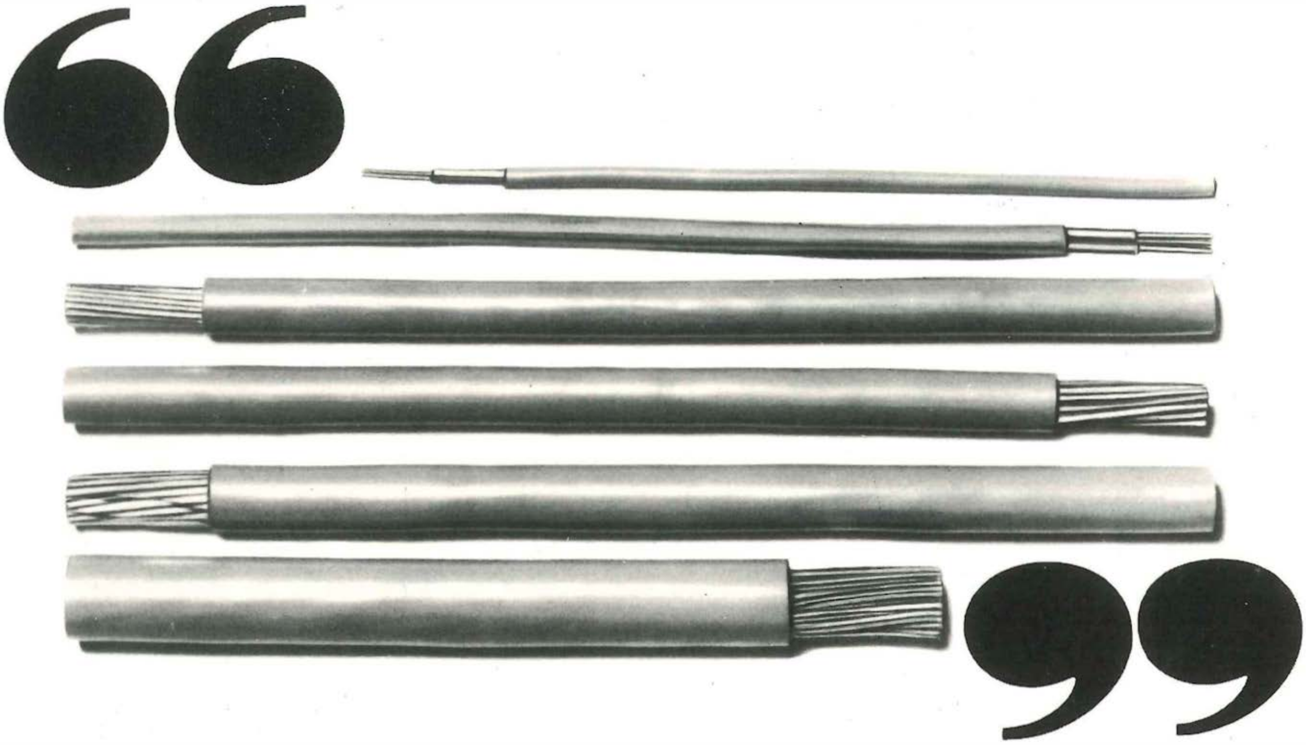
Post Office telecommunications journal

Autumn 1971 Vol. 23 No. 3

Price 9p



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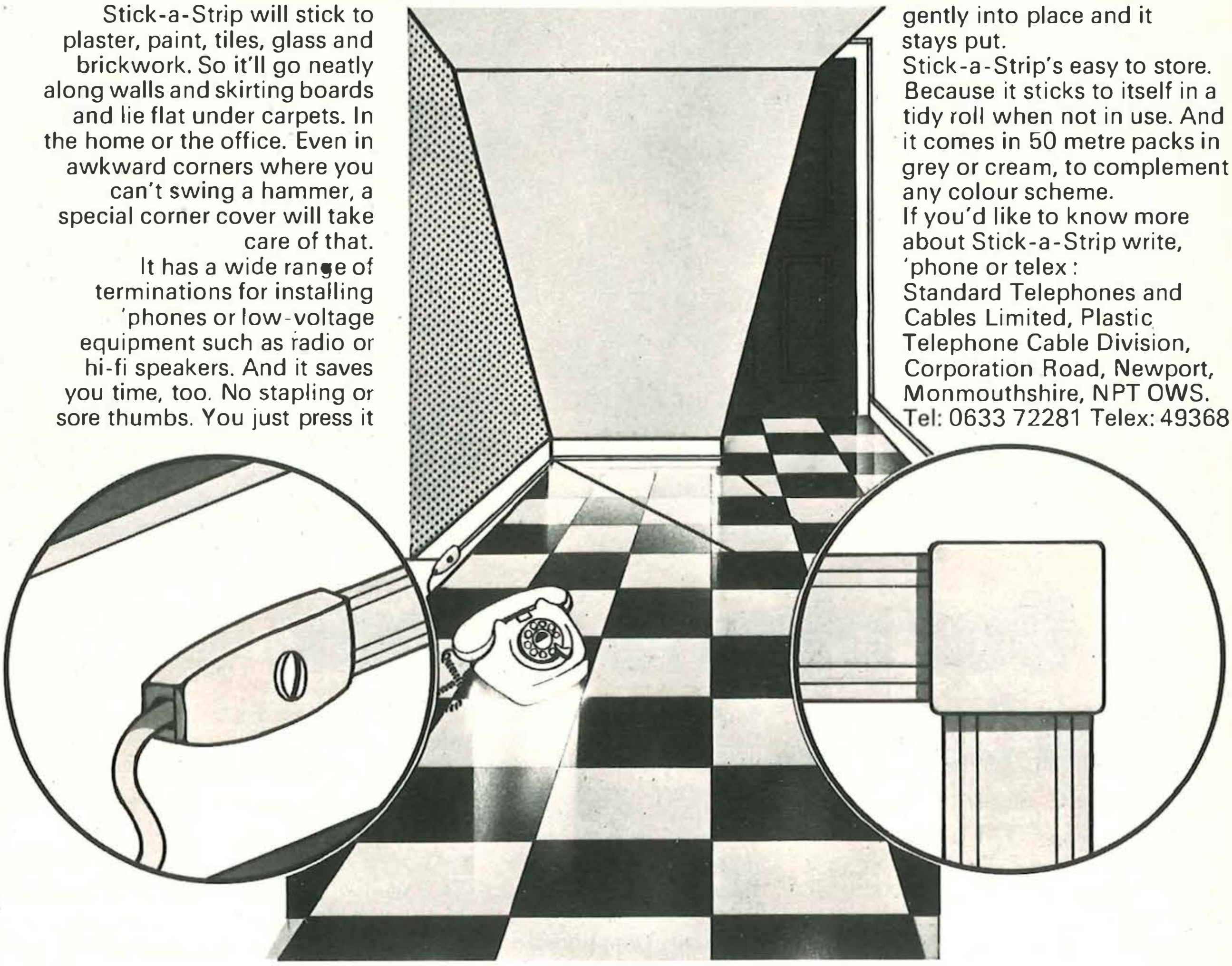

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Published by the Post Office of the United Kingdom to promote and extend knowledge of the operation and management of telecommunications

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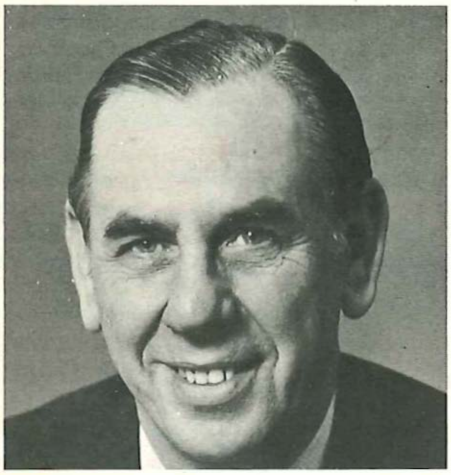


Mr Bill Ryland

In this issue

Cover: Dollis Hill, world-famous Post Office research station, celebrates its 50th anniversary this year, and a busy half century is recalled in an article on page 4. In the picture submarine cable developed at Dollis Hill is examined in a figure-of-eight test.

In an interview with the editor of Telecommunications Journal, Post Office Chairman Mr Bill Ryland answers questions about two important groups of people – the staff and the customers. Over the page he speaks about wider issues of international communications.

The staff and the customers

Q: *You have summarised the basic aims of the Post Office as providing a good service for customers, job satisfaction for the staff and making a fair profit. How are these objectives related to the telecommunications business?*

A: We are in business to provide a service, and this means giving the customer the kind of service he wants at a price he accepts as fair. If the customer is getting value for money he will want more of the services we offer, and in that way provide us with our profit – all of which will be ploughed back into the business – and the stimulus for growth. But all this depends upon the large number of people who work for the business, and unless they have a sense of satisfaction in the job they are doing we cannot give the customer value for money, in the broadest sense. That is why we need to have an enlightened personnel policy as one of our basic objectives.

So the basic aims are all inter-related?

Very much so. The other element is profit. Unless we make money to plough back into the business for expansion, improvement and modernisation we cannot have either customer satisfaction or job satisfaction.

Like all other large organisations the Post Office is at the receiving end of a number of complaints. To what extent is general criticism of the standard of telecommunications services justified?

Obviously we expect to receive complaints from customers, partly because even in the best circumstances something is bound to go wrong from time to time considering the huge number of calls we handle by day and night; and partly because, for a variety of reasons, we are not living up to our own standard in some parts of the country. However, if a successful call is one which gets through first time, whether or not the customer is free and available to receive it, then our success rate is not bad by comparison with many commercial enterprises.

That doesn't mean we should be complacent. After all, if something goes wrong with only one per cent of the millions of calls made each day, that still leaves a very large number of customers who have cause for complaint. If we can put things right or at least explain the cause of the trouble, that's fine – but it does not mean that the customer's complaint was not justified in the first place.

One advantage of receiving complaints is that it directs attention to those things which need to be put right. Our job is to ensure that when things go wrong they are put right quickly – that is much more important than explanation. And it is also important for the customer to feel that he has put his trouble in the hands of someone who understands his problems, and who will do something about them.

With an emphasis on the satisfaction of the present-day customer, is there a danger of concentrating on the short-term problems to the detriment of the long-term view?

No. The short- and long-term situations are both important. But unless we look after today's customers, there isn't going to be much of a long term anyway. We get our money from the charges to the present-day customer, and we need more of his business so that we shall have more money to invest for the future.

We are not in business to plan a whole lot of services that nobody will want or use. Of course, we must anticipate what the customer will want and act accordingly. This is a most difficult job and we must not anticipate it to an extent of seriously over-providing, so making services too expensive. On the other hand we must not under-provide so that good service is not there when the customer wants it. It's a question of judgement – and effective judgement.

So, preparation for the future is just as much part of the art of management as the day-to-day operations. I would be among the very last to decry the long-term studies that are being carried out by the Post Office. A great deal of valuable and essential work is being done. We are running a huge and complex organisation, and it would be quite easy to get into a mess in a few years' time if we did not prepare now for the needs of the future, both in quantity and quality. But we cannot – indeed dare not – ignore the priorities of the present-day customer.

Does the Corporate Plan which is being prepared for the business take into account both the short- and long-term problems?

This is exactly what it does. It aims to identify all the major activities needed to achieve the objectives we have talked about – customer satisfaction, staff satisfaction and profit – and to marshal them so that the business can move forward according to a total plan. The Corporate Plan concept includes an annual operating programme related to specific targets – it is derivative of the management by objectives approach. In a particular year the business will be committed to achieving a set of targets for improvements, growth, modernisation and profit, and all these things are then brought into the long-term programme.

How well do you think the business is coping in this present period of expansion?

First, I want to give credit to our people for what they are doing and have done. The size of the operation and the rapid rate of expansion that is being accomplished adds up to a tremendous achievement by a talented staff.

The people who work in the Post Office at all levels have great qualities of character and very considerable ability. In my view a large number of them stand comparison with anyone anywhere – and I mean anywhere. I said this to the Hardman Committee of Inquiry, and I back my view with a lifetime of experience in our Post Office and a knowledge of other administrations all over the world.

Having said that, I am sure they would readily agree that we have all a great deal to do to make the British service of the consistent high quality that we all want to see.

And what of the future?

There is a huge job of modernisation to be done, as well as dealing with the growth of the system, and the capital investment programme we have embarked on is of prime importance. Despite all the achievements of the past, our investment will have to take a higher proportion of national resources than ever before if we are to do our job properly. The Board is determined to maintain the investment programme necessary for an efficient service, but this means we have to find more money from our own resources and less from costly borrowing.

I think the sort of growth we are now experiencing will continue for some time, but we won't be able to sit back and wait for it to happen. We have got to work very hard to keep our standards high, to take advantage of new technologies and to make the money needed to finance it all.

People in the telecommunications business clearly have a great future – but they will have to work for it.

In this extract from a speech given to the American Bar Association meeting in London, Post Office Chairman Mr Bill Ryland says that international communication problems call for . . .

A global a

Why is it that man, once satisfied with rudimentary signs and signals like tom-toms and smoke, clamours for more and faster communications of the greatest possible sophistication?

How is it that people have so much more to say to each other as each year passes? Is it of value, socially and economically, that vast amounts of capital should be spent for these purposes? Need everything be so hectic? Need the pressures be so great? Will it never end?

I have a theory about all this. Not a very profound one; but I believe with a germ of truth in it.

The communications I am talking about are concerned with the exchange of information, ideas and knowledge. As the frontiers of knowledge are pushed out further and further, so man has more to enquire about, to learn, to absorb, and to teach. More to communicate about.

New ideas breed new technologies and these change the quality of life. Most of us hope and try to ensure that such changes are for good. Unfortunately this is not always so. In any case one should never overestimate technology. It doesn't solve all the problems. It takes second place to human spirit and human endeavour.

But it is a big contributor to change. And change creates needs. Material needs that have to be satisfied by the producers, the manufacturers, the suppliers and the business concerns. Hence more communications.

These themes can obviously be elaborated. The point I am making is that they all start with the spread and expansion of knowledge. Wherever we turn the nature, scope and growth of increased knowledge takes one's breath away. As each year passes man has to know, use and understand more just to live his life. There is still an incalculable amount that we realise we don't know but hope to know one day. There must be very much more that we don't even know we don't know.

It is no exaggeration, in my view, to say that the potential of increased knowledge is bordering on the infinite. It follows that the potential for communications must also be tremendous – although we must, I suppose, accept that it will stop somewhere short of the point where everyone spends all their life either making or receiving telecommunications!

My answer therefore to the question "will it never end?" is simply that it is only just beginning. If that is so we must prepare ourselves properly for what lies ahead.

Basically the international telecommunications network consists of a number of large and important telephone exchanges – frequently known as gateway exchanges. These are interconnected directly or indirectly by the transmission media which are to telecommunications what highways, motorways or what

‘The time will surely come when a telephone exchange will be put into orbit . . . We shall perhaps send engineers out to maintain it’

pproach

have you are to road transport. The gateway exchanges are located in and owned by the various countries of the world. They are part of their national networks. And they provide the link between those networks and the international highways. Some of them also link people between other countries by a sort of transit switching.

The transmission media are many and various. The ones that are most modern, efficient and effective are satellites and ocean cables.

Satellites work to earth stations. These are nationally owned and are the interface between the national and international networks. The satellite system itself is owned multinationally – nations of the world subscribing to its capital according to agreed formulae. It is directly controlled and developed by a consortium of owners under the title of INTELSAT. It is a world system, and a comprehensive entity.

The cable system on the other hand grows like Topsy. A cable by definition joins two or more countries. Others agree to make use of it on a contractual basis, and new systems are developed to suit the interests of the participants.

There is, of course, interconnection on appropriate terms between cable systems. The universality and the principles of the International Telecommunications Union will see to that. But is this what might be called molecular approach sufficient?

There is undoubtedly a great future for cables as there is for satellites. We will surely get widening opportunities for more varied and productive systems and facilities. But so far as one can see they will be dependent upon, and will indeed develop from, modern cable and satellite systems for a very long time to come. Inevitably this will mean more cable systems. If this process continues on a limited ownership basis may it not create restrictions, limitations and perhaps heavier costs than if cables were to become global in character as the satellite system is?

Even with interlocking ownerships and interests will it make sense to run a vast global automatic telecommunications service when the interconnecting links are not operated for the benefit of all as an interdependent whole?

These are speculations. But if there is anything in them, they could lead to a cable consortium not unlike the satellite consortium. Indeed the logical conclusion might be one body to handle both aspects. There would be some formidable difficulties to solve and some pretty hard financial bargaining. There would be some tough operational and managerial problems.

But we should not be deterred by problems if, in the end, we can find a better way. One that would make for better use of resources whether they be research, development, manufacturing, operational or financial. One that would enable the countries of the world to give their customers the best possible value for money.

It would mean a supra-national approach. But this is not unattainable. It has been done before. And it would have the advantage of removing or smoothing out national limitations that are sometimes imposed on cable schemes.

Let me give you an example. We establish a cable across the Atlantic in agreement with our American partners. All goes well to start with. Then we are told that, because of restraints placed upon the partners by the Federal Communications Commission they cannot use the system as much as we would like. This is because of some domestic consideration balancing satellite and cable interests. The result is that we lose some revenue on our investment for reasons which have nothing to do with us. Our American partners lose likewise. What is more we may be asked to limit our own use of the cable as well, as a condition of securing a landfall for the cable.

All this may be fine in the domestic scene, but I suggest it is out of place in the international scene. The action of one country should not pre-empt the judgements and freedom of action of other countries.

Telecommunications need to be operated in ways which facilitate the exchange of information and ideas and the spread of knowledge. It is surely the responsibility of the Governments of the world to make it possible for the telecommunicators of the world to do this job without let or hindrance in the common global interest. The present satellite arrangements were hard to hammer out. There was a great deal of negotiation and hard bargaining, but the result was the right one.

How else could we take advantage of the possibilities that lie ahead? Can I mention just one. We already see the possibility for large manned vehicles – laboratories and the like – to be put into space orbit. The time will surely come when a telephone exchange will also be put into orbit to operate a satellite system, not on the basis of individual circuits as now, but on a switching basis. We shall perhaps send engineers out to maintain it and keep it in trim on a tour of duty basis like people go off-shore for a period of duty manning a lighthouse.

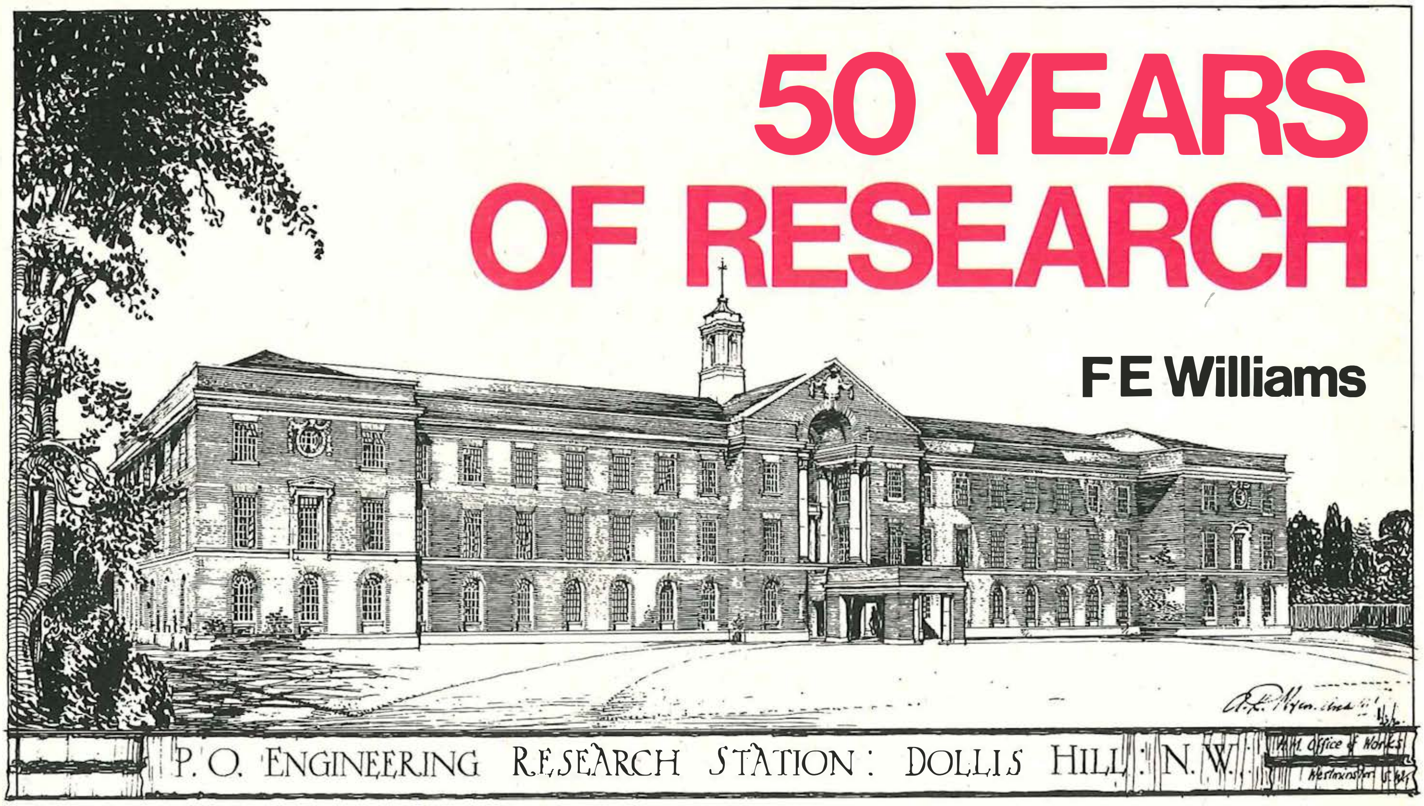
This could happen. It becomes possible, practical and realistic as part of a unitarily managed world system. It would be chaotic to try it otherwise.

Can we for much longer ignore the question whether the management of cable systems should follow suit – or indeed become part of the same project? The constitutional and institutional implications are enormous, but no one ever got to the mountain peak by being frightened at the foothills.

Dollis Hill, the Post Office Engineering Research Station in London, celebrates its 50th anniversary this year. It has been an exciting half-century during which huge strides have been taken in telecommunications technology and engineering. Post Office scientists and engineers have played a major part in these advances, from the earliest telephones through to the satellite systems of today. Dollis Hill is regarded as one of the great centres of telecommunications research.

