POST OFFICE

telecommunications

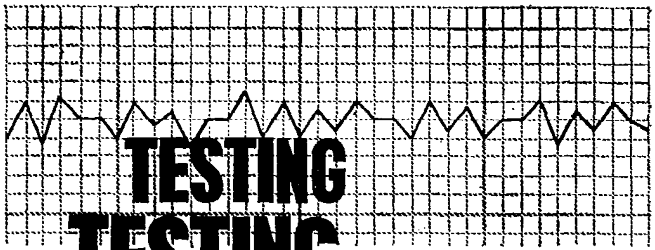
JOURNAL

ONE SHILLING

AND

SIXPENCE

SUMMER 1963



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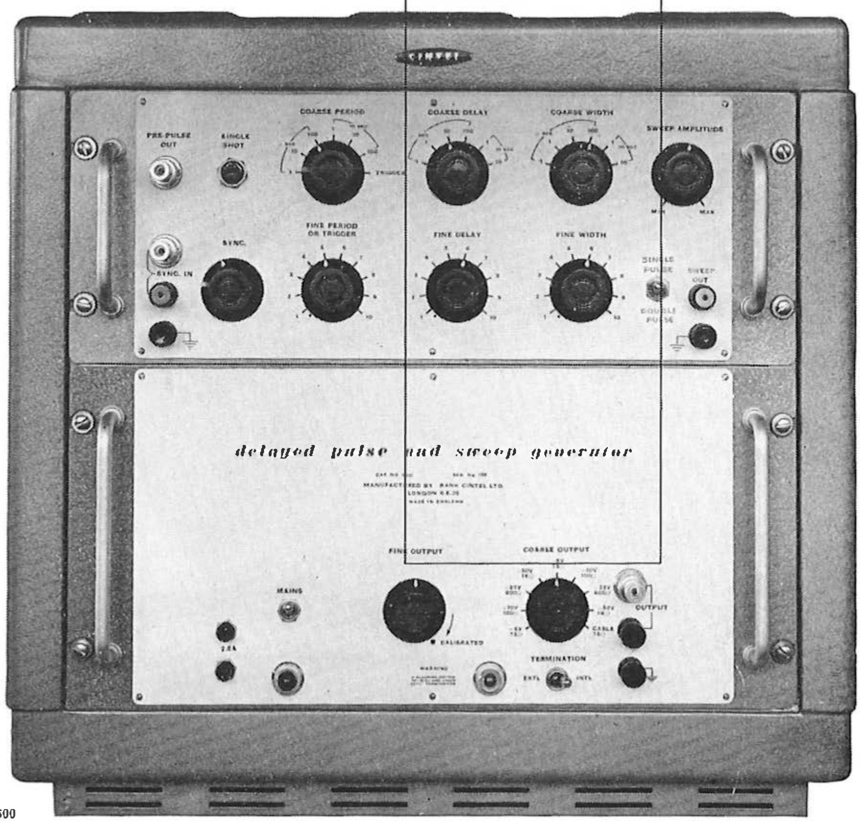

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Post Office Telecommunications Journal

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Contents

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The Reason Why

THE new telecommunications tariffs which, with increased charges for certain postal services, came into force on 29 April, are expected to produce additional revenue of £8 million in the coming year.

In 1960-61 the Post Office made an overall profit of £24.3 million and in the following year, £13.6 million. Why, then, when the Post Office makes profits of this magnitude must tariffs be increased?

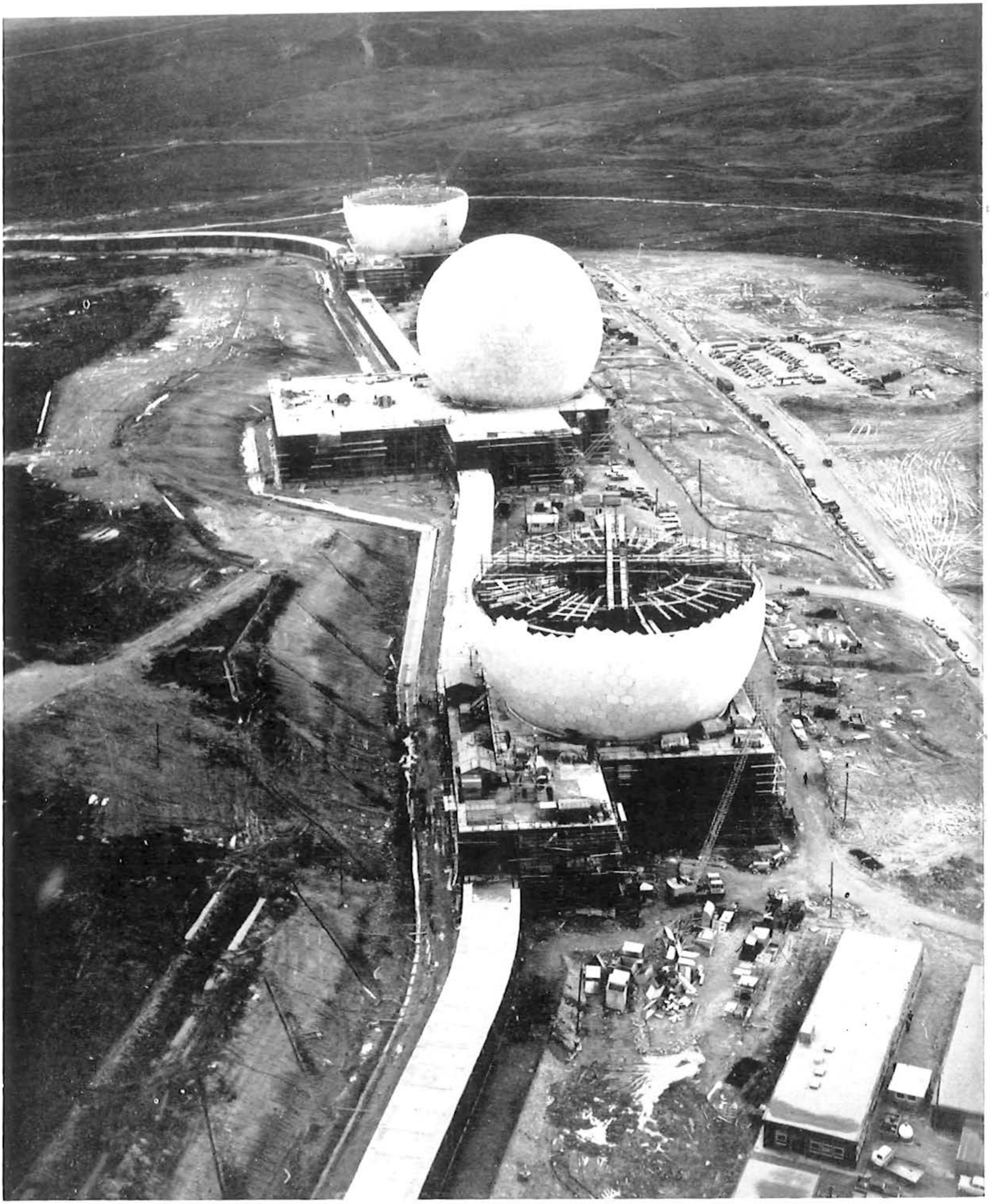
The answer is that the level of Post Office business in the past year has been generally much lower than had been anticipated. At the same time, expenditure—and particularly increases in pay and improved conditions of service which amounted to some £21 million—has risen. All this means that the estimated profit for 1962-63 will be only £9 million, made up of a profit on telecommunications services of £17 million and a loss on the postal services of £8 million.

The Post Office must get an adequate return on the capital invested and a profit of £9 million in 1962-63 would not be enough. The estimated capital requirements for 1963-64 will rise from £125 million this year to £155 million and the Post Office had both to increase tariffs for certain of its services and to increase its borrowing from the Exchequer.

The main increases naturally fall on the telecommunications side where the need for capital is much greater. But not all the changes will be unwelcome to the customer, for the heavier tariffs are partly offset by the important decision to double the time which STD subscribers can buy for 2d. on local calls in the daytime on weekdays.

The Post Office is constantly seeking new ways of reducing operating costs and stimulating business. Much has already been done and more will be done in future.

As the *Journal* went to press plans were being made to launch a publicity scheme to stimulate certain telecommunications and postal services. On the telecommunications side there will be television, press advertising and poster campaigns aimed at increasing local telephone calls and off-peak trunk traffic.



An aerial view of the three giant radomes, the centre one completed, at Fylingdales.
The radomes protect the tracking radar aerials and each is made up of 1,646 panels.

The Post Office helped to plan and provided the internal network of telephone communications at the Ballistic Missile Early Warning System station at Fylingdales, on the Yorkshire moors. It also installed equipment for some American companies and when the station comes into operation later this year a permanent staff of Post Office maintenance engineers will be on duty there 24 hours a day

BMEWS and the POST OFFICE

By J. E. Haworth, MBE

THE Ballistic Missile Early Warning System station at Fylingdales, in Yorkshire—a vital link in the United States' defence organisation against long-range rockets—is nearing completion. Soon the radars there will be scanning continuously to give warning not only to America but also in time for Britain's own deterrent forces to be activated.

The Post Office has played an important part in the building of this third BMEWS station (the others are at Clear, in Alaska, and at Thule, in Greenland), setting up an extensive network of telephone communications and carrying out work for several American companies. And when the station becomes operational later this year Post Office maintenance engineers will be in constant attendance.

The operational section of the Fylingdales station, which has cost £43 million, comprises three radar buildings connected by a passageway. The three buildings house the radar equipment and on top of each, supported on a massive plinth, is a radar antenna. The 80ft diameter parabolic reflectors are mounted on ball bearings and are steerable for scanning and tracking purposes. Each antenna structure, weighing about 160 tons, is enclosed in a radome, 140ft in diameter, which can withstand the fiercest gales.

The centre of the three radar buildings houses the computer and communications block in which the Post Office accommodation is located.

The power station, independent of the National Grid, has eight 16-cylinder diesel engines driving 3,000 kW alternators and can generate sufficient power to serve the equivalent of two towns the size of neighbouring Whitby and Scarborough. Any one engine can be taken out of service for maintenance without affecting the operation of the others so that power can be supplied to the station continuously and there is no break in the operation of the radars.

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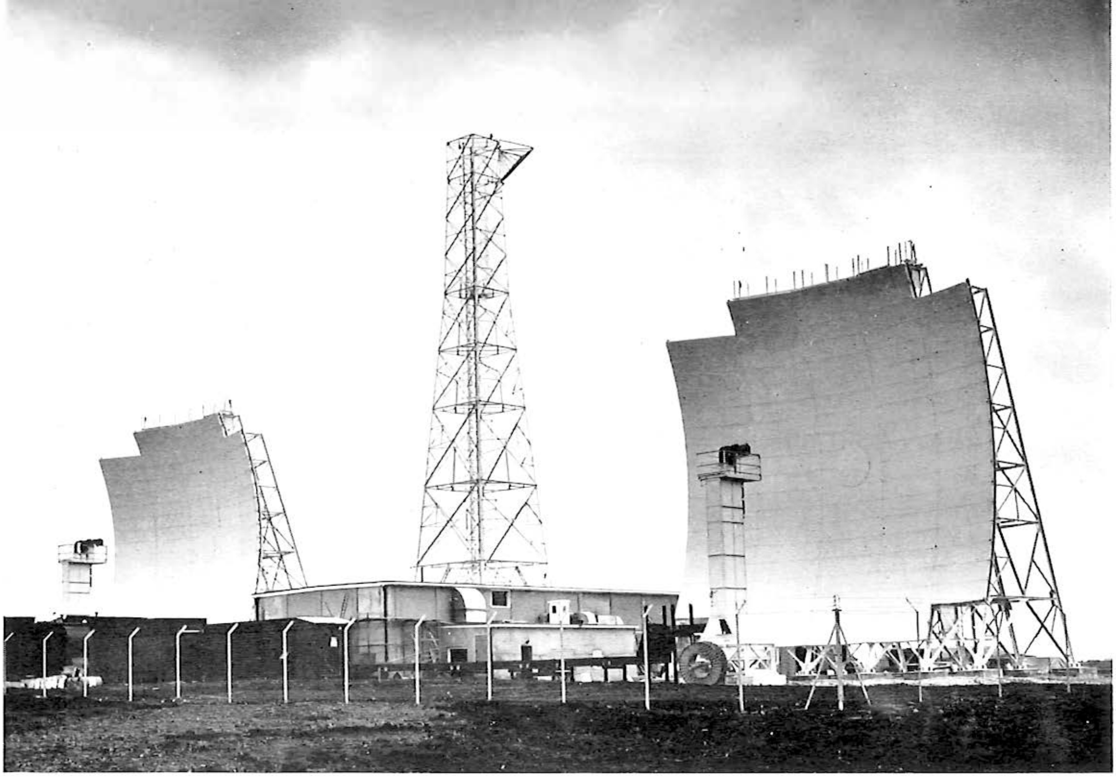

Two radio reflectors (left and right) which are part of the communications system.

BMEWS (*Contd.*)

Since powerful high frequency radiations of electro-magnetic waves can damage living tissue, a safety fence encloses the whole of the operational site and only in exceptional circumstances will anyone be allowed inside it. So that people can move with absolute safety the passageway—designed to give protection from the intense radiation fields and large enough for lorries to drive through—is extended at each side to the safety fence. The walls, roof and floors are made of sheet metal plates welded together and bonded to the steel frames of the buildings which, because of the need for complete screening, have no windows. All rooms are air-conditioned and surplus heat from the radar and computer equipment is used for general space heating.

Any radar station is relatively useless if the information displayed on the radar screens cannot instantly be transmitted to some point where counter-measures can be taken. Since the operations centre for the BMEWS system is at Colorado Springs, in the United States, the transmission paths are extremely long and as a precaution against a breakdown of one transmission path, the circuits between each radar station and Colorado Springs are shared over at least two independent routes.

In the case of the Alaskan and Greenland stations this has meant building special microwave routes. The Fylingdales station will have at least three separate routes, spread over trans-Atlantic cables and radio systems, to the United States. Contact with United States Air Force bases in Britain and on the Continent can be established through a Post Office private wire network or by way of the USAF-owned microwave radio network set up in recent years to link all major USAF stations. Equivalent communications have been planned for the Royal Air Force. There will be three cables emanating from Fylingdales and the station will be linked to Royal Air Force command and group headquarters by private circuits on at least two separate and independent routes.

Circuits will be provided for telegraph signals of 50 baud working for the RAF or 45.5 bauds to the United States; speech; and data given in coded form from information derived from the radars.

The data signal consists of a series of 1,500 c/s dipulses. The message structure totals 94 bits—ten for the starting signal, three for the store address, 63 for the message itself and 18 parity bits

The control room of the power house which generates enough electricity to serve two big towns.

—all transmitted at 75 bauds. The signals are transmitted over two circuits simultaneously and at the receiving end the two signals are compared and checked for parity. Throughout the BMEWS system the data signals are required to be re-generated at 1,000-mile intervals but since this is not practicable in the case of the trans-Atlantic circuits the regenerating equipment is situated at the cable terminals.

To transmit the data signals without introducing intolerable distortion the Western Electric Company has specified circuit characteristics for each 1,000-mile link and also for the overall 6,000-mile circuit. To meet them the circuit links in Britain will have to be set up to a high quality and the plant will have to give the minimum time delay and delay distortion.

The prime factor is continuity of service. The Western Electric Company specification, which considers the total communication outages, calls for a reliability approaching 100 per cent. Representatives of the Post Office Engineering Department and Western Electric Company have examined in detail typical repeater station installations, power plants and circuit records on some of the routes to be used. Where necessary work has been programmed to ensure a high grade of service, for instance, all power supply units will have stand-by facilities and all cables will be gas pressurised. Although the provision of high-grade circuits is essential it is equally essential that they should have a high standard of maintenance for as long as the station is in operation.

In any large project such as Fylingdales, the Post Office co-operates fully with the Ministries concerned from the earliest planning stages. Communications are needed for all phases of the construction work and it is often necessary to provide service in advance of permanent requirements.

The BMEWS project has been no exception. After the site near Fylingdales, on the border of the York Telephone Manager's Area, was selected in the summer of 1959, estimates of the cost of providing the communications were prepared by the Post Office Engineering Department. The following year, when work on clearing the area of unexploded bombs and ammunition began, a telephone for the use of the RAF Regiment was provided by the Middlesbrough Telephone Manager's Office which also arranged for a shared service

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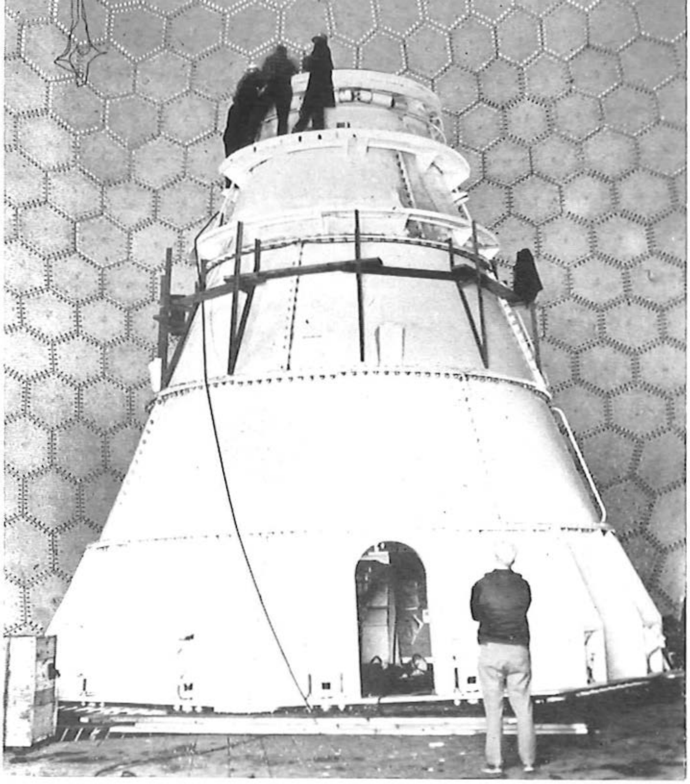

An inside view of one of the radomes.

BMEWS (*Contd.*)

connection to the Royal Automobile Club box near Goathland. At the same time the York Telephone Manager's Office provided, with commendable foresight, a 10-pair cable from the site to the serving exchange at Lockton (a UAX 12). The cable was connected to a mobile RAF PBX which was brought to the site and in service until huts were erected and a PMBX was installed. Meanwhile, Post Office Headquarters and the Engineering Department had been given full details of the constructional plans, telephone requirements for each phase and the final communication plans.

When construction work began under the direction of the Air Ministry Works Department a three-position PMBX 1A was installed in one of the temporary headquarters huts to replace the mobile RAF exchange. Exchange lines to Pickering and trunk subscriber lines to York were also provided. During this time the Air Ministry Works Department produced detailed plans of the buildings and frequently consulted the Post Office Engineering Department to decide cable entries, cable runs, equipment fixing, power supplies, lighting positions and so on.

By the autumn of 1961 the heavy civil engineering work was nearing completion. Roads had been constructed over the moorland, sites levelled out, foundations were in place and buildings were taking shape. As the installation phase of the work began the number of contractors and the staff employed on the site increased and so did the telephone requirements. To avoid unnecessary temporary provision of plant the southern section of the Pickering-Whitby cable needed for the final plan was quickly supplied and a number of pairs were connected to the switchboard at Pickering to give the additional services. In May, 1962, an extra position was added to the PMBX to cope with the demand for more extensions.

The Post Office also provided 28 miles of duct and a carrier cable from the site to York and installed carrier equipment at Malton and York. The installation work at Malton and Pickering was arranged to fit in with the new buildings programmed for STD. When the heavy civil engineering equipment was withdrawn duct work and on-site cabling began and arrangements were made to complete the Post Office accommodation in the operations building in advance so that the PABX could be installed. The PABX was brought into service on 22 July, 1962, ten days ahead of schedule and as the various sections of the site and cabling were completed telephone extensions were provided. Carrier cables and transmission equipment were installed by the end of 1962 and the northern section of the Pickering to Whitby cables were due to be completed by the Spring of this year to give an outlet to the north.

The Post Office has also acted as contractor for some of the American Companies. The Western Electric Company, for example, arranged for their data generators, transmitting equipment and line terminal equipment to be shipped from the United States to Fylingdales where it has been installed by Post Office staff. Special on-site cables have also been provided for the Western Electric Company and the Radio Corporation of America.

The work carried out by the Post Office at Fylingdales raised a number of unusual problems associated with both cabling and installation. Because of the high power radiated from the antennae every precaution has had to be taken to avoid interference with the communications and the Western Electric Company specified that all cables within 1,500ft of the operational buildings had to be in a ferrous metal screen bonded throughout and earthed. To avoid using steel-taped cables the Post Office provided steel ducts in the area and the North Eastern Region Headquarters designed and made a number of galvanised iron joint boxes which were sunk into the ground and bonded to the steel ducts. A galvanised iron lid was bolted on to complete screening and then encased in three-inch thick concrete, with removable covers. A layer of cement was placed on the bottom of the joint box so that the jointer's boots would not damage the galvanising.

