Post Office Telecommunications Journal

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Transatlantic Cable Agreement

WE ARE PRIVILEGED TO PUBLISH IN THIS ISSUE an account of what *The Times* has described as the "wise and welcome decision" to lay telephone cables under the Atlantic, thus providing new lines of communication between Great Britain, Canada and the United States.

The conclusion of the Agreement is a tribute not only to the skill of the scientists and engineers on both sides of the Atlantic, but also to the close relations which exist between the three countries concerned; the Postmaster General, indeed, when announcing the Agreement, emphasised that the lengthy negotiations had been to him "a very pleasant and happy experience".

The Agreement is, however, only a beginning. Our colleagues both here and across the Atlantic now face some three years of arduous work, in which their skill will be applied to one of the most difficult tasks with which they or their predecessors have been faced since, nearly ninety years ago, the 2,000 miles of the Atlantic Ocean were finally and successfully spanned by a telegraph cable in 1866.

We look forward with confidence to the day when, their operations successfully concluded, we shall be able to open and maintain a service which will mark a tremendous advance in the development of international communication services, and will strengthen the bonds uniting the peoples of the English-speaking world.

Signing the agreement: Mr. Winthrop Aldrich, American Ambassador; the Postmaster General; Mr. Frederic Hudd, C.B.E., representing the High Commissioner for Canada. (Standing) Mrs. Mitchell, G.P.O.

The First Transatlantic Telephone Cable

ANNOUNCING IN THE HOUSE OF LORDS ON December 1, 1953, that he had "just signed" an agreement "for the provision of the first transatlantic telephone cable", the Postmaster General, Earl De La Warr, added:—

"The new cable will completely transform telecommunications between this country and the North American continent. In place of the existing twelve radiotelephone circuits to the United States and two to Canada, unreliable and dependent as they are on the vagaries of atmospheric conditions, we shall have high-grade and reliable circuits, about twenty-nine to the United States and six to Canada, as well as a number of telegraph circuits to Canada.

"Further technical development may well increase the number of circuits.

"I should perhaps explain here that a circuit means capacity for one conversation, so that twenty-nine circuits means capacity for twenty-nine conversations simultaneously.

"Of very great importance also, the new cable will help us to give much better telephone and telegraph services to Australia and New Zealand *via* Vancouver. This will mean far less interference than with our present radio connections".

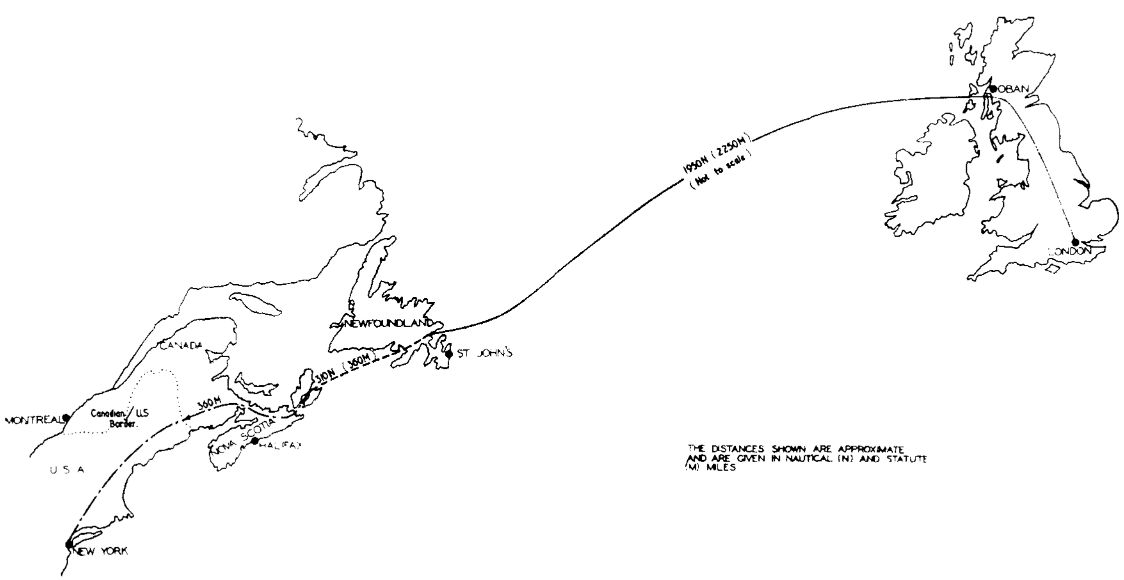
Commenting that the agreement "may well mark an epoch-making advance in communications between this country and the North American continent" Lord Listowel, a former Postmaster General, added:—

"A cable of this kind was a dream when I was at the Post Office in 1945. We hope that the dream is now coming true . . . it has taken many years of hard work by devoted public servants at the Post Office . . . and I hope that the noble Earl will convey the thanks and congratulations of noble Lords in all parts of this House to the research scientists at Dollis Hill, the Post Office engineers and others who have been concerned, and the Bell Laboratories".

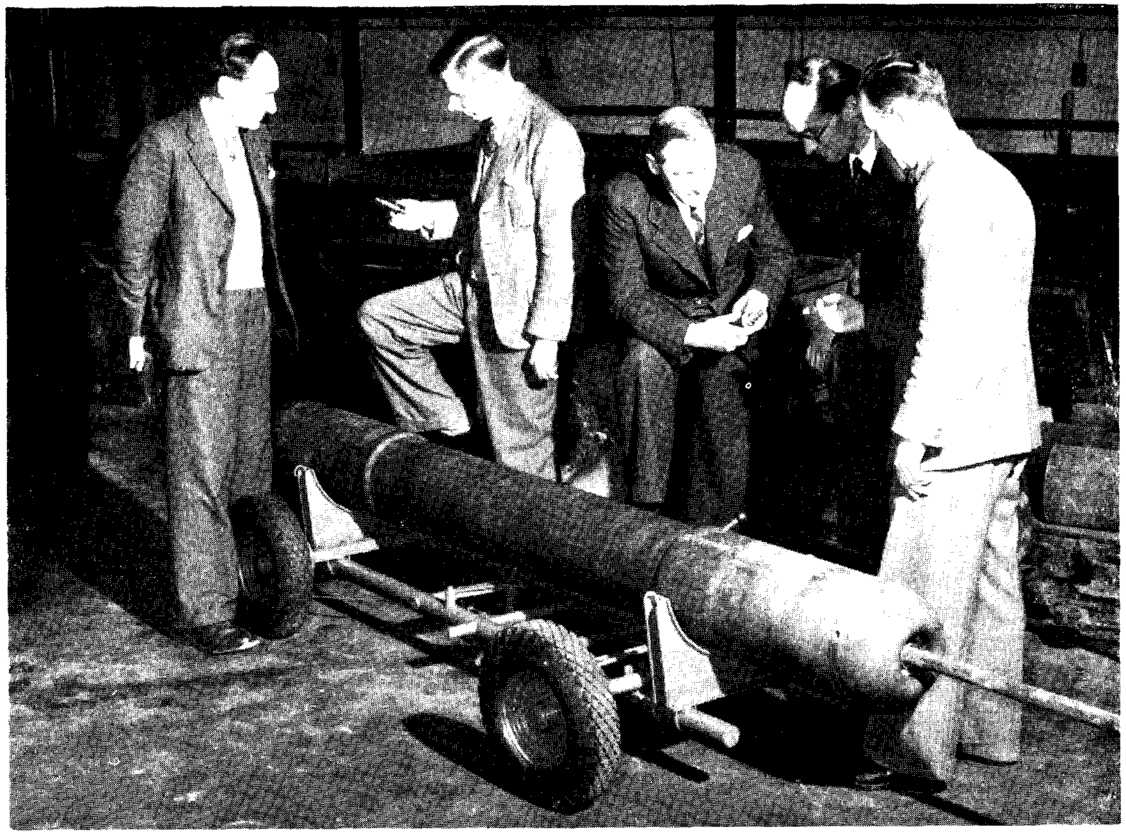
The agreement to provide line telephone service under the Atlantic was completed almost twenty-seven years after the first public telephone service by radio was opened between the old world and the new in January, 1927. This service was at first restricted to telephone subscribers in the immediate vicinities of London and New York, but it was soon extended to all parts of Britain and the United States; within ten months it was extended by landline from New York to several towns in Canada. During the first year 2,200 transatlantic telephone calls were made over the new service; in 1951, 99,000 calls were carried.

The transatlantic radiotelephone circuits are in principle open throughout the 24 hours of every day but in practice the service is liable to interruption during periods when radio transmission conditions are adverse. Some improvement can often be obtained during such periods by re-routing the transmission via an automatic radio relay station at Barbados but this does not completely overcome the difficulty. Research has been going on for several years to provide transatlantic telephone circuits with a quality of speech and reliability equal to that obtained on inland telephone systems. The repeatered cable is the answer.

Submarine telegraph service under the Atlantic has, of course, been available for nearly 90 years, since the first successful transatlantic cable permanently connected Great Britain and North America in 1866, an achievement which was the forerunner of world-wide telegraph systems linking the continents under the Atlantic, Pacific and Indian oceans. Despite considerable advance in technique these cables, which transmit the slowly varying electric currents that form telegraph signals, are incapable of transmitting the higher frequency currents which represent



The repeatered cable terminates at Oban and Nova Scotia; landlines will link Oban with London, and a micro-wave radio system will relay messages from Nova Scotia to New York



Post Office Engineering Research Branch staff engaged on the development of submerged repeaters: *Left to Right*—**Mr. D. C. Walker, Dr. G. H. Metson, Dr. R. A. Brockbank, Dr. V. G. Welsby and Mr. F. Jones**

speech. For that reason overseas telephone facilities for long distances have hitherto been provided by radio only.

Submarine cable telephony is not in itself, however, a new service. The first successful submarine telephone cable of any considerable length, an unloaded four-wire cable, was laid under the English Channel between Britain and France in 1891, a distance of only about 21 miles and in depths of not more than between 20 and 30 fathoms, compared with a distance of some 2,000 nautical miles which the new main transatlantic cables will travel, at depths to about 2,000 fathoms.

While development of such short-distance submarine cable telephony was proceeding, especially after the First World War, engineers on both sides of the Atlantic were busy working on the problem of repeaters which could be inserted in cables at intervals and, by amplifying transmitted electric currents having a wide range of frequencies, would enable the cable to transmit much higher frequencies than would otherwise be possible. Even without repeaters, modern cables of reasonably short lengths were capable of carrying a good number of telephone circuits, use being made of well established methods of carrier transmission. Clearly the wider frequency range made available by repeaters would enable a greater number of circuits to be provided over these same cables and would open prospects of telephone transmission over much longer cables.

American experiments with deep-sea submarine telephone cables began in 1920, but it was not until 1932 that submarine repeaters appeared to be eventually a practical possibility. Two years earlier trials in the deep waters of the Bay of Biscay under Dr. O. E. Buckley of the Bell Laboratories had led to the decision that repeaters

should be made in diameter and flexibility as much like the cable as possible so that laying could be carried out without stopping the cable ship.

Eventually a repeater housing was developed measuring two inches outside diameter and seven feet overall, of thin-walled copper tube supported internally by abutting steel rings, capable of withstanding sea pressure up to five tons per square inch. The housing, however, was only part of the requirements; long-life valves and electric components giving trouble-free service for up to twenty years had to be developed. War interrupted development in 1940 but in 1950 research had gone so far as to make possible the installation of two repeatered cables between Havana and Key West, a distance of about 120 nautical miles at a maximum depth of a mile.

British Post Office engineers were also working on this problem before the war, though the Research Department at Dollis Hill first concentrated on developing repeaters for inclusion in the existing telephone cables between Britain and the Continent. The first repeater to be used anywhere in a working cable was in a cable under the Irish Sea, designed and constructed at Dollis Hill and brought into service in 1943. The objective of further researches was to develop repeaters which would enable most cables in European continental waters to provide sixty circuits each. Nineteen of these repeaters have already been installed; the largest number in any existing cable is four, allowing 60 simultaneous conversations between Britain and Holland.

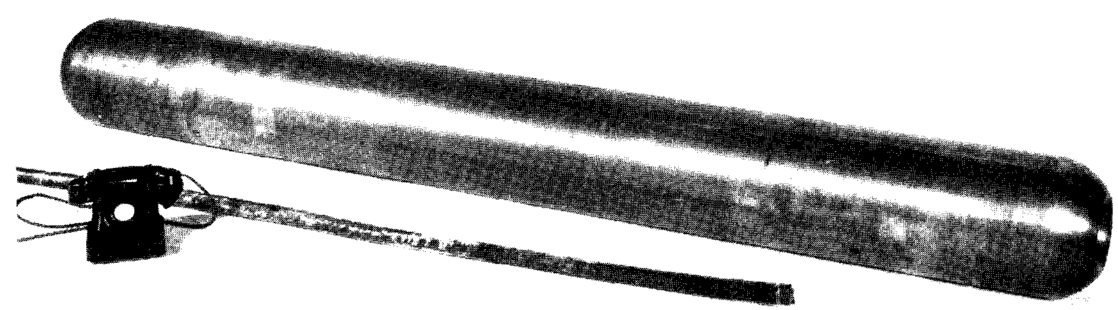
The American design repeaters will be inserted at intervals of about 40 miles in the main transatlantic cables running for 1,950 nautical miles between Scotland and Newfoundland. British design repeaters, with smaller rigid housings than those used in continental cables, will be inserted in the shorter section, the 310 nautical mile leg between Newfoundland and Nova Scotia.

One major difference between the British and American repeaters is that the British type have directional filters to separate the two directions of transmission, thus dividing the available frequency range of a single cable into two parts, one being used for each way of transmission. The smaller and more flexible American repeaters do not incorporate directional filters, and two cables are necessary on a single route, one for each way of transmission. Two one-way cables will therefore be laid between Scotland and Newfoundland, and a single two-way cable onwards from Newfoundland to Nova Scotia. There will be about 50 repeaters in each of the cables on the main crossing and about 13 on the shorter route.

Each repeater will consist essentially of a three-stage feed-back amplifier designed around long-life valves; between 300 and 400 valves and nearly 10,000 other electrical components in all will be laid under the ocean—and they are all planned to remain in service for up to 20 years. The success of the system depends on very few of these developing faults during that period, and longer.

