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tele communications

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CONTENTS

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The shape of things to come

THE outline of the shape of things to come when the Post Office is made into a public corporation in 18 months time, is clear from the official booklet *Preparing for Corporation Status* which is reported on elsewhere in this issue.

The booklet helps to disperse some of the long shadows which the problems of reorganisation have been casting over the Post Office for many months and clearly sets out not only the reasons for the change but also how the structure of the Post Office will be re-fashioned to enable the new Corporation to carry out its tasks successfully.

The aim to give the two main businesses—telecommunications and posts—greater freedom to develop more independently is reaffirmed and reflected in the decision to reorganise them on a functional basis both at headquarters and in the regions.

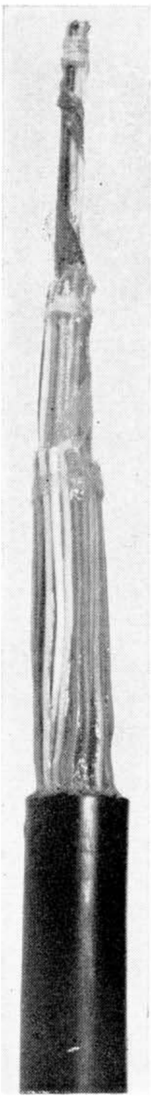
Reorganising the telecommunications side of the Post Office presents, perhaps, the biggest of all the problems, not least because it is one of the most intensively capitalised industries in the country. The capital expenditure of the telecommunications service has increased almost fourfold since 1939 and is likely to double again over the next seven years.

The reorganisation will also involve the integration of most of the Engineering Department with the Inland Telecommunications Department and the External Telecommunications Executive. The Engineering Department will disappear in name and all its functions which are vital to the success of the two businesses will be integrated with the businesses themselves.

The splitting of the provincial regions into separate and self-contained telecommunications and postal regions springs not so much from the change in status as from the volume of work which the present regions now have to handle. Since 1939, when the present regions were set up, the telephone service, for example, has nearly quadrupled in size. Nonetheless, the decision to set up separate functional regions will play a big part in creating the conditions for both the main services to develop more rapidly, efficiently and with much greater freedom.

This new cable is REALLY WATERPROOF

By E. E. L. WINTERBORN



A fully-filled 30-pair twin polythene cable with sheath removed to show the jelly fill.

The Post Office is now using a revolutionary type of waterproof cable in its local distribution networks which will reduce the breakdown of service due to water seepage to negligible proportions

A NEW waterproof cable which is expected to reduce service failures significantly is now being installed in the Post Office local distribution network throughout the country.

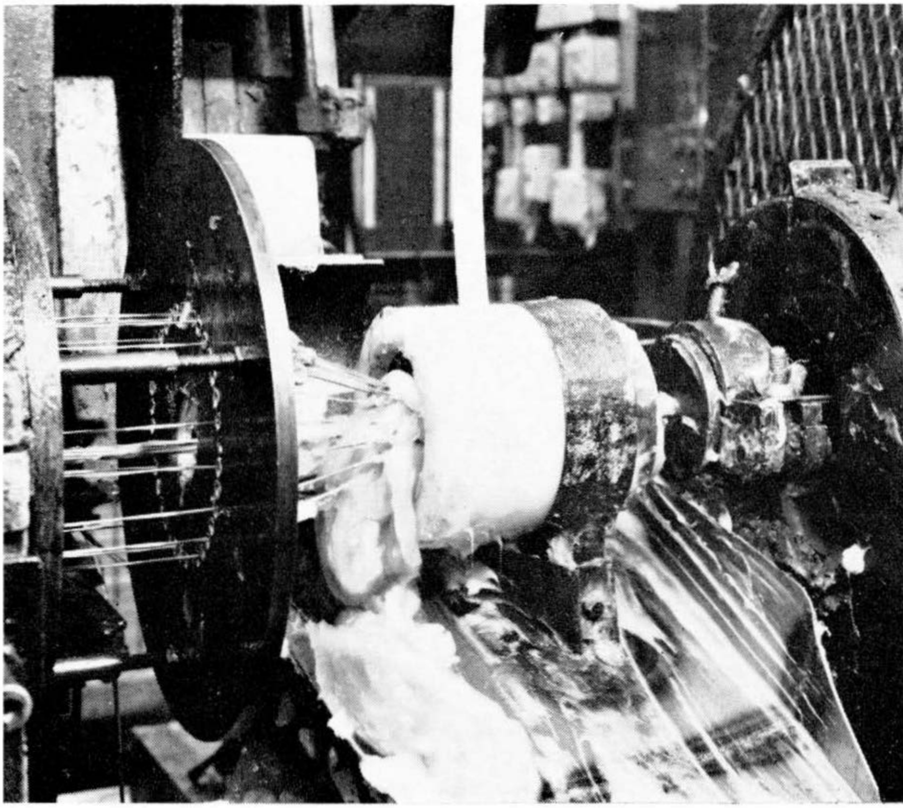
Until now, water seepage has been one of the main causes of breakdowns in service and one of the most difficult hazards which telephone engineers have had to face. The new cable should virtually put an end to the problem.

It has other advantages, too. It is lightweight, cheaper to produce than the cables it will replace and easy to splice.

Conceived and developed by British Insulated Callender's Cables Ltd. and now being made by a number of manufacturers, the new waterproof cable contains conductors which are insulated with cellular, instead of solid, polythene, the space between the conductors being filled with petroleum jelly which is a perfect water repellant. It is being installed in that section of the network which uses cables with up to 100 pairs. Some 25,000 sheath miles of such cables are installed each year.

Polythene-insulated and sheathed cables were first used in the Post Office network in 1950. Their introduction was gradual and it did not become apparent for some years that they failed to provide the complete solution to the water penetration problem which a solid film of polythene insulation was expected to provide.

These cables are usually buried directly in the ground which is frequently waterlogged. Water can penetrate the cable sheaths either as a result of damage caused by the digging activities of estate developers, public service utilities and householders, or through water vapour permeation. Water travels along the air spaces between the conductors, and even if breakdown of service does not then occur because of minor imperfections in the insulation, poor transmission quality and "overhearing" can result.



Petroleum jelly is injected into the new cable in a continuous flow. This new system of filling cables has many advantages for the cable manufacturer.

Pressurisation—the standard method used for detecting sheath defects in the larger exchange cables and enabling preventive maintenance to be carried out before water can enter a cable—is impracticable to operate economically on distribution cables. So, in 1963, waterblocks were developed for use in the distribution cables.

These waterblocks consist of semi-plastic, or putty-like, material injected into the cable strand at 20-yard intervals. However, producing satisfactory waterblocks created difficulties for the cable makers and removing the block material at the cable joint proved to be a considerable nuisance.

The new waterproof cable, now coming into general use, is expected to solve all problems since water cannot enter the petroleum jelly-filled space between the insulated conductors. In addition, the new system of filling with a continuous flow of material has considerable manufacturing advantages over the former system which involved the intermittent injection of block material. Nor do jointers find the petroleum jelly objectionable to work with.

It has been necessary to change the form of insulation in the new cable from solid to cellular polythene so that the original transmission characteristics of the cable can be maintained

The best insulation is air, but wires in cables must be prevented from coming into contact with one another so that the use of spacing material such as paper or polythene is essential. Even with these materials, however, air still plays a useful part but in the new cable the air is replaced with petroleum jelly. The only way to redress the balance is to arrange for the polythene insulation to contain a large number of air pockets—hence the use of cellular polythene.

The production of this new type of insulation, which possesses the correct degree of expansion and at the same time is sufficiently robust to withstand without damage the cable-making pro-

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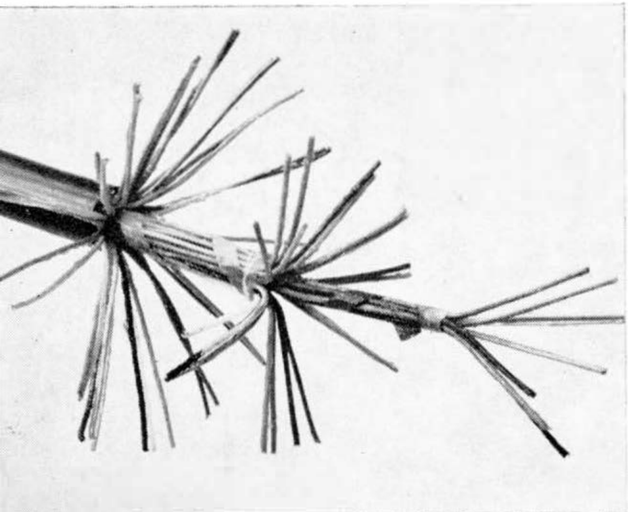

A fully-filled 30-pair twin polythene cable showing the jelly adhering to the conductors.

cesses and subsequent installation and jointing, is a notable achievement.

As a result of an extensive testing programme for compatibility, no undesirable effects are expected from the continued intimate association of the pharmaceutical grade of petroleum jelly used in the new cable and the cable insulation and sheath.

There could be a large area of application for cellular insulation and the experience gained with it in the new waterproof cable may lead to its use in other spheres—possibly in the 200 to 4,800 pair range of exchange cables or even in main cables, although not necessarily in association with petroleum jelly.

THE AUTHOR

Mr. E. E. L. Winterborn *is a Senior Executive Engineer in the Engineering Department's Test and Inspection Branch and is responsible for the Post Office purchasing specifications for cable and wire.*

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A NEW CABLE TO THE NETHERLANDS

THE shore-ends of a second submarine telephone cable between Covehithe (near Lowestoft) and Katwijk (in the Netherlands) are now being laid by the Dutch cable ship Poolster.

This new 480-circuit capacity link between Britain and the Netherlands will be about 120 miles long, with transistorised repeaters every eight-and-a-half miles. Power for the amplifiers will be fed along the central conductor of the main cable and the return path for the current will be by way of the sea.

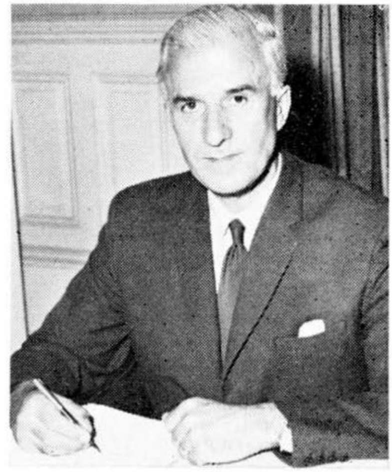
Two cable ends are being landed at Covehithe. The first is a four-mile long section of the main transmission cable and the other a one-mile length to provide the connection with the sea for power-feed purposes. The main sea cable is expected to be completed by the end of this year —probably by the Post Office cable ship HMTS Monarch.

This second cable between Covehithe and Katwijk is the third of the three 480-circuit cables announced last year. The shore ends of the other two cables—at Cayton Bay (near Scarborough) and Kristriansand (Norway) and at Hengistbury Head (Hampshire) and St. Helier (Jersey) have already been laid.

The shore-end cable is hauled ashore from the Dutch cable ship Poolster as she lies off Coverhithe. The new cable will have a capacity of up to 480 circuits.

As the day draws near when the Post Office becomes a public corporation, the Deputy Chairman announces significant changes in organisation and explains how the new measures are likely to affect management at all levels. He emphasises that there will be a growing need for individual responsibility and a more businesslike approach

PREPARING FOR CORPORATION STATUS



SWEEPING and far-reaching changes in the management structure of the Post Office to prepare it for the day when it becomes a public corporation are announced in an official booklet published as the *Journal* went to press.

The changes will affect management at every level throughout the Post Office. They will be introduced as soon as possible so that by the time the Corporation is created on 1 April, 1969, it will be geared to operate its two main businesses—posts and telecommunications—in a more positive and independent way, free from the inhibitions and lack of flexibility which have hampered the Post Office in the past.

"The Post Office needs to be reconstructed quickly into two separate businesses because each has widely different operating characteristics and problems; each is growing at a different rate and must be free to develop at its own pace; and each has its own requirements for successful management which demand concentration of attention," says the booklet.

"Underlying the structural changes is the intention to make three basic changes in the running of the Post Office: to assign clear responsibilities for specific end results throughout the Corporation; to change policies and practices in

In changing the status of the Post Office we are creating the environment for a new approach, says the Postmaster General in a foreword. This approach should give better opportunities for all who work in our great organisation

ways which will help and encourage all levels of staff to give their best performance; and to adopt a more positive approach to management to sharpen the sense of purpose and urgency of the entire organisation.

"This approach springs directly from the requirements of the Post Office's important tasks. The change of status provides a uniquely suitable opportunity to do what is necessary."

The interim organisation of the Post Office as a whole is set out in the chart on page 6. After vesting day the two businesses will have control of their own support functions, but during the interim stage a number of the responsibilities at present performed in the common services departments and which will in due course be transferred to the businesses, will be centrally located. Some buildings functions, for example, will be transferred to the businesses as quickly as possible, but other responsibilities of the Buildings and Welfare Department must remain centralised temporarily. As responsibilities are transferred to

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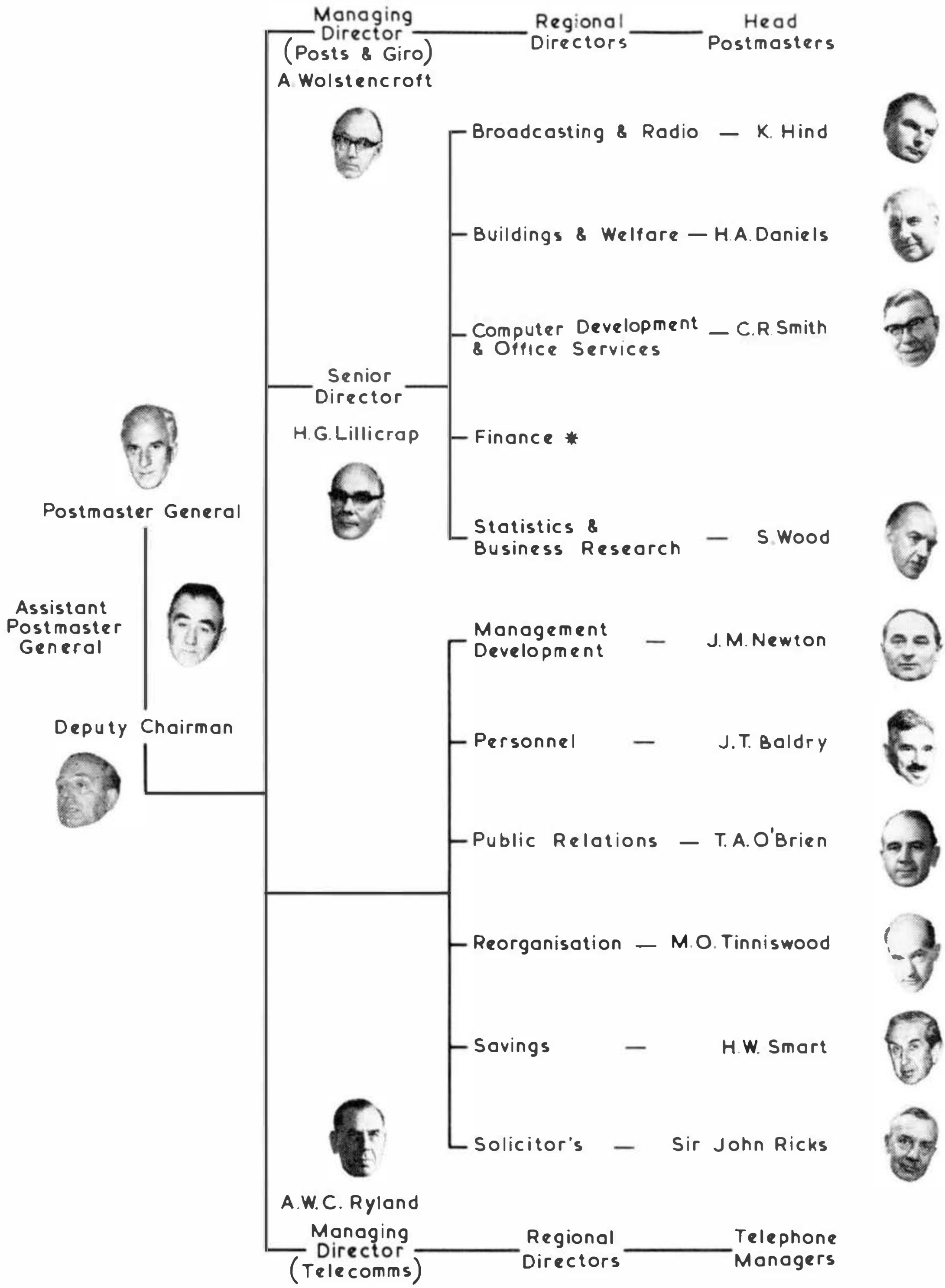

* Not being filled at Director level.

