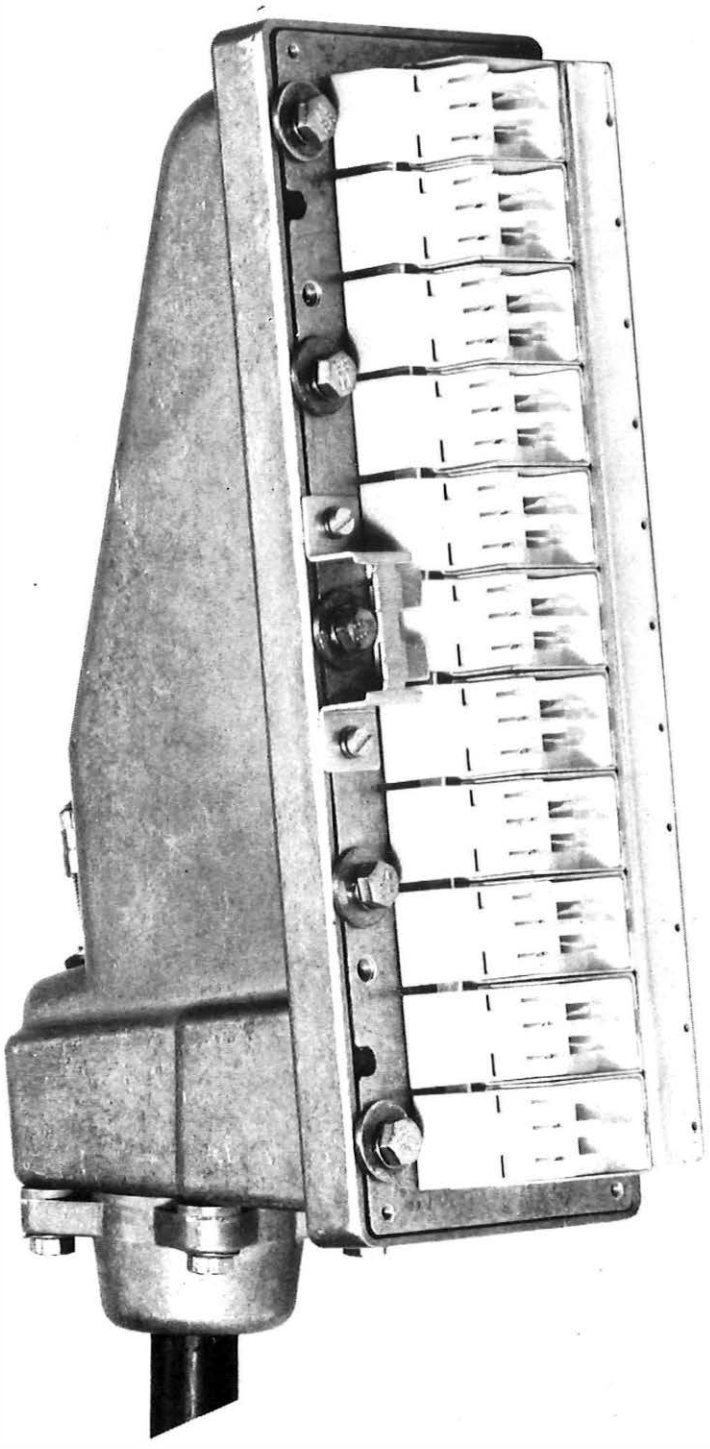
British TELECOM Journal

Summer 1981 Volume 2 Number 2 Price 30p

KRONE

A head of its time

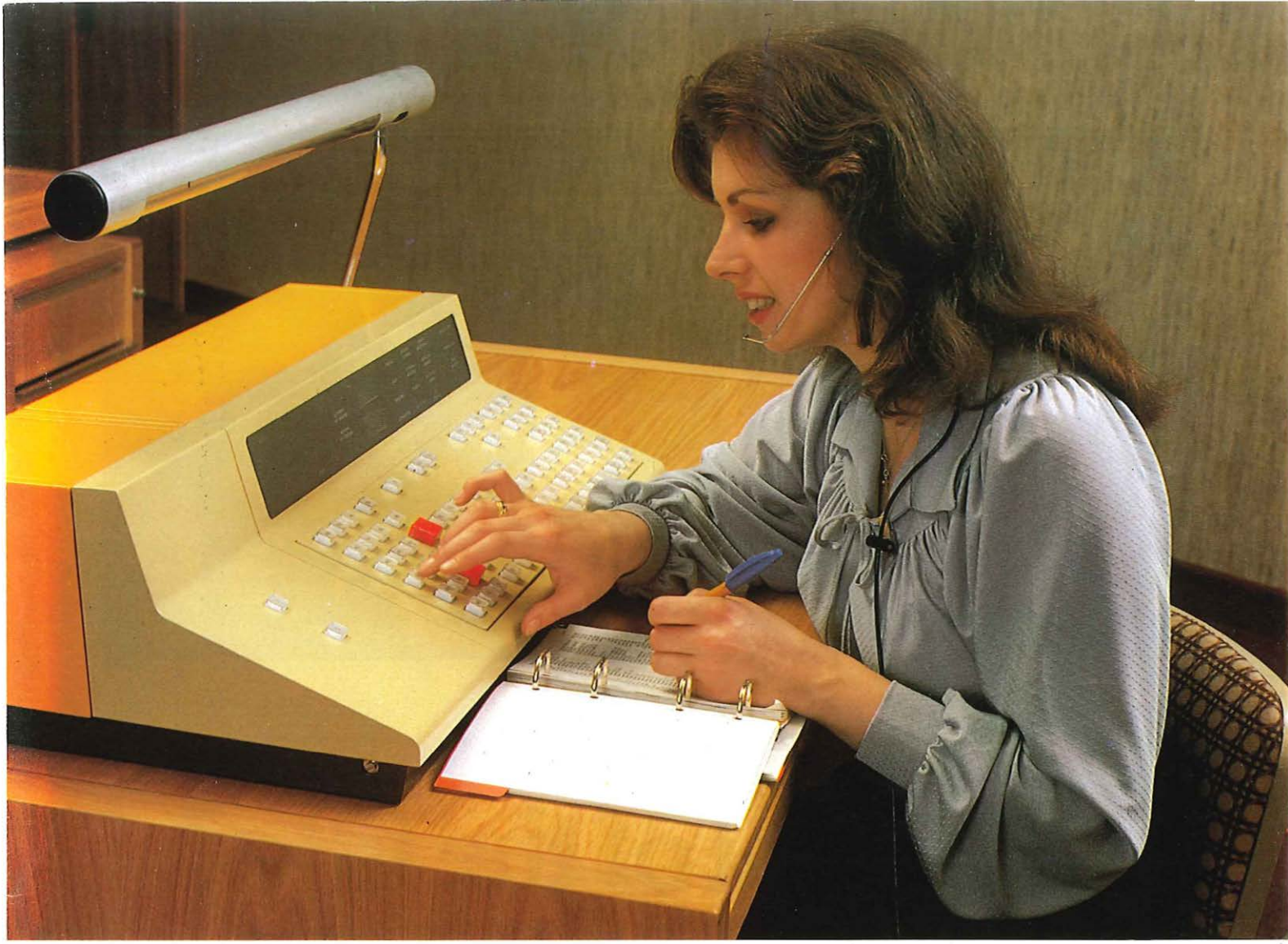


Krone's pulse code modulation cable head provides the most modern, efficient and quick connecting termination for PCM cable

Designed to accommodate 10 pair PCM cable for up to 120 channel systems, the head is of pressure-tight, screened construction – the housing being sealed firmly to the base plate and cable by means of a sealing compound. Each cable pair screened by a metallic shield. The PCM Head is just one of a selection of cable heads, sleeves and jointing boxes that comprise part of the extensive range of high-quality products designed and manufactured by the Krone Company – a range that offers everything from a complete telephone exchange to a single telephone instrument.
So if you want to get ahead–in any line of telecommunication – talk to Krone, first.

First ideas make Technology

Krone (UK) Technique Limited, Unit 12, Eastington Trading Estate, Eastington, Nr. Stonehouse, Gloucestershire. Telephone: Stonehouse (045 382) 6866. (4 lines). Telex 43350.



Introducing AURALITE... another powerful business communications device.

Wherever telephones are used two hours or more per day, Auralite lightweight headsets can bring increased efficiency, productivity, comfort and convenience.

Lightweight Auralite, nothing to match it

Auralite headsets replace cumbersome conventional headsets, and feature a unique acoustic voice tube, custom-fit earpieces, and an ultra-light, ½ oz capsule that's worn comfortably behind the ear or easily clipped to spectacle frames.

Auralite gives you freedom to move around

A push-together, pull-apart Quick-Release module allows you freedom of movement and automatically holds calls during temporary suspension of conversations. And the special Auralite cord permits high mobility without interrupting 'phone conversations at all.

Auralite, extensive application and benefits

Wherever telephones are widely used there's a need for Auralite. The benefits are increased efficiency and productivity, improved employee morale, and better customer service. Thanks to Auralite you can depend even more on the telephone which means a saving in travel expenses.

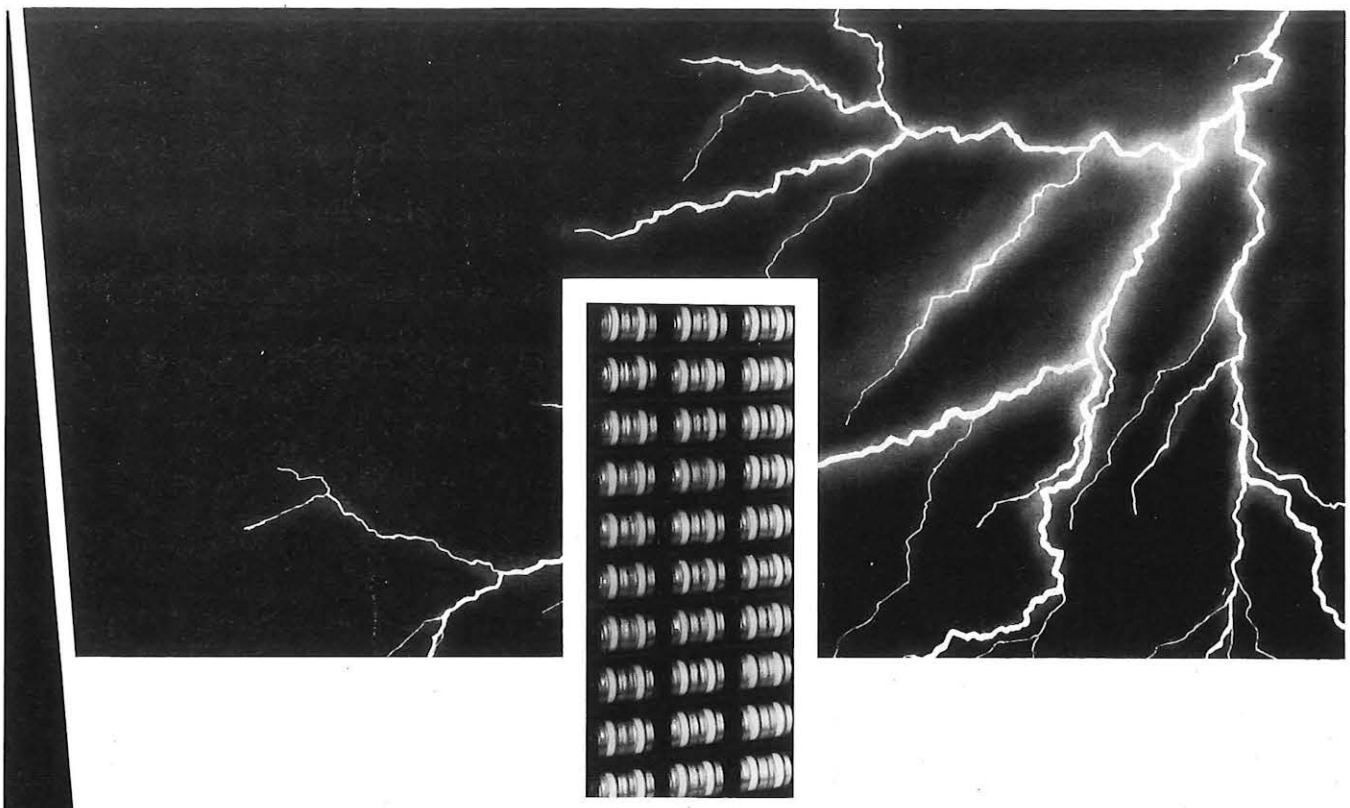
Auralite technology, tested in space

Auralite is a commercial version of headsets worn by astronauts. Its solid rugged design ensures maximum durability and extremely clear transmission and reception.

For more information contact your local British Telecom office on FREEPHONE 888 and ask for the Auralite leaflet.

AURALITE*

*A registered trademark of British Telecom. Supplied to British Telecom exclusively by TMC Limited.



Survival of the fitted.

This modern telephone equipment has protection "designed-in."

The reasons are well known to engineers – lightning strike or other electrical overloads can knock out whole telephone systems unless they are adequately protected.

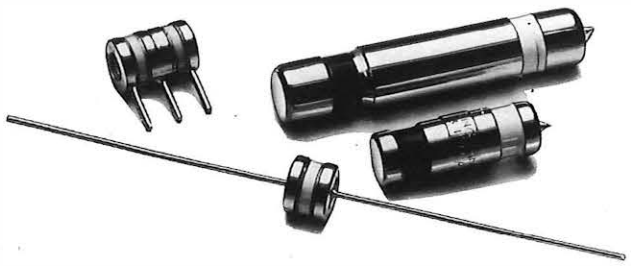
Protected with M-OV surge arresters or gas-discharge tubes, if that's how you know them.

Electrical surges are stopped in their tracks by M-OV protection, at minimal cost, at great speed and *every* time.

Why M-OV? Well, not only is M-OV technology world-renowned but M-OV arresters are tested no fewer than 11 times before they reach you. That's eleven extra reasons for insisting on M-OV.

M-OV protection is fitted by telecommunication authorities round the world from Asia to the Americas as well as being well in the lead in Britain.

If your equipment needs protection, don't wait until you've got a strike on your hands. Get in touch with M-OV today.



M-OV

A MEMBER OF THE GEC GROUP

GEC

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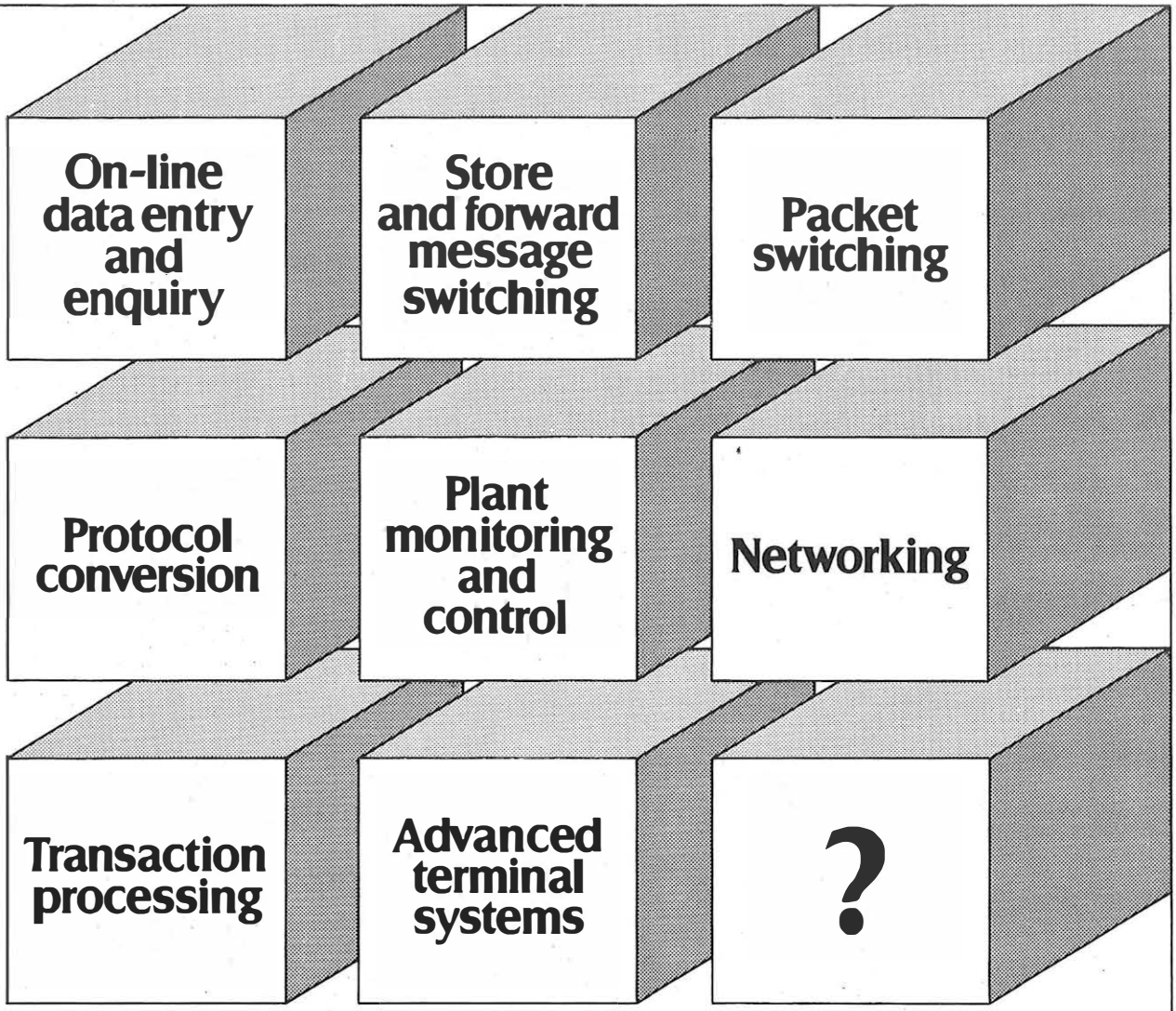
THE M-O VALVE CO LTD, HAMMERSMITH, LONDON W6 7PE, ENGLAND. TEL 01-603 3431. TELEX 23435. GRAMS THERMIONIC LONDON



Data Communications. The complete package from Ferranti.

Wherever industry has demanded innovation in data communications, Ferranti have provided the answers –

From advanced multi-processor hardware and software to the complete turnkey system.

Ferranti deliver on-line data entry and enquiry, store and forward message switching, packet switching, protocol conversion, plant monitoring and control, networking, transaction processing, advanced terminal systems and more.

In data communications, Ferranti have the product and the experience.

Talk to us, we can help.

Post to Information System Sales,
Ferranti Computer Systems Limited, Simonsway, Wythenshawe,
Manchester, M22 5LA, England.
Telephone: 061-499 3355 Telex: 668084

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Company_____

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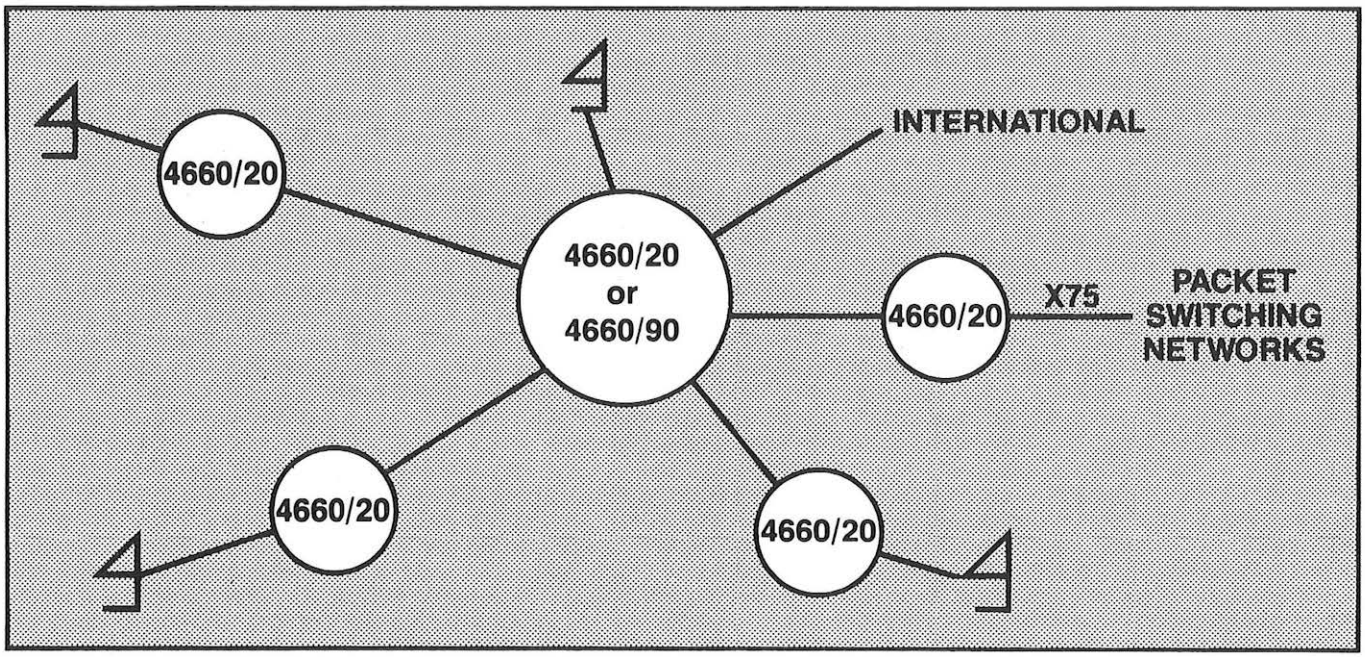
FERRANTI
Computer Systems

NEW TELEX/DATA SWITCH FOR NETWORKING



PLESSEY 4660/20

* Want a full performance micro-computer telex/data switch for the price of a concentrator?
* Would your telex network requirements be met by distributed small switches rather than a single large switch?
* Will you want interworking with packet switch networks?

Five Plessey 4660/20 systems are going into service with British Telecom for their inland network.

In one equipment, the new Plessey 4660/20 telex switch is the answer for PTTs who need a national telex network, or international gateway, and companies wanting to establish their own private telex networks.

* **Latest micro-computer technology with bubble memory**
* **Capacity 50-2000 lines**
* **Unattended operation**
* **Remote management**
* **Self contained for temporary applications**
* **Full compliance to CCITT standards**

For further details contact the leaders in telex and packet switching:

PLESSEY CONTROLS

Plessey Controls Limited
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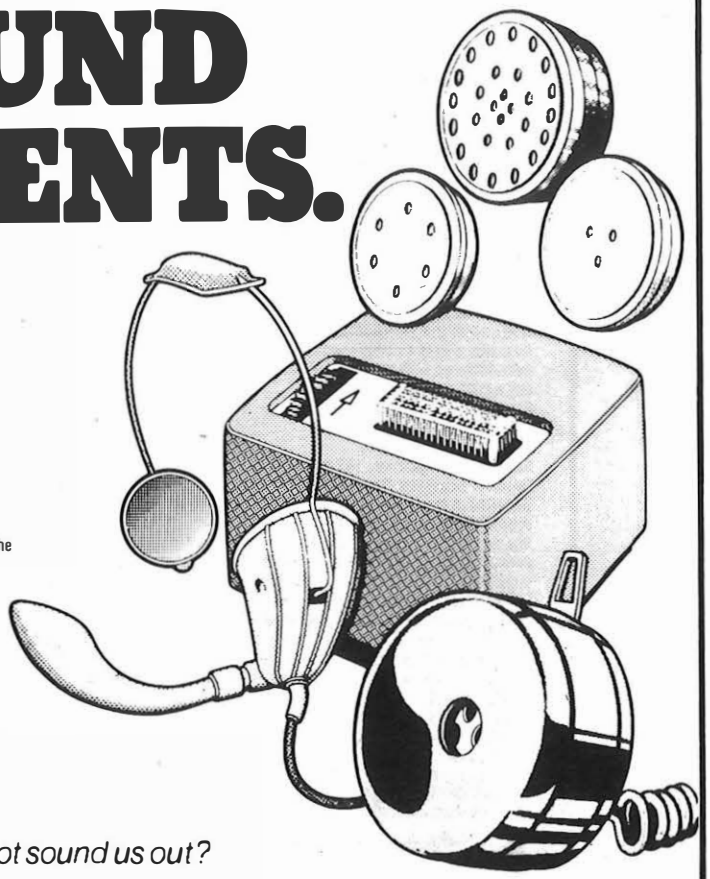
United Kingdom BH17 7ER
Tel: Poole (02013) 5161 Telex: 41272

0600 2 0346

GOOD, SOUND COMPONENTS.