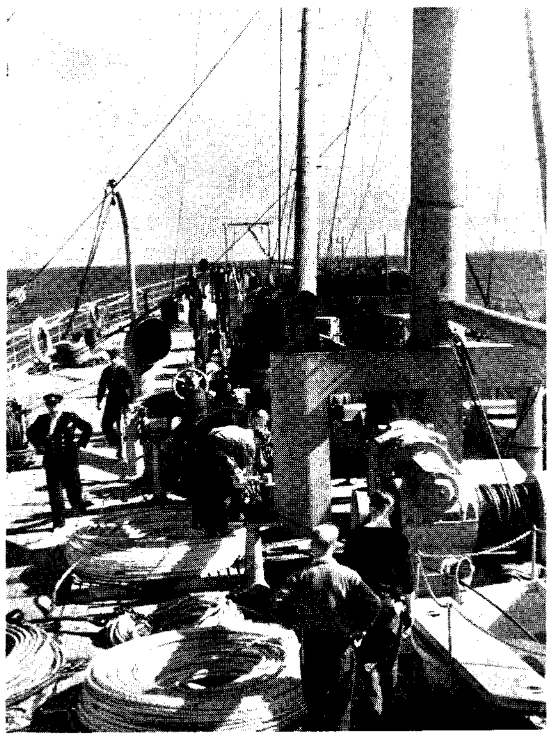
The repeaters will be energized by direct current

The Post Office type of rigid deep sea repeater which will be connected to the transatlantic cable



supplied over the central conductor of each cable from the terminal stations; about 2,000 volts will be needed between the central conductor and the sea at the ends of the long sections.

Manufacture of the cable will be divided between Britain and the United States, although a great part will be made in this country. The cables will be co-axial; at the outer conductor the diameter will be 0.62 inch, and the deep sea sections will be about 1.5 inch diameter over the high tensile steel armouring wires. High molecular weight polythene, a plastic product which has many



Fore deck of *H.M.T.S. Monarch*. Her laying equipment will be modified to lay cable and repeaters in one operation

advantages over the older materials such as gutta-percha, will be used for insulation.

The Scottish end of the cables will be connected by landline with London, terminating at the International Exchange, where it will be possible to connect subscribers all over the Kingdom and to link North American callers, through the Continental Exchange, with subscribers in Europe.

From the cable terminal at Nova Scotia a 360-mile overland micro-wave system will be built to carry the circuits onwards. The 29 American circuits will go right through to New York, the Canadian circuits branching off at an intermediate point to join the Canadian network.

One of the 36 high-quality telephone circuits in the cables will be divided into a number of telegraph channels and used to supplement the existing telegraph services—by cable and radio—between Britain and Canada and, via Vancouver and the present Pacific telegraph cables, to New Zealand and Australia.

The plans will be carried out in this country by the Engineering Department and External Telecommunications Executive of the Post Office; the Executive will be responsible for administering the British end of the system when it comes into service.

Double Laying Trip

The United Kingdom's share of the investment will be in kind and services, H.M.T.S. *Monarch* carrying out the whole of the cable laying. Although *Monarch* is the largest cable laying ship afloat, being of 8,056 tonnage and capable of carrying between 5,000 and 6,000 tons of cable, she will have to make two voyages to lay a single cable between Newfoundland and Scotland; her laying equipment will be modified to enable her to lay cables and repeaters in a single operation.

This new plan to revolutionize international communications and to bring the partners of the Western World even closer together is the product of co-operation in the fullest sense between Britain, Canada and the United States. In the long story of research and development first place must be given to the work of the Bell Telephone Laboratories of America. They and the Post Office Research Laboratories at Dollis Hill have made this project possible.

This record cannot conclude more fitly than by quoting once more from the Postmaster General's announcement in the House of Lords on December 1, 1953; paying a special tribute to the engineers on both sides of the Atlantic he added: "Thanks to their persistence and skill, something which has been a vision for a quarter of a century has become a reality and has made possible this tremendous advance in the history of communications".

Training Telephone and Telegraph Instructors

J. E. Sayers,
Headquarters Training Centre

RESPONSIBILITY FOR THE GENERAL oversight of training in telecommunications in the Post Office, apart from the engineering side, is shared at Headquarters between the Operations Branch of the Inland Telecommunications Department and the Training and Welfare Branch of the Personnel Department. Training in Telecommunications Engineering is the responsibility of the Engineering Department and is outside the scope of this article.

Broadly, the Operations Branch is responsible for the scope and content of training courses, while the Training and Welfare Branch is concerned with the training methods employed and the quality of the instruction given. In practice, the separation of responsibility cannot be clear-cut; the success of the work of the two branches depends on close co-operation between them and it often happens that one branch is working in what, in principle, is the province of the other.

The Training and Welfare Branch exercises a general influence on training methods in two ways—firstly, through the Headquarters Training Centre where all non-engineering instructors are trained in teaching techniques and, secondly, through Regions where the Regional Training Officers provide the link between instructors in the field, Regional Directors and, ultimately, the Headquarters Administration.

There are four main branches of telecommunications operational training in this non-engineering field: initial training for new entrant telephonists, post-school and refresher training given at a later stage to staff in telephone exchanges, initial training for new entrant telegraphists, and training in supervision for senior telephonists and telegraphists who are appointed to the "Acting List" for supervising duties.

The instructors employed in each of these branches of training are for the most part volunteers, although post-school and refresher training is sometimes arranged as part of the normal duty of all Assistant Supervisors in a particular exchange. Whenever possible, instructors are appointed by selection boards which include members of the telecommunications staff and the Regional Training Officer. New instructors attend the Headquarters Training Centre where courses in teaching techniques are arranged to meet the particular needs of the field in which they are to work.

The Headquarters Training Centre is at present situated in Cadogan Square, Chelsea, in South West London. The requisitioned residential

Film-strips are used as visual aids; an Assistant Supervisor from Middlesbrough Telephone Exchange demonstrates a switchboard

accommodation it occupies is now needed for its original purpose and the Centre will shortly be moving to a permanent home.

Many student instructors arrive in a state of tension even if they are not visibly nervous. This, a usual feature at the start of any training course, is made worse for new instructors by the knowledge that learning to teach will demand more individual participation than learning a normal vocational subject. At this stage the staff at the Centre have quickly to create a friendly atmosphere which will enable the student instructors to give of their best. This is necessarily a feature of technique courses as a whole and it is vital that any feeling of being on trial should be quickly dispelled. The lay-out of classrooms, as will be seen from the photographs, helps to create a conference atmosphere so that instructors will be made to feel that they are taking part not so much as individuals but as members of a group.

The courses last from one to four weeks, depending on the amount and type of training the new instructor is to undertake. Each course comprises sessions on the theory and practice of teaching, demonstrations by experienced instructors from the field in which the new instructor is to be employed, and "practice" sessions.

For "practice" training, the students come together in groups of between eight and twelve. Each student in turn practises the methods which he has been taught, by instructing his colleagues who play the part of learners. At the outset these "practice" sessions cause trepidation, but this soon passes as students enter into the spirit of the course. After practice, criticism is expected, and this is given by the students themselves, using the pattern and standards set by the Centre staff. Comments are offered in a helpful and good-natured manner and do much to foster confidence and improve methods.

One of the problems of this form of training is to get instructors to relate theory to practice. The theory is easily understood and readily accepted but putting it into practice is another matter. The structure of a three-week technique course provides for the theory to be educed from practice rather than the reverse. A course normally begins with a demonstration piece of instruction given by one of the Centre staff from the syllabus which the new instructor will be using. The group then comment on the demonstration. From the outset they recognise the more obvious features of good technique such as securing active participation by the class, the use of visual teaching aids, good timing, interest and logical presentation. The extent of recognition varies with individuals but all are able to take in some ideas for their own use later. These ideas are then consolidated by a short theory session which develops the features already recognised. The trainees' first active part is to talk for five or ten minutes to their colleagues on any subject they choose. This enables them to get the feel of addressing a group, perhaps for the first time in their lives. As they invariably talk about themselves, their hobbies or their experiences, it has the added advantage of helping them to get to know each other.

During the course each instructor has four periods of practice on vocational material. Theory sessions follow each round of practices and cover such things as the use of the blackboard, visual aids, questioning technique, teaching methods and planning the teaching session; this approach ensures that progress is made in easy stages. It is found that student instructors are more receptive to theory as an outcome of their own practice. Moreover, the Centre staff are able to draw on specific experience to illustrate a subject which, otherwise, might seem rather academic.

In addition to the formal teaching sessions there is opportunity to meet members of the Operations Branch with whom problems concerning the organisation of training in operating procedures are discussed. Often individual matters such as conditions of work and training equipment difficulties are raised, and answers are found to a host of questions about instructors and their job. At the final session students comment, in open forum, on the general arrangements at the Centre and on the instruction they have received in a genuine desire to suggest improvements to help those who are to follow.

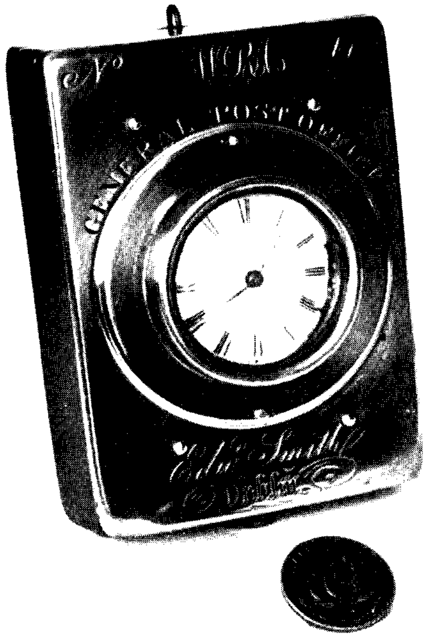
Training, properly conceived, includes more than the instruction which goes on in the classroom. Vocational training may start in a school, where principles are established, but it continues throughout working life. In this process the basic training given by the Centre is only a beginning. It is the use made of the newly trained instructor in the field and the subsequent training and direction given, which determine the results achieved. The Headquarters Training Centre does not claim in so short a time as one to four weeks to turn out a fully qualified instructor who can work entirely unaided. It can only aim to set a standard for self criticism, foster confidence, cultivate the right attitude towards the job of teaching and put the new instructor on the right road.

The common room at Headquarters Training Centre, 11 Cadogan Square

Post Office Clocks

E. C. Baker,

Librarian and Archivist



Mail Guard's watch (Ireland) circa. 1830

"O WOULD NOT LIFE BE CHARMING COULD we get rid of clocks" sings one of our modern Irish poets. While you may not be unsympathetic with his gravamen 'Time, Gentlemen, time!' you get the general impression from his poem that he would not approve of our current Rate Book and Engineering Stores Vocabulary. Among the stock items listed in that publication are more than half a hundred watches, clocks and time-recording devices. Three in every five of those clocks have been designed for use in telephone exchanges. Readers will remember, too, an article in the February, 1951, issue of this *Journal* on the latest major achievement of the Post Office in the matter of clocks. That article described quartz crystal clocks built at our Engineering Research Station.

The quartz crystal clock marks the beginning of a new era in the measurement of time since it is more accurate than the clock used during the past four thousand years, the rotation of the earth itself. That the angle through which the earth has rotated on its axis, measured with reference to the fixed stars, as a measurement of time elapsed between events, had been of vital importance to mariners once they ventured beyond the land-locked Mediterranean sea. To our own maritime nation the importance of that problem was recognised by the British Government when, in 1714, it set up a Board of Longitude and offered a reward of £20,000 for any method whereby a ship's navigator could determine his longitude to within 30 miles at the end of a voyage to the West Indies. It was 22 years before a clock was forthcoming, built by Harrison, a Yorkshire carpenter, which kept sufficiently accurate time on a sea voyage to satisfy that condition.

The earliest of our services to which the accuracy of clocks was of great concern was that given, from 1702, by our fleet of sailing packets carrying mails from Falmouth to the West Indies. The ships determined their longitude by the difference between Greenwich time, to which their chronometers had been set, and the local, or sundial, time of their observations. Nor was that problem limited to services which we provided by sea.

Within a few years of the introduction of mail coach services in 1874, detailed time schedules had been worked out for each route. It was the duty of one of the clerks at the General Post Office to hand to each mail guard a watch to be delivered to his successor on the journey or to the postmaster at the end of the run, if the guard went the whole way. The timepiece was fixed in a flat rectangular brass case. The clerk set the watch and locked it in the case before handing it to the guard who wore it in a pouch suspended from his shoulder. At each

post stage, where the horses were changed, the postmaster entered on a time-bill the time of the mail coach's departure by the locked timepiece, and by the local clocks; the latter indicated local, or sundial, time.

In the Post Office archives we have copies of blank forms reading: "General Post Office.

179—Sir, By the Bill of this day, you have omitted writing down the Guard's Names and Number of the Coach. I must beg you to be very particular in dating the Bills, also by Time Piece and Town Clocks both. Your most obedient Servant, THOMAS HASKER, Surveyor and Superintendent of Mails.—Postmaster".

Herbert Joyce in his *History of the Post Office* (1893) stated that, in 1792, the timepiece was regulated to gain about 15 minutes in 24 hours, so that when travelling eastwards it might accord with 'real' time, a corresponding allowance being made for travelling westward. He did not indicate his sources and we have not as yet found any records confirming that statement.

To raise money to meet heavy war expenditure, William Pitt, in addition to the usual device of increasing postage rates, put taxes on a diversity of things in 1796. After October 10 of that year anyone keeping a clock without paying duty was to be fined £10. Clocks were taxed at five shillings a year. Taxes on watches were from 2 6 to 10 - a year. Clearly that made it difficult for poor people to own timepieces and arrangements were made whereby a public clock was provided at places where local people met. These were known as Act of Parliament clocks and many of them were to be found in use years after that most unpopular tax was repealed in 1798. One of those Act of Parliament clocks came up for auction at a sale of a valuable collection of clocks, at Chippenham, within the past few months. It had hung in the Post Office at Charlton for many years.

When the new General Post Office was opened, in 1829, in St. Martin's le Grand, a turret clock by B. L. Vulliamy was placed in its portico. The clock had taken Vulliamy nearly two years to build and cost the Post Office £1,080. It had been intended for Lord Lonsdale's seat at Lowther Castle, but was diverted to the Post Office by the Commissioners of Her Majesty's Woods and Forests, later to become the Ministry of Works. The clock was working quite satisfactorily when the building was demolished over 80 years later. It was Vulliamy who prepared the first plans and specifications for Big Ben. One of his wall clocks, which has seen service in the old British Post Office at Alexandria, is still keeping time in one of the muniment rooms in our Headquarters Building.