This chart sets out the interim organisation of the Post Office as a whole the two businesses, BWD will assume responsibility for the preparations for setting up the Residual Ministry. A small group will also be created to deal with senior management development in the Post Office generally.

On the telecommunications side a new interim Headquarters will be set up which will involve integrating most of the Engineering Department with the Inland Telecommunications Department and the External Telecommunications Executive and absorbing a great deal of the work of the common service departments.

Under the Managing Director there will be three Senior Directors. One of them—Mr. J. H. H. Merriman (at present Senior Director Engineering)—will act as technical adviser to the Managing Director and be responsible for research and development, long-range planning and network planning and programming down to group switching centres. He will also be responsible to the Managing Director (Posts) for research and development in postal engineering and be a member of the present Post Office Board in a personal capacity.

The second Senior Director—Mr. A. B. Harnden—will be responsible for operational programming, sales and service, a marketing division and the External Telecommunications Executive. The third—Mr. E. W. Shepherd (at present Director of Finance and Accounts)—will be responsible for personnel and finance.

It is not proposed at present to make any changes in the structure and responsibilities of ETE except to transfer to it certain parts of the Engineering Department and the operating functions of the Wireless Telegraph Section. Its future position in the organisation will be reviewed later.

Two new departments are to be set up: a Management Services Department headed by Mr. T. H. Southerton (at present Controller, Factories Department) and a Purchasing and Supply Department led by Mr. K. H. Cadbury (at present Director Inland Telecommunications (Planning)). The Management Services Department will be concerned with increasing the efficiency and productivity of the business in all its aspects, but be essentially advisory. The decision whether or not to accept its advice will remain with those who have executive responsibility for carrying out the various functions.

The new Purchasing and Supply Department will be responsible for the Contracts Department,

★ ★ AFTER VESTING DAY ★ ★

When the Corporation is set up, a **Residual Ministry** will be created to carry out a number of functions at present performed by the Post Office—for example, broadcasting policy, governmental relations with the BBC, ITA and international organisations and the administration of the Wireless Telegraphy Act and so on. It will also assume such responsibility for the Corporation as is retained by the Government.

There will be a **Board,** small in number and composed mainly of executive members. Its composition will be announced when the Minister has appointed the Chairman.

The Secretary of the Board will also run a **Corporation Headquarters** which will be the focal point for inquiries from MPs and dealing with the Residual Ministry on general matters and so on. There will also be other centrally-located services, such as legal, public relations, statistics and business research, and small groups dealing with establishment, finance and personnel matters not decentralised to the two main businesses. Research and development, which will initially be put under telecommunications, is likely to become a corporation function.

Factories Department, Supplies Department, the Test and Inspection Branch of the Engineering Department and a group dealing with value analysis. It will work directly to the Managing Director and, until a separate Department is established for Posts, it will be responsible to the Managing Director (Posts) for stamps, clothing and so on.

The Regional and field organisations are also to be drastically changed, all provincial regions except Northern Ireland being functionally split under separate directors. "This process accords completely with the aim of allowing the two services maximum freedom to develop on independent lines," says the booklet.

Organisationally, the regions will conform as far as possible to the Headquarters pattern, Regional Directors at this stage reporting to their respective Managing Directors. How this general approach can be applied to the existing London functional Regions is being considered.

On the telecommunications side, the new regional organisation will normally have four main branches under the Director: Planning and Programming; Operations; Personnel; and Finance. The precise allocation of functions between these branches will depend on local circumstances.

The booklet adds that the sub-regional organisation is being considered separately. "Changes

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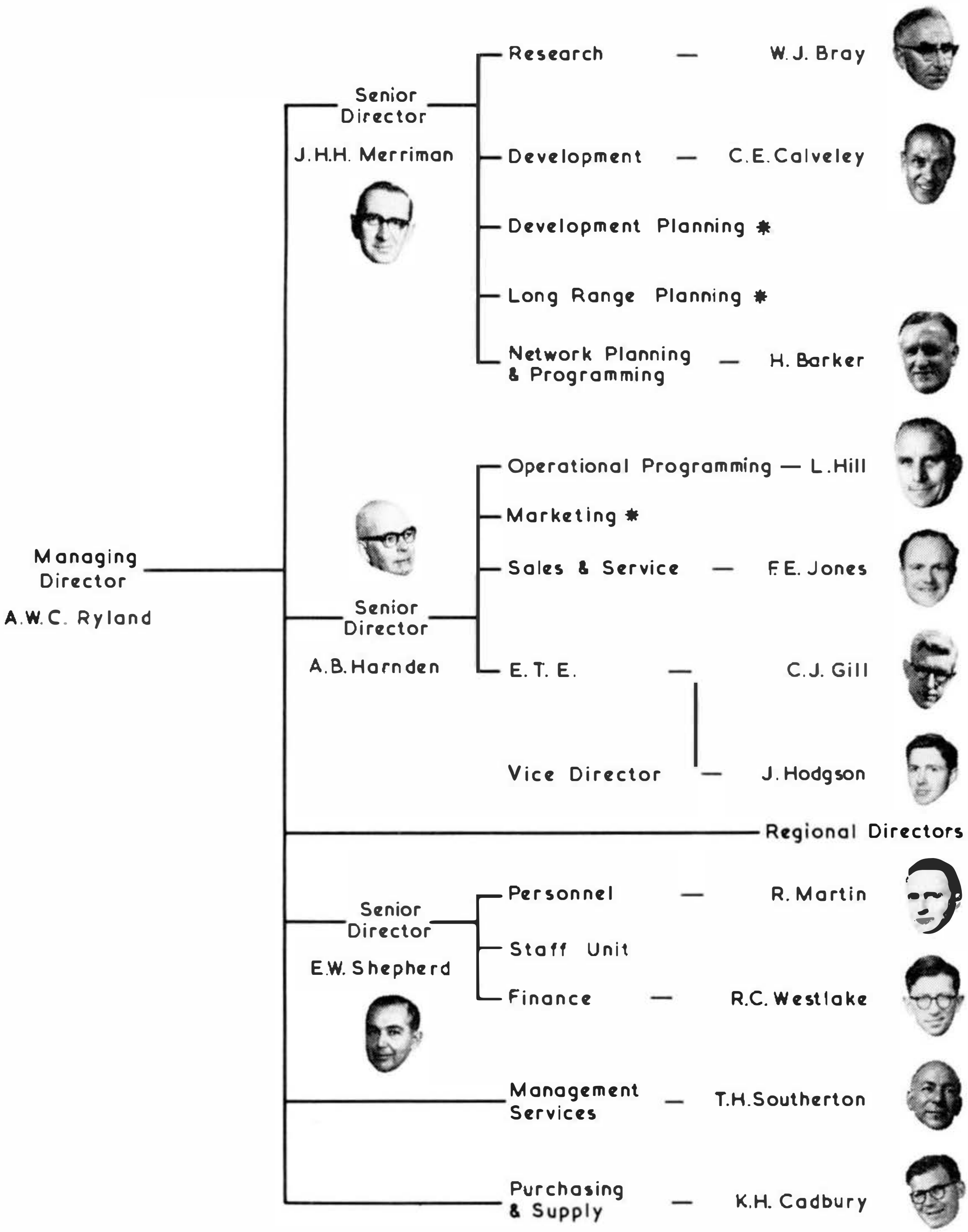
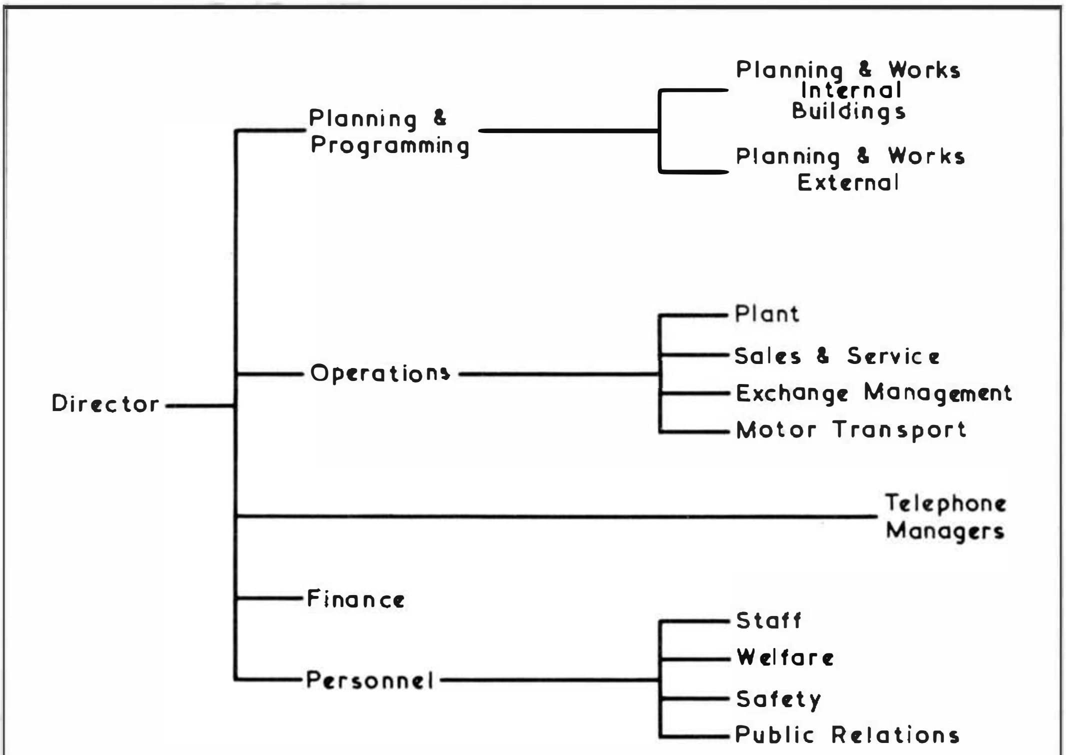
below regions could affect even greater numbers of staff than those already outlined. . . . "We shall aim to devolve more planning works from Regions to Areas where this would make a viable planning unit. In addition, it is possible that we shall appoint Service Managers in the larger towns (for example, those in which there is at present a significant engineering force)."



* Not being filled at Director level.

The interim organisation of the telecommunications headquarters



The interim organisation of the telecommunications regions

THE NEW REGIONAL DIRECTORS


Mr. Weaver


Mr. Glanfield


Mr. Wratten


Mr. Coleman


Mr. Knapman


Mr. Greenlaw


Mr. Revell


Mr. Edwards


Mr. Neal


Mr. Coates

The above have been appointed Directors Designate of the Telecommunications Regions with effect from 1 October:
South Eastern: Mr. L. J. Glanfield.
Eastern: Mr. D. P. Wratten.
Midland: Mr. W. L. A. Coleman.
North Eastern: Mr. D. E. Knapman.
North Western: Mr. J. V. Greenlaw.
Scotland: Mr. H. J. Revell.
South Western: Mr. S. J. Edwards.
Wales and Border Counties: Mr. E. E. Neal.

Mr. E. W. Weaver remains Director of London Telecommunications Region and Mr. G. H. Coates remains director of the joint postal and telecommunications headquarters in Northern Ireland.

More Positive Management

If the Post Office is to give the public the most efficient services possible, the change to a public corporation must be accompanied by a drive towards more positive management, says the Deputy Chairman

"THE organisation must clearly distinguish the factors critical to the success of each business and assign responsibility for them to individuals in such a way that the latter can be held accountable for the results at all levels," writes the Deputy Chairman, Mr. John Wall, in a section explaining the reasons for the changes.

"Flexibility must be built into the organisation to enable it to cope successfully with changes .... The existence of a complex of hierarchical structures in the past has required co-ordination through committees on many management issues, which has led to shared responsibility for almost all major decisions ... co-ordination is a problem and whatever organisation is adopted there will always be a need for lateral communication. But the organisation should be such that this does not blur the responsibility for decision taking ....

"Each business must have responsibility for the conduct of its operations and be provided with the support functions essential to efficiency. Thus, Posts and Telecommunications must each have control of its buildings, establishments and personnel, finance and motor transport. Above all, the engineering functions that are vital to the success of the businesses must be integrated with the businesses themselves....

"In essence the need is to divide the activities of the business according to the work to be done, not to fit in with a pre-determined hierarchical structure of grades.... It is necessary to organise by function and to integrate the various hierarchies whose activities are directed to a common purpose.

"The changes ... reflect the continuing need for a Post Office dedicated to giving the public the most efficient services possible, but they will not achieve this unless they are accompanied by a drive towards more positive management."

After referring to a statement by Messrs. McKinsey (consultants called in to study Post Office organisation) that rule books, pay and promotion practices and staff side relationships were three factors which tended to inhibit the drive towards more positive management, Mr. Wall says: "Whether or not we accept these statements in their entirety, they clearly raise issues which we must do something about.... There will always be a need for rule books, but they should not attempt to lay down every conceivable detail and should encourage initiative by local managers, after discussion with their staffs where appropriate, to interpret them to suit local circumstances. Again, the practice of full staff consultation, which will continue, highlights the need ... for both sides to look at the consultative machinery in order to minimise delays in introducing changes.

"Positive management rests on two principles: a ready acceptance of individual responsibility to manage so as to give the customer the most efficient services possible; and increasing cost-consciousness and financial awareness throughout the Corporation.

"The first calls for clear-cut and wise leadership coupled with recognition that management's principle task is to make decisions for which it will be held accountable, and for delegation of authority to lower levels so that management time can be focussed on the key problems of the Corporation, with particular emphasis on improving services and reducing costs.

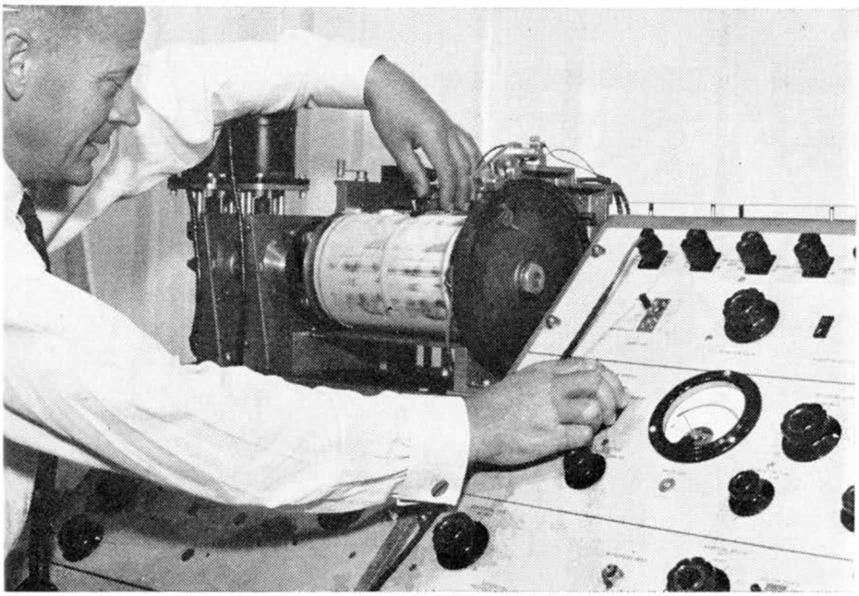
"The second recognises that the only right way to achieve the financial performance the Government requires is by constant dedication to cost-reduction and the improvement of productivity....

"This approach does not, of course, differ in essence from the way in which many Post Office managers have seen their jobs in the past. What is new is the environment within which managers and their staffs will be working and the greater scope which this will give for individual responsibility. In this way, methods of management which are already being tried will be developed. Managers will be expected to run their part of the organisation in such a way as to achieve set targets involving the basic elements of their jobs—giving their customers the best possible service and developing good customer relationships, making the maximum possible contribution to profitability and, since man management is so vital to success, developing staff relations in a progressive way."

UNCOVERING THE SECRETS OF SPEECH

By J. N. HOLMES

At a research laboratory on the outskirts of London, Post Office engineers and scientists are seeking the answers to the problems of speech and using the information to improve the telephone system



The author removes a completed spectogram from a spectograph at the Post Office speech research laboratory at Eastcote. Spectograms show the sound power of speech at different frequencies and how this pattern changes with time

SPEECH is the name given to the sounds people make when they talk, when they communicate using their mouths, tongues and vocal cords. However, the precise nature of speech is not at all obvious, and it is very important in the Post Office to know as much as possible about the basic process of speech communication.