The steel ducts were bonded to the steel structure of the passageway within which all cables run on open mesh racking fixed to the side of the tunnel. The cable runs are arranged so that the communication cables are well clear of other cables, not only along the length of the passageways but also throughout the cable runs in the buildings and in the voids between floors.

In addition, all the wiring between the PABX equipment and the telephones has been provided in steel conduits for screening purposes. All the conduit runs had to be planned long before the building was started.

Special attention had to be paid to the fixing of the equipment racks which could not be attached to the thin partition walls. Instead they have been fixed to the ceiling by rods which also support a false ceiling. This involved careful planning in the layout of the transmission room and a great deal of co-operation with the Air Ministry Works Department in the design stages.

Provision of temporary telephones before the underground plant was available to remote parts of the site was also difficult, particularly because of the earth-shifting operations. Aerial cables were used and these had frequently to be diverted as building operations progressed. Cables were often damaged and the maintenance of service and integration of temporary service with permanent requirements was a constant major problem.

● As the *Journal* went to press test signals were being sent out from the BMEWS station at Fylingdales which is now expected to be fully operational sometime this summer.

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Mr. J. E. Haworth began his Post Office career in 1936 when he entered the Engineering Department as an Unestablished skilled Workman. Until 1946 he was engaged on the development of equipment for the transmission of television and wideband telephony systems over coaxial cables. This was followed by work on crystal controlled high stability oscillators and associated equipment until 1951 when Mr. Haworth transferred to LM Branch and was concerned with audio equipment maintenance. In 1953 he was promoted to Senior Executive Engineer and became responsible for the provision of services for private renters.

TRANS-ATLANTIC MESSAGES

IN the article *Companion to Telstar*, in your Spring, 1963, issue, you refer to the successful use of the Tally Parallel System for sending messages across the Atlantic at high speed. Readers of the *Journal* may be interested to know that five successful demonstrations of this kind were made over *Telstar* from this country using different transmission systems—two basically British, two American and one Swedish.

They were sponsored by the equipment suppliers in co-operation with the Post Office which provided suitable circuits to connect with the satellite station at Goonhilly Down, and technical assistance.

The systems and the types of demonstration were:

1. Automatic Telephone and Electric Company Ltd. Using its Swift *PT750PT* system, this Company transmitted data from seven-track paper tape, serially, that is, the elements of each character one at a time, at about 60 characters a second. The equipment employs phase modulation and has circuits for detecting and correcting transmission errors built into it. The transmissions were made from the Post Office test centre in Fleet Building, London, to the United States and back, two *Telstar* circuits being connected at Andover, Maine.

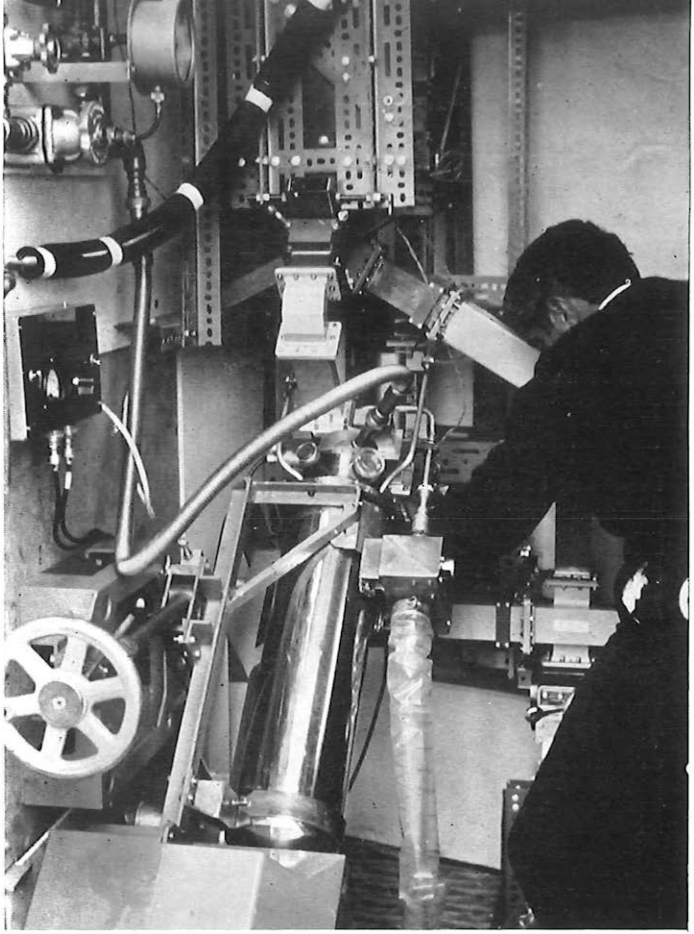
2. Bendix-Ericsson UK Ltd. Using its *Digital Data Link No. 430A*, this Company transmitted data from five-track tape serially at about 65 characters a second. The equipment employs frequency modulation and has an error detection and correction system which uses a Hagelborga code generated in the equipment from the input signals. The test arrangements were the same as for the *Swift PT750PT* system.

3. Smith Corona Ltd. This Company used American equipment throughout. Data of five-track paper tape was transmitted serially through a *Dataphone 202B* modulator made by the Western Electric Company, over a direct circuit to an associated company in New York, where it was received on a high-speed printer, at nearly 40 characters a second. Frequency modulation was employed and there was no error control system.

4. Standard Telephones and Cables Ltd. This Company used a modulation system designed by its Swedish associates company, operating at 1,200 bauds with a separate channel operating at 75 bauds. Similar circuit arrangements were made as for the *Swift* system, except that the operating point was the Company's laboratory at Harlow, Essex. Two demonstrations were given—one at more than 200 characters a second and one at six characters a second, using two different error-control systems.

5. Tally Europe Ltd. This Company demonstrated the *Tally Data Terminal* over a circuit between their London office and the head office of the parent company in Seattle, Washington. The equipment consisted of Tally eight-track tape readers and punchers working with a *Dataphone 402* modulation system made by the Western Electric Co. It uses a parallel transmission in which all eight tracks are sent simultaneously, using a different set of signal tones for each track. Operating speed was 60 characters a second.

All suppliers were well satisfied with the facilities and co-operation afforded by the Post Office and with the results of the demonstrations which showed that the *Telstar* transmission links gave results at least as good as an inland telephone circuit routed on modern plant, when used for data transmission.—**T. W. Rushton, ITD/PB.**



An engineer inspects the maser and its associated apparatus and waveguides at the Post Office Satellite Systems Ground Station at Goonhilly.

LASERS and

THERE is an exciting sound in the names maser and laser. And there are exciting possibilities, too, in the future use of these two revolutionary devices, particularly in the field of communications.

Masers—one is being used at the Post Office Satellite Systems Ground Station at Goonhilly to receive messages from *Telstar* and *Relay*—have already achieved a startling success in amplifying microwave radio signals so weak that they cannot even be detected by conventional types of equipment.

Lasers—or optical masers—are still in their infancy but already a wide range of uses is being forecast

ALTHOUGH both masers and lasers are products of very recent research, the maser has already found application outside the laboratory as well as within it and the laser bids fair to follow a similar course.

The maser is an amplifier of microwave frequencies and the name is derived from the initial letters of the expression "*m*icrowave *a*mplification by the *s*timulated *e*mission of *r*adiation". But any amplifier can become an oscillator if energy is fed back in suitable phase and amplitude from output to input and the term "maser" is used to describe both amplifiers and oscillators using the principle of stimulated emission of radiation. The amplification or oscillation may occur within either a crystal or a gas, the devices then being described, respectively, as solid-state masers and gas masers.

Lasers are akin in principle to masers but they operate at much higher frequencies, indeed, at frequencies at or approaching those of the visible range. The initial letter of the name stands for "light". The light or "near light" generated by a laser is unlike that to which we are accustomed in that it is coherent. To understand coherence, let us consider first such a common incoherent source as the filament of an electric lamp. The complex multi-frequency wave train generated by any tiny element of the filament is similar to that of all the other elements but the phase relationships are random. In the coherent source of the laser all elements combine in such phase relationship that a uniform wave is produced. Further, the light generated in a filament lamp is of many frequencies while that produced by a laser is of much narrower band and sensibly "monochromatic".

The maser amplifier is distinguished by the fact that it has practically no internal electrical noise. All amplifiers have some noise but in most applications this is not particularly significant because the noise is very much smaller than the signal to be amplified. However, some new communications techniques—notably communication by way of

MASERS

by F. J. D. TAYLOR, OBE

for them. The laser, which emits a beam of light so powerful and so readily focused that it can drill a hole in a diamond, vaporise the toughest metals and destroy malignant growths in the human body, may, in the not-too-distant future, be employed to carry thousands of simultaneous telephone channels, for short-distance radar detection and for signalling systems in space.

In this article Mr. F. J. D. Taylor, until recently Staff Engineer of the Microwave and Space Systems division of the Post Office Research Branch at Dollis Hill, describes the two devices and tells how they open up possible new fields of application

earth satellites—involve the reception of extremely weak signals. Such signals would be lost within the noise inherent in conventional amplifiers but they are still relatively great in comparison with the noise in a maser amplifier. A maser amplifier, in fact, forms the first receiving stage at the Post Office Satellite Systems Ground Station at Goonhilly Downs, Cornwall, and is used to amplify the signal received from a satellite at a power level of about only a millionth part of a millionth part of a watt.

Masers have also been used to increase the sensitivity of radio telescopes and so to heighten our knowledge of the location and magnitude of sources, such as the radio stars, of extra-terrestrial radio noise.

In lasers, as with masers, there are both solid-state and gaseous types. The active element in a solid-state laser may be, for example, a ruby rod while a gas laser may employ a mixture of helium and neon.

At present, the laser is still largely a laboratory instrument but a vast field of potential application can be foreseen for it. Its outstanding characteristic is the generation of coherent radiation. If, as is easily done, this is achieved over an aperture of many wavelengths, the beam divergence is extremely small. Typically, a beam would have a spread of only 50 yards at a distance of 100 miles from the source, from which it follows that energy can be constrained within a very narrow beam. It is also a fact that the energy intensity of the source, measured in watts per square centimetre, can be very high indeed.

Possible applications resulting from the high energy intensity are the drilling of hard materials—for example, diamonds—and localised attack on growths in the human body. High intensity coupled with small divergence may also result in power transmission without benefit of wires. For example, it is conceivable that power could be supplied to an earth satellite whenever atmospheric conditions permitted.

In the communications field the laser may find application in, for instance, inter-satellite communication and long-distance transmission in hollow pipes fitted with mirrors. However, much research needs to be done on the optical analogues of conventional modulators, demodulators and filters before such systems become practicable. A much earlier application may be to short-distance radar in the detection of movement at comparatively short ranges. Night surveillance of airfields is an example.

Lasers may also be useful in generating frequencies in the gap that now exists between about 500,000 Mc/s and the near-infra-red frequencies. It is likely that this will be effected by using two

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Lasers have already been used in Britain and the United States to fight disease and as an aid to surgery.

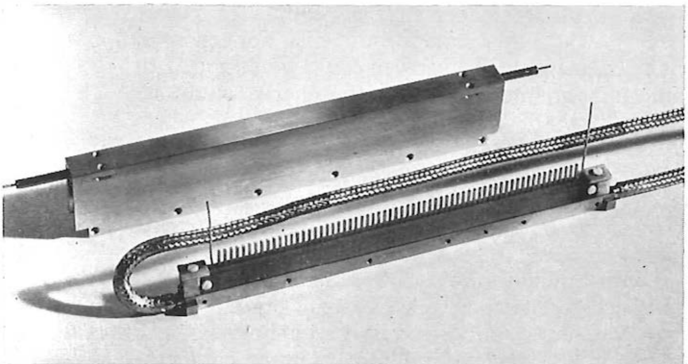
Recently, one was "fired" at a patient in the Middlesex Hospital, in London, to treat cancer. The patient felt nothing and the test was described as "most promising." In the United States, a laser was used to "weld" back the detached retina of a man's eye.

MASERS AND LASERS (*Contd.*)

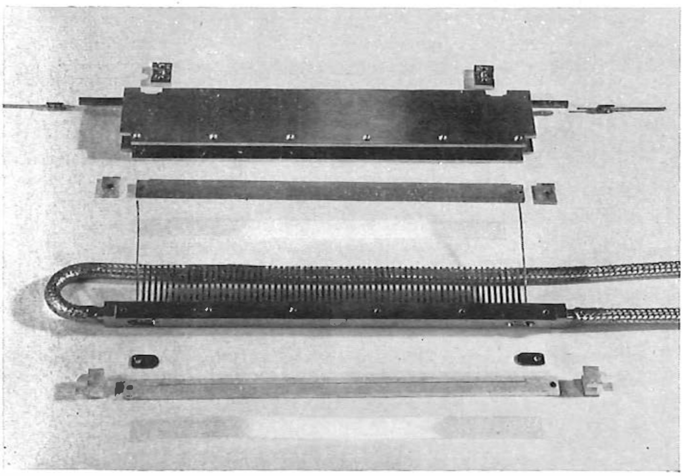
lasers generating different frequencies and subtracting the lesser from the greater to obtain a frequency within the band that cannot be covered with currently available techniques.

The principle of the stimulated emission of radiation cannot be explained quantitatively without reference to quantum mechanics but a general picture can be given fairly simply.

In a given material or gas at a given temperature there is a particular number of electrons at a lowest level of energy, fewer at the next higher and fewer still at even higher energy levels. It is important to realise that these energy levels can exist only in discreet steps. Nature cannot produce intermediate values. To raise a particle from one energy state to another requires a particular amount of energy equal to the product of a universal constant (Plank's constant) and the frequency of the electro-magnetic-radiation causing the transition. It follows that, for example, power of appropriate frequency can be applied to lift elementary particles from, say, the lowest energy state into that two levels higher and reach the condition when there are more particles in the third than in the second level. If, then, we apply a minute electro-magnetic field, at a frequency corresponding to the energy difference between the third and second levels, energy will be given up at the applied frequency by particles falling from the third to the second energy state. The applied electro-magnetic field is the signal we wish to amplify and amplification is effected by the above-mentioned energy release. The source of the energy is the generator used to "pump" the particles from the first to the third energy level.



Above and below: Elements of the Goonhilly maser.



Practical realisation of maser action is complicated, however, and can be illustrated by reference to, for example, a solid-state travelling-wave maser. In the first place, the active elements have to be orderly in space if they are to operate in unison and this demands the use of a uniform crystal structure. For a variety of reasons, specially grown pink ruby is the most commonly used material. To ensure that the available energy levels are the same for each ion the crystal has to lie within a uniform magnetic field of specific intensity and particular angle relative to the crystal axes. Further, since at normal temperatures a "pumped up" electron will "relax" quickly to a lower state, the crystal must be maintained at a very low temperature at which the "relaxation time" is relatively long. Typically, a maser will be operated at about —270°C.—only three Centigrade degrees above absolute zero. This requires the crystal to be immersed in liquid helium which, incidentally, boils at about —269°C. at normal pressure. At these temperatures air has long since become a solid.

From all this, it is obvious that a maser is a highly complicated device and considerable technological advances have been necessary to take it from the stage of laboratory tool to field-worthy instrument.

In the light of the foregoing description of the principle of operation of a maser it is unnecessary to expand on the way a laser works. The early lasers were pulsed devices. A suitable laser crystal, for example, a suitably dimensioned ruby rod with one end silvered and the other partially silvered, is surrounded by a gas-discharge tube which can be flashed to produce a short burst of very high-

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The latest type of laser—a small piece of specially-treated metallic compound (gallium arsenide) which generates intense infra-red light simply by passing an electric current through it—has caused considerable excitement among scientists.

Previously, all lasers—normally ruby crystals or gas mixtures—needed powerful light flashes or electric discharges to operate them, and impressing signals on the beam of light was an extremely difficult business.

Now, with the new laser, the beam can easily be "modulated" (that is, have signals impressed on it) simply by varying the applied electric current.

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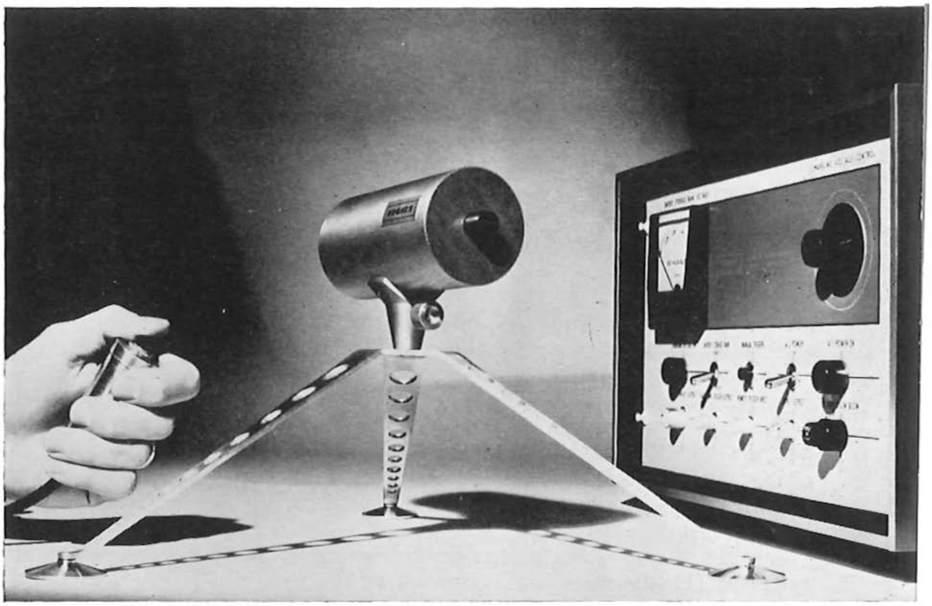

The Hughes I lb laser undergoing a test. It emits an almost parallel beam of light brighter than the sun.—*Courtesy, Hughes International (UK) Ltd.*

intensity light. This flash contains enough energy at appropriate frequencies to stimulate resonant emission within the crystal and an intense monochromatic beam emerges from the partially silvered end. Pulsed gas lasers have also been used, the "pump" being an electrical discharge through a mixture of gases, such as helium and neon. Continuous laser action has recently been demonstrated in several laboratories and a laser has been designed and made at the Post Office Research Station at Dollis Hill. Recently it has been found that very highly efficient laser operation can be obtained by passing a current through an appropriately treated semi-conductor crystal of gallium arsenide.

In conclusion, it must be stressed that both masers and lasers are still in their infancy, although rapid relevant progress is being made in both the research and development fields. They are not only tools of current use in laboratories but bid fair to open new fields of application.

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Mr. F. J. D. Taylor, who is now Staff Engineer of the Space Communication Systems Branch, joined the Engineering Department in 1932 and saw service in South Wales before transferring to the Lines Branch of the Engineer-in-Chief's Office in 1935. He was in the Army from 1942 to 1946. On demobilisation he was transferred to the Research Branch and served in three Divisions before returning to the E-in-C's Office in April, 1963.

ISD COMES TO LONDON

THE Lord Mayor of London, Sir Ralph Perring, picked up a telephone receiver in the conference room at Fleet Building at 11 a.m. on 8 March and dialled 13 digits.

Ten seconds later he was speaking to M. Jacques Marette, the French Minister of Posts, Telegraphs and Telephones, in Paris.

It was an historic occasion for the call marked the beginning of a new era in Britain's overseas telephone service—the era of International Subscriber Dialling.

For some years Post Office operators in London have been able to dial calls direct to subscribers in a number of European countries. Now some 350,000 subscribers on 65 of London's STD exchanges can dial their own calls to many thousands of subscribers on automatic telephone exchanges in Paris and its suburbs.

And this is only a beginning. By the Spring of 1964 all STD subscribers in London will be able to dial calls direct to all large cities and towns in France and to almost every exchange in Belgium, the Netherlands, Switzerland and Western Germany. Then, by early 1965, Denmark, Italy, Norway and Sweden will also be brought into the system. Later, and probably some time in 1965, STD subscribers in Birmingham, Edinburgh, Glasgow, Liverpool and Manchester will be able to dial their own calls direct to subscribers in France, Denmark, Norway and Sweden and in 1966-67 subscribers in more large cities and towns in Britain will be able to do so.

This new development in our overseas telephone service is going to bring some important benefits both to subscribers and to the Post Office. Since 48 more circuits have been provided to handle the increased traffic and because Continental operators will not now have to connect the calls, the service between London and Paris will be much quicker. Subscribers will be able to obtain their calls by dialling in about the same time—a matter of seconds—that it takes to make a dialled inland trunk call.