RECEIVER & TRANSMITTER INSETS
Receiver B.T. Insets No. 4T, 3T & 3U
Transmitter B.T. Inset No. 16
Available also is a comprehensive range of Rocking Armature Receivers & Microphones manufactured with impedances to suit all applications.

HEADSETS/HEADGEAR
Full B.T. range for all applications:
Operators Headset No. 1
Operators Headset No. 2
Receiver Headgear No. 16T and 16U
Receiver Headgear No. 16T and 16U double
Supplied in black and grey, with or without plug and lead.

RECEIVER WATCH 8T
The RECEIVER WATCH is an extension receiver but has numerous other uses as a handset extension in high noise areas and also for the hard of hearing. The RECEIVER WATCH is supplied with coiled lead and switched out of circuit when replaced on a hook provided at the rear of the telephone.

SPEAKERSET 2 (Amplifier and Loudspeaker No. 5)
This compact unit amplifies incoming speech sufficiently for it to be heard by a group of people in conference situations. It is particularly useful for anyone wanting both hands free while waiting for a call to be answered.

CONTINUITY TESTER
The 165A RESISTANCE CONTINUITY TESTER is manufactured to B.T. Spec No. S982A, has pocket and lanyard clip, is infinitely strong and fused to protect against live circuitry up to 100 volts R.M.S. Extensively used by British Telecom and supplied with test leads, they have interchangeable test probes and fine wire crocodile clips. It is of modern pocket-size design, distinctly audible and operates from an easily replaced PP3 battery.

A.P.Besson Ltd. *Why not sound us out?*

St. Joseph's Close, Hove, Sussex BN3 7EZ. Tel: 0273 722651 Telex: 877601.

ELECTRONIC CONVERSION EQUIPMENT

- ★ Transvertors
- ★ Power Frequency Changers
- ★ DC to DC Voltage Convertors
- ★ AC-DC Power Units

Valradio

Valradio Ltd., Browells Lane,
Feltham, Middlesex, England.
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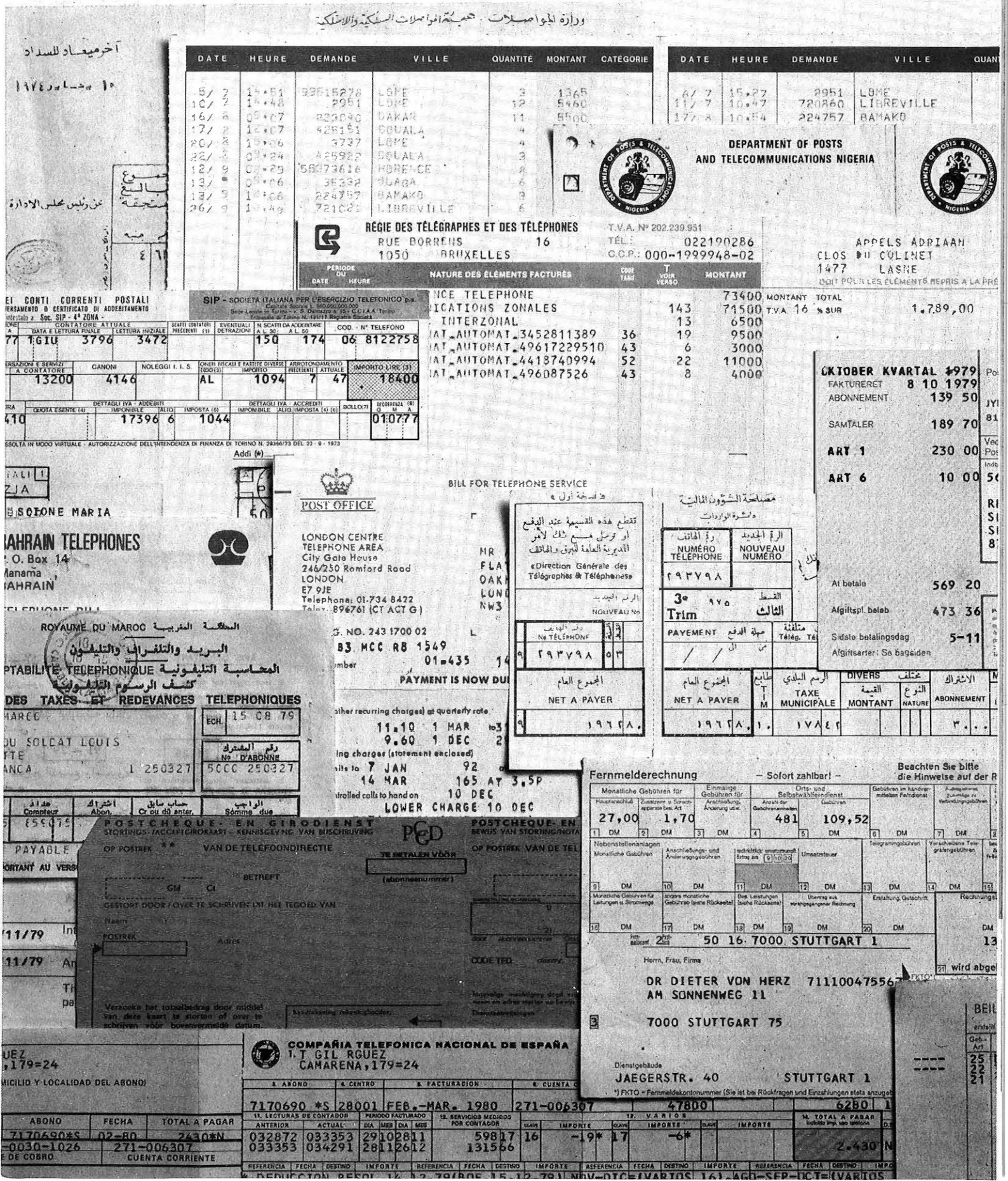
We help make these more acceptable.



We can't promise to make your subscribers actually welcome the bills you send them. However, we believe we can help you to make the bills more acceptable.

People get annoyed at having to wait for an extra telephone to be installed, or having to share a line, or not always having a clear conversation.

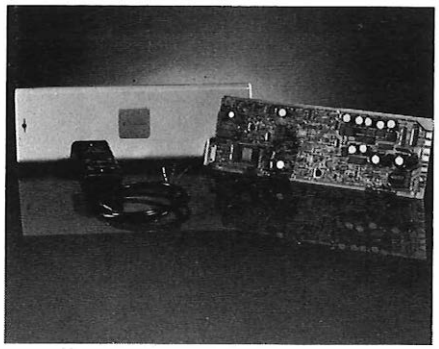
STC has the answers.

What's more, as well as making your subscribers more contented, we can help you generate extra revenue.

Here are some of the ways in which we can do it.

Extra phones, without extra cable

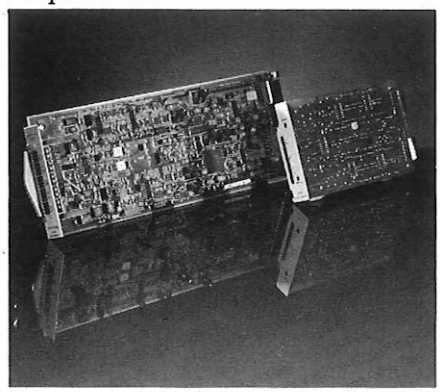
You can double subscriber service over existing cable with EXTRAPHONE subscriber carrier system. Each subscriber enjoys complete privacy, and each has uninhibited access to the exchange, because they do not have to share a line.



Installation is simple and not expensive, because subscriber units can be installed and removed as easily as the handsets. This makes the system particularly attractive for temporary applications, like shows and sporting events.

Extra voices, and how to suppress them

Some communications systems introduce voice echoes which your subscribers find intrusive. STC echo suppressors overcome the problem.



They are designed compactly, with integrated circuit logic and components of proven reliability.

Built-in tone disablers remove echo-suppression during data transmission. Additionally, commissioning and maintenance procedures are simplified and power consumption is reduced.

Extra clarity, over H.F. radiotelephony

On long-distance, high-frequency radiotelephone links, increased speech intelligibility and ease of conversation make STC's Lincompex equipment a clear advantage.

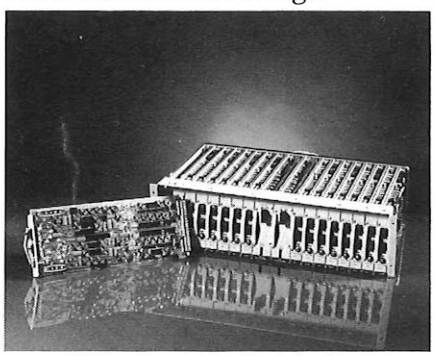
Users have said: "estimated increase in useable circuit time was up to 20%"; "marked improvement noticeable"; "greater potential call-handling capacity"; "lack of noise."

This means that there's every chance your system will be used more often, because Lincompex equipment helps conversation flow

Extra revenue: 3kHz, and all the rest

While 3kHz bandwidth channelling costs more to install, increased system capacity and savings in space make it well worthwhile. Figures show that capital cost can be recovered in well under a year.

On a typical 7-year, 15% interest loan, return on annual expenditure can be expected in the region of 360% to 490%. You not only provide better service—you make substantial savings!



For more detailed information on how STC's specialised transmission equipment can help you to improve subscriber service, complete the coupon or attach it to your letterheading.

This advertisement is one in a series presenting STC's wide-ranging capabilities in telecommunications and electronics.

To STC, Dept 810,
190 Strand, London WC2R 1DU,
England. Telex: 22385

Please send more information about STC's leadership in specialised transmission equipment.

- ☐ EXTRAPHONE System
- ☐ Echo Suppressors
- ☐ Lincompex Equipment
- ☐ 3kHz Channelling

Name _____

Position _____

Company _____

_____

Address _____

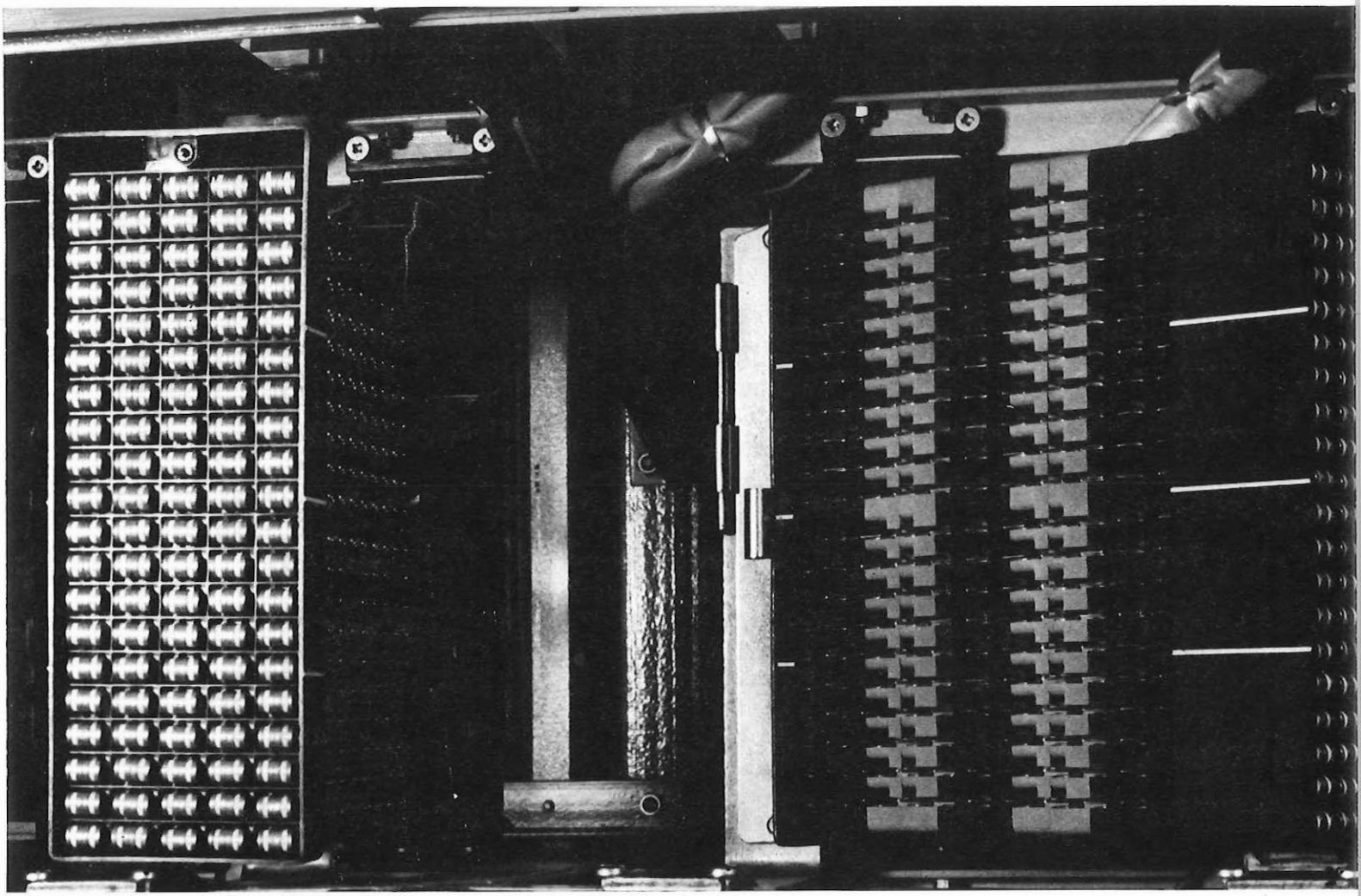
_____

G 3/2

Standard Telephones and Cables Limited
A British Company of ITT

STC. We help people communicate.

Jacks Test with Hinges



Jacks Test 39/2B. Hinge opened on right hand unit to facilitate work on wiring face of left hand Jack.

Jacks Test 39/2A 39/2B 40/2A 40/2B 42B.

Hinged versions of the existing range have been introduced to provide improved access for jumper wiring. The hinge is fitted between mounting bracket and fanning strip, with a secure latching facility.

An insulator foil protects wiring – fed through the fanning strip – from chafing against the hinge.

Hinge Kits 381A 381B

Available for retrospective modification of any protected Jacks Test.

NAME

TITLE

ADDRESS

Please send me further details of the hinged version of the Jack Test range.

Birkbys Plastics Limited, PO Box 2, Liversedge, West Yorkshire, United Kingdom WF15 6QA 0150 2 0046

Birkbys Plastics
a member of the **PLESSEY GROUP**

Birkbys Plastics Limited, PO Box 2, Liversedge, West Yorkshire, United Kingdom WF15 6QA.
Telephone: Heckmondwike (0924) 403721
Telex: 55332

Now British Telecom approved plastic components from Mullard.

Mullard has been granted full British Telecom D3006 approval for the supply of plastic-encapsulated integrated circuits.

A leading supplier of components to British Telecom for many years, Mullard is the first manufacturer to secure this comprehensive approval which covers the use of plastic-encapsulated semiconductor components.

Application is also being made for D3007 approval covering equipment demanding longer component life expectancies such as electronic telephone exchanges.

Mullard

MULLARD LIMITED, MULLARD HOUSE, TORRINGTON PLACE, LONDON WC1E 7HD. TELEPHONE: 01-580 6633. TELEX: 264341.
Mullard manufacture and market electronic components under the **Mullard, Philips** and **Signetics** brands.

The Cardphone –it lets you say more than money ever can.

Advanced design concepts and state-of-the-art technology make the Cardphone the public telephone of the future. The Cardphone by Landis & Gyr is a new concept in the provision of a telephone service to the general public.

By the use of highly secure holographic technology, the Cardphone pre-paid debit cards provide maximum protection against counterfeiting, copying and fraud.

With the pre-paid card, users need no cash to make a telephone call. The Landis & Gyr Cardphone telephone contains no coin handling system or cash vault, thereby reducing the inducement to vandalism or theft. Maintenance is simplified and system operation rationalised.

By inserting the card in the Cardphone telephone, the user can immediately read out on a display the credit availability on his card. The card is returned if a telephone call is not initiated by lifting the receiver.

Once a call has been dialled and connected, the display shows continuously the credit remaining on the card, and gives audible and visible pre-warning of credit expiry.

Carry over facilities are provided to allow the call to continue whilst another card is inserted into the Cardphone telephone.

We shall be pleased to tell you more about this advanced new concept developed by Landis & Gyr.

The Cardphone, a worldwide first.

LANDIS & GYR

Landis & Gyr Ltd.,
Telephone Equipment Division, Victoria Road, London W3 6XS Telephone: 01-992-5311

You'll be surprised where you can put a Perifile...

Operates from 12V DC or 240V mains power supply
Variety of packages and configurations including new single unit desk top version
Available with RS232 serial, Parallel or IEEE interfaces
Buffer protect and power fail option
Remote or local operation
Diagnostic EPROM now fitted as standard

SINTROM GROUP

Sintrom Electronics

Sintrom Electronics Ltd
Arkwright Road, Reading, Berks RG2 0LS
Tel: Reading (0734) 85464
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PROBLEMS . . . . . .?

Cescom equipment is designed with reliability in mind and to easily incorporate 'Customer Special Functions' at low cost.

Our standard range of equipment, plus our bespoke range, gives answers to many problems.

If you are thinking Message Switchers, Line Switchers, Terminal Controllers, Telegraph Selectors, Data Stores, Tape Readers or Telecommunication Operations
YOU MUST THINK CESCOM!

Cescom Electronics Limited,
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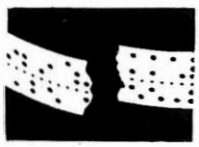

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YOU MUST THINK CESCOM!

Cescom Electronics Limited,
Harrow Road, Leytonstone, London E11 3QF.
Tel 01-534 7613. Telex: 893779 Cescom G

Announcing the most powerful computer in the GEC 4000 Series.

The 32-bit GEC 4090.

Standing high and mighty at the top of the GEC 4000 Series, the GEC 4090 is more than twice as powerful as the GEC 4085 yet compatible with current GEC software and peripherals.

Nine languages and Nucleus

Like all GEC 4000 Series machines, the GEC 4090 has a 9 language capability and is equipped with Nucleus. This award-winning central executive of the operating system is implemented not in software, but hardware. It handles important internal computer functions of protection, short term scheduling, memory management, input/output handling, semaphores and interprocess handling.

There the similarity (but not the compatibility) with other GEC 4000 machines ends.

32-bit wide store highway

Unlike other GEC 4000 machines, the GEC 4090 has a 32-bit wide store highway, a 32-bit wide mill for integer operations, a 64-bit wide mill for floating point operations and 16 Kilobytes of high speed cache storage normally achieving a 98% hit rate on processor bound jobs.

4 Megabytes of main store

Unlike the others, the GEC 4090 has up to 4 Megabytes of main store and 256 Megabytes of virtual system memory.

Comprehensive diagnostic facilities provided from the operator's console include self-test capability.

Long on advantages, short on delivery dates

Combining inherent reliability with extensive security of operation, you'll find GEC 4000s powering Prestel,* steering radio-telescopes, flying high in Nimrods as part of NATO and fulfilling vital industrial functions.

Designed, developed and manufactured in Britain, the new GEC 4090 is available on conveniently short delivery dates. An even more powerful reason for you to talk to GEC Computers. Right from the start.

For more information contact Tony Matthews (Ext 3799) or for Export, David Finlay (Ext 3807) on 01-953 2030.

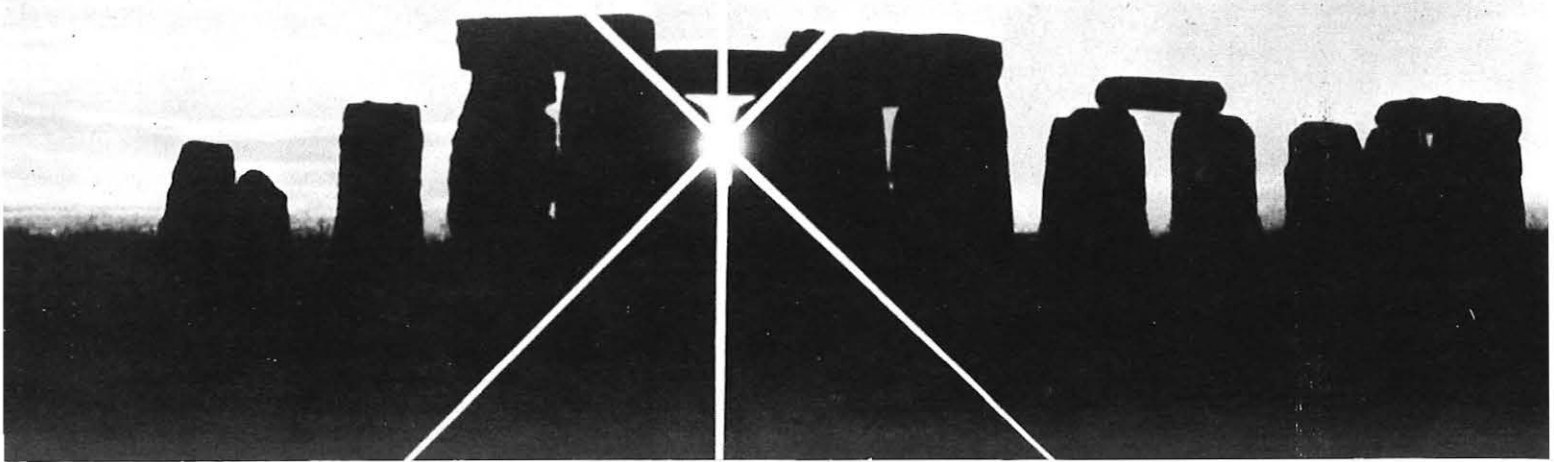
* Prestel and the Prestel symbol are trade marks of the British Telecom viewdata service.

GEC

GEC Computers
Right from the start

GEC Computers Limited
Elstree Way, Borehamwood, Herts WD6 1RX.
Telephone: 01-953 2030. Telex: 22777.

Holding Company. The General Electric Company Limited of England.



British Telecom Journal

Summer 1981 Volume 2 Number 2

Published by British Telecom, part of the Post Office, to promote and extend knowledge of the operation and management of telecommunications.

Cover: Keeping emergency telephone lines open for the Royal Navy is all part of the job for Malcolm Eddy, one of three British Telecom engineers based at Culdrose Royal Naval Air Station in Cornwall. Here emergency calls from coastguards alert the air-sea rescue missions which provide a round-the-clock service.

A positive approach

With the British Telecommunications Bill having received the Royal Assent in July it is hardly surprising that the period leading up to it has been one of intense activity within British Telecom.

As the Business faces a host of fresh challenges, far-reaching and flexible strategies have been devised and every opportunity has been taken to demonstrate the positive approach needed to succeed in the new environment.