The more we know about speech the easier it will be to make sure that the telephone correctly reproduces the important features for the listener. Clearly, there is no point in installing expensive telephone equipment to reproduce subtle details of speech sounds accurately if the listener cannot tell whether they are correct or not.

Laboratories all over the world, including the Post Office Speech Research Unit at Eastcote, Middlesex, are carrying out research on different aspects of speech communication and over the last 30 years or so a great deal has been found out. We now understand fairly well how speech is produced.

There are two basic types of sound source for speech. One is the noise of puffs of air being released by the vibrating vocal cords, which are not really cords at all, but folds of elastic tissue across the top of the trachea. If it were possible to chop someone's head off and listen to the noise coming from the vocal cords it would not sound at all like speech but rather like a harsh buzz. However, it would still have all the pitch inflections of natural speech because pitch is determined almost entirely by the frequency of vibration of the cords. The vocal cord buzz is used to produce vowel sounds and also a few consonants such as m, n and l.

The other type of sound source is the result of turbulence when air is forced through a constriction in the mouth. A good example is the hissing noise we produce when we make the sound

OVER

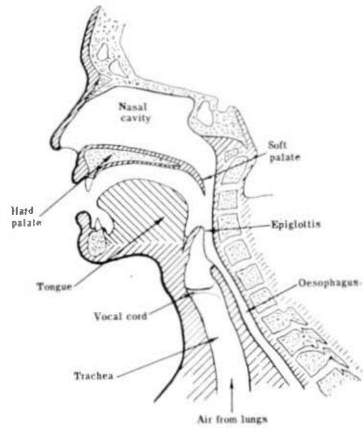
s. Some speech sounds, such as z, use both types of sound source at the same time.

The two basic sound sources are modified by the acoustic resonances of the mouth, throat and nose, and we control these resonances, mainly by moving the tongue, to control what words we are saying. Mostly the sound comes out of the mouth, but for nasal consonants, such as m and n, the airway through the mouth is blocked and the sound goes behind the soft palate and out of the nose. For most other sounds the soft palate is pressed against the back of the throat, thus preventing air from going through the nose.

We can break down continuous speech into a sequence of individual sounds. So, if we know how each sound is produced, what more do we need to know? Unfortunately, knowing roughly how speech sounds are made is only a first step in understanding what features are important.

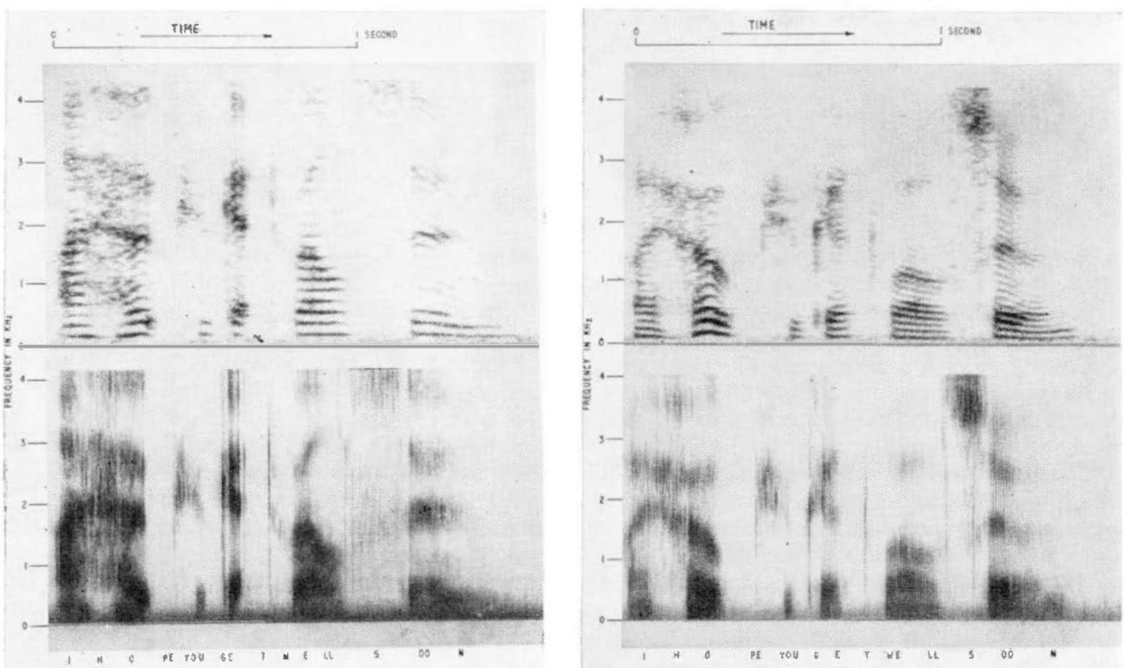
One difficulty in the study of speech arises because the meaningfully distinct sounds of a language (which phoneticians call the *phonemes*, of which there are about 40 in English) are not always produced in the same way. The actual sound cor-

This simplified section of the head shows the positions of the main vocal organs



responding to a particular phoneme can vary enormously, depending on which phonemes occur before and after, whether the speaker is talking slowly or quickly, what part of the country he comes from and many other factors.

A simple example of this variation is seen if you compare the word *high* in *high time* with that in *high mountain.* A normal listener would consider that these two words sound the same but, in fact, at the end of the word *high* in *high time* the tongue



These two pictures are of spectograms recording two different speakers saying the words: "I hope you get well soon." The upper spectograms were produced using a high resolution filter (30 Hz bandwidth) and the lower ones with a filter with lower resolving power (240 Hz bandwidth) will already be in position for the t, while in *high mountain* the lips will be closed and the soft palate lowered for the m. These variations make quite a lot of difference to the sound quality in *high* and are very important clues for recognising the following consonant.

Human listeners manage to cope with all these variations because they are so familiar with hearing speech that they subconsciously know all the differences which occur. They sometimes have difficulty recognising some sounds, but here context helps tremendously. Our experience of conversation is so great that we can guess most of the phonemes in a message so long as we hear vaguely what they sound like.

Having set the scene, the next thing is to introduce the instrument which all speech laboratories use to see what is happening in speech. This machine is called a spectrograph and the picture it produces is known as a spectrogram.

Spectrograms show how the sound power of speech occurs at different frequencies and how this pattern varies with time—see illustrations. The blackness of the picture at any point indicates how much power there is at a particular time and frequency. The machine contains an electric filter to separate the frequency components and, if the filter has enough resolving power, it is possible to separate the overtones of the fundamental frequency of the vocal cord wave as shown in the upper spectrograms. If the resolving power of the filter is not so high you get a better picture of the effect of the resonances in the mouth, without being confused by changes in fundamental frequency. These resonances are known as 'formants'.

Spectrograms show up most of the important features of speech and, in general, any differences between speech sounds one can hear can be seen on a spectrogram. Research workers use the spectrograph as a standard instrument for examining speech rather as a doctor uses a stethoscope.

One way of finding out what really matters in speech transmission is to study artificial speech. When speech is made by machine we know exactly how it is produced and can modify the machine in carefully controlled ways to see which changes affect the resultant sound quality. Obviously, you cannot do this with human talkers.

Speaking machines use electronic circuits for the functions of the vocal cords, mouth and so on. If sufficient care is taken to make these electronic circuits copy the human speaking system the artificial speech can then be virtually indistinguishable from the human speech it is imitating. The controls for such a machine must make the fundamental frequency, the formants, loudness and turbulent noise all change in the right way for the utterances being copied.

In addition to finding out what makes speech sound natural, artificial speech may also be used to find out what it is in speech that makes it say a particular message. We have recently investigated this in the Post Office using 'speech synthesis by rule'. In this, rules were formulated which related the control of a speaking machine to the phonemes in a message. These rules were embodied in a computer programme. The computer input was the text (in phonetic spelling) of whatever message was wanted. The output was the set of control signals for the talking machine. By listening to the faults in the artificial speech the rules which needed changing were found. We have now produced a set of rules which will make completely intelligible speech for any desired written text.

Apart from its uses for research, speech synthesis by rule has practical uses as a way of making computers talk. In many instances computers are now used to control various information services—such as stock market prices—and the telephone is frequently the only convenient way of getting the information to the people who need it. Computers now need to talk and synthetic speech is the most versatile way of fulfilling the need.

At present anyone wanting information by telephone from a computer can only indicate what he wants to know by dialling a suitable code number. Fairly soon it may be possible to speak the request and get the computer to recognise the words. Much research into automatic speech recognition is now going on, but the task is made very difficult by the variability in speech sounds. Even so a fair degree of success is already being achieved for a limited number of words and a usable system will be developed eventually. Once this has been done the way will be open for many more services for the public to be made available from the telephone.

THE AUTHOR Mr. J. N. Holmes *is a Principal Scientific Officer in the Joint Speech Research Unit where he has worked since it was first formed as part of the Post Office in 1956.*

Now satellites help out cables

By D. G. HOLLAND

Under a new mutual-aid system, satellites are now being used to restore services if a trans-Atlantic submarine cable breaks down. The scheme is a fine example of international co-operation in telecommunications

IT WOULD have sounded far-fetched only a few years ago to talk of satellites coming to the aid of submarine cables. But in today's rapidly-advancing world of communications this is now being taken for granted.

Guiding rules and principles for restoring cable services by satellite have been agreed by European an North American administrations under a Mutual Aid Pact. Now, when a trans-Atlantic cable fails, services are being restored with the aid of the satellites INTELSAT I (*Early Bird*) and INTELSAT II (launched over the Atlantic in March, 1967).

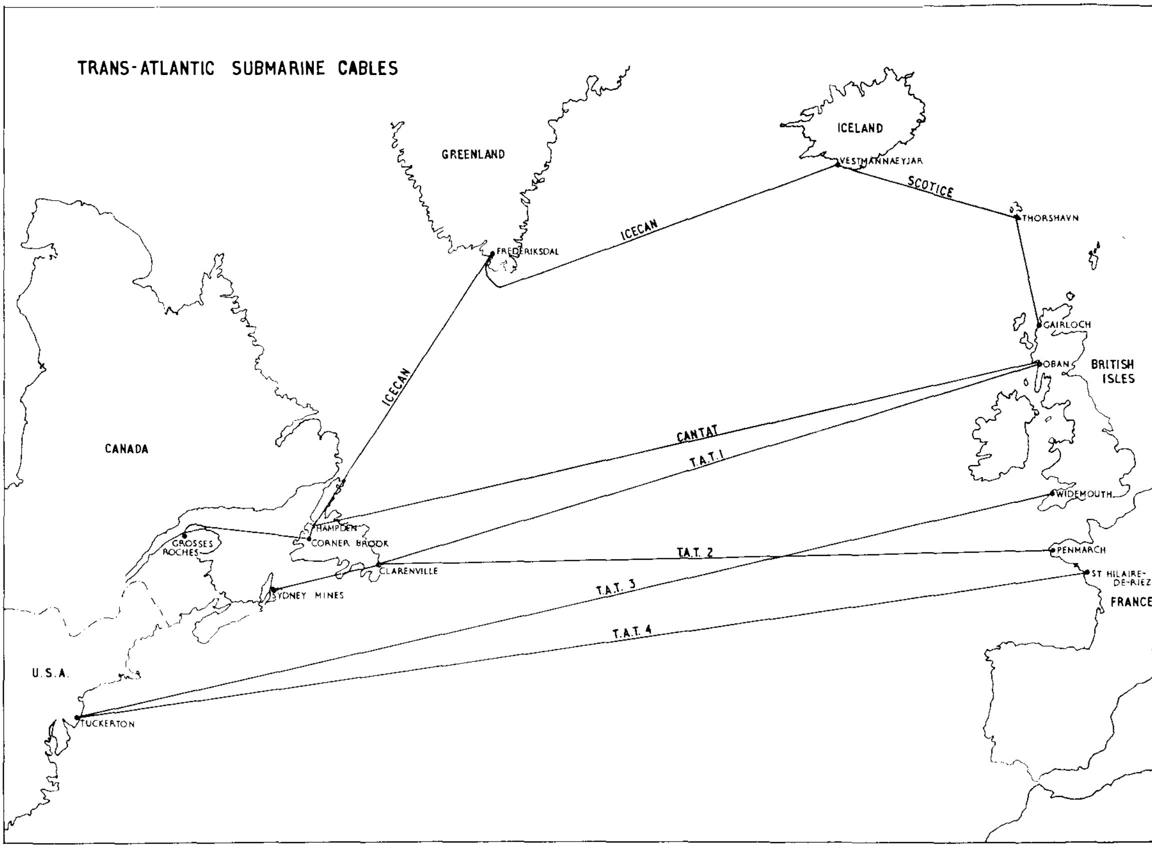
This form of mutual aid is expected in future to include all forms of telecommunications transmission systems.

Before satellite communications became possible, "mutual aid" meant that if a trans-Atlantic submarine cable failed, all the administrations and operating agencies involved co-operated to restore service as fully and quickly as possible over other cables. These mutual aid arrangements included the permanent exchange of groups in certain cables, the use of spare cable capacity for circuit re-routing and obtaining additional circuits over and above the two-to-one advantage normally gained by the London and Paris Time Assignment Speech Interpolation (TASI) installations.

By the middle of 1966, all trans-Atlantic cables terminating in Britain were fully utilised and only TAT—4 (from the United States to France) had any spare capacity. The rapid growth in demand for the trans-Atlantic cable services (now provided by six submarine cables) made plans for restoring service very complicated and unwieldy. The amount of individual circuit patching required at the many international centres involved took considerable time to achieve the planned results. In one

instance, more than 400 patch cords were in use in London alone and restoration procedures were still being carried out three days after the failure!

The availability of a four super-group broadband link through INTELSAT I, of which only a small part is at present used commercially, enabled a review of the restoration procedures to be undertaken with the object of obtaining a 100 per cent



Above: The trans-Atlantic cable system. Left: An engineer at work on Early Bird *(now called* INTELSAT I)*—one of the two communication satellites being used to restore service on cables.*

restoration of a failed cable by using the spare capacity of INTELSAT I and group patching instead of circuit patching.

At a meeting of submarine cable owners in Paris in May, 1966, six guiding principles were agreed for restoring cable services by satellite. First, there would be 100 per cent restoration for single cable failures; second, all services would be restored as rapidly as possible; third, easy engineering methods would be used; fourth, the restoration procedures would include spare cable and satellite capacity; fifth, there would be the least possible interruption of inter-European services; and sixth, a stable restoration plan would be maintained.

Subsequently, the cable owners and all interested administrations and operating agencies from both sides of the Atlantic approved the Restoration Plan at a meeting in Munich and a permanent Mutual Aid Working Group (MAWG) was set up under the chairmanship of Britain (represented by the External Telecommunications Executive of the Post Office). The main task of this Working Group was to finalise the plans in detail and to co-ordinate the extensive engineering work required to bring them into effect. The Group was also charged with responsibility for future plans and for up-dating the arrangements.