Railways put the mail coaches—as well as the stage coaches—out of business. They had the same problem, in a more acute form, as the mail coaches in planning time schedules for their services. All stations had to synchronize their clocks to 'railway time' as distinct from local time. From that practice followed the publication of tables showing the difference between railway time and local time for cities and towns in the United Kingdom. On July 29, 1872, there appeared in the *Postal Official Circular*—the forerunner of the *Post Office Circular*—the following important notice:—

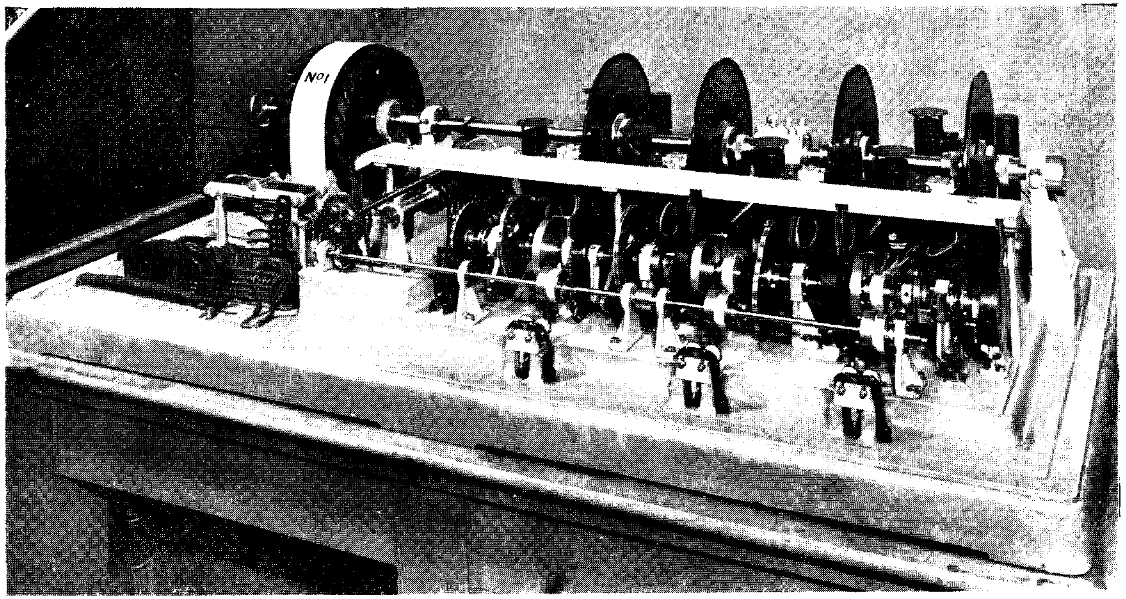
"GREENWICH TIME TO BE OBSERVED AT ALL POST OFFICES IN ENGLAND AND SCOTLAND

Hitherto it has been the rule of the service to observe local time for certain purposes at Country Post Offices, while Greenwich time (spoken of in the Book of Rules as 'London' or 'Railway Time') has been observed for certain other purposes.

In future Greenwich time (which is notified daily to all Postal Telegraph offices) is to be observed solely at all Post Offices in England and Scotland".

That notice gives a hint of a development which was to put an end to the usage of local time in our country, the development of telecommunications. Since 1852 the General Post Office had received, over telegraph companies' wires, an hourly signal transmitted from the Mean Solar Clock at Greenwich Observatory. That signal was also being transmitted at 10.0 a.m. each day to every telegraph office. Later the time of transmission was changed to 9.0 a.m. The local clocks were then, of course, being reset by hand. At the time of our notice telegraphs had been taken over by the Post Office, and telegraph offices opened in all but the smaller Post Offices. The Post Office also continued the distribution of time signals to other establishments.

Thornbury in his "Old and New London" (*circa.* 1880) described the Central Telegraph Office (which had been opened in 1874) in detail. He wrote: "Another interesting object is the chrono-



The mechanism of the Speaking Clock

pher . . . from which all England is supplied with the correct time. Sixteen of the most important cities in the Kingdom are in direct communication with this instrument, which is itself in direct communication with the Observatory at Greenwich. At two minutes before ten every morning all other work is suspended, in order that there may be no interference with what is called the 'time current', which, precisely at the striking of the clock, flashes the intelligence to the sixteen stations with which it is in communication. And not merely at these large towns, but at every Post Office throughout the Kingdom, the clerks at two minutes before ten are on the look-out for the signal which is to be passed along the line, and the clocks are adjusted accordingly. Messrs. Dent, Benson, and all the principal watchmakers in London receive the time every hour from this chronopher. Time guns at Newcastle and at Shields are also fired at 1.0 p.m. by batteries connected with the chronopher at the office, the clock attached to which is regulated for accuracy to the twentieth part of a second".

The Post Office can claim to have solved problems of mariners when beginning in December, 1927, with the co-operation of the Admiralty and the Board of Trade, an international time signal was broadcast throughout the world from Rugby Radio Station. Thereafter private wires for time-signal distribution were recovered.

It was on this recovery work that Mr. J. H. Garner, a Superintendent of the Central Telegraph Office who retired in 1945, has told me the following story, for the truth of which he vouches although he has not been in a position to produce any documentary evidence.

"Large numbers of lines" he said, "were nominated as chronopher lines, with a number of reserves, and great care was always taken that all such nominated lines were tested and maintained so that they were all in good order for the time signal. One such reserve was the TS-BS London-Bristol—proved and checked every day—and regularly at 9.0 a.m. the time signal was transmitted, as was thought, to a centre on the north coast of Somerset. . . .

"An enquiry was begun into whether the cost of maintenance of such lines was justified and in due course the Bristol line came under review, with the remarkable result that no trace of any circuit beyond Bristol could be found. Enquiries established that, years before, the line ran to a Customs and Excise and Coastguard centre on the Somerset coast, but changes had brought the centre into disuse and now only one coastguard remained.

"The engineers, being very thorough, traced and recovered what was left of the circuit and found its termination at the coastguard house where, boldly shown in the office window, was the well-known rod and ball with a notice that at 9.0 a.m. precisely the ball would fall to indicate Greenwich time.

"The coastguard admitted that he had not received a time signal for many years but the inhabitants expected a signal from him so he knocked the ball down with a stick each day. When asked how he got the time he said that by standing on a chair and looking along and across the road he could see by the 'Brown's' big clock when to knock the ball down.

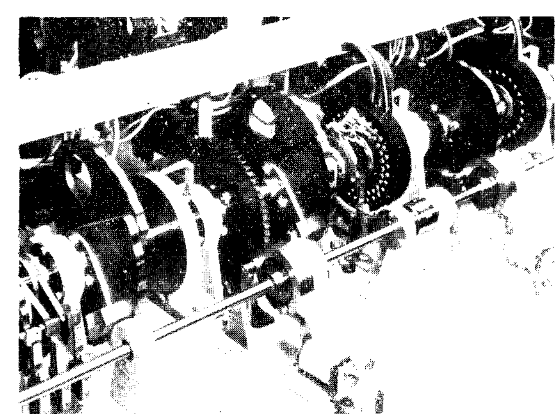
"He was told to cease the practice and the engineers, being curious, went along to examine Brown's clock. They found it a well-built English clock, and only 15 seconds slow. Asked how he kept the clock at correct time, Mr. Brown said: 'Oh, that's easy. By standing on my stool and peering sideways along and across the road, I can just see in the coastguard's front window the brass ball fall on the rod'."

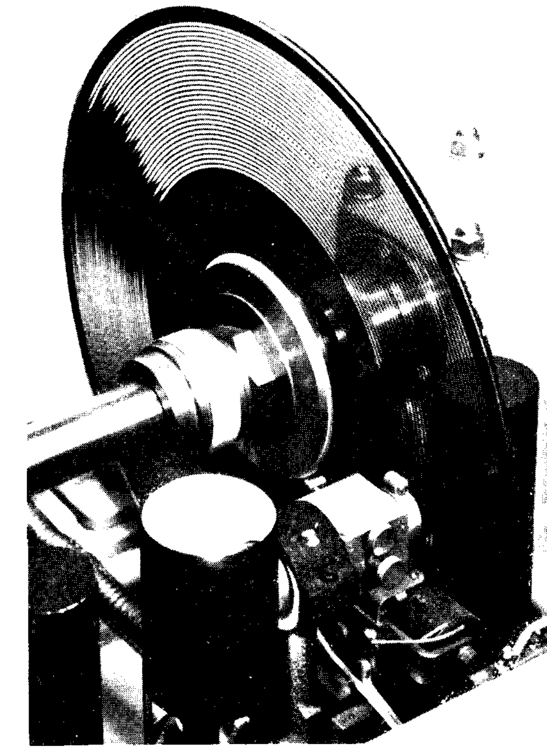
The device of a time-ball falling down a rod was not uncommon in the past. The first to operate in this country was at Greenwich Observatory itself, from which ships in the Thames could check their chronometers. The ball was hauled to the top of the rod just before 1.0 p.m. and, when it was first used about 1833, released mechanically. Later it was released by an electrical impulse. The curious may still see it in operation each day.

Electric clocks and time-measuring devices appeared soon after electric telegraphs, many of the early telegraph inventors being responsible for clocks as well. But electric clocks really came into their own with the development of telephone exchanges where they are particularly useful. The calculograph for timing trunk calls was first introduced in 1905. It saved the switchboard operator from having to compare the time stamped on the ticket with the time indicated by a clock. An automatic time-check by means of lamp signals had been introduced at a number of lamp-signalling exchanges by the end of that year.

By 1930, 400 mechanisms, known as Master Clock No. 36, were in service. That clock, which is used for transmitting electrical impulses of different time values, is not itself fitted with a dial. It sends impulses every half minute to operate alarm signals to disclose faulty or abnormal conditions on subscribers' lines or on automatic telephone equipment. It operates veeder clocks which bring the time indication down to switchboard level. It sends impulses every six seconds to time-check mechanisms and at the end of three

The Speaking Clock—Hours, Minutes and Seconds Cam Shaft





The Speaking Clock: "Even Minutes" Disc and Optical Unit minutes causes a warning lamp glow to enable the operator to time the call. A six, or a twelve, second time pulse is now available at all exchanges, each giving a thirty-second pulse.

If you speak to a member of the public about Post Office clocks, however, then it is TIM, the the Speaking Clock, which is almost sure to come to his mind. Horologers had long looked forward to the day when correct time would be readily available to anyone. The Speaking Clock service represents the realisation of their most sanguine hopes. TIM was not the first speaking clock, any more than the first quartz crystal clock to be produced by Post Office research engineers was the first to be made. In 1933, a speaking clock service was working in Paris where it had a very favourable reception from the public. That encouraged the research engineers to design a speaking clock for this country. The design of the clock they produced had little in common with the French clock.

Two clocks, one in reserve, were installed at Holborn Exchange and the new service made available to the public on July 24, 1936. Before then subscribers ringing an exchange to ask the time would be told by an operator of the time on the exchange clock. The accuracy thus possible was within about 30 seconds whereas the speaking clock was accurate to within a tenth of a second.

The sound records were photographed on to glass discs 12 inches in diameter.

Four discs only are required. One disc carries the following records: "At the third stroke", "precisely" "and ten seconds" and so on. Another disc carries the hours portion of the announcement: "it will be one" and so on. The third disc carries "o'clock" and the even minutes record. The fourth carries the "pips" and the odd-minute records. The needle for a record is a beam of light passing through the record to a photo-electric cell. The discs are rotated by a special motor and their movements relative to the light beams controlled by cam shafts. A special pendulum unit was designed to control the speed of the motor.

Later a second Speaking Clock was set up at Liverpool. Each of the two installations was connected to separate distributing trunk circuits forming closed loops London, Leicester, Derby, Sheffield, Leeds, Newcastle, Edinburgh, Glasgow, Manchester, Liverpool, Birmingham, London. Nottingham was served by a spur circuit (in April, 1939) as were Bristol, Plymouth and Swansea. In December, 1940, a spur circuit was routed from Glasgow to Belfast. Small wonder that to the man in the street there is only one Post Office clock—TIM.

Electronic Telephone Exchanges

In a paper read before the British Association, Mr. L. J. Murray, B.Eng.(Hons.), A.M.I.E.E., dealt with the probability that the present type of electro-mechanical automatic telephone exchange system will ultimately be superseded by completely electronic methods. He added, however, that several technical and economic problems had to be solved before our present exchanges can be completely replaced by electronic systems.

Mr. Murray described an experimental system in which the actual speech connections are still completed through electro-mechanical switches, but in which the control arrangements used for setting the switches are completely electronic, using principally the cold cathode type of tube. He showed a demonstration set working on these principles which is believed to be the first of its type seen in this country outside a laboratory. The main advantages of electronic switching methods, said Mr. Murray, lie in their vastly greater speed in setting up connections, which will be of great advantage in the extension of long-distance dialling by subscribers. He added, however, that the full advantage of this greater speed will only come when in the future it becomes possible to replace the present subscriber's telephone dial by a much faster device.

Flying Television.—The Americans are to begin experiments with flying television stations; planes which will circle over France and send programmes into Britain. Their object is to see how far into Britain the broadcasts can penetrate. It is thought that pictures will be received as far North as the Midlands. At first, we understand, American programmes recorded on film will be televised directly from the four-engined planes circling five miles over France. The test pictures will be picked up only by special sets operated by engineers.

Mark-Coding Telephone Tickets for Mechanical Trunk Fee Accounting

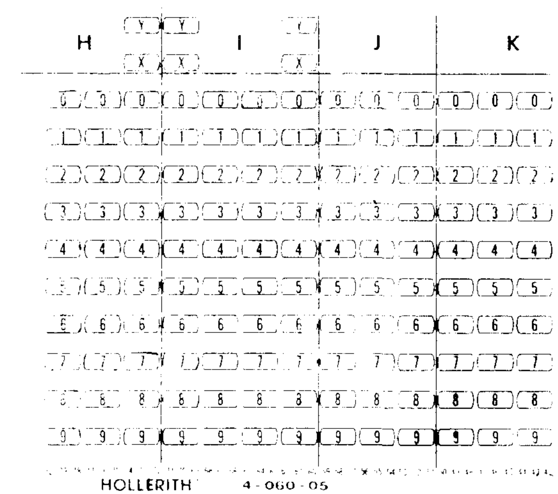
E. A. Smallwood,

Inland Telecommunications Department

EXPERIMENTS ARE BEING CONDUCTED AT Canterbury in the mechanisation of trunk fee accounting. The system in use sorts call tickets into numerical order and prepares trunk statements from them mechanically; for its operation it requires holes to be punched in the ticket to represent the calling subscriber's number and the particulars to be shown on the statement. Until the early part of this year this hole-punching operation was carried out manually in the T.M.O. Fees Group, a group of operatives using keyboard punching machines at which the information written on the tickets by switchboard operators was converted to punched holes. Attention has recently been concentrated on eliminating this expensive manual operation.