At the highest level is the creation of the new Board structure (see page 31). This provides roles for four new full-time members – all experienced senior managers from within the Business – with Managing Director Peter Benton stepping up to become Deputy Chairman.

Commenting on the changes, British Telecom chairman Sir George Jefferson said the appointments were designed to move decision taking down the line, closer to the interface with the customer.

"In the environment facing us speed of decision making will be of critical importance," he said. "It's going to be better to get a 95 per cent right decision taken in time to beat the competition than a 100 per cent decision taken too late."

The need to be more market responsive is also the reason behind the setting up of British Telecom Enterprises, a company headed by the Deputy Chairman and responsible for several separate or associated activities, including the marketing, supply and distribution of British Telecom customer equipment.

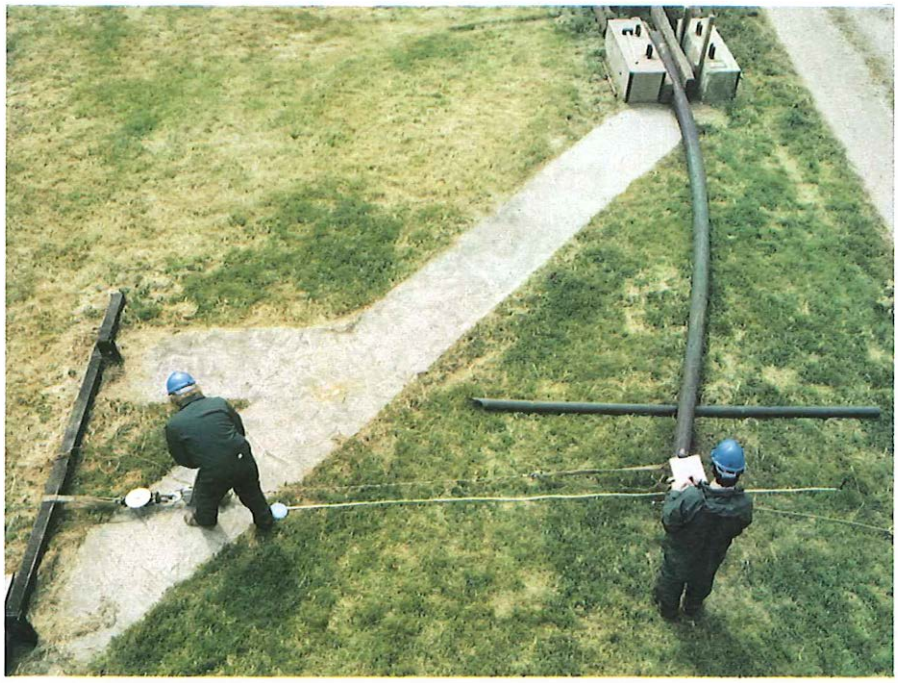
Of vital importance too is the setting up of a new 950 strong sales force – recruited both from within and from outside British Telecom – to sell telecommunications services to business. The new streamlined organisation will offer businessmen tailor-made solutions to their communications problems and each major customer will be able to rely on his own account executive.

There will be major account managers assigned to national and international corporations and they will regularly meet senior management and deal with current sales and long-term development plans. Market account executives will advise larger regional companies on all aspects of telecommunications and be responsible for one-off specialist assignments. Finally, marketing service representatives will look after medium to smaller businesses and help them grow.

As Sir George Jefferson has said: "We are determined to make British Telecom a resounding success in the new environment . . ."

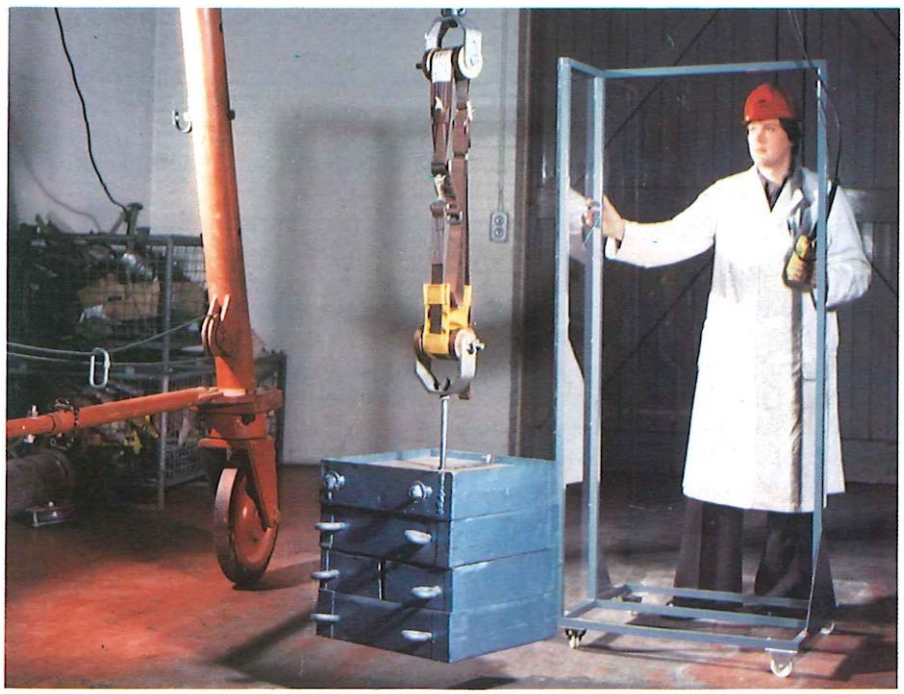
Safety by design

D G Clow



As technician Dave Baker increases the pressure, assistant executive engineer Peter Smith measures the deflection a telephone pole withstands as it undergoes tests at THQ's Smallford trial centre near St. Albans.

Probably the most vital piece of equipment for a linesman is his safety belt. Tests carried out by Quality Assurance Division make certain it will stand up to the rigorous conditions in which it will be used.



Within British Telecom, safety or reliability considerations are a vital element in the design of equipment and plant, particularly in the external field. The three main priorities are the safeguarding of life, the ensuring of acceptable levels of serviceability and guarding against irreparable plant damage.

Consider the steerable dish aerials at the satellite earth stations at Goonhilly and Madley, for instance. They constitute a vital and costly item in the communication system and naturally the operational staff would prefer never to lose service time because of aerial problems. But there is a considerable economic penalty in providing an aerial to a standard which would ensure service in the extremely high winds which very occasionally occur in this country.

So a compromise has to be reached between serviceability and cost, and it is accepted that from time to time, the aerial will not be able to be steered accurately enough in extreme winds to maintain service. It would, of course, be far more serious if the structure, the drive systems or other components were to be damaged or the whole aerial destroyed so the design must ensure that the likelihood of this happening is very remote.

The linesman's safety belt is a good example of equipment where life is very much at stake. In this case, the designer is concerned solely with ensuring that the belt will support an engineer under all conceivable circumstances.

How then is safety or reliability achieved in practice? Some seem to think that if an item breaks, all that is needed is to make the replacement twice the size; in practice this could precipitate an even earlier failure elsewhere! The fact is that the design of an economical and safe piece of equipment or structure can and often does involve many engineering and scientific disciplines.

If an item is to avoid damage or destruction, its strength must be greater than the forces and loads applied to it. The relationship between strength and working load is often expressed as a 'factor of safety'. Application of this factor is complicated because the actual loads or strengths are seldom known accurately, and many things happen which can give rise to variations. Ultimate designs must therefore make allowance for these uncertainties.

Recently, for instance, it was necessary to determine the safety margins of telephone poles used in a particular situation. Because of variations in the diameters of the poles and the shape and strength of the cross sections resulting

perhaps from different growing conditions, the only satisfactory way to gain useful strength information was to test to destruction a large sample of poles and plot the results on a histogram.

The shape of the curve is typical of tests on most materials but, of course, the actual values of strength will be different and so will the degree of variation about the mean strength. From such a curve it is possible to gain information on the statistical probability of particular property being obtained. These predictions can then be used in calculating safety margins.

Obviously, economic factors prevent tests like this on buildings or radio towers, so the engineer must build up his safety analysis by a combination of analytical and experimental data, trying all the time to reduce the number of unknowns he has to contend with. It is a sobering thought that the most variable factor of all is caused by humans, compared with which, material variations are minor.

There are four ways of ensuring safe equipment and structures. Firstly, there is historical experience. For example, an analytical justification for the design of manholes is very difficult, but the performance of many thousands under busy roads for many years gives considerable confidence that even if it cannot be proved fully by analysis, the designs are generally sound. What history does not reveal is when an item has been 'over-designed' and that a cheaper and more efficient product is possible.

The second source of information is gained from theoretical analyses. Here, computers have given the structural engineer in particular a powerful new weapon in understanding how forces are distributed through a complex structure. The example of a three-dimensional analysis of the backing structure for a new steerable dish for Goonhilly could not be analysed nearly so effectively by hand calculation.

The third source of data comes from testing in controlled laboratory conditions. In some cases, full-scale tests can be set up as when testing personal safety items such as safety belts. Models can also be used. Illustrated here is a 1/24 scale model of a microwave radio tower which was used for wind tunnel tests. Results from this test showed that the wind loads as normally calculated overestimated the actual loads by about 25 per cent and it was possible to fit more aerials to the actual tower without prejudicing its performance.

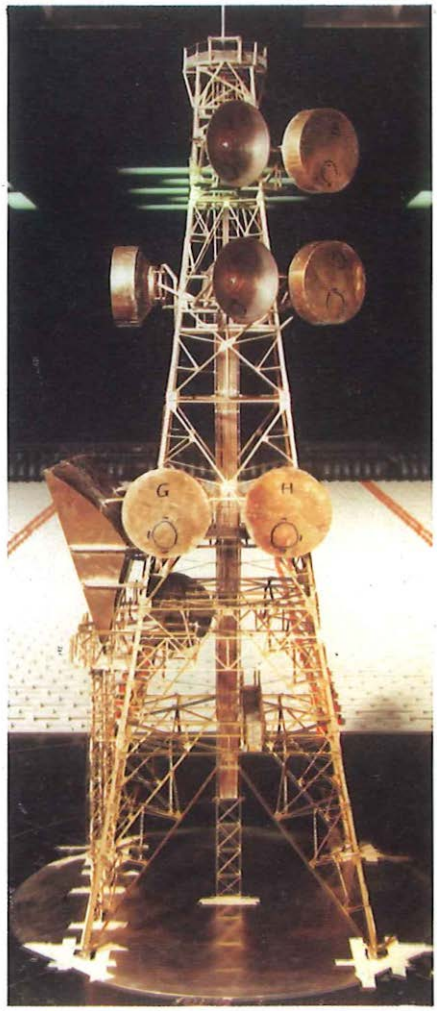
The fourth source of basic information is observing the behaviour of new items in field use. This can be a very slow method of gathering data unless, of course, the design was bad to start with!

British Telecom uses a whole armoury of weapons in the battle to produce telecommunications 'hardware' which is both reliable and economical, and the External Plant Development Division at Wembley and the Quality Assurance Division of the Procurement Executive in London and Birmingham are ever vigilant to ensure that equipment reaches its destination totally safe and serviceable.

Mr D. G. Clow is a head of section in the external plant division of the Network Executive's Transmission Department. His responsibilities include civil and structural engineering.

British Telecom Journal, Summer 1981

A concrete manhole cover is put under pressure at Smallford to determine its breaking point.



This 1/24 scale model of Kirk O'Shotts microwave radio tower was used in wind tunnel tests.

This table shows potential causes of equipment failure.

STAGE OF PROCESS	SOURCE OF WEAKNESS
Specification and design	Wrong assumptions Misapplied theory Calculation error Incorrect drawings
Material properties	Undetected substandard material Unanticipated changes with time, temperature and so on
Manufacture	Inappropriate techniques leading to degradation of material properties 'Locked-in' stresses
Assembly and installation	Misassembly Parts overstressed by forced fitting Incorrect procedures used
Operation	Inadvertent overloading Misuse Corrosion and decay Wear Fatigue Ill-considered modifications

PMJ O'Dell & LA Baron

Record

Following an extensive seven-year operation involving staff ranging from development engineers to doctors, British Telecom's 9000 inland directory enquiry (DQ) service operators have now switched to working with microfiche copies rather than the familiar but bulky directories.

Microfiche is the name given to a system where information, whether in words, figures or drawings, is recorded and reduced on to photographic film. It is simply a more compact way of holding the same information as already held in paper form. It was in 1973 that the Post Office decided to pursue a simple, manually-operated microfiche system in favour of other more sophisticated versions which had proved unsuccessful during trials. The aim was to produce a system that was cheap, easy to use and would last until a fully-computerised (DQ) system became available.

Those most affected by this change are the 30,000 telephonists and supervisors, of whom 9,000 are employed on DQ work in 263 centres throughout the UK. About 1.7 million calls are handled each working day and, by using paper directories, averaged 53 seconds to com-

Each film plate of microfiche contains the equivalent of 70 pages of information contained in a standard directory as Shepherd's Bush chief supervisor Irene Williams shows.

reductions for DQ

Left: Shepherd's Bush directory enquiry centre before the introduction of microfiche readers. Note the large array of directories used by each operator.

Below, left: The same suite after microfiche was introduced earlier this year.

plete. This is much better than most countries, including some with computerised systems. Operator expertise in using the paper records and obtaining information from the caller in the order of town, surname, initials and finally address, were the main reasons for this good service.

More than 350 million calls are made annually to the DQ service of which 85 per cent are successfully completed. Only two per cent of calls which fail can be considered the fault of British Telecom while the remaining 13 per cent fail for many reasons, but principally because of inadequate or incorrect information given by the caller.

So why, then, if the service had been so good with paper records, was it then necessary to replace them with microfiche? The answer is that directories and other information which cover the British Isles were fast outgrowing the storage space available at an individual operator's position. Also, some directories were becoming very heavy and therefore difficult to handle.

One way of making more space could have been achieved by progressively moving less frequently-used directories to separate positions or to a bookcase, but any operator handling an enquiry which required reference to one of these directories would then need either to walk to or transfer the call to the nominated point. Both methods would cost more because of the increased time spent on these calls and studies in the early 1970s showed that costs would escalate after 1980 unless an alternative was found. It was this, combined with the knowledge that not only would paper costs increase but also that greater printing capacity would in future be required.

As a result of the small trial in mid-1973 using simulated calls, a 'live' trial was conducted a year or so later to assess the practical and economic potential of the system. The trial, coupled with costing studies, was held at Walsall with 'Southampton'-type positions, Nottingham with office-type positions and Bloomsbury in London with non-standard positions, and proved the system viable. At the end of the trial, operators completed questionnaires which gave plenty of room for personal comment. Reaction was mixed with about 30 per cent for the system, 30 per cent against, and 40 per cent had no preference.

This was not unexpected because the

microfiche reader used in the trial was only a slightly modified version of a commercially-available model and the microfiche format was virtually a straight transfer of the paper record format. The result was, however, sufficiently encouraging to warrant further study and from the completed questionnaires, observations and practical experiences, a schedule of requirements was drawn up. From this, a prototype microfiche reader was developed, incorporating a capability to be used on all types of DQ position. Alongside this development, a similar exercise was under way which used the microfiche data itself.

Late in 1976, the prototype reader and improved fiche were tested at the same three DQ centres. More than 90 per cent of the operators who took part liked the system. Throughout these trials, a wide range of human factors were studied by Research Department, which in turn consulted the Occupational Health Service and the Medical Research Council's Applied Psychology Unit at Cambridge.

How then, does the system work? The fiche – the films strips holding the information – are postcard size and contain the equivalent of 70 pages of directory information. Consequently they cannot be read by the naked eye. Details are therefore inserted at the top of the fiche to clearly show the name of the directory, the number of the fiche within the directory (the final fiche has the word 'last' after its number), the date the computer produced the directory and the first and last entry on the fiche.

Directory information is grouped into frames, each of which contains up to 65 lines of information. Each fiche can hold up to 396 frames – 33 columns in 12 rows – three of which hold index information. The fiche themselves are housed in purpose-designed panels held in binders similar in size to a public directory.

A great boon for DQ operators is the inclusion of information not found in public directories, such as ceased lines, ex-directory entries and number changes. Separate lists of people with common names, in street order as well as in normal alphabetical sequence can also now be held on each position for the whole of the UK fiche record, whereas with paper, it had to be restricted, as with the other information, to the five most frequently-used directories at any DQ centre. Under the old system, total space needed to hold all the British Isles directory information with the additional information was around some 18 feet, whereas with fiche, it is about three feet.

Having jumped the technical hurdle, the next problems to face were of an organisational and financial nature – implementation alone was estimated to cost £3.6 million. Contracts for equipment and stores had to be let and distributed to the field, often to a very tight timescale. And because operators generally deal with all types of switchboard work, nearly all the 30,000 telephonists and supervisors had to be retrained.

Perhaps the biggest task was in the production of fiche masters, their duplication and subsequent distribution. Staff in the Data Processing Executive and Reprographic Services had to produce eight million fiche as well as continued production of their paper counterpart. Now, with the microfiche system operational, the workload will increase to 13 million fiche in the first year, and by about eight per cent a year thereafter.

Further improvements will continue to make the microfiche system even better, but the longer-term objective must be the introduction of a fully-computerised DQ system able to offer facilities that cannot be provided by even the most sophisticated type of microfiche.

Using microfiche these operators can deal with an average of at least one call a minute.

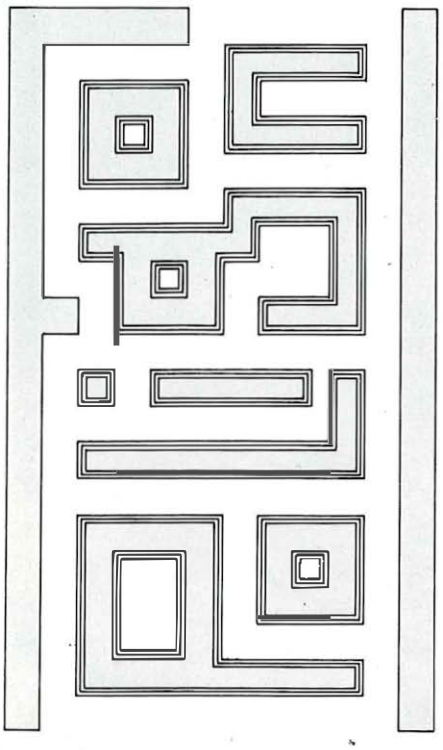
Mr P. M. J. O'Dell is a senior telecommunications superintendent in the operator and exchange-based services division of Marketing Executive's Residential and Customer Services Department.

Mrs L. A. Baron is a telecommunications traffic superintendent in the same group.

British Telecom Journal, Summer 1981

the helping hand

B J Woods



Poligon, a mini-computer-based system evolved at the Research Laboratories, Martlesham, is now being used to help in the design of integrated circuits which are playing an increasingly important role in British Telecom development.

In a rapidly changing technological environment, it is essential that engineers can design and develop trial systems much more quickly than has been customary in the past. The design of integrated circuits (ICs) is a good example, particularly those few which are required for research purposes.

The need for custom designed 'silicon chips' to achieve reductions in size, power consumption and cost was recognised during development work on a range of new digital signalling receivers. The filter and detect (FAD) circuit developed at Martlesham is an example of a circuit that has been taken beyond the feasibility stage. Enough of these chips have been produced to implement several MF4 signalling receiver and decoder boards, some of which will be installed in the first System X local exchange at Woodbridge, Suffolk.

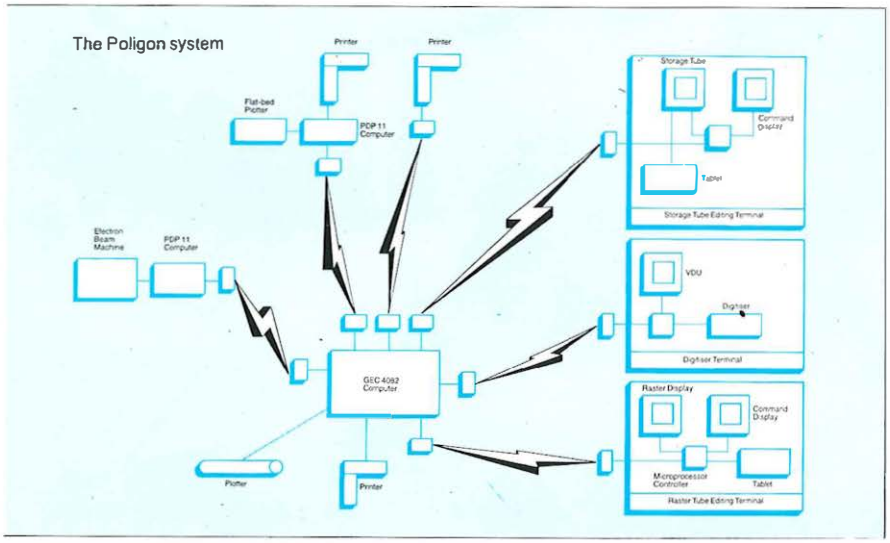
The manufacture of an IC requires up to eight photographic masks each containing many thousands of shapes (rectangles and polygons) all of which have to be carefully thought out and positioned by the designer. On completion, all this data has to be output in a suitable form to drive an artwork generator which will produce the masks from which the IC can be produced.

Without the aid of a computer, it would be very difficult (if not impossible) for such a layout to be performed. The system has been developed, therefore, as an expandable and easy to use computer aid to assist the designer in this task. A suite of 43 programs enables the designer to input the data describing an IC, modify it, examine it, check it and output it in a variety of forms.

Input of raw data may be performed by describing the various components in a simple language in which the shape type, mask layer and co-ordinate information is specified. Alternatively, a rough sketch of the layout may be laid on a digitiser. By using a special probe, co-ordinate information from the sketch may then be extracted.

In general, ICs are designed by interconnecting blocks in a hierarchical fashion. Blocks from previous designs can therefore be used when designing a new IC. All this data is eventually brought together and may be manipulated at an interactive graphics workstation. Considerable thought was given to the design of the graphics workstation in order to make it ergonomically acceptable. It consists of four components – a graphics screen, an alphanumeric screen, a graph tablet and a keyboard.

Two different types of graphics screen enable the designer to view his layout in a pictorial form. A storage type monochrome screen can display a large amount of flicker-free information in great detail. Alternatively, a colour master screen is available which can



AEE Dick Ilsley uses Poligon to help design integrated circuits at British Telecom Research Laboratories, Martlesham Heath.

show a less detailed picture but with a choice of up to eight colours.

The alphanumeric screen is a colour TV set with a teletext (Prestel) decoder. It is used to display information to the designer and keeps him informed on the current status of his design. It can also display pages from an 'electronic manual' thus giving him an instantly available source of reference either in a learning mode or as an aide memoire. It has the advantage of colour and, being capable of displaying only 24 lines of 40 characters, constrains the software from overloading the designer with too much information at once.

The graph tablet is a small (11 inch square) digitising surface together with a hand-held probe. Moving the probe across the tablet surface causes a cross hair cursor to move in sympathy on the graphics screen. Thus, the designer can use it to specify co-ordinate positions or point at an existing item on his layout. In addition, by laying a 'menu' on the tablet surface, the designer can initiate software options by simply probing the tablet. As this reduces the amount of typing, there is less chance of mistakes being made.

In keeping with the need for ease and simplicity of use, designers are able to create their own menus with as many or as few options on the tablet as they require. Options not immediately available from the tablet may be accessed by probing a sub-menu. The menu may also be configured to suit left or right-handed designers. For some forms of input such as block names or text strings, it is more convenient to provide a standard keyboard. Input from both tablet and keyboard is arranged to give an immediate confirming response on the alphanumeric screen.