The preparation of the plans had to take account of various operational and technical limitations imposed by the existing cable network and the relatively long propagation time of the geo-stationery satellite route. These limitations include such things as the need to restore many private wire services on cable facilities with diverse routings; the technical inability of some

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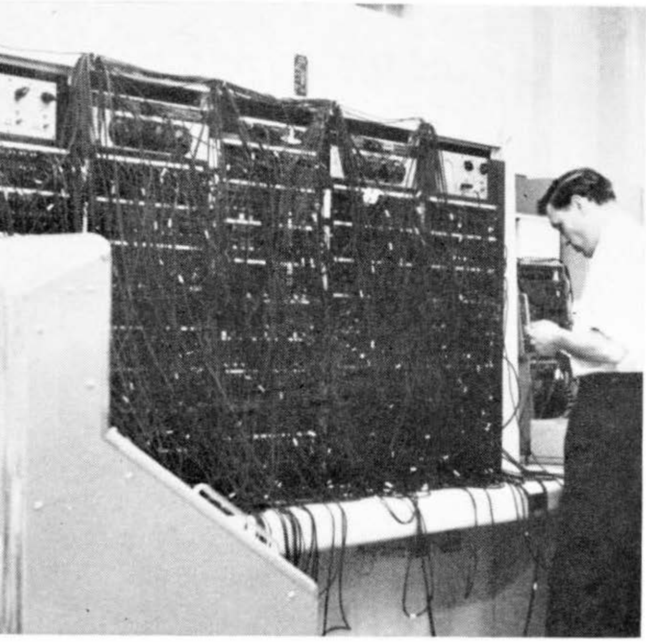
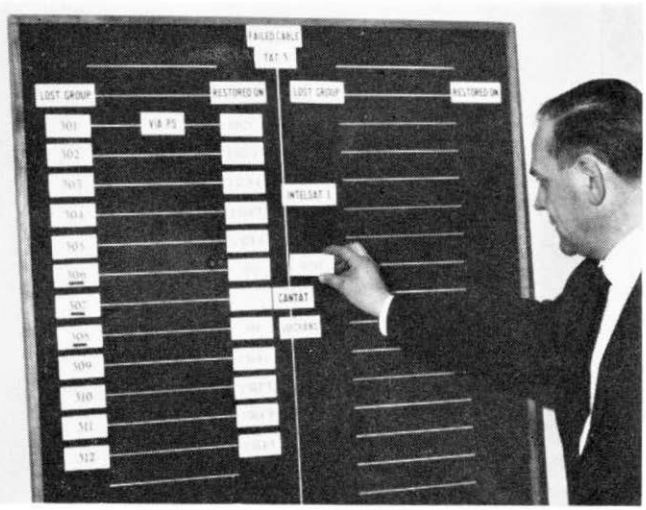




Left: AEE Mr. C. Moore at work on one of the patching positions at the London International Maintenance Centre during a cable failure before the new restoration scheme was introduced. Above: Mr. L. Thomas, of ETE, Chairman of the Mutual Aid Working Group, tries out some of the many possible combinations to produce the restoration plan.

telegraph-type equipment to achieve restoration over a long propagation time circuit; the need to restrict the number of telegraph-type circuits in a group to avoid equipment overloading; the need to keep TASI connection channels in one medium that is, either all cable or all satellite; the need to avoid restoring long haul Commonwealth circuits in the Commonwealth Trans-Atlantic (CANTAT) cable by way of the satellite; and, finally, the need to extend the 12-hour operational day of the normal satellite service to 24 hours.

Two of these problems have now been solved. All telegraph-type equipment in Europe, except data equipment, has been modified to take account of the long propagation times associated with satellite working; and, in the event of a trans-Atlantic submarine cable failure, the satellite link remains operational for 24 hours a day throughout the period the failure lasts.

The main aim of the group patching plan is to ensure speedy restoration of priority services requiring a cable routing. To this end, five groups in the TAT-3 and four in TAT-4 have been selected to have both a low priority and a capability of satellite restoration. This arrangement makes possible the immediate restoration of TAT-1 in TAT-3 and TAT-2 in TAT-4 by transferring the low priority groups in TAT-3 and TAT-4 to the satellite network. Failure of TAT-3 or TAT-4 is met by using three groups in the surviving cable for restoring failed priority circuits, the remaining groups being restored by satellite. Similar arrangements exist for the failure of CANTAT.

Because of the physical arrangements of submarine cable circuits, there are no trans-Atlantic through groups between any of the principal International Maintenance Centres where group patching would be carried out. Submarine cables consist of groups of sixteen 3kHz channels and, on inland networks, groups of twelve 4kHz channels.

Since routing of circuits over the inland sections had been decided by the individual administrations there was no guarantee that 12 circuits in one group arriving at, say, London, would be the same 12 circuits arriving in a group at White Plains, in New York. Straightening out the 12-channel groups of circuits meant that there had to be some 300 changes on all the cables involved.

The final selection of the individual circuits within a 12-channel group had to take account of operational and technical limitations and, in addition, to ensure that there was adequate

TWO MORE SATELLITES

TWO NEW communication satellites are now in synchronous equatorial orbit.

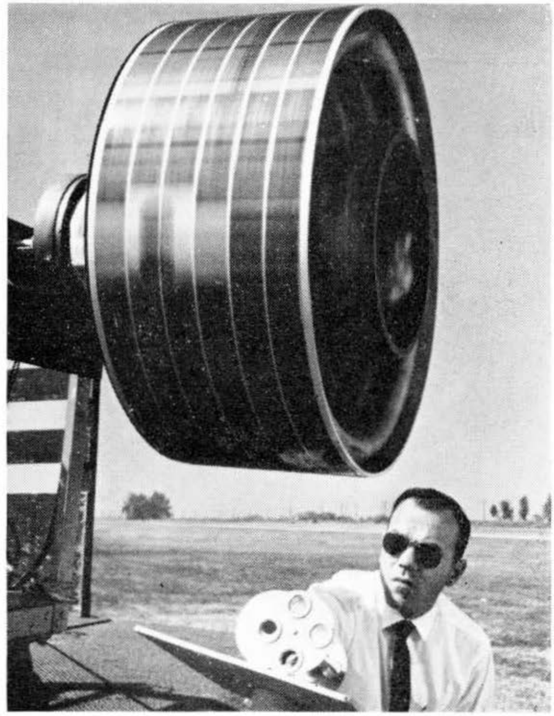
They are the INTELSAT II satellites (owned by the International Telecommunications Satellite Consortium, of which Britain is a member), a bigger and improved version of the *Early Bird* (INTELSAT I) satellite.

The first INTELSAT II satellite was launched over the Pacific Ocean in January, and the second over the Atlantic in March.

Like *Early Bird*, the INTELSAT II satellites provide roughly the same relaying capacity—240 two-way telephone circuits or their equivalent—between high performance earth stations. However, the INTELSAT IIs have higher transmitter power and less aerial directivity so that they can serve a larger geographical area. Unlike *Early Bird*, the new satellites have transponders without amplitude limiters, thus allowing signals from a number of earth stations to be relayed simultaneously. Only two earth stations at a time can operate by way of *Early Bird*.

The INTELSAT II satellites were launched primarily to supply support communications for the United States' moon-landing programme but about half of their capacity will be available for other commercial requirements. The Pacific satellite will provide commercial circuits for earth stations in the United States, Hawaii, Australia, Japan, Thailand and the Phillipines. The Atlantic satellite, which supplements *Early Bird*, will allow Spain and Italy to start regular satellite communication service with the United States.

A new generation of communication satellites—the INTELSAT III—is already being developed and it is hoped that the first of them will be launched in June, 1968. They will have a total transmitter power of 20 watts and directive aerials designed to cover little more than the visible earth's surface. Three will probably be launched, positioned over the Atlantic, Pacific and Indian Oceans respectively, so that a virtual global coverage will be feasible. Each new satellite will probably have a capacity of about 1,200 two-way telephone channels.



INTELSAT II *undergoes final testing before being launched over the Atlantic. This satellite is also being used to restore service on failed submarine cables. It is able to handle hundreds of telephone calls and television signals.*

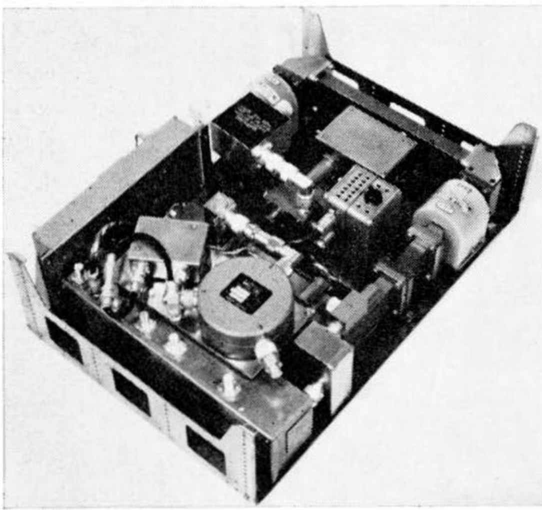
diversity of routing for United States telephone and telegraph services to those countries with smaller traffic routes—Sweden, Norway, Denmark, Holland and Belgium, Switzerland, Italy and Greece. An additional 200 circuit changes had to be made to achieve the required group allocations.

Although the new restoration plans meet service objectives, several technical problems had to be solved before the plans could be implemented. There were the difficulties, for example, of operating cable-type echo suppressors on satellite routings, of using a complete TASI equipment by way of a satellite and of operating sixteen 3kHz channel groups over satellite links for the particular case of a CANTAT restoration. In co-operation with the Interim Communication Satellite Committee and the manager of the Space Sector, COMSAT, the administrations involved have carried out a series of test programmes which proved that these difficulties could be overcome without loss of service.

The setting up of the Mutual Aid Working Group and of the scheme for restoring failed trans-Atlantic cable services by satellite is yet another example of the splendid co-operation which exists in the telecommunications field. But the Group's work is by no means ended. It will need to continue to update the arrangements as the availability and use of satellite facilities change.

Mr. D. G. Holland, *an Assistant Executive Engineer in External Telecommunications Executive, Engineering Branch, is Secretary of the Mutual Aid Working Group. He joined the Post Office as a Youth-in-Training at Baldock Radio Station in 1945.*

NEW EQUIPMENT FOR GOONHILLY



A prototype FMFB demodulator. It occupies a complete shelf of a CASE-type 62 rack.—Picture by courtesy of GEC (Electronics) Ltd.

A £150,000 contract has been placed by the Post Office for the supply, installation and testing of new and highly-reliable intermediate frequency and baseband equipment for the second aerial now being built at the Satellite Communication earth station at Goonhilly.

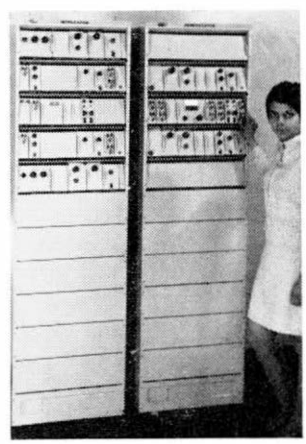
The new equipment will include three modulator and seven demodulator units for transmitting and receiving multi-channel telephony. Each unit will be able to accommodate any capacity from 12 to 252 channels.

In addition, there will be modulator and demodulator equipments for transmitting and receiving a television channel capable of handling colour programmes for 525 and 625 line standards, thus making it possible to interchange colour television programmes between Britain and North America.

Each set of equipment, which is being supplied by GEC (Electronics) Ltd., will possess a high degree of reliability and contain duplicate units which will be brought into service automatically should the quality in any of the channels deteriorate. All the equipments will be completely transistorised.

The new modulators have been developed to provide the very high linearity of operation which the transmission of multi-channel telephony signals over satellite systems demands and will be able to operate over a bandwidth of 32 MHz around a centre frequency of 70 MHz.

The demodulators to be used for receiving telephone traffic are of the threshold extension type, using a frequency modulation feed-back loop to achieve a threshold carrier-to-noise ratio some 5 dB lower than that of a conventional frequency-modulation demodulator handling 252 telephone channels and correspondingly larger threshold extension for smaller numbers of channels. They will be all solid-state devices and incorporate a specially-developed voltage-controlled oscillator to give the necessary highly linear control characteristics over the wide bandwidths required.



Typical modulator and demodulator rack layouts. The equipment is shown mounted in CASE-type 62 racks.

A novel feature of the new system will be the incorporation of carrier dispersal techniques to avoid undue concentrations of energy in the frequency spectrum when the carriers are not modulated with traffic. By this means, interference between carriers during periods of reduced traffic is minimised.

THE NATIONAL DATA PROCESSING PLAN

By C. R. SMITH

The Post Office is going ahead with its plans for a new data processing service based on a closely-linked network of computers covering most of the country. This article describes how the system will be set up and operate

A Leo 326 computer — one of seven similar computers now being used by the Post Office and located in London, Portsmouth, Derby, Edinburgh and Lytham St. Annes. Picture: Courtesy English Electric.

. . . and after sub-paragraph (iv) there shall be added the words: "and (v) the provision of services and facilities for the processing of data by computer".

NOW that these words—which form the operative part of a Bill passed by Parliament at the end of July—have become law, a brand-new Post Office service has been born.

It is to be known as the National Data Processing Service and it will present Post Office people with one of the greatest challenges they have yet had to face because it will have to compete for business with private enterprise without any special protection.

Before talking about the National Data Processing Service, let us take a short look at where computing now stands in the Post Office. As has so often been the case with new developments, the

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Left: One of the three LEO 326 computers in London, now being used for telephone billing and a wide range of other work

Post Office was well in the forefront in the use of modern computers. From the first of the modern type computer installations which it made in 1959 —used primarily for the calculation of wages and salaries—it has steadily developed plans for the use of computers throughout the whole fabric of Post Office organisation.

In the Computer Development and Office Services Department proposals have been prepared covering most of the major activities in the telecommunications, postal and banking fields, while at the same time considerable effort is being made in the Engineering Department into the use of computers for scientific and technical work. Thus, in Docos House, in London's Commercial Road, one may find a team at work on a design for the new Giro service to be opened next year, while next door another team is finishing a project which will enable a computer to produce the duty schedules for the thousand or so drivers providing the central mail services in London.

Throughout the country, postal and telegraph officers are looking up railway timetables to find out how to send mails from their offices to points all over the country. Another team in Docos House is engaged on the difficult task of reducing this operation to a computer process. Many readers will know that computer processes for preparing telephone bills in all their complexities are well on the way to implementation. Other teams are at work on various components of the processes performed in Telephone Managers' offices to put them on computers in such a way that they are linked together. This particular project is, in fact, as sophisticated an enterprise as has been projected or undertaken anywhere in the world.

Three machines in Chesterfield, Derbyshire, are used all day to read automatically the serial number of certain values of postal orders. These machines each sit on the end of a telephone line which terminates on a computer in Kensington, London, which, while receiving and dealing with the information extracted from the postal orders in Chesterfield, may at the same time be engaged in reading MATS cards for the preparation of telephone bills and preparing warrants for the repayment of savings certificates in the Savings Department.

All this means that the Post Office, although it would by no means claim to know all the answers to the many problems which arise in the computer field, has at least a very considerable store of expertise on these matters, and when the plans have all been brought to fruition a very large load of work will have been transferred to computers.

Post Office computers have already been installed in London, Portsmouth, Derby, Lytham St. Annes and Edinburgh and further installations in Leeds and near Liverpool are being planned. It is expected that by 1971, the Post Office will have 20 of the largest kind of modern computer just to look after its own requirements.

There is no fear of the computer taking over entirely from the human being in the Post Office. It is true that large volumes of routine and semi-routine work will be done by the machines but the rate of growth of Post Office business and the

Postal Order processing at Chesterfield, showing Crosfield Document Reader and Marconidata terminals.

people required to exercise the many new skills which the computer itself has created will mean that, in general, the Post Office will still find it difficult to recruit all the people it needs.

The other thing about the Post Office's own requirements is that they will require that these computers will have to be linked together. For example, when a computer in Leeds has finished the processing of a new subscriber connected to the system it will need to send a message to another computer—perhaps in Derby—saying: "*Mr. So-and-So of such an address is now a telephone subscriber; the number is* 123-4567; *he has the following inventory of equipment on rent; his date of commencement is so-and-so; please bring him on to the telephone billing system*". When the bill is ready, the computer at Derby which has prepared it may, in its turn, send a message to a computer near Liverpool telling that computer that the subscriber has agreed to pay his bill by Giro transfer. The picture is, therefore, that by the early 1970s the Post Office will have created for its own purposes and stretching over much of the country, what has been referred to as a "computer grid".

The National Data Processing Service will expand and develop the facilities offered by this grid and make them available to the general public. As the Postmaster General, Mr. Edward Short, said when introducing the Second Reading of the Bill in the House of Commons: "*We aim to provide any data processing service for which there is a customer with whom we can come to terms*". At the same time, the Postmaster General listed seven kinds of service which we would make available to the general public. These were: the sale of computer time or of data preparation or input services; a service of consultants who could advise and design computing systems for customers; a service of programmers who could write programmes for such applications; the connection of computer to computer, for example, by the Datel service. Then he said the Post Office would also develop the "desk top" computer; and what is known as the "data bank" facility.