50 YEARS OF RESEARCH

F E Williams



The brick-faced buildings of the Research Station stand imposingly on the summit of Dollis Hill, about eight miles to the north west of the City of London. The Department has a total staff of close on 1,500, housed in well-equipped – although somewhat cramped – laboratories, and it is difficult now to imagine the primitive conditions 50 years ago when the first group of less than 100 engineers moved into temporary wooden huts on what was then a rural site.

Although 1921 marked the beginning of the research establishment at Dollis Hill, this was not the beginning of research work in the Post Office. Some early experimental work in connexion with telegraphy and telephony took place in 1878, but it was not until 1904 that a few members of the Engineering Department were relieved of their executive duties to pursue investigations of a purely experimental nature. A room was allocated in the Central Telegraph Office and some good work was done in those early days with very limited resources.

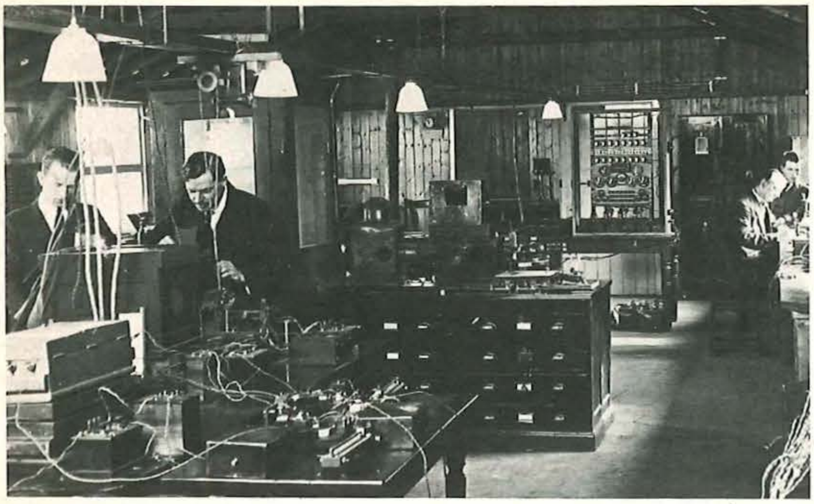
In 1909 the Research Section was given official recognition as a separate entity and in 1912, when the Post Office took over the National Telephone Company, the Section was augmented by amalgamation with the Company's Investigation Department. Although additional laboratories in King Edward Street, London, had been provided to supplement the Central Telegraph Office accommodation, it soon became evident that re-housing of the scattered groups of the Research Section was desirable.

The outbreak of war in 1914 delayed the proposals, but eventually it was decided to embark on a more ambitious research programme and to build a Research Station on a new site of eight acres at Dollis Hill. At that time Dollis Hill was a pleasant green hill surrounded by fields and farm land, leading down on the north side to the canal reservoir known as the Welsh Harp. This hill-top site was chosen mainly for the relative absence of noise and vibration from rail and road traffic – an important consideration in those days of dependence on sensitive mirror-type galvanometers for electrical measurements – and of freedom from electrical interference from railways and tramways.

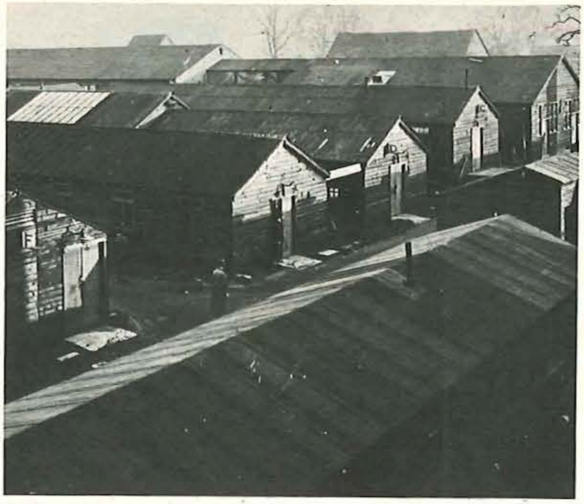
The first group of research workers arrived in 1921. Their accommodation was ex-army wooden huts which were, some years later, replaced by permanent brick buildings. In 1933 the main block of the present buildings was opened by the Prime Minister, J. Ramsay MacDonald, and the transfer from the temporary huts to the permanent buildings was practically complete. Subsequently, the adjoining farm site of 2½ acres was acquired, and after the 1939–1945 war further buildings were added, including a new block housing a modern Drawing Office and well equipped machine shops.

With the rapid expansion of London, the rural serenity of Dollis Hill did not survive for long. In the 1930s the suburb of Neasden sprang up, and the fields leading down to the Welsh Harp gave place to rows of semi-detached houses. Part of the southern slope of the hill was preserved as a public park, but the surrounding woods and fields have gone for ever. So too have the prospects of any further expansion of the Research Station since it is now surrounded on all sides by houses.

In the 1920s, research centred mainly on the transmission of telephony and telegraphy by cable and by radio. By modern standards, both the laboratory equipment and the standard of accommodation provided for the research staff seem primitive. Even under these conditions, many noteworthy contributions to communications were made – such as the design of the radio transmitters for the long-wave station at Rugby, and in 1926 West's historic measurements of the acoustical impedance of human ears which led to the design of the first artificial ear to provide a realistic termination for measuring the performance of telephone receivers. In those days of electric tramways, a serious problem was the protection of



1924: The transmission laboratory.



1926: The complex of huts which was Dollis Hill.

Post Office cables from corrosion by the electrolytic action of stray currents, and effort was devoted to developing accurate methods of measuring such currents.

The early 1930s brought the slump, and qualified engineers and scientists were not finding jobs easily in industry. With foresight, the Post Office went ahead with recruiting, and soon the new buildings were well staffed with highly qualified young men.

This was the era of many new developments, such as the first speaking clock – using photographic sound recordings on glass discs, and controlled to a guaranteed accuracy of a tenth of a second by a master pendulum. These were the years that saw the pioneering work on quartz crystals for the frequency control of oscillators and radio transmitters, the work on frequency standards, and the development of voice-frequency signalling for the telephone network. Wide-band transmission systems for frequency-division multiplex telephony and for television were developed using coaxial cables, first installed between London and Birmingham. In the development of television, Dollis Hill engineers played a large part in providing the links for outside broadcasts – such as the first direct televising of the Cenotaph Service in 1937.

In 1939 came the Second World War and the red bricks disappeared beneath a blanket of camouflage netting. But the work went on, at first directed towards supporting the Armed Forces, and later towards planning the post-war reconstruction of telecommunication services.

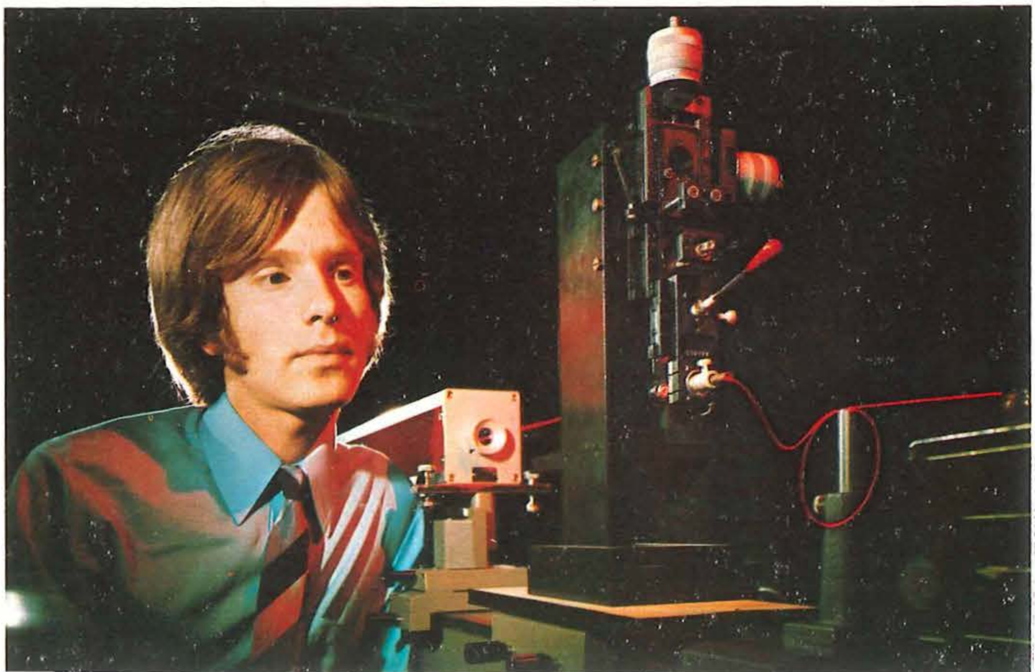
In 1943 the first submerged repeater ever to be installed in a working cable, designed and made at Dollis Hill, was laid in a telephone cable crossing the Irish Sea. The new Post Office cable ship, the Monarch launched in 1945, was specially equipped to lay the new submerged repeaters, and research engineers from Dollis Hill sailed in her to see their precious repeaters – amplifiers sealed in water-tight cases – lowered into the depths. It is said that some of these laying trials, in rough weather, tried the Dollis Hill engineers much more severely than the repeaters. This was a significant development that was to pave the way, some years later, for a transatlantic telephone cable.

The first pair of transatlantic telephone cables, a joint enterprise between Dollis Hill and the Bell Telephone Laboratories, were laid in 1956, and had 51 submerged repeaters laid in each cable on the bed of the ocean between Scotland and Newfoundland. A prime requisite in these repeaters was that all the components in the amplifiers should have a very long life. Metson, by his work on oxide-coated cathodes, showed that a major cause of failure of thermionic valves was the growth of a resistive layer between the oxide cathode and its supporting core. Another major contribution to submarine cable technology was made by Brockbank, who designed a lightweight cable whose tensile strength lay in its central steel core instead of in external armouring.

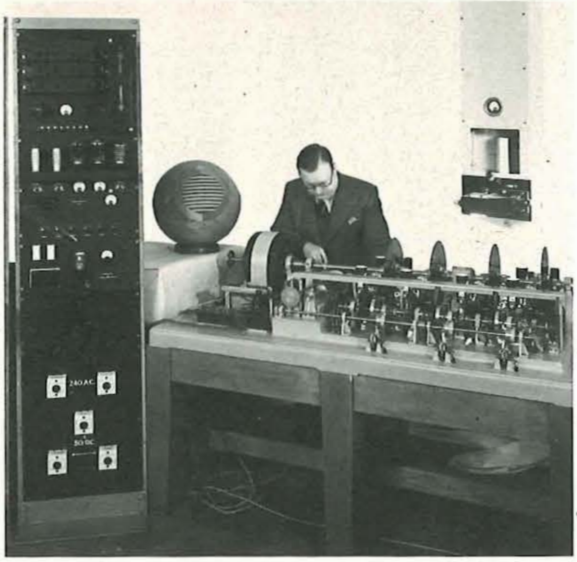
Meanwhile, other teams worked in different fields. Ayers, working on the formant analysis of speech, made his electronic speech machine, known as ESME. New surveys were made of the acoustic characteristics of human ears and mouths and greatly improved artificial ears and voices were constructed for use in telephone measurements. Research on trunk signalling systems formed the basis of the national trunk mechanisation scheme; and electronic techniques were applied to the development of new switching systems. With the expansion of the telephone network, the need arose for a telephone set of higher sensitivity than hitherto, for use on longer local lines, and in 1958 the 700-type set was evolved. This incorporates Wilson's automatic regulator, an ingenious device that reduces the sensitivity of the set when it is connected to a short line.

In the radio field, great advances were made in microwave propagation, and Dollis Hill played a major part in the design and testing of the satellite

1971: Present-day Dollis Hill. Scientific Officer Russell Jackson uses a laser during development work on optical fibre communication systems. He is measuring the scattering attenuation profile of a glass fibre, using red light from the helium-neon laser on the left. On the right the looped fibre "glows" because of the light lost by scattering. Photograph by Bill Abbott, Research Department.



1936: Dr E. A. Speight, principal designer of the Speaking Clock, checks the completed equipment at Dollis Hill prior to the first installation at Holborn telephone exchange. The time announcements were recorded optically on glass discs. Note the large transmitting valves on the left. Today small transistor amplifiers are used.



1954: Tense moments for three research engineers waiting on the deck of cableship Monarch to see their experimental submerged repeater laid in deep water in the North Sea. It resulted from years of development and trial and led to the laying of the first transatlantic submarine telephone cable between Oban in Scotland and Newfoundland in 1956. From left to right Dr D. G. Welsby, now of Birmingham University, Mr E. F. S. Clarke and Dr R. A. Brockbank.

1958: Dollis Hill engineers developed the 700-type telephone which was of higher sensitivity than any previous telephone set ever made anywhere in the world. It incorporated Wilson's automatic regulator to prevent excessive loudness on short connexions. Mr F. A. Wilson is now an Assistant Staff Engineer in Telecommunications Headquarters. In the picture Miss Yvonne Gordon, still on the staff, carries out an articulation test on the prototype of the new telephone in the speech-testing laboratory.

earth station at Goonhilly. In the semi-conductor field, studies were made of the utilisation of transistors and the newer microelectronic circuits to improve telecommunications. Research came to the aid of the postal services, and sophisticated mail-handling devices were designed and constructed.

Now, in 1971, the field of research in telecommunications is becoming ever wider. Work is proceeding on new digital transmission systems for the future, and on electronic telephone exchanges; on new customer services, like viewphone and data transmission; on wide-band transmission systems, by microwave in waveguides, and by light beams in optical fibres.

In postal mechanisation, new ground is being broken by Coombs in his work on the reading by machine of post codes on live mail – so that one day all letter sorting can be done by machine without the need for sorters to read the addresses.

With so much expansion in so many fields, the pressure for more laboratory space increases every day, and so at last, a move from Dollis Hill has become inevitable. A new site has been found at Martlesham in Suffolk, not too far from London for the research man to come up for a day's meeting at Headquarters, or a technical paper at one of the learned institutions, and yet allowing room for expansion. Here, on 100 acres on Martlesham Heath on the site of an old bomber aerodrome, a brand new research station is being built, purpose-designed and equipped with every conceivable facility for telecommunications research.

The main research block will be fully air conditioned, and the spacious laboratories will include many specially equipped rooms – such as the anechoic and reverberant chambers for acoustic measurements. Here, as at Dollis Hill, the social side has not been overlooked. The Administrative block will contain a fine new theatre, primarily designed for technical lectures but also adaptable for social uses.

Already temporary laboratories are being used for microwave experiments with waveguides, and construction of the main building proceeds apace. Permanent laboratories should be ready by the end of 1972 and the move of the staff from Dollis Hill to the new research station completed by mid-1974. Before long the name "Martlesham" will become synonymous with Post Office research, just as the name "Dollis Hill" has been for 50 years.

Mr F. E. Williams has been involved in research at Dollis Hill since 1933, his entire Post Office career. He was a Staff Engineer in charge of the branch concerned with telephone transmission, electro-acoustics and human factors engineering until his retirement earlier this year. He is now working part-time at Dollis Hill in a consultative capacity.

One plus One equals...

TWO PHONES ON A SINGLE LINE

L W Kingswell

The Post Office has over £500 million invested in its local telephone cables networks which provide customers with a round-the-clock service. Yet each customer uses the service for only half-an-hour a day on average. Not surprisingly, the Post Office is constantly looking for ways of making better use of this investment.

One way would be to obtain additional telephone connexions from the local cable network that already exists, and a big step towards this goal could come next year with a large-scale product trial of the "One plus One" Subscriber Carrier System.

In theory, this system could double the capacity of local networks without the addition of a single cable pair.

Current feasibility studies in Bournemouth, Shrewsbury, Oldham and Tunbridge Wells Telephone Areas have been encouraging – the One plus One should enable planners to provide one extra exclusive exchange line on almost any working underground cable pair in their area. Certain practical and economical limitations preclude complete penetration.

Its great advantage over other shared-line methods such as party-line service is that sharing customers can each use the line at any time and in total privacy.

If next year's trials are successful, the system would be used for new exchange connexions or to provide an existing customer with a second connexion, without having to install additional cable. In areas of abnormal growth rate it could provide service while cable was being laid. Later, the carrier units could be used elsewhere.

The system would also be useful in the provision of temporary service at conferences, exhibitions and other such events. At the same time other carrier frequencies could provide a means for transmitting burglar and fire alarms and "piped" music programmes over the same telephone line.

The feasibility of carrier frequency transmission in the local network has been well known for some years, but it is the advent of modern technology and components which is now allowing the practical realisation of the technique.

The One plus One Subscriber Carrier System is connected to a working exchange line to provide a second exclusive exchange connexion. It consists of a compact, transistorised, conversion unit fitted at one subscriber's home or office and a similar unit connected to the line at the telephone exchange.

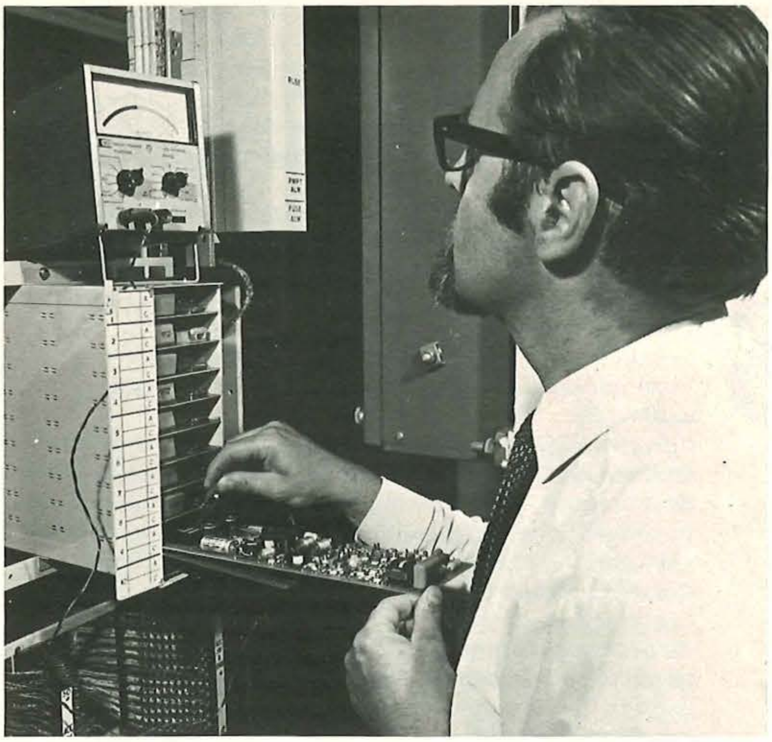
The telephone connexion fitted with a conversion unit functions independently and operates in the frequency band between 19 and 96 kHz, while the other is left working conventionally at normal audio frequencies up to 3.4 kHz. Both circuits use perfectly normal telephones but components within the conversion units convert the speech and signalling from one telephone into the higher-frequency signals which are superimposed upon the voice-frequency circuit. The signals are separated by filters, one within the exchange conversion unit and another fitted externally at the point where the line divides to serve the two subscribers.

Before considering the design details of the Carrier units considerable investigation was undertaken to determine the suitability of the local distribution network for Carrier working. For example, there are about 100 varieties of local cable currently in use. Underground and aerial cable, drop-wire and open wire are all found in various combinations. Conductors may be of copper, aluminium or even steel. However, overall limits imposed by normal telephone transmission requirements allow the cables to be used at frequencies up to about 150 kHz without the need for intermediate amplifiers. The One plus One has been designed to operate between 19 and 96 kHz because cross-talk and attenuation performance is better at lower Carrier frequencies. In fact the nominal frequencies to be used in the forthcoming trial will be 40 kHz for transmission in the subscriber-to-exchange direction and 64 kHz in the exchange-to-subscriber direction.

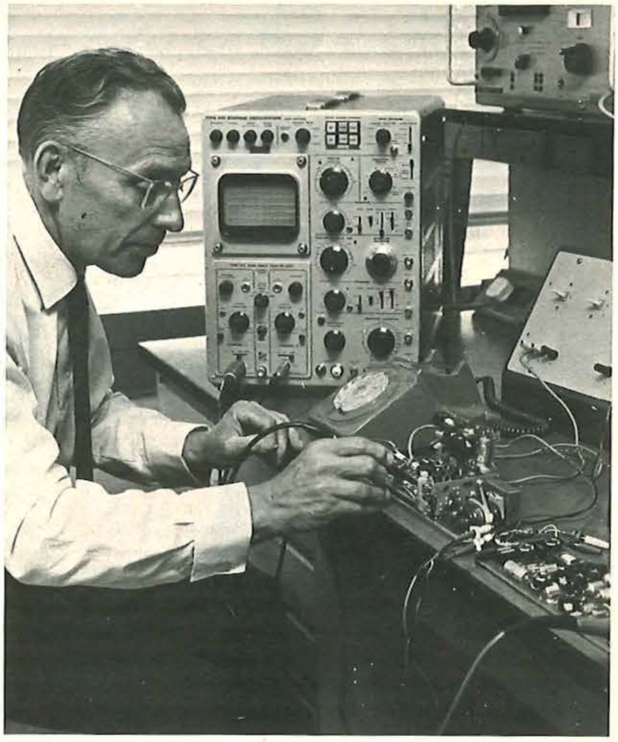
Although the maximum line loss at these frequencies is about 40 dB, four times greater than the conventional audio circuit, this is compensated for by the inclusion of amplifiers in the Carrier units. There could be problems on open wire routes from radio interference generated by local high-power, low-frequency transmitters, but so far as underground cable is concerned Carrier equipment is expected to be suitable for use without the need for special selection of pairs in the majority of cases.

Design has been aimed at making the equipment capable of introduction with the minimum of interference to normal procedures. It operates with standard telephones, requires no setting up adjustment and is insensitive to line reversal.

Carrier equipment in a customer's



Executive Engineer Mr G. C. Toussaint checks transmission levels on one of the 10 printed circuit cards of a carrier unit at Wembley Exchange. The exchange is near the Telecommunications Development laboratories at Alperton and was used by engineers to examine exchange installation problems.