Operations at the workstation range from the very simple – inserting a single rectangle or polygon – to the more complex – moving and stretching shapes, manipulating blocks of information and merging together polygonal shapes. Facilities are also provided for operating on complete masks (making shapes larger or smaller) and for rotating, reflecting, deleting, and copying shapes or blocks.

Although the software is thought to contain all the necessary facilities that a designer could require, a 'macro' facility is provided that enables the designer to 'record' any sequence of operations that suits his particular requirements. These may then be 'played back' with a single operation.

A particularly important feature of any IC design package is its ability to check the final layout. ICs are designed to conform to a set of layout rules imposed by manufacturing constraints. It is important that any deviation from these rules is detected and corrected before the IC is fabricated because mask corrections after this are an expensive process.

Peter Gill, AEE, uses a probe on the digitiser connected to the Poligon system to translate a layout drawing of a microchip output stage into data which can then be used for further computer processing.

Poligon aids the designer by providing a set of rule-checking facilities. First, he can check that all the rectangles and polygons making up his design are valid since strange shapes such as polygons with zero area can occur as a result of interactive editing operations. He could then perform a set of dimension checks to ensure, for instance, that shapes on a single layer are separated by a minimum distance.

As the final step before fabrication, Poligon provides the designer with a number of programs for producing multi-coloured plots for visual checking. Thereafter, data can be output in a variety of ways to suit a range of artwork generators.

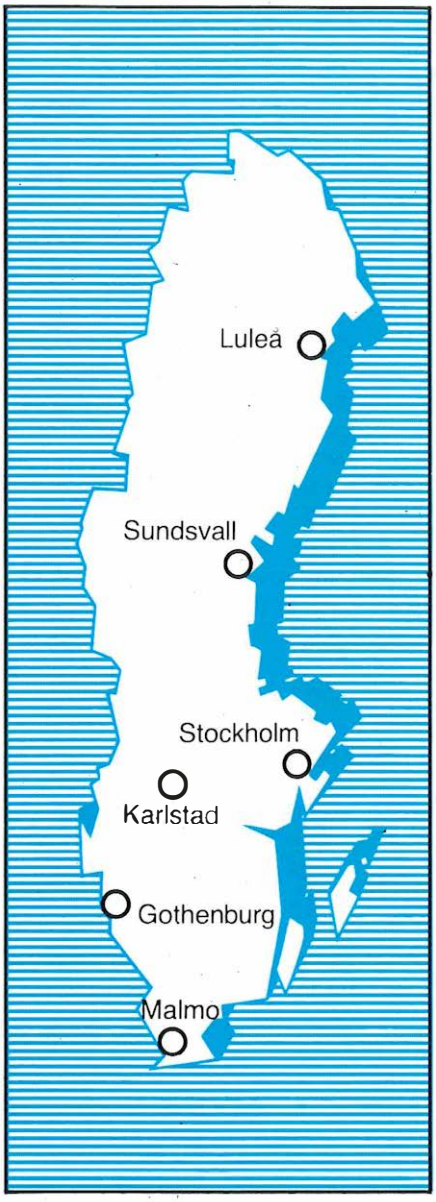
One of the design objectives of Poligon was to make it expandable. In a high technology area such as IC design, particularly in a research environment, there is a continuing need for additional software to meet changing requirements. With the availability of in-house expertise, changes and enhancements to the software can be made much more readily than with a bought-in turnkey system.

Recognising the cost of software development and maintenance, considerable thought was given to the choice of programming language at the outset of the project. By using a high level, structured language (Coral), it has been possible to implement the original and many enhancements relatively quickly and with few snags.

The Poligon suite was implemented on a GEC 4080 computer. While portability was not a high priority at its inception, the use of Coral has meant that its transfer to a VAX 780 computer has been relatively straightforward. Poligon is now being marketed worldwide by Compeda Ltd.

Mr B. J. Woods is a head of group in the computer controlled systems and mathematics division at British Telecom Research Laboratories Martlesham.

This, the sixth in our series of articles on overseas administrations, looks at Sweden whose telecommunications system is considered by many to be the best in the world.



The Swedish telecommunications administration, Televerket, manages to combine a wide range of services with efficiency, high manpower productivity and low tariffs in a way which many leading countries find difficult to match. Not surprisingly, Televerket is happy to share its wide range of performance statistics and experiences with other administrations – and its own users – following on from the Swedish tradition of open government.

Like British Telecom, Televerket is a state-owned public utility operating on a commercial basis. It has been entrusted by Sweden's Parliament to provide modern telecommunications and is responsible for national and international telephone, telex, telegraph, data and radio communication services. Although Televerket is given freedom to operate within the framework of Government regulations, in the last resort it must answer to the Minister of Transport and Communications to whom budgets, investment plans and tariff increases must be submitted for approval.

The administration has only two organisational levels – headquarters and areas. Four regions which existed until three years ago were disbanded in favour of greater delegation and decentralisation. All 20 areas now report to the Director General and Board of Televerket and each area executive manager is responsible for economy and service on a local level.

Supplementing the areas, four nationwide divisions also report to the Director General. These are an Alarm Systems Division which sells and installs internal alarm systems and intercom telephones predominantly; Materials Division which is similar to British Telecom's Procurement Executive; a Radio Division which is responsible for transmitting radio and television programmes and for collecting receiver licence fees, and finally an Industrial Division (Teli) which manufactures much of Televerket's own equipment such as exchange equipment and telephone sets.

To anticipate possible competition and improve commercial efficiency and flexibility, Televerket asked the Government to allow it to set up a holding company called Teleinvest. Its task would be to own and administer the share capital of Televerket's subsidiary companies. Permission was granted by Parliament late last year and in January 1981, Teleinvest was formally established. Already five subsidiaries, Swedtel (100 per cent ownership), Swedcom (100 per cent ownership), Teleindustrier AB (100 per cent ownership), SOS-AB (50 per cent ownership) and Datasaab (9.5 per cent ownership) are administered by Teleinvest.

Swedtel is a telecommunications consultancy mainly for developing countries while Swedcom play a similar role but is directly involved with installation, operation and maintenance. Teleindustrier AB is the manufacturing company to which all equipment production will be transferred before mid-1985. SOS-AB's goal is to co-ordinate with local authorities all the emergency services so that rapid and effective action can be taken. The remaining 50 per cent of

SOS-AB's share capital is shared equally between the Swedish Association of Local Authorities and the Swedish Federation of County Councils. Datasaab is a manufacturing company in electronics and is owned principally by LM Ericsson Telephone Company. Televerket also has a subsidiary Ellemtel, not affiliated with Teleinvest. Controlled equally by Televerket and LM Ericsson, Ellemtel is engaged in research, design and development.

At the heart of Televerket's success is a highly saturated market. With a system size at March last year approaching 6.5 million telephones and 4.7 million connections, the Swedish network is only a quarter the size of the UK's. But Sweden has a telephone penetration of 78 telephones per 100 inhabitants compared with the UK's 48. The United States is the only country in the world with a higher telephone penetration than Sweden.

Contrary to popular belief, the equipment used in the Swedish telephone system is not entirely crossbar or electronic. Some 40 per cent of connections are on step-by-step (rotary) exchanges, less than one per cent on electronic and the balance on crossbar. Corresponding UK figures are 75 per cent, 10 per cent and 15 per cent.

Reason for the Swedish success lies largely in the opportunities resulting from the highly penetrated market. Limited residual system growth and low fault incidence has meant that the Swedes have more recently been able to combine telephone area engineering installation and maintenance groups, pooling skills to maintain the best use of staff resources. This also results in increased job satisfaction, but is probably only viable in heavily-penetrated telephone networks where installation and maintenance work needs are low.

The delegation of responsibility for economy and performance to small groups has brought about a dynamic 'Productivity Results Scheme' (PRS) involving all local staff.

PRS allows Televerket to assess staff productivity in defined 'results units' and pay them according to their combined achievement. Results units are both geographical and functional with functions able to cross equivalent British Telecom hierarchies so that engineering wages can be affected by the performance of sales staff and vice versa. The final productivity assessment takes account of many factors including customer service, quality of service, manpower performance and financial measurements such as improvements in the ratio of income to expenditure.

Televerket is currently testing a new type of doorless telephone kiosk which can be more easily used by the physically disabled.

A stage in the manufacture of the new push-button Diavox telephone set which uses voice frequency signalling and has been developed with the modern AXE stored program control exchanges in mind.

The new A345 electronic PBX which can serve between 500 and 7,000 extensions.

PRS relies on close co-operation from Televerket's 43,000-strong workforce as well as the three trade unions. Staff consultation is achieved through works councils at all levels which consider a wide range of issues including working environment, work organisation and personnel management activities in general. Pay is negotiated centrally every year and a sum of money is allocated to each telephone area, but the executive manager has some freedom to negotiate adjustments to this with union branches locally.

Already, 95 per cent of Swedish households – mainly apartments in urban areas – are provided with plug and socket terminations. This means that subscribers can take their phones with them when they move house, and can collect or exchange them at telephone shops, removing the need for non-essential engineering visits and so reducing Televerket's costs. In some telephone shops, the customer can also hand in defective sets for repair or replacement.

Televerket's market position has been defended by extensive monopoly powers in practice, if not in theory, for although

the administration has no formal monopoly, it has no competitors either. Generally, all equipment attached to the network must be supplied, installed and maintained by Televerket. Some private attachments may be allowed as long as they meet the technical requirements, but approval is only given if the administration does not provide equipment with the same or similar functions. A current Government investigation is expected to result in a slight relaxation of Televerket's rigid attachment policy.

Televerket has taken full advantage of the stable, ordered environment in which it operates to increase efficiency and keep costs down. But in future, the company faces problems which, in part, result from this very stability – particularly those concerning plant replacement.

Existing plant – almost all step-by-step or crossbar and financed during earlier periods of growth – has now largely been written out. Swedish tariffs are cheap because current account costs, especially depreciation and interest charges, are low, but now that the company is entering the electronic age, concern is growing about how it will finance future investment and replace this ageing equipment. Televerket has been largely self-financing in recent years but current funds are unlikely to meet capital requirements for the next telecommunications era. As a temporary measure, Parliament recently decided to extend Televerket's revolving credit at the National Debt Office by 800 million kroner (£80 million).

Because the market is so well penetrated, there is little scope for adding more subscribers to the network. The extra revenue to support increased investment will therefore fall on existing customers – either by encouraging greater telephone use or by tariff increases of which there have been two in the last year. Recognising this, Televerket is promoting supplementary subscriber apparatus and stimulating higher calling rates through its recently-formed central marketing department which has chosen the residential sector as prime target.

All calls are currently charged at the same rates throughout the day with no reductions for off-peak periods, but to encourage greater use of the telephone, Televerket intends to introduce an evening cheap rate period as well as at weekends and on public holidays. It is also looking at the possibility of introducing a special peak rate tariff during the morning to minimise use at that time. This, together with local call timing and rationalisation of trunk call distance steps expected by the end of 1982, would bring the Swedish tariff structure closely in line with that of the UK.

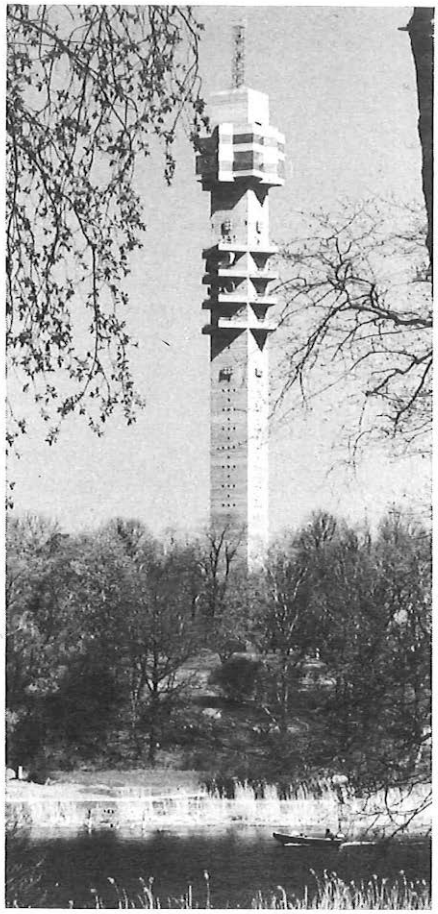
Televerket is also relying on the expansion of growth areas such as data communication and the development of new products and services to consolidate its current healthy situation and to ensure its future prosperity. The growing need for data communication is reflected in the number of modems installed which in the last financial year increased by 30 per cent.

Since early 1979, Televerket has pressed ahead with its own videotex trial service known as Datavision. And, after a establishment of a joint public data network known as the Nordic Data Network; and following the introduction of the Databas 300 service to the United States in March last year, Swedish users can access a large number of host computers in the American Tymnet and GTE Telenet networks. Interworking with Euronet is planned for this year.

Since early 1979, Televerket has pressed ahead with its own videotex trial service known as Datavision. And, after a period of stagnation, telex is thriving again and is being converted to all-electronic network and terminal equipment. Two years ago, a service known as Telex 080 was introduced, which can store a telex message when the called number is engaged and automatically forwarded it when it becomes free.

Examples of new products include Televerket's modern range of electronic PBXs. First deliveries of the ASD 551 for between 200 and 600 extensions, and the A345 for between 500 and 7,000 extensions, have been made during the past year, and in two to three years, these PBXs will dominate the market. The new Diavox telephone set, introduced on a limited scale in 1979, has a keypad instead of a dial, uses voice frequency signalling and has been developed with the modern AXE stored program control exchanges in mind. An experimental version of AXE has been on trial for several years and the first prototype exchanges have recently been opened near Stockholm and Gothenburg.

With a long history of co-operation between Televerket and L M Ericsson, telecommunications in Sweden is much more closely and vertically integrated than in many countries. Indeed, Televerket's industrial division, Teli, often manufactures equipment for L M Ericsson on a sub-contract basis when production capacity is overstretched.



The Kaknas television tower at Stockholm.

Televerket's efficient organisation, which perhaps characterises the Swedish scene, its background of success, stability and true Nordic sense of order, augurs well for the next generation and places it in a good position to meet the challenges that lie ahead.

The next article in the series takes a look at the United States.

The authors – **Mr O. P. Sellars, Mr J. J. E. Swaffield, Mr J. F. L. Stubbs** and **Mr S. Lunt** – are all members of the international comparisons group in the Service and Performance Department of THQ. They acknowledge the help of **Messrs I. Lonnqvist** and **J. Wiberg** of the Central Administration of Swedish Telecommunications.

Wedding for the world

British Telecom technicians Johnny Frank and Alan Norton set up one of the four microwave dish aerials to be erected on the roof of Abbey Life Building in St Paul's Churchyard for the Royal Wedding. The aerials were used to transmit television pictures from St Paul's to the London Telecom Tower, the main centre of operations for transmission to 500 million viewers throughout the world.

A worldwide audience of some 500 million people – the largest in the history of television transmission from this country – were able to enjoy live coverage of the wedding of Prince Charles and Lady Diana Spencer at St Paul's Cathedral on 29 July – thanks to months of careful preparation by British Telecom.

London Telecom Tower was at the centre of operations which relayed pictures of the wedding day celebrations to countries as far away as Australia, Hong Kong and South America. On-the-spot coverage via France for viewers in Western Europe was relayed by the Eurovision network.

Television coverage was transmitted from London Telecom Tower to earth stations at Goonhilly in Cornwall and Madley in Herefordshire to satellites over the Atlantic and Indian Oceans and across the world. Circuits for world-wide radio provided by British Telecom from the international sound programme centre at Mondial House near London Bridge included some broadcasts in stereo.

Requests for television and radio circuits began as soon as the wedding was announced and it soon became clear that British Telecom would be dealing with the largest television event it had ever had to cater for. Staff were also responsible for providing outside broadcast facilities for BBC and ITV, linking cameras sited along the route of the royal procession and in St Paul's Cathedral to the nearest point in the transmission network.

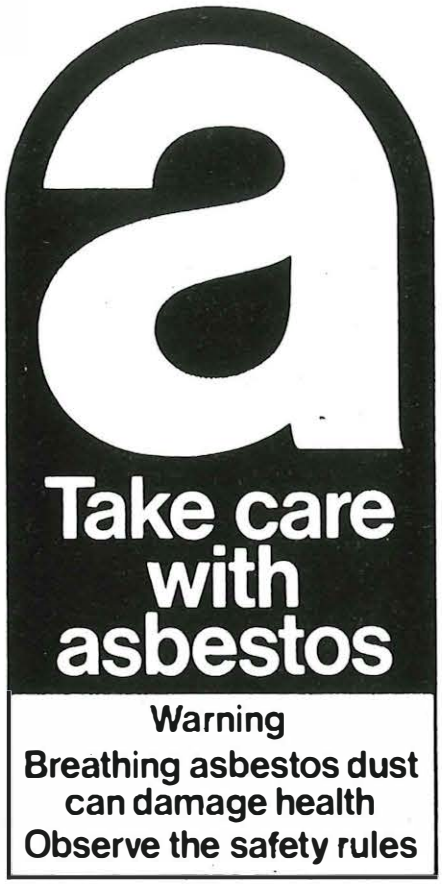
British Telecom has a long association with broadcasting dating back to the earliest days of television in the 1930s. Among the major events brought to homes throughout the world have been the landings on the moon, the Olympic Games, World Cup football, Eurovision song contests, United States elections, the Pope's tours throughout many lands and coverage of royal visits.

British Telecom Journal, Summer 1981

R D Edwards

Asbestos

Few industrial problems in recent years have evoked as much emotive response as asbestos and the extent to which it is a health hazard. This article takes a factual look at the steps taken by British Telecom to safeguard its staff.



Although asbestos was first considered a health hazard as long ago as the 1920s to workers in the industry, the extent of the risk was not well understood, and regulations concerning the substance were not as comprehensive as they might have been. In 1969, when more was known, new regulations were introduced through the Factory Acts, yet by 1975, continued public concern was being voiced through the media.

As a result of this concern, the Government set up a committee to review the risks of contracting lung disease both to employees in the asbestos industry and to the public at large. In the same year, following a request from its staff side, the Post Office reflected this general disquiet by setting up its own investigations into the use of asbestos within the organisation. The 'Asbestos Products Working Party' consisted of representatives from both staff and official sides, and its terms of reference were to examine the use of asbestos in the Post Office and to consider protection for employees.

But first something about the material itself. Asbestos is the familiar name given to a group of mineral silicates which occur naturally in fibrous form in certain rock formations. Each type has certain characteristics – fibre size, texture and colour – but these are not discernible to the naked eye. The main sources of supply to this country are Canada and South Africa, although no asbestos is mined in the United Kingdom.

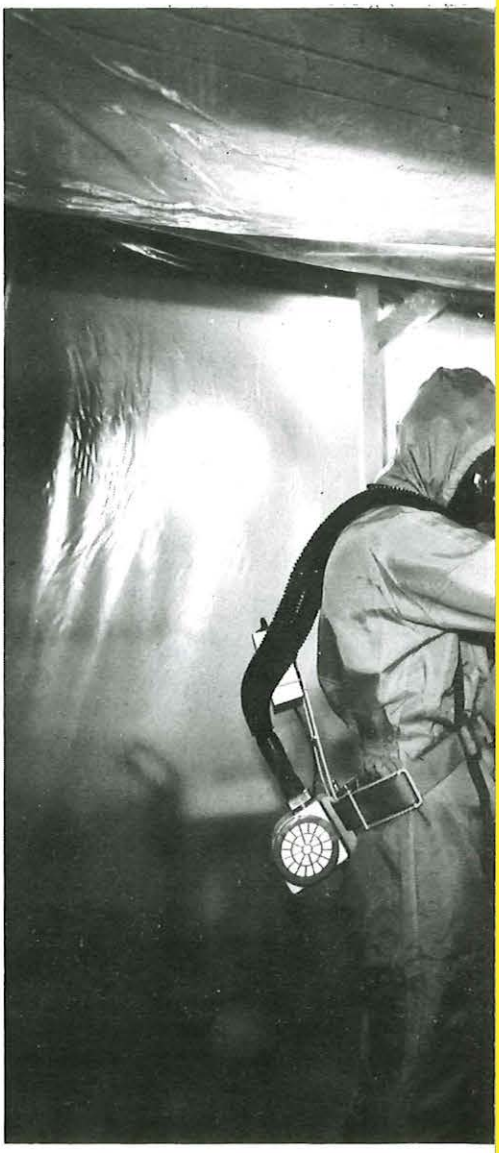
The material and its virtues were known many centuries ago, and the word asbestos is of Greek origin meaning 'unquenchable'. In ancient times it was used to reinforce clay pots and was even woven into garments which could be cleaned by putting them in the fire! In modern times the properties of the material have been widely employed in all sorts of manufactured goods.

In some cases the uses are well known, as in thermal insulation, fire protection materials, fire stops, building materials, clutch linings, brake linings and gaskets. In other cases, uses are less obvious such as for reinforcement in plastic goods, sound insulation materials as well as a binder in certain paints. It can readily be understood, therefore, how asbestos has been considered a boon particularly for its fire protection properties.

There are three common types of

Technicians from all over the country attend the asbestos recovery courses held at British Telecom's Regional Engineering Training Centre at Didsbury near Manchester. Here, in a typical telephone exchange situation PVC sheeting is used in the building of a screen around a cable hole before asbestos removal can begin.

Wearing the special protective clothing and Respirators 2A, instructors John Coop and Alan Crookell demonstrate the correct removal procedure for asbestos lagging.



asbestos in general use. These are chrysotile (white), by far the most common, crocidolite (blue) and amosite (brown). The hazard arises from inhaling airborne dust and of the three types, blue asbestos can be broken down into the most minute splinters and is therefore most likely to produce fine airborne dust when worked on or abraded. It should of course be understood that asbestos materials are perfectly safe when the fibres are locked into their parent product. It is only when the material is cut or drilled or when dust from a previous operation is disturbed that a hazard exists.

The Asbestos Products Working Party agreed at the outset to apply the most stringent standards – those relating to blue asbestos – throughout the Post Office, so that there should be little need to identify any particular asbestos. Every known use of asbestos in the organisation was investigated and eventually 69 items were found and listed.

Among items with a high asbestos content was a cable jointer's insulation blanket which has now been replaced by a woollen product. Another item which was found to contain asbestos was a widely-used filling compound used to plug walls.

Where practical, the asbestos was replaced by a non-asbestos material, or eliminated altogether where it was found to be redundant. In some cases, however, the continued use of asbestos proved unavoidable, so it was carefully enclosed and new safe working practices were devised and introduced.

Another important result of the Working Party was the introduction of special notices attached to building and insulation materials containing asbestos, warning against cutting or drilling without authority and without taking the proper precautions.

Special items of protective equipment were also investigated by the working party and as a result the best have been made available, in particular two types of respirator. The Respirator 1A has been issued widely and is intended for use when carrying out limited drilling and sawing operations in suspect materials, such as on partitions in customers' premises.

The Respirator 2A, is used for 'short term' removal work and is certificated as being safe in unlimited concentrations of asbestos dust. Special clothing and vacuum cleaners with high filtration standards are also available and, as might be expected, comprehensive sets of working instructions were prepared giving all information necessary about the equipment and safe working practices.

On a more general level, it may be useful to mention the Voluntary Labelling Scheme for consumer goods. The scheme was introduced in 1976 by the Department of Prices and Consumer Protection and applied to all UK-manufactured goods which contained asbestos and could conceivably release asbestos dust. Among items included were oven gloves, oven door replacement seals, ironing board replacement rests, simmering pads, wall-plugging compounds, brake linings, insulation boards and cement sheets.