The "desk top" computer is a service in which,

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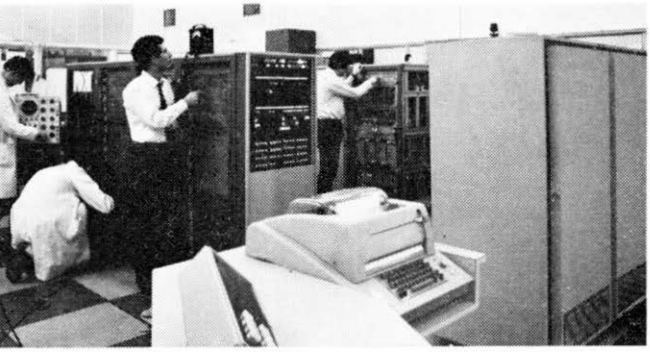
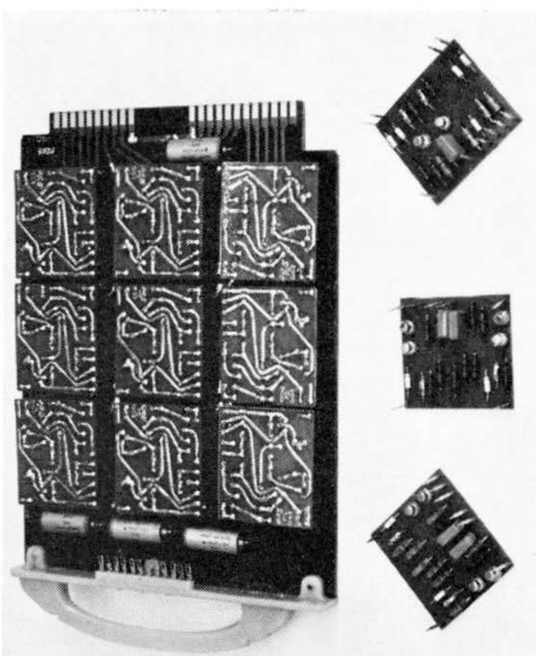
An operator at the console of one of the payroll computers (National Elliott 405), in use since 1959



An English-Electric System 4-70 computer. Five of these machines are on order and will be installed at Bootle, Leeds and Bristol

by means of some kind of desk top keyboard and printer, or perhaps a cathode ray display tube connected by wire to a large remote computer, all the facilities of that machine can be made available, for instance, to an engineer or scientist sitting at his own desk. A teleprinter is an obvious example of a remote interrogation unit which could be used in this kind of application. The difficulties are very considerable and a great deal of work and development will probably still be needed before the economics will allow this system to be as commonplace as one day it surely must be.



A printed circuit board of a LEO 326 computer. These boards use sub-modules which allows more logic circuitry to be incorporated in a single board, thus giving greater computing power without increasing the computer's size

The "data bank" is a concept where a file of information is maintained centrally on a computer in such a manner that it can be immediately interrogated. The file may be, for instance, a file of design formulae or of standard constructions for pre-cast concrete structures. The information might be maintained by a professional or trade body and, if maintained on a computer of the National Data Processing Service, would then be available to anyone who had access to the network. There seems almost no limit to the kind of development which could take place once the desk top computer and the data bank facilities have been brought into the realm of economic practicability.

A considerable part of the discussions which took place while the Bill was passing through Parliament was concerned with ensuring the confidentiality of information about private business which might be stored in the computers or come to the knowledge of people who were working in the Service. On storage, there is obviously a problem when a number of people have access by wire to a computer which contains information itself belonging to a number of different people. The problem, of course, is to prevent a user having unauthorised access to someone else's information and there are several techniques by which this can be done. The usual way is to make the intending enquirer answer a series of questions put to him by the computer and these can be made as complicated, or changed as often, as desired. If the user does not give the right answers to the questions the computer asks him, he will not be allowed access to the information. A further safeguard can be introduced by arranging that this dialogue can take place only from certain specified terminals.

The point was also made during the discussions in Parliament that people working in the Service, particularly those engaged on consultancy or programming work, would get to know a great deal of confidential information about the business which they were studying and it was very important that this information should not be divulged to other people. To cover all the points, a further

It was too early yet to say where the computer centres for the new National Data Processing Service might be set up in future, said the Postmaster General answering questions in Parliament on 4 July.

The service, he said, would be based at the start on the centres required by the Post Office for its own internal data processing needs. These were at present in London, Portsmouth, Derby, Lytham St. Annes and Edinburgh and also planned for Leeds, Glasgow and Bristol.

"The location of further installations will depend on a balance of advantage in which factors such as quality and ease of recruitment or other regional aspects will certainly be important. Although the physical location of the computer installation will be fixed by considerations of practical convenience, computing facilities by remote working will be very widely available."

clause was therefore inserted in the Bill which places an obligation of secrecy on officers of the Post Office (this includes even the Postmaster General) that they shall not, save as required by law, disclose information supplied to the National Data Processing Service without the consent of the customer concerned. The confidentiality of information entrusted to the National Data Processing Service is, therefore, protected by law.

The National Data Processing Service will constitute a very big challenge. The public service will have to be built up from the very beginning and in the face of intense competition from private enterprise. We have made arrangements under which we shall continue to work for the other Post Office services as we have in the past. We have no intention of neglecting these very important and substantial customers and shall not, therefore, be able to take our systems and programming staff away from the work they are now doing for them. Indeed, we have never yet had enough staff to be able to do all the jobs we have been asked to do.

It will be some time before we shall be in a position to provide all the services I have mentioned and the growth of the new side of the business will depend very much on recruiting new staff for computer systems and programming work in considerable numbers. We hope to attract young people who want to make a career in computers and this we shall certainly be able to offer them. We shall need at least 100 new entrants a year for several years to come and the success of the new service will depend very considerably on whether we can do this.

The new service will take over and run most of the existing Post Office computers, working in which should be even more stimulating and challenging than it has been in the past because we shall develop them into self-contained units run commercially to make a profit. To do this it is likely that we shall start building up systems and programming units attached to the provincial centres.

The National Data Processing Service will be run as an entirely independent service and not as part of the Postal or Telecommunications Services. I believe that it can be successful and that in time it will be a very big Post Office business. The difficulties are many and considerable but I am sure that Post Office people will face up to and overcome this new challenge as they have so many others in our long history.

THE AUTHOR

Mr. C. R. Smith *joined the traffic staff of the telephone service in Birmingham nearly 40 years ago. He spent the pre-war years working in the telephone service both in the provinces and at Headquarters, in the postal service in the provinces and on administrative work at Headquarters. He returned from active service to do postal travelling work in a Region, served a spell at the Management Training Centre and became a Postal Controller. Nine years ago he returned to Headquarters to take charge of the Central Organisation and Methods Branch which became the Computer and Office Services Department of which he is currently Director.*

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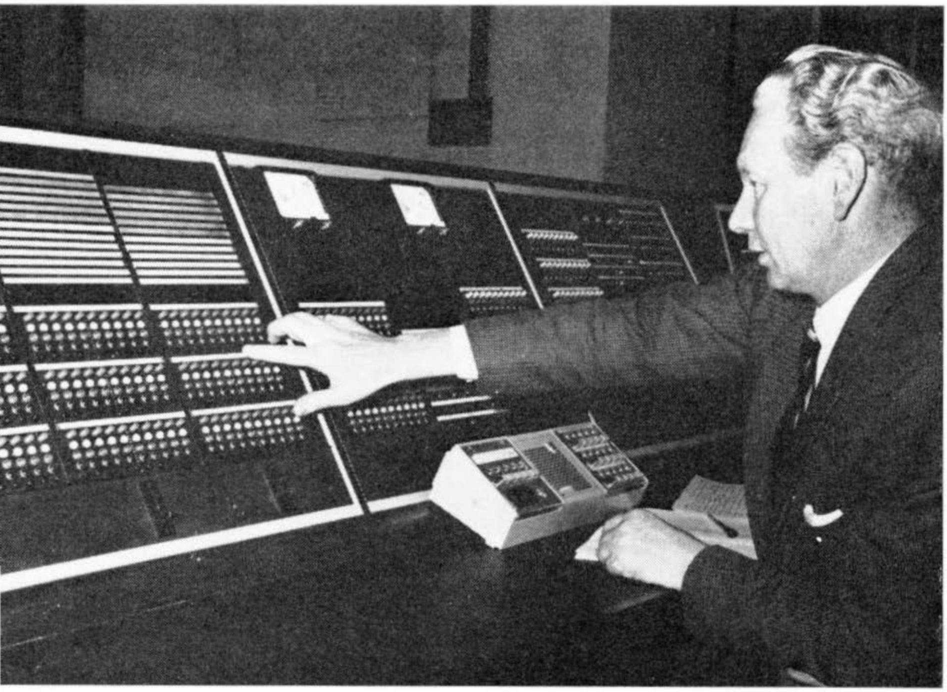
Long-Term Saving

Deposits in Post Office Savings Bank Investment accounts have now passed the £100 million mark. This sum has been paid into the 275,000 accounts opened since the new service began on June 20th, last year, giving the substantial average of £363 per account. The payment of interest at a rate of five and a half per cent per annum has been maintained throughout the period. Only £5 million has been withdrawn since June 1966 (five per cent of the total amount), a clear indication that the new facility is fulfilling its intended role as a useful medium for longer-term saving. An Investment account can be opened by any depositor who has at least £50 in a Post Office Savings Bank Ordinary account or accounts.

A BIG STEP FORWARD IN OVERSEAS TELEGRAPH MECHANISATION

By A. T. GRAY



Overseas Telegraph Supervisor Mr. B. D. Knight keeps a watchful eye on the traffic flow at the Traffic Control Console.

SINCE the first halting steps in overseas telegraph mechanisation were taken a few years ago* developments have shown the wisdom of making haste slowly.

Telegraphy—particularly overseas telegraphy—is a traditional art and both administrations and operators are loth to change procedures established when communications were difficult and real skill was necessary to convey a telegram from one point to another.

The overseas tape relay unit—opened in January, 1964—fully demonstrated this. Although very tolerant of message formats and procedures, it ran into many difficulties in its early days. However, after about the first year of operation most distant stations had "come into line". New procedures established to cater for the changed circumstances worked well and it became possible to conceive a more sophisticated equipment which would dispose of more traffic more speedily and more efficiently. Such equipment, installed at the outset, however, would have been doomed to virtual failure; practices and disciplines, eminently satisfactory for operators sending direct one to another, just do not work when one of them is replaced by a machine.

For the past 18 months, a mixed automatic/semi-automatic message relay centre has been under construction in Cardinal House, Farringdon Street. It will relay properly processed traffic automatically; other traffic can be routed by a simple press-button operation. Messages which cannot be

* *See the Winter, 1962 and Spring 1964 issues of the Journal.*

A new centre is soon to be opened in London which will speed and improve the overseas telegraph services. Initially it will handle between 35,000 to 40,000 messages a day—most of them automatically

Overseas Telegraph Operators Mr. F. M. Thomas (right) and Mr. D. R. Jenner check outgoing monitor copy on teleprinters.

handled automatically are printed out (at 75 bauds) before an operator and, as soon as sufficient of the message has appeared to enable its routing to be determined, depression of the route, priority and start buttons sends it on its way.

Operating is not always quite as simple as this might suggest because messages rejected by the automatic equipment will also be handled in the same way and these will require fairly close scrutiny to see if they need editing before being released.

The new centre will relay initially about 35,000—40,000 messages a day and, on opening, will replace the present overseas tape relay unit and also provide for a measure of expansion. Unfortunately, developments in the international telegraph field have not turned out precisely as forecast. Within weeks of the new centre being brought into service it will be utilised to the limit of its initial capacity and, as soon as live traffic data can be collected and staff released for the job, relief measures will be put in hand.

One of the big difficulties in planning in the overseas telegraph field—indeed, n any field of overseas telecommunications—is predicting the direction in which other administrations will tend to go. Britain is still the major focal point in the world for overseas telegraph traffic and this, from one point of view, is unfortunate since we have to be prepared to operate a variety of systems depending on the situation at the distant end. Although we can persuade, we cannot dictate; at the time of writing, despite efforts on our part to modernise them, we still operate Morse services to two countries!

When the new installation was planned a few years ago it was expected that, with the rapid spread of automatic telex working, most administrations would tend to move away from the idea of message relay working towards that of circuit switching for which an automatic telex network forms the ideal basis. Telex development has, in fact, gone very much along the lines foreshadowed and, technically, the extension of circuit switching is practicable over a very wide area.

However, for a variety of reasons (almost as many as there are countries), administrative difficulties obstruct such development and it now seems likely that message relay operation will stay with us to a greater extent, and for a longer period, than was expected. No doubt, most of these

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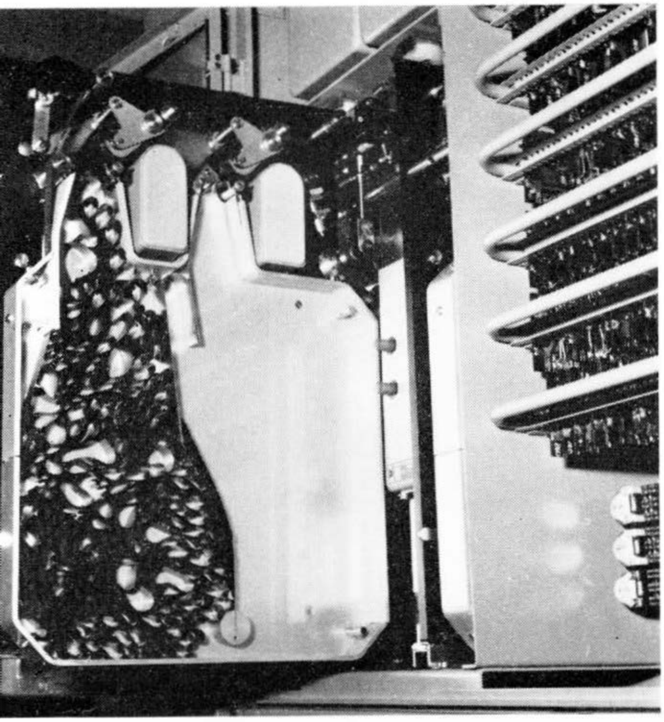
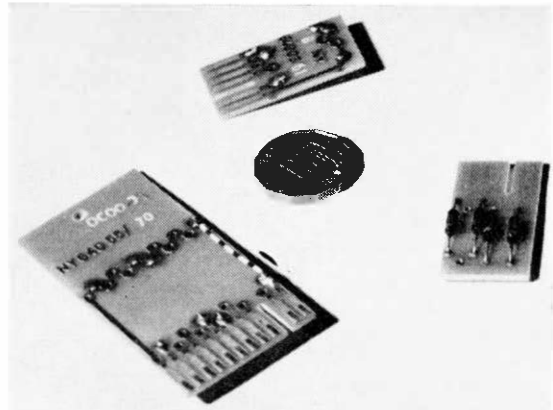


Left: This is the 40,000 character magnetic tape store which is used for storing messages until lines are free for transmission. Below: Diode logic cards (their size compared with a threepenny piece) which are used for character recognition. This equipment enables messages to be routed automatically.



obstacles will disappear in time and it will then be possible to make a choice between the two systems on the basis of technical and operational merit. Even then their relative advantages will be finely balanced and biased heavily by conditions peculiar to each country. We will probably have to be prepared to accommodate both systems and the rather difficult problem of inter-working for a long time yet.

Technical details of the new system were described briefly in an article in the Summer, 1966 issue of the *Journal*. The initial installation is designed to carry a busy hour load of 45 erlangs (rather more than 3,000 messages). This figure is not so meaningful as it would be in the telephone world since both sources and operators are limited; a certain amount of traffic build-up is normal in the telegraph sphere and any casual variations in traffic levels tend to reflect themselves more in the period for which a peak level is maintained than for the peak itself to vary.

Several useful and unusual operating facilities are provided. For example, a constant indication of incoming traffic level is presented to the control officer. If it rises to a dangerous extent, the load can be regulated by "busying" a sufficient number of inputs from points in the United Kingdom. The effect at the out-stations concerned is that one or more of their auto-transmitters is declutched and it becomes impossible for them to feed traffic into the system. There is a "fail-safe" provision in that if the control officer does not act, the system will itself busy inputs so as to protect itself from overload but it will do so in a random manner.

In addition, the fact that traffic is held in store for more than a pre-set period (depending on priority), or contains more than a pre-set number of messages (depending on the out-going route), is brought to notice. Information about the quantity or priority of traffic stored for any or all routes can be printed out by means of a simple push-button operation.

Furthermore, any errors in the sequence of serial numbers presented by any input are recorded on a local teleprinter, thus forming a permanent record on which action can be taken to recover any missing messages. The last received (or forwarded) number on any channel can be displayed by a simple key operation and a complete print-out of last forwarded numbers can be obtained as a routine.

As a guard against channel failures going undetected for a long time, a lamp indicates any channel on which no traffic has been received for 15-30 minutes. Traffic can also be diverted automatically from one route to another.

Overseas Telegraph Operators Mr. N. A. Harteam (foreground) and Mr. H. Middleton are seen here routing traffic semi-automatically.

Finally, if any incoming channel is "garbling" it can be marked and alarmed, either automatically by the register if it is an automatic input, or by a push-button operation if it is connected to an operating console.

Throughout the whole exercise the various staff interests have co-operated fully; the layout of the equipment and design of the operating positions owe much to their suggestions. We are not so sanguine as to believe that the new centre will be completely free from teething troubles. But it is certain that it will get off to a much better start than the present tape relay unit, which had the uphill job of spreading the relay gospel throughout the world. It is gratifying to record that despite the near-execration with which the tape relay unit was received at the outset, several countries are now installing broadly similar equipment and we have already had a few approaches from possible purchasers for our own unit.