The Lord Mayor of London makes the first subscriber-dialled call from London to Paris. On his left is Mr. Ray Mawby, the new APMG.

In addition, since dialled calls from London to Paris are now being charged in 2d. units for every 4.28 seconds and there is no three-minute minimum as there was under the old system, many subscribers will be able to save money. They will, in fact, pay only for the time they use.

The new service will almost certainly attract more business on the London-Paris route and at the same time will help the Post Office to deal with much more traffic without having to increase its staff of French-speaking operators.

As Mr. Ray Mawby, the recently appointed Assistant Postmaster General, said when asking the Lord Mayor of London to make the inaugural call, "We are moving as fast as we can towards our ultimate goal of enabling every subscriber in this country to dial his own calls to as many people as possible in other countries."

The first telephone conversation between London and Paris took place only 72 years ago over a cable laid by HMTS *Monarch* between St. Margaret's Bay in Kent, and Sangatte, in Northern France. This cable had two telephone circuits of 160lb copper wire per nautical mile and cost £23,704.

M. Jacques Marette, French Minister of Posts, Telegraphs and Telephones, receives the first direct-dialled telephone call from London.

In the first year just over 25,000 calls were made in both directions (today about 914,000 calls a year are made from Britain to France, of which about 800,000 are from London to Paris).

To meet the increasing demand for telephone service between Britain and France the system was extended to other principal French towns and to Birmingham, Cardiff, Bristol and several towns in Lancashire and Yorkshire in 1904. Seven years later four circuits were in operation between London and Paris and in 1912 a zone system was introduced.

The Anglo-French telephone service re-opened after World War One with five Paris circuits and one each to Boulogne, Dunkirk and Lille, and by 1925 this number had increased to 21, of which 18 were to Paris.

The next important developments were in 1930 when the United Kingdom ship-to-shore service was extended to Paris and later to all parts of France and when another Anglo-French cable, between Canterbury, Seabrook and Le Portel was opened.

Until 1933 the British end of overseas circuits had terminated in a special foreign section of the London inland trunk exchange but in that year a separate International Exchange of 121 sleeve controlled positions equipped for 480 Continental circuits was opened at Faraday Building. In December, 1933, another Anglo-French cable was brought into use.

Since World War Two the number of circuits has grown rapidly and by February, 1963, there were 192 in operation in both directions. Now, with the introduction of International Subscriber Dialling, there are 240.

★

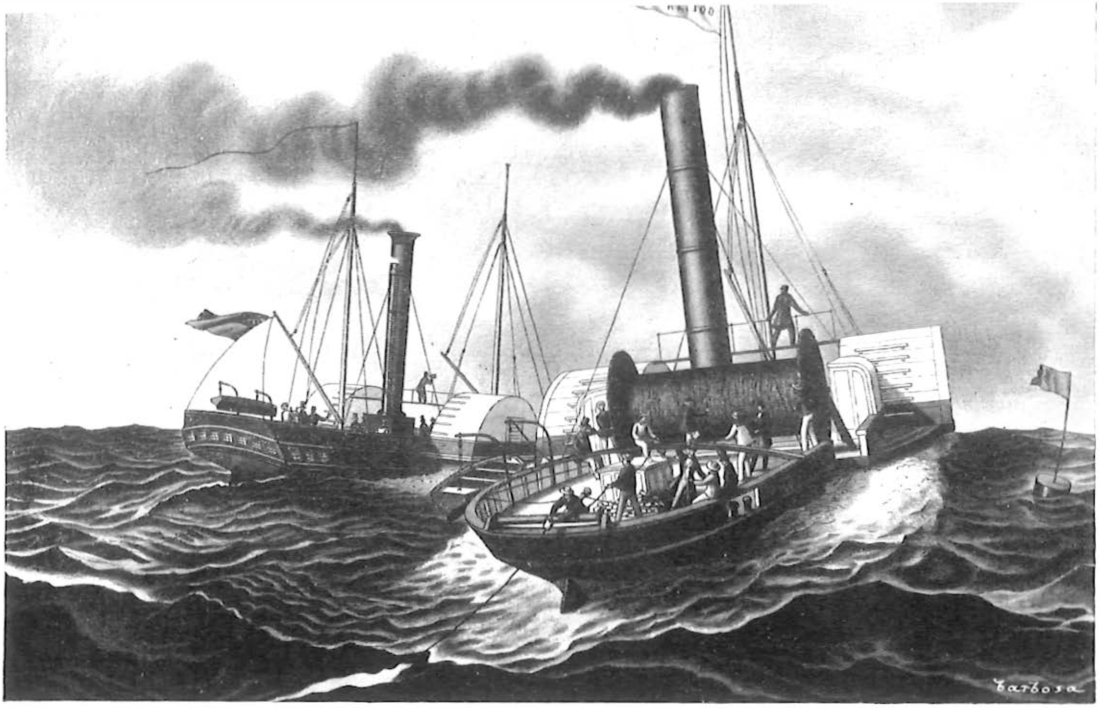
By the end of February this year Subscriber Trunk Dialling had been introduced at 455 exchanges in Britain, with a total of 1,585,000 connections, or 30.1 per cent of all connections in the country. At the end of January, 1963, 26.5 per cent of the inland trunk traffic was subscriber trunk dialled.

●

Nearly 27,000 subscribers are now holding about 69,000 telephone credit cards. Regulations permitting the use of credit cards in the Channel Islands came into force on 25 March.

●

The first part of the Fiji-Hawaii section of the COMPAC submarine cable was laid in January by the Cable and Wireless cable ship *Mercury*. The operation, which involved the laying of 1,166 nautical miles of cable, 45 submerged repeaters and three equalisers, was successfully completed on 30 January when the cable end was buoyed off in 3,000 fathoms.



Accompanied by HM Steam Survey ship *Widgeon*, *Goliah* lays the first Submarine cable from Dover to Cap Gris Nez on 28 August, 1850.—Courtesy: *Illustrated London News.*

EXPANDING THE NORTH SEA CABLE LINKS

By O. P. SELLARS
and Miss J. E. TEAKLE

The European telephone cable network has grown rapidly since the first telephone cable, with two circuits, was laid across the English Channel 72 years ago. Today, by submarine cable and microwave radio link, there are more than 1,300 circuits in use to the Continent. Yet even these are not enough. So, to cope with the ever-increasing demand for telephone service in both Britain and on the Continent many more cables are to be laid across the North Sea in the next few years. The first of these new cables—between Britain and Western Germany—will be completed early in 1964 and the rest (another to Germany, two to Holland and one each to Denmark and Norway) will be in operation by the end of 1966. Capacity to Belgium will be increased by inserting transistorised submerged repeaters in an existing cable. This article describes how the European network has expanded since 1891 and discusses the possible future requirements

THE first cable across the English Channel was a telegraph cable laid in 1850 by the steam-tug, *Goliah*. More than 40 years passed before the first submarine telephone cable was laid in 1891 to provide two circuits between London and Paris and, for the first time, telephone conversations were possible between Britain and the Continent of Europe.

From this very small beginning the number of speech circuits between Britain and the Continent has grown in the past 70 years to more than a thousand, routed in 18 different cables across the Channel and North Sea.

Although a number of cables were laid to France and Belgium in the 30 years from 1891, only 15 circuits were in use in 1920. In the next 20 years up to the outbreak of World War Two, eleven cables were laid to the Netherlands, Belgium and France. By means of landline extensions an international service, hitherto confined to France and Belgium, was rapidly expanded to embrace the whole of Europe and the number of circuits to and from London increased to nearly 200.

When the service was re-opened in 1945 rapid expansion quickly followed. New techniques, such as coaxial cables with submerged repeaters along their length, enabled many more circuits to be provided and greater distances to be spanned. Direct cables were laid to Norway and Sweden and the French route was strengthened by a line-of-sight microwave link. By 1960 the number of public telephone circuits between Britain and the Continent had increased to nearly 800.

Today just over 1,300 circuits are in use to the Continent. These include about 1,050 public speech circuits and the rest are telephone circuits either leased for private use or channelled to carry telegraph traffic. The circuits are routed in cables over four main routes—to France, Belgium, Netherlands and Scandinavia. Circuits to Spain, Portugal, Italy and Switzerland are obtained by way of France and circuits to Germany and East European countries are routed more or less equally between Belgium and the Netherlands. Denmark is obtained by way of the Dutch cables and Luxemburg via Belgian cables. Of the working circuits 580 are routed via the French cables and radio link, 650 by way of the Dutch and Belgian routes and 80 are to Scandinavia.

Only a few spare circuits remain in the routes across the North Sea. Circuit estimates in 1960 showed that the routes to Holland and Belgium would probably be exhausted by 1964 and that the routes to Scandinavia and France would probably be fully employed a few years later. It was clear that extra capacity was required across the North Sea rather than across the English Channel. However, since the length of the crossing no longer

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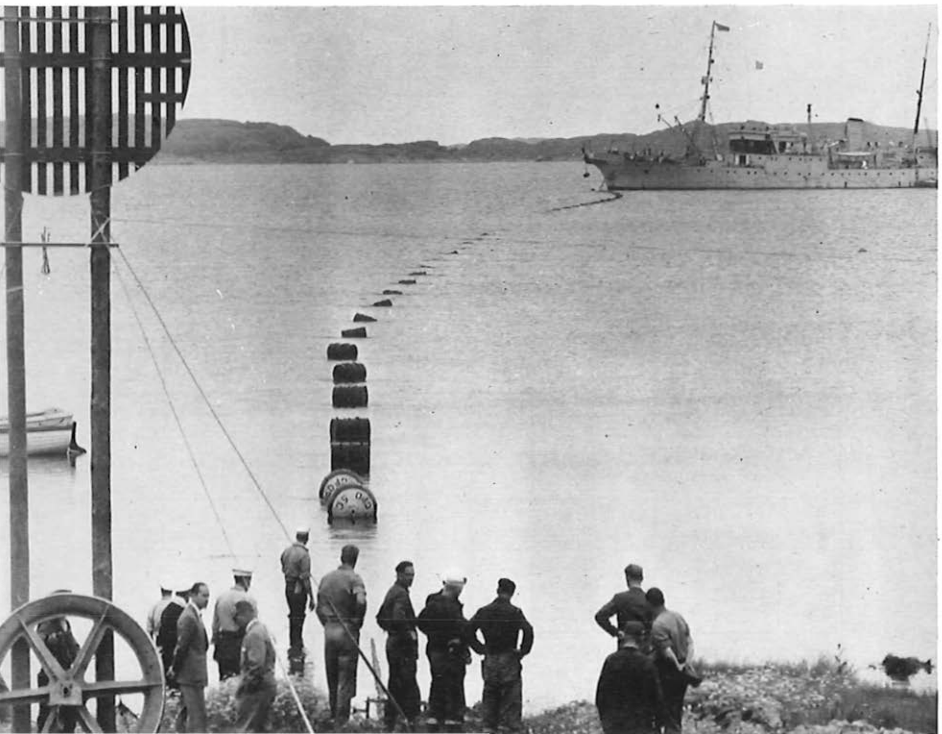


HMTS *Ariel* laying the shore-end of the Anglo-Swedish cable off Sandvik, Sweden, in May, 1960.

NORTH SEA CABLES (*Contd.*)

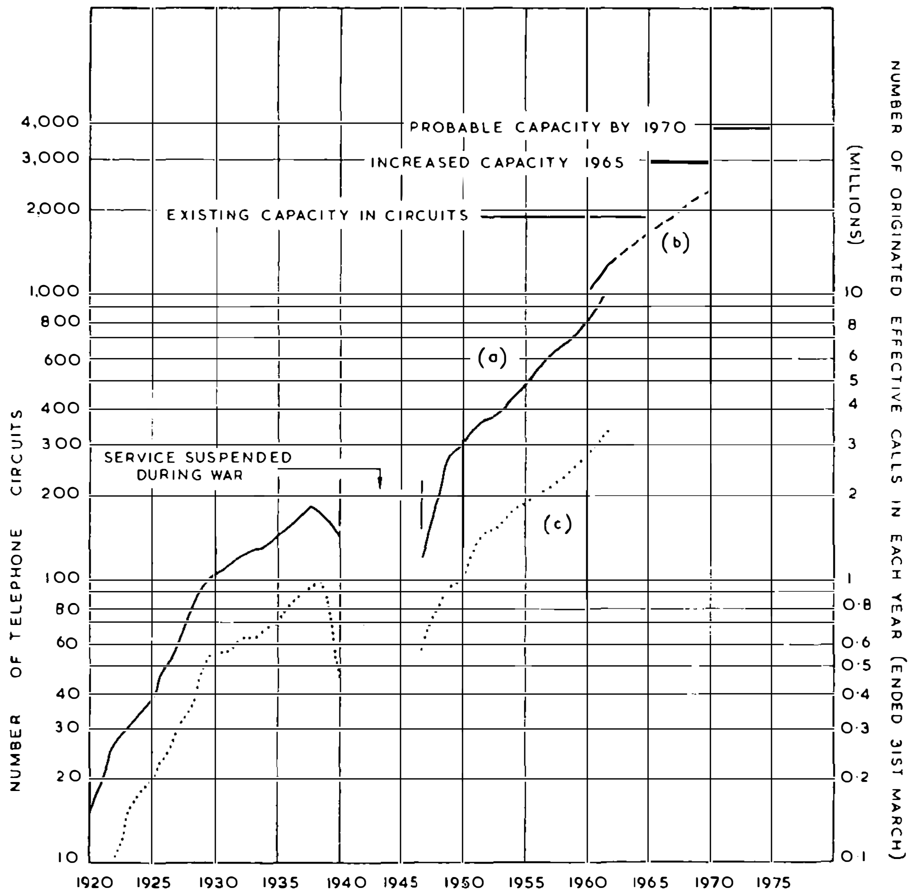
presented technical difficulty it was not immediately clear in which country, or countries, the new cables should be landed. Germany and Denmark were the only countries bounding the North Sea which were not directly connected by telephone cable to Britain. The Netherlands and Belgium (through which the German and Danish circuits are routed) would require to be consulted in any proposal for a direct cable and this could mean reducing their revenue from transit traffic.

Previously, the provision of a new cable was simply a matter of bilateral agreement between the administrations of the countries in which the cables landed. The new situation seemed to require all the countries bounding the North Sea to be consulted to secure agreement on what cables should be provided and to draw up a timetable of service dates. In this way the rather piecemeal development which had taken place since 1891 could be replaced by a comprehensive plan.

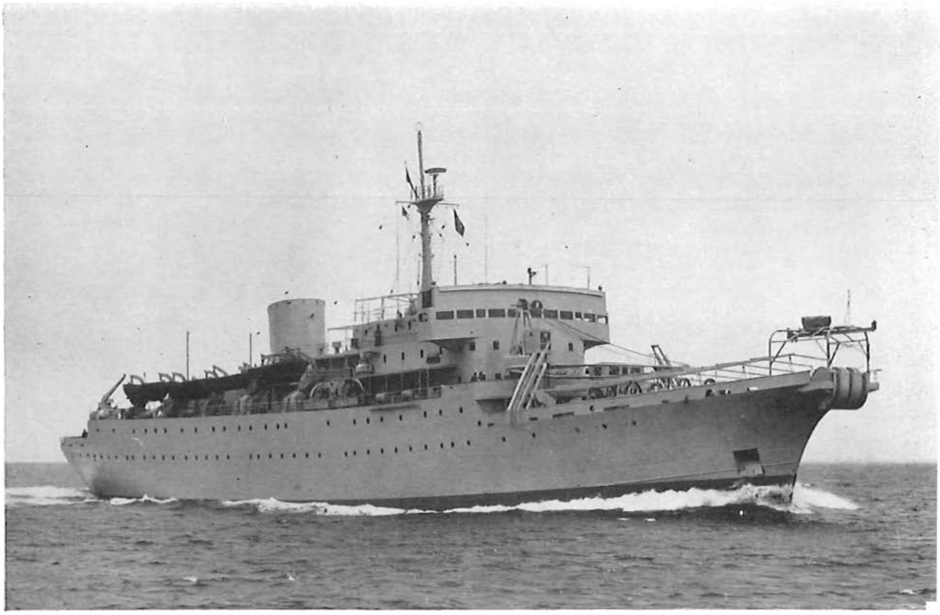
Another reason why a plan of this kind was considered necessary was that the growth of circuits envisaged was such that five or six new cables might need to be laid within as many years. A single plan agreed by all the countries involved would ensure speedier placing and completion of contracts and the provision of sufficient circuits to cope with subscriber dialling from here to the Continent in 1964. Except for a few short cables such as those between Denmark and the Netherlands and between Denmark and Sweden, all North Sea cables radiate from Britain. The British Post Office was thus in a unique position of being able to co-ordinate and progress the plan, and towards the end of 1960 the External Telecommunications Executive invited the administrations of countries bordering the North Sea to discuss proposals for increasing the circuit capacity to the Continent.

The North Sea Cable Conference, held in London in February, 1961, was attended by representatives from Great Britain, Belgium, Denmark, France, Western Germany, Holland, Norway and Sweden. After discussing traffic forecasts and various engineering and financial considerations,

This graph shows how the number of telephone circuits and calls has grown since 1920. (a) denotes public telephone circuits; (b) growth of circuits, all types, foreseen by the North Sea Conference; (c) the annual number of originated effective calls.



HMTS *Alert*, the Post Office's newest cable-laying ship, will probably lay the new North Sea cables. Launched in 1960, *Alert*, which has diesel-electric engines, is commanded by Capt. J. P. Ruddock and has a complement of 120 officers and men. She is 418 ft. long.



including the relative merits of cables and tropospheric scatter radio links, the delegates agreed the following provisional programme of new cables over the succeeding five or six years: two to Germany, two to Holland, one to Denmark, one to Norway, with extension to Sweden, and one to Belgium. It was also agreed that these cables should generally provide 120 circuits of 4 Kcs bandwidth, the maximum capacity permitted by technical developments at that time.

Good progress has been made with the planning arrangements and, following invitations to tender on an international basis, contracts have been awarded to Standard Telephones and Cables Ltd for all the cable, repeaters and terminal equipment for the cables to Germany, Denmark and the first of the new cables to Holland. It is hoped that the first Britain-Germany system will be in operation in February, 1964, and the second in December, 1964. The Danish and Netherlands systems are planned for service towards the end of 1964. This will mean that an additional 500-odd circuits will be available to cope with International Subscriber Dialling (ISD). The 0.62 inch cable has been chosen for these four systems.

As a result of technical developments, cables with capacities in excess of 120 circuits are now practicable and, in the light of fresh traffic studies, it has been agreed that the second new cable to Holland should be a high capacity system carrying 420 or more circuits. This is expected to be ready for service by June, 1966. The cable will be 0.935 inch type.

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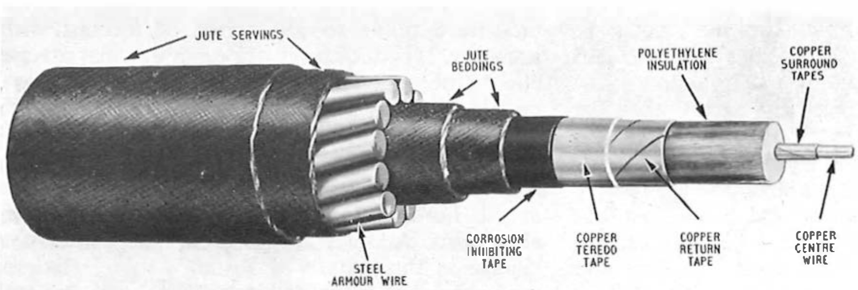

A section of the 0.62 cable (shore-end type) which will be used on the links from Britain to Germany, to Denmark and to Holland.

Assembling one of the newly-developed transistor submerged repeaters which will be used in one of the Anglo-Belgian cables to increase its capacity from 216 to 420 circuits.—Courtesy: *Submarine Cables Ltd.*

NORTH SEA CABLES (*Contd.*)

The last of the new cable routes now in the planning stage is the Britain-Norway-Sweden scheme. The landing points for this cable in Britain will be at Cayton Bay, near Scarborough, and at Kristiansand, in Norway, and the scheme is being planned to be ready for service in December 1966. The capacity of the cable, which will also be of the 0.935 inch type, will be 264 circuits.

New terminal stations are being built at Winterton, Norfolk, for the German and Danish cables and at Covehithe, Suffolk, for the cables to Holland. New coaxial cable routes will be laid between the terminal stations and London.

The London Conference also agreed that the capacity of one of the Anglo-Belgian cables (St. Margaret's Bay-La Panne No. 6) should be increased from 216 to 420 circuits to provide reserve capacity against breakdown, and a contract has been placed with Submarine Cables Ltd for recently developed transistor-submerged repeaters and terminal equipment. The existing circuits will be temporarily re-routed by way of the Anglo-French microwave link between Tolsford Hill and Loos which is to be augmented by an additional broad-band channel. For the time being the project for an additional cable to Belgium has been deferred.