Importers have been encouraged to join the scheme and by now a good percentage of goods should be labelled. It will be evident that many of these goods are unlikely to release fibres in normal use but it is helpful to know that asbestos is present in goods, particularly for those interested in 'do-it-yourself' activities. But of course the most crucial factor is that people should heed all the warnings, otherwise all the effort will have been wasted.

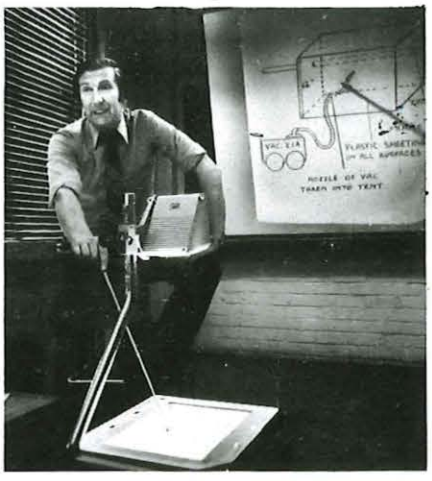
Because it is the dust which can be dangerous, asbestos cement sheets, for example, should be worked on in the open air, and be damped down before beginning sawing or drilling operations. The same principle applies when cleaning out brake drums. The dust should not be shifted with a dry brush, but removed with a damp cloth which should then be placed in a plastic bag, sealed and put in the dustbin. If a respirator is available on personal issue it should be worn when carrying out such jobs at home.

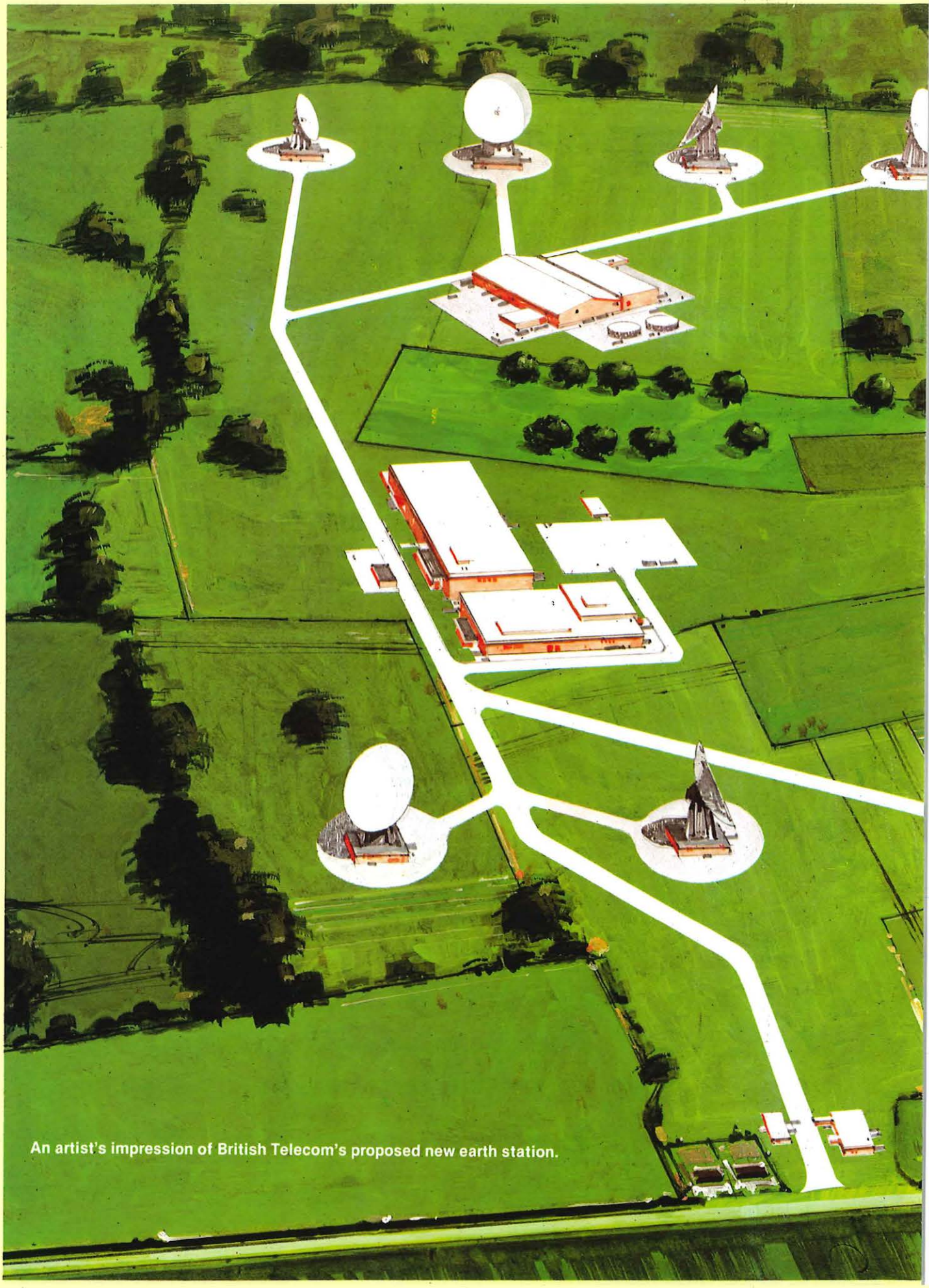
Through its Working Party and its general instructions, British Telecom has played a full part in alerting its staff to dangers where they exist and eliminating any unnecessary asbestos hazards. With the help of its staff, British Telecom will have proved its resolve in aiming for a cleaner and safer working environment for all.

Mr R. D. Edwards is a head of group in junction planning and operational planning division of Network Executive's Transmission Department. He was formerly a member of the Asbestos Products Working Party.

British Telecom Journal, Summer 1981

Lecturer/AEE Graham Bell uses visual aids to demonstrate the correct way to prepare an area for asbestos recovery.





An artist's impression of British Telecom's proposed new earth station.

Building for the future

An 87-acre site at Stert near Devizes in Wiltshire has been bought by British Telecom International who hope to build a third satellite communications earth station on it. If planning consent is obtained, it is aimed to have the first dish aerial operating by early 1986 and four aerials on site by the end of the decade.

The new station is necessary because of the limited capacity at Goonhilly and Madley for coping with the proliferation of new satellites in the Intelsat system which carries telephone, data, telex and television links internationally.

As the number of satellites increases and as they become more complicated, more than one dish aerial will be required to work to each one. Imminent developments at present include a second Intelsat satellite in geo-stationary orbit above the Indian Ocean and a possible fourth over the Atlantic.

And then there is Inmarsat, the international maritime satellite communications system which the new station may also serve. This is expected to grow rapidly in the next few years becoming operational early in 1982.

British Telecom has already given assurances that the new station will not spoil the area in which it is to be built. The aerials will be sited so that they blend with the well wooded landscape and the largest will be no more than 120 ft high. They will be painted in the colours thought to be most suitable.

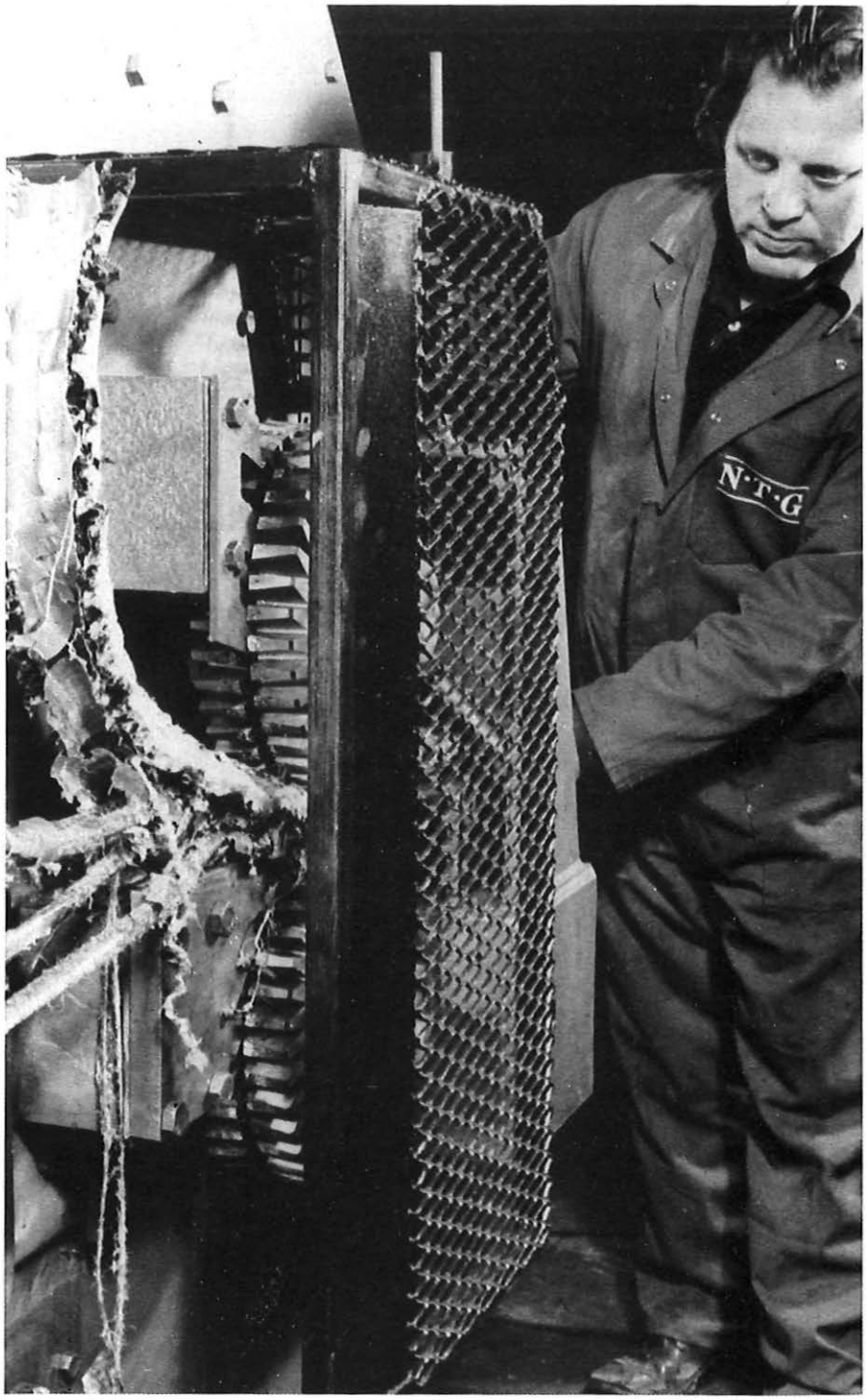
Any unused parts of the site – bought for £180,000 at public auction – will be fenced off from the station buildings and rented back to local farmers. Local inhabitants have been assured that there will be no noise, smell, pollution, television interference or other hazards when the station becomes operational.

The first Post Office earth station at Goonhilly Downs in Cornwall was opened in 1962 and Madley in 1978.

British Telecom Journal, Summer 1981

A gain for plastic!

M P Moorjani



A Rotary Shear cable stripping machine. This is one of the types of machine British Telecom is proposing to buy.

With more than 8,000 tonnes of plastic covered scrap cable and 320 tonnes of telephone cases and handsets returned to Supplies Depots around the country every year, the economics of reclaiming the plastic materials used in these products is constantly under review within British Telecom.

Although recycling is a well-established art that dates back to the earliest use of metals, its application to plastic is governed by a number of technical restraints and other factors such as safety, conservation, fuel shortages, the availability of raw material and so on.

Polyethylene (PE) and polyvinyl-chloride (PVC) are the most commonly used major plastics throughout the world, and both are widespread throughout British Telecom where they are used to sheath and insulate cables. Their characteristics include flexibility, strength combined with lightness, a high resistance to corrosion and yet they retain good electrical insulation properties.

Although PVC is more expensive than PE, it is flame retardant, making it a better insulant for all cables installed in telephone exchanges, factories and customers' premises. On the other hand, polyethylene is used to sheath most external cables and foam polyethylene is used to cover the conductor wires. Local distribution cables, generally up to 100 pairs, are filled with petroleum jelly to keep out moisture whereas other cables have a built-in aluminium moisture barrier and are air-pressurised to prevent water from entering the cable.

Scrap cable in British Telecom is sorted according to type, and of the 8,200 tonnes of the plastic-covered variety received each year for sale at the various depots, plastic waste content amounts to 2,870 tonnes. Apart from the copper and aluminium in the conductors, cable may contain other metals such as steel wire which is used for reinforcing, and of course, the aluminium in the moisture barriers. As there is no fixed sale price, the cable is sold to the highest bidder, with copper conductor cable attracting higher prices than the aluminium type.

If cable core and sheath can be sold separately, the selling price can reach 10 per cent more than for the whole cable with sheathing. Another factor is the variation in the market price for metals which can vary greatly from day to day. Cable diameter also affects the price, and although a pallet may contain cables of different diameters, a potential buyer must bear in mind that smaller cables have a smaller proportion of metal than larger cables.

The overall diameter of the cable determines the amount of plastic it contains. In the case of external cables, the average proportion of polyethylene – the sheath and insulation – averages around 35 per cent by weight. Sheathing weight alone is about 25 per cent of the

Plastic covered scrap cable is stacked at Crayford Supplies Depot in Kent before being sold to the highest bidder.

Every day, stocks of telephone cases unsuitable for renovation are collected by a contractor from British Telecom's Cwmcarn factory in Wales and taken away for regranulation. About 300 tonnes a year are taken.

A wide range of plastic instrument mouldings are renovated at Cwmcarn. Here assistant factory technician Mrs Sylvia Cross begins polishing a binful of handsets – just a few of the tens of thousands of items handled at Cwmcarn each week.

total. Polyethylene sheathed cable represents 58 per cent of all plastic covered scrap cable, and PVC sheathing another 31 per cent. The remaining 11 per cent is made up of other types such as vulcanised india rubber.

British Telecom buys its cables from different manufacturers, and although each works to laid down specifications, different companies add their own 'special ingredients' to the plastic insulation and sheathing. These vary not only from company to company, but also from year to year as manufacturers develop their own plastic mixtures. When a cable is returned to stores therefore, it is sometimes impossible to determine its make-up – a vital necessity for certain types of recycling. Additives known as 'antioxidant stabilizers' are often used to prevent the plastic from deteriorating. In most external cables, carbon black – of which there is about two per cent in polyethylene – is also added to provide an ultra-violet screen.

Because of the different types of cable and plastic used, degradation occurs in a number of ways. During manufacture, cable sheathing used on local distribution cables absorbs about one per cent of the petroleum jelly used as a moisture barrier – rather like jam on bread – and during years of use, this absorption may increase to about 10 per cent, making it more difficult to recycle. Where cables are air-pressurised this problem does not occur.

The plastics industry generally has spent a great deal of time and effort looking at recycling and have identified two types of waste – clean process waste and contaminated products. Most waste material from British Telecom comes into the second category. Although clean process waste may be reused using a simple regranulation process, recycling contaminated products is currently complicated and uneconomical where virgin material is required. But there are many applications for lower quality recycled plastics within British Telecom, such as moulded joint boxes, block terminals, cable drums and cable reels – items where specifications should not preclude the use of recycled materials.

At the present time, a more recent recommendation from a study set up by Supplies Division (now reorganised as part of Materials Department) on ways of processing is being considered by British Telecom. This is to buy cable stripping machinery, and implementation is now being negotiated between management and unions. The cable strippers can remove all types of insulation from the cable, enabling British Telecom to sell at the higher price. Granulation was considered, but given the high initial capital outlay, would only provide a net increase in revenue equal to cable stripping.

Of one million telephone cases and handsets returned as scrap to Factories Division each year, only about a fifth – 200,000 – are suitable to be returned to the field after minor work. A scheme to repaint some of the remaining 800,000 items is currently being discussed, and following full negotiations between management and staff associations, it is hoped to introduce a marketing trial.

If this proves unsuccessful then about 200,000 cases and handsets are suitable for recycling. Made of acrylonitrile butadiene styrene – ABS for short – the cases and handsets can be regranulated and plastic separated from the contaminating material. The regranulated plastic could then be remoulded into items such as block terminals and joint boxes.

Five years ago, a study recommended that cable drums made from recycled plastic should be purchased for a trial period. The recommendation was not implemented, however, because of opposition from cable manufacturers, who own most of the drums and so the concept of using plastic cable drums was then dropped.

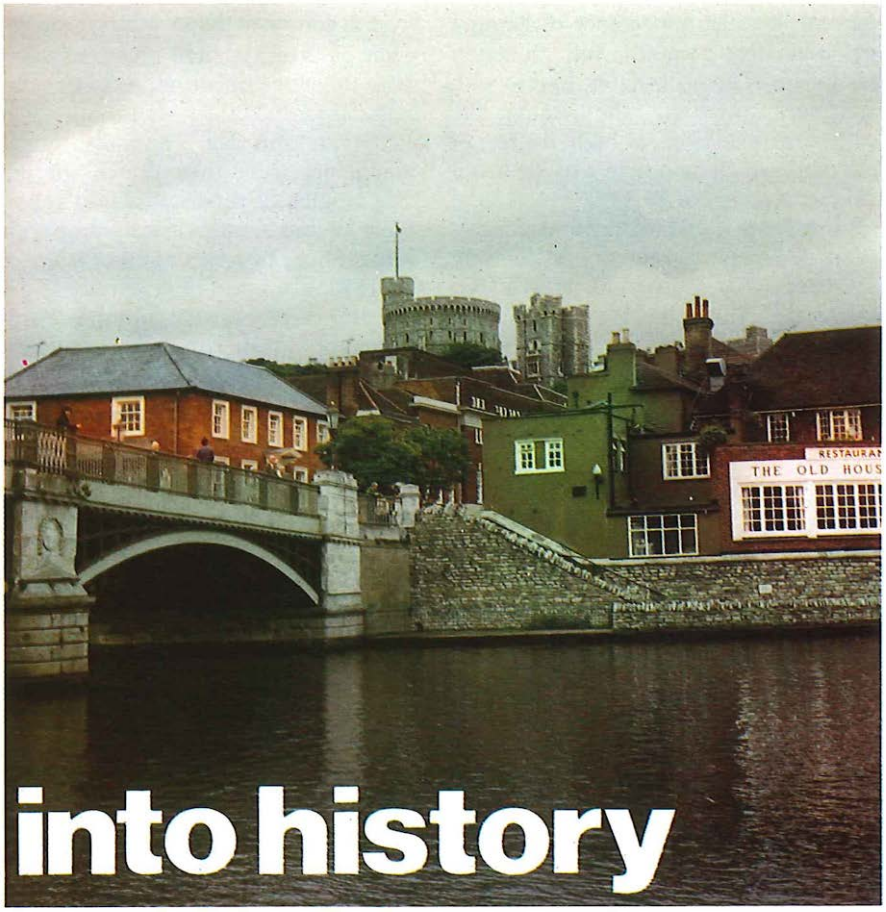
Wherever economically possible, British Telecom will continue to recover, recycle and re-use plastic waste not only in its own interest but in that of the nation. As well as saving valuable resources, British Telecom is playing its part in protecting the environment.

Mr M. P. Moorjani is an executive engineer, formerly in the value engineering division but now in junction planning and operational planning division of Network Executive's Transmission Department. He was responsible for identifying high cost areas in production and maintenance of external plant.

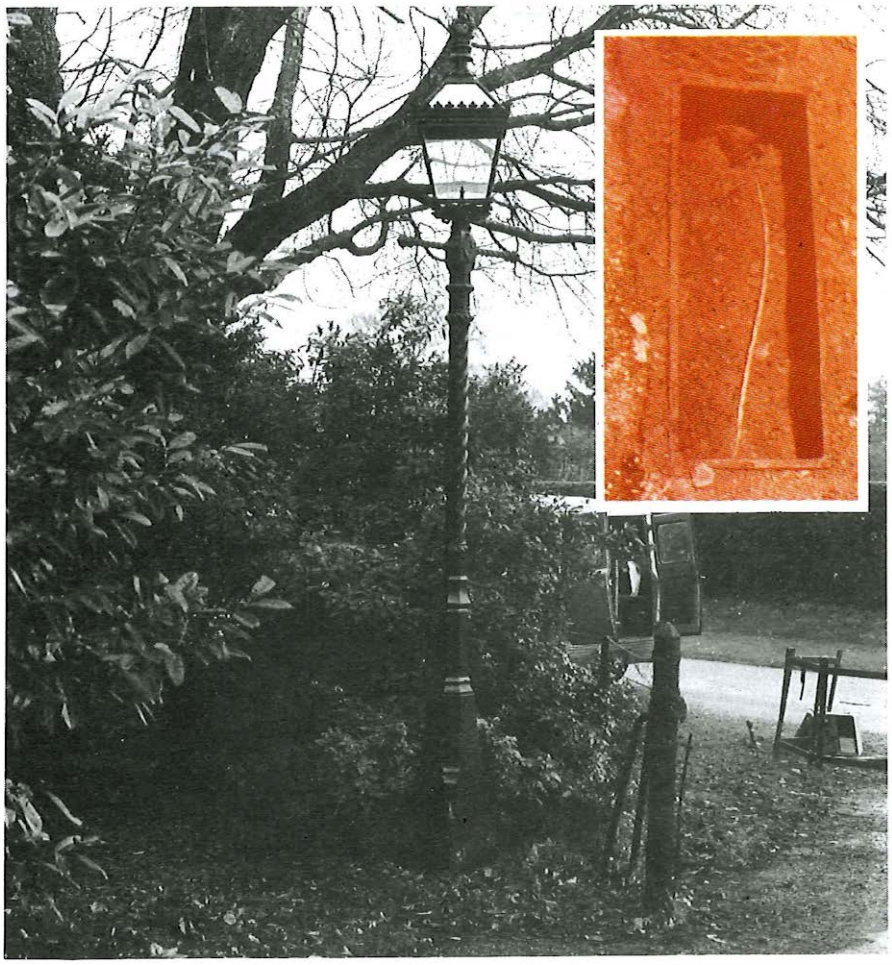
British Telecom Journal, Summer 1981

The recent discovery of a telephone cable – unused since 1900 – in the grounds of Windsor Castle has revealed much about the royal town's telecommunications heritage. This article is based on an award-winning entry by **J C Duncan,** a technical officer from Reading Telephone Area, in the 1981 Institution of Post Office Electrical Engineers Essay Competition.

Digging into history



The spot where the old cable marker was found. Inset: the cable as it was uncovered at the bottom of its chamber.



It was during underground cable survey work in the grounds of Windsor Castle, that British Telecom engineers unexpectedly came across an old cable marker. Partially obscured by bushes, it was found in the border of a lawn near the Royal apartments which Queen Victoria had once occupied. As the presence of a conduit or a cable was not indicated on the underground plant diagram for this particular area, the engineers began to excavate. At a depth of 600 mm, they uncovered a flat diamond-patterned iron plate, with raised lettering which, when cleaned, became legible as 'Post Office Telegraphs'.

Further digging around the edges of the plate revealed that it formed an integral part of a buried iron box. When the cover was removed, a cable insulated with gutta-percha was found lying at the bottom of the chamber. The cable had no external protective sheathing, and consisted of four wires, each separately covered with a coating of gutta-percha, a resin derived from the bark of certain trees found in Malaysia and the Pacific Islands.

The conductors had been twisted into a gentle helix along the cable's length to keep them tightly together and in close formation. Surprisingly, the gutta-

percha gave the appearance of being a material that would still function satisfactorily as an insulator. Indeed with continual bending, the leather-like substance exhibited a high degree of elasticity which held firmly to the metal conductors.