Punched-card accounting companies have developed systems in which holes are punched automatically from appropriate information recorded by an operative striking through printed entries: thus to record a subscriber's five-digit number necessitates five columns, each consisting of the digits from 1 to 0. Fig. 1 shows a section of a card of this type, and Fig. 2(*a*) shows a telephone ticket with the calling subscriber's number (23456) recorded. One system, termed "mark-sensing", uses the electrical resistance of each pencil mark, "sensed" or measured between contacts brushing over the ticket, to control the "punching" machinery. The Post Office has conducted several experiments involving such systems. After investigation, however, it was decided to accept the Post Office Engineering Research Branch's proposal to design a photo-electric scanning device specially for this purpose.* Briefly this consists of banks of photo-electric cells, which by their response to the light—or lack of light—reflected from the brightly illuminated coding "field" of the ticket, actuate "punches"; thus a pencil mark in the "field" causes a punched hole in the card. The pencil marks must be sufficiently dense to vary the electrical resistance of the cells, and must conform to specified limits, indicated by the "ovals"—termed lozenges—enclosing the digits. Two marks in one column (for example, one "normal" and one excessively long straying from an adjacent column) would cause the machine to reject the ticket. Since the system cannot distinguish between pencil marks and black printing, it is necessary either so to adjust the optical system

Fig. 1. (black ink)



* *An account of the design and operation of the scanning device is to appear in a future issue of the P.O.E.E. Journal.*

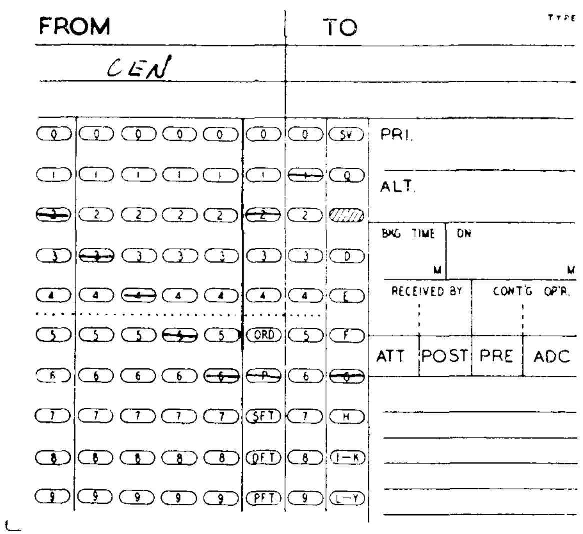


Fig. 2a. (red ink)

that no ink is "scanned", or to use a "coloured" ink and an appropriate colour filter. Both systems have been tried.

This article deals with the evolution of a telephone ticket suitable for use with such a machine. The main problem has been to resolve the difficulties arising from the sometimes conflicting requirements of telephone operators and the scanning system. Again, it was not known how operators could adapt themselves to the new technique, or if any nervous or physical strain would result, and it was necessary to calculate, if practicable, any additional recording time over

First five columns for calling subscriber's number
Next two columns for duration of call
Last column for charge letter and whether chargeable or not
Sixth column for type of call

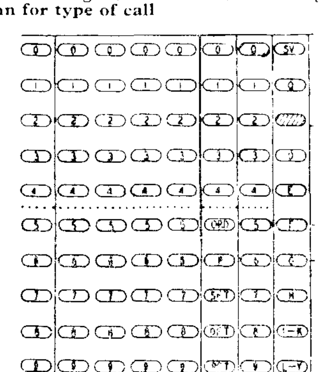
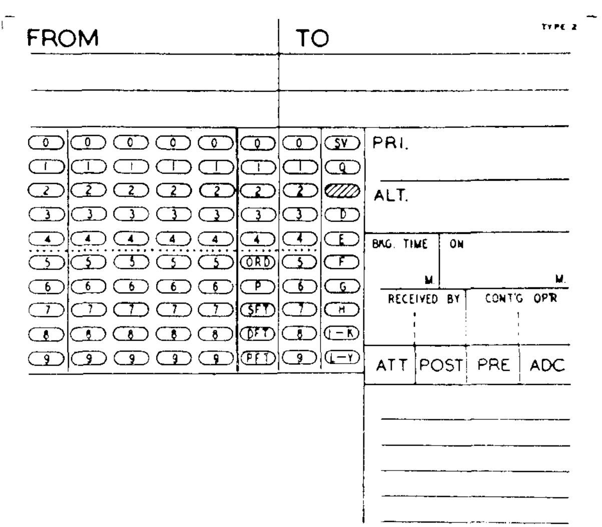


Fig 2b (red ink)

that taken with tickets TT2; if switchboard operating costs were increased excessively the accounting advantages would be nullified. On the principle of learning to walk before trying to run, it was decided that, if the tests were successful, and the system were tried at an exchange, "mark-scanning" should initially be restricted to (*a*) the calling subscriber's number, (*b*) the type of call, and (*c*) the charging particulars. Fig. 2(*a*) shows the type of ticket envisaged; in this, a 21-minute "personal" call of charge letter G has been recorded against Central 23456. Fig. 2(*b*) gives the detailed lay-out of the "fields".

The design of the scanning machine largely controlled the possible design of the coding field and it is hardly surprising that first designs owed much to the ticket used in previous "mark-sensing" experiments conducted by the Department. The tickets—Figs. 2(*a*), 2(*b*), 3 and 4—were printed in red instead of black, thus ensuring complete "filtering". Since the large "field" of Figs. 1, 2(*a*) and 2(*b*) seriously restricted the space available for other entries, a reduced field—Fig. 3—was tried, although it was feared that this would make marking more difficult. Again, the shape of the tickets of Figs. 2(*a*), 2(*b*) and 3 is inconvenient for switchboard use, and a further design Fig. 4 was prepared, suitable for use on a ticket of TT2 dimensions. These three tickets formed

Fig. 3. (red ink)



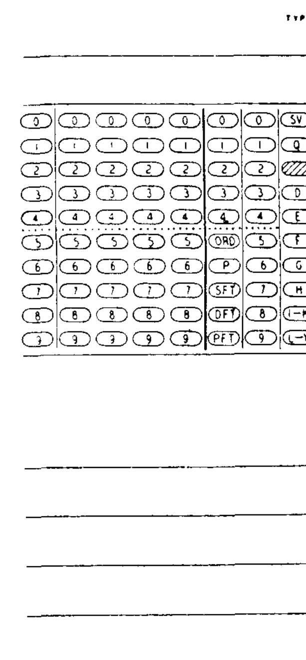


Fig. 4. (red ink)

the basis of the first series of trials at the Post Office Research Station at Dollis Hill.

Teams of operators and observers were assembled, and the operators' times and reactions measured when using "mark-coding" tickets and ordinary TT2 tickets in recording telephone numbers of 4 digits only, and later, exchange names and numbers. In order to reduce possible sources of discrepancy, each observer timed each operator in turn. Observations on each type of ticket were continued until it was clear that statistical stability was reached; then the various tickets were used in rotation of 30-minute periods. The results are summarised in Table A.

The unexpected conclusion emerged that the smallest field was the most suitable and the fastest; the operators stated unanimously that the smaller hand and wrist movements made coding less fatiguing. The results were doubly encouraging, showing that operators could assimilate the new technique. Recruits should assimilate "mark-coding" more easily than operators already habituated to manuscript recording and that a recording time not greatly different from normal was possible.

There was clearly scope for investigation into the shape, size and lay-out ("vertical" or "horizontal") of the field, and of the types of "lozenges" containing the digits. Hitherto it had been assumed that the strict limits defined by a "lozenge" were necessary to enable operators to restrict pencil movement, and thus prevent false marks in adjacent columns; now, in view of the small degree of "marking displacement" found, it seemed that this requirement could be relaxed and "lattice" patterns (for example) tried. But operators strongly disliked red ink printing and green was tried as being more restful to the eyes, although it is not so satisfactory as regards "filtering".

Table A

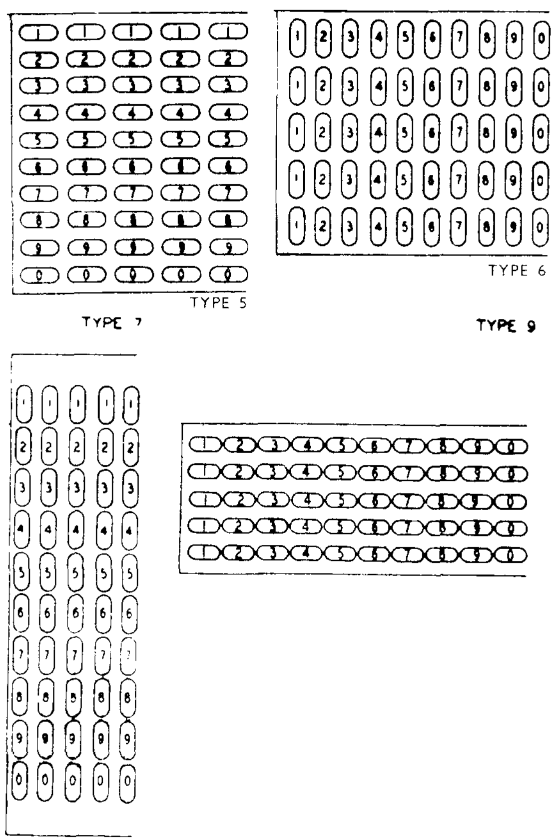
CONDITION	TICKET	TOTAL NO. MARKED	NO. CANCELLED BY OPERATOR	NO. OF ERRORS FOUND	AVERAGE RECORDING TIME (EXCESS OVER THAT FOR TT2 IN SECS.)
4 digits only	TT2	3,200	23	4	—
	Type 1	3,200	20	Nil	0.83
	2	3,200	22	2	0.53
	3	3,200	23	2	0.46
Exchange name and 4 digits	TT2	3,200	10	3	—
	Type 3	3,200	45	3	0.68
Exchange name and 5 digits	TT2	800	15	5	Not timed
	Type 3	800	35	1	

Some of the "field" designs used in the second trial are shown in Fig. 5. The same system was used, 24 tickets of each type being taken in turn, and the complete cycle consisted of six types arranged to give the maximum variety of "mark" and "field". Four-figure numbers only, without exchange names, were used throughout. It soon became clear that the repeated changes of design throughout the cycle had a disturbing effect. Nevertheless certain trends emerged. Fields allowing an "oblique" mark were preferred and had the shortest "marking" time, but the error rate was higher than could be tolerated and their use would unduly complicate the scanning device. The operators expressed strong dislike of a vertical field—Types 7 and 11—and two others were substituted. Of the others only Type 5 (substantially the same as Type 3) was comparable in "marking" time; further, it had a reasonably low error rate. A summary of the results is given in Table B. "Incorrectly" marked tickets include those in which the pencil mark was too short to actuate the machine, or ran into the adjacent column, thus causing the machine to reject the ticket.

Now it was decided that "oblique" marking could not be accepted: that, although the "lattice" pattern showed promise, the oval type "lozenge" helped operators in positioning marks; that green printing should be retained. The tests had now reached a stage at which a trial with "live" traffic could be held, and normal "call value" observations of recording times taken.

At four exchanges a selected operator spent a period each week recording on tickets TT2; for the remainder "mark-coding" tickets (Fig. 7)

Fig. 5. (green ink)
"Lozenge" patterns—vertical and horizontal



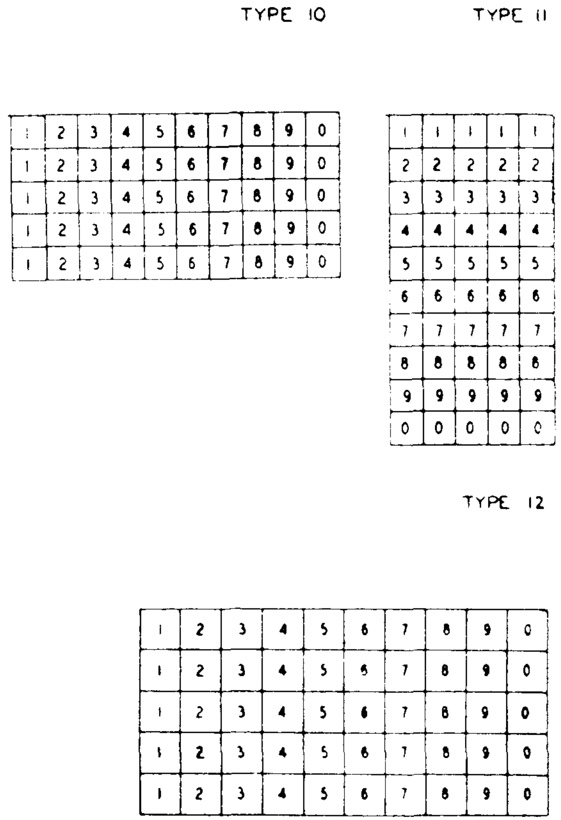


Fig. 6. (green ink)
"Lattice" patterns—vertical and horizontal

Table B

TYPE NO.	NO. OF TICKETS CODED	% INCORRECT
4	3,600	5.25
5	3,600	2.75
6	2,400	2.75
7	2,400	6.75
9	2,000	9.0
10	3,600	20.5
11	3,600	8.25
12	2,000	13.25
TT2	400	2.0

were used. An operator in parallel recorded all calls on tickets TT2 for accounting purposes. The number of calls handled half-hourly by the selected operator, and by the remaining staff, was recorded; this was to assess (*a*) the selected operator's load using "mark-coding" tickets compared to her load using standard tickets, and (*b*) a "mark-coding" load adjusted to the load of the average operator "half-hour". The need for this was early visualised, as under the stimulus of novelty operators might work above their normal rate. It was impossible to allow mathematically for the incidence of traffic, the varying loads presented to, and the different abilities of, individual operators, and the comparison adopted was regarded as the only practicable alternative. A brief summary of the results on the ten weeks' trial is given in Table C.