By 1965, with four new cables and a second radio link to France, the present number of circuits will be increased by more than a half and by 1970 should be more than doubled.

Whether these new cables will suffice until 1970 depends on several factors, the influence of which on future traffic trends cannot be forecast with accuracy. It is not known, for example, what precise effect International Subscriber Dialling will have on telephone traffic. The inevitable stimulus which ISD will give will be partly offset by the elimination of operator holding time and possibly by a reduction in paid time per call, although delegates at the London Conference were not unanimous about this. Another factor is the possibility of a change in the pattern of Britain's trade relations with other European countries. The experimental communications satellites *Telstar* and *Relay* have shown that telecommunications by way of relay stations in outer space are possible but it is not known yet either when a commercial satellite system will be in operation or whether it will be practicable to use it for comparatively short-distance traffic.

The 1961 Conference was the first of a series that will probably be needed from time to time to review traffic trends and to take heed of the latest engineering developments.

★ Information for this article was obtained from *One Hundred Years of Submarine Cables* by G. R. M. Garrett, MA, MIEE and Post Office Green Paper No. 43 by Captain J. G. Hines, MIEE. The authors thank their colleagues in ETE and the Engineering Department who gave valuable assistance.

THE AUTHORS

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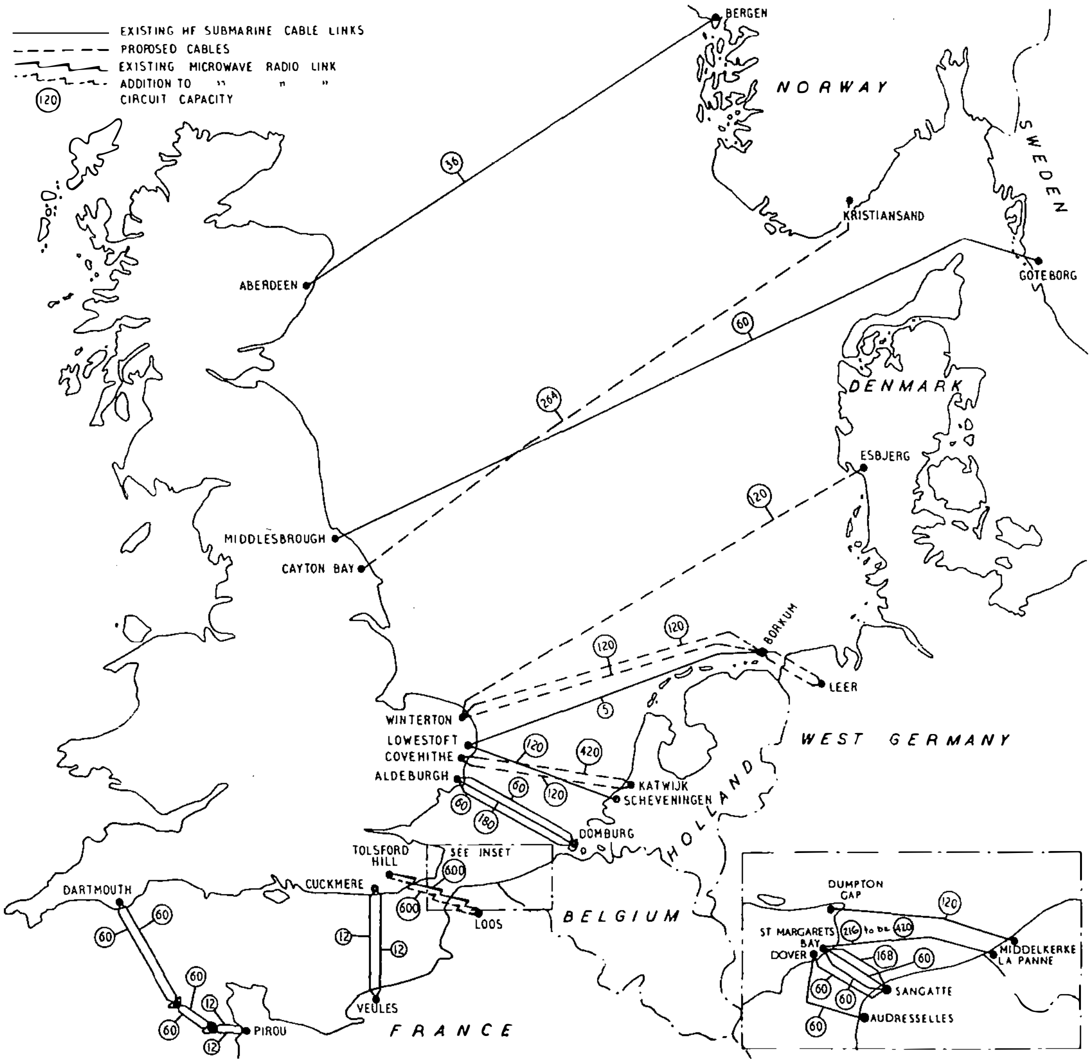
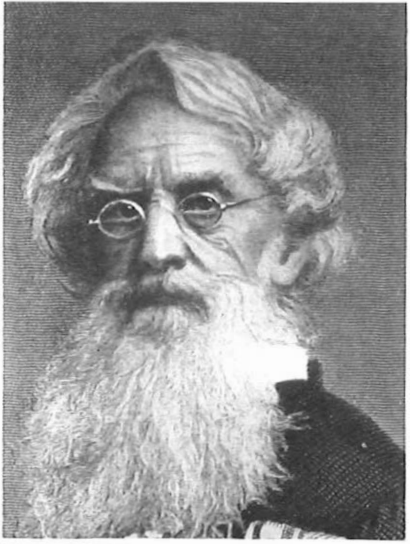
Miss J. E. Teakle *joined the Post Office as a Clerical Officer in the Accountant General's Department in 1939. After three years in the Auxiliary Territorial Service during World War Two, she returned to AGD and was promoted to Executive Officer in 1949. Three years later she transferred to the Inland Telecommunications Department and on promotion to Higher Executive Officer in 1960 moved to the External Telecommunications Executive. She is now engaged on work connected with satellite communications.*

This map shows the existing and proposed submarine cable and microwave radio links across the Channel and the North Sea.





Samuel Morse, inventor, painter, electrician.

IN HONOUR OF SAMUEL MORSE

SAMUEL Morse, inventor of the world-famous code which bears his name, has joined the select band of people commemorated on plaques on London buildings.

Ninety years after his death in 1872, a plaque to his memory has been unveiled at 141, Cleveland Street (then 8, Buckingham Place, Fitzroy Square) where Morse lived from 1812-14.

Samuel Morse, born in Massachusetts in 1791, came to London at the age of 20 to study painting under Sir Benjamin West, President of the Royal Academy. On his return to the United States he was recognised as one of the most important of early American painters, of landscapes and portraits.

It was not until the 1830s that Samuel Morse developed a serious interest in the science of telegraphy and, oddly, the invention for which he will always be remembered was only an incidental part of a much more comprehensive idea. Long convinced that the primitive telegraph instruments of those days could be improved, Morse began in 1832 to experiment on new and more efficient systems. By then the principle of electro-magnetism had already been applied to telegraphy but the instruments in use left no record of the message and generally depended on a magnetised needle spelling it out by swinging from side to side, by striking bells or pointing to letters and figures round the edge of a dial. These machines were also very slow and fatiguing for the operator to watch.

What was needed, said Morse, was an instrument to record reliably and more rapidly a message as it was sent and which could also be read at leisure. Thus, he conceived the idea of a recording telegraph in which a series of electro-magnetic impulses were transmitted to a pencil suspended over a revolving drum. The pencil responded to the long and short impulses by writing long and short undulations which, in various combinations worked out by morse, represented letters and figures.

Later, Morse built an experimental model of his recording telegraph but the device was so complicated that he and another American, Alfred Vail, set to work to simplify it by introducing the now-familiar Morse key. Morse and two other inventors, Gale and Henry, then developed a relay mechanism which boosted signals every 20 miles.

Morse and his comrades now had a practical telegraph system and in 1839 it was put into service between the Supreme Court in Washington and Baltimore. Almost immediately the operators found that they could quite easily read the long and short sounds the apparatus made. Thus, Morse code was born and the need for the device which Morse had spent so long to perfect no longer existed. Within the next 20 years or so the Morse code was being used all over the world.

Alderman H. C. Rowe, of St Marylebone Council, unveils the plaque at the house where Morse lived 150 years ago.

The Royal Army Pay Corps' IBM 705 computer installation at Worthy Down, showing an officer at the console. This computer, which deals with soldiers' pay accounts, was used for the 1961 national census.
Courtesy: SOLDIER, the British Army Magazine.

Which Computers?—

THE TSU HELPS TO FIND THE ANSWER

By J. W. FREEBODY

A small and little-known group in the Post Office—and one with a vitally important job to do for all Government departments—is the Technical Support Unit of the Engineering Department. With a staff of only 18 engineers and scientists, it carries out, on behalf of the Treasury, searching investigations into automatic data processing systems, assessing their technical merits and thus helping in the selection of the most efficient and financially economic computers for office work in Government departments

SINCE it employs in this country about a million civilians, some 400,000 of whom are classified as industrial and the rest as office staff, it is not surprising that the British Government has had a long-standing interest in mechanisation.

All Government departments, acting on the overall advice and stimulus provided by the Treasury Management Services, are constantly pursuing means of increasing their efficiency, work in which Organisation and Methods officers play an important role.

Much has already been accomplished. One index of the degree of mechanisation so far attained is the consumption of punched cards which, in some 70 Government punched-card installations, now amounts to about 1,500 million a year.

When the electronic digital computer appeared in the early 1950s it was soon apparent that it was

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THE TSU *(Contd.)*

a powerful new tool of enormous utility in science and engineering, in industry and commerce and in Government and defence. By its nature, a computer can do whatever we know how to order it to perform, and, since it works incredibly quickly, accurately and tirelessly, it can make a striking contribution to efficiency.

In the clerical mechanisation field it was obvious that much that was new had to be learned if costly failures in the use of computers were to be avoided. It was also clear that comprehensive organisational and work studies and comparative costings of manual and other methods would have to be carried out to determine whether a computer system was feasible and economic in any given application. The need for staff education and consultation and for specialised training of selected staff in computer system analysis and programming was also recognised. It may surprise some to learn that the cost of planning and programming a computer project and the initial conversion of data commonly ranges from 50 to 100 per cent of the cost of the computer system and may even exceed this if the project is large and complex and involves integrating a number of previously separated work processes. The need for care in the feasibility and planning stages and in organising work for the computer to harness it most economically is, therefore, self evident. Equally important is the need to choose the best equipment for each project. This is no easy task with the large number of competing systems and the rate at which new designs appear.

Technically, computer systems consist of a good deal of electronic equipment and devices assembled into complex logical structures coupled to many forms of high-speed electro-mechanical equipment —all operating usually in an air-conditioned room. Thus there are many technical features which must be taken into account when comparing the merits of different designs and long-term reliability and maintenance aspects are important factors.

The efficient and timely exploitation of automatic data processing systems in Government service means that as much as possible must be known about the current state of the art and developments so that the planning of new fields of exploitation are started as soon as possible. The Treasury and departmental project officers have to study current designs of systems to determine their suitability for given projects and their views have to be supported by critical technical appraisals of the logic, engineering and programming aspects. Many other technical considerations—for instance, how and to what standards should computers be tested before acceptance and how, by whom and to what standard should computers be maintained—also have to be taken into account.

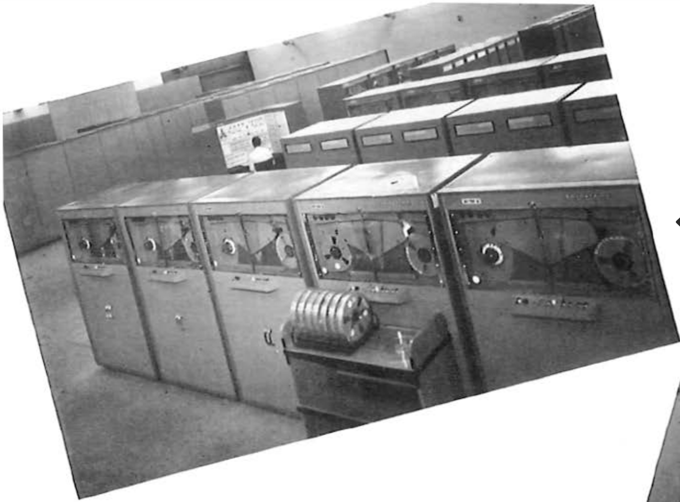
Obviously, technical specialists, skilled in computer engineering and working closely with the Treasury and Departmental project officers, are required to give their advice and it was for this reason that the Treasury, in agreement with the Automatic Data Processing Steering Committee* set up the Technical Support Unit (TSU).

The TSU was formed to provide a consultative service to the Treasury Organisation and Methods Division† on automatic data processing systems for office work in Government departments and to undertake or arrange experimental work necessary to find solutions to data processing problems.

The Unit's technical consultative service includes giving advice on development, manufacture and supply as well as on the problems of operation, such as programming and maintenance. To achieve this aim the Unit makes itself familiar with operating and technical developments in this field throughout the world and advises the Treasury on

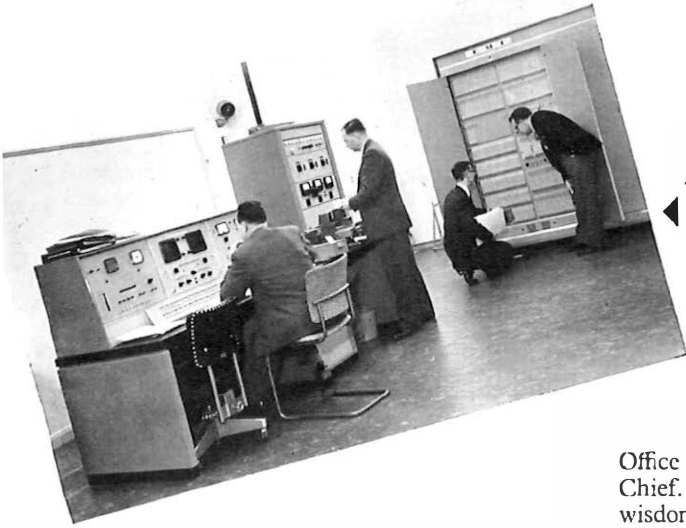
◀ The Admiralty's EMI 1100 computer at Copenacre which carries out naval stores accounting and provisioning work. Left: a programmer at the console. Right: operator at punched card reader.

*The ADP Steering Committee was constituted in 1957 to supervise the development of long-term plans for the use of automatic data processing systems for office work in Government departments and to supervise their development, planning, provision and method of operation.



The main computer room at the Ministry of Pensions and National Insurance headquarters at Newcastle where data for the Government graduated pensions scheme is processed. The computer is an EMI 2400.

The MPNI graduated pensions scheme computer showing (right) the console and (left) the paper tape reader and punch.



The Ministry of Labour's Emidec 1100 computer installation at Watford. This machine is transistorised and British made.

technical aspects of training and allied specialist staffing problems. The Unit is also at the disposal of all Government departments.

In addition, since it is essential to link the Unit to a source of experience in allied technical and scientific fields, it was decided that organisationally, the TSU should be housed within the Post Office under the supervision of the Engineer-in-Chief. Subsequent experience has confirmed the wisdom of this arrangement and the TSU, formed in April, 1958, with a Staff Engineer in charge, has since grown to a total of 18 engineering and scientific staff in three sections which are responsible for *(a)* systems appraisals and acceptance testing; *(b)* engineering design and installation and maintenance problems; and *(c)* programming techniques and problems.

†The title of the Treasury Organisation and Methods Division was changed recently to Management Services.

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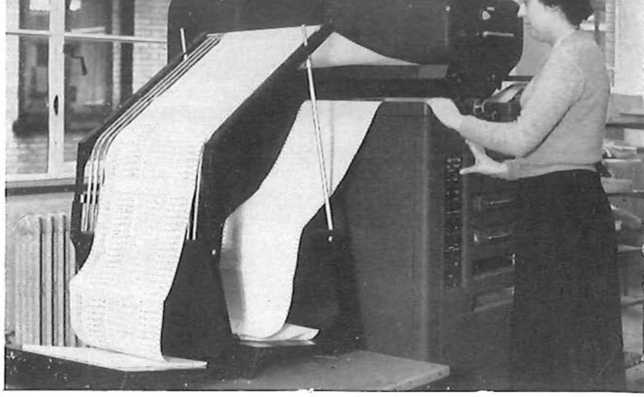

Two pictures of the Post Office's own LEAPS computer system. Left: An operator prepares data in punched tape form for input to the computer. Right: Payroll documents for issue to local pay units being printed by one of the two high-speed Samastronic printers. The printhead shown here is driven electrically from magnetic film on which payroll details have been recorded by the computer.

THE TSU *(Contd.)*

It has not been possible for the TSU to undertake much work in its own laboratory but close contact has been maintained with the research and development work carried out in numerous contractors' laboratories and with Government research establishments, such as the National Physical Laboratory and the Royal Radar Establishment.

The TSU investigations cover the design, manufacture, testing and maintenance of systems and seek to reveal the state of development and production of new systems when, as frequently happens, they are marketed before their design is complete. If a system is already in use by other customers information on their operational and maintenance experience is sought.

Ideally, computer systems should be investigated before purchase with the thoroughness normally given by the Engineering Department to a new telephone exchange design or transmission system. Since this is not practicable, the design study is made as exhaustive as the available effort and time allow and is needed to form a sound technical judgment. This means examining all peripheral equipments and the logical and circuit structure of the system. The circuit techniques and components and their conditions of use are also studied.

The capacity of the channels used for transferring data in and out and within the computer and the execution times of orders in the instruction code are closely looked into to verify that data rates accord with the contractor's claims. The pulse distribution and timing features of the system are also examined to check that adequate margins exist to give a good performance. This technical examination aims to reveal any technological restrictions not apparent from the sales and other literature and especially restrictions in the operation of peripheral equipments, for example, the rate at which commands may be given to magnetic tape units.

Nor must the possible need for future expansion of the system be overlooked. The size of the core store, for example, frequently has to be augmented to increase the machine's working capacity and additional tape decks and peripheral items may also have to be added. The TSU therefore assesses the practical expansion, the ease with which this can be accomplished and possible upsets to the user's work.

In addition, the programming features of the machines and the nature, extent and availability of programmes are assessed, as well as the contractor's competence and capacity to give adequate assistance to the project, including facilities from programme testing. The contractor's manufacturing and testing facilities and methods are also examined to judge his competence to meet delivery dates.

The design and availability of the programming "software" has an important bearing on the ease with which a project can be converted to automatic data processing and its subsequent running efficiency and profitability. The TSU is paying increasing attention to these aspects in its studies of systems, particularly since the subject is assuming greater importance with the emergence of more sophisticated programming languages and of machines capable of parallel processing.

Normally, no computer system is worth buying if it cannot be relied upon to give a consistently good performance and unless it can be economically maintained for at least ten years. For this reason close attention is paid by the TSU officers to the many design features which have a bearing on reliability.

The best modern computers and peripheral equipments are very reliable and maintenance costs and out-of-service time are reasonably low. Some, however, are not so good and experience indicates that although the electronic portions are usually extremely reliable and present little difficulty to good quality maintenance staff, the high-speed electro-mechanical equipment is much more of a problem and can even be a hazard. This is particularly noticeable when the devices have not been exhaustively developed and tested by the contractor before marketing. To check reliability TSU engineers have to spend a great deal of time studying and testing peripheral equipments and following up any further development work necessary to overcome defects. One investigation method which has proved profitable in revealing the reliability and maintenance requirements of new peripheral equipment has been to end a TSU study with a five-day operational trial in the contractor's laboratory under simulated field conditions and using critical test programmes. As a result many useful modifications have been made.

The Post Office proposes to make much greater use of computers in the future. Plans for large-scale development of computer applications are now being considered by the Central Organisation and Methods Branch which is responsible for computer systems in the Post Office.

Following an investigation by the Technical Support Unit it has been agreed with the Treasury that in general, and until more experience is gained, contract labour should be used for maintaining Government automatic data processing installations. Contractors tendering for automatic data processing equipment for Government projects are required to quote their annual charges for maintenance and give some indication of the likely changes in costs over a ten-year period. These figures are taken into account when assessing the relative merits of competitive systems. The contractors' technical organisation and competence for field maintenance and the arrangements they propose for individual projects, including the

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Mathematicians and scientists at the Post Office Research Station, Dollis Hill, prepare data programmes for the National-Elliott 803 computer.

THE TSU *(Contd.)*

backing services they have available, are also studied in detail before a contract is awarded.

After a computer system has been installed fault statistics are submitted monthly to the Treasury and the TSU so that a watch can be kept on performance and any technical or maintenance weaknesses brought to light.