Routed in a 50 mm diameter iron pipe, the cable passed through the jointing chamber in a continuous length. To locate the cable's destination, an electrical device was used to induce an electric field into the four-wire cable and the induced current was then intercepted by a receiving instrument. One end of the cable was traced to a brick-built chamber in a drive some 70 metres away, and the other end to Frogmore House, a former residence of Queen Victoria's married children.

The box was opened and four wires, the remnants of the gutta-percha cable, were found protruding from a hole in the wall adjacent to a buried polyethylene cable. Within the dank atmosphere of the brick jointing-box, the gutta-percha insulation had crazed, and much of it had parted from the wires. But although a thick film of green copper carbonate had formed on the bare conductors, the gutta-percha in the cavity of the brick wall was still well preserved.

The engineers attempted to withdraw the cable from the iron pipe, but it was held fast because silt had filled the bore. But part of the cable was snipped off and despatched to the metallurgical department of wire manufacturers Thomas Bolton and Sons of Stoke on Trent. The company carried out an extensive spectrographic analysis to determine the percentage composition of the metals, and discovered that the wire had almost certainly been produced by them many years ago.

Although the gutta-percha provided effective insulation, the problem of providing outer protective sheathing on cables still remained. With the early cables, the gutta-percha coated conductors would be passed to a wire-rope maker to be lapped with hemp strings, coated with tar, and wound helically with zinc-dipped iron wires.

Several methods of sheathing the insulation with a metallic covering were tried. On single-conductor telegraph cables, the problem was easily solved by using hydraulically-pressed lead sheathing, but on multi-core cables, the task proved more difficult to resolve. Attempts were made to produce a lead-sheathed multi-wire cable, but were not successful. But in December 1869, William Alfred Marshall, a telecommunications engineer from Middlesex, filed a patent that introduced a fresh approach to the sheathing problem.

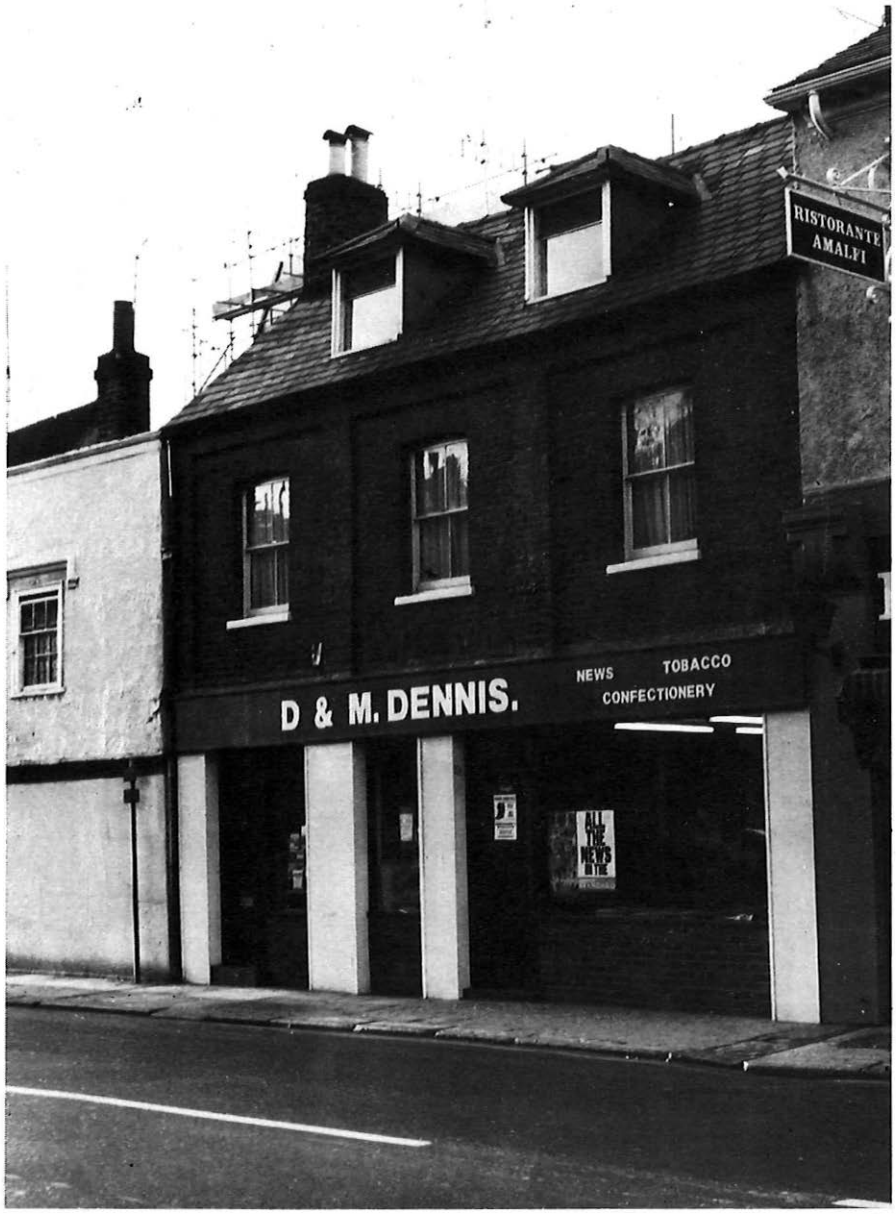
The basis of Marshall's method was to wrap the wires in cotton, or some other material, and to steep them in a vat of molten paraffin wax. The wax-saturated conductors were then drawn through long lengths of pre-formed lead tubing while air was simultaneously drawn out of the tubing by a vacuum process.

In 1870, a length of this cable was laid in Windsor Great Park for the Postal Telegraph Authorities to provide a telegraph link between Windsor Castle and Cumberland Lodge, a distance of nearly three miles. Unhappily for Marshall, the cable failed after a few months of service.

Following the discovery of the old cable by the engineers, another chance find was to provide further clues. In November last year, some minor roofing repairs were being carried out at a newsagents shop near Windsor Castle. Until 1912, the building had belonged to the National Telephone Company (NTC) and was in fact the original telephone exchange at Windsor. The owners, aware of the building's former importance, had taken a keen interest in its history. This proved fortunate, for when the builders removed a section of the roof that had been sealed off, they found scattered among the rafters remnants of NTC documents covering the period 1894 to 1907.

The NTC documents included letters, telephone accounts, workmen's time-sheets and stores requisition books. Their condition varied. Some were perfectly preserved, but others had completely disintegrated. The reports of the former managers of the Windsor

The newsagents in Windsor which housed the town's original exchange and where National Telephone Company documents covering the period 1894 to 1907 were recently found.



telephone district and the antiquated letter-books containing correspondence that had taken place between the NTC's Windsor office and its administration centre at Reading proved to be a particularly rich source of information. By supplementing these documents with information drawn from Windsor Castle's archive, it became possible to trace the telecommunications history of both Windsor and the Crown, and consequently, the reason for the installation of the gutta-percha cable.

Cooke and Wheatstone invented their electric telegraph in 1837. By 1842, 17 miles of telegraph route had been constructed along the railway line between Paddington and Slough; yet seven more years passed before the wires were extended to Windsor. Vehement opposition to the railways by the Crown and by Eton College was the reason for the delay. Eventually, in 1849, the railway, and with it the electric telegraph line, reached Windsor.

But, for the Electric Telegraph Company, who had nurtured the idea of a royal appointment to supply a telegraph line to the Castle, it was a bitter disappointment, because the Crown continued to use the public telegraph office for the next five years. However, with the coming of the Crimean war in 1854, the Crown changed its mind. Telegraph messages, lengthy military despatches and news of the war flooded the public telegraph rooms at Windsor and hindered other state business. Faced with long delays in the office, Queen Victoria ordered her own telegraph instrument, which was duly installed in November 1854.

No further record of telecommunications activity in Windsor Castle is to be found until the telephone made its appearance in 1878. It had been introduced in Britain a year earlier, when W H Preece brought over the first pair of telephones from America. At Osborne House, Isle of Wight, on 14 January 1878, less than two years after he had patented the telephone, A G Bell demonstrated the use of the telephone to Queen Victoria. The Queen, writing in her journal, noted that "it is rather faint and one must hold the tube close to one's ear".

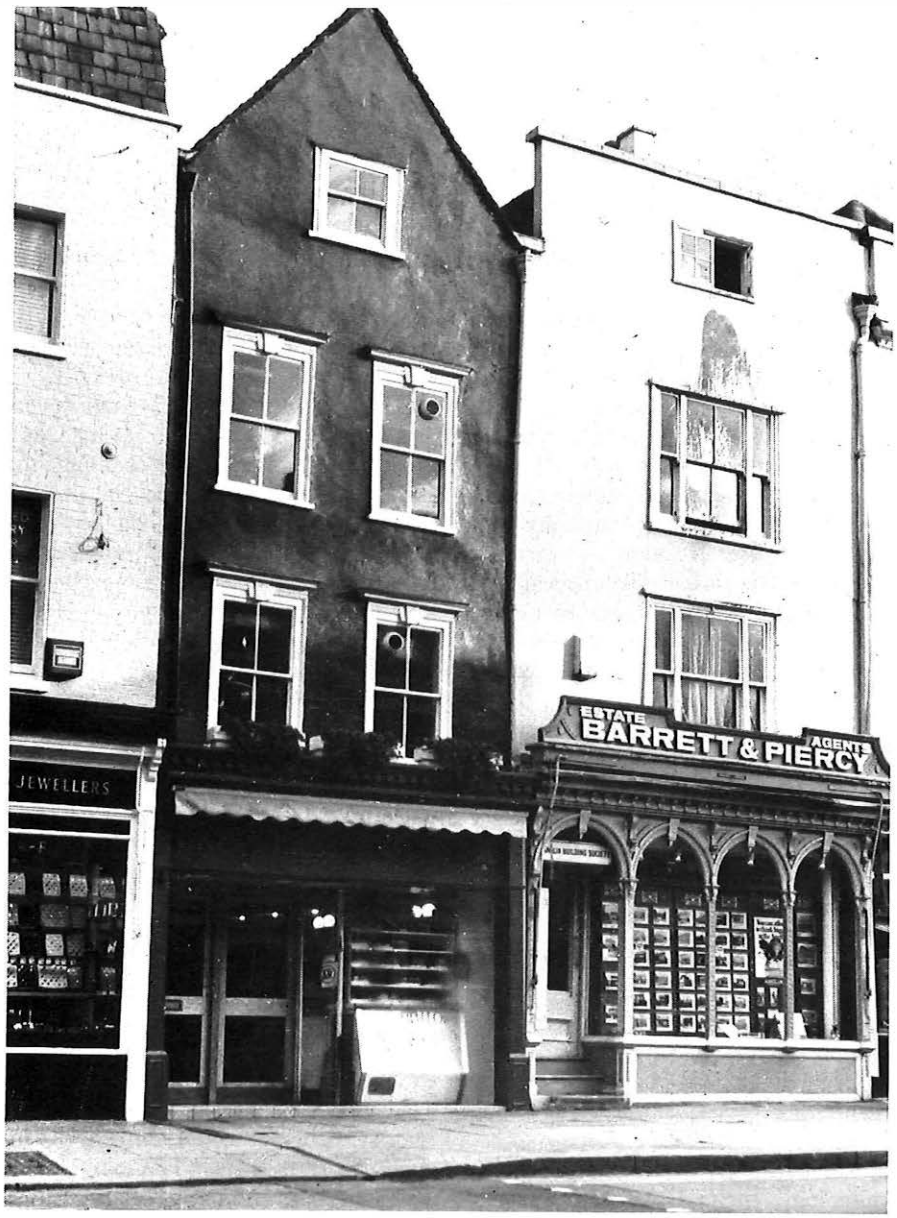
After the demonstration, the Keeper of the Privy Purse, Sir Thomas Biddulph, wrote to Bell to tell him that the Queen would like to buy the two instruments used in the demonstration at Osborne House. In reply, Bell offered to "make a set of telephones expressly for Her Majesty's use". Presumably this was done, for there was no further correspondence with Bell, and certainly no indication that he was responsible for the installation of telephones at Windsor. The Lord Chamberlain's report of expenditure for 1878 does however list 'a telephone for Windsor Castle', and, in the following year, further spending for the installation of telephones is recorded.

In 1882, three telephones were hired from the United Telephone Company (UTC), but were subsequently removed because the rental charged for them was considered to be too expensive. But before this was done, six telephones were purchased in December 1883 from Taskers, a firm based in Sheffield.

The Queen had expressed a desire to have a telephone link between the Castle and Frogmore House, the occasional residence of her married children. This meant that, when the Court was not in residence at the Castle, the Queen could be contacted by telephone while she was visiting her children. So in December 1883, the superintending engineer of the General Post Office issued instructions for the laying of a 50 mm diameter iron pipe and four-wire gutta-percha cable from Frogmore House to the Castle, a distance of 1138 metres. In March 1900, the line was abandoned when the NTC laid a new seven-pair cable in a 76 mm diameter iron pipe to Frogmore House.

This small part of telecommunications history had helped to pave the way for many more royal connections and indeed, in this year of the marriage of the future King, telecommunications links will again be channelling thousands of messages for and on behalf of the Royal Family.

This hairdressing salon sandwiched between a jewellers and an estate agent in Windsor High St, was once used as a public telegraph office and handled transmission and reception of Court messages between 1850 and 1854.



Boost for business in London

A revolutionary new telecommunications network costing £17 million over the next three years is to be provided by British Telecom for London's business community. The aim is to beat delays in provision and to provide, by 1983, a first-class service for the capital ensuring that it becomes an internationally-recognised centre for telecommunications excellence.

The new network will 'overlay' existing London services and will radiate from Baynard House, where last year, the first System X electronic exchange was brought into service. By September, the first phase of circuits will have penetrated the heart of the capital's commercial centre – the City and Holborn areas. And by the same time next year, service will have been provided throughout central London.

Designed to meet demand for new services such as video conferencing, high-speed data links, facsimile and electronic mail, the network will use conventional cable as well as rooftop laser and microwave radio beams. A major feature is immediate provision of service for customers prepared to pay for these premium facilities.

British Telecom will be able to offer some of these services years ahead of their availability elsewhere in the world and it recognises that the United Kingdom's economic recovery will be aided by the immediate provision of fast, modern and efficient telecommunications services.

Although most of the new network will be carried by cable beneath the streets of London, rooftop microwave links will be used to provide service quickly on routes where underground circuits are not available. Laser systems – carrying speech or data on pencil-thin beams of light operating in the infra-red part of the spectrum just below the visible light range – are soon to be evaluated by British Telecom engineers.

The network will use digital transmission techniques, in which different forms of information – speech, text, data and pictures – are all sent in the form of light or electrical pulses, instead of traditional wave form. Advantages include:

- Much higher transmission speeds to match advanced terminal equipment.
- Many different services capable of being sent on the same carrier without interfering with each other, so reducing equipment costs.
- No reduction in speech or picture quality as a result of amplification along the route.
- Compatibility with advanced technology, such as optical fibre laser beams, or microprocessor-controlled telephone exchanges.

Facilities to be provided by the network will include high-quality private circuits to support all the premium services at present envisaged, such as high-speed data and facsimile, communicating word processors, and two-way conferencing with video as well as speech. Private circuits will be provided on demand, with, if required, exclusive transatlantic connections, not just to specialised satellite services available in North America, but to the small-dish aerial users of such services.

Another advantage of the new network will be immediate access to small-dish satellite service aerials working to European satellites scheduled to come on stream in late 1983, providing rapid and flexible communication between Britain and mainland Europe. And customers will be able to achieve even faster access to the digital data service, due to be provided over private circuits within Britain from 1983, and then to the integrated services switched digital network, starting in 1985, based on System X exchanges.

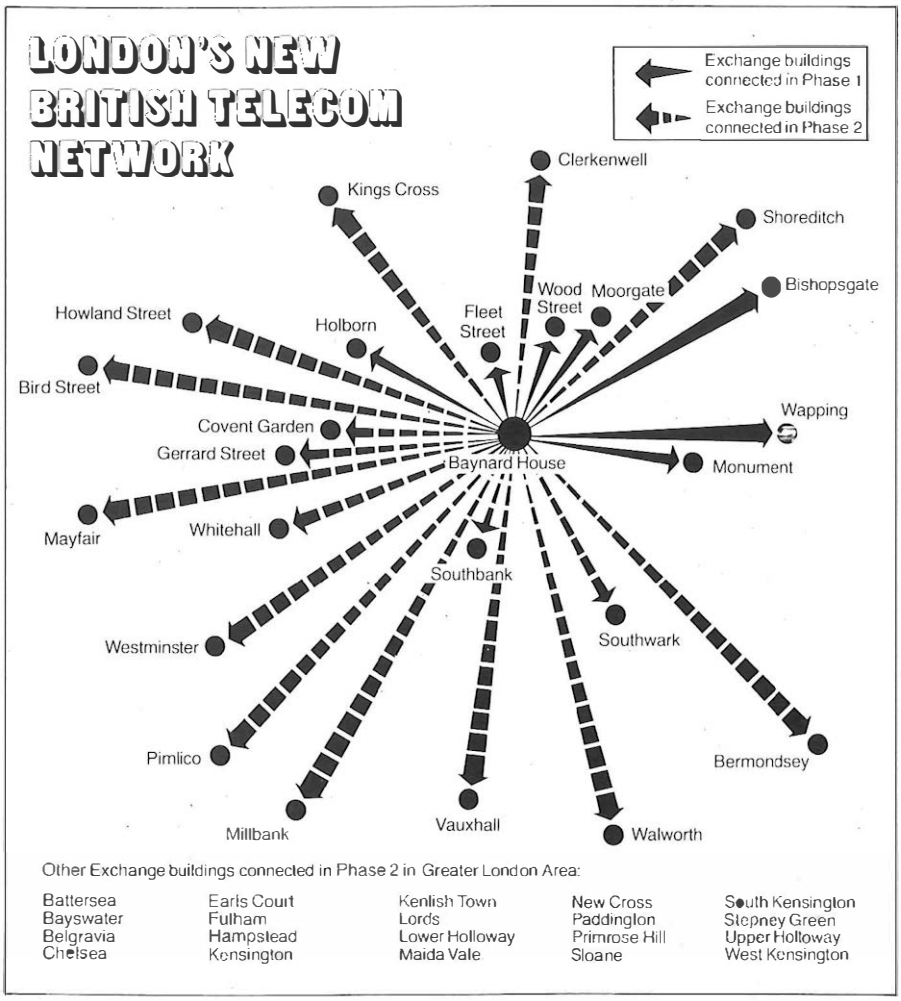
Because customers connected to the overlay network would form a clearly defined group, British Telecom is to set up a joint policy committee with them to

see what other services could be provided, and how similar networks could be introduced for other cities, and then interconnected. This joint committee would confirm that Telecom's initial plans were on the right lines, monitor progress, advise on detailed service requirements, and formulate policy.

As well as the overlay network, British Telecom will be installing a further London-based network as part of the three-year programme aimed at speeding the provision of private circuits generally. This 'star-shaped' network – based almost entirely on cables – will be set up between telephone exchange buildings in central London. By eliminating many of the problems of linking private circuits through several exchanges, it will allow their general provision in about two weeks.

This network will serve two main purposes. First, it will enable British Telecom to supply private circuits rapidly between customers on the overlay network and other users, and secondly, will provide extra capacity between exchanges, dramatically improving British Telecom's ability to provide conventional private circuits for customers not on the overlay system.

British Telecom Journal, Summer 1981



Capital success story

London's telecommunications services account for much of British Telecom activity. The capital now has six million telephones, 77,000 private circuits, 23,000 telex machines and 11,000 phone boxes. In 1980/81, this huge capital asset – valued at £4,859 million – generated £1,052 million in revenue, nearly a third of British Telecom's total income. London Telecommunications Region employs 55,000 to run and maintain its systems and equipment, serving 3.4 million customers.

Within the last nine months, LTR has introduced measures to improve services. To overcome problems caused by shortages of exchange equipment and underground plant, a crash programme of exchange extensions – using equipment brought in from other areas – and a rescheduling of the cable installation programme, has brought down the waiting list to 30,000 from a total last September of 49,000.

Even more dramatic has been the improvement in providing telex service with delivery times now down to eight months, compared with 18 last September. And by next September, delivery times will drop still further, to just three months from the date of order. To speed private circuit provision, a special project group has been set up to co-ordinate and oversee activities, which has resulted in a halving of provision times to between seven and nine months.

The reliability of the basic telephone network has continued to improve as a result of quicker fault location and repair. So now out of every 100 attempts to dial local calls in London, only two fail because of congestion or faulty equipment, while the comparable figure for STD calls is three. In part, the improvement stems from the introduction of new 'measurement and analysis centres' where computer-controlled equipment sets up test calls to check the network throughout the night.

There has also been a marked improvement in the efficiency of the fault repair service with 70 per cent of all faults now being remedied by the end of the next working day, compared with 52 per cent a year ago.

Buried treasure

D L Lisney

Beneath the streets of all major cities lie a tangled web of cables, ducts, pipes and sewers which provide all the vital services. British Telecom is currently looking at new methods of locating both its own and other utilities' underground plant.

Although it is not quite true to say that city streets are paved with gold, it is a fact that under the pavements lie vast assets on which the life of the community depends.

Because much of this 'buried treasure' dates back many years and has developed in the main on an *ad hoc* basis, it is not surprising that much of its existence may be uncertain and its position unknown.

But public utilities need to know the whereabouts of these services to economically repair, extend or modify them, to avoid damage to other services, to reduce the possibilities of injuries to

Technical officer Brian Edwards uses the Locator 1E to pinpoint a buried service cable. Coupled as a metal detector, this equipment provides a visual indication by means of a meter at the front.

One of the applications of the Locator mains cable close to British Telecom headphones to detect the 50Hz tone

their staff, and to properly plan and carry out new work.

Some of these objectives can be helped by establishing co-operation between each of the utilities, and to this end, an organisation known as the National Joint Utilities Group – NJUG – exists to provide that opportunity. (See *British Telecom Journal,* Winter 1980/81.) One result of this co-operation is the Susiephone scheme, a one-call system which allows contractors seeking information about the location of underground plant to make just one Freefone call 48 hours before work is due to start. The contractor is then told just which utilities have plant in the area. Even so, as there are always likely to be problems with records and plans, such schemes will need the support of locating equipment used at the work site.

Perhaps the two most commonly-used locators are local knowledge and the spade. Although a crude instrument, the spade can locate by physically striking against the service. Used with care, common sense and not too much force, it can be reasonably reliable, not cause too much damage, nor injure too many people. But if the service being struck does not have the best protection, or if destructive tools like picks or forks are used, the results of striking the wrong service can be deadly.

Clearly, most of the danger comes from electricity power cables which, perhaps surprisingly, do not usually electrocute, but cause severe burns as a result of flying molten metal from the cable and tools. So, therefore, a major priority for users of more sophisticated locating equipment is the detection of these electricity power cables. A broken gas main is perhaps less spectacular, but can give rise to explosions some time after the damage. By comparison, a damaged telecommunications cable is not so exciting, but their complicated contents often make for expensive and lengthy repair work.

British Telecom has for some years, used a device to detect and locate its own cables. Known as a Locator 2, it consists of a 1 kHz oscillator connected to one end of the cable sheath and earth, and a search coil connected to a small transistor amplifier and headphones. As the detector passes over the cable, the coil picks up the magnetic field radiated by the 1 kHz current flowing in the cable. In one position, the signal becomes louder as the coil passes over the line of the cable. If the coil is then turned through 90 degrees, a sharp reduction in the signal will occur when the coil is directly above the cable. The first position detects the presence of the cable while the second enables the position of the cable to be located with great accuracy. A simple extension of this second technique allows the depth of the cable to be measured and the same equipment can be used for detecting and locating most electric power cables using 50 Hz current.