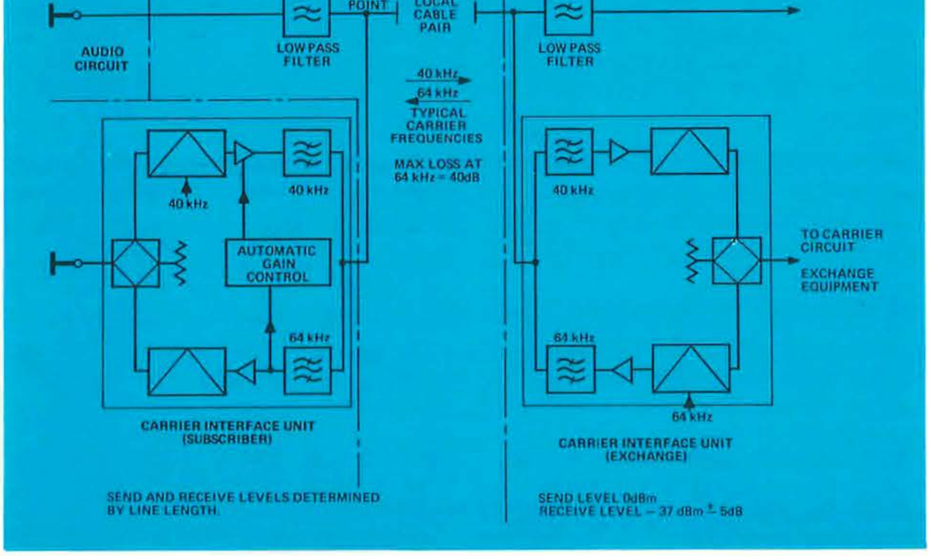


The author checks a carrier circuit to ensure that dialling signals received at the "exchange" are free from distortion. A subscriber's unit, next to the telephone, and an exchange unit on the right of the picture are connected to an artificial line.

premises will be housed in a compact grey plastic case. Terminals will be provided within the unit for connexion to the line and to the telephone instrument. The low-pass filter required for the subscriber end of the audio circuit will have wire tails and will be constructed so as to be suitable for pole mounting to avoid disturbing the subscriber for whom the pair was originally provided. At the exchange both Carrier equipment and filter are mounted on a single printed-circuit card which is plugged into a mounting containing 10 Carrier systems.

Power for the exchange units will be provided from the exchange battery. A small current is required even when the Carrier circuit is not in use because the Carrier receivers must be kept active in readiness for a call. Each Carrier card will dissipate 0.1 watt when in this quiescent state rising to 0.5 watt when active. The subscriber's unit operates from a 9 volt dc supply, the provision of which posed possibly the greatest problem in the design of the new system. A continuous current of about 2.0 mA is required to maintain the equipment in a state of readiness.

"Off Hook" power requires an average of 0.4 watts with a maximum of 2.0 watts while the bell is rung.



Various methods of powering the unit are possible, ranging from the use of a local primary battery to operation from the ac mains. But the technique adopted makes use of a small nickel-cadmium battery, trickle-charged over the line from the 50 volt exchange battery. This has been made possible by a recent development which allows a relatively high charging current to be drawn from the line when it is not in use by the audio subscriber. Incoming or outgoing calls on the audio circuit cause the battery charging circuit to be disconnected automatically from the line.

Because of the need to keep costs as low as possible the Carrier equipment has been designed to cater only for the simple loop-disconnect signalling requirements of a normal exchange line.

When the handset of the telephone connected to the Carrier unit is lifted, the 40 kHz oscillator is automatically switched on and its output transmitted to line. At the exchange this output is detected and made to operate a relay, contacts of which re-establish the dc signalling loop between the Carrier unit and the exchange calling equipment. At the same time the exchange 64 kHz oscillator will be automatically switched on, modulated with dialling tone and transmitted back to the subscriber's unit which detects the dialling tone and applies it to the telephone receiver. Although a much more complicated exercise than with the ordinary telephone circuit, in practice the Carrier subscriber should be unaware of any difference between the operation of his telephone and a

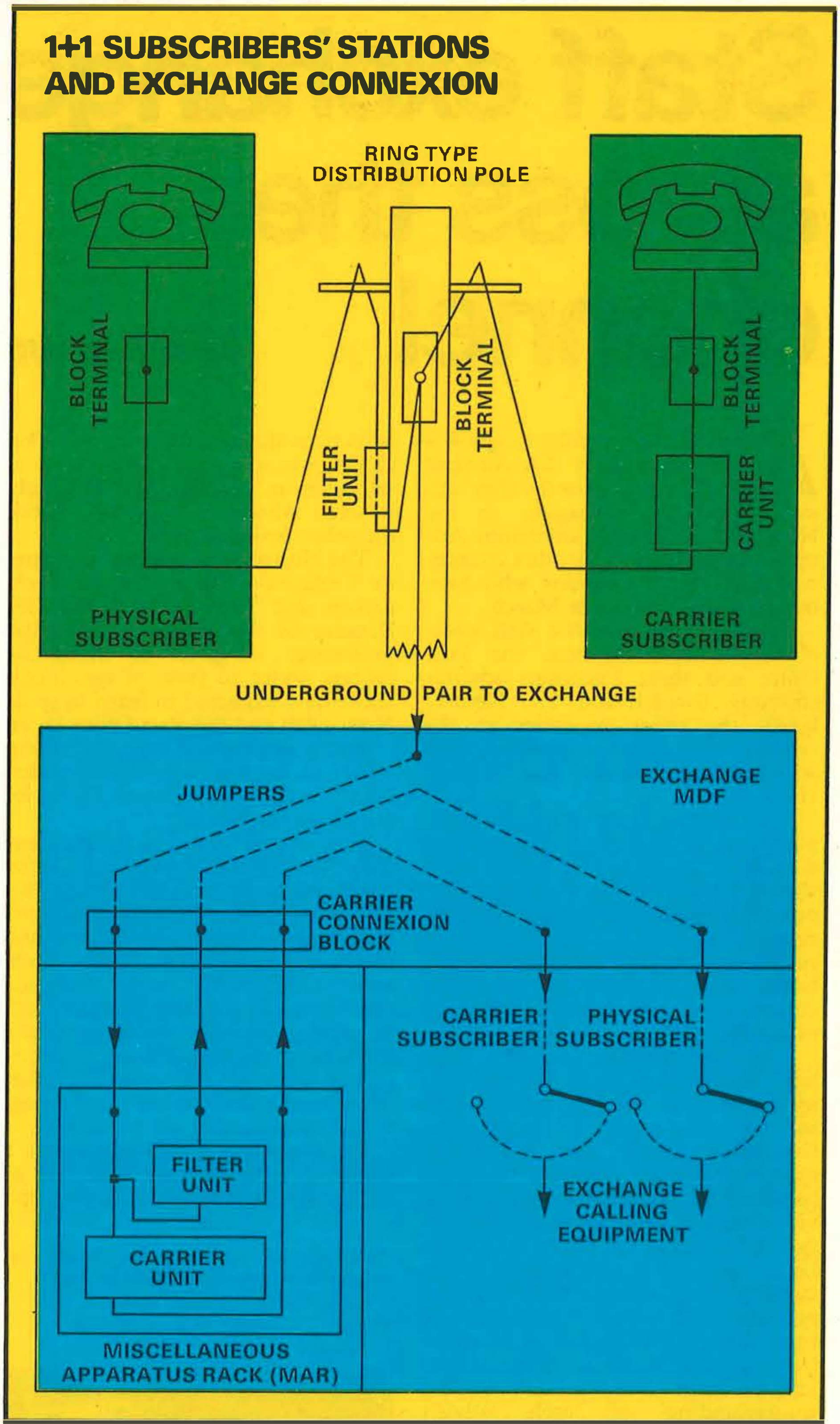
An engineer checks the connexion between the block terminal and the smaller filter unit on the right.

conventional direct exchange line.

On an incoming call to the Carrier subscriber the ringing signal is detected by the exchange unit and will cause the 64 kHz oscillator to be switched on. The Carrier frequency, modulated with the ringing voltage and interrupted at the ringing cadence, is then transmitted to line. This is detected by the subscriber's equipment and after amplification rings the telephone bell. When the handset is lifted the ringing is inhibited and at the same time the 40 kHz oscillator is switched on and its output transmitted back to the exchange. Receipt of the 40 kHz frequency by the exchange unit causes the relay to re-establish the dc loop and give ring-trip conditions to the final selector.

The new system will comply with national and international standards of transmission and signalling. Automatic Gain Control within the units causes the equipment to have the same nominal Carrier frequency performance regardless of the line length. Carrier derived exchange lines will therefore have a guaranteed standard of transmission performance no matter the distance between the subscriber and the exchange, and compared with direct exchange lines will offer an improved performance on longer lines.

In all, there are some 75 semiconductor devices used in two units. These, combined with the remaining components, are mounted on printed wiring boards either plugged into the exchange assembly or mounted in the subscriber's unit. The complexity of these circuit boards prevents detailed local maintenance which will be limited to replacement of complete faulty units.



Since the cable pair is common to both connexions a test carried out at the exchange on the audio circuit will indicate line conditions applicable to both circuits. However, if a functional test of the Carrier circuit is required it will be necessary to include Carrier equipment in the testing circuit.

The current feasibility studies have proved that both installation and maintenance is straightforward, and although the forthcoming trial will be on a far greater scale – 10,000 systems have been ordered from GEC – indications are that few difficulties should arise.

If successful, the One plus One Subscriber Carrier System should provide an added degree of flexibility in the planning and provision of future exchange lines.

Mr L. W. Kingswell is a Senior Executive Engineer in Telecommunications Development Department's laboratory at Alperton House, Wembley. He is head of a group responsible for the development of local-line carrier systems and has been closely involved with the present One plus One system for the past four years.

Staff exchange across the channel

M L Brown

The Post Office is once again taking a full part in a staff interchange scheme with the telecommunications administrations of Norway, Sweden and the Netherlands. Staff from each of the countries travel to their neighbours

A group of Post Office engineers left for Norway this Autumn where for 12 months they will work alongside colleagues in the Norwegian Telecommunications Administration. Already in this country is a party of Norwegians who have been at work here since March.

The visits are part of a staff interchange scheme between the Post Office and three European administrations. Sweden and The Netherlands, the other countries in the scheme, interchange engineering staff with Britain for shorter "fact-finding" visits.

The British Post Office is again playing a full part in the scheme after a lapse of four years in which visits abroad by Post Office staff were suspended because of foreign currency restrictions. Late last year visits were resumed to Sweden and The Netherlands and an interchange with all the countries in the scheme will take place this year.

The interchange scheme was launched in the mid-1950s. Some idea of the original thinking behind it is indicated in a statement by the Joint Committee which first considered staff interchanges. It said: ". . . we had in mind the question of arranging visits abroad with the primary purpose of securing the benefits likely to be derived by the individual in his capacities as a worker and citizen; the secondary aim would be to contribute towards the fostering of good relations between the people of this country and of other countries and mutual understanding of each other's problems."

Originally, all interchanges were for 12 months and were on a reciprocal basis. The officers involved replaced their opposite numbers and were paid by the administration of the country to which they had been sent.

Over the years, however, the scheme has evolved into two separate parts – the long-term, 12 months interchange with Norway which is basically a working interchange, and short-term one month interchanges with Sweden and The Netherlands which are much more in the nature of training visits. Each country now pays its own officers and, in addition, the Post Office pays a special allowance to its engineers in Norway and normal subsistence allowance to those visiting the other two countries.

The Norwegian interchange is open to Technical Officers, Senior Technicians and Technicians I and IIA. Because of the length of the visit, preference is given to unmarried officers under 30 years of age. Those chosen are expected to learn to speak Norwegian and the Post Office assists in this by arranging a language course. While in Norway the officers undertake an actual job, although the period serves also as training.

The shorter visits to Sweden and The Netherlands are open to Senior Executive Engineers, Area Engineers, Executive and Assistant Executive Engineers to study engineering organisation and technical practices, Technical Officers to study technical practices, and Leading Draughtsmen to study drawing office practices. Preference in selection is given to officers under 45 years of age and they are not expected to learn the language of the country they are visiting.

In both types of interchange it is hoped that the officers will gain an appreciation of the country and people they are visiting and that they benefit socially and culturally as well as technically from the experience.

Asle Pedersen from Tromso, Norway, is on an exchange visit to Britain and is currently at Faraday Repeater Station in London. He is pictured manning the fault reporting table.

From the reports by staff who took part in the 1970 visits and from a review undertaken in 1969 among engineers who had previously taken part it is clear that the interchanges are considered a great success and that those who have taken part are grateful to have had the chance.

The actual benefits to the individual are more easily seen than are the benefits to the Post Office which tend to be somewhat intangible. The following extracts from a questionnaire, part of the 1969 review, show clearly what participants consider to be the benefits of the scheme . . .

"A suitable officer will gain an additional language; he will gain culturally and will be able to look at Britain and her policies from a foreigner's eyes."

"The interchange could be considered as a form of open training course which may permit more originality and improved facility in appreciation of technical innovation."

"Greater appreciation of certain aspects of life in the UK when compared with the foreign administration. Cultivation of a more critical yet balanced outlook on technical organisation and national topics."

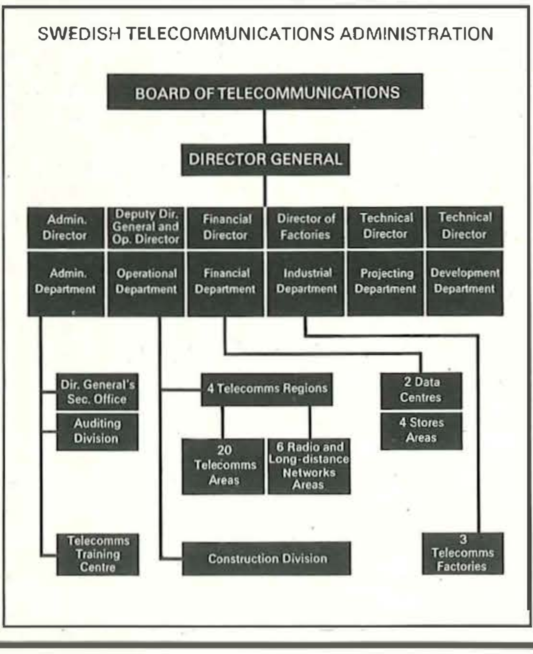
The interchange scheme is currently administered by a Joint Study Group made up of Post Office officials and members of the Council of Post Office Unions. There is separate consultation as necessary with the Society of Post Office Engineers. The scheme is currently operating on the same basis as before the suspension in 1966 but when it has been firmly re-established and is again running smoothly it is hoped to consider possible changes such as extension to other European countries.

Mrs M. L. Brown is a Higher Executive Officer in the Recruitment and Manpower Division of Telecommunications Personnel Department dealing with promotion policy for engineering and allied grades. In addition she is secretary of the Joint Study Group which is responsible for deciding the policy of the interchange scheme.

or across the channel to see how the "other half" works. A description of how the exchange scheme is organised is given here. We also publish one of the results of the scheme – a report on the Swedish Telecommunications Administration. It is part of a report written by Mr D. C. Jones, formerly an Assistant Executive Engineer in Bristol Telephone Area, after he had made a four-week exchange trip to Sweden last year. Mr Jones is now working on secondment in Hong Kong.

Stored Program Control-and windmills

A helicopter flies in material for the construction of a microwave radio tower in the mountains of North Sweden.



Engineers have their own boats for installation work in the Stockholm archipelago.

The Swedish Telecommunications Administration is one of the trading concerns run by the State. The Board of Telecommunications, appointed by the King in Council, has authority of decision in all matters relating to the telecommunication services except those which, in conformity with special regulations, must be submitted to the Government.

At the central administration level the various activities are carried on by six different departments. The Heads of these departments form a Directorate, headed by the Director General. Extensive powers of decision have been delegated by the Board to the Director General, who in turn may delegate such powers to his subordinates as is required for everyday business.

For regional administration the country is divided into four Regions. Each is headed by a Regional Director who exercises control of the traffic and engineering services as well as certain financial control. The regions are subdivided into 20 administrative units – telecommunications areas and radio and long-distance network areas.

Independent of the regional organisations there is a Construction Division which deals with the construction and laying of new trunk cables, the building of radio-link towers, etc.; a number of data processing centres, several stores administered by the Financial Department; and factories which are managed by an Industrial Department.

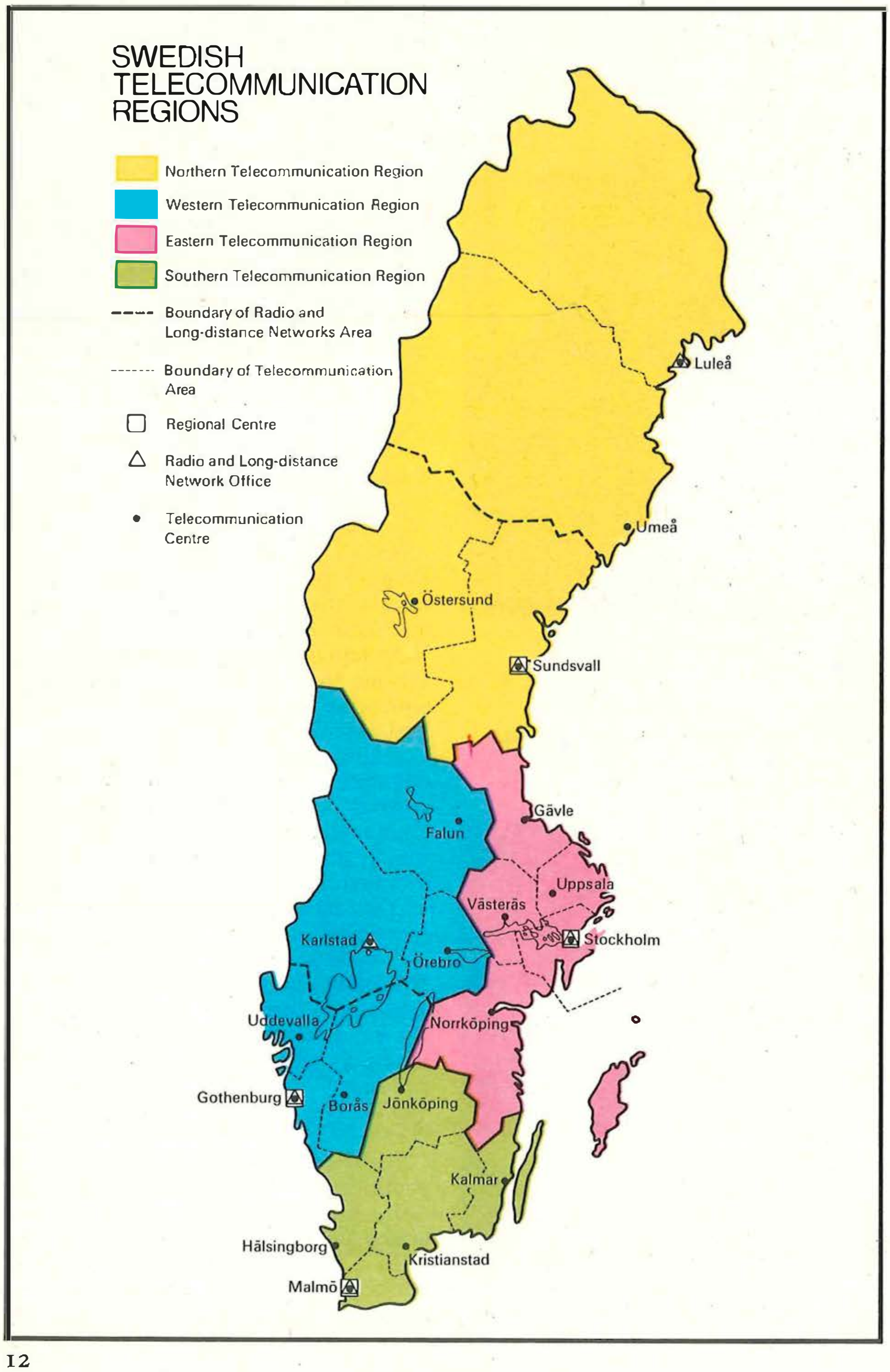
The factories have been active for more than 75 years and produce considerably more than half the automatic telephone exchanges, private branch exchanges and telephone sets installed by the Swedish Administration. The assembly and testing of the equipment produced is also very frequently carried out by the Industrial Department's own staff.

Although most of the factories' products are sold to the Administration, sales promotion is now also aimed at the international markets and sales activities are carried on in competition with private enterprises. By operating its own factories the Administration can exert, to some extent, a control over prices and can perform tests and experiments on a large scale which enable it to keep in the vanguard of telecommunications developments.

Another advantage is that three important functions come together in the same enterprise. The Administration's Development Department carries on extensive development and design work, the Industrial Department has factory experience of the adaptation of the designs to mass production and the Operational Department has experience of operation and maintenance of the equipment delivered by the Industrial Department. This has been extremely valuable in the Administration's endeavours to make telephone operations cheaper and more efficient.

During the first week of our visit we spent some time at the 508 ft Kaknas Tower, the tallest building in Scandinavia and built primarily for radio and TV relay purposes. We also saw the Stored Program Control telephone exchange at Tumba outside Stockholm, the first to go into public service outside the USA. With Stored Program Control the functions previously carried out by relay sets, registers, markers, etc. are controlled by a program read into a memory store which determines the working routines of the exchange.

Stored program control permits very much more diversified working routines in the exchange, and the possibilities of variation are limited only by the capacity of the program memory. For a small extra cost, therefore, new traffic facilities for the subscribers can be introduced, such as abbreviated dialling enquiry and transfer, ring-back on busy, etc. It also becomes possible to draw up programs for fault tracing which facilitate the maintenance of the exchange.



The middle two weeks of the visit were spent in Malmo, Sweden's third largest city with a population of 259,000. Malmo is the headquarters of a Telecommunications Area which covers the southern part of Sweden with 177 exchanges serving 250,952 exchange lines and 310,180 telephone stations. The work of the Area is covered by four divisions: Construction – installation of network, cables, exchanges and equipment; Operational – operation of telephone and telegraphic traffic, maintenance; Sales – commercial tasks, accounting; Personnel and Administrative.

In the Operational Division a Maintenance Control is staffed by 40 women in two sections each under the control of a male Line Master, roughly equivalent to an Inspector. Faults are reported by subscribers direct to the girls who test the lines, record the faults and pass them direct to the maintenance men. When the engineer has cleared the fault he reports back to the girl who tests the line and records the clear and the time the circuit was back in service. Records of all faults are passed direct to a computer via data links for future analysis. The control deals with an average of 600 faults a day.

We had an interesting visit to Lund, a university city, some 12 miles north-east of Malmo. They have an L. M. Ericsson 500-line switch exchange which uses motor-driven selectors, the motive power coming from driving shafts on the side of the racks. The selectors are rather slow working and being mechanical switches they require more or less regular inspection, cleaning and lubrication.