Certain of the "selected" operators—and the reserves who substituted them—complained of nervous strain and the incidence of sick leave was slightly higher than normal. This may have been because of the overload carried—in one case of the order of 80 per cent.—rather than to the actual use of the "mark-coding" system, but clearly further investigation was needed. Further, good switch-room illumination was required if eyestrain was to be avoided.

The next step was to introduce a complete exchange to "mark-coding", preferably a small minor exchange before proceeding to a group centre. Bexhill Central Battery exchange was chosen and thin card tickets, substantially as reproduced in Fig. 7, were used. In general, while the other conclusions reached were substantially the same as those from the earlier trial, there was considerably less evidence of nervous fatigue and eyestrain, which strengthened the impression

Fig. 7. (green ink)

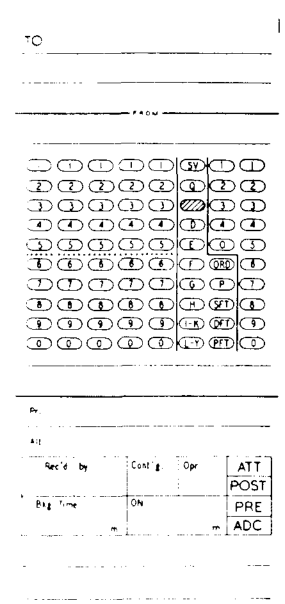


Fig. 8. (green ink)

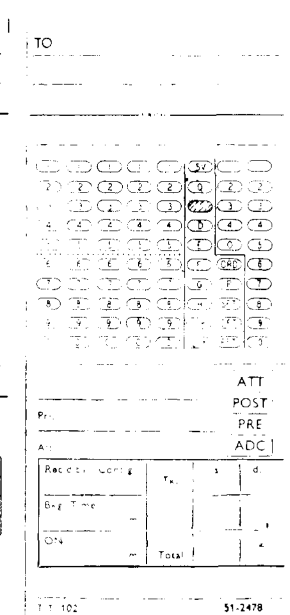


Fig. 9. (black ink)

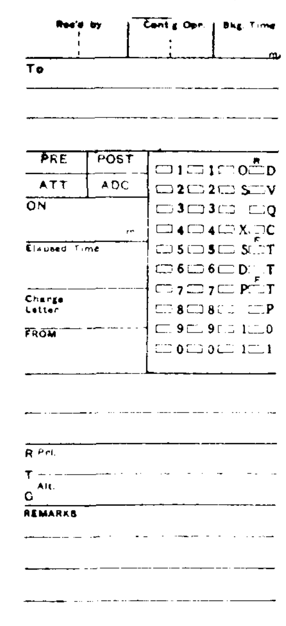
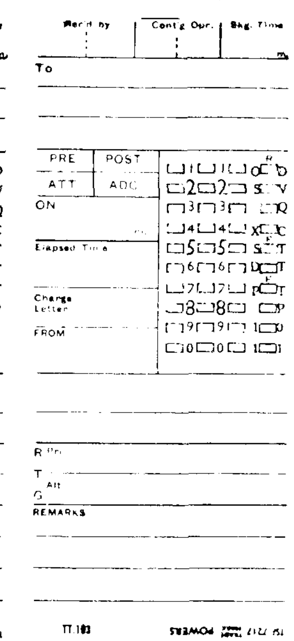


Fig. 10. (black ink)



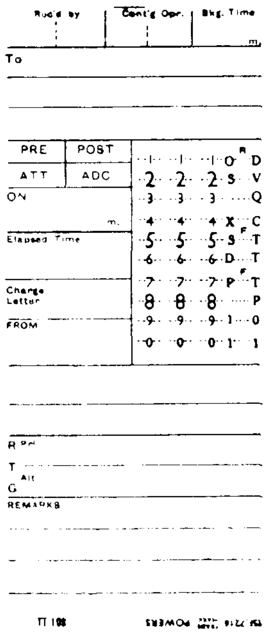


Fig. 11. (green ink)

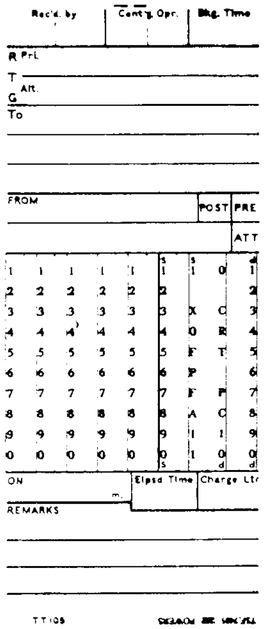


Fig. 12. (black ink)

that the strain had been due to overload. Having proved that "mark-coding" would not disrupt the service, the way was clear to introduce it at a group centre.

For this trial, King's Lynn Exchange was chosen, and once again thin card type tickets (Fig. 8) were used. Circumstances combined to give the system a severe test; both the Christmas "peak" and the extremely heavy traffic resulting from the death of H.M. King George VI were handled during the three months' trial, but at no time was it ever considered necessary to revert to ordinary ticket recording. This in itself is fairly conclusive proof that "mark-coding" is a practical proposition. Despite the heavy loads carried, on this occasion there was much less fatigue and nervous strain among switchboard operators; exchange staff on accounts duties complained of eyestrain, but under a mechanical accounting system this work would of course be performed automatically. Call value observations showed that an increase in recording times of the order of 1.5 seconds would result, but further research into the design and lay-out of the tickets might reduce this.

Research into the design is now proceeding concurrently with a field trial of the scanning machine in the Canterbury Area. Experiments have shown that as operators gain experience they can restrict their marks within reasonable bounds and it is possible to dispense with "lozenges": further it has now been found practicable to reduce the width of the scanning beam and to modify the "type of call" code so as to avoid the beam traversing any printed portion of the tickets. A much clearer, more "pleasant-appearing" type of ticket results. Figs. 9, 10, 11 and 12 show some of the latest designs in which it will be seen how far we have travelled from the early days. The ticket shown in Fig. 12 has been used in the Canterbury Area for several months, including the holiday pressure period. Detailed results from Canterbury were not available when this article was written but it may well be that a ticket based on one of these latest patterns will eventually prove satisfactory.

Table C

EXCHANGE	ADDITIONAL TIME (SECS.) NEEDED FOR RECORDING M/C TICKETS		% OF TICKETS FAILING TO CONFORM TO LIMITATIONS OF SCANNING DEVICE		% OF TICKETS SPOILT		% OF RECORDING IRREGULARITIES—TICKETS	
	Timed Toll	Long Distance	Marks short	Marks long	M/C	TT2	M/C	TT2
Guildford ...	1.0	0.3	1.8	—	·53	—	·95	·235
Portsmouth ...	2.1	2.5	.15	—	·57	.14	·54	.04
Reading ...	1.5	2.9	.16	—	.88	.6	.61	.025
Brighton ...	1.2	6.5	2.86	.41	1.13	.2	·35	.026

1878
(Fig. 1)

The Evolution of British Post Office Telephones

H. J. C. SPENCER, A.M.I.E.E.,
Engineer-in-Chief's-Office

195-?
(Fig. 14)

THIS ARTICLE TRACES THE DEVELOPMENT OF the telephone instrument within the British Post Office alone and, as the history of the telephone is truly an international one, this is far from being the complete story of its evolution. Also, only the "main stream" of development within the Post Office is dealt with, so that many special purpose telephones have received no mention.

When Graham Bell invented the telephone the function of the Post Office was to provide postal and telegraph services and consequently the tendency was for it to be regarded as an auxiliary telegraph instrument. After a short period of complete indifference to the invention telephones were offered by the Post Office as alternative instruments on A.B.C. telegraph lines.

The type of telephone used for this service in 1878 is illustrated in Fig. 1. It was brought into circuit in place of the A.B.C. instrument by means of a switch and while it was recognised as being quicker and simpler to use than the telegraph instrument it was not considered to be as reliable. This telephone was a combination of a Bell receiver, very similar to Bell's original invention, and a Crossley transmitter, a British invention which was one of a number of Carbon Pencil transmitters based on Professor Hughes's theory of microphonic contact. It was used with a local battery and induction coil, which were contained within the telephone. The decorated top of the telephone was a guard for a large pinewood diaphragm on the rear of which the carbon pencils were fixed.

Telephones of this type were soon superseded by Gower-Bell telephones like the one shown in Fig. 2. The Gower transmitter was another variation of the Carbon Pencil theme only with more pencils than the Crossley. The receiver worked on the Bell principle, but was considerably larger and heavier than the conventional receiver, so much larger and heavier in fact that it could not be held to the ear in the usual manner but was listened to through speaking tubes. The change from the conventional receiver of the earlier telephone to speaking tubes sounds a strange step today but in those days speaking tubes were quite familiar and their use was thought justified by the increased power of the new receiver. Much later in the history of the telephone the arrangement of the magnets in this receiver was repeated, on a much smaller scale, in the design of auxiliary "watch" receivers.

The Gower-Bell telephone remained the Post Office choice for many years, and was continuously developed. By 1891 it had become known as the Universal Telephone, so-called because it could be adapted for use under practically any conditions likely to be met with in Post Office service. It retained the Gower Transmitter but the receiver and speaking tubes had given place to a pair of Bell receivers. The calling signal was a trembler bell which was rung by a battery at the subscriber's premises under the control of a relay operated by a signalling current received from the exchange. A feature of this system of working which has a modern sound was that when an operator rang the subscriber's bell she could hear the interruption in current caused by the trembler bell contact, a forerunner of ringing tone.

While the Post Office was providing the telephone as an alternative telegraph service private companies sprang up throughout the country for the purpose of providing telephone exchange service proper. The companies had the right of use of the vital telephone patents, Bell's receiver patent, the Carbon Microphone patent of Edison, and later the patent for Blake's transmitter, and their eventual choice of instrument was one using Bell's receiver with a Blake transmitter, as is illustrated in Fig. 3.

In the 1880s important legal decisions were made which confirmed that the Postmaster General's monopoly in providing telegraphic communication extended also to telephonic communication and placed the destiny of the telephone in Britain in the hands of the Post Office. The Post Office straightway announced its willingness to provide telephone exchange services and in pursuance of this policy converted a number of A.B.C. Telegraph switching centres to Telephone Exchange working, using Gower-Bell telephones, but it was in no position to fill the void that would have been created had the private systems been closed down. Consequently licences were issued to the private companies and their activities continued until 1912, although several local authorities continued for some years to operate their own telephone systems under licence and one (Hull) still does so.

Patent difficulty

The Post Office's efforts to compete with the private companies were hampered by the restricted choice of instruments imposed by the possession by its rivals of the telephone patents which did not expire until 1890-91, and the small scale of the Post Office telephone activities up to this time can be judged by its total of 4,691 working exchange lines.

The year 1889 was a landmark in the history of telephony, for Deckert, an Austrian, patented his Granular Carbon transmitter. It was by no means the first transmitter of the type. The original invention had been made by the Rev. Hennings in England as early as 1878, but the earlier granule transmitters, while being powerful compared with other types, had suffered from "packing" of the granules and many inventors had wrestled with this problem before Deckert found a solution to it. A good carbon granule transmitter is 1,000 times as powerful as the Bell receiver, which had been used as a transmitter in the very early days of telephony, and without this great increase in power long-distance telephony before the age of electronic amplifiers would have been impossible.

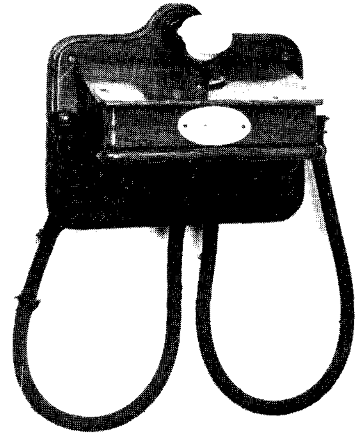


Fig. 2

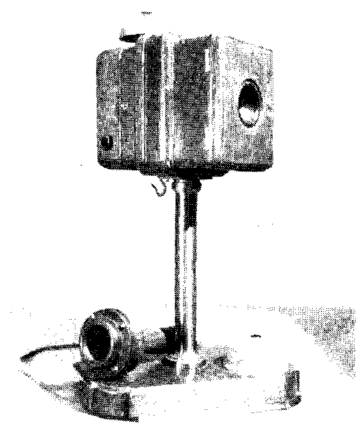


Fig. 3

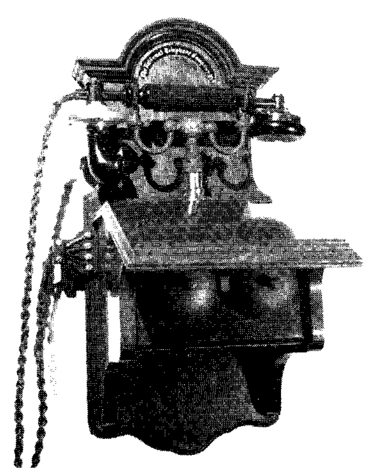


Fig. 4

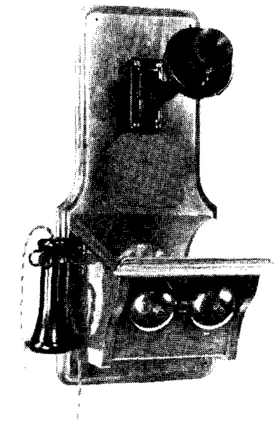


Fig. 5

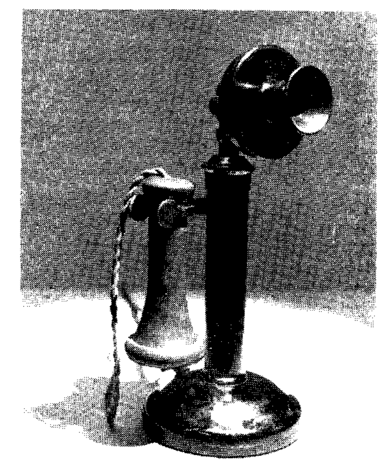


Fig. 6

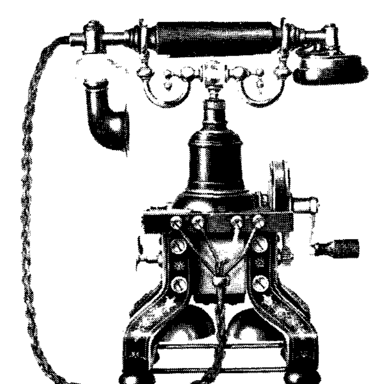


Fig. 7

The Deckert transmitter was adopted as their standard by both the Post Office and the private companies, now amalgamated to form the National Telephone Company. It was a mixed blessing for the Company, as its increased power caused serious overhearing between lines on earth return systems, which they used to economise in line plant, and it had to be confined to metallic circuits only. The Post Office had always been worried about the possible effects of induction and had installed metallic circuits from the beginning so that this difficulty was not met with.