Here, the oscillator is not necessary and indeed cannot be connected safely to a power cable. Like the 1 kHz tone, the 50 Hz, and its harmonies – in the form of a hum – can be heard in the headphones. This equipment is today accepted as the standard for detecting and locating electric power cables. Although a very effective safety aid, it is not infallible and will not detect some power cables. Similar equipment is also commercially available and is now being used increasingly by all those who need to dig below the streets.

A more elaborate locator which uses the same principles consists of an oscillator which can either be connected

2A is to look for buried electric plant. Here Brian Edwards uses from the cable

New equipment like this discriminatory borer is constantly being evaluated. It can penetrate the soil and reach duct or cable without damaging the service.

directly to the cable or coupled to it by a coil or cable from above ground. Called the Locator 1, it operates at a low radio frequency and can detect and locate any service having a longitudinal metal component. Both the transmitter and receiver unit can be mechanically coupled to form a metal detector capable of finding a cable in the middle of an open field or a lost buried manhole cover.

An extension of this facility is the ability to return to a previously 'marked' buried spot. The receiver can trace a small transmitter unit pushed through a sewer or duct to locate the above-ground position of a blockage. Again, the receiver unit also has a 'hum' detector so that electric mains cables can be positively identified. But even this device cannot detect and locate all services – particularly those very close together or underneath other services. Indeed, no locator currently in service can detect and locate all-plastic pipes like water and gas unless marked by a metal foil tape or longitudinal wire.

One alternative now being considered by British Telecom Research Laboratories at Martlesham is the use of non-destructive tools – one such device – known as a discriminatory borer – has already been developed. Looking like a pneumatic drill, the tool penetrates the soil through vibration which although strong enough to pass speedily through soil, comes to a halt as soon as it reaches a cable or duct. Although not strictly speaking a locator, it can reach down and touch pipes and cables without harming them. In particular, it is useful in confirming the findings of other location work. Perhaps the most interesting use of this tool to date has been the examination of the buried portions of the abutments of the Clifton Suspension Bridge at Bristol to establish the extent and presence of buried vaults. The tool saved time and money by avoiding long and tedious excavation work.

For the future, Research Department is looking at the use of radar locators. These are rather like the systems used in Vietnam to detect mines, and elsewhere to detect corpses. But with technical hurdles still to be overcome, it is likely to be some time before any viable field equipment becomes available.

Mr D. L. Lisney is a head of group in the external plant development division of Network Executive's Transmission Department, with responsibility for the development of external plant test equipment.

British Telecom Journal, Summer 1981

Calls without cash

A further step towards the cashless society has been taken this summer with British Telecom trying out 200 payphones which accept plastic cards rather than coins. The trial has been centred on airports, railway stations and busy central sites in London, Birmingham, Manchester and Glasgow.

Cash cards mean that customers do not have to worry about having the right coins to make a telephone call. Cards containing either 40 or 200 units can be bought for £2 or £10 from telephone shops, post offices or newsagents.

The lack of cash makes the phones less attractive to thieves and vandals and also removes the need for British Telecom to organise regular collections. Jammed coinboxes will also be a thing of the past.

Cardphones can be used to contact all overseas countries which can be dialled direct from the UK. Because it is microprocessor-controlled, the cardphone can be programmed to enable calls to certain numbers – 999 for instance – to be made without a card.

A display on the equipment tells how much credit is left on the card and as a call progresses the units – holograms printed on the card – are thermally erased. Secret codes laid on the cards during manufacture provide a high level of security against forgery.

British Telecom Journal, Summer 1981

The new cardphone.

Training tomorrow's technicians

A Rain

A particular and specialised activity within British Telecom is the continuous search for suitable apprentices for the Research Laboratories at Martlesham Heath.

Coral Woodard, a second year TTA, uses a lathe to make a brass mounting for use in the investigation of the reliability of integrated circuit packages.

Third year TTA Richard Prodger uses an oscilloscope to check pulsed light output from a laser.

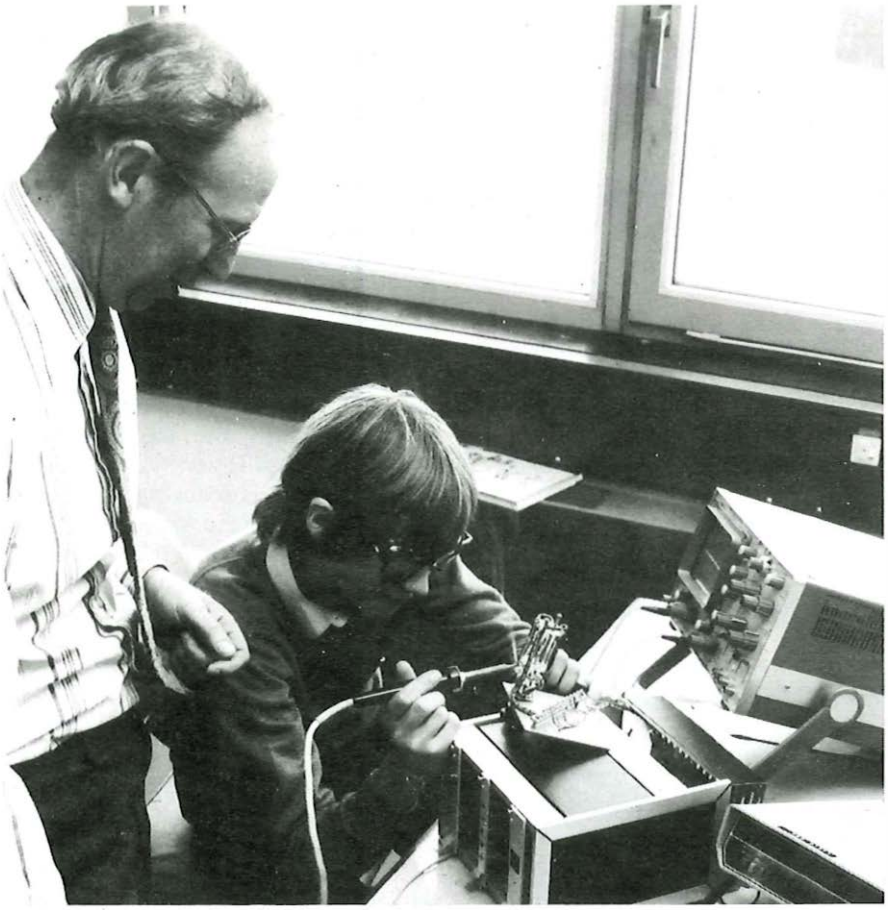
Since 1971, when the first group of TT(A)s was recruited locally at Martlesham, Telecom Research Laboratories have steadily built a good working relationship with the local schools and the Suffolk Careers Service. A prime example is the involvement in the local careers convention and visits by fourth and fifth form pupils from local schools to see first hand the work of BTRL.

Usually such a visit will include a short talk by a second year apprentice at the work place to show the type of work undertaken. On occasions, invitations are accepted to visit a school and talk about BTRL as part of the schools careers information service. Basically the recruiting procedures are the same as for the rest of British Telecom and there are more than enough suitable applicants satisfying the basic requirements of 4 GCE 'O' level (or CSE grade 1) passes in the required subjects.

Laboratory TT(A)s represent by far the largest group in a year's intake – the remaining few places are taken by TT(A)s in either the building services department or in the mechanical workshop – and attend college on block release to study electronics or telecommunications, depending upon their 'O' level results. As well as attending college in the first year, they are given a series of in-house courses similar to those which telephone area apprentices attend at Bletchley Regional Training Centre. They must also attend a six-week production appreciation course, not only as part of their Technician Education Council (TEC) studies, but also to give them formal workshop training so that they can use any of the divisional workshops at Martlesham Heath.

Towards the end of their first year, these TT(A)s begin formal laboratory training. In the second year, they experience two other areas of work and will attend a two-week drawing office course to ensure that they can present diagrams and mechanical drawings correctly. And to make sure that the Martlesham laboratory apprentices are not out of touch with the operation of telephone areas, they spend five weeks visiting Bletchley training centre and the Eastern Telecom Region.

In their third year, they attend college again, this time on day release. Two further periods of laboratory training are



Technical officer Harry Connolly instructs Stephen James, a first year TTA during a wiring course.

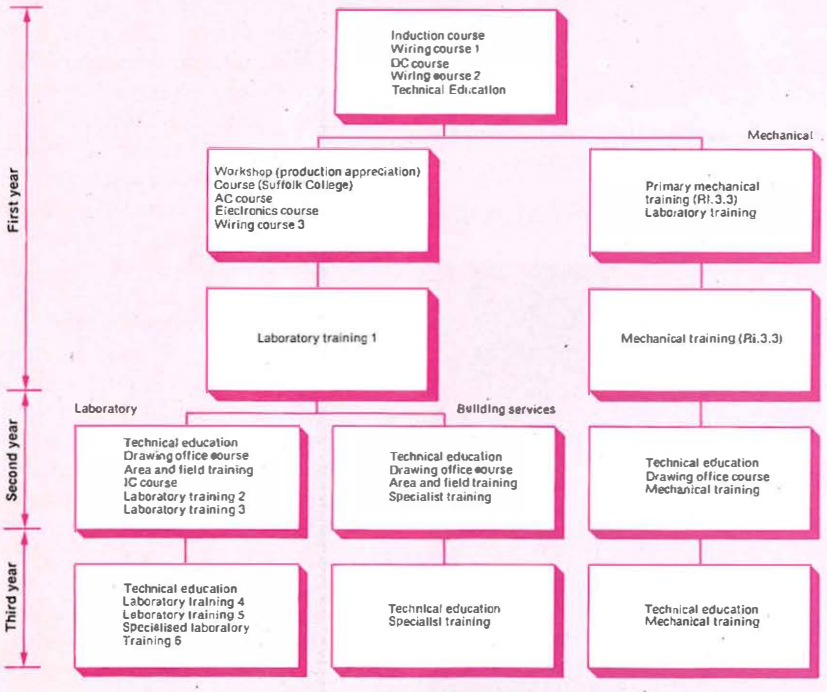
followed by their allocation to a final group where they spend six months before completing their apprenticeship. During their three years, they will have studied digital switching systems, transmission systems, customer apparatus and materials, and advanced technology, and in doing so will have gained a good insight to BTRL work.

Apprentices with a mechanical aptitude start with preliminary training, learning basic machining skills such as milling, drilling, turning and grinding and included as well, in their first year, is a short, basic electricity course plus six weeks in a laboratory to provide an understanding of the link between laboratory and workshop duties. The rest of the time is spent learning about various parts of the workshop complex where they will work with numerically-controlled machines, types of plastic moulding techniques and prototype sheet metal work. Individual projects are set at fixed times during the three years and the apprentices also attend the local further education college on day release to study for the mechanical TEC course.

The third and final group of entrants – the building services TT(A)s – attend initial courses on electrical theory. They then join Martlesham's Site Services Division where they spend three months with the groups responsible for maintenance and construction facilities. The work is varied and includes planning, estimating, planning and maintaining the heating and ventilation systems, lift maintenance, refrigeration plant, gas-fired installations and accommodation services. Here again, these apprentices attend the local college, and in this case take the TEC electrician's course.

At the end of three years, all the apprentices have a thorough understanding of BTRL's work and most are regraded as technicians 2A. With continued studies and satisfactory progress at work, most can expect early promotion to technical officer, supplying the business's research facility with trained minds second to none.

BTRL Apprentice Training Scheme



Mr A. Rain is an executive engineer in the Technology Executive's Personnel Unit at Martlesham. He has special responsibility for TT(A) training.

MEN AT THE TOP

Sir George Jefferson, Chairman of British Telecom, has announced the appointment of four new designate members of the British Telecom Board. It was the intention that when the British Telecommunications Bill received Royal Assent, the appointees would be invited by the Secretary of State for Industry to become Members of the Board of the new British Telecommunications Corporation.

The appointments are: Mr J M Harper, Managing Director (Inland); Mr J Hodgson, Managing Director (International); Mr J S Whyte, Engineer in Chief and Managing Director (Major Systems) and Mr I D T Vallance, Member for Organisation and Business Systems.

In addition, Mr Peter Benton, currently Managing Director, is to become Deputy Chairman. The existing executive members (designate) of the British Telecom Board are: Mr F D Perryman, Board Member for Finance and Mr M Bett, Board Member for Personnel and Industrial Relations who joined in March.

British Telecom's chairman SIR GEORGE JEFFERSON, joined last year.

He was with English Electric, where he became deputy chief engineer and director of English Electric Aviation. Sir George then joined the British Aircraft Corporation to become successively director, chief executive, chairman and managing director at BAC (Dynamics Group).

The responsibilities of MR PETER BENTON as managing director telecommunications have been developed to that of a full deputy chairman.

His specific tasks will include the running of British Telecom Enterprises in addition to his overall responsibility as the Corporation's number two executive.

Mr Benton was appointed BT's managing director in 1978.

MR JOHN HARPER, ten years ago, became the youngest-ever headquarters director in the then Post Office.

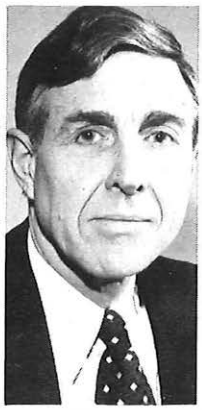
In 1958 Mr Harper, 51, was part of the team which planned the introduction of subscriber trunk dialling.

Seven years ago he was made a senior director; in 1978 assistant managing director for telecom; and in 1979, a deputy managing director.

Since 1969, MR JIM HODGSON, 55, has been responsible for all international and maritime services.

This was as director of ETE, then as senior director external telecommunications with a seat on the executive management committee of Post Office Telecommunications and then as senior director, International.

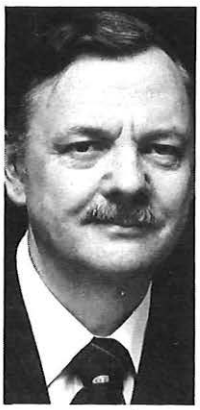
He has been a director of Cable and Wireless.



MR JOHN WHYTE'S new role will be to foster and develop engineering skills.

After a time as senior director, development, he was promoted in 1979 to deputy managing director (technology).

Mr Whyte, 58, is a council member of the Electrical Research Association and is deputy chairman of the National Electronics Council.



Co-ordinating strategic planning in the medium and long term will be part of 38-year-old MR IAIN VALLANCE'S new role.

In 1978 he was appointed director of telecom financial planning and in 1979 moved to the Procurement Executive, as director, materials department.

Mr Vallance is a trustee of the Post Office Staff Superannuation Fund.

Designate Board member for finance is MR DOUGLAS PERRYMAN, 51.

Mr Perryman rose to become director-general of finance with the National Coal Board after joining the board in 1957. He had worked in Scotland and Durham.

Mr Perryman is a chartered accountant and a Fellow of the Institute of Chartered Accountants.

Board member designate for personnel and industrial relations is MR MICHAEL BETT, 46, who joined in March.

He joined General Electric as personnel director in 1972, and in 1977 became an associate director. Later that same year he went to the BBC as director of personnel.

Mr Bett is a member of the Civil Service Arbitration Tribunal.

There are also three part-time board members. SIR GEORGE MACFARLANE, who for much of his career has been engaged in electronics and radar research, was a member of the committee of enquiry into the Post Office in 1977.

MR DAVID CORMIE is chief executive of Reed International's building and home improvement division and has been with Mac Fisheries, chief accountant of Unilever, and chairman and managing director of Batchelors Foods. He is also the vice-president of the Institute of Chartered Accountants.

MR JOHN LYONS, general secretary of the Engineers' and Managers' Association, joined the board last year.

Where is this conversation going to end?

It will be Britain's telephone users of the *future* who get the full benefit of the biggest change the telecommunications network of this country has ever known. As well as for ordinary conversations, they'll use it for a host of data services too; shopping, banking, information.

We're talking about System X – the unparalleled British achievement in telephone technology which can help build the integrated digital communications networks that the world needs. Right into the next century.

In this change to digital systems – which is now really gathering momentum – Plessey is helping to set the pace.

Plessey is one of the companies which joined forces with British Telecom to develop System X. It's a major factor in our national export strategy and Plessey is fully committed to promoting it worldwide, and selling it hard.

One of a series of advertisements for the general public about the achievements of the British telecommunications industry.

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telecommunications & office systems

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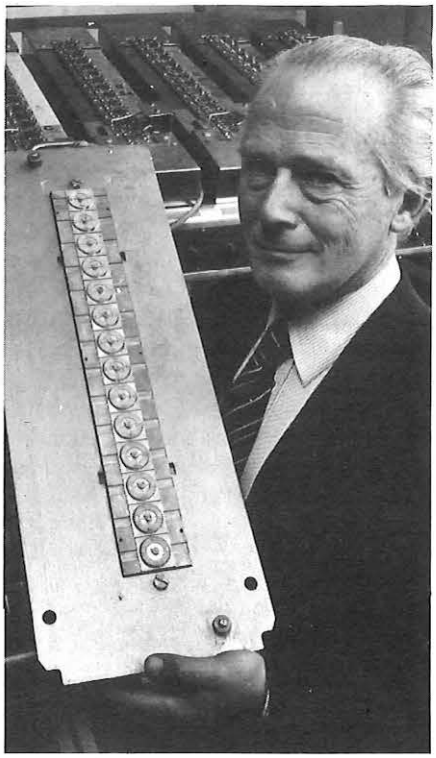
Pioneer's top award



Winner of the 1981 Martlesham Medal – awarded to past or present employees of British Telecom for outstanding achievements in telecommunications science and engineering – is Mr Dennis Baker, currently head of the microelectronics division at the British Telecom Research Laboratories.

Mr Baker, who pioneered the introduction of the world's first silicon transistors used in submarine cable amplifiers and led the team who coined the term 'microprocessor' received his silver medal from Sir George Jefferson, Chairman of British Telecom.

Sir George commented: "Dennis Baker has made an unrivalled direct contribution to the development of the vital amplifiers used in today's high-quality, high-capacity undersea cables. His transistors have permitted submarine amplifiers, or repeaters, to perform deep down in the oceans without a single failure for up to 10 years."

Mr Baker's present duties involve him closely with very small geometry circuits of increasing complexity for System X, the new family of computer-controlled digital exchanges and he is taking a leading role in the work done to explore computer-aided design.

MISCELLANY

Teletex launch

A high-speed desk-to-desk message service opening up the era of the electronic office is to begin early next year, Mr Peter Benton, British Telecom's Managing Director, has announced.

The new service will offer Teletex terminal users the ability to prepare and edit correspondence and the means of accurately and rapidly conveying the information to a distant terminal – typically a full page of text will be transmitted in a few seconds.

Users of the service will be able to type letters, internal memoranda and other messages on their terminals as if they were ordinary typewriters, and then send the correspondence directly over the telephone network. Setting up calls, transmission and reception will be fully automatic, without anyone having to be present at either end.

Text can be prepared in A4-size pages in either upright or horizontal format. When prepared, the message is held in a store in the terminal. This allows the message to be sent immediately or delayed for transmission at a time convenient to the user. The store will also receive and hold incoming messages, for display when required.

More borrowing powers

Sir George Jefferson, chairman of British Telecom, has warmly welcomed the Government's decision to increase Telecom's £180 million external financing limit by £200 million.

He said the move was evidence of the Government's recognition in difficult times of the importance of a high level of investment in telecommunications but added that given the scale of that investment, the increase was not as much as British Telecom believed necessary if Britain was to have the telecommunications services it needed.

Sir George stressed that the addition to Telecom's 'cash limit' – the level above which its Government borrowing during 1981/82 must not rise – was not a handout, nor was it aid to a 'lame duck'. He said British Telecom had always been a profitable and wealth-creating business, sustaining work for thousands inside and outside its ranks, and paying for most of its huge investment programme from its own resources.

He went on: "We invested £1.5 billion in 1980/81, and that was not enough. We intend to invest £2 billion in 1981/82, and that is relatively low compared with investment by competitor countries. We have already carried out stringent economies, shaving £200 million from our programme last year and about £250 million from this year."

And Sir George added: "We still believe more borrowing is necessary, from whatever source, if we are not to make damaging cutbacks in our essential improvements to Britain's present and future telecommunications programme. Such cutbacks would damage not only our ability to provide service, but also seriously affect the manufacturing capability of our supplying industry."

Turning to the need for a long-term solution to British Telecom's investment problems, Sir George pointed out that the British Telecommunications Bill currently passing through Parliament opened British Telecom to competition. "We welcome competition. But our rivals can borrow in the open market – and we believe that we should be allowed to do the same."

Communications 82

Communications 82, organised by the Institution of Electrical Engineers, is to be held between 20 and 22 April next year at the Birmingham Metropole Hotel. The conference aims to provide a forum for communication engineers, and topics will include public telecommunications as well as business and private communication systems.

The IEE have invited papers and have recommended discussion of new developments such as electronic switching, telematics, optical fibre systems, microwave systems and radio communications. Papers on strategy, user and operating interests, systems technology and components have also been requested.

A million more

Nearly a million more phones have now joined Britain's direct-dialling network. Panama, Sierra Leone and the Philippines have all recently joined the ever-growing list of countries on IDD-international direct dialling from the United Kingdom.

Film award

A top American award has been won by British Telecom for the film *Desire to Work*. It received the runner-up Silver Screen Award at the US Industrial Film Festival held annually in Chicago.

With between 1,500 and 2,000 entries, competition is always strong and it is the first time British Telecom had won an award at the festival. In previous years Telecom films have, on several occasions,

received certificates of creative excellence.

The film which lasts 20 minutes was made for the International Year of Disabled People and illustrates some of the Telecom aids that are playing a vital part in helping the disabled to compete for jobs on equal terms. It was produced by Pacesetter Productions.

Contracts

Trend Communications Limited – More than £3 million for electronic telex terminals, based on the 800-series teleprinter range, capable of full electronic message editing, message storing, automatic dialling, and storing and retransmitting incoming messages over the public switched network. The teleprinter order places the Buckinghamshire company high up the list of world telex terminal suppliers.

Ferranti Computer Systems Limited – For a third Autoflood test equipment system to test protocol and load testing of packet switching systems, including the International Packet Switched Service (IPSS). Software for the system was developed by British Telecom's System Evolution and Standards Department.

Hawker Siddeley Group Limited – For two Blackstone ESL Mark 2 generating sets to be commissioned for use at a London switching centre by the end of the year.

TMC Limited – £9 million for a wide range of exchange peripheral equipment and telephone instruments. Orders include short duration announcers and director electronics for exchanges, as well as 200,000 multi-frequency telephones, 30,000 push-button phones and 13,500 linesman's telephones. All instruments will be manufactured at the company's Airdrie factory.

Marconi Communications Systems Ltd – £4.5 million for 30-channel pulse code modulation systems vital to the speedy establishment of a fully integrated digital transmission network in the UK.

Videotex agreement

Following extensive discussions, the 26 member countries of the European Conference on Posts and Telecommunications (CEPT) have reached agreement on a unified approach to videotex (viewdata) standards.

This means that the existing European systems – the British Prestel system, the French Teletel system and the German Bildschirmtext system – have been merged into a single standard which incorporates the advantages of each of them. The new system has a high degree of compatibility with these existing systems and the result, is the culmination of technical discussions over a period of three years.

Prestel's 10,000

Prestel – British Telecom's world pioneering public viewdata service has now registered its 10,000th user. It is already the largest computer-based information service of its kind anywhere and Prestel customers can now access more than 185,000 'pages' of information supplied by more than 500 independent organisations.