We also saw the different types of telephone apparatus, including PABXs. All telephones are now mounted with plugs and jacks, similar to the Post Office Plan 4. Jacks are fitted as standard in all new dwellings and there may be up to six at no extra charge. Extension leads with plug and jack fittings are also available. Subscribers can call at the exchange and collect their telephones if they are moving into a new house; this saves a visit to the property by a fitter.

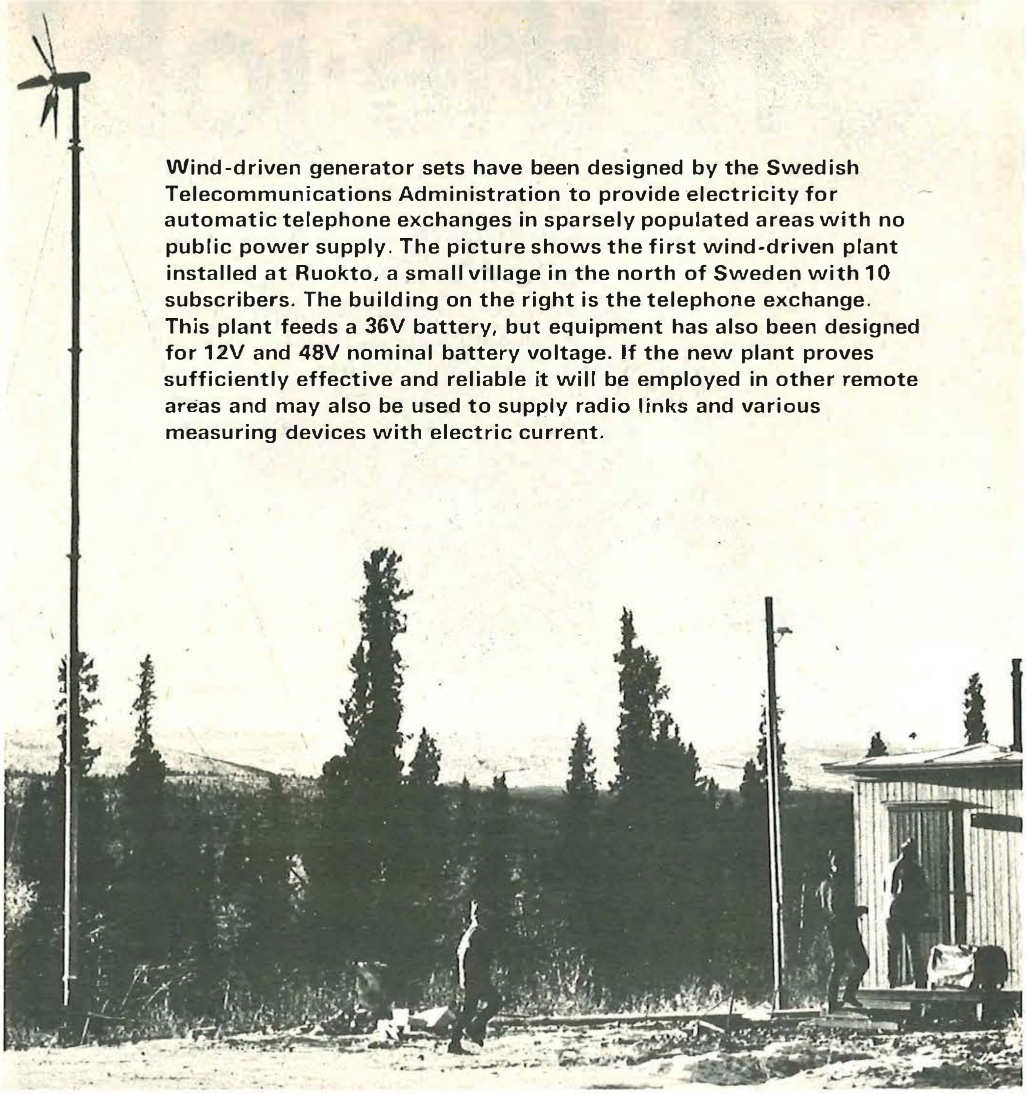
We spent a day with a Line Master responsible for cable maintenance. Trunk cables in Sweden are lead covered and many are mole-ploughed across fields, following the shortest practical route. Cable creepage is unheard of and there is a reduction in damage by contractors or road works parties.

At the Construction Division we made quick visits to the Works Control and Installation Control, each staffed almost entirely by women. In the former, eight women issue work to 75 units and in Installation Control the girls control the work of 20 men.

For the final week of the visit each member of the party followed his own programme. My particular interest being External Planning I spent some time with the External Planning Groups and I saw the new subscriber's drop-wire which is being introduced. It has a separate seven-strand suspension wire, the same as self-supporting aerial cable. The two-pair size will be standard as it is just as cheap to produce as the one pair.

One interesting fact to emerge was that the Swedes had no plans for the introduction of aluminium cables, although they had been looking at these since 1966. In the Swedish network half the cables are lead covered and half polythene sheathed.

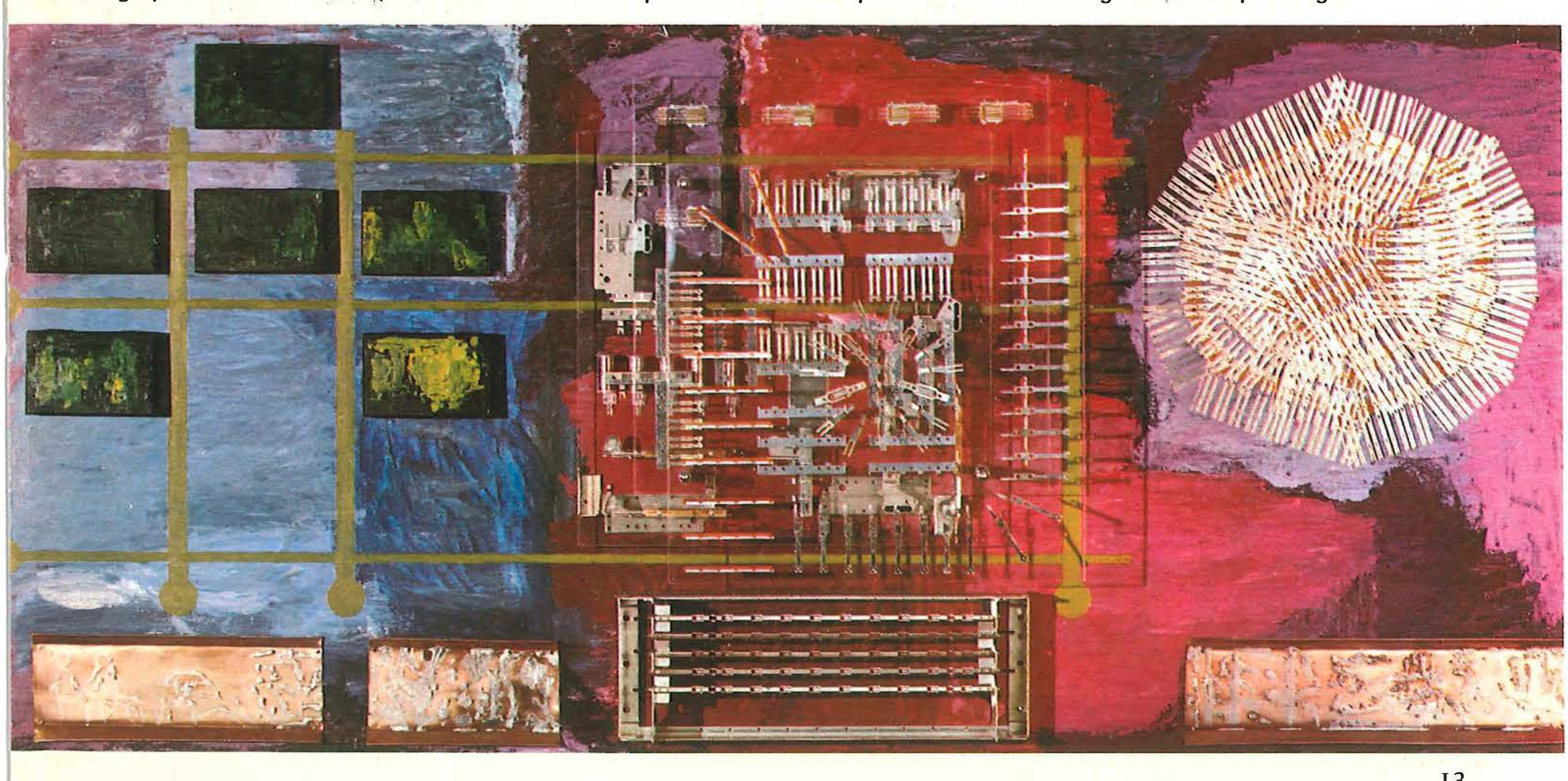
Personally I feel that I benefited from the interchange. It broadened my outlook, making me more readily aware of other methods of working.



Wind-driven generator sets have been designed by the Swedish Telecommunications Administration to provide electricity for automatic telephone exchanges in sparsely populated areas with no public power supply. The picture shows the first wind-driven plant installed at Ruokto, a small village in the north of Sweden with 10 subscribers. The building on the right is the telephone exchange. This plant feeds a 36V battery, but equipment has also been designed for 12V and 48V nominal battery voltage. If the new plant proves sufficiently effective and reliable it will be employed in other remote areas and may also be used to supply radio links and various measuring devices with electric current.

In the high mountain areas engineers use snow scooters to reach isolated telegraph lines in need of repair.

Below: This colour painting, measuring 7 ft by 3 ft, decorates the entrance hall of the Swedish Administration's Industrial Department building. It was painted by Mr K. V. Tahvanainen, Public Relations Officer, but was submitted under a pseudonym. All the parts of a crossbar switch have been attached to the centre of the painting and to the "aerial". The left side of the picture includes plates that can be opened to show drawings and small paintings.



'Off-the-job'

apprentice training

S W Brown and A J Lowes

The quality of the training given to young telecommunications apprentices in the Post Office has, over the years, been second to none. This is confirmed by the fact that so many men now occupying senior positions began their careers as Youths-in-Training.

Successful as the past record has been, changing circumstances and technological progress demand constant reappraisal of training techniques. In recent years there have been considerable changes in working conditions and organisation in Telephone Areas, where the majority of apprentices are employed, which have made effective training by established methods difficult.

Traditionally, field training is carried on through the first two years with separate courses at Post Office regional engineering training schools and block or day release courses at local technical colleges. This clash between academic and practical work has placed conflicting demands on Trainee Technician Apprentices (TTAs) as new engineering recruits are now known. It is also difficult to find sufficient field staff of the right calibre to train apprentices and there is interference in field staff productivity because, in the early stages, work has to be slow if training is to be thorough and conscientious.

As a result the Post Office is now experimenting with a new training system in the Brighton Telephone Area. For the first time first-year TTAs are being taught "off the job." They spend three days a week at a new, fully equipped, telecommunications training centre provided by Brighton Education Committee and equipped by the Post Office, and two days a week at Brighton Technical College with periodic visits to telephone exchanges, transmission stations and other Post Office premises. Field work begins only in the second year.

First year "off the job" training has been adopted for a number of reasons. It assures every apprentice uniformity of instruction over the entire range of training activities. By eliminating field work, at its most ineffective in an apprentice's first year, more time is spent in meaningful work in the controlled atmosphere of the training centre. Finally, "off the job" training does not affect the productivity of field staff.

There were three compelling reasons for sharing the scheme between Brighton Telephone Area Engineering Training staff and Brighton Technical College. Firstly, the local College had a large and active telecommunications section. Secondly, Brighton Education Com-

Above Left: An introduction to overhead work using "mini" training poles in the grounds of the Brighton centre.

mittee were able to provide a site and buildings suitable for a Training Centre. Finally, the annual intake of TTAs in the Brighton area justified setting up such a centre.

The final form of the new scheme evolved after many months of deliberation by a joint committee representative of Brighton Technical College, the Telephone Area, local Union representatives, the South Eastern Telecommunications Region and Telecommunications Headquarters Training Branch.

The integrated training programme is covered in two years followed by live work under guidance in the field during the third year. The first year "off the job" training is followed by a second year of three weekly courses on specialised work each followed by three weekly periods of field training in live conditions. The vocational training required is divided into six activities – broadly speaking practical work in telephone installation, customers' apparatus maintenance, local line maintenance, exchange maintenance, internal construction and external construction. Instruction is given concurrently in all six rather than in separate complete blocks. By this means it should be easier to convey the idea that the provision of telephone service is very much a team effort and to eliminate a narrow view of any one engineering activity.

The technical studies for all first-year students are confined to the City and Guilds Syllabus 49 (Telecommunications Technician Course). This provides an opportunity to build a firm foundation for future studies, although it is appreciated that some recruits will be eligible for immediate entry into the Ordinary National Certificate course. Subsequent follow-on courses will be decided at the end of the first year.

An important advantage in concentrating on one first-year course for all students is that it enables the order of presentation of the City and Guilds syllabus to be altered so that it is possible to integrate the theoretical treatment with the practical work to the mutual advantage of both.

Initially some 48 TTAs joined the scheme. Three full-time lecturers, all previously employed by the Post Office, have been recruited to the staff of Brighton Technical College and, in addition, two Post Office engineers have been seconded to the Education Authority for two years. By this interchange of lecturing staff from the practical field every two years the scheme will be served by up-to-date information on new techniques and procedures.

Occasional lectures are given by the Area Training Officer on Post Office organisation, conditions of service and kindred subjects, while other Supervising Officers from the Area speak on their field of work.

The Training Centre has specialised equipment designed, supplied and installed by the Post Office, and working conditions have been made as realistic as possible. From the outset all the practical exercises have been carried out as real jobs, even to booking out stores on appropriate vouchers from their own Section Stock run on Post Office lines.

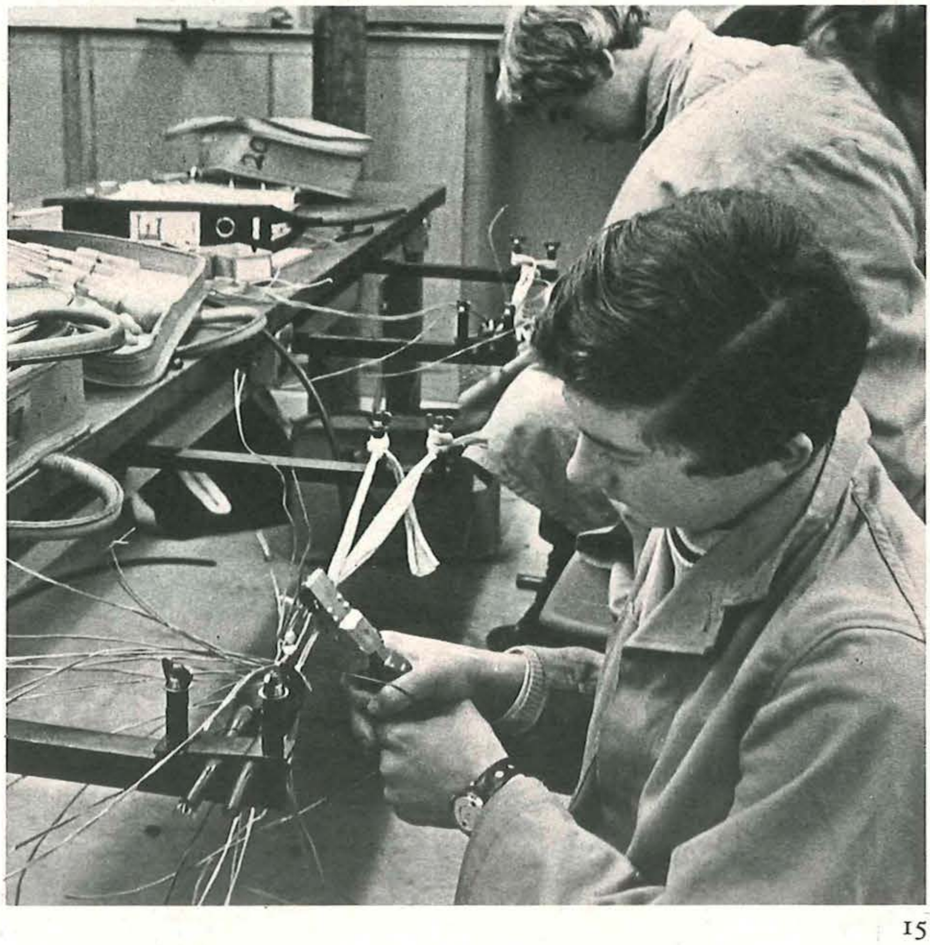
The initial first-year course under the new scheme has now been completed and there is ample evidence that the interest and enthusiasm of the apprentices is being maintained at a high level. It is undeniable that interest is more easily sustained with a full programme of activities, and a further incentive is present in a comprehensive system of continuous assessment of progress. This enables any shortcoming to be revealed at a stage when it can be effectively remedied. Without undue emphasis on competition an apprentice knows what progress he is making and can concentrate on any weakness. This reporting procedure will also build up a detailed objective history of an individual's training and will indicate any pronounced aptitude – something which will be of great help in deciding on the operational role to be filled by an apprentice when he becomes a technician.

At the end of the first year the best academic path for each TTA to follow has to be considered. To help in this there is the continuous assessments from College and Training Centre and the result of the City and Guilds examination. Due regard will be paid to these factors and a minority of the boys of the more academic type may be entered for the Ordinary National Certificate course. Added to the normal syllabus will be sufficient material for them to take the second-year examinations of City and Guilds Syllabus 49 in addition to ONC examination. This will provide a safeguard should the results of the latter be unfavourable.

Experience so far confirms that the experiment is fulfilling its early expectations but staff are constantly on the alert to detect any weaknesses and devise modifications to meet them. The experiment has already aroused much interest beyond the Brighton Area and consideration is now being given to the preparation and application of a comparative test in an attempt to establish whether there is a cost benefit in the scheme apart from its value in relieving pressure on training resources in the field.

Mr S. W. Brown is Regional Training Officer for the South Eastern Telecommunications Region. He has been a part-time lecturer at Brighton Technical College and Worthing College of Further Education.

Mr A. J. Lowes, a former teacher, is Area Training Officer for Brighton and is a member of the Engineering Advisory Committees for Hastings and Worthing Colleges of Further Education.



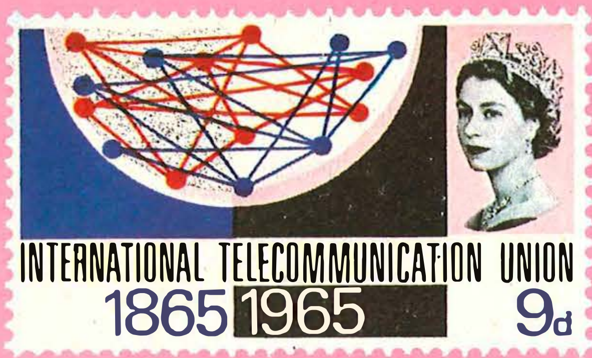
Right: Trainees learn polythene cable jointing in one of the training centre's work rooms.

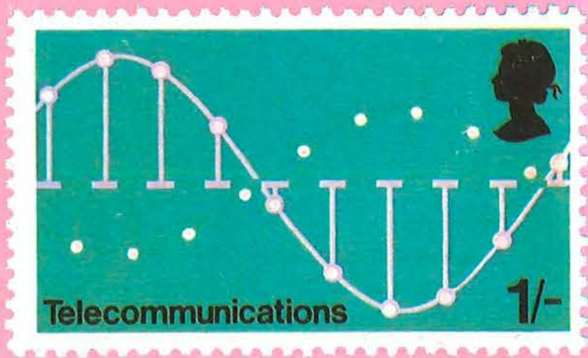
collecting with a

A G Rigo de Righi

Curator of the National Postal Museum

Right: Four British stamps which each feature a telecommunications theme. The top two stamps commemorating the opening of the Post Office Tower and the centenary of the International Telecommunications Union were both issued in 1965. The other two, featuring Post Office technology, were issued in 1969. The 9d stamp marks the progress of International Subscriber Dialling towards an integrated world telecommunication system. Centre is a hemisphere of the globe and in the corners there is a segment of a stylised telephone dial. Seen as a sheet, every intersection of four stamps shows a complete dial. The subject of the 1s stamp is pulse code modulation which enables up to 24 telephone conversations to be made over one pair of wires simultaneously. The designer has symbolised the wave patterns of two voices travelling interleaved on one circuit.