Surprisingly, telegraphy—the oldest of the telecommunications media—is quite suddenly going through a period of such rapid technical development that new systems are liable to become very quickly out of date. Much that was impossible a few years ago is now on the cards; much that was technically possible then is now old hat. We are already looking at those impossibilities which might conceivably become possible in a few years time and starting to plan ahead to the next stage.

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When Andorra's internal telephone system was linked to the European grid on 3 July every other country in Europe became within reach of telephone users in Britain. Until then, Andorra was the one European country to which telephone service from Britain was not available, although for some years it has been possible to put calls through from Andorra to Britain by way of the French network. Connection from Britain to Andorra is made through the Continental Exchange in London which routes calls through Paris.

★

The Bell Telephone Company says it is developing a cordless telephone which will soon be ready for field trials. It will be connected to the telephone network by radio.

The new telephone, which is battery-powered, can be carried in a coat pocket and operates exactly like an orthodox telephone, having a dial and providing simultaneous two-way conversation.

It will have a range of between 100 to 1,500 feet from a fixed station which translates its radio pulses into conventional line current pulses.

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The number of telex installations in Britain now totals more than 20,000—almost double the number in use four years ago. Just over 8,000 telex machines are now working in London.

Introducing . . . THE DATEL 300 SERVICES

The Datel services are to be expanded with the introduction of Datel 300 which will speed business transactions and increase office efficiency

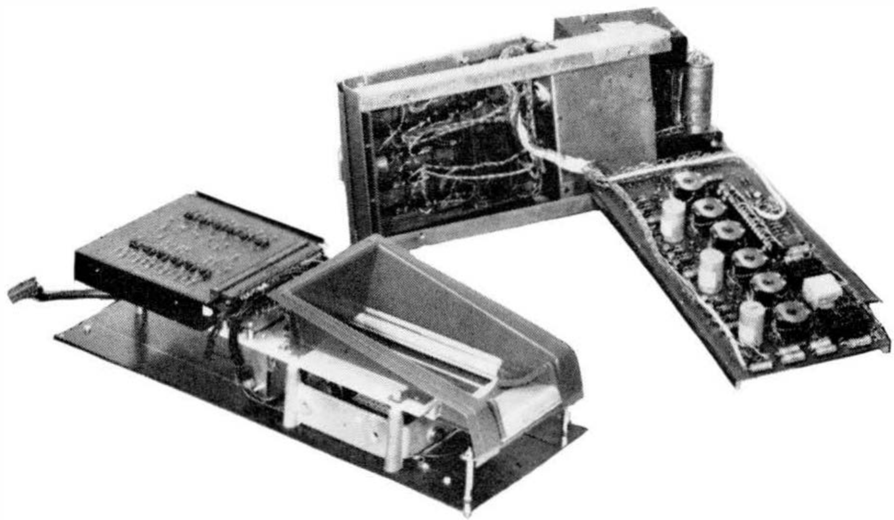
By R. H. TRIDGELL, BSc., MIEE

A Datel modem No. 3 with card reader. The card has just been read and the operator is pressing the "check" button on the modem in order to listen to the reply signals.

TO CATER for customers who want to send small quantities of data, perhaps daily, from a number of points to a central office, the Post Office will soon introduce a new series of services to be known collectively as Datel 300.

Designed to speed business transactions and increase office efficiency, the new service—apart from its advantage of speed—ensures against inaccuracies which inevitably occur when data is relayed verbally by telephone. It should prove a boon for companies owning say, a chain of shoe or grocery stores since it provides them with a new, quick, and accurate method of stocktaking.

A dismantled Datel modem No. 3. The circuit board (right foreground) carries the line signalling oscillators and supervisory receiver.



In a shoe shop, this could be achieved by inserting a punched tabulator card containing details of the shoe size, colour and name of the manufacturer in each shoe box and retaining the card after the shoes are sold. Details on cards could then be transmitted by Datel 300 service to head office where a day-to-day indication of stock positions and sales trends could be kept.

In a grocery store, a suitably-equipped cash register could provide a similar method of stock-taking by recording details of transactions on punched paper tape which could be torn off at intervals and details transmitted to a data processor at a central depot.

To equip a group of shops—assuming all have a telephone—with the Datel 300 service, each branch or outstation requires either a Datel Modem No. 3 or No. 5. These are connected to a central depot, or head office, by ordinary telephone calls to a Modem No. 4 or No. 6 (the instation modems) which, in turn, are linked to a data processor. These modems translate the customer's data into telephone line signals at the transmitting end and reverse the process at the receiving end.

To provide this service as economically as possible, emphasis in system design has been on simplicity of equipment for outstations. The entire equipment rests on a table beside the telephone and measures only about 16 inches by 20 inches. Operating procedure simply involves an operator at a branch shop telephoning head office and, after a brief conversation with her opposite number, both switch to the Datel modems and the data can then be transmitted.

Because the punching codes used on tabulator cards differ from those on punched tape widely enough to encourage the use of different line transmission codes, two systems of Datel 300 will be offered and different facilities will be given different service numbers in the 300 range.

The Datel Modem No. 3 is the outstation for the system where punched tabulator cards are used in a branch shop. It comprises a main unit and, normally, a card reader. The main unit incorporates a 'Telephone' or 'Data' selection key; the line signalling oscillators; keyboard; CHECK key; supervisory receiver; and, if required, wires for connecting a customer's private equipment. There are three line signalling oscillators, all operating simultaneously. Their outputs are added together to produce data signals in a form technically known as a ($3 \times \frac{1}{4}$) code.

Each Modem No. 3 has a simple keyboard for the insertion of variable data—for example, the selling price of a pair of shoes. Keys are provided for sending the numerals nought to nine and, in addition, there are five spare keys marked with geometric symbols to which arbitrary meanings can be assigned. The CHECK key is for use at the end of each block of data transmitted to send a special 'end of block' character and then to suppress oscillators until the key is released.

OVER

Left: A view of the inside of the Datel modem No. 4. The unit shown at the right is for checking the data.

Below: An experimental version of the Datel modem No. 5 here seen being used for reading an edged punched card. The punching is six-track.

While the CHECK key is being used to suppress transmission from the outstation it is possible to hear reply signals from the instation by means of the supervisory receiver which operates an included loudspeaker. These signals may be either simple tones indicating whether the data has been satisfactorily received or recorded speech replies which would be assembled under the control of a central computer. The supervisory receiver can also be used if required for listening to the tones resulting from the transmission of data.

The card reader on the Datel Modem No. 3 consists of a spring-loaded tray accommodating a single 80-column punched tabulator card. The reading system is optical with a light source below the tray and photo diodes above it. The card is inserted into the tray which is then pushed past the photo diodes into the body of the reader. Reading at 20 characters a second takes place as the tray returns to its normal position. The reader is able to accept all possible card punchings described in B.S.S. No. 3174:1959.

The Datel Modem No. 4 is installed at card system instations. Basically it detects each of the 12 possible line frequencies and presents this data on 12 output wires. Disturbances on the telephone line usually upset the ($3 \times \frac{1}{4}$) pattern. A checking unit may be included which examines this pattern and the only data which is then presented is that adjudged correct by this unit and any detected line disturbance incidents are indicated on a separate wire to the data processor. A further feature of the Datel Modem No. 4 is the supervisory transmitter which generates the reply signals to an outstation.

The Datel Modem No. 5 is the outstation for the paper tape system and differs from the card version in a number of important details. It has no tabulator card reader or keyboard but is equipped instead with a paper tape reader capable of reading all normal tapes from five to eight tracks at 20 characters a second. This reader can also read an 'edged-punched' card, not to be confused with a notched card used in manual filing systems. It is driven by a small electric motor and data is transmitted in a $(2 \times \frac{1}{4})$ 2 code.

The Datel Modem No. 6 is installed at tape system instations and is linked to a data processor at a head office and indicates the presence, or absence, of data frequencies on eight output wires. If a data checking unit is inserted, transmission errors are detected and the whole character is presented on the output wires in a form directly corresponding to the input tape.

The new equipment for the Datel 300 Service is sufficiently flexible to fit many less usual situations. Customers' specifications, which are supplied to manufacturers by the Inland Telecommunications Department of the Post Office, describe all the details of the system and the rules for its use.

The equipment is being developed and manufactured for the Post Office by Associated Electrical Industries Ltd.

THE AUTHOR

Mr. R. H. Tridgell *is a Senior Executive Engineer in the Telegraph and Data Systems Branch of the Engineering Department. He joined the Post Office in 1942, as a Youth-in-Training at the Research Station in Dollis Hill.*

And new modems for the future

THE Post Office has placed a £250,000 order with Standard Telephones and Cables Ltd for fast, adaptable new modulator-demodulators (modems) to be used with the new high-speed data transmission services which will be introduced by the end of 1968.

The new equipment will allow 2,400 bits-a-second transmission on private circuits in what will be known as the Datel 2,400 Services. Standby facilities for alternative transmission over the public network at either 1,200 or 600 bits-a-second can also be included.

The new modem, which is being produced to a Post Office specification, can be adapted for other transmission rates and Post Office engineers will be able to use it in planning further extensions of the Datel Services.

The Datel services, which enable data for computers to be transmitted over telephone and telegraph lines, are meeting a constantly increasing demand. At present more than 250 industrial and commercial organisations use the services and the number of customers is growing by about 50 per cent a year.

NEW POST FOR COLONEL McMILLAN

COLONEL Donald McMillan C.B., O.B.E., who is to retire shortly from the Post Office where he has been Director of the External Communications Executive since 1955, has been appointed Chairman of Cable and Wireless Ltd. and its associated companies. He will take up his new duties on 1 November.

Colonel D. McMillan, ETE Director for 12 years, and an expert on electro-acoustics.

Joining the Post Office in 1925 as a Probationary Inspector, Colonel McMillan served first with the Radio Section and Research Branch of the Engineering Department, concentrating on electro-acoustical problems. During this time he was a member of various Government committees which dealt with acoustical problems, including the Medical Research Council Committee which produced the hearing aid for the National Health Service.

In 1952, Colonel McMillan took charge of the branch in the Engineering Department responsible for the acceptance testing of all new and repaired engineering plants. A year later he became Deputy Director of the External Telecommunications Executive, in charge of operations and engineering. He was promoted to Director in 1955 when he was also appointed a United Kingdom member of the Commonwealth Telecommunications Board. He was also appointed in the same year to the Court of Directors of the Cable and Wireless Ltd. Group of companies and subsequently served on the Commonwealth Pacific Cable, the South East Asia Commonwealth Cable and the Commonwealth Management committees for the Commonwealth Telephone Cable projects.

In World War Two, Colonel McMillan served in the Middle East and other overseas theatres, being twice mentioned in despatches and awarded the OBE. He was made a Companion of the Order of the Bath in 1959.

Mrs. Glynis Dyer, Repair Service Clerk at Portsmouth, answers a complaint. Note the four-tier filing system which gives her access to the record cards of all the subscribers in her area.

At nine exchanges throughout the country specially-trained telephonists are being used to help speed and improve the Fault Repair Service. They handle complaints from dissatisfied subscribers, leaving engineers free to put the faults right. Their motto is . . .

FRIENDLY AND HELPFUL

By G. J. STEVENSON

A NEW system is being tried out at a number of Maintenance Control Centres which is helping the Post Office to give a speedier and more efficient service to subscribers when they report faults on their telephones.

For the first time, complaint receptionists—called Repair Service Clerks—are being employed so that they can deal efficiently and sympathetically with every complaint. All telephonists, they are specially selected and trained to deal with subscribers who are likely to be in a most dissatisfied and critical frame of mind.

This highly personal service, which has been operating successfully for some time in other European countries and in the United States, was first tried out in Britain at Chatham and Glasgow in 1963. Results were favourable so the trials have now been extended to Gloucester, Portsmouth, Swansea, Preston, Newcastle, Birmingham (Midland) and Monarch in London. Some valuable experience has already been gained from these trials and plans are being made to introduce Repair Service Clerk working at other large centres.

Repair Service Clerk working consists of a reception unit, where subscribers complaints are attended to by the complaint receptionists, and a test desk unit, staffed by engineers. The test desk staff receive the complaint from the clerks, diagnose the fault and then pass the details for fault clearance.

When a subscriber whose telephone line is controlled by a Repair Service Clerk MCC wishes to make a complaint, he dials a complaint reporting code. This code will in future become the national code 151. The call is answered promptly by the receptionists who sit at a desk specially manufactured by the Post Office Factories Department, which is positioned at a high-capacity (65,000 card) rapid-access filing unit. This unit has four coaxially-mounted containers which contain the record cards of every telephone subscriber in the area and can rotate independently. Each card records the name, address, details of previous faults and routing and apparatus details.

After receiving a complaint, the Repair Service Clerk records the relevant details, with any access information necessary, on to a fault docket. The subscriber's card is then extracted from the filing system and the Clerk, while still talking with the subscriber, makes an informed analysis of the difficulty. Details of the complaint are then associated with the record card and passed to the test desk unit for technical diagnosis and distribution to the faultsmen.

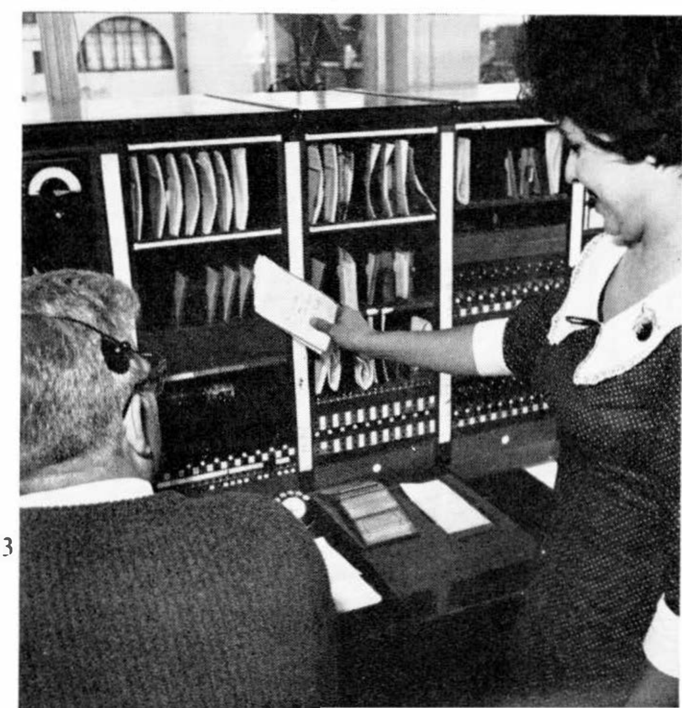
In earlier field trials, test desk working was divided between two distinct groups: Diagnostic Testing Officers, who carried out initial testing, and Fault Distribution Officers, who sent the work to the appropriate section of the field staff. This system has not, however, proved entirely satisfactory and a change in the pattern of organisation is being considered.

The application of this new system depends very largely on the size of the Maintenance Control Centre which must have sufficient subscribers to provide enough traffic to occupy three Repair Service clerks in the busy hour. Three is the absolute minimum if full coverage is to be provided and, on current average complaint rates, the minimum number of subscribers required to produce sufficient traffic is 30,000.

A survey of the scheme, which is now operating in nine experimental Maintenance Control Centres, has shown that in many instances careful questioning of a subscriber by a person with only a little

OVER

Above: The disembodied hand of a Repair Service Clerk searches out the record card of a complaining subscriber with a fault to report. Each of the four tiers of cards rotates independently. Below: Mrs. Margaret Wells, a Portsmouth Repair Service clerk, collects completed fault report cards from the test desk.



A general view of the Maintenance Control Centre at Portsmouth. The special desks were made by the Post Office Factories Department.

technical knowledge can produce a report which can easily be interpreted by the engineer. Every Centre has achieved an average time-to-answer of 15 seconds—less than ten in some instances—and several centres have received very favourable comments from the public. There has also been a drop in the number of service complaints received by post.

Subscribers apparently like and appreciate the friendly and helpful approach which is adopted by the Repair Service clerks.

THE AUTHOR

Mr. G. J. Stevenson *is a member of the team from Telephone Exchange Standards and Maintenance Branch of the Engineering Department responsible for the field trial of the Repair Service Clerk System. He joined the Post Office in 1953 as a Youth-in-Training in the Liverpool Telephone Area.*

★ ★ ★

WITHIN the next seven years seven new trunk exchanges—together costing £32 million to build and equip—will be erected in a ring around London at distances of between eight and nine miles from the city centre.