The contract arrangements for Government purchase of automatic data processing equipment include a number of technical conditions which seek to ensure a good long-term standard of performance. Standard conditions and principles governing trials which the equipment must undergo at the contractor's works and for on-site acceptance tests are also laid down. The time table and the details of the tests employed in these trials are laid down by the TSU and agreed with the appropriate Government department and contractor. The latter is responsible for operating and maintenance during a trial but the TSU supervises and adjudicates on behalf of the Controller of the Stationery Office. The Stationery Office is the contract authority for all Government automatic data processing projects, except those for the Post Office whose own Contracts Department will, in future, be responsible. The acceptance trials of Post Office computers are carried out by the Engineering Department.

Since 1958 some 30 computors have been installed for clerical purposes in a number of Government departments and many more are on order or in various stages of planning. More than £3 million has been spent on automatic data processing equipment for Government projects so far and a further £10 to £15 million is expected to be involved in other projects planned to become operational by 1970 and which include several large computers for Post Office clerical mechanisation schemes.

The pace of technical development of automatic data processing equipment is very rapid as many new devices and techniques emerge from priority research and development work on defence equipment. Many contractors can supply systems and competition is keen. Deciding which is the best buy is not easy and involves considerable team effort, in which the Technical Support Unit plays a vital part in co-operation with many skilled people in Government departments and in the Treasury.

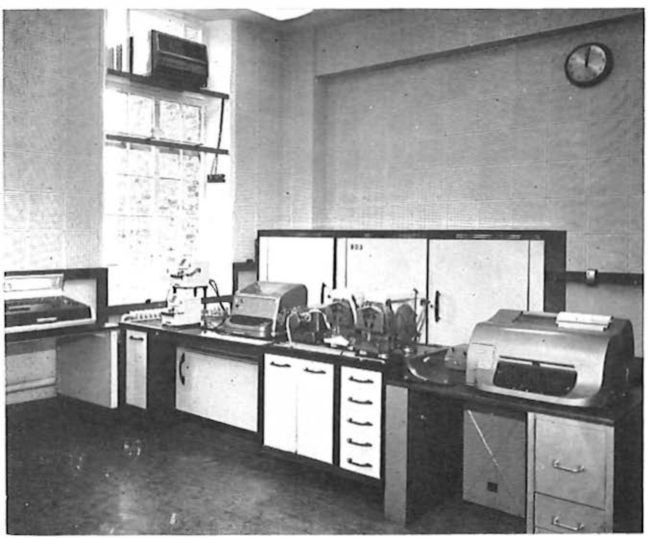
Computers are indisputably here to stay as reliable and valuable devices for improving efficiency and integrating work processes. Their intelligent employment, however, demands a well-co-ordinated effort in which organisational, operational, engineering, economic and human factors are adequately considered.

Management at all levels must taken an active interest in the exploitation of these new techniques and engineers and other staff who provide support in the fields of application are assured of an interesting professional life in resolving the many problems and the satisfaction of contributing to increasing efficiency.

In the Post Office, apart from the use of computers for clerical mechanisation and management purposes, scientists and engineers are finding benefits from using computers to help solve problems in research, design, planning and in the economics of plant utilisation and operation.

The uses to which computers can be put will doubtless grow and play an increasingly important role in improving the quality and productivity of scientific and engineering work.

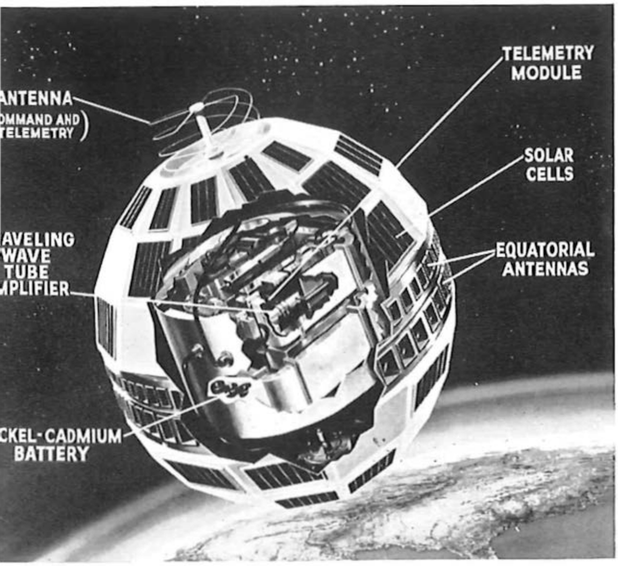
A general view of the National-Elliott 803 computer at Dollis Hill, showing the console and input and output equipment. Among the many programmes this computer has carried out are calculations involving valve design, design of electrical filters and the design problems relating to coaxial cables and transmission systems.



The Author

Mr. J. W. Freebody, Whit.Sch., BSc(Eng), ACGI, DIC, MIEE, Staff Engineer in charge of the Technical Support Unit, began his career in the Post Office Engineering Department in 1933 as a Probationary Assistant Engineer. He spent 20 years in the Telegraph Branch, covering all aspects of the development, provision and maintenance of the telegraph service and being promoted to Executive Engineer and Assistant Staff Engineer during that time. In 1958, when the Technical Support Unit was set up, Mr. Freebody was promoted to Staff Engineer and took charge of it.

HOW TELSTAR WAS CURED



A cutaway drawing of *Telstar*. The decoder is immediately below the travelling wave tube amplifier.—*Courtesy: American Telephone and Telegraph Company.*

THE remarkable story of how the disabled *Telstar* satellite was brought back to life by scientists and engineers reaching out 800 miles into space is told by the American Telephone and Telegraph Company's magazine *Long Lines*.

It is an impressive achievement, described by Mr. A. H. Mumford, Engineer-in-Chief of the British Post Office, as "in some respects even more wonderful than the original launching".

The story began on 23 November last when *Telstar*, after faithfully performing all that had been asked of it, suddenly refused to answer commands from the earth. Fortunately, the statellite's telemetry equipment continued to operate and sent back messages about its internal condition and on the radiation it had encountered. From these reports it was apparent that *Telstar* had been put out of action by absorbing too much radiation.

On the ground, the Bell Telephone System engineers and scientists went to work. What had happened and how could it be corrected? They knew that some transistors react strangely when exposed to large amounts of radiation and decided that the fault was in the transistors in the decoders—the instruments which receive ground signals and translate them into action in *Telstar*.

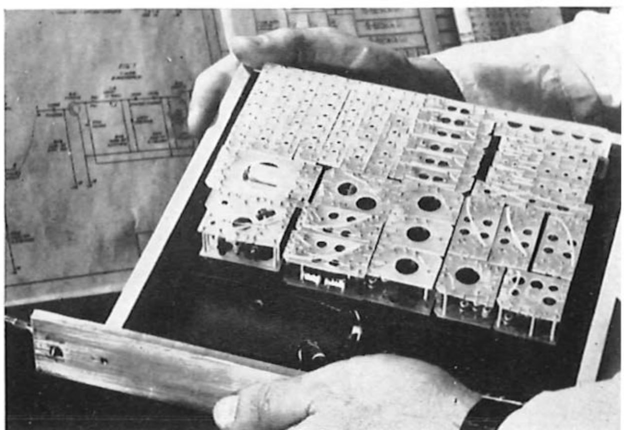
A number of laboratory tests were carried out and as a result it was found that transistors affected by surface radiation sometimes recover when the voltage is reduced or removed. But could the voltage in some way be removed from the transistors in *Telstar's* decoder, circling the earth 800 miles away? In the beginning this seemed impossible since the only known way was to disconnect the satellite's batteries and this could be done only by sending a command to *Telstar* via the decoder which was not reacting to messages—a perfect example of the vicious circle.

But the scientists and engineers were not beaten. They built a duplicate decoder and subjected it to the same radiation which *Telstar* had suffered. The duplicate decoder failed in precisely the same way as the decoder had failed in *Telstar*. Detailed testing showed that the fault lay in one transistor in the "zero gate" one of the two "gates" which allow impulses to pass through. The "gate" opened by the long pulses was still working and the chances were that this was so with *Telstar*, too.

So far, so good. But how could the affected "gate" be made to function again? The scientists finally hit upon the idea of sending a long pulse with a notch in the middle which would trick the decoder into registering a short, or "zero" pulse. The idea was tried out on the duplicate decoder and it worked.

OVER

A duplicate of *Telstar's* decoder which went wrong.—*Courtesy: AT and T Coy.*



TELSTAR *(Contd.)*

On 20 December, the scientists and engineers sent two commands to *Telstar*. The first worked, turning on a switch, and the satellite leapt into action.

Shortly afterwards more commands were sent up to *Telstar* to switch the power supply from the storage batteries directly to the solar cells so that when the satellite passed into the earth's shadow, all power would be removed. In this way *Telstar* would be given a short rest that might cure it of its radiation sickness. There was a chance that full power would not be able to be switched on again in which case *Telstar* might never again operate successfully. But the chance had to be taken.

As it turned out, normal command was partially restored after *Telstar* had passed through the earth's shadow several times and fully restored on 3 January this year after the switching-off treatment had been repeated. The next day *Telstar* successfully relayed live television across the Atlantic.

To ensure that this extremely skilful long-range operation does not have to be carried out again, *Telstar II*, due to be launched as the *Journal* went to press, has been subjected to much stronger radiation tests and its most vulnerable components are being extensively shielded.

A BRITISH STEP INTO SPACE

THE Government is to carry out a detailed study to determine a suitable design for a British space communications satellite. Two systems will be considered: the medium orbit of 7,500 nautical miles, which would require a large number of satellites; and the synchronised orbit where a much smaller number would be put up to a height of 22,300 nautical miles.

This significant first step towards a British system of world-wide communications by satellite was announced in Parliament on 29 March by Mr. Julian Amery, Minister of Aviation, who said that the Post Office would be helping with the studies.

The first stage in the plan will be undertaken under the joint guidance of the Royal Aircraft Establishment at Farnborough and the Signals Research and Development Establishment at Christchurch. The former will deal with the satellite and the latter with the communications system. The communications branches of the Armed Services will also co-operate in the studies.

Mr. Amery said that the project study will be carried out on the assumption that the satellite would be put into orbit by the European Launcher Development Organisation's three-stage launcher, the first propulsion stage of which is Britain's Blue Streak rocket. It was thought that the ELDO launcher would be powerful enough to put the satellite into a medium orbit but that a little more power or an additional motor will be needed to put it into the higher, or stationary, orbit. The ELDO launcher was planned to put a test pay-load into orbit by 1966-67.

The Woomera site in Australia will probably meet every requirement during the development of the satellite but an additional site nearer the equator might be needed for launching an operational communications satellite.

"Our tentative conclusion," added Mr. Amery, "is that it should be possible to develop and produce, if it were so decided, a space communications system by the time the ELDO launcher is ready so that no time would be wasted by international negotiations or any aspect of that kind. We could be ready within about two or three years of the Americans."

During the debate on the motion calling for the provision of a British and Commonwealth telecommunications satellite, the Assistant Postmaster General, Mr. Ray Mawby, said Britain was determined to take its proper place in this new era. Britain's own studies had been directed at a system employing 12 satellites in an equatorial orbit but by itself this would not constitute a global system.

"The capital cost of such a separate system might be £160 to £190 million, the annual cost ammounting to £32 to £37 million."

The Post Office's experimental Satellite Communications Ground Station at Goonhilly was nearer the design of the ultimate operating station

Mr. W. J. Bray

Mr. F. J. D. Taylor

A 50,000-MILE 'PHONE CALL—TO THE HOUSE NEXT DOOR!

AT about 10.30p.m. on 21 March, Mr. F. J. D. Taylor, Staff Engineer in the Space Communications Systems Branch, and Mr. W. J. Bray, Staff Engineer in the Microwave and Space Systems Division of the Engineering Department's Research Branch, who both live in Wembley, had a three-minute telephone conversation.

Nothing unusual in that, you might think. But there was. Although Mr. Taylor and Mr. Bray are next-door neighbours, their voices were travelling over some 50,000 miles on one of the two longest-distance telephone calls ever made.

Mr. Taylor and Mr. Bray were speaking to each other by way of the satellite *Relay*, each being linked by landline to the Post Office Satellite Communications Ground Station at Goonhilly Down, Cornwall. Remarkably, reception was as clear as if the call had actually been made direct from the next door house.

The telephone conversation between Mr. Taylor and Mr. Bray was the second time in one day that a 50,000-mile telephone call had been made. They were both achieved by connecting all the 12 channels in the multi-channel carrier equipment at Goonhilly and sending the conversations up to and down from *Relay* six times before passing them on.

The first 50,000-mile call was made from Goonhilly by way of *Relay* by Mr. R. W. White, Asst. Staff Engineer in the RWD Division of the Research outstation, Castleton, who telephoned Captain C. F. Booth at his home in Harrow and, on behalf of the staff at Goonhilly, wished him good luck on his retirement as Deputy Engineer-in-Chief.

Telephone calls over such vast distances are a considerable achievement and of great interest in relation to the static three-satellite system of world-wide communication. Under this system the three satellites would be stationed at a height of 22,300 miles above the earth, each visible to a third of the earth's surface and travelling at the same rate as the earth revolves. Signals relayed by way of satellites are subject to delay in reception but until now the effect of the delay on conversation has not been known. In fact, the delay on both conversations made over the 50,000 miles calls up to *Relay* and back again six times was one-third of a second.

In recent weeks the Goonhilly station has also been involved in sending and receiving telephone, telegraph and television signals to and from the United States by way of both *Telstar* and *Relay* and engineers at Goonhilly and at Rio (Brazil) ground stations have exchanged telephone conversations.

Step into Space (*Contd.*)

than any other in the world, added Mr. Mawby. "We are now going to improve and extend the equipment at Goonhilly so that it will be ready to become an operational station when the first regular system of communication satellite is put into orbit.

"We are also putting in hand a design study for the communications part of the equipment which goes into a satellite—the radio receivers and transmitters which pick up the signals from the ground stations and re-transmit them back to earth at increased power."

Right: An oper
Exchange in Lo
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On 30 March this year operators at the International Exchange in London and at the White Plains Exchange in New York dialled the first telephone calls direct to subscribers on opposite sides of the Atlantic. The introduction of semi-automatic working on the trans-Atlantic cable route to New York (soon to be available, too, between Britain and Canada) is a big step forward to the day, which may not be too far distant, when subscribers in Britain will be able themselves to dial direct to other subscribers in many parts of the world. In this article the author describes the new system and highlights its many advantages

DIALLING

SINCE TAT I—the first trans-Atlantic telephone cable—was brought into service in 1956 the development of terminal equipment has progressed steadily to provide an increasing number of traffic channels. Perhaps the most notable advance was the introduction of TASI (Time Assignment Speech Interpolation) equipment which, with the additional cables laid since 1956, has led to a substantial expansion of the North Atlantic routes and to a corresponding increase in traffic.

Apart from minor progressive changes, operating procedures have not been greatly affected by this expansion. But the next stage—operator dialling across the Atlantic, made possible by further technical development—involves a complete change of methods.

The basic effect of this change is to provide the facility for operators in the London International

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number. Left: A White
calls a London number.
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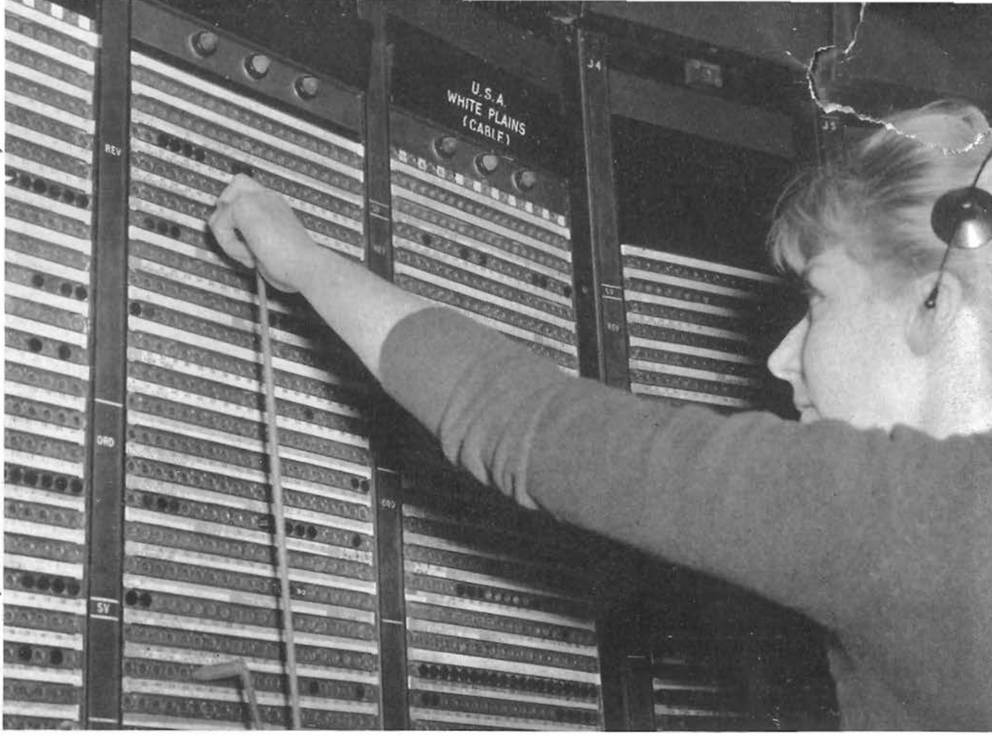
four-wire switching sys-
the multi-leaf bulletins.



ACROSS THE ATLANTIC

By M. BOULTON

Exchange and the White Plains Exchange, New York (the "gateway" exchange for calls between Britain and the United States) to complete calls directly to customers on the other side of the Atlantic without the assistance of another operator in the called country.

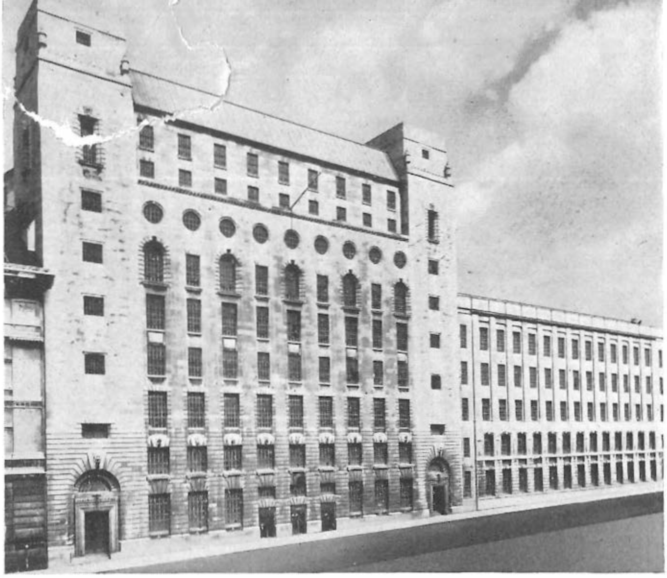
Before considering the resultant changes to operating procedure let us take a look at the American internal telephone numbering system.

The United States (including Alaska, Hawaii and the Caribbean Islands) is divided into 104 Number Plan Areas (NPA), each identified by a three-digit numerical code. Since it is geographical this division at once pinpoints an important factor in the identification by the London International Exchange operator of the information she needs to route a call to an American customer, that is, the need for her to know the name of the place to which the call is required in addition to the number of the called telephone. To avoid confusion between places with the same name, the name of the state in which the place is situated must also be known.

In any one NPA all customers' numbers which can be reached semi-automatically (the very large majority of the 75 million telephones in the United States) consist of either seven numerical digits or a two-letter code, plus five numerical digits. In the latter case the two-letter code is always the first two letters of the name of the exchange and within any one NPA there is no duplication of numbers.

The full telephonic address of an American telephone subscriber is, therefore: Place name, State (or NPA code), plus (*a*) exchange name and number, or (*b*) two-letter, five-figure number, or (*c*) seven-figure number.

OVER



Faraday Building, London, home of the International Exchange where the Continental Exchange is also housed.

TRANS-ATLANTIC DIALLING *(Contd.)*

It is obviously impracticable to include in the International Exchange Visible Index Files (VIFs) all the 35,000 or more cities, towns and localities listed in the United States' NPA code directory.

A list of the most frequently called places in the United States was, therefore, obtained from an analysis of tickets for calls made from Britain during an average week and only those places in which all exchanges can be reached semi-automatically were included. This has resulted in the inclusion in the VIFs of 110 place names, the states in which they are situated and the appropriate NPA codes. This list includes New York City, in which there are 425 exchanges, as a place name to which 50 per cent. of the traffic from Britain is directed. It is expected that about 95 per cent. of calls from Britain to the United States will be routed semi-automatically.

This form of presentation of information for places in the United States has been used in the International Exchange since September, 1962, and has enabled International Exchange operators to pass forward the routing information, in addition to the called customer's number, when setting up a call via the White Plains operator under the manual procedure. More important, it has helped to familiarise them with this type of routing detail.