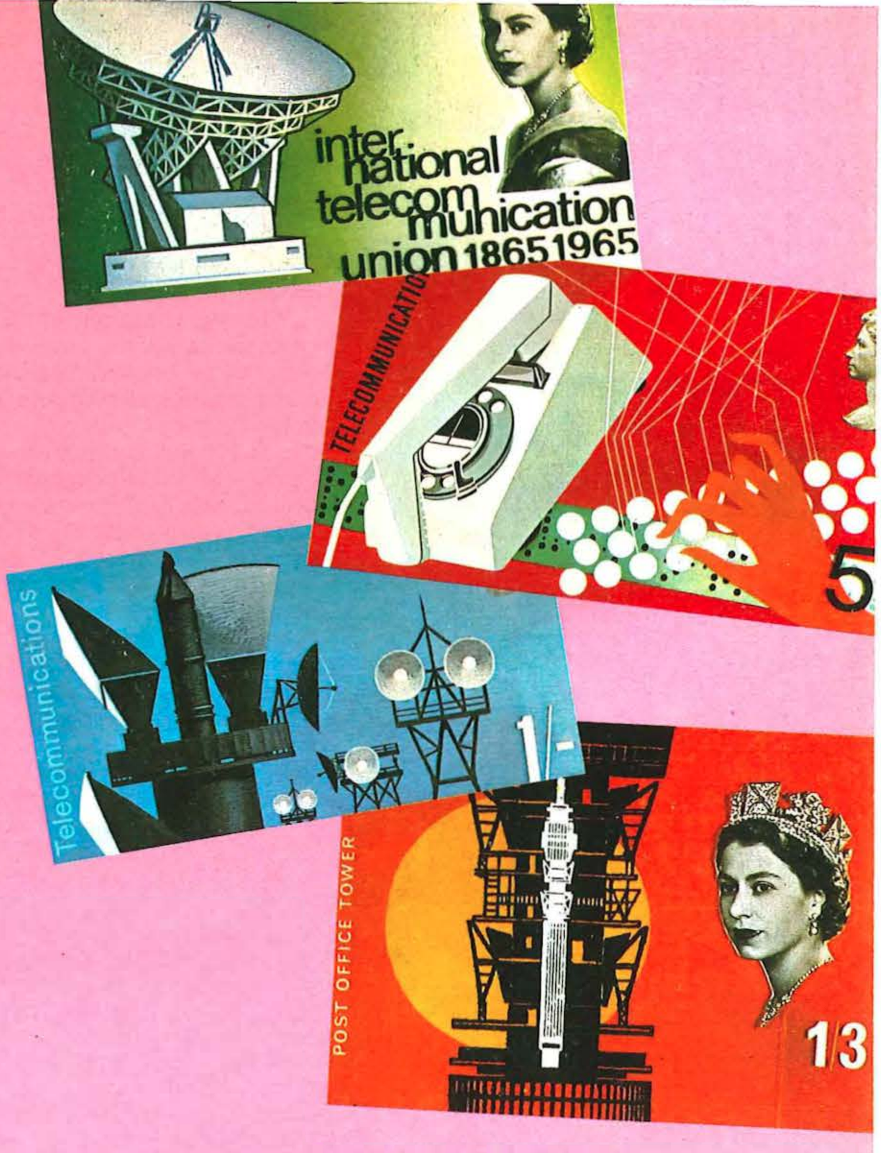




Below: The special stamp, featuring an Intelsat IV communications satellite, issued by Switzerland to mark the World Space Conference and the first World Telecommunications Exhibition "Telecom 71" held in Geneva this summer.

theme

Stamp collecting is nowadays enjoyed by a growing number of people of all ages in every part of the world. An increasingly popular branch of philately is "thematic" collecting – the collection of stamps to illustrate a particular theme. And since telecommunications is often featured in stamp design, what better for the telecommunications man than a collection of such stamps? It can be a fascinating and colourful hobby.
Some of these stamps from different countries are shown here along with other designs which were not accepted and which can only otherwise be seen in the National Postal Museum in London.
Many British stamps commemorate or highlight telecommunications achievements. From 1851 until taken over by the Post Office in July 1869, no less than 10 private telegraph companies in this country issued their own stamps.
These were followed by Post Office issues, both of adhesive telegraph stamps and of telegraph forms with embossed postage stamps, as well as special issues for Army Telegraphs which were used in campaigns in Africa between 1884 and 1901.
More recently, several issues of British commemorative stamps have illustrated telecommunications and related themes. These include: 1960, First Anniversary of European Postal and Telecommunications Conference and British Technology (4d Jodrell Bank Radio Telescope); 1963, Opening of COMPAC (Trans-Pacific telephone cable); 1965, Opening of Post Office Tower and Centenary of the International Telecommunications Union; 1967, British Discoveries (4d Radar, 1s 9d Television); 1969, Post Office Technology (1s Pulse Code Modulation, 9d International Subscriber Dialling).
A great many overseas countries have also issued telegraph and telephone stamps and stamps with a telecommunications theme. During this summer Switzerland issued a special stamp in honour of the World Space Conference at Geneva (Intelsat IV) and New Zealand has issued two stamps to commemorate the opening of the country's first satellite earth station at Workworth.
The United States has honoured, philatelically, over the past 40 years Samuel Morse, Graham Bell and Edison and the centenaries of their first telegraph and trans-Atlantic cables. France, Germany, Austria, Italy and many other nations have commemorated their pioneers and new achievements in telecommunication. The countries of the Pacific for instance, celebrated, like Britain, the 1963 opening of COMPAC, which links North America, Hawaii, Fiji, New Zealand and Australia.
The scope for a collection of telecommunications stamps is as wide or as limited as the collector chooses to make it. It might even include, as a colourful and interesting sideline, the collection of the very attractive special greetings telegrams forms used by the Post Office, Cable and Wireless and Western Union.
All the stamps and designs mentioned and illustrated, and hundreds more, can be seen in the Post Office's National Postal Museum next to the London Chief Post Office in King Edward Street.



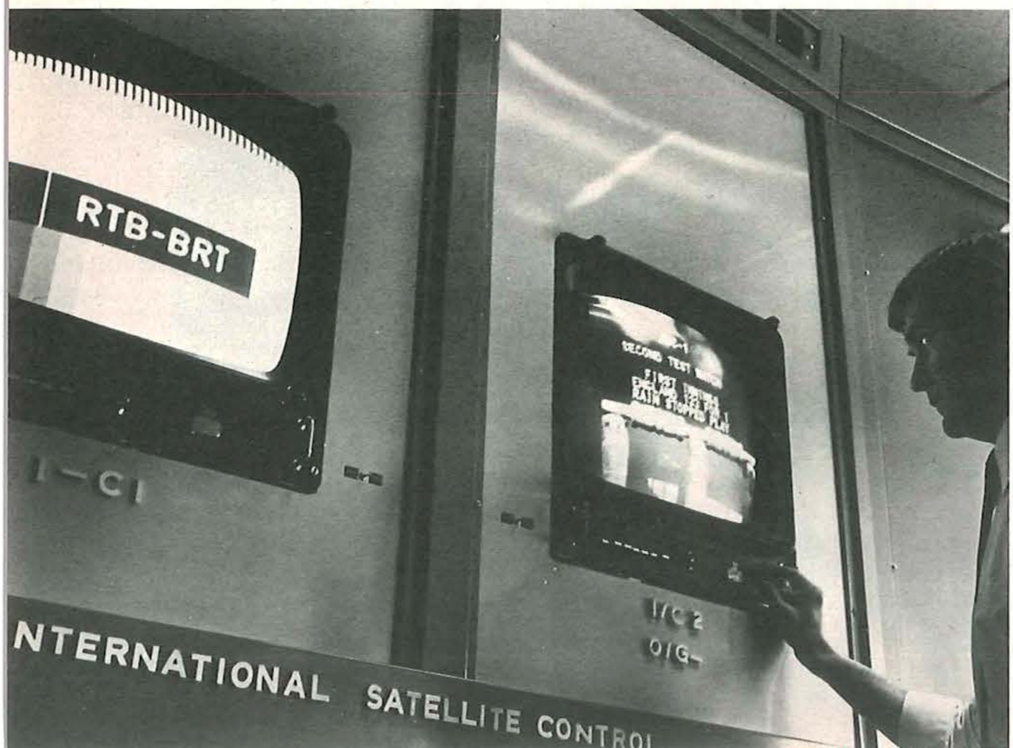
Four British designs on similar themes to the stamps on the left. This group was not chosen for use.

The stamps issued by New Zealand, Fiji, Australia and Britain to mark the opening of the COMPAC submarine telephone cable.

World TV from the Tower

A J Sudbery

At the International Control Centre adjustments are made to a monitor during broadcasts of the Australia-England Test Match. On the other monitor test signals are being checked between London and Brussels prior to forward transmission of a programme over the Eurovision link.



Great events, seen as they happen all around the world, make compelling television viewing in homes throughout Britain. It has all become possible since the advent of communication satellites which now provide a 24 hours-a-day link around the globe.

The organisation of such broadcasts is complex. Satellite channels have to be booked, satellite tracking earth stations alerted and links made between the originating country and the television companies around the world – all of which involves a great deal of technical expertise and skill.

To control these broadcasts, International Television Centres (ITCs) have been set up by communications administrations. In this country the control of international and intercontinental television broadcasts has until recently been the responsibility of the BBC, acting on behalf of the Post Office.

Now the Post Office is itself operating an International Television Centre which has been set up at the Post Office Tower in London. Staff at the Centre are responsible for ensuring that the highest quality of vision signals reach the ITA and BBC and, on occasion, other ITCs throughout Europe which require onward transmission of programmes over the Eurovision link.

Before each broadcast the Centre has to establish a link with the distant earth station and ITC, send or receive a series of test signals, correct distortions which may have occurred in the signal during its long journey through space, and throughout the broadcast monitor signals continuously to ensure that quality is maintained and incipient faults spotted and followed up before they become objectionable to the viewer.

All of the pre-broadcast operation has to be completed in the 15 minutes prior to the start of programme transmission. First, the carrier frequency used for television – it is different from that used for telephony – is actuated by station staff at Goonhilly Earth Station in Cornwall where the satellite signals are first received and then relayed over microwave radio links to the Post Office Tower. It then takes Goonhilly five minutes to complete tests to ensure that signals are coming from the satellite. The signal is then passed to the ITC where staff have just 10 minutes left for the delicate and exacting task of correcting any distortions present.

This is done by viewing the signal on a cathode ray oscilloscope. The transmitting station sends a series of internationally agreed test signals to check the various parameters required to produce a good picture. The tests cover the overall level of the signal, its picture synchronising pulse ratios and waveform response and field time distortions. They are completed by the viewing of a colour bar signal which enables the control officer to obtain a subjective analysis of the circuit.

One of the biggest problems in television transmission is the level of unwanted "noise" in the signals and checks on the "noise" levels are made before and during each broadcast.

The actual correction of distortions is achieved by the introduction of a series of resonant-type equalisers which restore the signal as near as possible to its ideal wave form. This is a job which requires considerable experience and some say it is more an art than a science. When the best possible results are achieved the circuit is offered to the customer and the distant ITC extends its end of the circuit to the programme source.

The programme is monitored throughout the transmission on a colour picture monitor and cathode ray oscilloscope. Because satellite transmissions are so expensive timing of transmissions are noted and interruptions recorded so that accurate accounting can be done.

The London Centre can be linked by telephone with any other ITC anywhere in the world. This is set up by means of a four-wire speaker which is routed over land lines to Goonhilly from where it can be extended via satellite to the country originating a broadcast. A teleprinter service to Goonhilly is used for co-ordination of operations.

Since its opening the new centre has successfully handled transmissions of the England Test matches relayed from Australia, the "Children of the World" programme transmitted to many nations to celebrate World Telecommunications Day, the last Apollo moon-landing and the British Lions tour of New Zealand.

Mr A. J. Sudbery is an Executive Engineer with responsibility for telephony and television transmission at the Post Office Tower.

A common sense approach to cutting costs

D J Earl

Value Analysis is a highly organised and critical approach to the job of reducing costs. It puts emphasis on the function of each part of a product with the aim of eliminating all unnecessary total costs, while preserving essential performance requirements.

It originated in the USA more than 20 years ago and is now widely applied there to design, manufacturing and purchasing operations. There is a growing interest in Value Analysis in this country and it is appropriate that the Post Office, as a large purchaser of equipment, has established a Value Analysis Branch in Purchasing and Supplies Department.

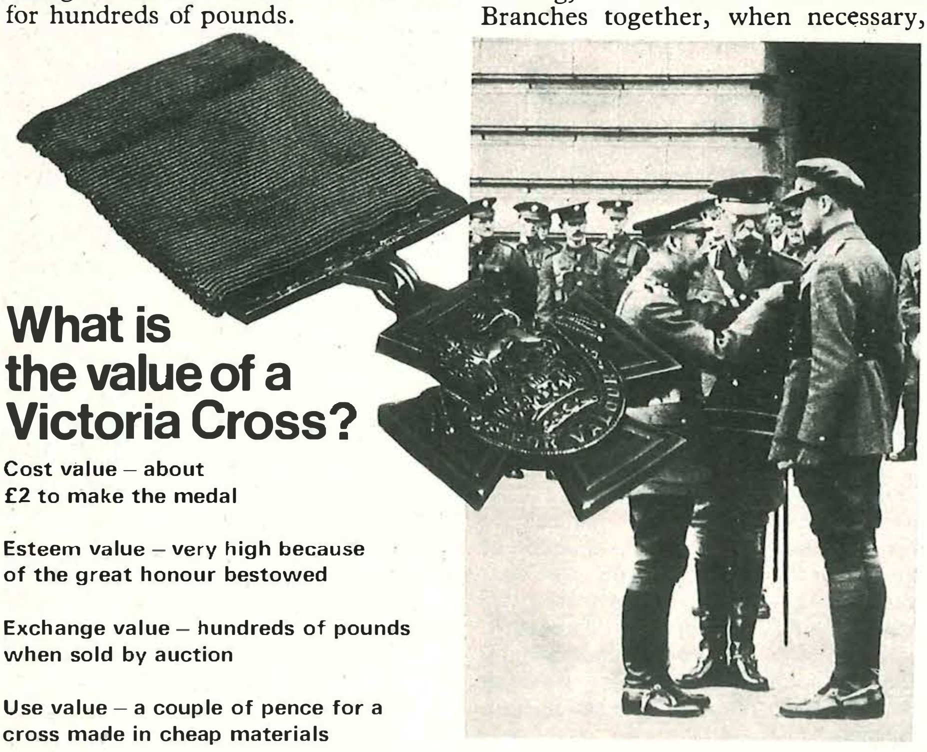
In defining Value Analysis it must be realised that value can mean a variety of things to a number of people. There is **Cost Value** – the manufacturing cost which is the sum total of the material, labour and overhead charges in producing an item, and which can be accurately determined. There is **Exchange Value** – the monetary or barter equivalent based on those characteristics which enable an item to be sold or exchanged in the open market, and which is highly influenced by the competitive situation existing at the time. **Use Value** is the monetary equivalent of the properties and characteristics which contribute to its performance while **Esteem Value** is the monetary equivalent of the properties and characteristics which encourage ownership.

An example which covers all these values is the Victoria Cross. The Cost Value is about £2 whereas the Use Value could be provided by as little as 2½p, say a plastic medal of recognisable shape attached by a safety pin. The VC once awarded has great Esteem Value and a very high Exchange Value since it can be auctioned for hundreds of pounds.

Of these four variations, Value Analysis is primarily concerned with Use Value – obtaining the lowest cost to accomplish reliably the function of the item, and occasionally with Esteem Value in obtaining the lowest cost for providing an item of sufficiently attractive appearance. The latter is essential where equipment is fitted in public places or customers' homes.

Value Analysis can be applied only to items already in production and service when it is possible to quantify the savings resulting from the implementation of the Value Analysis recommendations. The same techniques applied to an item at the design stage is called Value Engineering and results in cost prevention rather than cost reduction.

One of the fundamentals of the technique is that the work is carried out, not by an individual or a particular interest, but by a team representing all interested parties and therefore covering different aspects. Depending on the item under review, the composition of a team in the Post Office usually includes representatives from Design and Development, Purchasing, User or Sales and Service Branches together, when necessary, with Management Services, Factory and Supplies, Regions and Areas and manufacturers representatives. Success is dependant on the enthusiasm of the team in applying the principles and techniques and on their working together to achieve a combined result.



What is the value of a Victoria Cross?

Cost value – about £2 to make the medal

Esteem value – very high because of the great honour bestowed

Exchange value – hundreds of pounds when sold by auction

Use value – a couple of pence for a cross made in cheap materials

Items suggested for analysis come from Post Office divisions, from manufacturers and within Value Analysis Branch itself. A major source is a systematic trawl of stores data provided by the Supplies Division computer. This includes details of all engineers' demands in descending order of total annual costs and quantities. It is therefore possible to select items bought in large quantities and at high annual cost as well as inexpensive items of a simple nature purchased in even larger quantities.

In the latter case, a short and simple Value Analysis exercise involving minor changes to a specification or drawing often reveals significant savings.

To achieve the best results the application of Value Analysis must follow a carefully planned programme. This is referred to as the Job Plan and has five distinct stages – Information, Speculation, Evaluation, Planning and Implementation.

The Information or fact finding stage is concerned with gathering together as much reliable information as possible. This should include details that will supply the answers to the questions, What is it? What does it do? What does it cost? What is it worth? It should also include the latest purchase price, current stock position, present and future demand, together with detail drawings, assembly drawings, specifications, and design history of the item.

At this stage the emphasis is on functions, and a cost breakdown of the item should be obtained and attributed to each function. In some instances a part has many functions and cost has to be attributed on a part basis. To make the identification as simple as possible it is usually possible to identify one as the basic function and to refer to the remainder as secondary functions. A typical example is a propelling pencil. The primary function is to "mark paper" and not "hold lead", whereas secondary functions are "adjust length" and "attach pocket". It is essential that these functions are accurately defined as the speculation to follow is based on them.

The Speculation stage supplies the answer to the question, "What else will perform the function?" This is the creative part of the activity, governed by the individuals taking part and carried out in "brain storming" sessions. For these sessions to be effective they must be free-thinking, with team members encouraged to put forward suggestions no matter how impractical they may at first seem.

Speculation should first consider the function of the whole assembly and then the function of constituent parts. This is important as it does not necessarily follow that the existing breakdown is the best solution. Other aspects investigated at this stage, other than function, are material content and wastage, standardisation, rationalisation, process of manufacture, tolerances, surface finish, direct labour costs, and other minor elements including packing and transport.

At the Evaluation Stage each solution must be evaluated on the basis of cost rather than feasibility which will indicate which of the proposals, taken together, are capable of offering the least expensive solutions. Invariably, there will be a number of bad points associated with any such solutions but every effort should be made to eliminate or overcome them. In costing the various alternatives it may be necessary to obtain co-operation from specialist manufacturers and suppliers, and in suitable cases they are invited to join the team.

Once a final selection of proposed changes has been made the Value Analysis team plans the development and introduction of the new design, considering the time and cost of development, the need for laboratory models and field trials, and any other costs involved in putting their final recommendations into practice. A report can then be written listing the recommendations and indicating the expected savings.

Experience has shown that the implementation stage is invariably the most difficult. This stage is the direct responsibility of Branches other than Value Analysis Branch which is not authorised to commit any of them to a particular action. The Value Analysis report therefore makes recommendations in sufficient depth to establish a case for further development, the final acceptance of the report coming from the appropriate Development Branch.

Since the Value Analysis Branch was formed early in 1968 it has initiated exercises into some 80 items of equipment ranging from Cordless Switchboards and Letterboxes to Jointers Tents and Jumper Wire. Some case histories are given with this article.

Value Analysis is a relatively simple and proven common sense approach to cost reduction, and represents a modern arrangement technique that can be used to extremely good effect by an organisation as large as the Post Office. With full co-operation between Value Analysis Branch and the Development and User Branches on the one hand, and between the Post Office and its suppliers on the other, tremendous savings can be achieved to the mutual benefit of all concerned.

Mr D. J. Earl is a Senior Executive Engineer in the Value Analysis Branch of Purchasing and Supply Department.

VALUE ANALYSIS: case histories

The old Desiccator with solid casing and (right) the new type – a throw-away bag.

An example of what can be achieved by Value Analysis techniques is the **Telephone Directory Holder** at present in London kiosks.

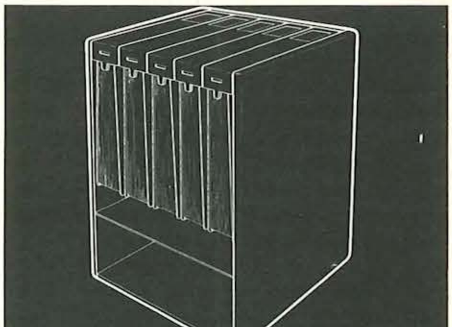
The London-type holder differs from the simpler and cheaper type used in the provinces in that the directories are suspended on swinging carrier arms. They proved so popular, however, that it was decided to extend their use to provincial centres. This would have entailed the provision of some 50,000 units over the following five years.

A breakdown of costs showed that 60 per cent of the total was covered by three items – the swinging arms, two side-castings and a shelf. The latter could be eliminated because in London it was required only for fringe area use when local directories were required, and in the provinces was not required at all. This enabled the sides to be simplified. A more durable version with sideplates and carriers in plastic has been produced with the arrangement so put together that it will lend itself to varying the number of directories required.

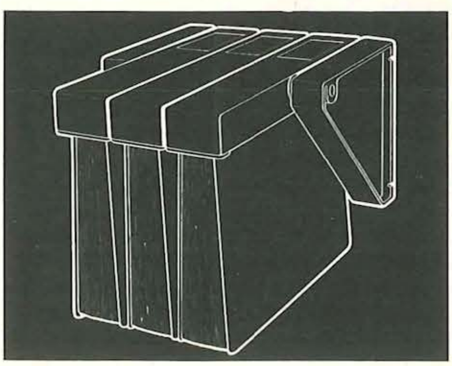
Desiccators 1 and 2 used for drying out cabinets and pillars contain silica gel treated with cobalt chloride which changes colour as moisture is absorbed. For a cost of 23 per cent of the original purchase price they can be re-activated to extend their overall life. A cost breakdown showed that the functional part of the item was only 10 per cent of total cost, the remaining 90 per cent being incurred in providing a case and inspection window able to withstand the re-activation temperature of 130°C.