Known as Sector Switching Centres, they will be located at Ilford, Wood Green, Edgware, Eltham Kingston and—probably—Croydon. They will handle, each on a territorial basis, trunk calls made by and to London subscribers which are at present dealt with by a number of large trunk exchanges in central London.

Each new sector switching centre will have automatic switching equipment and, in addition, will be staffed by telephonists to handle perponal calls, the credit card, Freefone, alarm and emergency services and assist subscribers when they need help.

Setting up the new switching centres in London's suburbs will help to overcome the difficulty of finding suitable buildings and sites for new buildings and the problem created by extensive underground cabling in central London.

The new system will simplify switching arrangements after the old exchange letter codes have been discarded and help to produce a more economical, faster and more efficient telephone service.

★ ★ ★

There are now more than 200 million telephones in service throughout the world, of which 93.7 million are in the United States, 14 million in Japan, 11 million in Britain, nearly nine million in West Germany and eight million in Soviet Russia.

According to the American Telephone and Telegraph Company's annual publication *The World's Telephones*, which gives these figures, the most talkative people on the telephone are the Canadians. They averaged 635.6 conversations a person during the year 1966. The British average was only 127.1 conversations.

The number of overseas telephone calls rose enormously. Between the United States and overseas points, for example, 8.1 million calls were made—an increase of 26 per cent over the previous year.

PROMISING PROSPECTS FOR A DIGITAL NETWORK

The Senior Director of Engineering takes a look into the future and sees the possibility of a wholly digital telephone network

Closed-circuit television—here seen being used at the Stock Exchange—offers many advantages to business and industry.

WITH the advent of Pulse Code Modulation (PCM) switching there seems to be no technical reason why a future telephone network could not become wholly digital, with digitised speech being generated and reconverted within the subscriber's terminal equipment.

After taking this look into the far future when he recently addressed the British Council of the European Movement's conference on European Co-operation In Telecommunications, Mr. J. H. H. Merriman, Senior Director of Engineering in the Post Office, went on to warn that the economic viability of a wholly digital network was as yet highly speculative.

But, in possible future situations where penetration of the telephone service was nearly 100 per cent and where many individuals might require two or more channels for their own domestic use for the great variety of services that might be available, the greatest promise lay in accelerated development of digital switching and transmission. This development should go ahead as vigorously as possible, backed by every justifiable resource.

Inevitably, the idea of a wholly digital network gave rise to speculation about the pros and cons of a rationalised network—that is, a network planned as a whole, growing in a planned way, using common techniques for transmission and switching and managed and directed continuously by centralised computer complexes.

"If such a network could be achieved overnight, the advantages would not need stating," said Mr. Merriman. "But that is not practical. Changes take time, but that is not to say that rationalisation should not be studied and exploited as rapidly as practicable, bearing in mind the dramatic growth rates in most European administrations. Advances in telecommunications can be secured only through patient, collaborative development of internationally acceptable technical operational standards."

Mr. Merriman said that the accelerating growth in demand for telecommunications services in all well-developed countries was occurring at a time when technology was changing rapidly and making possible new facilities and features. To the conventional and familiar telephone, telex, telegraphy, facsimile and data services must now be added other services in increasing variety and including

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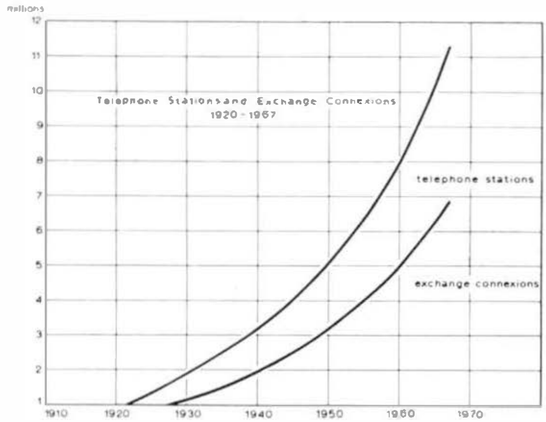
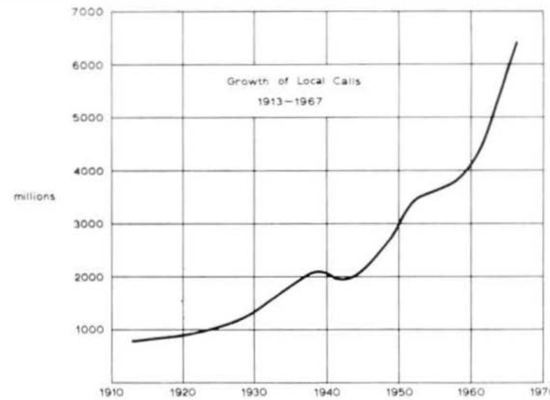




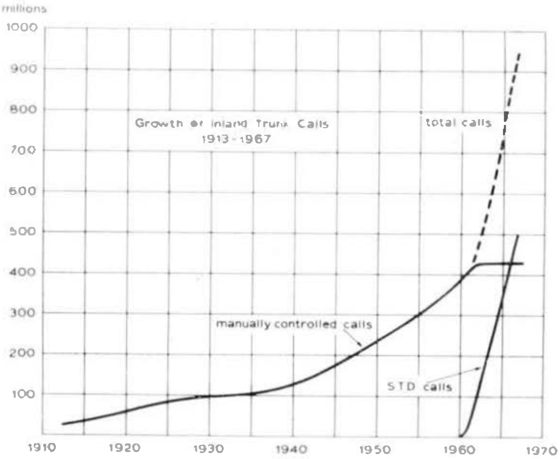
These graphs show how rapidly the telephone system has grown in Britain over the past half century.

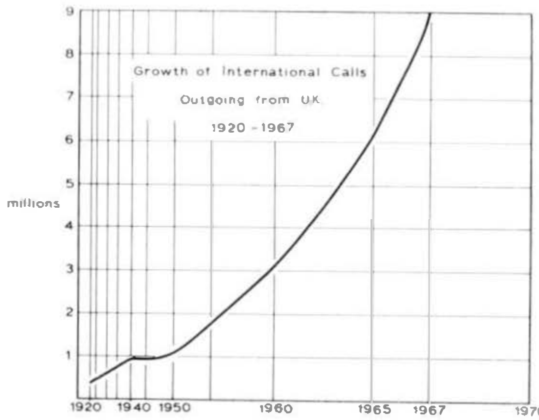
educational television, slow-scan picture transmission, radar information for air traffic control, telemetry, remote operation of domestic and industrial apparatus and reading of gas, oil and electricity meters in homes. These services all have to be co-ordinated into an efficient, smooth-running and economically viable overall service that nations expect from telecommunications systems.

This, in itself, was a sufficiently complex problem. But growth was compound, both in numbers and geographical spread. Planning could, therefore, no longer be based on national needs alone. Development had to be undertaken against a background of world-wide needs for fast, accurate and economically-acceptable communications. This implied increasing inter-dependence of national plans and on this depended the continued expansion of global telecommunications facilities. "Indeed," added Mr. Merriman, "it is quite unthinkable that telecommunications development could be effective without the continuous interchange of development views between telecommunications administrations."

Mr. Merriman introduced a further warning note when he went on to say that while new techniques might seem to offer great opportunities for improved and increased capabilities in existing national systems, it must be noted that present systems represented very large investments that could not be written off prematurely. Moreover, existing systems and services had become highly integrated with the commercial and social structures of the countries they served. This did not mean that a system could not be updated and expanded more or less continuously. On the contrary, this process had been going on almost from the time the first telephone network was put into service. However, it implied that the technical, social and economic interdependence of a telecommunications system exercised a powerful influence on the way it developed. Equipment had to be capable of interworking with what was

Tests being carried out at the new closed-circuit television studio at the Engineering Department's Headquarters.



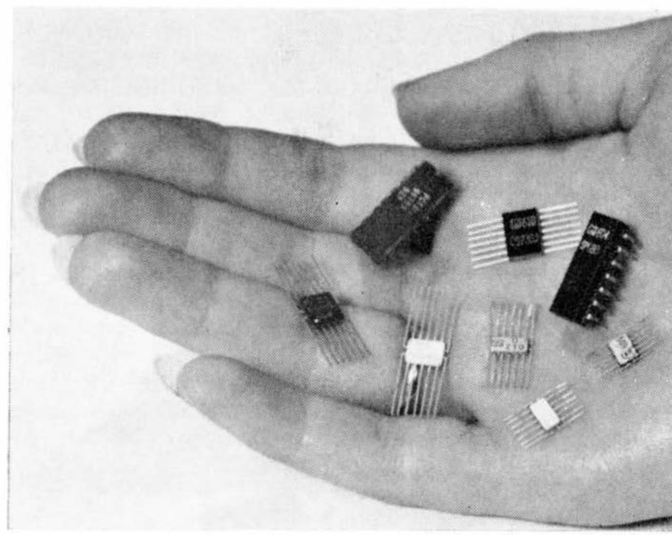


already there. Technically there was no great difficulty in achieving operational compatability through the medium of interface equipment. But here was a dilemma since the very presence of such interface equipment—often complex and costly—was an obstacle to efficient and economic operation. The alternative was to restrict certain types of service to certain areas or to certain types of customer but both were costly to administer and undesirable in their social consequences.

Customer terminal equipment was perhaps slightly less affected by the nature of the system to which it was connected but new customer services could not always be provided everywhere at an economically acceptable price until the exchange and transmission equipment was ready to provide those services in the most efficient way. Here, the problem again was mainly one of "interfacing". Special interface units could usually be provided at the exchange to enable new services to be given to the customer, but if the exchange equipment could not in itself provide the new services efficiently, the cost of the interface equipment might be unacceptable to user and administration alike.

Mr. Merriman went on to survey the more specific aspects of exchange and customer terminal equipment development and speculate on future possibilities.

The exchange performed a vital role in the operational and commercial viability of a network. It had to provide a wide and complex range of facilities and give the customer the service he wanted with minimum trouble and high dependability 24 hours a day and at an economic price.



The introduction of micro-electronic devices has played a very large part in the big leap forward in telecommunications technology.

The customer had to be able to use it effectively without knowing how it worked. He was increasingly expected to set up his own calls which, in a global environment, implied the selection of numbers containing from 14 to 17 digits. Advanced and efficient operator assistance services also had to be provided.

There was a large variety of types of exchanges —manual, electro-mechanical and now electronic. Most exchanges were basically electro-mechanical operating at a dial speed of ten digital pulses a

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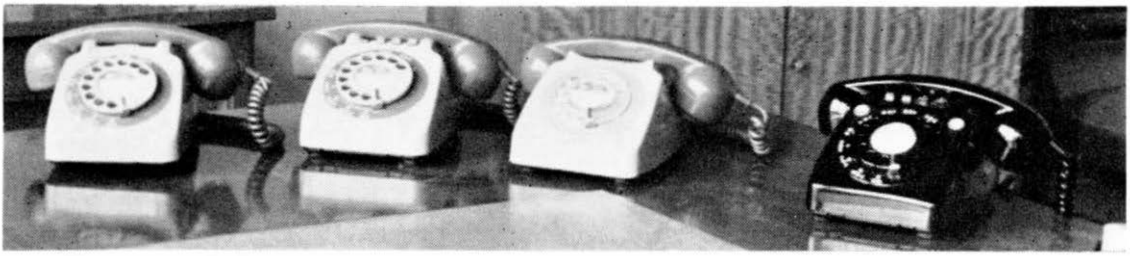

The range of 700-type telephones. Left to right: the 706, which has a facility for one press button; the 710, fitted with four press buttons; the 746, with two press buttons and a carrying handle; and the Keymaster—the smallest basic switchboard—with one exchange line and up to five extensions.

second. This was a highly economic method of providing a reliable national automatic service but, on a global basis, it was not ideal for setting up connections at high speed through several intermediate exchanges in different countries or even within a country for long-distance calls. The development of cross-bar switching systems had gone part of the way towards providing faster and more versatile systems more in step with the demand for fast national and international connections. But even these left something to be desired.

The electronic systems which were now coming along aimed at producing high-speed systems fully capable of meeting the foreseeable needs for international connections, accompanied by a greatly extended range of customer services.

At present the economics of electronic systems were less attractive in capital cost than competing electro-mechanical systems and their rate of introduction could be largely conditioned by the availability of capital and the rate at which production capacity could be built up. Their potential for cost reduction, however, was substantial, particularly in the area of automatic production and their greatly reduced maintenance charges which would enable administrations to achieve significant economies in overall running costs. "It is now more or less universally accepted that electronic systems can satisfy the foreseeable future requirements of an exchange to a greater extent than any electro-mechanical system, especially in terms of quality of service, minimal maintenance costs and flexibility in providing new services," added Mr. Merriman.

Advances in electronics had led to enormous advances in computer technology and electronic switching techniques. Already computer technology was influencing the design of electronic exchange systems and, conversely, the concepts of service security and maintenance, developed during research into electronic exchange systems, were affecting the development of continuously-operating data processing systems in vital areas such as air traffic control.

Switching techniques were also appearing in a new form with the development of automatic message relay centres and multi-access computer complexes.

The range of repertory diallers. Left to right: the Autodial No. 101A, which stores up to 32 numbers; the Magicall, which stores up to 400 numbers on a magnetic tape; the telephone No. 746 required with any repertory dialler; and the Autodial No. 102A, storing up to 30 numbers.

"The time has already arrived when telecommunications switching capabilities are affecting the development of computer and data processing systems," added Mr. Merriman. "The Data Processing Service which the British Post Office is soon to set up is an excellent example. Switching and data processing are becoming increasingly intermingled, each borrowing from the other, supplementing the other's capabilities and widening the services available to the customer. This should be of considerable importance to the components industry because it should mean an increasing demand for devices of common application which give prospects of reduced equipment costs as overall demand increases."

Dealing with current development in the switching field, Mr. Merriman said that a variation of the TDM system was the development of PCM switching methods in which the digital signals carried intelligence by coding the analogue signal amplitude as a sequence of simple on-off pulses eminently suited to direct transmission over lines. PCM switching offered a system completely compatible with PCM transmission, with clear possibilities for economies through the elimination of an exchange analogue-to-digital interface equipment at tandem points.

PCM was on order for many areas to augment the traffic-carrying capacity of local junction cables and it was a logical step to extend its use to greatly-improved cross-city traffic through tandem exchanges in which the switching of the channels is carried out in the micro-second time scale of the PCM signal itself and not in the ten impulses-a-second time scale of the subscriber's dial.

All recent and projected developments in the design of new exchange systems had two main objectives: the provision of fast and reliable services on a world-wide basis; and the provision of new facilities for users and for the improved management of the network by the administration. The first objective was closely linked with the development of new systems based on electronic controls operating on the switching network. PCM switching could be expected to develop to include a wide range of applications, especially in the field of high-speed data transmission between computer complexes and between subscribers to centralised data processing centres.

The second objective was linked to the increasing use of computer-like controls of switching networks. These controls would not necessarily be computers but they would draw heavily on practices common in the computer world. The use of stored-programme control techniques, for example, could eventually greatly facilitate the introduction of new facilities more or less on demand and, if necessary, simultaneously over the whole of a switched communications system. Exchanges of the future might well provide on an increasing scale a generalised communications facility, fast in operation and able to provide a wide range of customer requirements more or less on demand.

