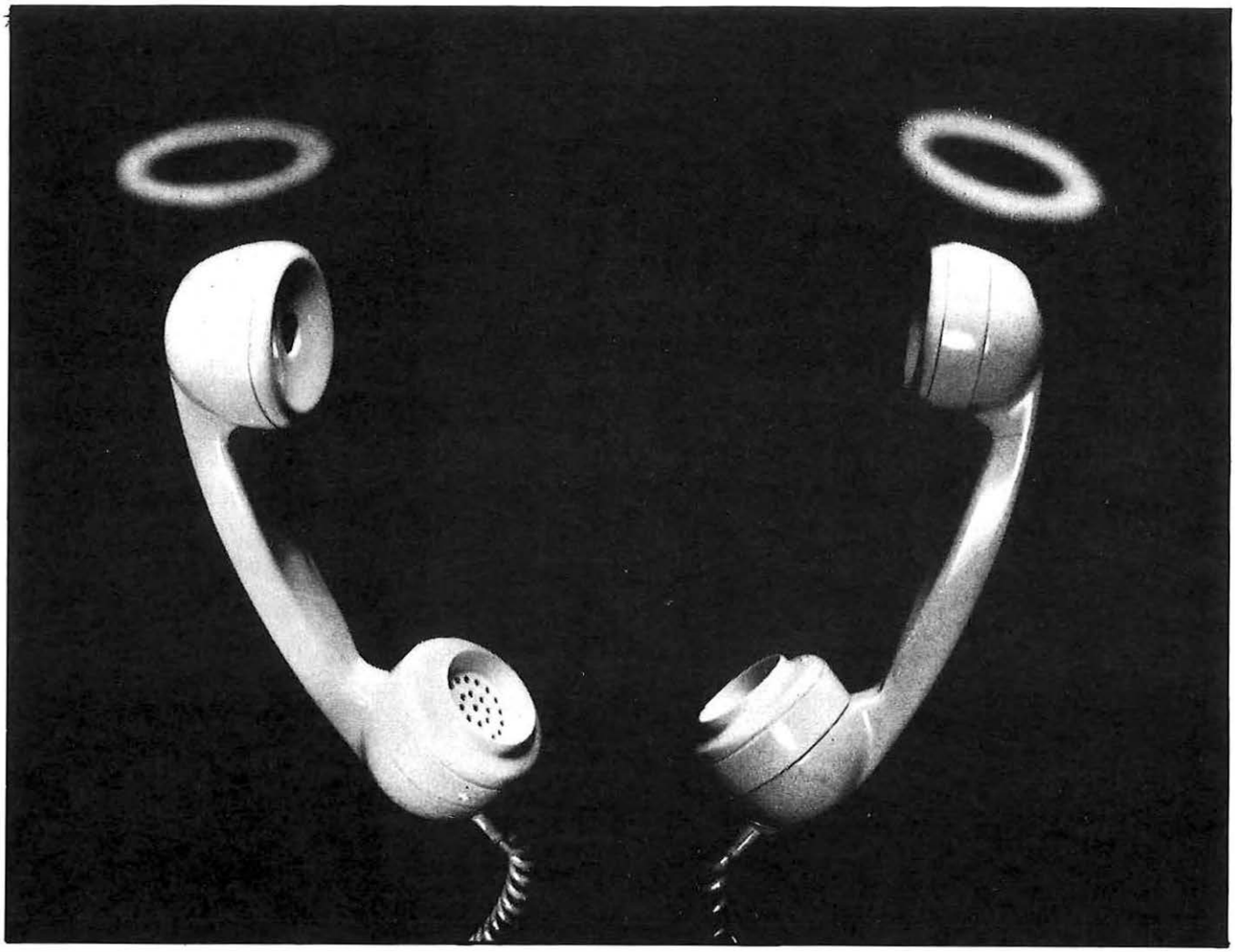


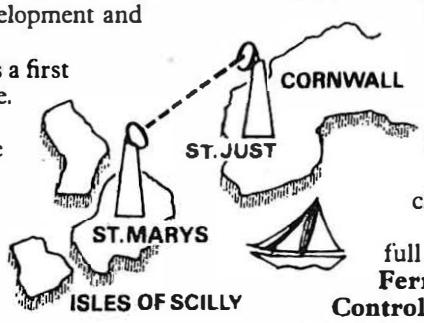
# what St.Just says to St.Mary's is their business:

# how they get in touch is ours.

Communication is our bread and butter and we put a lot of effort into research, development and new techniques.

A recent reward for this work is a first contract from the British Post Office. The contract is for a 300-channel microwave link system for telephone communication between Cornwall and the Isles of Scilly. The terminals are at St. Just and St. Mary's.

The link is fully duplicated with space diversity and full automatic supervisory and control facilities. The equipment is the new, all-solid-state, Ferranti Type 14000/300. The whole of the radio equipment at each terminal fits in a 5 ft. 6 in. rackside with room to spare. It is built to the most exacting standards to provide long-term reliability of communication.

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Be a saint, telephone or write for full details.

**Ferranti Limited, Communication and Control Dept., Silverknowes, Edinburgh, EH4 4AD, Scotland. Telephone: 031-332 2424.**

## the 300 channel microwave link

# FERRANTI

# It's really a phone extension

Most people know that live TV coverage of the moon landing came to Europe via the Post Office Station at Goonhilly.

But TV spectaculars are only the tip of the iceberg at Goonhilly. Those great dish-shaped aerials are being used by Post Office Telecommunications primarily for long-distance phone calls around the world.

Within a year well over twenty countries will be reached by satellite links.