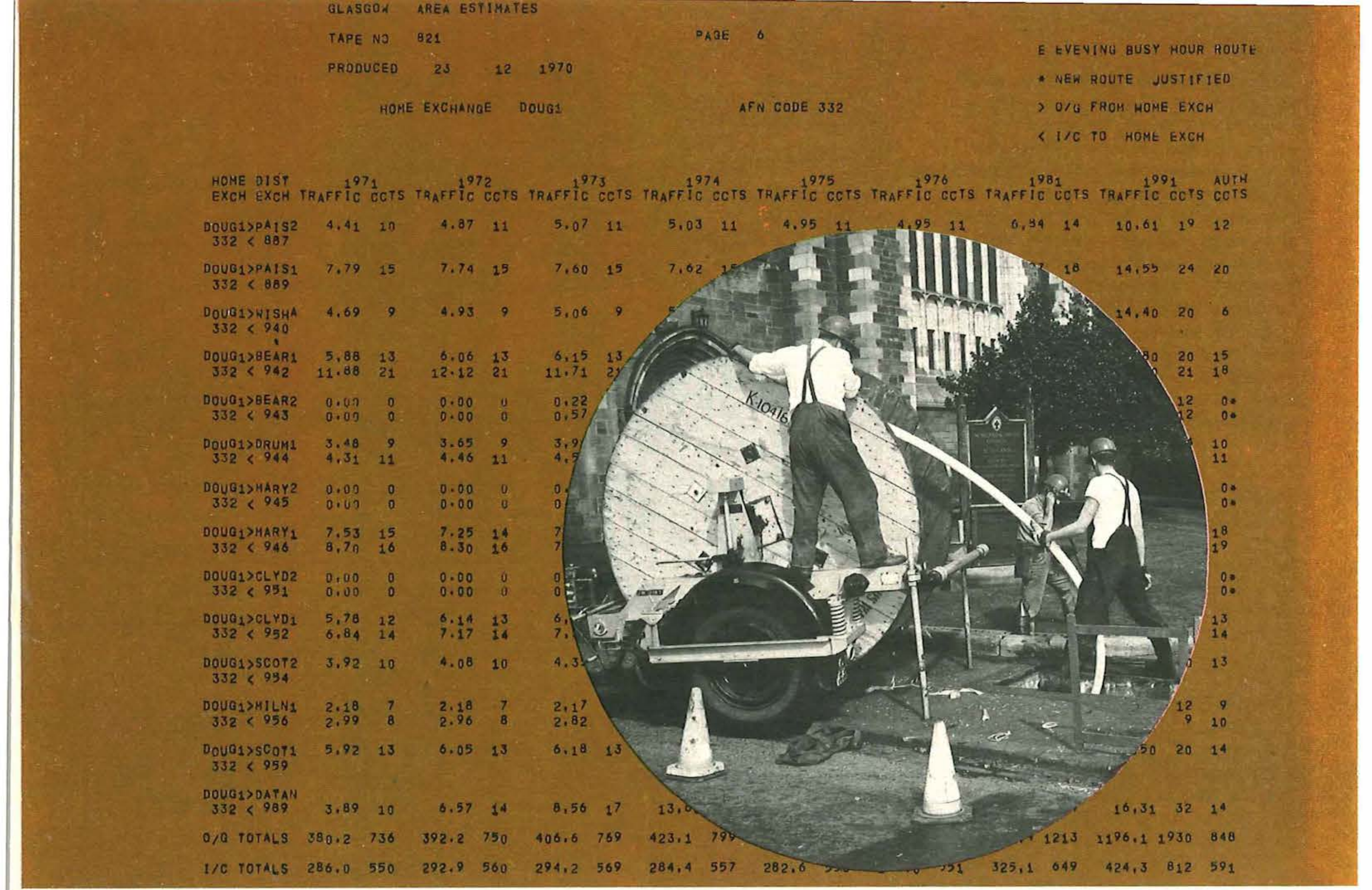
Value Analysis first produced the idea of a moulded case in Methylene Pentane (TPX) which is transparent and capable of withstanding 130°C. This produced cost savings of approximately 65 per cent because, with a larger area of silica gel visible, a lower percentage of cobalt chloride was needed. The team did not stop there but went on to recommend production of Desiccators in the form of a throw-away bag. Although it cannot be re-activated the savings are approximately 80 per cent of the original cost.

The Post Office is at present spending £700,000 per annum on **PVC wire.** Cost breakdown showed that 35 per cent of this cost was required for the function of the wire – the remaining 65 per cent went on braiding and lacquering to protect the PVC insulation from abrasion. With the large number of plastics now available a solution can be found which does not need the extra protection from abrasion.



The original Directory Holder and (below) the new design which resulted from a Value Analysis exercise.





T J Maley

A DAME WITH ALL THE ANSWERS

In Glasgow Telephone Area trials have been successfully completed of a new computerised system to forecast local requirements for the Annual Schedule of Circuit Estimates. It is known as DAME (Director Area Mechanised Estimating). Further trials started earlier this year in Edinburgh and three of Manchester's Director Areas. Ultimately it is hoped to introduce DAME on a national scale.

Every year hundreds of Post Office staff throughout the country become involved in the preparation of the Annual Schedule of Circuit Estimates. From an analysis of a mass of facts and figures forecasts are made of the future short and long-term growth in telephone trunk and junction circuits.

This is currently done by the trend line technique, the projection of lines on a graph, showing current and past trends in traffic levels from which the likely future trends can then be estimated.

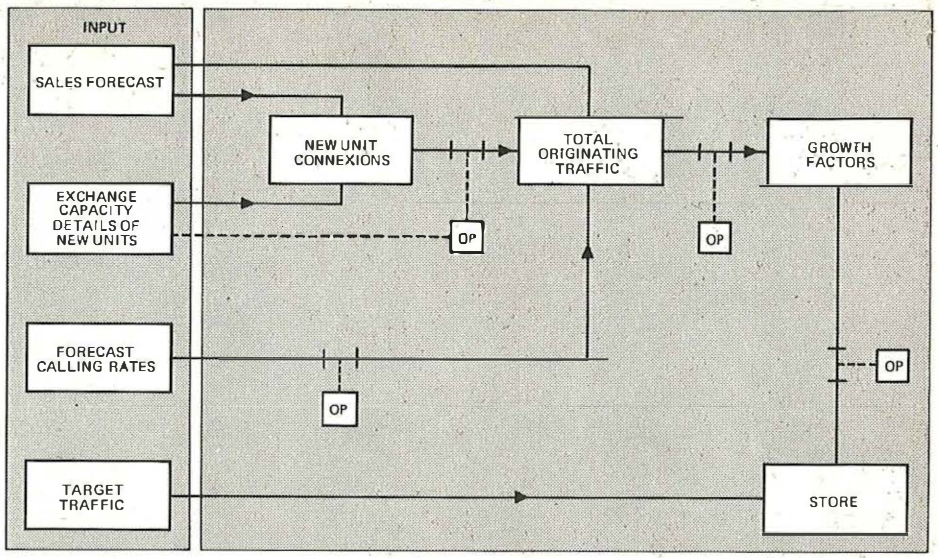
This system has never been wholly satisfactory on local routes which form a major part of the exercise. The graphs, for instance, normally assume that traffic will continue to grow at the same rate as before when ideally they should take account of changes in connexion growth rate, variations of the ratio of business to residential subscribers, and changes in customer habits as expressed in calling rates, all of which are difficult to express graphically with any degree of confidence. Other factors to be considered are national policy on tariffs and growth and the general economic situation.

Yet another problem is the huge volume of work involved. Graphs have to be produced for each route in a Telephone Area and from this emerges a mammoth amount of simple calculation and paperwork before an Annual Schedule of Circuit Estimates (ASCE) is finalised. The tasks are repetitive and because of this the system becomes subject to human error.

In Glasgow Telephone Area a new system, Director Area Mechanised Estimating (DAME) has been used with increasing success on local circuit estimates for the Area's 1970–75 and 1971–76 ASCE. DAME has proved itself to have none of the anomalies of the trend line techniques. It employs a computer to do the day-to-day sums, eliminating the "slide rule bashing" and much of the paperwork so that staff are free to concentrate on the more important aspects of the job. The computer is programmed so that account can be taken of all the factors likely to affect the growth pattern of a particular route. It makes possible too, much greater participation by

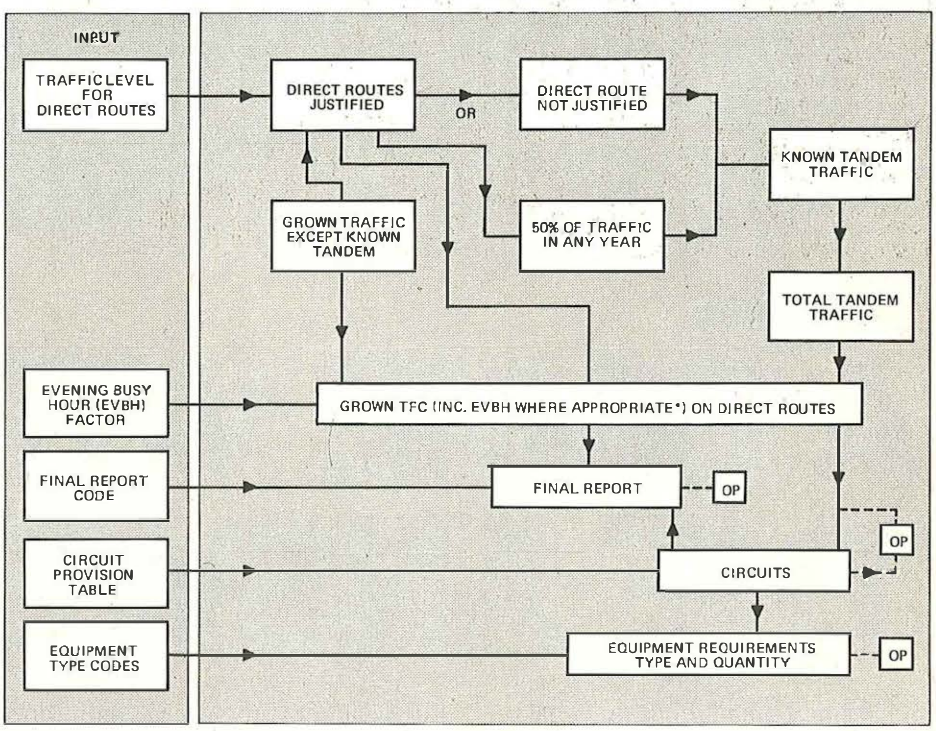
Three computer processes are used to estimate an exchange's traffic growth. In Phase I, factors arising from within the exchange's own immediate area are used to produce an initial forecast of circuit requirements. In Phase II (not shown) the computer looks at surrounding exchanges, determines how these will affect the traffic of the exchange it is dealing with, and produces a final estimate. In Phase III the computer uses this estimate ("Grown Traffic") to help determine new routes, tandem route requirements and to produce a final report.

DAME SYSTEM-PHASE I COMPUTER PROCESSES



OP = OUTPUTS TO AREA FOR CHECK, CONSIDERATION AND AMENDMENT IF REQUIRED.

DAME SYSTEM - PHASE III COMPUTER PROCESSES



*EVBH (TRAFFIC NOT PRINTED – ONLY CORRESPONDING DAY TRAFFIC) OP = OUTPUT.

traffic, sales and engineering experts and, equally important, allows much more consideration of local knowledge. For example, the calling rate over a group of new connexions can depend very much on the type of area in which they are situated. The rate is likely to be much higher from a business area than from, say, a Council housing estate, and this can be allowed for.

DAME is presently confined to external routes originating in Director Exchanges and carrying 95 per cent or more local traffic. It therefore excludes STD and 100 level routes.

Working with eight base dates – the five years of an ASCE plus the preceding and two following years – the computer will estimate traffic and circuit quantities, propose new routes and keep estimates within stated overall traffic levels.

Input to the computer includes all existing or planned Director Exchange units, suitably coded for easy identification by Area staff and by the computer; existing business and residential calling rates plus those forecast for the eight base dates; current connexions for each unit, again in business and residential components, plus forecast connexions for all eight base dates and the subscriber capacity of each unit. Where a forecast exceeds the capacity of an exchange the computer will arrange for the surplus to be carried forward to an additional unit, either planned or existing and which has been identified in the input, and ensures that the forecast business to residential split is maintained.

Routing data required by the computer includes day busy hour traffic levels on existing and potential routes, codes for statistical and equipment quantities, the traffic level which justifies direct routing, a code for the circuit provision table, a factor to allow for evening busy hour traffic and existing and authorised circuits. Also input is a target figure for each existing or planned Director Unit, in effect an estimate of the total originating local traffic at the fifth ASCE year.

The next stage is the intricate and very complicated task of estimating future traffic. Sufficient to say that the program enables the computer to consider the input data appropriate to each exchange and to each route of an exchange so that by a series of multiplications, additions and comparisons it will produce for any given exchange in the Director Area estimated traffic for each route for each year of the ASCE. In producing these estimates the computer has taken into account all the factors likely to affect the growth pattern. For example, because growth inevitably is governed by changes at each end of a route, the computer at a very early stage in the process has calculated that part of the growth which is due to the distant end.

The program is cycled so that each exchange is dealt with in turn, their growth factors assessed and all the relevant targets are taken into account. Finally, the computer considers the need for new routes and produces an estimate of circuits required for both existing and new routes.

At all stages the computer provides printouts for checking against input and for agreement of growth factors etc. For example, the total current traffic should equal the product of calling rates and connexions for each exchange, once allowance has been made for the exchange efficiency factor. The penultimate printout shows forecast traffic for all routes and routings for each exchange together with circuits. The computer finally provides for each exchange a printout showing its outgoing and incoming routes in distant exchange code order. This can be used to prepare the ASCE.

In Glasgow the Engineering and Traffic Divisions have worked closely together on the DAME project to their mutual benefit. Due to other streamlining of ASCE preparation being implemented in Glasgow concurrently with the DAME scheme it has so far not been possible to make a firm estimate of time saved, although this was probably minimal. However, the system has proved that it allows for work to be more easily completed at the correct staff level and certain ancillary benefits undoubtedly make DAME an economic proposition.

Such benefits occur in the areas of exchange design, long term forecasts, stores quantities and tandem utilisation. In the design field it is necessary to ensure that designs prepared by Equipment Planning groups line-up with ASCE forecasts and vice versa. By using the same basis for growth and agreeing inputs, problems in this area diminish and should disappear. The DAME system also produces forecasts for the 10th and 20th year and consequently if the input connexions and calling rates are in line with national policy sufficient information should be provided for long term forecasts for Director Units. Input codes denoting the type of equipment on a route allow the computer to produce equipment totals for each exchange and for the Area which is of obvious assistance in stores ordering. Similarly, coding has allowed the statistical summaries required.

As for future developments, an interface program has already been written which will allow output from DAME to be input direct into the Circuit Estimating by Computer (CEC) phase 2 system which is used to printout the ASCE. It is also probable that DAME will be the means by which at least a partial control over the growth of the local networks will be provided. So far such control has never been exercised largely because of the huge volume of calculations and comparisons which would have had to be made. But with the computer capable of doing such calculations quickly and more accurately it would be possible to calculate an overall growth for all routes and to compare such a total with a stated figure.

In Glasgow all groups involved in the DAME project and Operational Planning Department staff in London have been very satisfied. Certainly, we in Glasgow are very proud to have been in the vanguard of this project which could eventually affect about 50 per cent of all subscribers in the United Kingdom.

Mr T. J. Maley is a Telecommunications Traffic Superintendent in Glasgow Telephone Area and has been involved in the DAME project for the past three years. He has also worked on junction circuit estimating in the London area.

The cordless revolution

A new telephone switchboard system which combines some of the most advanced communications techniques currently available and which, in physical design, is different from anything that has been produced before, will radically change the concept of telephone switchboard operating when it is introduced by the Post Office in about four years time.

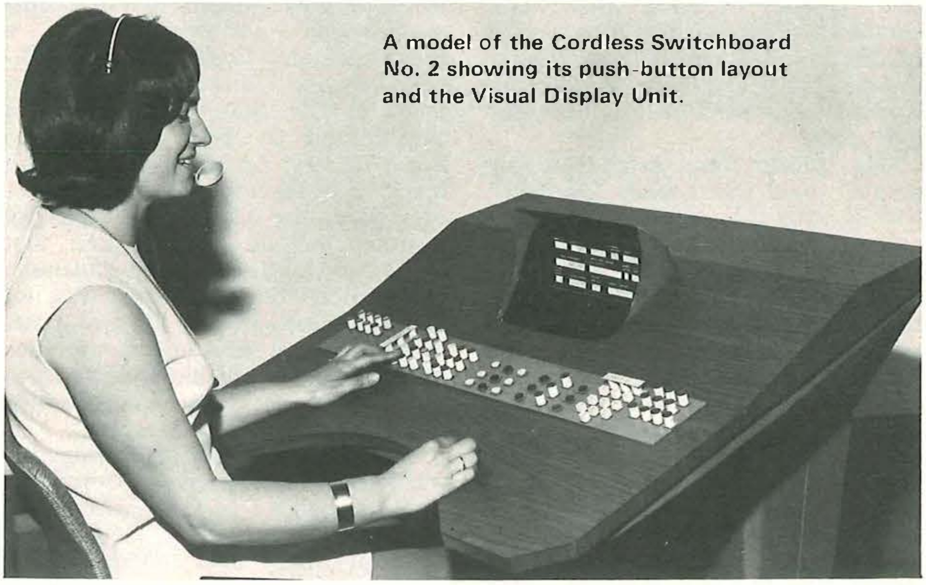
The major purpose of the new system, the Cordless Switchboard System No. 2. (CSS 2), is to streamline switchboard operation, while at the same time providing the best possible equipment from an ergonomic and human factors viewpoint, so effectively reducing the overall operating time for a call.

The new system will use stored program control – a computer process – and pulse code modulation techniques pioneered by the Post Office. PCM will make it economically possible to site switchboards some hundreds of miles from the exchange equipment they are using. These Call Connecting Centres can be set up in areas where staff are most readily available.

From the operators' viewpoint there will be no cumbersome cord connexions; no laborious writing out of charging information. Instead, the operator will use push buttons to control the setting up of a call. The call details, such as calling and called customers' numbers, the type of call and charging information, keyed into the system by the operator, will be used by the equipment to set up the connexion. At the same time the details will be recorded on magnetic tape which can later be used in computer preparation of the telephone bill. Everything keyed by the operator appears on a Visual Display Unit, similar to a small television-type screen, which is an integral part of the switchboard design and which is sited directly in front of the operator.

Calls for the operator will be switched and controlled at centres known as Auto-Manual Switching Units (AMSUs) which will be sited at the hub of collecting areas for operator traffic. Each AMSU will control up to three Call Connecting Centres each with up to 100 positions. The new switchboards will be used for both national and international traffic and it will be possible for a switching unit in the centre of London to be controlled by operators at, say, Glasgow. Calls will normally stay linked to the operator's position until it is clear the call is successful and only then will the operator release it.

The Cordless Switchboard System No. 2. is regarded as the logical progression from the Cordless Switchboard No. 1 of which there will soon be 4,000 positions in use in this country. The layout of switchboard and keys has been scientifically designed to ensure that telephonists will work with minimum fatigue. There has been close liaison between the designers, the Post Office Human Factors Research Laboratory and the Medical Research Council who provided specialist assistance in the fields of ergonomics and applied psychology. Staff Associations representing telephonists and their supervisors have also worked closely with the Post Office in formulating the requirements for the new system.



A model of the Cordless Switchboard No. 2 showing its push-button layout and the Visual Display Unit.

Nations agree spac

New earth stations have rapidly extended satellite communications to many nations. In its infancy the international satellite system provided only one pathway at a time. There are now more than 140 pathways, and the number is still increasing. Interim arrangements for the international operation of the commercial satellite system were agreed seven years ago by a handful of nations. This year important new agreements were signed which allow all participating countries to have a fair say in the administration and operation of the satellite system.

In August 1962 the United States Congress passed the Communications Satellite Act establishing the Communications Satellite Corporation (COMSAT) on a private commercial basis. It was the chosen instrument of the United States for the establishment, in co-operation with other countries, of a commercial international satellite system. Exploratory discussions, in which the United Kingdom played a leading role, were held during 1962. These discussions led to the conclusion in August 1964 of an Interim (intergovernmental) Agreement and an associated Special Agreement which were signed on behalf of the Government and the Post Office respectively.

There were two agreements because the organisation of a global communications satellite system involves on the one hand questions of a political and industrial nature which are the concern of governments, and questions of a financial and technical nature which are the concern of telecommunications authorities; the two Agreements were, of course, closely inter-related.

There were two main reasons why the Agreements were labelled "Interim." Firstly, although it was necessary to establish the global system, it was felt that developments which could not be foreseen in 1964, and actual experience of the system, should be taken into account in deciding what form the permanent organisation should take. Secondly, the 1964 Agreements were negotiated between 19 countries, but all the 130 or so members of the International Telecommunication Union were eligible to accede to them and a total of 79 countries has now done so; it was to be expected that these countries would wish to have a voice in the establishment of a permanent organisation. The 1964 Agreements therefore provided for a review after five years.

The Interim Agreements were concerned with the "space segment", that is with the satellites themselves and the tracking, control, command and related facilities and the equipment required to support the operation of the satellites. Earth stations are owned and operated nationally. The Agreements were built around provisions that the telecommunications authorities signing the Special Agreement would jointly own the space segment and would contribute towards the capital requirements in proportion to their estimated use of the system; that responsibility for the design, development, construction, establishment, maintenance and operation of the system would be in the hands of an Interim Communications Satellite Committee (ICSC) consisting of representatives of the largest users, and of groups of users of the system; and that COMSAT would act as Manager of the system. As the second largest user of the system, the Post Office has played a leading role in the ICSC and in its various advisory committees from the outset.

In many ways the 1964 Agreements worked extremely well and the development of the system exceeded expectations from technical and operational points of view.

Alongside these successes, certain failings of the Interim Agreements had become evident, the chief ones being:

- *an overwhelming United States preponderance in the organisation, which, although not surprising given the state of the art at the outset in 1964, was clearly not desirable as a permanent feature.*
- *a lack of machinery enabling governments and telecommunications authorities which had signed the Special Agreement, but were not represented on the* ICSC, *to have an appropriate say.*
- COMSAT, *designated in the Agreements as the manager of the system, was also a Signatory of the Special Agreement and this dual role sometimes led to a blurring of responsibilities.*

In 1969 the ICSC prepared, and submitted to governments, a report proposing the form the permanent, or definitive, arrangements should take. This report provided an opportunity for a fundamental review of the organisation and its responsibilities by both governments and telecommunications authorities, and a Plenipotentiary Conference was convened by the United States Government at the State Department in Washington in February 1969 to negotiate new Agreements. Although many of us thought that the negotiations would be difficult, it is doubtful whether anyone contemplated that they would take two years to conclude. Fortunately the Conference was not in continuous session for two years but during this period the Conference itself, or bodies which it established to carry on the work, were in session for a total period of nine months.

The United Kingdom Delegation was led by the Foreign and Commonwealth Office and consisted of representatives of that Department and of the Post Office, with representatives of other Departments attending meetings from time to time.