In addition to the routing information for calls to subscribers, the VIFs also include two other items of information for each place name listed. The first is the routing code to enable International Exchange operators to reach operators at the Terminal Toll Centre (analogous to Group Centres in Britain) for assistance or Directory Enquiry information. The second is the start number of the coinbox telephone number series which can be used to confirm whether, for a transfer charge call, the called number is that of a coinbox telephone—in which case the call booking is passed to the White Plains incoming operator to complete—or an ordinary telephone—in which case control of the call is retained by the London operator.

The presentation to White Plains operators of routing information for exchanges in Britain is somewhat different. In the White Plains operators' routing information (their multi-leaf bulletins) each United Kingdom exchange to which access is required is listed individually and shows the numerical equivalent of the STD code and, as a second listing, the numerical equivalent of the code, if available, to reach the Directory Enquiry operator.

Records of incoming traffic have been analysed to determine a comparatively short list of exchanges to which access can be given and to which there is sufficient traffic to justify their inclusion. The result is a list of all the exchanges in the London director area and 292 others, including some of the exchanges in provincial director areas and some manual exchanges. Although all the director exchanges in the provincial director areas are accessible to White Plains operators, the multi-leaf bulletins include only those most frequently called so that the total number of exchanges listed is reduced to manageable proportions.

Semi-automatic working on the TAT cable brings operators of some manual exchanges in Britain into direct contact with operators in America without the intervention, unless specifically required, of a London International Exchange operator. It is not envisaged, however, that an "inland" exchange operator should do more than attempt the connection of a straightforward call or, since operating procedures and expressions in our inland system differ considerably from those used in the international services, give Directory Enquiry information to White Plains operators. In the United States the inland and international procedures are similar and advantage is being taken of this to provide the London International Exchange operators with direct access to Terminal Toll Centre operators in the United States by keying the "operator code" shown in the VIF appropriate to the place required, followed by the code "121". The tremendous size of the United States, which prevents the White Plains operator from having, in many instances, more information than the London operator of "local" conditions, makes this facility particularly valuable. To obtain Directory Enquiry information for the place required the London operator keys the appropriate "operator code" followed by "131".

The next two stages in the connection of a call semi-automatically to the United States presents the International Exchange operators with a new method of selection of overseas circuits and brings into much greater prominence the use of the key set, which has hitherto only been used infrequently for overseas calls extended to the European continent.

Under semi-automatic working the TAT circuits are no longer individually accessible from the switchboard outgoing junction multiple but are terminated on switching equipment. Access to them is gained by keying a single digit code ("1") via one of the group of common access circuits in the outgoing junction multiple.

On straightforward calls the American ringing tone is received, followed by the establishment of a satisfactory direct connection between the International Exchange operator and the called customer. One of three other American tones or verbal announcements can, however, be encountered.

1. *"Busy" tone, 600 c.p.s., 60 i.p.m. (0.5 secs on, 0.5 secs off): Called subscriber's line busy.*
2. *No circuit tone, 600 c.p.s., 30 i.p.m. (0.3 secs on, 1.7 secs off): Circuit congestion between switching centres in the United States.*
3. *Re-order tone, 600 c.p.s., 120 i.p.m. (0.2 secs on, 0.2 secs off): United States local switching centre equipment or local circuits busy.*

A tape recording of these tones has been obtained from the American Telephone and Telegraph Company and is being used in the training of the International Exchange operators.

If all the TAT circuits are engaged when the operator attempts to set up a call, the British "equipment busy" tone is received.

On the American dial the letter "O" is placed with the figure "6" instead of the figure "o" as in Britain and American equipment is designed to accept six pulses instead of ten for the letter "O". It is necessary, therefore, for International Exchange operators to recognise the letter "O", if it appears in the first two letters of the American exchange name or in the two-letter portion of a two-letter, five-figure number, and key figure 6 and not the figure zero. A label is attached to the key plate next to the "MN6" key to remind operators of this need.

Semi-automatic working provides another ingenious facility known as "language assistance" which is being used by American operators and operators in European countries other than Britain. But for working between Britain and the United States there is expected to be little need for "language assistance".

Nevertheless, having keyed a call direct to a subscriber's number and received an answer or a tone signal, it may still be necessary for the controlling operator to seek the assistance of the incoming "gateway" operator—for instance, to obtain interpretation of an unrecognised tone signal or a quotation of the cost of a transfer charge call. This latter facility is particularly useful to London operators. Without it they can quote only an approximate rate since calls paid for in the United States are subject, in addition to the normal telephone call charge, to a tax which varies from place to place, and it would be impracticable for them to hold and consult comprehensive records of surcharges. This type of assistance can be obtained by operating the cord circuit SPEAK key and the position RING CALL key which operates a calling signal at the incoming "gateway" exchange. The intervention of the incoming operator into a call by this means does not disturb the original connection.

It is possible with semi-automatic operation to connect the majority of calls without the assistance of an incoming operator. But some will still require the attention of an operator in the called country—where, for example, the required place

OVER

The White Plains Exchange, New York, "gateway" for calls between the two countries. — *Courtesy A.T. and T. Coy.*

TRANS-ATLANTIC DIALLING *(Contd.)*

or exchange is not listed in the routing information or the charge for a transfer charge call is to be charged to a coin-box telephone in the United States (a facility not allowed for calls to Britain). In these cases the controlling operator obtains the help of an incoming operator by keying a special code instead of the subscriber's number. In London this is "151" to obtain a White Plains incoming operator and in the reverse direction "Code 11", for which a special key is provided in the key set.

For a call to a place routed via, but not terminal, in the United States, the International Exchange operator has to book the call forward to an operator at the White Plains (New York), Oakland (California), or Miami (Florida) exchanges depending on the destination of the call. Under manual operation this involved a connection from London to a White Plains incoming operator and from there to the required "interchannel" operator. Semi-automatic working now enables the London operator to call this latter point direct by keying the appropriate "operator code", followed by a particular code allocated to the required "interchannel" operator, for example, the "Japan" section operator at Oakland.

For calls to Britain the situation is simplified because all calls are handled in the one exchange in London. But the advantages offered by semi-automatic working are being used to provide the White Plains operator with direct connection, by keying "Code 12" (for which another special key is provided in the key set), followed by a three-digit code, to the "interchannel" call booking operator in the International Exchange for calls beyond Europe, or by a two-digit code to the "extended" call booking operator for calls to places within Europe but outside Britain.

Another example of this streamlining of procedure afforded by semi-automatic working is the "leave word" call facility which is very popular in the United States and is becoming increasingly so in Britain. If the required subscriber is not immediately available on a "person-to-person" call, the individual answering the telephone can request that the called subscriber should advise his "international" operator when he becomes available to accept the call. In these circumstances the person answering is advised to tell the called subscriber to ask his "international" operator for a specific operator number at the controlling exchange where the ticket for the call booking will have been deposited to await action. This latter operator is known as the "leave word" operator. When the called subscriber reports his availability to his "international" operator she passes this report directly to the controlling exchange "leave word" operator by keying, for example, Code 1249 into London, for a call originating in Britain, or "1130" into White Plains for a call originating in the United States. Then, if the person making the call is available the call can proceed.

The introduction of semi-automatic working on the TAT cable may pass unnoticed by the customer. So, no doubt, will the introduction of this system to Canada in 1964. But, paradoxically, it is a very significant step towards subscriber dialling across the Atlantic. Although some very difficult problems remain to be solved before this is possible there can be no doubt that trans-Atlantic International Subscriber Dialling is only a matter of time.

One important effect of the new trans-Atlantic operator dialling system is that a cable circuit will not be taken into use until the complete number has been dialled. In addition, should there be any difficulty, one operator will be more easily able to help the subscriber through to the wanted number.

The system is already in use on short-sea cables, such as those across the English Channel and in other parts of the world, but this is the first time it has been used over such long-distance submarine cables from Britain.

When the new trans-Pacific telephone cable—COMPAC—is opened later this year operators will be able to dial direct from London to Australia (and similarly in the reverse direction). Operator dialling between London and Canada and New Zealand will follow.

The Author

Mr. M. Boulton joined the Post Office in 1945 as a Youth-in-Training at the Research Station, Dollis Hill, subsequently becoming a Skilled Workman IIA. In 1948 he moved to the London Telecommunications Region, East Area, as an Assistant Telecommunications Superintendent, and then to Home Counties Region in 1950 where he became a Telecommunications Traffic Superintendent.

On promotion to Senior Telecommunications Superintendent in 1958 Mr. Boulton went to the External Telecommunications Executive, spending one year (1960-61) as Exchange Superintendent of Continental Exchange. He is at present in the Operational Projects and Developments Section of Operations Division.

SPIRIT DUPLICATION SAVES TIME—AND MONEY

By A. HANSON and W. R. PARRY

★

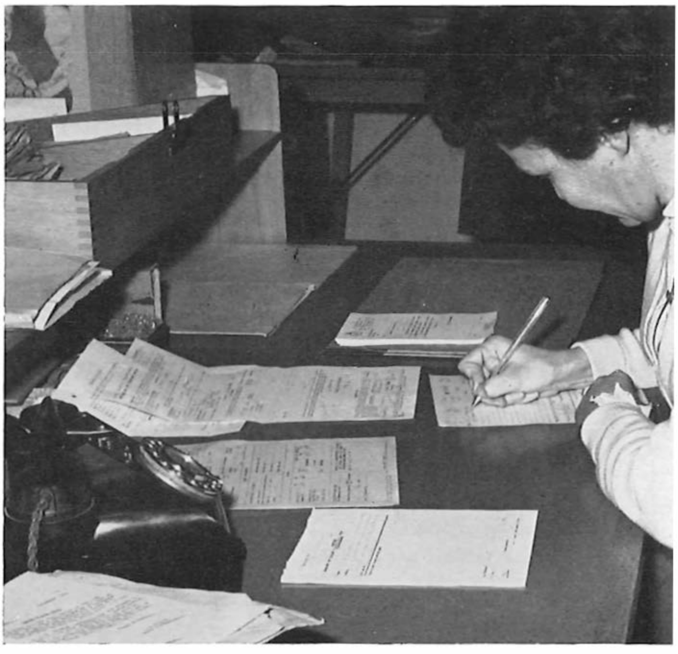
Just over five years ago the Chief Clerk and a Higher Executive Officer at the East Telephone Area Headquarters revived the idea—previously considered by the Central Organisation and Methods Branch but put into cold storage because the techniques then available were inadequate—of producing telecommunications forms by a speedier, more reliable and more efficient method called spirit duplication. Now, spirit duplication is to be extended throughout the country and is expected to save the Post Office at least £35,000 a year. This article—describing an outstanding example of local initiative and co-operation with Headquarters—tells how some of the problems were overcome and how spirit duplication works

THE story of the successful application of spirit duplication in the Post Office goes back to August, 1957, when a new type of spirit duplicator came to the notice of the East Telephone Area Headquarters.

This type of machine enabled one to duplicate up to 300 facsimile copies of the original from handwritten masters, on the back of which a carbon impression was formed. It was more reliable and produced much cleaner and more accurately registered copies than any previous system had been able to achieve.

It was first suggested that the machine would be suitable for producing jointing and diversion schedules (A154s) prepared in planning groups for use by external field staff working on local line development schemes and generally needing one sheet for each distribution point. Previously, the copies had been prepared in manuscript with ordinary carbons and the bottom copies were not always legible. Producing between five and eight

OVER



Mrs. Olive Waters, a clerical officer at East Area headquarters, prepares the master copies of the advice notes.

Mr. W. R. Parry (left) and Mr. A. Hanson look on as advice notes are run off at East Area HQ by Miss Ellen Welsh.

SPIRIT DUPLICATION (*Contd.*)

copies meant at least two hand-written sets and sometimes three.

A case for the use of the spirit duplicator, from which it was thought that a saving of about 2,000 man hours a year could be made, was put forward. At the same time it was envisaged that other work, including area correction transfer schedules and number change lists, could be done by the machine to save the equivalent of a typist and that it might also be suitable for producing advice notes.

The machine was received in East Telephone Area Headquarters in February, 1958, and, after consultation between the authors and the local Clerical, Drawing Office and Engineering staff representatives, production of A154s began. A little later an Area instruction describing the new process and inviting new jobs for it was issued.

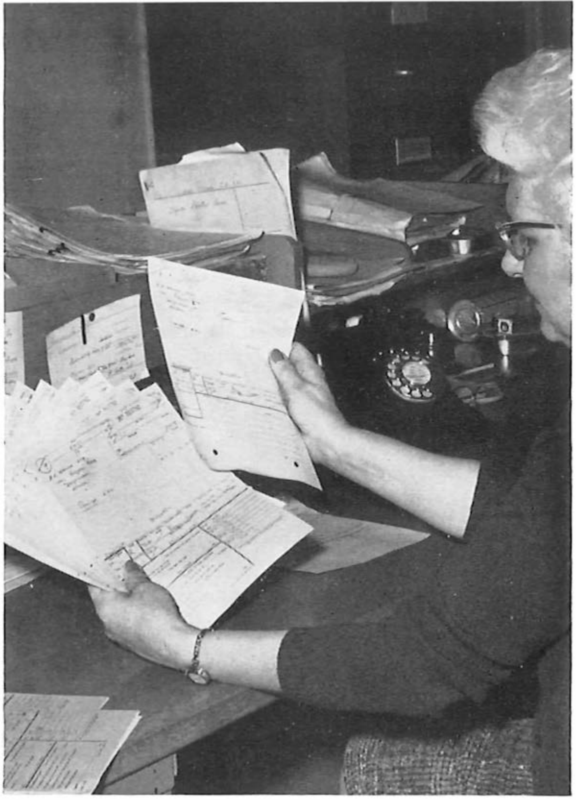
Initially there was difficulty with the type of carbon paper supplied but when this was overcome it was clear that spirit duplication was going to save a great deal of time. Jobs which previously had to be typed could now be written by the originators and distributed more quickly. On occasions the process was used for tasks requiring up to 300 copies.

Once the success of the machine in producing A154s and a wide range of instructions had been established, it was decided to take up again the original suggestion, which had been anticipated to some extent but had not then found favour in some Headquarters departments, of producing advice notes by spirit duplication. The main virtue of the machine was its ability to turn out quickly rather more copies than could conveniently be produced by typing and carbon paper. The upper limit seemed to be about 300 copies. Above that number the Area's electric stencil duplicator was more suitable.

The authors carried out some experiments locally to produce dummies on plain paper, using stencilled imitation advice notes and the spare "pinks" of normal printed advice notes. This made clear that while the printed advice note forms could be used they were not entirely satisfactory. Ideally a special print of the advice note paper, designed particularly to allow more room for writing in details, should be used. At that stage doubts about the success of the venture were overcome only by the knowledge of the considerable savings which might be gained.

Fortified by further experience, the authors asked London Telecommunications Region Headquarters for permission to carry out a small-scale experiment in producing live advice notes, pointing out that this work in the East Telephone Area office occupied the time of about three typists and was accomplished only at the expense of delaying other work each day until all the advice notes were completed. It was known that, in other areas of the London Telecommunications Region, where there was difficulty in obtaining typists, advice notes which could be produced in a few hours by spirit duplication were habitually delayed by a week or even longer.

It was also emphasised that since advice notes produced by spirit duplication were exact facsimiles of the text written by the Sales Territorial Clerical Officer, no further checking would be needed in Sales and the advice notes could, if necessary, be issued direct from the machine. Although there would be objections that a hand-written copy was not as legible as a typed one, it was pointed out that many other important documents in use in the



Mrs. M. D. French, a clerical assistant, sorts advice note copies for distribution.

Post Office were also hand-written. The Sales Clerical Officers issued on an average only between five to ten advice notes a day and it was not asking too much to expect them to be written carefully and legibly. A standard instruction laying down how an advice note should be written would reduce errors. The seven-copy advice notes then being produced on non-electric typewriters were often hard to read on the fourth to seventh copies, and 3s. and 8s., for instance, tended to be confused. But duplicated copies were as good at the 50th as they were at the first and additional copies could easily be run off where previously two or more typings were necessary.

The idea of going back to a hand-written advice note was a novel one and even the oldest of old hands could not remember anything but typed ones. It was not surprising, therefore, that LTR Headquarters should take some time to think it over before deciding to back the proposal.

There were three main objections to the scheme. The first was that hand written advice notes would be insufficiently legible, even if the copy was perfect. Post Office Headquarters said—and proved—that the pro-formas used as drafts for typists were by no means legible. However, it was pointed out that the writers knew that their writing was known to the typists, that the typed advice note would be returned for checking and correction and that the pro-forma was not the final accounting document. In the experiment the authors envisaged that the advice note would be examined by the Clerical Officer but the main intention was simply to check that the copy was perfect. It had been discovered, too, that the Premium Bond Office had found that in one month in 1958 out of 760,000 application forms written by the public fewer than 50 queries were caused by bad writing of names and addresses, suggesting that when people had a financial interest in writing clearly they could, and would, do so. Similarly, the Clerical Officer who did not write clearly would soon be sufficiently plagued by test clerks and installation offices to cause him to mend his ways.

The second objection—that duplicated copies might be imperfect—was easily shown to be unwarranted since specimens of 50 copies, where the last was as good as the first, could be produced. So long as the right sort of paper was available all copies would be equally good and the duplicator was likely to give a better performance on registration of under-copies than was obtained with a typewriter. As a *tour-de-force*, copies were produced which had been fed through the duplicator twice and where the registration of the second impression with the first was so good that only careful scrutiny could detect that there were two impressions.

The third objection—that exchange clerks and technicians would take longer to read advice notes—was probably true but it was explained that it would be possible with spirit duplication to use a heavy grade of paper for all copies, thus giving increased legibility of the manuscript entries which have to be made subsequently on under-copies.

Later, after consulting the Headquarter departments involved, a Senior Sales Investigation Officer from the Inland Telecommunications Department produced another and seemingly unanswerable objection. The London Telecommunications Region, which had had its own version of advice notes for many years was about to change over to the national style on which the carbon sheets between copies were not the same size as those on the seven-copy advice note with which the

OVER

SPIRIT DUPLICATION (*Contd.*)

authors were familiar. Hitherto, every copy of an LTR-type advice note had contained the same information as the top copy. This was no longer to be so. The new nine-copy pack had been carefully worked out with two sizes of carbon paper to give different amounts of information on the various circulating copies.

There was, it seemed, no solution to the problem. But, happily, the Senior Sales Investigation Officer, with his greater knowledge of the National Advice Note Pack, sat down and worked out the answer.

From that moment the experiment never looked back and after staff side co-operation at all levels had been obtained it was tried out on two sales teams in the East Telephone Area with very promising results.

An instruction for sales clerical officers was prepared before the experiment started. The spirit duplicator masters were numbered serially in a special range provided by the Supplies Department and were treated as advice note packs for security purposes. The Clerical Officer prepared the master, using a ball-point pen and copying the number in manuscript immediately below the printed number, and passed it to the Sales Directory Clerical Officer who made out the Directory Advice Pack (DAP) pro-forma used in LTR and inserted the DAP number on the master.

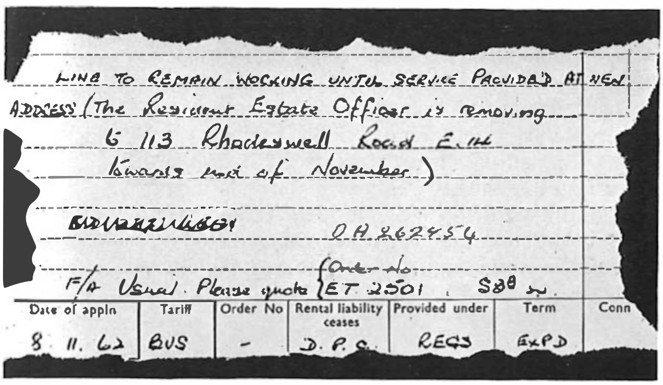
Subsequently it was found that a different type of copy paper was needed. This—with new-type masters which have a top copy, a protective tissue, a piece of carbon attached and bear a pre-printed and reproducing number—was obtained. The masters are treated as security documents in the same way as are the present pre-numbered advice note packs. After removing the protective tissue a clerical officer adds the variable details to the master, using a ball-point pen over a hard, smooth surface, and printing the important details. The completed master is sent to the duplicator operator who loads the machine with copy paper, printed in register with the master, in correct advice note colour sequence and including an orange copy to replace the pro-forma. After the master is attached to the machine the copies, identical with the master and bearing the same number, are produced. A clerical assistant distributes the copies in the normal way but without detailed checking. During the experiments an average output rate of one complete set every 53 seconds was achieved.

Legibility is no problem. In fact, many users say they find the new advice note easier to read than the typed flimsy carbon copies with which they previously had to deal.

The new system is already being used in the East, City, Centre and Brighton areas and it has now been agreed to extend it throughout the country during 1963. Detailed costing of the project shows that the spirit duplication of advice notes is expected to save more than £35,000 a year.