Meantime, Post Office Telecommunications will be bringing you the World Cup live from Mexico. And getting on with the bread-and-butter job of keeping Britain in touch with the world by phone.

**The phone service is moving forward**

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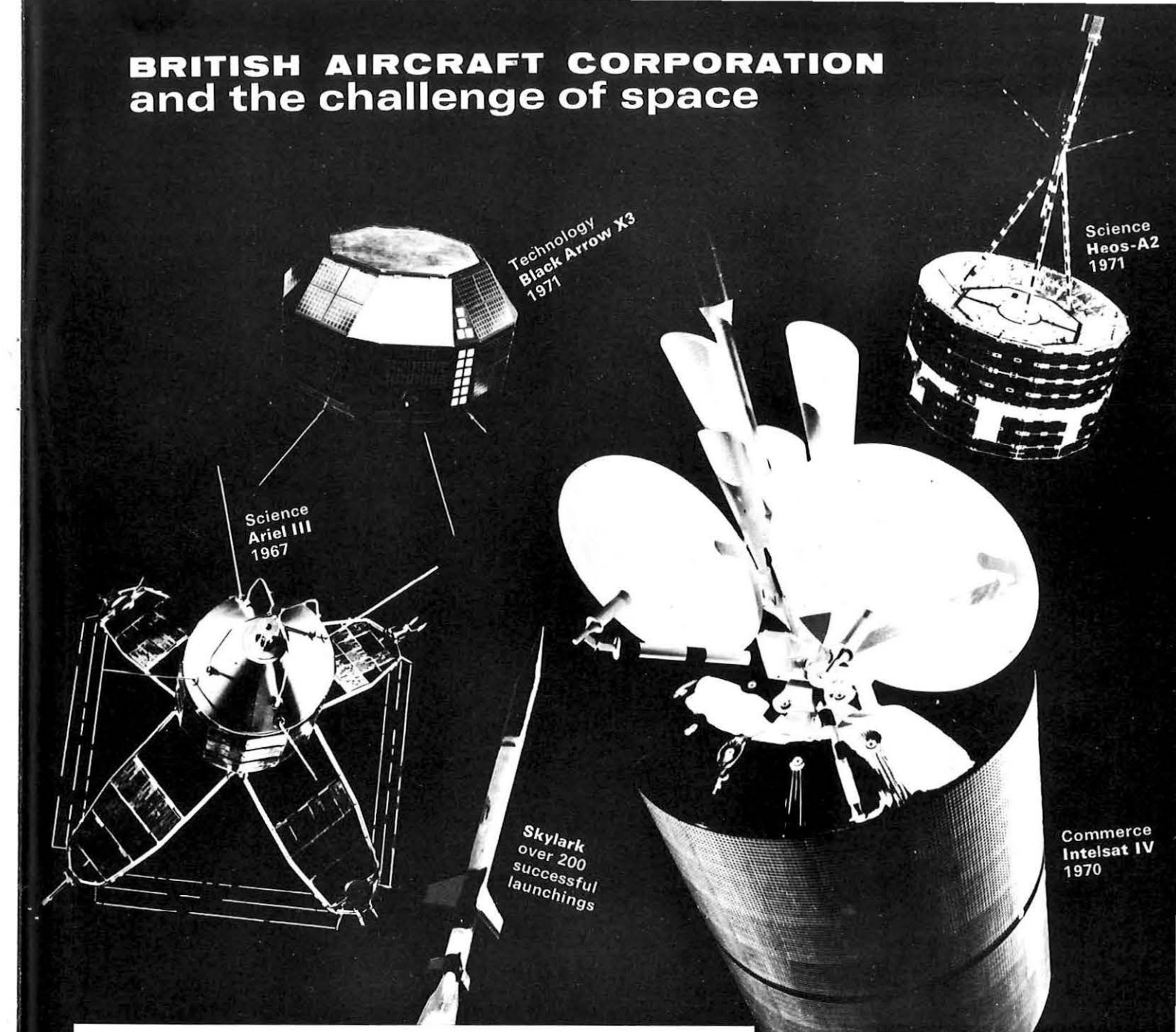
# BRITISH AIRCRAFT CORPORATION
## and the challenge of space




British Aircraft Corporation's association with the unmanned space programme on both sides of the Atlantic spans many years and covers technological and scientific as well as communications satellites.

During the next decade the use of satellites will be enormously expanded, not least in the telecommunications category. In this respect BAC's contribution to Intelsat IV, the world's largest communications satellite, is significant.

BAC's Space and Instrumentation Group are supplying major sub-systems for this giant satellite including structures, attitude control and power supply elements. In addition BAC will be testing and assembling two of the first four flight satellites in a new specialised space facility at Bristol. Intelsat IV has a simultaneous relay capacity of 6000 telephone channels or twelve colour TV programmes.

BAC's capability extends far beyond the design and manufacture of space hardware: it embraces all the associated skills for the supply of complete space communications systems.

BAC have the resources, experience and intention comprehensively to meet the peaceful challenge of space.



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# the maintenance eliminators

You'll be hearing a lot about the Crossbar in future. It's a beautifully simple and ingenious switch system by Swedish Ericsson which has already enjoyed years of success all over the world. As any service engineer knows, one of the most important features in any system is the ease of maintenance: the Ericsson Crossbar Switch System is practically maintenance free and that's why Crossbar has been adopted for use in remote areas where maintenance can be tricky and places where there are few skilled engineers available.
It's quiet, efficient and fast. It's neat, tidy and space-saving. It's used on PAX as well as PABX. Swedish Ericsson would be pleased to demonstrate Crossbar to anyone interested or to send along technical literature.

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