"The present distinction between speech and

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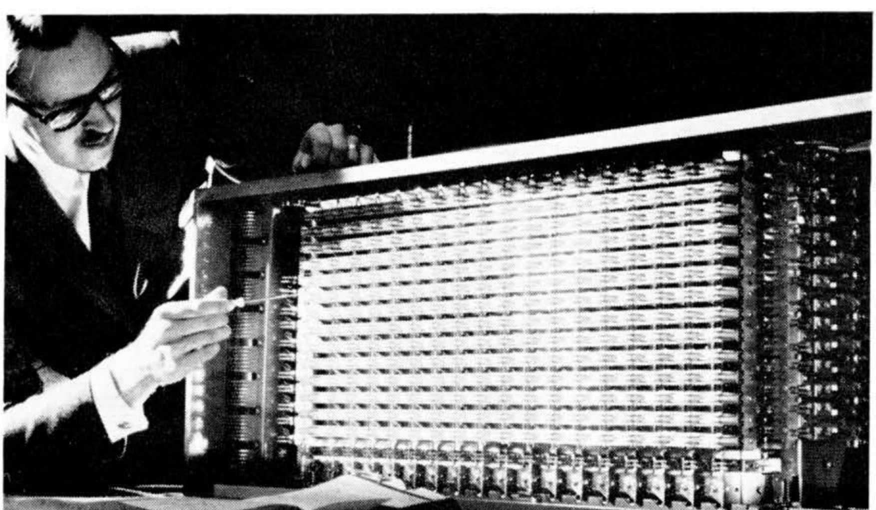
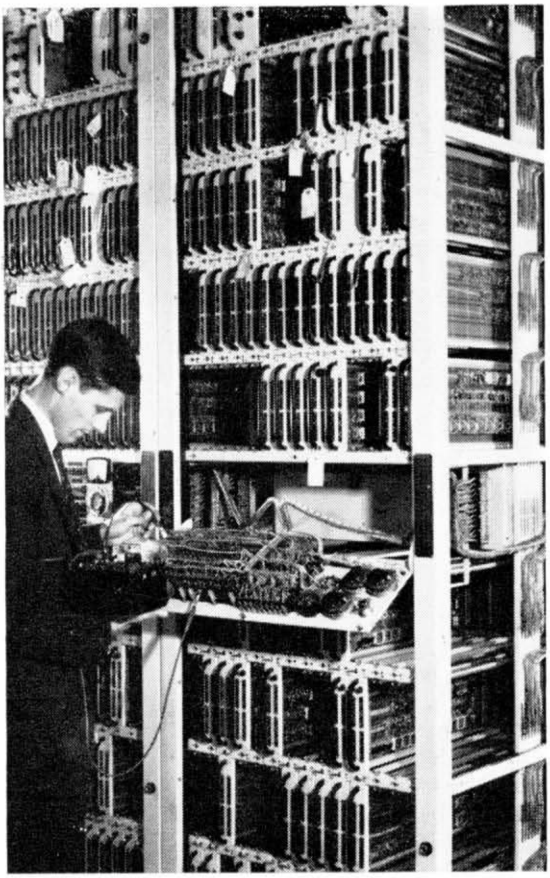


An engineer tests the multiple connection of wires at the back of a new crossbar switch.



Checking a circuit on the electronic common equipment of an incoming trunk register-translator.

digital transmission could become increasingly blurred, eventually merging into a state where the nature of the signal to be transmitted will be of little significance to the telecommunications administration," said Mr. Merriman. "For the ordinary residential subscriber, push-button telephones may be expected to replace dial telephones. A typical household could, in the long run, expect to be connected to the communications system by a general-purpose connection able to handle almost any kind of transmission from colour television to facsimile reproduction. This same connection could also be able to interrogate the gas and electricity meters automatically without the intervention of the customer."

Technologically, current developments opened up tremendous possibilities. People might be able while away from their homes to control their domestic heating and cooking systems, to receive or leave recorded messages and keep watch over children, invalids or old people. They might be able to use the home television equipment to obtain visual displays of consumer goods at a suppliers depot by keying special codes into a remote computer system; to pay their bills through a computer organised banking system; to use a facsimile system to obtain national and local news services, to place shopping orders and confirm travel and theatre bookings; to consult public records and obtain information about public utilities and services; and to obtain access to a public library system of references.

For the business subscriber, the present specialised private automatic branch and manual switchboards might give way to a general purpose facility which would provide both private extension-to-extension facilities and public exchange connection facilities by way of electronic equipment located centrally in public exchange buildings and serving many subscribers with complete privacy. Time-consuming and costly alterations to the facilities at present provided by the local private branch switchboard might disappear and be replaced by an order to the telephone administration to alter the programme allotted to the user in the centralised equipment. The need for private telephone operators might be largely reduced by direct inward and outward calling to and from extension telephones with a wide range of inter-extension, code calling, paging, dictation, transfer and conference facilities. Switchboards would be replaced by consoles easily operated by a clerk who would also do other work. Key-phones and inter-office viewphones would become available fairly quickly.

"Combined data and speech equipment will become available for alternative communication by keyset or console to a distant computer complex or by speech in the ordinary way," Mr. Merriman added. "Business organisations with common interests should be able to pool their requirements to set up economically viable specialised data centres on a multi-access basis. Typical possibilities are centralised data banks available to public utility services and giving data on forward planning of development areas, current road programmes and so on, medical banks for doctors and consumer marketing data for producers."

Mr. Merriman said that broadly, there were two switching requirements: local switching and through switching. This division offered opportunities for developing many of the possible new services fairly quickly. Zone and transit centres—or their equivalents—were relatively few and could more easily be supplemented and eventually superseded, by new systems which offered faster and more flexible services without an undue economic penalty often completely in step with growth in demand and the need to replace old equipment.

Group centres offered somewhat better opportunities for early modernisation than did local exchanges. This led to the further possibility that the Group Switching Centre could become the call processing centre for several local exchanges, thus enabling many customers to obtain access fairly soon to the more advanced services made available through the introduction of centralised electronic data processing equipment at the Group Switching Centre, backed up by wide band data links between local and group exchanges.

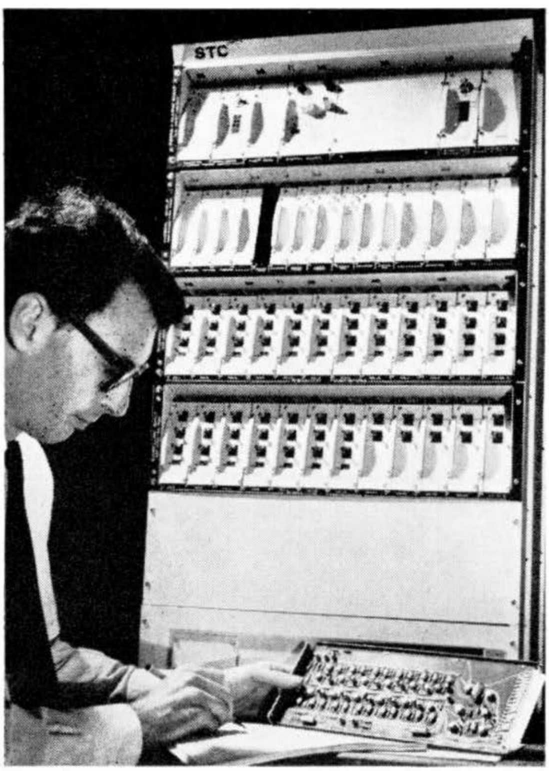
"Today," said Mr. Merriman in conclusion, "telecommunications administrations have to face two tremendous trends: the explosive growth in demand for services and the dramatic possibilities springing from accelerating technology. Each alone presents difficulties. Together they represent challenge and opportunity. Technological limitations no longer set limits to what may be done. The task of a telecommunications administration in looking to the future is to judge how to deploy its skills and resources—human and material—so that technological opportunity may best be harnessed in the service of the community."

. . "ESSENTIAL FOR PROGRESS" . .

"TELECOMMUNICATIONS is probably the most important of all branches of communication," said the Postmaster General, Mr. Edward Short, when he opened the Conference.

"It provides the nations of the world with the social, business, intellectual and other links essential to the happiness, prosperity and progress of mankind. Good telecommunications are essential to the health and cohesion of a modern community, whether a single nation or a community of nations such as is emerging in Europe.

"The best way of tackling the problem created by the inexorable growth of traffic is to marshal all the skill and science at our disposal into studies of the very essence of communication so that we can break through into new techniques. Out of such studies already have come pulse code modulation, lasers and holography. There must be others. Otherwise, with the very rapid growth of telephone and telex traffic, the call for more television channels, broadcasting, closed-circuit programmes for education as well as entertainment and the growing demand for high-speed data services, we will have difficulty in keeping our capacity ahead of demand."



Tests being carried out on multiplex common equipment for one of the 24-channel PCM systems which were recently put on trial in Britain.

★ ★ ★

The Post Office is experimenting at a telephonist training centre in London with micromotion-film analysis as part of a comprehensive study of telephone switchboard operating. The use of this technique—believed to be the first time such a system has been tried anywhere in the world—makes it possible to study in great detail the operating processes involved in handling calls on switchboards.

The first results of the experiment are encouraging and already demonstrate its value in simplifying operating procedures and generally streamlining the method of connecting calls from the public.

Telecommunications Statistics

In this issue the figures presented are for the complete financial year to 31st March, 1967, compared with those for the two previous years.

	Year ended 31 March, 1967	*Year ended 31 March, 1966*	*Year ended 31 March, 1965*
The Telephone Service at the end of the Year			
Total telephones in service	**11,392,000**	10,720,000	9,980,000
Exclusive exchange connections	**5,576,000**	5,241,000	4,853,000
Shared service connections	**1,356,000**	1,294,000	1,177,000
Total exchange connections	**6,932,000**	6,535,000	6,030,000
Call offices	**74,511**	74,629	74,764
Local automatic exchanges	**5,838**	5,687	5,592
Local manual exchanges	**259**	342	437
Orders in hand for exchange connections	**220,800**	227,100	175,000
Work completed during the year			
Net increase in telephones	**672,000**	740,000	615,000
Net exchange connections provided	**747,000**	808,000	694,000
Net increase in exchange connections	**397,000**	505,000	410,000
Traffic			
Effective inland telephone trunk calls (inc. SV effective)	**930,000,000**	841,000,000	736,000,000
Cheap rate inland trunk calls	**207,000,000**	186,000,000	161,000,000
Overseas telephone calls:			
European Outward	***8,532,000**	7,045,000	5,779,000
Extra European: Outward	***803,000**	641,000	537,000
Inland telegrams (including Press, Service, Rail Pass and Irish Republic)	**9,968,000**	10,892,000	11,610,000
Greetings telegrams	**2,472,000**	2,575,000	2,592,000
Overseas telegrams:			
Originating UK messages	**6,197,000**	7,192,000	6,928,000
Terminating UK messages	**7,201,000**	7,180,000	6,864,000
Transit messages	**5,940,000**	5,635,000	5,304,000
Inland telex:			
Metered units (including Service)	**203,000,000**	173,000,000	161,000,000
Manual calls (including Service and Irish Republic)	**112,000**	80,000	121,000
Overseas telex calls	***12,899,000**	10,630,000	9,110,000

Figures rounded to nearest thousand. *Figures estimated.

Publication and Price. The *Journal* is published in March, June, September and December, price 1/6. The annual postal subscription rate is 6/6 to any address at home or overseas.

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, GPO Headquarters, St. Martin's-le-Grand, LONDON, E.C.1. Telephone: 01-432 4345. Remittances should be made payable to "The Postmaster General" and should be crossed "& Co.".

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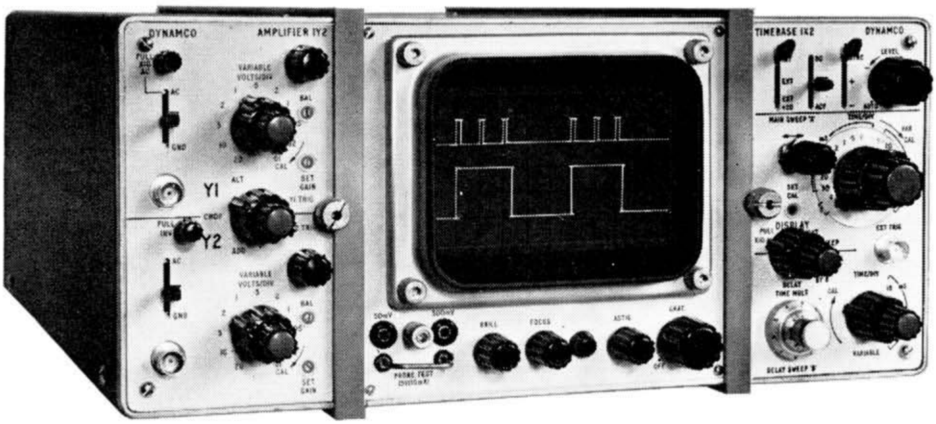
71 SERIES OSCILLOSCOPES



The 71 Series portable Transistorised Oscilloscope features plug-in X and Y modules and 10cm x 6cm display. The Display Unit (7100) contains a short mesh-screened c.r.t. operating at 10kV for high writing speeds.

VERTICAL DEFLECTION

1Y1—30MHz Single Channel

10mV/div. d.c.—30MHz
1mV/div. 10Hz—5MHz
Signal delay

1Y2—30MHz Dual Channel

10mV/div. d.c.—30MHz Channel 1 and 2
1mV/div. 10Hz—5MHz Channel 1
Signal delay

1Y7—15MHz Single Channel

50mV/div. d.c.—15MHz
5mV/div. 5Hz—1MHz

HORIZONTAL DEFLECTION

1X1—Wide Range Time Base

Sweep Range 0.2μs/div—5 sec/div.
Magnifier X10 for 20ns/div.
All normal trigger modes plus Single Shot

1X2—Sweep Delay Time Base

Main Sweep 0.2μs/div.—0.5 sec/div.
Delay Range 10μs through 0.5 sec
Bright-up 'strobe'

1X6—General Purpose Time Base

Sweep Range 0.2μs/div.—0.5sec/div.
Magnifier X5 for 40ns/div.

Typical size and weight of a 71 Series Oscilloscope is Height 6.5", Width 13.8" Depth 16.3", Weight 28½lb.

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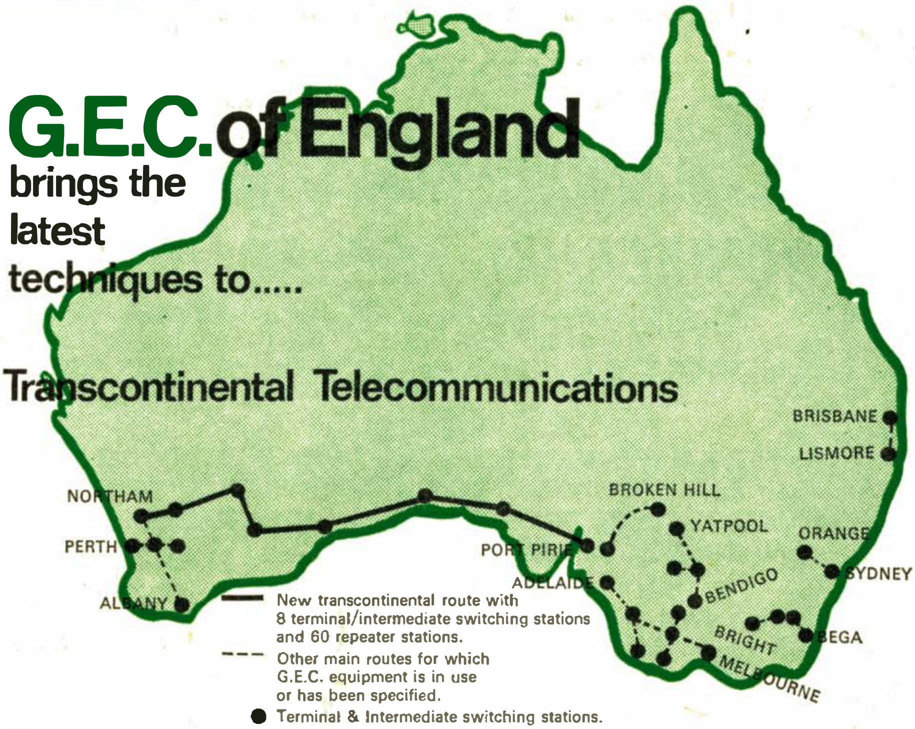
G.E.C. of England

brings the latest techniques to.....

Transcontinental Telecommunications



G.E.C. (Telecommunications) Ltd. of Coventry, England is proud to have been selected, in the face of intense international competition, to supply the new 2000 MHz transcontinental microwave communication system linking eastern and western Australia.

The system, worth $8,000,000 Australian dollars and one of the longest civil microwave links in the world, will be in service in 1969. By this time, telephone traffic over the 1500 mile route linking Perth and Adelaide—as far apart as London and Moscow—will amount to about one million calls a year. Initially, the system will provide two bothway radio bearer channels, one main and one standby, with a capacity of 600 telephone circuits. The standby channel may also be used to provide a television link giving a nationwide T.V. network. In addition a separate T.V. link will be provided between Northam, near Perth, and Kalgoorlie.

The completely semiconductored equipment, with its inherent advantages of greatly improved reliability, lower maintenance costs and substantially reduced power consumption, enables the many advantages of solid-state techniques to be fully exploited and offers particular advantages in countries where access to remote stations is difficult. Furthermore, the standard equipment is being specially modified to enable wind-driven generators to be used for the main source of power, with standby diesel generators, at isolated unattended repeater stations which can be as far as 400 miles from the nearest maintenance centre.

This new link will be the biggest single contribution made by G.E.C. to Australia's telecommunications network. Similar links supplied by G.E.C. of England already connect centres in five states.

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