The next aim is to put directory information on to a tear-off strip below the advice note and several other suggestions for further extending the scheme have been proposed. Eventually, it may be possible to send advice notes direct from the duplicating point to the installation office and the exchange.

This story is a lesson in co-operation at all levels and thanks are due to all those in the Central Organisation and Methods Branch, Inland Telecommunications Department, London Telecommunications Region and the Accountant General's Department who contributed to its success and to the members of all grades and divisions of East Area who bore the burden of the experiments.



Part of a master copy showing how an error can be painted out before distribution.

Mr. A. HANSON has been Home Counties Region Procedures Officer (SEO) since 1962. He joined London Telecommunications Region in 1939 and later moved to the Ministry of Home Security. After serving as a wireless mechanic in the Royal Electrical and Mechanical Engineers he returned to LTR North Area, subsequently spending five years at LTR Headquarters in the Buildings Division and three years at East Area.

Mr. W. R. PARRY entered the LTR in 1939 as an Executive Officer and worked in the Regional Finance and Staff branches until 1949, with a five year break in the Forces. He was then seconded to the Treasury's Training and Education Division for 18 months and returned to the LTR on promotion to Higher Executive Officer in the Regional Buildings Division. He has been Chief Clerk in the East Area since 1956.

THE NEW EXCHANGE AT WOOD STREET

By A. I. L. RIPLEY

A view of the "island" suite at the new Wood Street Exchange which will be recovered during the course of the extension. Maximum capacity will finally be reduced to 96 positions.

THE London Continental Control Centre (Wood Street Exchange) which opened on 25 August last is the first Continental exchange to be separated from the main Continental Exchange at Faraday Building.

It is also unique since all operating work is conducted in English.

This double departure from previous practice marks an important phase in the development of the Continental telephone service. The new exchange has already proved to be an outstanding success, providing much-needed relief to the Faraday Building exchange.

Most people picture a Continental exchange as one in which operators are fluent in many languages and able to speak to operators abroad in the latters' own language. In fact, the recognised official operating language is French, though administrations are free to agree on the use of other languages.

In the Faraday Building Continental Exchange, French is the main operating language, English being used on the routes to Scandinavia, Germany, Holland and on a few minor routes where the distant administration finds it easier to recruit English-speaking telephonists. Some Post Office operators are fluent in a number of languages for which they receive additional allowances, but this is primarily to assist foreign callers in this country rather than for operating to another country.

It has always been difficult to recruit enough linguists who are not only fluent in French but who also have sufficient command of English to understand the subscribers' requirements and operate over the inland telephone system. The continuing growth in the number of Continental calls requires more linguist operators and obvious advantages are to be gained by segregating those calls requiring a linguist operator to control them from those which can be controlled by a non-linguist operator. This separation is now accomplished by instructing subscribers in London to dial code 104 for calls to countries where French is the operating language and code 105 for calls to countries to which operating is conducted in English. This facility was already in use in exchanges in the London City and Centre areas to separate these streams of traffic to the Faraday Building Exchange. The Wood Street Exchange could thus be conveniently loaded with either type by diverting the terminations of a sufficient number of code 104 or code 105 circuits. Code 105 traffic was selected because routes operated in English are relatively free from delay working and the problem of equalising delays between the Faraday Building and Wood Street exchanges is thus minimised.

OVER

The London Continental Control Centre at Wood Street is equipped with a low-type multiple.

NEW EXCHANGE (*Contd.*)

The use of two access codes (104 and 105) for Continental calls involves splitting the access routes and so adds to the total circuit and relay set requirements. This has limited the growth of the two-code scheme for the time being but, as soon as additional line plant and associated equipment becomes available, it will be extended to the whole of the London Director Area. The Wood Street exchange will not provide enough positions to take the whole of London's 105 code traffic and the balance will be segregated on separate suites of positions in the Continental Exchange switchrooms in Faraday Building.

The switchroom at Wood Street previously housed the International Exchange. It had a capacity for 117 positions, but for the new exchange the layout is being improved by recovering an "island" suite, thereby reducing the maximum capacity to 96 positions. Until 1964, by which time all positions will be converted to give standard Continental operating facilities, the Exchange will be limited to 55 positions of the sleeve control type, equipped as they were for international working but with minor modifications—such as those necessary in the timing clocks to provide normal and coin-box switching to give a tone signal to the subscriber, and the provision of the new type Visible Index File frame.

The Answering Jack Field has a six-panel repetition and until 1964 no more than 85 booking circuits will be connected. The outgoing Junction Multiple has a four-panel repetition but until the equipment is modified to give a full outgoing multiple of Continental circuits, all calls to the Continent are connected on a junction lending basis over 72 three-wire tie circuits terminating on positions in Faraday Building 5 Main Switchroom.

The tie circuits are equipped with through signalling, sleeve signalling being used to avoid transmission losses. This arrangement enables Wood Street operators to call assistance operators into the circuit at distant Continental *tête-de-ligne* exchanges. Incoming access from operators on the Continent over semi-automatic routes and from the Faraday common service levels to the Wood Street delay positions was provided in December, 1962. This enables operators at the Wood Street Exchange to deal with their own suspended and delayed calls.

Although plans are being developed to open more Continental exchanges to relieve the load on the Faraday Building exchanges, the Wood Street Exchange may well remain unique in being the only centre at which operating is conducted entirely in English since it is not practicable to have a Continental exchange staffed entirely by linguist operators. Any exchange employing linguist operators must also deal with sufficient traffic in English to provide operating experience for potential linguists while they are completing their French training and for the non-linguists who are required for, and spend most of their time on, exchange clerical duties.

Allowing for the progressive introduction from 1964 of Subscriber Dialling on Continental routes operated in English this means that the Wood Street Exchange, when used to full capacity, will probably divert from Faraday Building as much of its Continental traffic operated in English as is operationally desirable. Any further Continental exchanges opened to relieve those at Faraday Building will, therefore, most probably handle traffic in both English and French.

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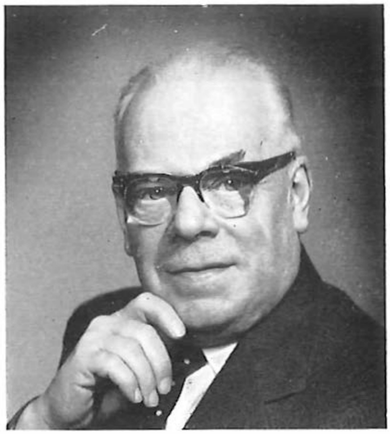
Mr. A. I. L. Ripley entered the Post Office in 1932 as an Assistant Superintendent of Traffic, Class II. He served with the Army for six years in World War Two and since 1954 has been with the External Telecommunications Executive working on telephone and telegraph equipment planning. He has an honours degree in physics and is a Chief Telecommunications Superintendent in the Telephone Operations Section of ETE Headquarters.

Farewell to Captain Booth



Captain C. F. Booth, CBE, one of the world's outstanding authorities on satellite communications.

AFTER some 40 years' distinguished service in the Post Office, during which he earned a reputation, nationally and internationally, as one of the world's leading authorities on radio matters, Captain C. F. Booth, CBE, MIEE, Deputy Engineer-in-Chief, retired on 31 March.

It was appropriate—and no doubt a matter of personal gratification—that his outstanding work in the past few years in the field of satellite communications culminated in the highly successful operation of the Goonhilly ground station which has brought so much added prestige to both the Post Office and to British industry.

Captain Booth joined the Radio Branch Laboratories at the Post Office Research Station, Dollis Hill, in 1923, and worked there for some 25 years. He became an expert in quartz crystal techniques and primary frequency standards and achieved the distinction of becoming the first Staff Engineer in charge of the Laboratories when, in 1949, they became a separate Branch.

In 1951 he left Dollis Hill to take charge of the Radio Planning Branch and was later appointed Deputy Director of the External Telecommunications Executive when it was set up in 1952. He was promoted to Assistant Engineer-in-Chief in January, 1954, and to Deputy Engineer-in-Chief in February, 1960. He was awarded the OBE in 1947, and the CBE in 1956.

His wide experience and competence led to his selection for international conference work. He led the United Kingdom delegation at the Plenary Meetings of the CCIR in Stockholm in 1948, Geneva in 1951, Warsaw in 1956, Los Angeles in 1959, and Geneva in 1963. The Los Angeles meeting was followed almost immediately by a meeting in Tokyo of the Plan Committee, CCITT and ECAFE at which he also led the British delegation. He was the senior British technical delegate at the Extraordinary Administrative Radio Conference in 1951, and led the British delegation at the Ordinary Administrative Radio Conference in Geneva in 1959. In 1961 he also led the British delegation to the VHF/UHF Broadcasting Conference in Stockholm, when agreement was reached on frequency assignment plans for television developments (Bands IV and V). In addition, he was Chairman of CCIR Study Group IX.

Captain Booth's contributions in the international field were exceptional and did much to maintain the position and prestige of both the Post Office and Britain. He also found time to play an important part in the work of The Institution of Electrical Engineers and was for many years a member of the Radio Section Committee, and its Chairman in 1950–51.

With this background, it is not surprising that Captain Booth was able so successfully to lead the Post Office technical effort in satellite communications, work to which he devoted his last three years of service. During this time he visited many countries, travelling more than 70,000 miles in helping to plan tests of experimental satellites.

His many friends in Britain and abroad will wish Captain Booth good luck on his retirement and the Post Office in particular will long be grateful to him for the outstanding services he rendered to the science of telecommunications.

THE NEW CTO AT FLEET

By *W. A. STRIPP*

After 90 years' residence in St. Martin's-le-Grand, the Central Telegraph Office has packed its bags and moved to a new home in Fleet Building. This article traces the beginnings of the new CTO and describes how it is now organised and equipped to provide an even better service

THE story of the new Central Telegraph Office really begins in 1958 when the old CTO was handling overseas phonograms, teleprinter work on behalf of the cable companies and the cable room and certain types of inland traffic, and when it also operated the Inland Telex Service for London and Home Counties Region. There was an extensive street tube system which was proving very expensive to operate, and a telegraph delivery office, and the CTO also provided about 150 telegraphists to 49 other delivery offices in the London postal area.

Most of the inland phonograms originated in London were handled at four appointed offices—known as the ring centres and situated at Stratford, Finchley, Chiswick and Lee Green. These ring centres had been opened for defence reasons in World War Two and by 1958 they had largely outlived their purpose. The CTO building itself, built in 1874, had been severely damaged by enemy action and, although restored, the accommodation was far from satisfactory and the building was ripe for demolition.

In 1958, it was decided that the ring centres would be closed and their work concentrated on the CTO which would be replaced by a new office.

Left: The Inland Telegraphs Instrument Room showing phonogram operators taking down telegrams dictated by London telephone callers.

It had already been agreed that the overseas work should be transferred to Electra House, thus releasing the CTO to take on the work from the ring centres.

The transfer of the overseas work, the closing of the ring centres and the automatisation of the telex exchange took place in 1960 and 1961 and by early 1962, when the street tube system was closed, the CTO had become once more a self-contained unit—now awaiting transfer.

In the meantime planning of the new office went ahead. Following a review of telephone requirements space had become available in the new Fleet Building and it was decided to install the telegraph instrument room in a third floor room originally planned as an automanual exchange. Space was also allocated for the counter and writing and clerical staff, a delivery room, observation room, apparatus room and a small teleprinter workshop.

The removal of the CTO to a new building presented a unique opportunity to establish a large office embodying the best methods, layout and procedure that could be devised and thus to improve traffic handling and service at reduced running costs. One important aim was to reduce the amount of movement, both of staff and of messages, within the office—problems which had been somewhat troublesome in the old CTO.

One of the first tasks was to analyse the make up of the London Inland telegraph traffic—its origin, destination and type and how it was handled. To this end a very detailed survey was made and work-flow diagrams and charts were produced. Procedures and practice at the four ring centres and the old CTO were also studied, with particular reference to the non-operating work which was absorbing between 35-40 per cent of staff hours. These work-flow diagrams were most valuable since they indicated which types of work should be related, those that could be combined, and, in some cases, abolished. The outline plan for the new office layout and organisation was derived from these studies.

The original conception was that combined working should be adopted. This system of combined phonogram acceptance and forwarding, which had been developed a year or two earlier, had been adopted at a number of smaller and medium-sized offices and was also thought to have possibilities for large offices. However, about 70 positions would have been needed in the CTO and the problem of controlling and supervising a combined installation of this size would have presented considerable difficulties. Furthermore, it had been decided to use phonogram automatic distribution (PAD) equipment with call queueing facilities for handling phonogram traffic and there were considerable doubts about the wisdom of adopting combined working with PAD equipment at an office of this size, especially since there had been no previous experience in this particular field.

Finally, it was decided to adopt conventional working, that is, separate suites of phonogram and forwarding positions during the main part of the day (in "large office" conditions), but to seize the advantage of combined working during nights and at weekends, excluding Saturday mornings (in "small office" conditions). Fourteen combined positions were therefore provided for use as forwarding positions only during the day but for combined acceptance and forwarding at night. (For this latter purpose they are paralleled with

OVER

Forwarding telegrams to their destinations.

Above: A close-up of the incoming printergram section showing the compartments for the abbreviated address cards. Note the small size of the cabinets on the right.

Left: Telegraphists at work in the printergram section at the new CTO. They are handling telegrams to and from telex subscribers.

THE NEW CTO (*Contd.*)

14 normal phonogram positions so that one or other, but not both, can receive calls through the PAD queue.)

These positions also have a third function. Most telegraph offices have considerable difficulty handling the very high levels of traffic on Saturday morning—up to 80 per cent above that for an average weekday—and this presented serious problems that had to be taken into account in office planning. The main problem was to provide additional positions but in such manner that they were not idle on every day except Saturdays. The combined positions were therefore arranged so that they could be used when required as additional TT (telephone and telegram) acceptance positions. An additional group of 14 circuits was provided outside the queue, each being associated with a position and normally "busied". They are brought into use individually by inserting a headset plug into an extra jack on each position. This arrangement does, of course, create some shortage of forwarding positions which, however, can be very largely corrected by taking into use the machines normally used for printergrams and multelex, and which are lightly loaded on Saturdays.

The teleprinters used for incoming traffic—both TAS and printergram—have been mounted vertically in three-tier stacks so that operators can sit at the positions instead of having to move from machine to machine. At nights and during weekends an appropriate number of the printergram incoming circuits are key-switched from their stacks to the TAS stacks where a corresponding number of incoming TAS circuits are automatically "busied" so that the entire printergram section can be closed down.

The originating (sent by subscribers) and incoming (received from other printergram centres for transmission to London telex subscribers) printergram traffic is received at adjacent stacks and then disposed of on a common group of TAS forwarding positions, the machines having end of line lamps to facilitate working to subscribers' telex machines. Traffic to subscribers is routed through the teleprinter automatic switching centre and thence through the Fleet Telex Exchange.

Arrangements for dealing with incoming TAS teleprinter traffic are the result of the study of workflow. The incoming teleprinter stacks are at one end of a 70 ft-long table and the received traffic is passed, mainly by conveyor bands, through positions for "unpacking" abbreviated addresses, enveloping and addressing, tracing difficult addresses, telephone delivery or teleprinter transmission and ending up in the finished traffic racks.

Since new operational furniture and equipment had to be made, it was decided to depart from traditional ideas and to produce purpose-made tabling, each table designed for the particular job it had to do. There are obvious advantages in keeping table tops as clear as possible and one way to achieve this was to mount the TAS signalling units in the apparatus room instead of on the tables, leaving behind only the dials, keys and lamps. This allowed scope for an improved arrangement of equipment on the tables themselves.

Particular attention was paid to the design of the combined positions. The standard combined position, comprising an L-shaped table with an added console, has the disadvantage that the operator normally has to move her chair each time she changes from the teleprinter to the typewriter. As a result of experiments on this problem a position was designed which produced the correct relationship between the two machines and between the machines and the rest of the equipment.

Only the dials, keys and lamps in constant use are mounted on the flat part of the table. The equipment used less frequently, for example, the paper-fail lamps, and out-of-service keys, are mounted on a sloping fascia at the rear of the table—accessible, but out of the way. Cabling is run behind this fascia which is hinged to the table.

Because 13 teleprinter stacks are required in the room their size has been reduced as much as possible to avoid operators developing a sense of being shut in. By housing the signalling units in the apparatus room and reducing the internal clearances to a minimum the cabinets have been reduced to 4 ft 6 ins by 1 ft 6 ins by 1 ft 8 ins, the smallest yet developed for this purpose.

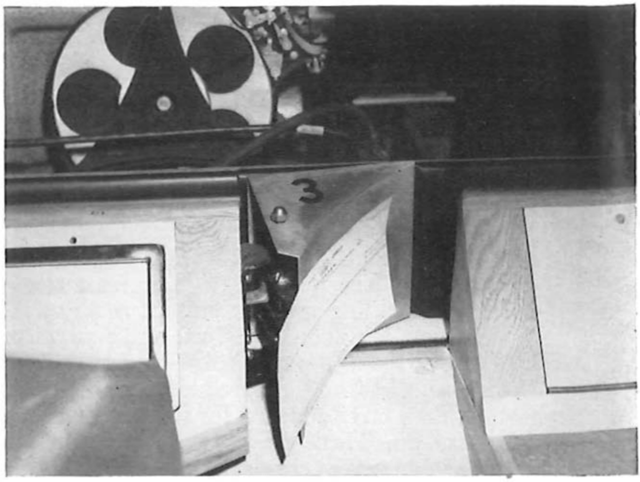
The band conveyors on the phonogram and TAS positions are of a standard type but those on the printergram and incoming TAS suites are of a new design. The printergram table has two bands. One, running part of the length of the stack positions, is for "C" printergrams and terminates at the "unpack" position. The other runs the length of the stacks and of the outgoing TAS positions and is for the "A" printergrams after they

OVER

The specially designed phonogram forwarding positions. The operator in the foreground is accepting a telegram by telephone. By simply swivelling her chair to the left she can then forward the telegram on the adjacent teleprinter.

THE NEW CTO (*Contd.*)

have been gummed at the stacks and for the "C" printergrams after they have been unpacked and routed. The portion of the band covering the outgoing TAS positions is so made that it provides a mechanical means of distributing the traffic to each position in turn. The band walls have gaps opposite each pair of positions, each gap occupied by a moveable flap and the flaps operating sequentially at half-minute intervals under the control of a simple electro-magnetic device. When operated, the flaps divert messages going down the band to a tray which is easily accessible to the operator on either side of it. When the flaps restore, traffic flows past them to the next pair of positions. Thus each pair of positions on each side of the table receives traffic for half a minute in turn and this half minute operation provides an adequate work load at the forwarding positions. By key operation any flap can be kept permanently open if the relative positions are un-staffed. The incoming TAS conveyor is of similar type.

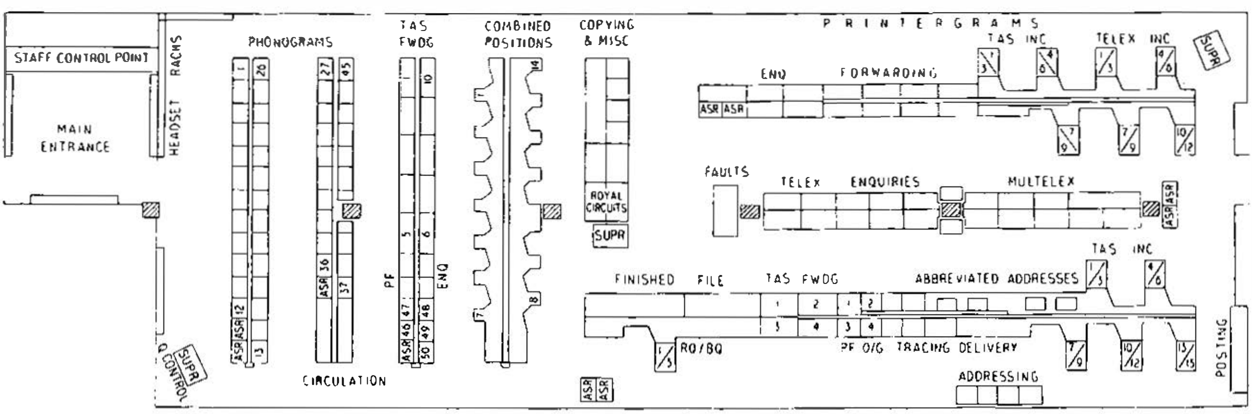


Telegrams travel along a V-trough conveyor and are diverted to transmitting positions by diverters working automatically on a timed cycle. This picture shows the automatic diverter in the operated position.

The layout of the instrument room falls broadly into two main divisions. The general plan is that phonogram traffic is accepted and forwarded at one end of the room while teleprinter received traffic, including printergrams, is handled at the other end. The two main streams of work converge during treatment towards the middle of the room, where the finished traffic accumulates and certain miscellaneous functions are carried out.