Another innovation of this time was the Handset. Ericsson in Sweden had thought of combining the transmitter and receiver in a handset in 1884 but the transmitters of the day did not take kindly to being moved about and the receivers were bulky so that the idea was not much used. With the coming of the Carbon Granule transmitter, and of improved magnetic materials for receivers the idea became practicable; the movement of the transmitter was actually advantageous, as it mitigated "packing". Both the Post Office and the Company put into service telephones using the Ericsson handset; a Company telephone of 1900 fitted with one is shown in Fig. 4. The handset is fitted with a carbon granule transmitter similar to the Deckert but of Ericsson design. Handset telephones of this type were very popular with users and they remained in service for some purposes until very recently.

Expansion

Post Office activity in the telephone field increased greatly with the turn of the century. The Telegraph Act of 1899 restricted the Company's activity to those areas where it had already established exchange services, so that the onus of providing service elsewhere, mainly rural areas where the numbers to be served did not make the system economic, fell upon the Post Office. In addition, the Post Office set out to provide a telephone service within London alongside the Company's. The time was very propitious for large scale expansion as the Common Battery system had just been invented in America and had proved to be much superior to the older systems. The Post Office was able to introduce telephones for the C.B. system, based on American designs, which were destined to remain unchanged in principle for very many years.

At this time the Post Office started to number its telephones in the series that is still being used.

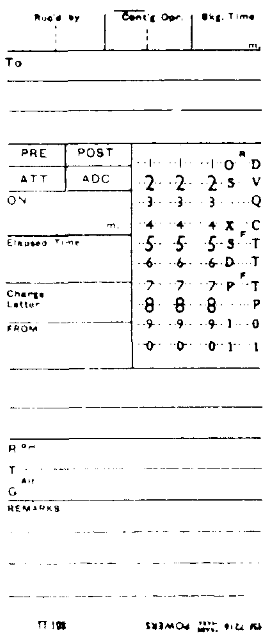


Fig. 11. (green ink)

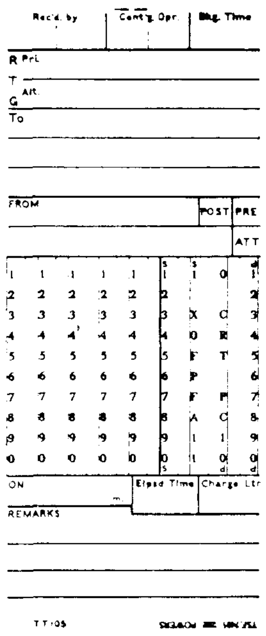


Fig. 12. (black ink)

that the strain had been due to overload. Having proved that "mark-coding" would not disrupt the service, the way was clear to introduce it at a group centre.

For this trial, King's Lynn Exchange was chosen, and once again thin card type tickets (Fig. 8) were used. Circumstances combined to give the system a severe test; both the Christmas "peak" and the extremely heavy traffic resulting from the death of H.M. King George VI were handled during the three months' trial, but at no time was it ever considered necessary to revert to ordinary ticket recording. This in itself is fairly conclusive proof that "mark-coding" is a practical proposition. Despite the heavy loads carried, on this occasion there was much less fatigue and nervous strain among switchboard operators; exchange staff on accounts duties complained of eyestrain, but under a mechanical accounting system this work would of course be performed automatically. Call value observations showed that an increase in recording times of the order of 1.5 seconds would result, but further research into the design and lay-out of the tickets might reduce this.

Research into the design is now proceeding concurrently with a field trial of the scanning machine in the Canterbury Area. Experiments have shown that as operators gain experience they can restrict their marks within reasonable bounds and it is possible to dispense with "lozenges": further it has now been found practicable to reduce the width of the scanning beam and to modify the "type of call" code so as to avoid the beam traversing any printed portion of the tickets. A much clearer, more "pleasant-appearing" type of ticket results. Figs. 9, 10, 11 and 12 show some of the latest designs in which it will be seen how far we have travelled from the early days. The ticket shown in Fig. 12 has been used in the Canterbury Area for several months, including the holiday pressure period. Detailed results from Canterbury were not available when this article was written but it may well be that a ticket based on one of these latest patterns will eventually prove satisfactory.

Table C

EXCHANGE	ADDITIONAL TIME (SECS.) NEEDED FOR RECORDING M C TICKETS		% OF TICKETS FAILING TO CONFORM TO LIMITATIONS OF SCANNING DEVICE		% OF TICKETS SPOILT		% OF RECORDING IRREGULARITIES—TICKETS	
	Timed Toll	Long Distance	Marks short	Marks long	M C	TT2	M C	TT2
Guildford ...	1.0	0.3	1.8	—	·53	—	·95	.235
Portsmouth ...	2.1	2.5	.15	—	·57	.14	·54	.04
Reading ...	1.5	2.9	.16	—	.88	.6	.61	.025
Brighton ...	1.2	6.5	2.86	.41	1.13	.2	·35	.026

1878
(Fig. 1)

The Evolution of British Post Office Telephones

H. J. C. SPENCER, A.M.I.E.E.,
Engineer-in-Chief's-Office

195-?
(Fig. 14)

THIS ARTICLE TRACES THE DEVELOPMENT OF the telephone instrument within the British Post Office alone and, as the history of the telephone is truly an international one, this is far from being the complete story of its evolution. Also, only the "main stream" of development within the Post Office is dealt with, so that many special purpose telephones have received no mention.

When Graham Bell invented the telephone the function of the Post Office was to provide postal and telegraph services and consequently the tendency was for it to be regarded as an auxiliary telegraph instrument. After a short period of complete indifference to the invention telephones were offered by the Post Office as alternative instruments on A.B.C. telegraph lines.

The type of telephone used for this service in 1878 is illustrated in Fig. 1. It was brought into circuit in place of the A.B.C. instrument by means of a switch and while it was recognised as being quicker and simpler to use than the telegraph instrument it was not considered to be as reliable. This telephone was a combination of a Bell receiver, very similar to Bell's original invention, and a Crossley transmitter, a British invention which was one of a number of Carbon Pencil transmitters based on Professor Hughes's theory of microphonic contact. It was used with a local battery and induction coil, which were contained within the telephone. The decorated top of the telephone was a guard for a large pinewood diaphragm on the rear of which the carbon pencils were fixed.

Telephones of this type were soon superseded by Gower-Bell telephones like the one shown in Fig. 2. The Gower transmitter was another variation of the Carbon Pencil theme only with more pencils than the Crossley. The receiver worked on the Bell principle, but was considerably larger and heavier than the conventional receiver, so much larger and heavier in fact that it could not be held to the ear in the usual manner but was listened to through speaking tubes. The change from the conventional receiver of the earlier telephone to speaking tubes sounds a strange step today but in those days speaking tubes were quite familiar and their use was thought justified by the increased power of the new receiver. Much later in the history of the telephone the arrangement of the magnets in this receiver was repeated, on a much smaller scale, in the design of auxiliary "watch" receivers.

The Gower-Bell telephone remained the Post Office choice for many years, and was continuously developed. By 1891 it had become known as the Universal Telephone, so-called because it could be adapted for use under practically any conditions likely to be met with in Post Office service. It retained the Gower Transmitter but the receiver and speaking tubes had given place to a pair of Bell receivers. The calling signal was a trembler bell which was rung by a battery at the subscriber's premises under the control of a relay operated by a signalling current received from the exchange. A feature of this system of working which has a modern sound was that when an operator rang the subscriber's bell she could hear the interruption in current caused by the trembler bell contact, a forerunner of ringing tone.

While the Post Office was providing the telephone as an alternative telegraph service private companies sprang up throughout the country for the purpose of providing telephone exchange service proper. The companies had the right of use of the vital telephone patents, Bell's receiver patent, the Carbon Microphone patent of Edison, and later the patent for Blake's transmitter, and their eventual choice of instrument was one using Bell's receiver with a Blake transmitter, as is illustrated in Fig. 3.

In the 1880s important legal decisions were made which confirmed that the Postmaster General's monopoly in providing telegraphic communication extended also to telephonic communication and placed the destiny of the telephone in Britain in the hands of the Post Office. The Post Office straightway announced its willingness to provide telephone exchange services and in pursuance of this policy converted a number of A.B.C. Telegraph switching centres to Telephone Exchange working, using Gower-Bell telephones, but it was in no position to fill the void that would have been created had the private systems been closed down. Consequently licences were issued to the private companies and their activities continued until 1912, although several local authorities continued for some years to operate their own telephone systems under licence and one (Hull) still does so.

Patent difficulty

The Post Office's efforts to compete with the private companies were hampered by the restricted choice of instruments imposed by the possession by its rivals of the telephone patents which did not expire until 1890-91, and the small scale of the Post Office telephone activities up to this time can be judged by its total of 4,691 working exchange lines.

The year 1889 was a landmark in the history of telephony, for Deckert, an Austrian, patented his Granular Carbon transmitter. It was by no means the first transmitter of the type. The original invention had been made by the Rev. Hennings in England as early as 1878, but the earlier granule transmitters, while being powerful compared with other types, had suffered from "packing" of the granules and many inventors had wrestled with this problem before Deckert found a solution to it. A good carbon granule transmitter is 1,000 times as powerful as the Bell receiver, which had been used as a transmitter in the very early days of telephony, and without this great increase in power long-distance telephony before the age of electronic amplifiers would have been impossible.

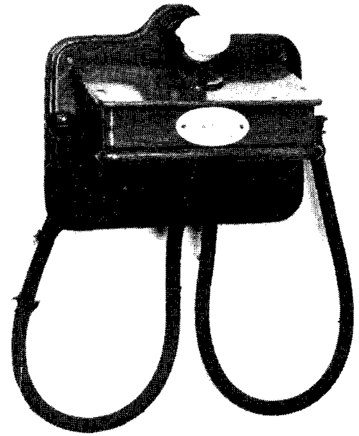


Fig. 2

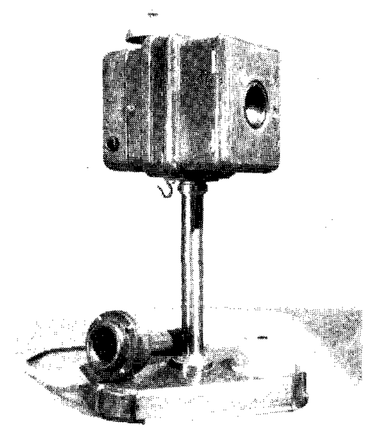


Fig. 3

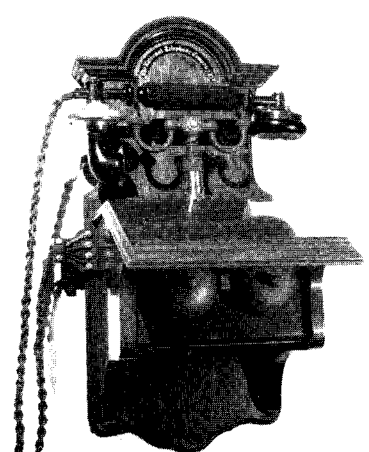


Fig. 4

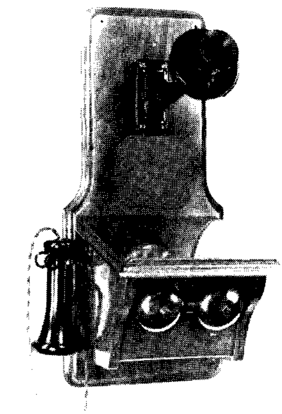


Fig. 5

Fig. 6

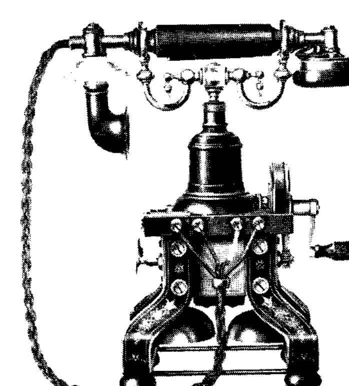


Fig. 7

The Deckert transmitter was adopted as their standard by both the Post Office and the private companies, now amalgamated to form the National Telephone Company. It was a mixed blessing for the Company, as its increased power caused serious overhearing between lines on earth return systems, which they used to economise in line plant, and it had to be confined to metallic circuits only. The Post Office had always been worried about the possible effects of induction and had installed metallic circuits from the beginning so that this difficulty was not met with.

Another innovation of this time was the Handset. Ericsson in Sweden had thought of combining the transmitter and receiver in a handset in 1884 but the transmitters of the day did not take kindly to being moved about and the receivers were bulky so that the idea was not much used. With the coming of the Carbon Granule transmitter, and of improved magnetic materials for receivers the idea became practicable; the movement of the transmitter was actually advantageous, as it mitigated "packing". Both the Post Office and the Company put into service telephones using the Ericsson handset; a Company telephone of 1900 fitted with one is shown in Fig. 4. The handset is fitted with a carbon granule transmitter similar to the Deckert but of Ericsson design. Handset telephones of this type were very popular with users and they remained in service for some purposes until very recently.

Expansion

Post Office activity in the telephone field increased greatly with the turn of the century. The Telegraph Act of 1899 restricted the Company's activity to those areas where it had already established exchange services, so that the onus of providing service elsewhere, mainly rural areas where the numbers to be served did not make the system economic, fell upon the Post Office. In addition, the Post Office set out to provide a telephone service within London alongside the Company's. The time was very propitious for large scale expansion as the Common Battery system had just been invented in America and had proved to be much superior to the older systems. The Post Office was able to introduce telephones for the C.B. system, based on American designs, which were destined to remain unchanged in principle for very many years.

At this time the Post Office started to number its telephones in the series that is still being used.

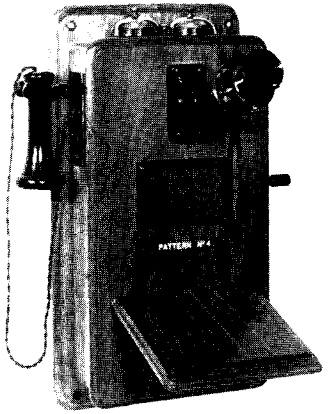


Fig. 8

Fig. 9

Fig. 10

Telephones No. 1 and No. 2 are illustrated in Figs. 5 and 6. They were both designed for C.B. working, being electrically identical, and illustrate a Post Office policy, still followed, of giving the subscriber a choice between a table telephone and a wall telephone. The wall telephone was a complete installation in itself but the table telephone had to be used with a bell-set, the "Candlestick" shape (used for its economy in desk space) having no room for the bell, capacitor and induction coil.