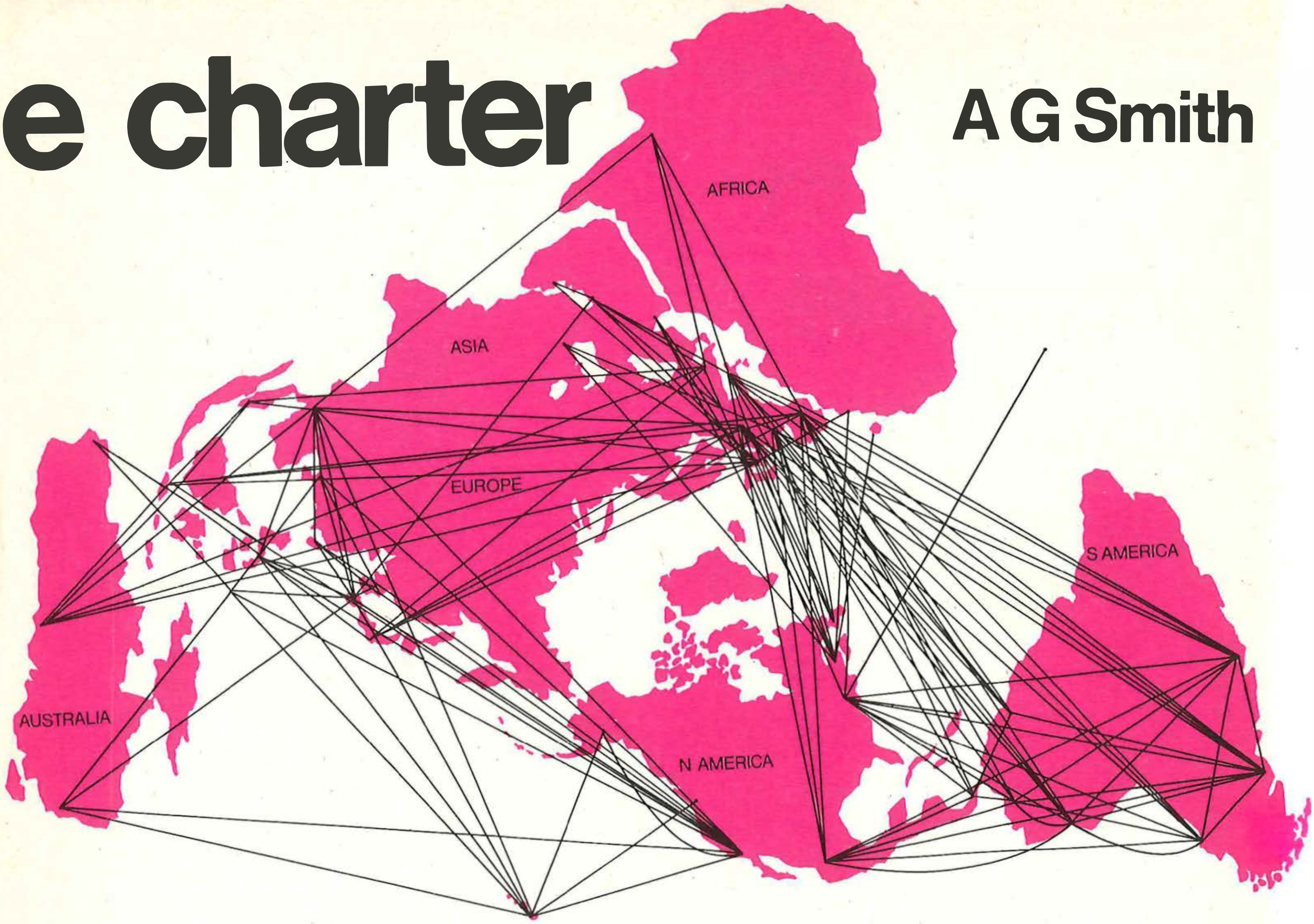
The negotiations were difficult because of the large number of delegations taking part and because of the blend of political and telecommunications considerations involved. They were disputatious and often delicate. Eventually agreement was reached on May 21 this year and texts were initialled. The Agreements were opened for signature on August 20 and are expected to come into force towards the end of 1972.

The definitive arrangements consist of a new Intergovernmental Agreement and an Operating Agreement (replacing the Special Agreement). Their main purpose is to continue and carry forward the global commercial communications satellite system established under the Interim Agreement and the Special Agreement. The following are their main features:

An international telecommunications satellite organisation to be known as INTELSAT (an acronym which has been used for some years, but without any legal significance) is created with the legal capacity to own property, place contracts, and so forth. It will be the owner of the space segment of the satellite system and each Signatory to the Operating Agreement will have an investment share equal to its percentage use of the system; the shares will be adjusted periodically to keep invest-

e charter

A G Smith



ment in line with use of the system.

INTELSAT will have the following organs: an Assembly of Parties to the Intergovernmental Agreement, a Meeting of Signatories to the Operating Agreement, a Board of Governors and an Executive Organ.

The Assembly of Parties will be composed of representatives of Governments which have signed the Intergovernmental Agreement. It will meet every two years with provision for extraordinary meetings if required. Each country will have one vote and decisions on matters of substance will be taken by a two-thirds majority. The Assembly will consider those aspects of INTELSAT which are primarily of interest to the member governments, and it will have only a consultative role in matters of general policy. Authorisation by the Assembly will, however, be required before INTELSAT can provide specialised services of a kind other than those normally available to the public, such as radio navigation services and meteorological services.

The Meetings of Signatories will be composed of representatives of the telecommunications authorities which have signed the Operating Agreement. It will meet annually with similar voting arrangements to those of the Assembly of Parties and with a broadly similar consultative role as regards operational and commercial policies.

The Board of Governors will have similar functions to those of the ICSC and it will be responsible for the design, development, construction, establishment, operation and maintenance of the INTELSAT space segment. It will be composed of up to 25 members and will be somewhat more widely representative than the ICSC. Each member will have a vote equal to the investment of the Signatory or Signatories which he represents and, as stated above, investment will be related to use. Post Office investment and voting power will be about 10 per cent, as compared with 7.2 per cent under the Interim Agreement. The US investment, and vote, on the other hand will drop from 53 per cent to about 40 per cent; in any event no member will be able to cast more than 40 per cent of the total vote. Decisions not reached unanimously will be taken by at least four members holding two-thirds of the votes.

The management will become fully internationalised at the end of a six-year transitional period. During this period, COMSAT will perform technical and operational management functions, but on the basis of a contract to be negotiated in accordance with a number of basic principles laid down in the Agreement; a Secretary General, appointed by and solely responsible to INTELSAT, will take over all non-technical and non-operational functions from COMSAT and will have the role of monitoring COMSAT's performance under the contract. At the end of the six years a Director General will assume complete responsibility for all the management functions.

In addition, the Intergovernmental Agreement lays down a number of general principles which in part confirm principles on which INTELSAT is already working and which in part fill in gaps or make some changes. Thus the prime objective of INTELSAT remains the provision of international public telecommunications services on a commercial basis, although domestic and regional services may also be provided as well as the specialised services which have been referred to above.

Before the Agreements were achieved many difficult and sometimes conflicting considerations had to be resolved, but the way has been paved for a healthy organisation which will carry on with the development of the global system on a commercial basis, with all the partners feeling that they have the opportunity to make their voice heard and for their interests, whether large or small, to be safeguarded.

Mr A. G. Smith is an Assistant Secretary in charge of the Satellite Communications Division of the Post Office's External Telecommunications Executive.
He participated in the negotiations which led to the new agreements.

D R Barrett and G A Smith

Computer maps the building programme

The tremendous growth of the telephone service has made it much more difficult for managers to keep in close touch with what is happening to the increasing number of jobs under their control. In this respect, probably no area of work has been affected more than the Buildings Control Programmes. In the North Eastern Telecommunications Region there would have been about six major Telephone Exchange buildings in planning during any one year in the late 1950s, and it was not difficult to remember how each case stood. Recently there have been about 70 such cases a year, and much greater pressure to have buildings available on time.

Even in relatively straightforward cases, eight years will often elapse between first seeing the need for a new exchange and its being brought into service. So the size of the current buildings programme and the maze of operations necessary to bring each scheme to a successful conclusion creates considerable administrative problems. The need to ensure that each case is progressed satisfactorily and that nothing vital is overlooked is being achieved in North Eastern Region with the aid of a computer.

Prior to the computer's introduction, the Region used the familiar Master Control Sheet procedure (A5733). This is a type of progress report which identifies key dates from initial site data preparation to final equipping of the exchange and bringing into service. For simplicity of operation the Control Sheets are confined to principle stages only and, because of the sheer volume of cases being dealt with, it has never been easy to assess the effect a delay at one particular stage will have on subsequent stages. There has always been an optimistic tendency to hope that some later stage could be speeded up.

One way to achieve closer control is by more frequent checks on the progress of each job and then forecasting what the future situation is likely to be in comparison with the date a building is required to be ready for equipment.

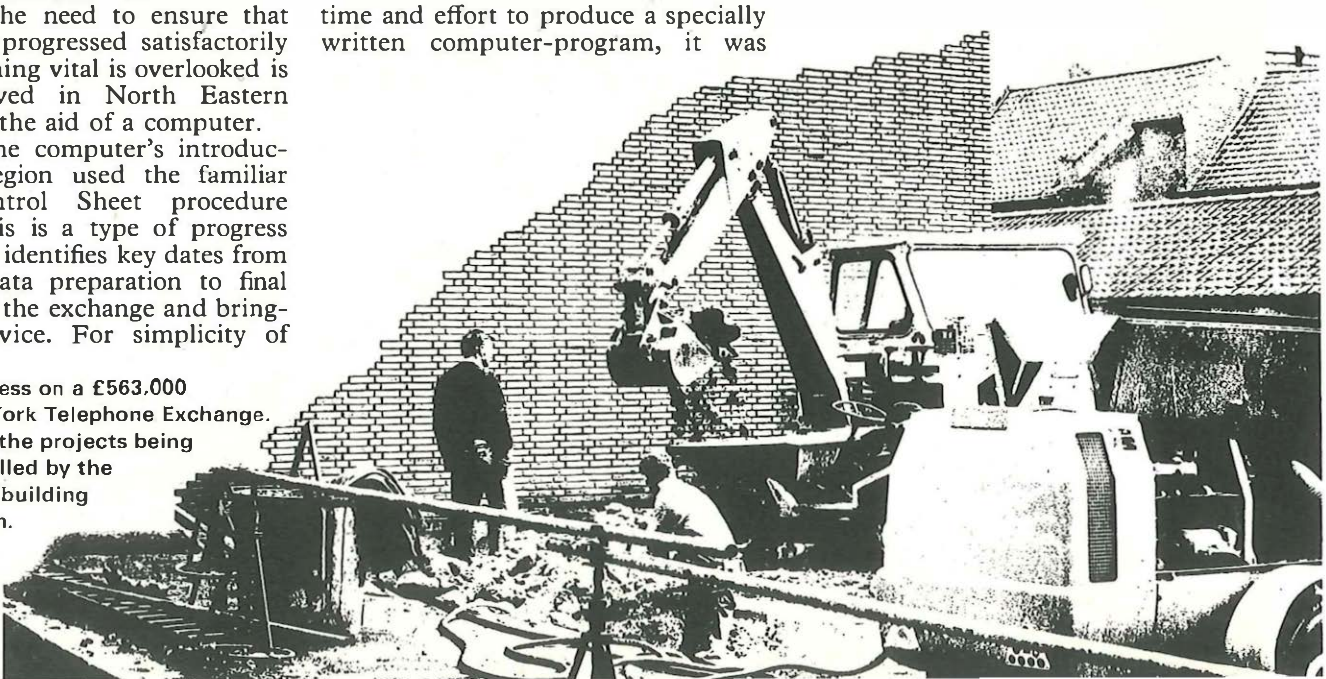
Ascertaining what point in the planning process has been reached on each job at a particular date can only be done by asking the people concerned. Having obtained that information, forecasting the future situations on the jobs and producing printed information for issue to people with various interests and functions can be done with speed and accuracy by a computer.

Because it would have taken some time and effort to produce a specially written computer-program, it was decided to use an ICL 1900 PERT "package" program. This program enables the computer to deal in rapid sequence with a number of similar but unrelated schemes and provides for sophisticated sorting and printing arrangements. It also includes a method of producing planning networks from a standard library held on magnetic tape and eliminates the need to design a network for each individual scheme.

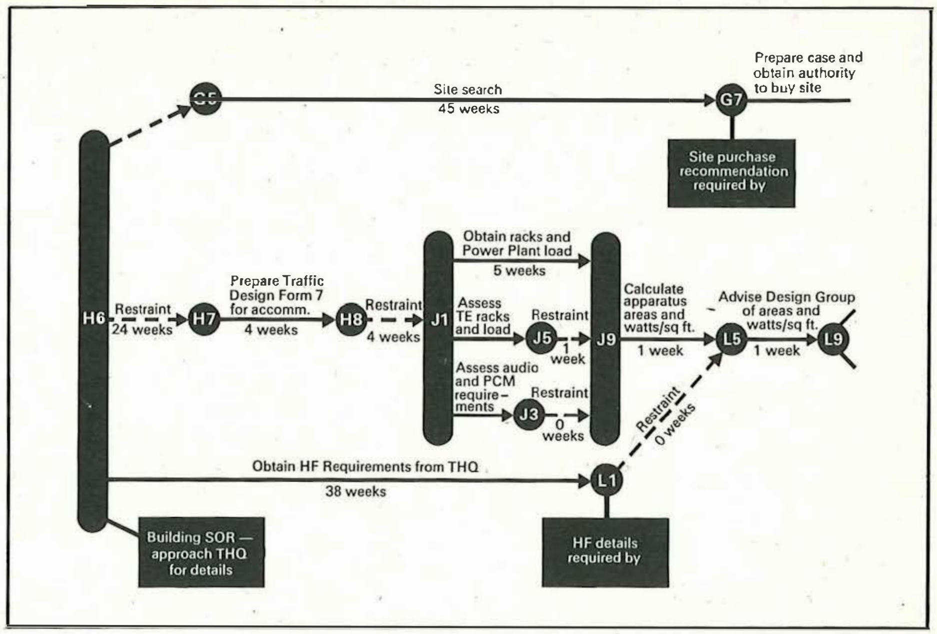
The Computerised Class 1 Building Planning Control System does not attempt to handle building construction procedures, but only to bring the office planning processes under closer control.

In total, 300 jobs are covered by some 12,000 activities and 5,200 named events. On each job there are 75 main items of procedure to be controlled and co-ordinated involving staff at THQ, RHQ and Telephone Area levels. An arrow logic diagram of the whole of this series of operations could be prepared but, in fact, the detail has been broken down into five separate smaller networks to save expensive computer time in processing information not immediately relevant in a time sense. The five networks contain all the essential procedures for preparation of Schedule of Requirements (SORs) for site, preparation of SORs for a standard and non-standard building, and planning for a non-standard and standard building.

Information is input to the computer on 80-column punched cards. To set up an Area's 10-year buildings programme, input must provide the name of the exchange, when it is expected to exhaust, which of the five standard networks is appropriate, and what progress has been made in the planning procedure. The computer then creates on file a suitable network for each project and prints-out a complete analysis of all events and activities. Against each event is given the earliest date by which it can be achieved, relative to the current stage



Work in progress on a £563,000 extension to York Telephone Exchange. This is one of the projects being closely controlled by the computerised building control system.



Above: Details on the computer output are checked after completion of an updating run by Mr D. R. Barrett, one of the authors, and Miss Lynn Littlewood who prepares the computer data.

The diagram shows the type of planning network used by the computer system for the preparation of Schedule of Requirements for a standard-type building. It is one of five standard networks which can be produced from a library held on magnetic tape.
The letter-figure codes are computer references. The "Restraint" periods shown are a method used to prevent the computer producing information before a specified time.

of planning, and the number of weeks by which the whole scheme is early or late, in relation to achieving the objective by the required date. Once all schemes are on the computer, updating is achieved by reporting progress along each network.

The information from the computer falls into two main types. There are work schedules which indicate to people when they should aim to carry out their particular items of work due in the next month or two, and there are schedules of significant dates for key stages on all jobs. Within each main type there are different forms of computer output designed to suit differing requirements according to people's functions. Whatever the form of output, the relative urgency is indicated for each case in terms of how early or late (in weeks) the job stands. Another type of print out shows only jobs which are late by more than a specified time.

The computer information is produced on one comprehensive document – three different documents were required by the manual system. No clerical amendment is needed at the points using the information with the result that there is no variation in accuracy between the sets of information held by different people.

The use of a PERT programme in this fashion is somewhat different from the conventional Critical Path Method (CPM) techniques. Where CPM provides sufficient detail for the fine control of a single project, this specialised control system conveys an adequate amount of broad information for the whole 10-year programme of building planning work and leaves the manager with a degree of freedom to time the execution of work as he sees best.

By dealing with one Telephone Area at a time – there are seven in the Region – it is possible to have new information available within two days of the date chosen as the progress report date. Under the general guidance of the Critical Path Methods team the system is operated by an Executive Officer assisted by a Clerical Officer, and the cost of hiring computer time works out at about £2,500 per annum on the basis of updating the information for one Telephone Area a week.

Meetings chaired by the Deputy Controller of Buildings are held following each computer run to discuss the situations revealed and decide what action should be taken. Because of the more accurate and comprehensive nature of the information readily available to him he is able to exercise a degree of overall control hitherto not possible.

Mr D. R. Barrett, a Chief Telecommunications Superintendent, is head of North Eastern Region's Critical Path Methods team and acts as an adviser for the computerised buildings planning control system.
Mr G. A. Smith is a Senior Telecommunications Superintendent and a member of the Long Term Planning Group in North Eastern Region headquarters.

International centres

Telephone centres for the handling of operator-assisted international calls are to be set up outside London for the first time. Initially centres are to be brought into operation in 1973 at Glasgow and Leicester and others will follow later.

The Glasgow switchroom which will be installed in Dial House, the city's new multi-storey telecommunications centre, will have 100 switchboards and will deal with calls from Scotland and most of the North of England. At Leicester, 70 boards in the city's Cardinal House exchange building will serve the remainder of the North of England and the Midlands.

Ultimately there will be 400 international operators at Glasgow and 280 at Leicester providing a 24-hours-a-day service. They will route calls over the telephone trunk system to London and then on to countries abroad, controlling switching equipment in London from their switchboard panels. The two provincial centres, together with the new London Wood Street exchange where equipment is now being installed, will augment the capital's existing centres.

Operator-assisted international calls have always been dealt with in London, but the proportion of traffic from outside London is expected to increase from 30 to 40 per cent over the next four years.

The new centres will help cope with the increasing international traffic from the Regions and should help ease the problem of recruiting and retaining suitable staff in London.

The Post Office has also been improving other international services. A direct telephone link has been opened between Britain and Tunisia. Previously calls between the two countries had to be routed via Paris.

International automatic telex has been extended to Japan and to Russia with direct links to Moscow and Leningrad. Operator-controlled telex service has also begun to Alaska, Guinea, French Guiana and Indonesia.

In the data transmission field Datel 600 service is now available to Hong Kong and Datel 100 services have been extended to Hungary, Portugal and Yugoslavia.

STUDIES FOR DIGIT

W G Simpson

In an earlier article Mr W. G. Simpson discussed how a digital transmission system could be more widely exploited in the Post Office's telecommunications network. The article looked at the reasons for using such a system and the various types of transmission media which have to be considered. It also explained the principle which will be used in the assembly of the different types of high-capacity digital signals. In this article the author deals with studies carried out on digital transmission, and the problems which have to be overcome. He also explains the multiplexing methods – how input signals from a number of different services are output as one signal.

Digital transmission systems, because of their flexibility, performance advantages and greater use of existing channels, are expected to be linked to the long-distance networks by about the end of this decade. But before then much work must be done, and some studies have already been carried out under Post Office contracts by GEC-AEI and Plessey Telecommunications Research.

One part of the studies involves a possible digital system operating at 120 Mbit/s (120 million binary digits transmitted a second). It covers transmission, multiplex equipment and analogue-to-digital converters for a wide range of services including voice channels, colour television, Viewphone and data transmission. It also includes work on the encoders needed for putting the standard 12-circuit "building blocks" used in the present frequency division multiplex network into a form suitable for transmission on a digital network.

The study results will assist in the recommendation of suitable parameters for equipment for an experimental system which will give field experience in the operation of high-capacity digital multiplex and line equipment.

The digital line link will use 0.174 coaxial pair and the studies have been specifically directed at a speed of about 120 Mbit/s to carry the level in the hierarchy appropriate to a colour TV signal and corresponding to 1,620 digital speech channels. This speed is consistent with currently available technology, and it should be possible to use the same spacing of 2 km for the digital regenerators as for the repeaters in the present 12 MHz fdm system on 0.174 coaxial pairs.

In addition to the overall information rate and the regenerator spacing there are several other parameters which have to be fixed for a digital line system. These include the line code, that is the form of signals sent into the cable, the signal amplitude, and whether every repeater will be fully regenerative. It is first necessary to decide what amount of impairment can be tolerated for the line link. Two main impairments can be introduced by a digital-transmission system – errors where pulses are omitted or inserted but in the incorrect time positions; and jitter, where pulses of correct amplitude are displaced in time by small variable amounts from their correct time positions.

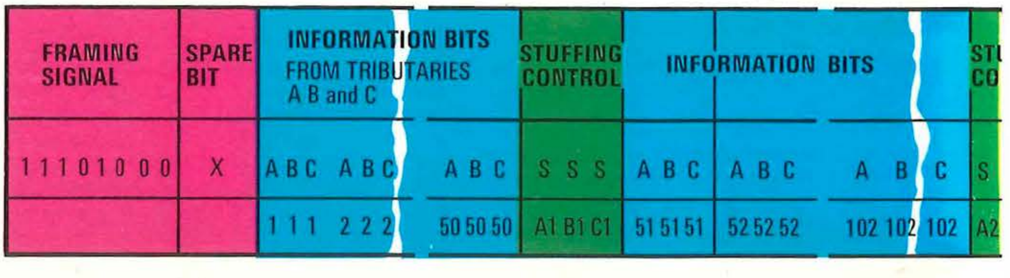
Errors can occur due to noise and in a coaxial cable system the principal source of noise will be thermal noise in the regenerator input circuits. Noise effects can be reduced by raising signal amplitudes but only at the expense of an increase in the power needed for the generator. The digital regenerator, however, tends to need more power than an fdm amplifier because, in addition to an equaliser and analogue amplifier, it requires a decision circuit and a pulse generator. Power feeding will therefore be a more acute problem in digital line systems. One way of reducing the power requirements is to replace some regenerators by analogue amplifiers although this will cause the cable imperfections and equalisation inaccuracies to accumulate and increase the error rate. The possibilities offered by such "hybrid" systems will form part of the current studies.

There are many factors to be considered when choosing the line code to be adopted. The present 24-circuit system uses a "three-level" code, i.e. +1, 0, −1, in which alternate "one" signals are transmitted with opposite polarity. This was adopted to eliminate the dc components which cannot be transmitted by the transformers needed for power feeding. However, difficulties in regeneration will result if insufficient "ones" are present in the signal because the timing information in the regenerator has to be obtained from the received signal. Code conversions can be included in a line system to ensure that sufficient timing information is always present.