Since its launch in September 1979, the Prestel network has been expanded to most large centres of population throughout the country. Access to the service at local call rates is now available to 62 per cent of the nation's telephone customers.

Billing centre opens

A new computer centre producing nearly 3 million phone bills a quarter for south-east England has been opened in Portsmouth. Run by British Telecom's computing organisation, the Data Processing Executive, it houses three ICL series 2900 computers and has room for growth.

Its main job is producing telephone bills for one-sixth of the country – for customers in Brighton, Cambridge, Canterbury, Colchester, Guildford, Oxford, Portsmouth, Southend and Tunbridge Wells. It issues about 2.8 million bills a quarter, representing about £125 million in revenue.

25 not out

Once again, British Telecom is providing the ever-popular Cricket Information Service which this season celebrates 25 uninterrupted years of providing latest scores, prospects of play and results.

The service – which last year received a record 32 million calls – was first introduced for the second test against Australia at Lords in 1956 for callers in the London area. Today, the service is available from more than 150 centres nationwide.

The Wimbledon Tennis information service was also available during this year's tournament. Introduced in 1973 it had received five and a half million calls by the end of last year.

Improving IDQ

With international telephone calls doubling over the past five years and growth still continuing plans to improve and expand the international telephone directory enquiry service have been announced by British Telecom.

Two new centres, devoted exclusively to dealing with international directory enquiries, are to be provided in London, and Scotland. Each will eventually employ nearly 200 international operators.

The London centre, at Kelvin House, Judd Street is planned to open in May next year and will handle international directory enquiries from the whole of the London area. The centre, at Irvine, Ayrshire, will eventually handle all calls from outside the London area. It is planned to come into service in mid-1983.

Radioline on the air

British Telecom's latest recorded service – Radioline – which began in July, has been welcomed by the Royal National Institute for the Blind.

Radioline, available on 01-246 8035, gives details of Radio 4 programmes and is expected to provide an invaluable service for the 100,000 registered blind and partially-sighted people in Great Britain.

The new service has been introduced by British Telecom and BBC Radio 4 for a trial period as part of the International Year of Disabled People.

Bureaufax expands

Businessmen and others with urgent documents to send to other parts of the world can now take advantage of British Telecom's expanded Bureaufax service, following the opening of counter services in London at Temple Avenue in the City, and at Trafalgar Square.

Until now, Bureaufax acceptance has been by facsimile, by post or by hand at the main Bureaufax Office at Cardinal House, Farringdon Road, Central London only.

Further counter services are opening at 11 more sites throughout Britain, including London, Gatwick, terminals one and three at Heathrow Airport, Birmingham, Norwich, Reading, Bedford, Plymouth, Portsmouth and Cardiff.

100 Monarchs

The 100th Monarch 120, British Telecom's world leading advanced business telephone exchange has been installed at Lloyds Bank, Moorgate in the City of London.

Originally launched last December in Central London and Scotland, Monarch a digital-electronic PABX (private automatic branch exchange) is now being introduced into other areas with nationwide penetration by November.

Monarch, offering up to 120 extensions, harnesses the power of its microprocessor control to offer small-to-medium businesses a wide range of facilities normally available only on much larger 'tailormade' installations.

4TEL. PREVENT PHONE FAULTS RIGHT ALONG THE LINE.

Because 4TEL is the only maintenance system to test every single line every night, it's very good news for telephone administrations and customers alike.

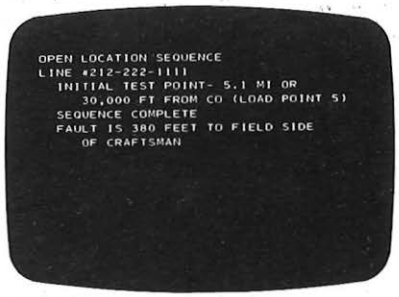
Using distributed computer control, 4TEL measures at unrivalled speed – 600 measurements a minute. In a service area with 100,000 subscribers, that means more than 2.5 million measurements in six hours.

In the daytime, 4TEL's line testing and line diagnostic capabilities allow faults to be distributed to the right faultsman first time. On each line test 4TEL is able to distinguish the nature and severity of the fault.

4TEL's powerful fault location capabilities then lead him quickly to the vicinity of the fault.

Great savings in costly cable repairs can be achieved by early fault detection through preventive maintenance programmes and by helping to eliminate wasteful changing over of pairs when faults cannot be found by conventional methods.

Installing this efficient, economical system means that the entire Repair



Service Control operation can be centralised and substantial improvements gained in the quality of customer service.

Test information is displayed on a screen or printer in the RSC in plain language so that it can be acted on immediately. A faultsman can not only be directed to the fault, but he can verify the repair while he's still on the scene.

4TEL immediately permits major improvements in responsive and preventive maintenance.

4TEL from Teradyne, one of the world's leading manufacturers of computer controlled test equipment, has been field proven in rural and urban environments and is testing 2½ million lines now.

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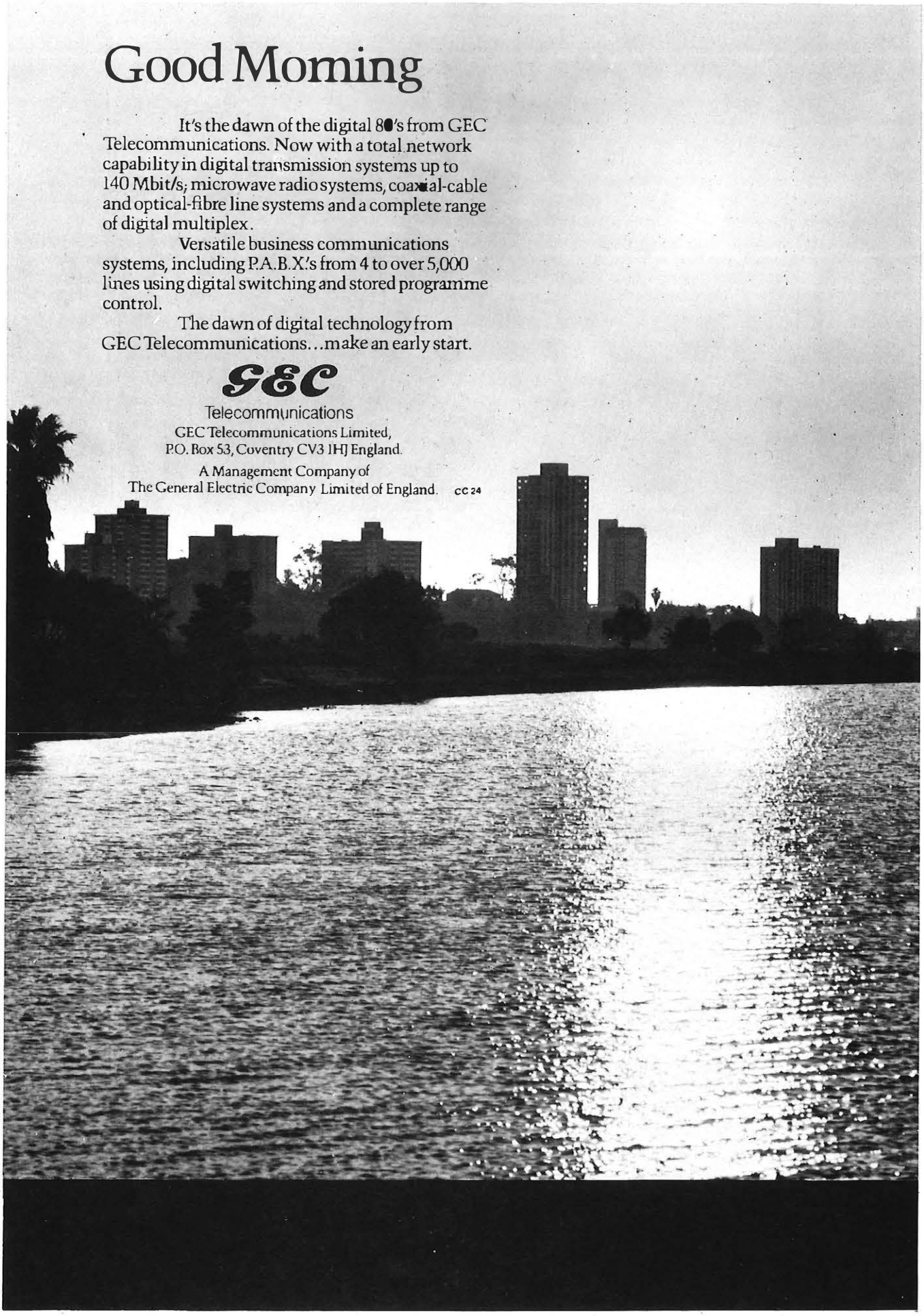

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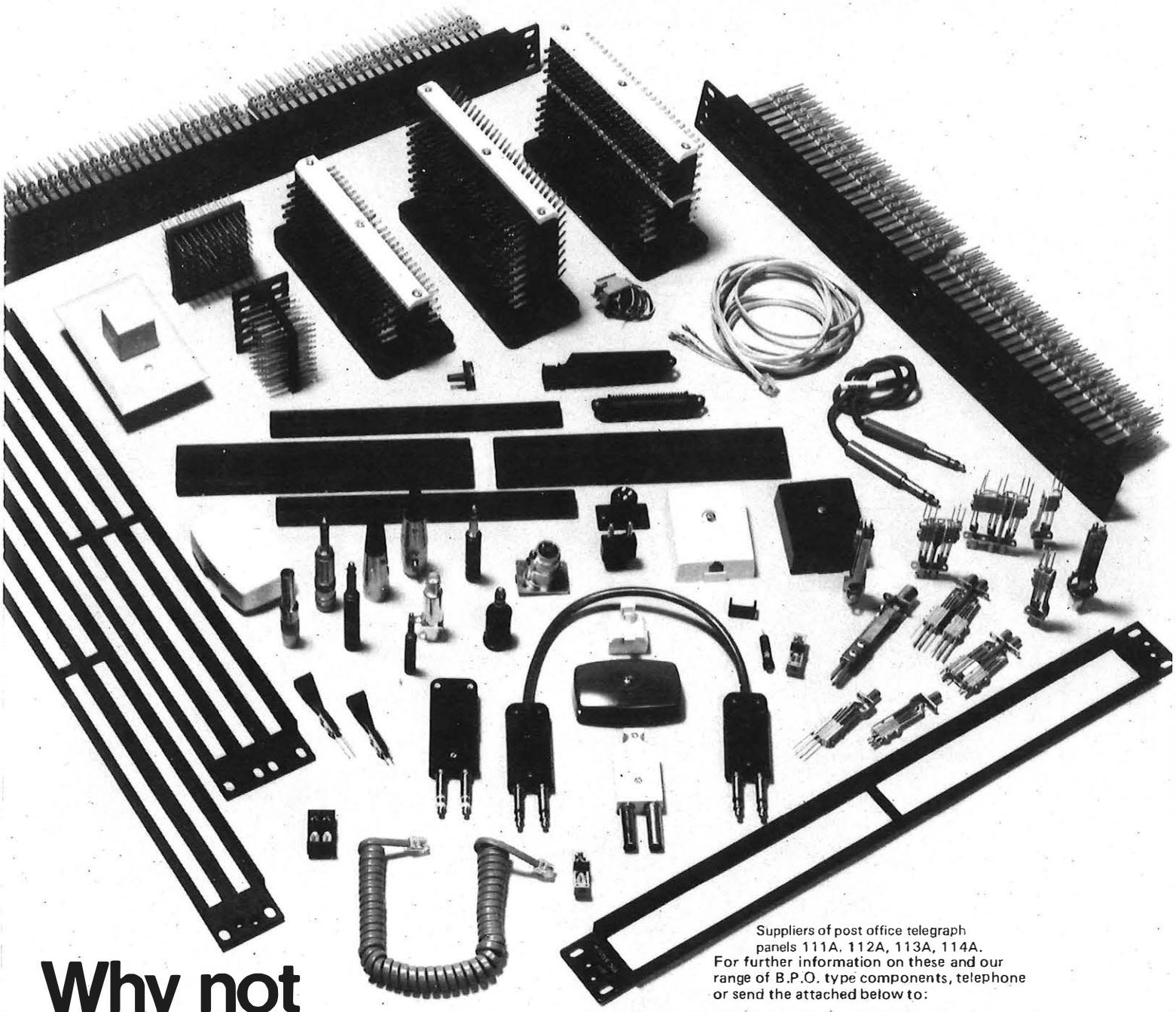

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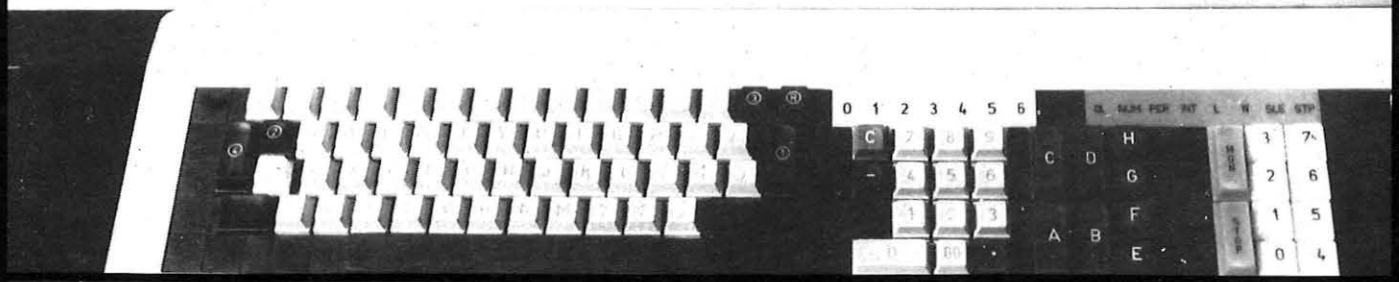

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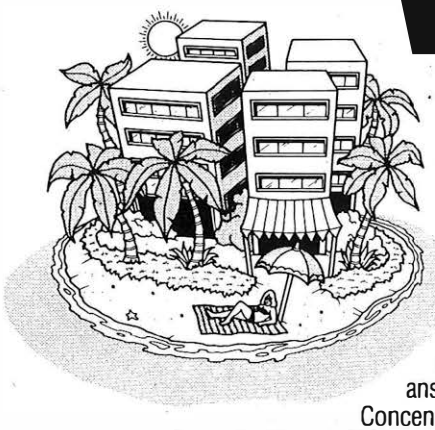

What's the oldest problem in the telephone authorities' book? Shortage of available trunk lines.

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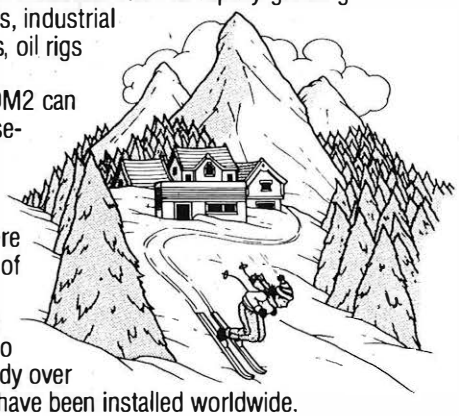
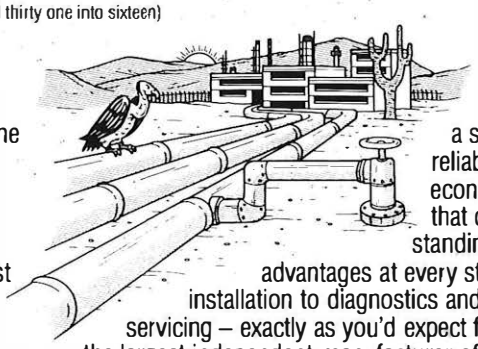
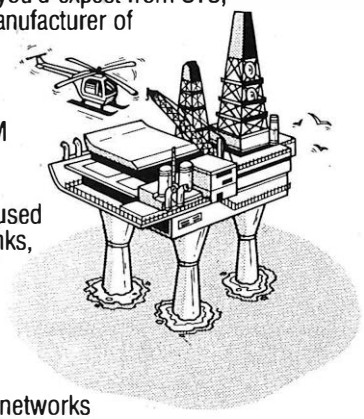


And COM2 can even prove useful in city centres and similar locations where the problems of disturbing existing cable runs are all too familiar. Already over 150 systems have been installed worldwide.

How does COM2 work? Simply by combining the proven TASI principle of voice multiplexing with the latest advances in microprocessor technology – a task Storage Technology Corporation is ideally suited for.



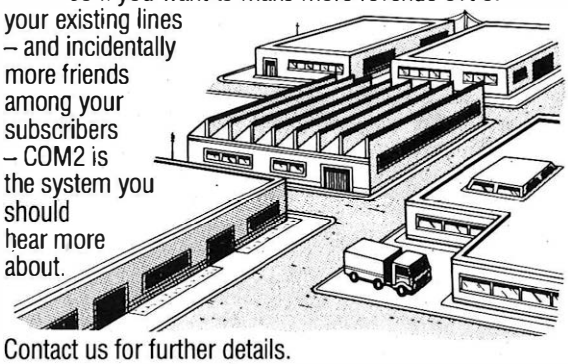
The result is a superbly reliable and economic system that offers outstanding performance advantages at every stage from installation to diagnostics and servicing – exactly as you'd expect from STC, the largest independent manufacturer of high speed computer peripherals in the world today.



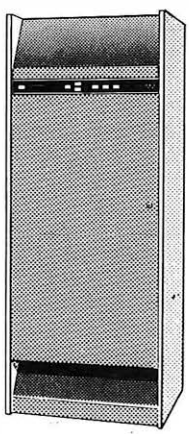
COM2 provides PCM quality speech and can accommodate data up to 9600 BPS – and it can be used on all types of terrestrial links, as well as satellite and undersea cable applications.

Finally, COM2 interfaces with most switching systems in use today, and networks can be easily upgraded as future needs require.

So if you want to make more revenue out of your existing lines – and incidentally more friends among your subscribers – COM2 is the system you should hear more about.



Contact us for further details.



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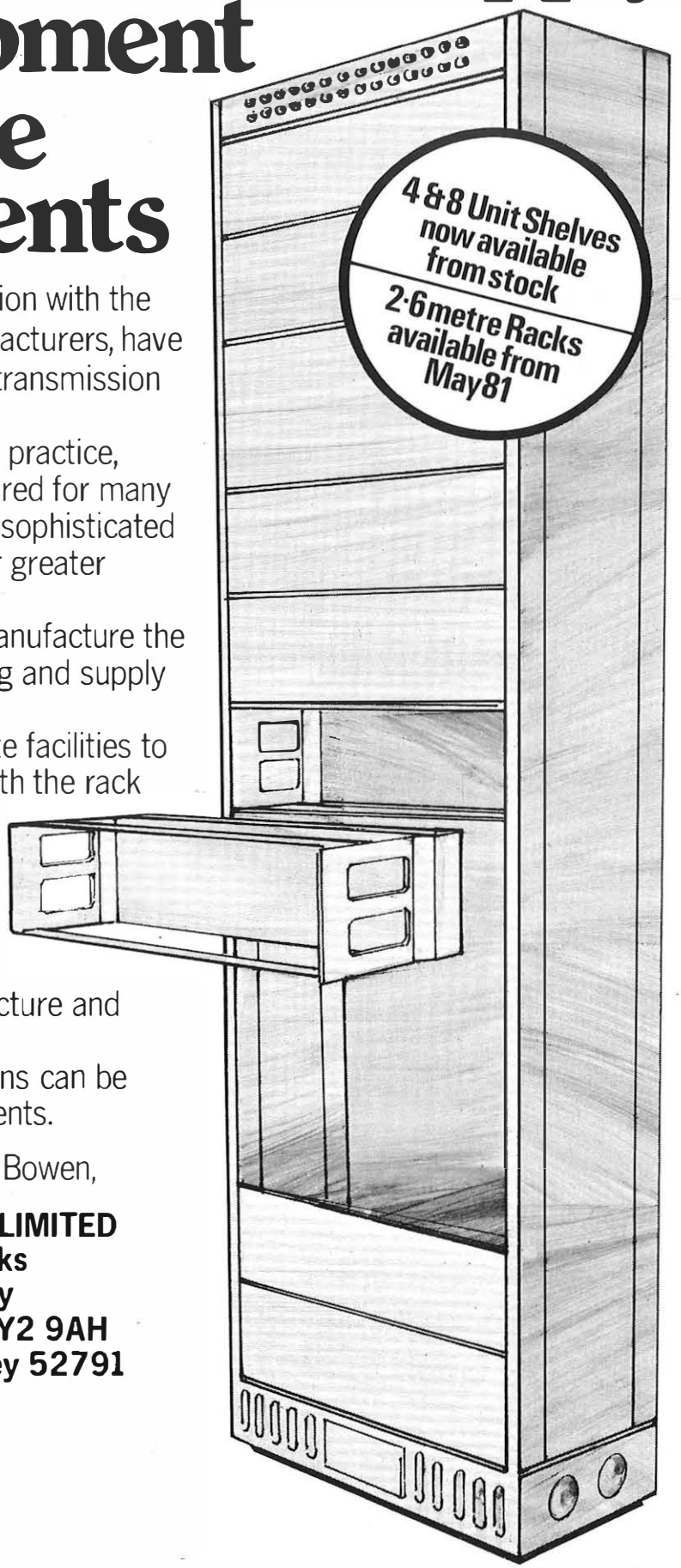

The British Post Office, in conjunction with the telecommunication equipment manufacturers, have developed a new racking system for transmission and other equipment applications.

This is to replace existing 62 Type practice, which Herman Smith have manufactured for many years. It will house equipment in very sophisticated miniaturised forms and will offer a far greater packing density.

Herman Smith on their part will manufacture the metalwork for this new type of racking and supply any company or public body.

The company has full and adequate facilities to make and inspect this equipment—both the rack and the incorporated shelves—to the exacting requirements.

At present, the company is supplying 62 Type wired assemblies and racks to the Post Office and is fully approved for Post Office manufacture and also to 05/24 M.O.D. standards.

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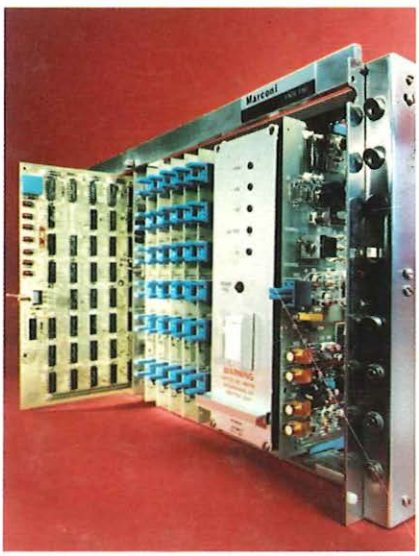
Look what happens when we rack our brains

Small may be beautiful, but microminiaturization is no easy task. Even when, like Marconi, you have been designing, developing and manufacturing PCM digital transmission systems since 1967.

Our new third-generation system embodies years of experience in this field. Designed for the international marketplace and conforming fully with CEPT and CCITT 30-channel recommendations, the system finds wide application in junction, trunk, local and data networks, and forms the basic building block in the creation of an all-digital integrated services network.

The use of the latest LSI and microprocessor technology, in the new British transmission equipment practice, has resulted in a very compact, reliable and flexible design. Timeslot access facilities are provided to permit speech, data and music channels to be multiplexed together; and the use of a microprocessor-based signalling sub-system allows a wide variety of exchange interfaces to be provided.



As well as the basic 30-channel equipment, Supergroup and Hypergroup codecs will be available shortly, which will assist further in the introduction of digital working.

To find out more about Marconi's digital transmission systems, please contact Tony Trewin on Extension 556.

Marconi Communication Systems Limited

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