Electrically the most important feature of these telephones was the transmitter. This was a carbon granule transmitter invented by A. C. White, an American, and known as the "Solid Back" transmitter. It was a most efficient transmitter for its day and remained as the standard Post Office transmitter for C.B. use until displaced by the modern inset transmitter in 1930.

Handset advantages

It will be noticed that neither of the telephones in Figs. 5 and 6 uses a handset. There were two main reasons for this. First, the handset has to be made with the distance between mouthpiece and earpiece large enough to cater for the unusual head so that, for the average user, the distance between the lips and the transmitter is greater than that obtainable with separate receivers and transmitters and there is some loss of transmitting efficiency. With the increasing number of trunk calls which, as the trunks were not amplified, demanded the utmost transmission efficiency, this could not be tolerated. Secondly, carbon granule transmitters of the time varied considerably in resistance with changes in position and might even become disconnected when the plane of diaphragm was horizontal. On the C.B. system the transmitter forms part of the signalling circuit and high resistance or disconnections in it give false clearing signals to the exchange. Owing to these shortcomings of the handset, both the Post Office and the Company standardised on fixed or hinged transmitters for C.B. use.

While using the C.B. systems for large exchanges the Post Office evolved new systems for small rural exchanges. These were known as Central Battery Signalling systems and while they gave the signalling advantages of the C.B. system the transmitter was fed with current from a battery which was part of the telephone instead of from the main battery at the telephone exchange. The advantage of this was that it allowed the use of small primary batteries at the telephone exchange

instead of larger secondary cell installations, the charging of which presented problems before the electricity supply mains were as widespread as now.

For the C.B.S. systems, telephones No. 3 and No. 4 were designed. They were the local battery counterparts of telephones No. 1 and No. 2, which they resembled physically, but were fitted with a special transmitter for use with local batteries. This transmitter was made in the form of an easily replaced capsule known as a transmitter inset No. 3. Transmitters made in this way are not repairable and when faulty are scrapped. They are cheaper to make initially and the ease of replacement is a valuable maintenance feature. Some "Solid Back" transmitters were also made in inset form and in modern times the use of inset transmitters is universal.

When taking over the Company's system in 1912, the Post Office inherited, besides some C.B. exchanges, a large number of magneto exchanges and their associated instruments. An essential part of a magneto telephone is a hand generator by which the subscriber calls and rings off. A telephone which incorporated this bulky component in an ingenious way is illustrated in Fig. 7. This was an Ericsson telephone, nicknamed the "Skeleton", which was absorbed into the Post Office series as telephone No. 16. The decorative legs are actually the magnets of the generator.

Oldest in use

The Post Office had introduced a magneto instrument, telephone No. 11, into service in 1902. This was very similar to the C.B.S. wall telephone, telephone No. 3, with the addition of a generator, and it is illustrated in Fig. 8. It bears the distinction of being the oldest Post Office telephone still in current use, being the standard wall instrument for those places where the magneto system lingers on.

The first major change in the main series of Post Office telephones was caused by the introduction of automatic working which, while the automatic system was fundamentally C.B., required the addition of a dial. Between 1914 and 1924 several telephone dials and circuits were tried and eventually standard telephones were introduced. The new telephones were coded Nos. 150 and 121 and are illustrated in Figs. 9 and 10. Apart from the provision of dials they differed little from their predecessors of the C.B. system and in 1929 these were superseded by the automatic instruments, the dial being replaced by a

Fig. 11

Fig. 12

Fig. 13

dummy for C.B. working. This has the advantages that the number of different telephones is reduced, and that when a C.B. system is converted to automatic working it is necessary only to replace the dummy by a dial instead of changing the instrument. These two telephones are still the Post Office standard telephones.

The first 30 years of the 20th century had been a period of extraordinary stability in telephone design, for the transmitter and receiver being used in 1930 were the same as those introduced at the beginning of the C.B. system. Things now began to stir however and the next Post Office telephone was revolutionary in many ways.

The new shape, which was first seen in 1929, was that of telephone No. 162, illustrated in Fig. 11. The Post Office, in co-operation with a manufacturer (an innovation of its own), designed and developed it specifically for its own services. It involved the return of the Handset, made possible by the design of a new more sensitive transmitter and a new receiver, and used a circuit designed to reduce sidetone. (Sidetone is the hearing in the receiver of sounds picked up by the transmitter of the same telephone. It has a deleterious effect on receiving efficiency for the background noise picked up by the transmitter at the receiving end tends to mask the wanted sounds from the distant end. It also has an adverse effect on the transmitting efficiency of a telephone, for its presence in the receiver causes a talker to lower his voice subconsciously. Reducing the loudness of the sidetone results in the speaking level being kept up with consequent increase in transmission. This is similar to the often observed effect which causes some deaf people to talk more loudly than people with normal hearing.)

Emphasis on intelligibility

The transmission elements of the new instrument were designed with emphasis on intelligibility rather than on sheer loudness of the transmitted sounds, which had been the criterion of efficiency in the past.

The new transmitter is of the carbon granule type, made up in inset form, but it differs from earlier ones in that it uses the immersed electrode principle to minimise changes in resistance caused by changes of position, and even when it is held with the diaphragm horizontal the signalling path through it is maintained.

Physically the telephone was a table-set made up largely from plastic mouldings. Like the candlestick it does not contain all the essentials of the subscriber's installation and has to be used with a bell set. For the new telephone an entirely new bell set was designed the cover of which is also a plastic moulding. While suitable for independent fixing to a wall the bell set can also be attached to the base of the telephone to form a combined set, the bell set cover and the telephone case being shaped to form a pleasing assembly as shown in Fig. 12. Besides its use as a table model the new telephone, when mounted on a specially designed moulded plastic bracket, is also suitable for fixing to a wall so that a wall telephone equivalent of the new design is not necessary. The use of plastics for the telephone enabled it to be made satisfactorily in different colours, for a plastic is coloured red right through, and eventually telephones in Ivory, Jade Green and Chinese Red were made as alternatives to the usual black.

Further improvements

At the same time as this handset telephone was introduced to service a change was made to the telephones Nos. 150 and 121 so that the new inset transmitter could replace the old "Solid Back" and the telephone illustrated in Fig. 9 actually shows this change. The efficiency of these telephones was thus improved but they still suffer from the ill effects of sidetone. A Local Battery equivalent of the telephone No. 162 was also introduced under the title telephone No. 196.

Slight changes have been made to these handset telephones since they were first designed. The circuit has been changed to a more efficient anti-sidetone one and a new and more efficient receiver with an improved frequency response has been fitted. The only externally apparent change is the fitting of a sliding drawer in the base of the telephone which is used for keeping lists of dialling codes made necessary by the growth of the automatic system.

The No. 162 type of telephone was followed in 1938 by a telephone the shape of which originated in Sweden. It is a combined set, a desirable feature for installation purposes, and is neater than a combined set made up from the No. 162 type of telephone and its bell set, but is not so suitable when the telephone and bell are wanted in different places, as an extra bell then has to be used. The handset and electrical circuit are identical with later versions of the previous telephone so that there is no improvement in transmission. A valuable feature of the design is that up to three push button keys can be fitted to it and these can be used for auxiliary purposes in extension working. The telephone illustrated in Fig. 13 uses them to control an extension bell, and the key facility also makes the telephone very suitable for some kinds of shared service working.

Telephones of this shape are too long to be used on brackets as wall telephones, but hitherto this has not mattered as telephones of the earlier shape met the need. Now, however, the widespread use of shared service has created a demand for a wall telephone to which keys may be fitted and a new telephone is being designed for this purpose. A prototype of this telephone of the near future is illustrated in Fig. 14 in which one of the calling keys may be seen.

The standard of transmission provided by present day instruments is generally accepted as striking the right balance between economy in instruments and line plant on the one hand, and effective transmission of speech on the other. Any improvements to transmitters, receivers and circuits will probably be used to allow increased resistance of line between the telephone and the exchange (the performance of telephones falls as line length increases) so giving economies in line plant and possibly numbers of exchanges. The transmitting power and receiving sensitivity of telephones are ultimately limited by overhearing on the lines to which they are connected and it may be necessary to include a regulating device in any telephones much more efficient than the present ones to prevent the limits being exceeded when they are used on short lines.

In recent years the contribution of the higher frequencies of speech towards intelligibility has been fully recognised and the frequency response of transmitters and receivers has been improved. The limit of worth-while improvement in this direction has almost been reached, however, for it has been found that little increase in intelligibility is achieved by transmitting speech frequencies above 3,500 cycles per second so that there is no economic justification for making telephones which transmit and receive higher frequencies. It has always to be remembered that a new telephone for general use will have to work alongside five or six million older telephones for perhaps 20 years, so that no violent break with the past, such as a big change in the balance between transmitting and receiving sensitivities, is possible.

Inland Telecommunications Statistics

In the three months ending 30th September, 1953, there were 102,000 new demands for telephone service (the highest quarterly figure for over two years) and 99,000 new subscribers' exchange connections were installed. The number of shared service connections at 30th September was 663,000 compared with 625,000 at 30th June.

The number of telephones in service at the end of the period was 6,052,000, a net increase during the quarter of 64,000 (including an increase of some 580 public call offices). The number of outstanding applications was 384,000, representing a decline in the quarter of some 24,000.

72,100,000 inland trunk calls were made of which 19,273,000 (some 27 per cent.) were at the cheap rate. In the corresponding quarter of the previous year the figures were 68,005,000 and 17,998,000 (some 26 per cent.) respectively.

The number of inland telegrams (excluding Railway and Press) amounted to 9,409,000 including 1,727,000 (18 per cent.) greetings telegrams. In the same quarter of 1952 the figures were 9,961,000 and 1,712,000 (17 per cent.).

At the end of September, 1953, there were 47,926 telephonists, 9,019 telegraphists and 54,915 engineering workmen employed. The corresponding figures for September, 1952, were 48,361, 9,630 and 54,459.

New Post Office Depot.—The new Post Office Supplies Depot, established in modern factory premises at Bristol Road, Bridgwater, was opened on October 21, 1953, by the Mayor of Bridgwater. Twenty-five of the staff of forty are Bridgwater men.

The depot provides 70,000 square feet of storage space and deals with telephone and telegraph equipment. It is to be gradually extended over the 18-acre site to become one of the Post Office's biggest depots, providing employment for several hundred people.

What does a Telephone Salesman do today?

C. Llewellyn, M.B.E., lately Senior Sales Superintendent, Tunbridge Wells Area*

IN THESE DAYS OF SCARCE RESOURCES THE title "Sales" is more or less a misnomer, but in normal conditions it is well deserved and very apt. Some people imagine that there is no more need for salemanship for telephones than there is for postage stamps, but although there will always be a demand for any kind of useful facility, a well-designed and applied sales technique will undoubtedly increase this demand. This is an accepted principle of commerce.

In October, 1944, a Study Group sat under the chairmanship of Mr. B. L. (now Sir Ben) Barnett which included in its terms of reference ". . . to investigate any other questions which bear on the need for, and the efficiency of, a sales staff in the Post Office organisation". This Study Group reached the conclusion that it would be impossible for the telephone service to take its full and rightful place in the national economy if the Post Office were passively to rely on spontaneous orders, and it was the unanimous opinion that canvassing is the only stimulant sufficiently selective to produce orders where plant is available and so achieve economical development.

Sales staff, supported by a national advertising campaign, can stimulate demand generally when plant and equipment are universally available, or they can concentrate on seeking new customers to provide a useful financial return to the Post Office in districts where plant exists, without stimulating demand in places where plant is scarce. They can also sell more extension telephones to old or new subscribers and thus increase the average revenue per installation; even spontaneous residential applicants for service seldom think of asking for an extension to the bedroom. And, of course, there is a market for house exchange systems and the potentially profitable Private Automatic Branch Exchanges, for private circuits, telex service and other special services.

From tradition and early training our natural concern is to produce orders and to expand the telephone service but, unfortunately, restriction of capital investment, shortages of labour and material and other considerations have stopped our work in this direction since 1939. In the meantime a large unsolicited demand has kept us busy.

First, there was the release of demand which had been pent up during the war, and then the demand which arose from the industrial switch-over from war to peace production.

The telephone is still relatively cheap; until July 1, 1952, rentals were only 15 per cent. above their pre-war level, and even now they are only 50 per cent. above. Compared with the general rise in prices it might have been said, until the recent increase, that the rental of a residential telephone in the provinces had come down to what would have been the equivalent of about 10s. a quarter before the war. No wonder there has been an unsolicited demand—and if we had been able to go out and sell the service we could have had a "field day".

The wide-spread spontaneous demand will not continue for ever. Money is getting tighter; building costs are high so that the new house-owner has not much cash to spare; house rents may go up; our competitors, who sell other amenities, are making a strong attack on the residential market in the form of refrigerators, television sets, vacuum cleaners, washing machines and so on, and there must be a lot of threadbare carpets crying out for replacement. The time will come when we shall have to stimulate demand by canvassing—though this may have to be selective at first.

All this is in the future, however, and in the meantime the Sales Division has plenty to do. Where formerly the provision of service was a straightforward job and the Sales staff could concentrate on getting orders, we now have to contend with waiting lists, enquiries about the availability of plant, limitations on line constructional work for individual applicants, the farmers' "self-help" scheme, the operation of a priority system and the development of shared service. Our powers of persuasion are now more often used in reverse, in explaining to would-be subscribers why they cannot have service. In addition, there is the job of estimating future development to be carried on.

Three-level system

The organisation to deal with this work is three-tiered with the Chief or Senior Sales Superintendent in control, and Sales Superintendents each in charge of a team of Sales Representatives and Clerical Officers.

The Senior Sales Superintendent's job is to ensure that the sales policy of the Post Office regarding telephone and allied services is followed and that the regulations governing the provision of telephone services are understood and properly applied. He deals with all major sales problems and satisfies himself that the work in his Division is running smoothly and efficiently. He watches progress in the provision of telephone lines and stations and sees that telephone kiosks are provided where required. He studies conditions in his Area and makes sure that the estimates of demand for service prepared by his Development Section are sound. He attends the Telephone Managers' regular monthly meetings for heads of divisions. He acts as the Telephone Manager's agent in relations with the public and keeps in touch with the Press.