If the number of levels used in the signal is increased, the bandwidth of the signal can be reduced. This will reduce cable effects, worsen the signal to noise ratio for the same total signal amplitude, and require a more complicated decision circuit. It does not seem likely that more than a few levels – say five maximum – would be used. A multi-level code means, in effect, that successive pulses can have different amplitudes. By not exploiting all the combination of pulse amplitudes possible in groups of two or three successive pulses, it is possible to increase the timing content and also to reduce the dc component.

When multiplexing a number of digital signals into one output signal it is necessary to allocate time positions in the output to each of the input signals and to be able to identify these allocations at the demultiplexing point. Blocks of adjacent pulse positions may be allocated to each input – this is known as word interleaving. If a word of eight bits is used and aligned with the eight bits of a channel time slot in the input signal we have a

This illustrates the frame structure proposed for the experimental digital transmission system to be installed by the Post Office. Different streams of traffic are multiplexed into a single output – in this case three streams incoming at 2.048 Mbit/s into an output at 6.336 Mbit/s. (A full frame of 636 bits represents approximately 1/10,000th of a second. The 636 bits come from information bits, framing signal and stuffing control). The frame will carry a maximum of 206 information bits for each stream and the framing signal is used to identify the different streams. When an input falls below 206 bits, stuffed bits (dummies) are inserted to bring it back to the required level. The stuffing controls enable the system to identify these dummies and to ignore them.



AL TRANSMISSION

special case of word interleaving called time slot interleaving.

Whichever method is used multiplexing involves storage of the input signals with a read-out at the higher speed output rate; storage is also needed for the converse operation at the demultiplexing point. The amount of storage depends on the size of the words which are interleaved and will be least if a word of one bit is used – i.e. bit interleaving. The amount of storage used has a significant effect on the cost of multiplexing equipment so that unless special requirements point otherwise, bit interleaving is the most likely to be used.

The identification of the position of the respective inputs when demultiplexing is achieved by means of an extra signal inserted at a known point in the time allocation and called the framing signal. The number of bits allocated for this signal and their position in the frame have a major effect on the time needed to recognise at the receiving end when frame alignment with the sending end has been lost and also on the time needed to regain frame alignment.

At the point in the multiplexes where the several inputs are combined to form a single output stream, it might seem essential that the speeds of the input streams are exactly equal to an appropriate fraction of the output speed. This can be accomplished by arranging that the speeds of all the signals are locked to each other and is known as synchronous multiplexing. In this case it is necessary to make arrangements not only to ensure that all the sources of digital signals carried by the network have a fixed speed relationship with each other, but also to see that changes in the transmission time through any link of the network can be allowed for. Changes of transmission time may be caused by the effects of temperature on cables and may also be the result of changes in the pattern of the signals being transmitted. Some form of elastic storage is needed when compensating for these changes.

A variant of this method is to use separate but highly accurate clocks in combination with buffer storage. Differences in speeds would be absorbed by the stores until they become full or empty. At that time information bits would then be lost or repeated. In this arrangement a clock accuracy of 10^{-9} would cause a 64 kbit/s speech channel to have one bit in error about every three hours.

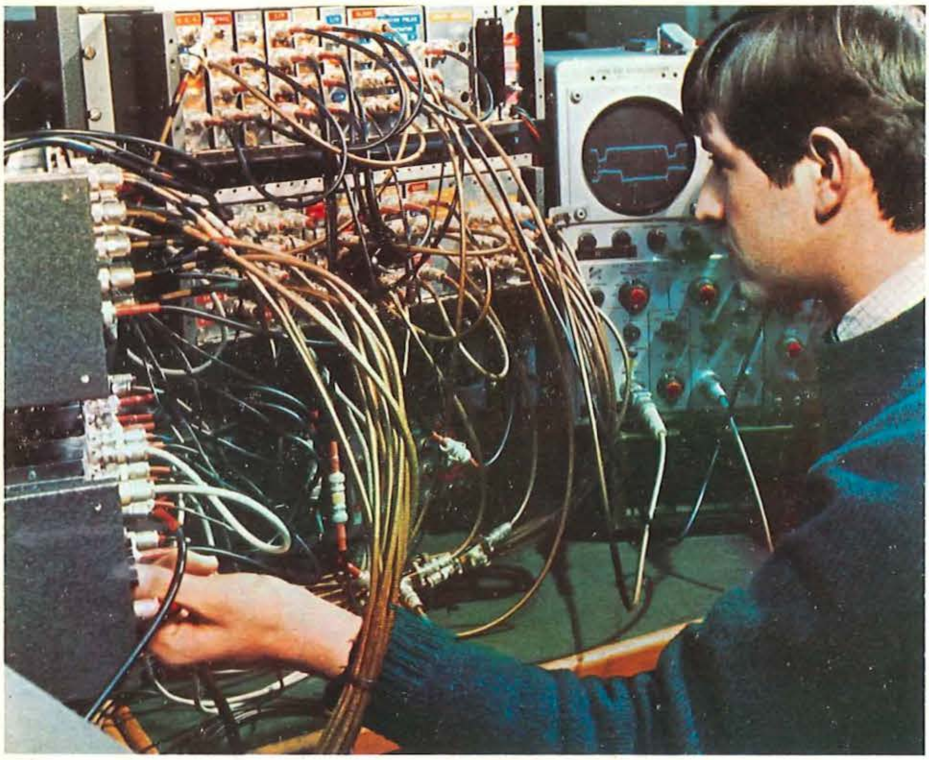
The speed relations necessary when multiplexing can also be arranged by making the output speed faster than the sum of the input speeds. Sufficient additional bits are then inserted into the combined stream to give the required output rate. The number of these added, or "stuffed", bits depends on the exact speeds of the input signals and some of the added bits are allocated to a stuffing control channel which informs the demultiplexer exactly which bits have been added. This method is called pulse stuffing and can accommodate relatively large variations in the speeds of the input signals. The sources of digital signals need only have moderately accurate clocks, which can be independent, and variations in transmission time have no effect. No information bits are lost or repeated.

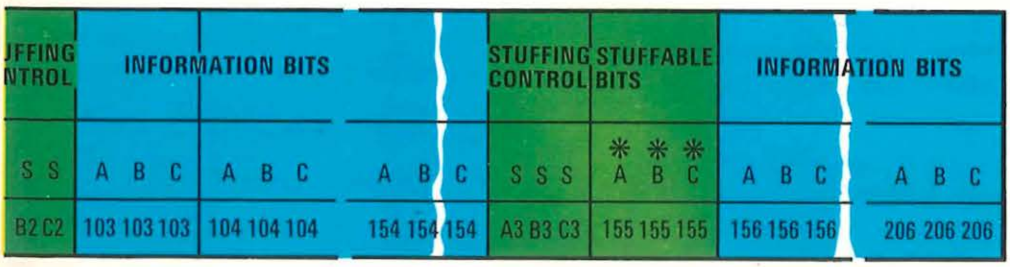
All these synchronising methods may be used in the digital network, but the pulse stuffing method is very flexible and will be adopted initially for the hierarchical multiplexing.

It has only been possible in this and the preceding article to outline some of the transmission problems in a digital network and to introduce some of the concepts. Digital transmission is certain to play an increasing part in the telecommunications network of this country, and its full benefits can only be realised if the fundamental system design is sound. There are many new and interrelated factors to be considered but, with care, the only impairments which digital transmission are subject to – error and jitter – can be a negligible amount.

As high speed digital systems are introduced into the network they must compete economically with existing and projected analogue systems, but the possibilities for improved performance and economy are very great and ultimately digital transmission may predominate.

Tests are carried out on an experimental 120 Mbit/s PCM encoder for television at GEC's Hirst Research Centre, Wembley.





Mr W. G. Simpson has been involved for some time in the development of digital transmission systems. A Staff Engineer, he now heads the Line and Radio Systems Planning Branch of Network Planning Department.

miscellany

£2¼ m. improvements

The Post Office is spending £2¼ million on more equipment and facilities to improve its radiocommunications with British merchant ships. Already, operating facilities have been provided at the control centre at the Post Office radio station at Burnham-on-Sea, Somerset, and extra transmitters have been installed at the transmitting stations at Dorchester and Portishead.

The developments will enable British ships to communicate directly with Burnham from all parts of the world. They follow the closure in the summer of the Long Range Area Communications scheme because of changes in Commonwealth communications systems.

The scheme, launched in 1942, was a world-wide system of radiocommunication with ships and was operated jointly by the Post Office, Ministry of Defence (Navy) and some Commonwealth countries. Under the scheme ships could communicate with overseas Royal Naval and Commonwealth radio stations who passed their messages on to Burnham Radio Station where Post Office and Naval staff worked side by side.

At a ceremony at Burnham to mark the end of the scheme and the part played by Naval personnel, Vice-Admiral J. R. McKaig, Flag Officer Plymouth, presented a commemorative plaque to Mr T. N. Carter, officer in charge at Burnham.

Plug-in phone for motorists

With the help of Post Office engineers a 24-year-old industrial design student has produced a prototype portable "carphone" small enough to fit into the glove compartment of a car. Bernard Howard (above), of the Royal College of Art, says motorists could lean out their car windows and plug in to calling boxes set up in laybys, car parks and garage forecourts. Payment for the call would be by credit card bought in advance. A novel feature of the handset is that the cord can be stored in a groove in the back. This idea has been patented. The carphone idea was taken up by Bernard last year after he had approached Mr Richard Stevens, Design Manager for the Telecommunications business, for advice on a suitable project for a college course. Mr Stevens said of Bernard's design: "It is an interesting idea and we shall certainly be looking at it very closely. But at this stage it is only a gleam in a student's eye. There are still many technical and economic problems to be studied."

Datel extensions

The Datel 200 service can now be used at speeds above the normal maximum of 200 bits per second (bit/s). An extension to the service offers most customers transmission of computer data at 300 bit/s over the public telephone network. This will help Datel 200 customers who have printing and visual-display terminals capable of operating at higher speeds.

Using the existing Modem No. 2, the extended service is expected to operate satisfactorily on 80 per cent of calls made at the higher rate, but in some locations transmission at 300 bit/s will be unreliable or impossible.

A new modem now under consideration could give a guaranteed rate of 300 bit/s, but it will not be available for about two years.

A further improvement to Datel 200 is the introduction of the Dataplex 110 service which enables computer bureau customers to be connected to a bureau many miles distant for only the price of a local call. Dataplex 110 is designed to multiplex up to 12 terminals operating at up to 110 bit/s into a private long-distance circuit. Each circuit can then connect up to 12 customers operating on the Datel 200 service to a remote time-sharing computer.

These extensions to the Datel service were introduced to meet the changing needs of customers, said Prof. J. H. H. Merriman in London recently. Prof. Merriman, Board Member for Technology, added: "As well as laying long-term plans for new data transmission services, the Post Office is alive to the need to expand and improve existing services."

He was speaking at the presentation of awards in the Dial-a-Computer Competition organised by the New Scientist and Honeywell Information Systems Ltd. The Post Office offered each award winner free installation of a telephone and modem, and up to £300-worth of telephone calls.

One of the competition winners was Mrs D. B. Hoodless, Executive Director of Community Service Volunteers, whose husband is a Post Office Economist.

New contracts

Standard Telephones & Cables – £6.2 million for extensions to 73 telephone exchanges, the largest at Wapping, Cardiff, Rochdale, Yeovil, Uxbridge, Portsmouth and Hayes North. £6 million for crossbar equipment for new exchanges and extensions including Covent Garden, Crawley, Cambridge, Leicester, Leeds and Bristol.
GEC-AEI – £750,000 for microwave radio equipment to extend radio relay links between Bristol and High Wycombe and Leeds and Newcastle.
Plessey – £3.9 million for the supply of PMBX and PABX telephone switchboards and a large number of relay sets. £1 million for Frequency Division Multiplex and 4 mHz coaxial line systems for trunk route circuits.
Marconi Communication Systems – £1½ million for the supply of pulse code modulation equipment.
Dynamco – £250,000 for a quantity of their latest range of oscilloscopes. £100,000 for 112 precision TV waveform and picture monitor test sets.
Trend Electronics – £100,000 for the development and production of telegraph transmission test equipment, deliveries to begin at the end of 1971.

Home typing

An almost unlimited supply of experienced typists could be opened up for commerce and industry by a new audio-typing system which relies entirely on the telephone. Simply by picking up a telephone in her home a typist can be connected to an office tape recorder containing three to four hours of dictation.

The new system, launched by the Norwich Union Insurance Company, has been approved by the Post Office which has provided special telephones and installed private lines linking a Secretarial Centre at the company's head office with typists' homes up to eight miles away. The Post Office is also co-operating in a trial of the system using the public telephone network which would enable typists to be employed from anywhere in a local telephone area provided local exchanges had the capacity to handle the additional long-duration calls created.

While working at home, a typist uses a normal telephone attached to a small control unit into which is plugged a foot control and headset. When ready to work she dials an ex-directory number to reach the Secretarial Centre where she is connected to a tape player either by a supervisor who is in charge during normal office hours, or automatically if her call is after hours. The typist has full control of the tape player. With the foot control unit she can start, stop and play-back the tape.

With private circuits a smaller control unit is connected to a special telephone into which the headset and foot control are plugged. Contact with the Secretarial Centre is made simply by lifting the telephone handset.

Electronic boom

Britain's 100th electronic telephone exchange (TXE 2) was opened earlier this year at Bawtry near Doncaster.

The Post Office opened its first electronic exchange at Ambergate, Derbyshire, in 1966 – the first production electronic exchange in Europe and the first small-to-medium-size exchange of its kind in the world.

Electronic exchanges are now coming into service at a rate of more than two a week. This will be increased to three a week over the next four years so that by 1975 there will be more than 700 in operation.

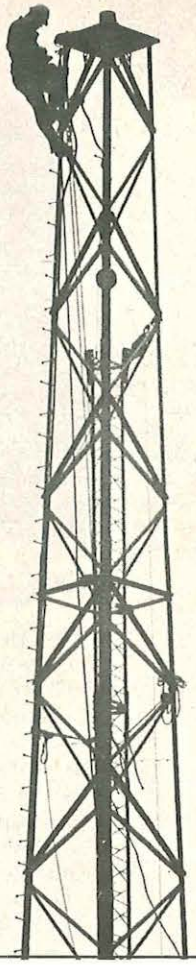
The size range of this type of exchange covers about two-thirds of Britain's exchanges and about one quarter of subscribers. Initially they will meet the needs of up to 2,000 lines but two models now being developed will be capable of growing to around 8,000 lines.

Electronic exchanges, although more expensive initially than conventional electro-mechanical equipment, require much less maintenance, have lower running costs and greater reliability; installations and extensions are easier and they need less space.

Member retires

Sir Richard Hayward, Board Member for Industrial Relations since October 1969, left the Post Office at the end of September because of ill health. Sir Richard was Secretary General of the Civil Service National Whitley Council (Staff Side) from 1955–66 and Chairman of the Supplementary Benefits Commission from 1966–69.

End of a landmark



A Post Office rigger helps accomplish something not even the bombs of the Second World War could do . . . demolish the 162 ft-high radio masts of the Dollis Hill Research Station.
The two masts, a feature of the London skyline since 1938, were put up to help studies of short wave radio propagation. They were requisitioned by the Admiralty during the war and survived a London blitz when a blast from a bomb did no more than dent the leg of one tower. They have been dismantled because they no longer meet the high safety standards required and because they have no long-term value for Post Office operations.
Stringent safety precautions were observed during dismantling.
Work took place only at weekends when the Station was free of staff.
A modern-type Post Office mast was built inside each of the old ones to provide a working platform in the sky for the riggers so that parts could be unbolted and lowered in safety.

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'Parafil' is a special kind of rope.

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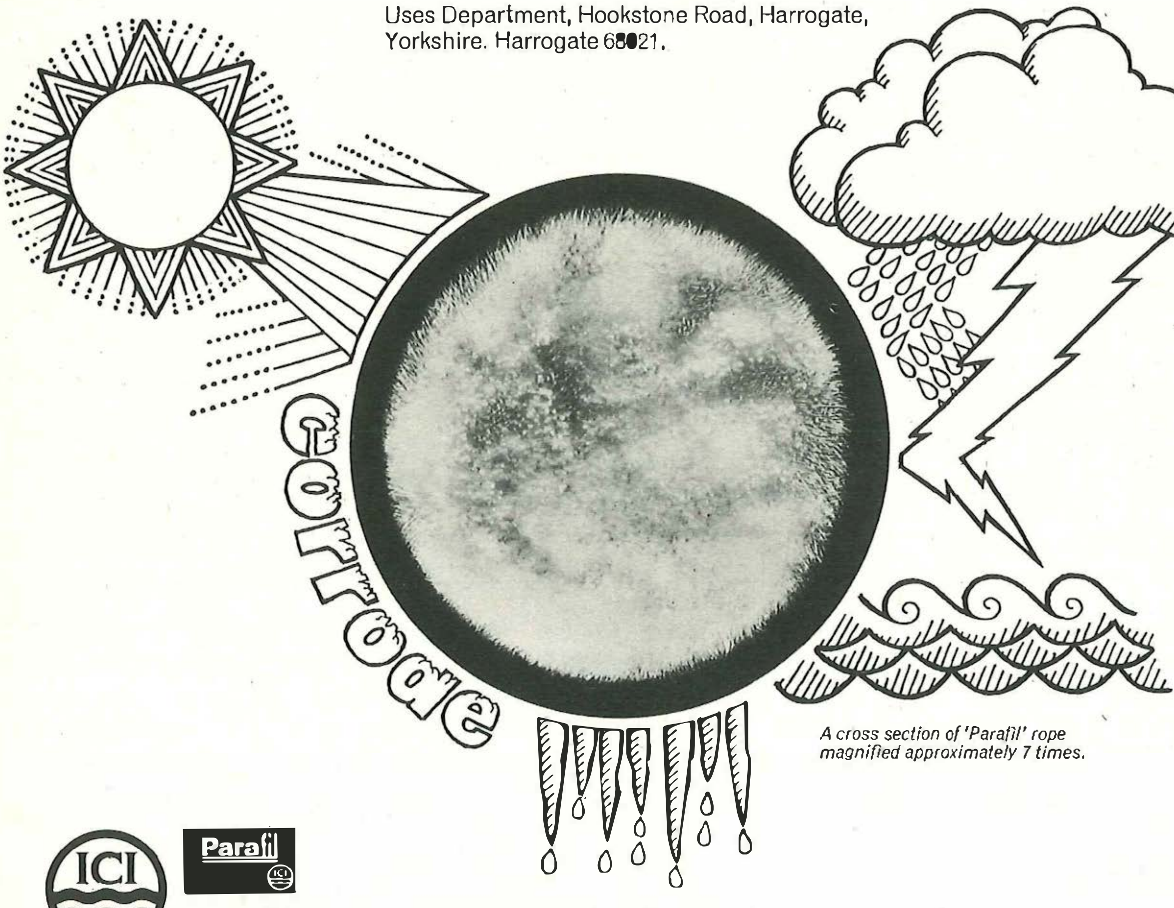
It's marketed in the U.K. by British Ropes Limited, Anchor and Hope Lane, Charlton, London, S.E.7. and by Marlow Ropes Limited, Lloyds Avenue, London, E.C.3.

To find out more, contact these firms direct.

Or contact ICI Fibres Limited, Industrial Uses Department, Hookstone Road, Harrogate, Yorkshire. Harrogate 68[illegible]21.



A cross section of 'Parafil' rope magnified approximately 7 times.

ICI Parafil

ICI Fibres work hard for industry

'Parafil' is a registered Trade Mark of ICI

Telecommunications statistics

(Figures rounded to nearest thousand)

	Quarter ended March, 1971	Quarter ended Dec., 1970	Quarter ended March, 1970
TELEPHONE SERVICE			
Inland			
Net demand	290,000	279,000	337,000
Connexions supplied	277,000	272,000	293,000
Outstanding applications	296,000	284,000	293,000
Total working stations	14,979,000	14,712,000	13,959,000
Total working connexions	9,214,000	9,057,000	8,551,000
Shared service connexions (Bus. and Res.)	1,716,000	1,686,000	1,564,000
Total effective inland trunk calls	402,439,000	377,446,000†	346,456,000†
Effective cheap rate trunk calls	107,932,000	104,390,000†	81,816,000†
External			
Continental: Outward	4,407,000	4,160,000	3,753,000†
Inter-continental: Outward	646,000	548,000†	436,000
TELEX SERVICE			
Inland			
Total working lines	33,000	31,000	29,000
Metered units (incl. Service)	106,160,000	65,507,000	76,598,000
Manual calls from automatic exchanges (incl. Service and Irish Republic)	37,000	59,000	44,000
External			
Originating (U.K. and Irish Republic)	6,747,000	6,085,000†	5,475,000
TELEGRAPH SERVICE			
Inland telegrams (incl. Press, Service and Irish Republic)	789,000	1,923,000	1,836,000
Greetings telegrams	208,000	525,000	481,000
External telegrams:			
Originating U.K. messages	921,000*	1,826,000	1,788,000
Terminating U.K. messages	893,000*	1,779,000	1,693,000
Transit messages	731,000*	1,621,000	1,577,000

**Subject to industrial action.* †*Amended figures.*

Publication and Price. The *Journal* is published in January, April, July and October, price 9p per issue. The annual postal subscription is 50p—reduced to 36p for former Post Office staff.

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 by 750, 1,500 or 2,000 words. The views of contributors are not necessarily those of the Board or of the Post Office.

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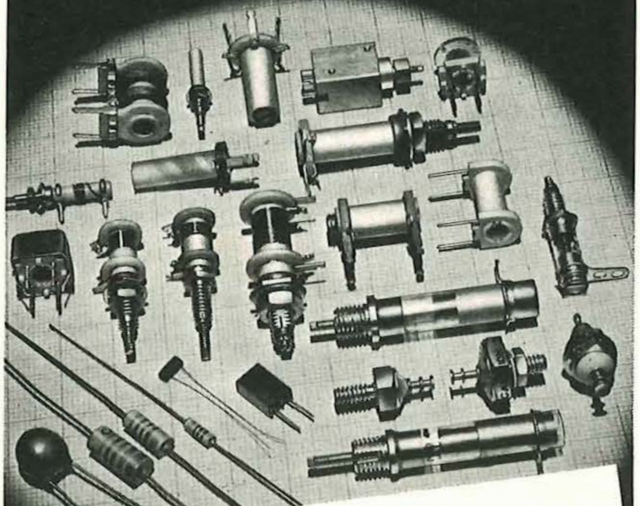

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Post Office Telecommunications Journal is printed by BKT Printers Ltd., London and Tonbridge, and is published quarterly in January, April, July and October by the Post Office.