The new Central Telegraph Office has 178 operating positions compared with 249 at the old CTO. In the phonogram section the queue control equipment is mounted on a special panel on the supervisor's desk while the queue display lamps are mounted on the pillars adjacent to the positions. The time to answer, staffing and so on, meters are in the apparatus room below, except for the lost calls meter which has been brought up to the supervisor's table to give some indication of the

This diagram shows the layout of the Instrument Room at the new CTO.



level of traffic being offered under queue full conditions.

Staff enter the room by way of a foyer which contains signing-on and staff-control points, duty charts and so on, thus reducing the noise level in the main instrument room.

The new CTO was opened on 21 October last year and appropriately the first message accepted began with the words "Heartiest congratulations to you . . .". On 12 November the CTO was honoured by a visit from Lord Geddes of Epsom, a former CTO telegraphist, who formally opened the new office in the presence of a number of past and present CTO staff and of some of the main users of the telegraph services.

The new office has now happily settled down to providing a high standard of service and there can be little doubt that much has been gained by installing the office all in one room instead of spreading over three very large rooms, as in the former CTO. The movement of staff and of messages has been reduced and the changed methods of working and the more functional layout have enabled significant staff economies to be made.

The CTO staff representatives, who were fully consulted throughout, took an active part in planning the new office, in staff training, and in the preparations for the opening. Their co-operation has played no small part in the success of the venture. Much credit is also due to the staff as a whole, most of whom had been at the old CTO for all their working lives. They carry with them into the new CTO the fine tradition and spirit of service that always characterised the old Central Telegraph Office.

Mr. W. A. Stripp is a Deputy Telecommunications Controller in London Telecommunications Region. Following early experience in the Engineering Department Testing Branch he became an Assistant Traffic Superintendent in Birmingham. After serving with Royal Signals from 1939-1945, he worked in Brighton Area until 1950 when he was promoted to Chief Telecommunications Superintendent in the Inland Telecommunications Department. In 1958 he was appointed Assistant Controller, Telegraphs and was transferred to his present post in 1963. He wrote, The Civil Aviation Communications Centre, *in the November, 1953 issue.*

BACK TO THE KEYBOARD

To show that he had lost none of his old skill, Lord Geddes of Epsom insisted on sending a message by teleprinter when he opened the new Central Telegraph Office at Fleet Building, Farringdon Street, London, on 12 November. Lord Geddes, a former general secretary of the Union of Post Office Workers, was once a Post Office telegraphist and delivered his first telegram from the old building in St. Martin's-le-Grand in 1914.

The planning and installation of the new office has taken more than three years. The new CTO has a staff of only about 750, compared with 5,000 employed in the early 1900s.

A major innovation in the new office is a queuing system for those who want to telephone telegrams. Any call not finding an operator goes into a queue so that it is dealt with in the order made and is not overlooked.

MISCELLANY

NEXT YEAR'S PROSPECTS

THE achievements of the telecommunications services in the past year and plans for future development are highlighted in the White Paper, *Post Office Prospects, 1963-64* presented to Parliament on 19 March.

Taking into account additional revenue of £8 million expected to accrue from the tariff increases which came into force on 29 April, telecommunications profits are expected to rise to about £23 million in the coming year. Expenditure on fixed assets in 1963-64 is also expected to rise from £122.8 million in 1962-63 to £145.4 million.

The White Paper says that both inland and overseas telephone traffic expanded rapidly in the past year, the number of calls on the inland trunk service rising by about 14 per cent. Next year many more circuits are to be provided, partly by raising the capacity of existing plant and partly by using more cables and radio links. Local telephone call traffic did not rise as rapidly but it is still about five per cent above the level of the previous year. To cater for the increasing demand for telephone service it is expected that service will be provided to about 510,000 additional subscribers. It is planned to add more than 300,000 local lines to the network to serve this increase.

The total number of telephones, including extension instruments, will be about 9.25 million by the end of March, 1964 and the waiting list, which totalled 45,000 at the end of December, 1962, may rise a little in the coming year. The White Paper also says that:

By March, 1964, the number of manual exchanges will be reduced to about 500, automatic service will be available to about 90 per cent of subscribers in the country and two in five will have Subscriber Trunk Dialling facilities;

The TAT 3 cable between Britain and the USA will be brought into service in the autumn of 1963 and by the end of the year the COMPAC cable will be completed; the first direct telephone cable to Germany will go into operation in 1964 when manufacture of a second cable to Germany and of one to Denmark will begin.

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AN electronic instrument which can isolate the sound of any part of the human heart cycle for immediate analysis or subsequent study has been developed in the United States.

It is an electronic stethoscope, produced by the Bell Aerosystems Company, which enables a doctor to eliminate all other portions of the heart-beat cycle while bringing into focus only those heart sounds he wants to hear. Output from the device can be fed into conventional earphones, or a loudspeaker and audio analysis; connected to an oscilloscope for visual display; or recorded on an electrocardiograph as a permanent record. All three can be employed simultaneously so that a doctor can see, hear and record a patient's heart sounds at the same time.

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The photograph of the receiving aerials on page 17 of our last issue was reproduced by courtesy of Messrs Belling and Lee Ltd. of Enfield.

A Car Telephone Service for London

A CAR telephone service through which subscribers will be able to make calls to and receive them from any part of the country, is to be introduced in the Greater London area by the end of 1964. Known as the London Radiophone Service, it will be similar to the pilot scheme which has been operating in South Lancashire for the past three years.

In the beginning the new service will cover an area 25 to 30 miles from Central London, extending as far as Canvey Island in the east, to Godstone in the south, to Slough in the west and to Hatfield in the north. Later, the scheme will probably be extended in the north-west and north-east and as far as Luton.

Subscribers, who will buy or rent the mobile transmitting equipment from an approved dealer, will pay a licence fee of £7 10s. a quarter. For calls made over the system there will be a radio charge of 1s. for three minutes, plus a call charge of 3d. for three minutes for calls in the service area and normal trunk rates for those outside the area. Subscribers making a large number of calls will pay at special rates.

The radio frequencies used will be around 160 mc/s for the mobile transmitters and 164 mc/s for the base stations transmitters. Frequency modulation will be used and the base stations will have duplex and the mobile stations semi-duplex working. There will be a common calling channel and a number of conversation channels divided between the base stations according to traffic demands. These base stations will probably be set up in the areas of Crystal Palace, Kings Langley and Brentwood.

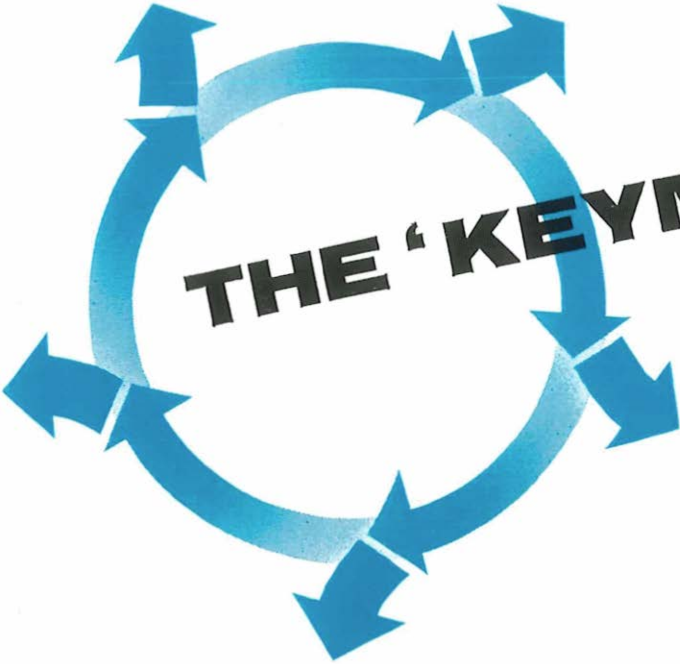
★

Capital Management

MR. R. J. S. Baker, for seven years head of the Post Office Sites and Buildings Branch and now an Assistant Secretary in the Training and Welfare Branch of the Personnel Department, was given leave of absence for a year to study capital investment in other industries.

The result of his studies is contained in his recently-published book "The Management of Capital Schemes" (*London School of Economics*, 42s.)—an erudite examination of the little-known science of capital management.

"Capital development", says Mr. Baker, "consists of complex pieces of machinery—steel structures, lumps of concrete, holes in the ground and ideas which can never be realised without taking other people's dearly cherished land, creating dirt and confusion and perhaps making people change their jobs. It involves, above all, people . . . skilled in the indefinable arts of very large-scale general management and administration . . . who can think in terms of years and decades and tens of millions of pounds."



THE 'KEYMASTER'

The 'Keymaster' House Exchange System has a capacity of one exchange line and five multiple-stations. One multiple-station can be replaced by a 2-wire external extension and a second by a 2-wire tie-line to a distant telephone installation. All stations have direct access to the exchange line by press-button operation, and intercommunication is available between all stations over a common circuit. Both the exchange line and intercom. circuits include supervisory lamps to signal the 'circuit engaged' condition. Exchange calls may be transferred within the system and 'night service' facilities are available at any station.

'The Keymaster' telephone, accepted by the British Post Office, is a natural development of an Ericsson design already approved by the Council of Industrial Design, and contains six push-buttons, an a.c. bell, d.c. buzzer and two signalling lamps. Signalling, switching and battery feed relays, common to all stations, are concentrated in a wall-mounted unit. The system operates on 50V d.c., derived from a power unit, and the inter multiple-station cable is 21 wire.

The 'Keymaster' telephone can be wall mounted if required and monitoring and exchange barring facilities are available as optional extras.

ERICSSON TELEPHONES LIMITED
ETELCO LIMITED

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Telecommunications Statistics

	Quarter ended 31 *Dec.* 1961	*Quarter ended* 30 *Sept.* 1962	**Quarter ended 31 Dec. 1962**
Telegraph Service			
Inland telegrams (excluding Press and Railway)	2,869,000	3,253,000	**2,883,000**
Greetings telegrams...	691,000	895,000	**741,000**
Overseas telegrams:			
Originating UK messages	1,623,000	1,610,000	**1,606,000**
Terminating UK messages	1,625,000	1,619,000	**1,620,000**
Transit messages	1,409,000	1,245,000	**1,342,000**
Telephone Service			
Inland			
Gross demand	106,000	122,000	**125,000**
Connections supplied	99,000	100,000	**108,000**
Outstanding applications	146,000	150,000	**149,000**
Total working connections	5,171,000	5,272,000	**5,311,000**
Shared service connections	1,130,000	1,107,000	**1,101,000**
Total inland trunk calls	118,454,000	†135,567,000	**138,730,000**
Cheap rate trunk calls...	26,934,000	†33,775,000	**30,529,000**
Overseas			
European: Outward	839,000	981,000	**991,000**
Inward	838,000	†*930,000	***944,000**
Transit	3,000	*10,000	***10,000**
Extra-European: Outward	78,000	84,000	**94,000**
Inward	98,000	105,000	**117,000**
Transit	18,000	†14,000	**16,000**
Telex Service			
Inland			
Total working lines	8,000	10,000	**10,000**
Metered units	19,459,000	22,333,000	**26,494,000**
Manual calls (Assistance and Multelex) ...	3,000	2,000	**3,000**
Calls to Irish Republic	20,000	19,000	**22,000**
Overseas			
Originating (UK and Irish Republic) ...	1,131,000	1,302,000	**1,439,000**

† Amended figure. * Includes some estimated figures.

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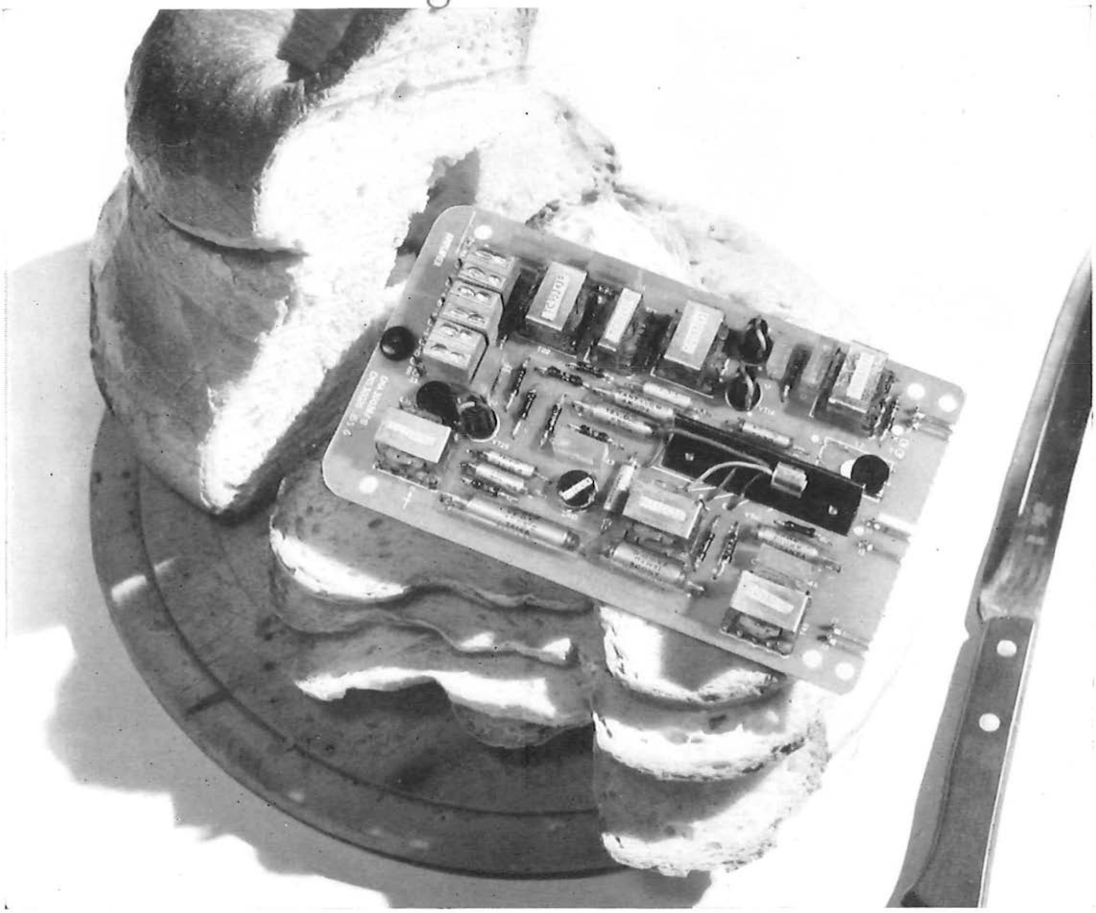
Contributions. The Editorial Board will be glad to consider articles of general interest within the telecommunications field. No guarantee of publication can be given. The ideal length of such articles would be 750, 1,500 or 2,000 words. The views of contributors are not necessarily those of the Board or of the Department.

Communications. Communications should be addressed to the Editor, Post Office Telecommunications Journal, Public Relations Department, Headquarters, G.P.O., London, E.C.1. Telephone: HEAdquarters 4345. Remittances should be made payable to "The Postmaster General" and should be crossed "& Co."

GPO

it's the filling that matters...



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CARRIER

AT&E Type CM Carrier Equipment offers substantial saving in prime and operating costs whilst taking full advantage of the small size and proven reliability of modern components. Thus conventional methods have been discarded in favour of an advanced card mounting printed circuit technique. The result is a compact, reliable system with up to 90% power saving over equivalent valve equipment. AT&E Type CM Carrier Equipment has been chosen by British and overseas railways, and by other organisations, for microwave, open-wire and cable carrier communications.

*Fully transistorized *Plug-in printed circuit cards *Mains or battery operation *Optional in-built out-band 3825c/s low or high level signalling for ring down or dialling *Suitable for extension to existing valve equipment *Up to 96 channels per rackside *Easy accessibility *A third of the size of an equivalent valve equipment.

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STC LIGHTWEIGHT HEADSETS, designed for use by private and public telephone operators and approved by the British Post Office, are fast superseding the use of the older breast type instruments.

The main advantages of this STC product are extraordinary light weight, a high degree of comfort, stability and manoeuvrability and constant level of transmission regardless of head movement. The headsets are made in black, grey or ivory nylon plastic which is virtually unbreakable.

The "Rocking Armature" principle—an important STC development in telephone receiver design—which gives improved sensitivity and frequency response has been incorporated into these instruments.

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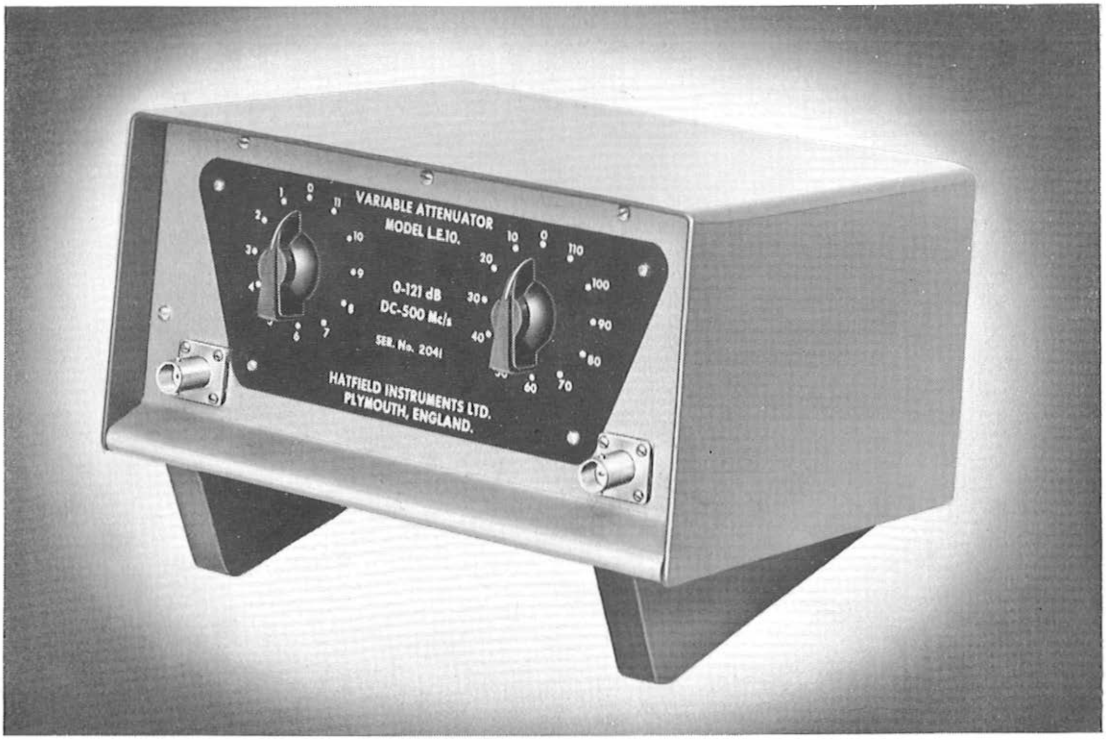

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Impedance levels: 50 or 75 ohms

BNC sockets Price: £76 : 10 : 0

Write for full details of these Attenuators and the range of Hatfield Instruments including: Stabilised D.C. Power Unit, D.C. Amplifier, A.C. Power Supplies, Coaxial Switches, Valve Millivoltmeter, Balanced Crystal Modulator, Transistorised Temperature Controller, R.F. Bridge, Transistor Adaptors.

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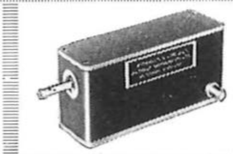

Type RV

Frequency range:
DC to 300 Mc/s

Attenuation:
0-10 dB in 1 dB steps
or 0-100 dB in 10 dB steps

The tandem arrangement illustrated gives 0-110 dB attenuation in 1 dB steps

Prices from £11 : 10 : 0

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Frequency range:
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Attenuation:
0-11 dB in 1 dB steps
or 0-110 dB in 10 dB steps

Impedance levels:
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Models available for Ledex Drive

Price : £29 : 15 : 0

Both models are available as single units for building into equipment.

HATFIELD BALUN

TMC

Extensible Line Connector

The TMC Extensible Line Connector provides complete telephone service to ten subscribers using only one exchange line, and is extensible to accommodate twenty-two subscribers using four lines. Thus four pairs out of a cable free the remaining pairs either for new subscribers or for connection to other TMC Extensible Line Connectors, permitting further groups of ten to twenty-two subscribers to be given service.

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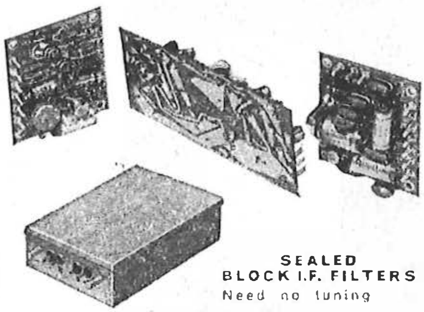

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