Sales Superintendents work direct to the Senior Sales Superintendent and are responsible to him for controlling staff, for the work of the Division, and for maintaining good relationships with other divisions. They are also expected to spend some of their time in the field assisting and directing their visiting staff, and they deputise, in turn, for the Senior Sales Superintendent.

The Sales Representative who deals with cases in the subscriber's home or office has always had a territory of his own and in some cases is out-stationed in his territory. He deals with the complicated and other telephone problems which are often more easily resolved by discussion, as well as any simple cases which can be dealt with economically in the immediate neighbourhood of his other important calls.

The Clerical Officers who, with the Sales Representatives, make up the Sales Superintendent's team, deal initially with all incoming demands and handle the ordinary cases by correspondence.

At one time it was considered that the clerical work could more conveniently be handled on a functional basis and the office was staffed by a number of specialists in all types of work. For example, one Clerical Officer would deal exclusively with new applicants; another with removals; another with transfers, and so on. To-day each Clerical Officer has a territory coinciding roughly with that of a Sales Representative, and he may deal with all types of case arising in this territory.

Personal responsibility

Despite the modern movement towards specialisation, which means functional working, there is no doubt that the present territorial system in Sales Divisions has considerable advantage. Territorial Clerical Officers can exchange duties without difficulty and each can take a section of the Area under his control. He issues the advice note for the work to be done and sees each case through to its conclusion. He is then able to check the completion of the job on the closing of the advice note. This all goes to make the work more interesting and gives each officer a feeling of personal responsibility for the subscribers within his control.

In addition there are certain services such as private wires, firemen's call bell systems, Government services and defence requirements. These present unusual problems and do not occur often enough in a small territory to provide the ordinary Sales Representative with sufficient practice to give them expert treatment. Special service Sales Representatives are, therefore, available in most areas for this purpose.

Post-war entrants to the service may be surprised to learn that under the "Appointment Plan" which was in operation in the 1930s, it was the object to provide service by an appointed day.

* *Since writing this article Mr. Llewellyn has retired.*

often within one week of the signing of an agreement. The Sales Representative in the field telephoned the orders to the office, as soon as they were received, where they were recorded and passed immediately to the engineers. It was not unknown for telephones to be installed within hours in very urgent cases of illness or other emergency. The plant was there, or the Sales Representatives would not have been canvassing the district. To-day, before we can even think of accepting an order, we have first to ascertain if line plant is available and if the job is within the limits of construction for the particular class of applicant concerned. This frequently requires a physical survey by the engineers.

Waiting lists

As one would expect, there is much correspondence with impatient applicants, many of whom have been waiting for several years. A separate list is kept for each exchange area, on which applicants are recorded in date order, each graded in one of a number of priority categories. High priority is given to public services, or to individuals whose work is essential to public safety and well-being, such as airports, fire services, mines, hospitals, police and doctors. Next, we have farmers, then general business or industrial applicants and finally new residential applicants. Limitations on engineering construction vary with the class of applicant.

Shared service has been a great help. In the early days after the war the Sales Division persuaded existing exclusive line subscribers to accept shared service voluntarily in a "help your neighbour" spirit. It was surprising, in fact, how many subscribers were prepared to co-operate in this way, even at a time when common metering of local calls was the rule. In special drives Sales Representatives were able to persuade more than 30 per cent. of the subscribers they visited to share their lines voluntarily with neighbours who were on the waiting list. Since January, 1948, however, it has been necessary to insist on an undertaking from all new and removing residential subscribers that they will share their lines when called upon to do so.

With voluntary and compulsory sharers there are now over 650,000 subscribers with shared service, about half of whom could not have been given service without it. More than a quarter of all residential subscribers now have shared service. We take a good deal of trouble in arranging satisfactory partnerships, of course, and the great majority of sharing subscribers have settled down quite happily. There is now a difference of 30s. a year between the rentals of exclusive and shared service, and although this is still insufficient to encourage many people to *apply* for shared service as distinct from exclusive service, it is quite likely that many existing sharers would carry on with shared service even if they now had the free choice which we hope some day to give them. Many new applicants, however, remain doubtful of shared service until they have experienced it and many of my interviews with applicants arise from their attempts to avoid signing the undertaking to share their lines when called upon to do so. For example, there are the important business executive who is sure confidential conversations on his home telephone will be overheard, the lady who strongly objects to "Mrs. So-and-so" as a partner and others.

Public goodwill

I think it may be claimed that in dealing with the unsatisfied demand the Sales Division has retained public goodwill for the Post Office in very trying circumstances. We think, at any rate, that public criticism would have been much more severe if applicants had failed to obtain the sympathetic treatment, frank explanations, and general information we have been employed to give them. The balanced use of correspondence in straightforward cases and personal approach in complicated cases; the special efforts made to accommodate very long-standing waiting applicants; the "selling" of shared service; and the sensible operation of the priority system have been some of the fundamentals of sales work since the war. The result is general recognition that the Post Office is doing its best, with justice to all, within the limits of scarce national resources. It is a wearing job, but it is worth it.

The Sales Division's other function is to provide forecasts of future demand for telephone service in each exchange area. A separate section of the Division is responsible for this work; it is under a Sales Superintendent and consists of Sales Representatives known as Development Officers.

When surveying an exchange area, the Development Officer visits the area and records every tenancy on a field note sheet. He also ascertains from various sources, such as the Council Surveyor, details of any future plans for building. The existing and proposed residential and

business tenancies are classified into grades; residential tenancies are graded on the rateable value of the tenancy, and business tenancies on the existing and potential number of exchange lines. These grades are then given a value based on the existing and expected number of telephone lines, taking into account the probable effect of full publicity and canvassing. From these basic figures summaries are prepared to give a forecast of the requirements in telephone lines in five-year periods up to the end of a "planning" period of approximately 20 years. The current planning period ends in 1975.

Records are maintained which enable the estimates to be compared periodically with achievement; adjustments are made when necessary. These development studies are used for planning by both the Engineering and Traffic Divisions and, as the provision of external plant and internal equipment is based primarily on these figures, a high degree of accuracy is necessary if wasteful expenditure is to be avoided.

In pre-war years it was confidently expected that telephone growth would reach "saturation" during the now current planning period, but such an assumption would not be made today. It now seems reasonable to expect in most districts a steady growth for a period which for planning purposes can be regarded as indefinite. There are upwards of 14,000,000 houses in Great Britain, and only 1 in 7 of them is on the telephone. We have a long way to go before we need to worry about saturating our market in the residential field.

Integrated work

The Sales Division's activities are so closely integrated with those of other divisions in the Telephone Manager's office that a complete understanding between all ranks is most necessary if the Area is to function successfully. Our main contact, I suppose, is with the Engineering Division, primarily at two points; the advice note control and the planning group. From the advice note control we get all the information required about external plant for new services and it is to this point we direct our enquiries on progress in the completion of advice notes. Our Development Section is in very close touch with the planning group in connection with the preparation of fundamental engineering plans and relief schemes. We rely on the Traffic Division to supply us with telephone numbers for new applicants and to keep us informed about the availability of exchange equipment; from our Development Section the Traffic Division gets forecasts for their exchange planning. We have daily contact with the Clerical Division for details of existing installations.

I think it may be worth while, in conclusion, to recall that since the war the number of Post Office telephones in operation has grown from under 4,000,000 to over 6,000,000. Each year we have been connecting over a half as many more new subscribers as we did in our best years before the war.

If some one asks, "What does a salesman do when he has nothing to sell?" I would reply that we *have* something to sell—even though, for a few years yet, we may not have to go out and look for our new customers. At the beginning of this article I said that "Sales" is more or less a misnomer today, but on second thoughts it is quite a fitting description of the point in any organisation at which the customer is first met for the exchange of goods or services for money. There is no need to change the name while the Sales Division waits to get back to the more satisfying job of persuading people to agree with us that they should be on the telephone.

Radio Aids to Navigation.—Increasing use is being made of radar, not only for navigating purposes but also in other spheres. The Uganda Government, in conjunction with the East African Meteorological Department, has carried out trials with specially developed radar equipment to detect dangerous cumulo-nimbus clouds at long range, thus enabling aircraft to take avoiding action.

Another use to which radar has been put is in connection with speed trials for ships. The traditional method is to measure speed over a measured mile but this method, if not conducted with great care, can lead to inaccuracies. With the aid of radar the ship on trial carries a continuous wave transmitter receiver, and similar equipment is carried on a buoy, or on another ship. In this way, any distance travelled by the ship from or to the relay station can be measured, and the speed determined; the run may be of any convenient length, and the effect of current or tide is eliminated, as the buoy is affected in the same way as the ship.

TWO HOME COUNTIES TELEPHONE AREAS

COLCHESTER

Burnham-on-Crouch, Essex—looking towards the estuary

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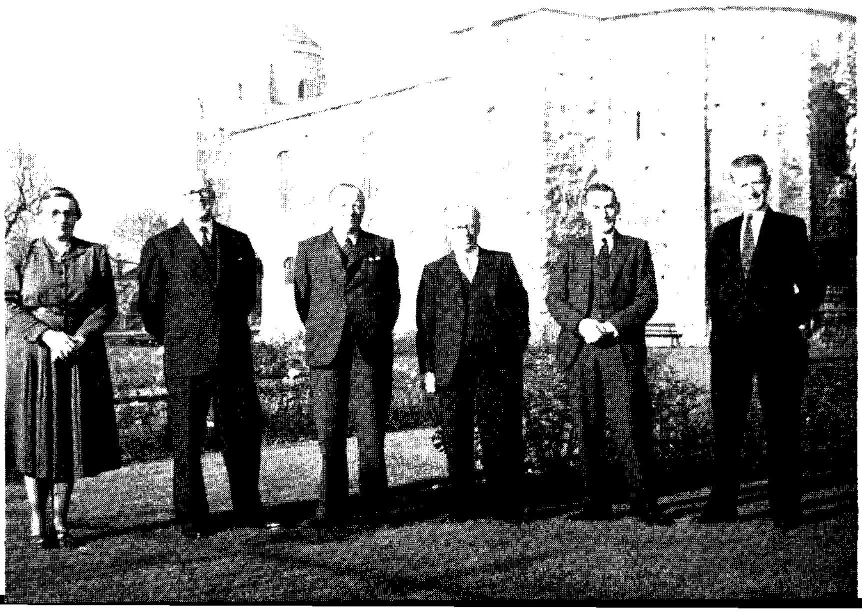
Left to Right : Miss R. T. LORD, Clerk Secretary ; P. BOOTH, Acting Chief Clerk ; A. F. O'ROARK, A.M.I.E.E. Area Engineer ; L. H. BROWN, Telephone Manager ; R. F. CHESTER, Senior Sales Superintendent ; J. J. O'ROURKE, Senior Traffic Superintendent.



Colchester makes claim to be the oldest town recorded in British history and much of its massive Roman wall still stands. Colchester has connection with Shakespeare's Cymbeline, Queen Boadicea, King Cole (of nursery rhyme fame), and the Civil War. Its Castle is the largest Norman keep in the country and is constructed largely of Roman building materials ; the Castle houses a museum with an exceptionally fine collection of Roman remains among which are two amphoræ discovered four years ago when excavating for the foundations and basement of the extended Colchester exchange.

Colchester is the headquarters of the Area which covers parts of the counties of Essex, Suffolk and Norfolk and is of 1,311 square miles in extent. Its 110 exchanges, 81 of them automatic, serve 34,542 subscribers' connections with 53,017 stations. The total staff on the Telephone Manager's establishment is 779.

Along the 60 miles of coastline are many well-known holiday resorts such as Clacton, Frinton, Walton-on-Naze and Felixstowe. Yachting enthusiasts are catered for at Brightlingsea, West Mersea, Pinmill and Wivenhoe. At Wivenhoe shipbuilding has been in progress since the reign of Queen Elizabeth I.

The Oyster Feast for which Colchester is famous, and which was founded in antiquity, has been revived in recent years in full splendour. Engineering works at Colchester give employment to many but the main industrial activities of the Area are centred at Ipswich.

The 350th anniversary of the death of Colchester's most distinguished son William Gilberd has recently been observed. He was physician-in-waiting to Queen Elizabeth I, but his fame rests on his exhaustive and original treatise on magnetism published in 1600.

The bulk of the territory is given over to agriculture and fruit growing. Many of the scenes made familiar by the paintings of John Constable and Thomas Gainsborough are to be found in this Area, within whose confines both men were born.

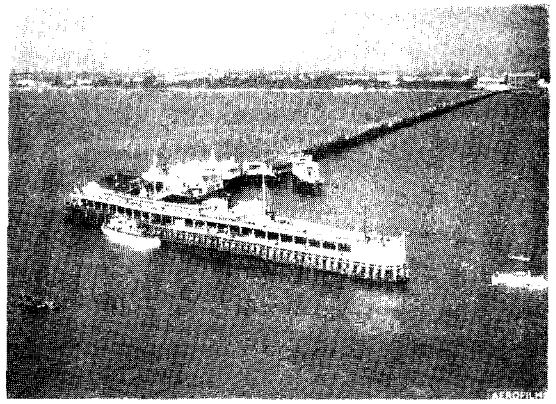
Aldeburgh, in the north east corner of the Area, which is widely known for its annual festival of Music and the Arts, is also the landing point of Anglo-Dutch cables.

SOUTHEND-ON-SEA

The Southend-on-Sea Telephone Area is one of the smallest in the Kingdom, covering an area of 400 square miles and having 37,012 telephone subscribers.

Known as " Sunny Southend " the Headquarters town takes its name from the fact that it is situated at the south end of the ancient parish of Prittlewell, which contains the famous Priory founded in A.D. 1100.

It possesses the longest pier in the world, which is 1¼ miles long, and the farthest receding tide of the coastal towns. The Borough also embraces Shoeburyness, the driest spot in Britain, Westcliff and Leigh, prominent in ancient naval history and now famous for its cockles.



The pier at Southend-on-Sea (*By courtesy of Aerofilms, Ltd.*)

★

Southend enjoys the greatest popularity, both as a holiday resort and as a residential locality. Indeed, the Area as a whole, with its proximity to London, has become one of the dormitories of the metropolis and this largely accounts for the high telephone density of residential subscribers.

The principal industrial area is at Chelmsford, the County Town of Essex, where much engineering and electrical equipment is manufactured, whilst at Basildon one of the " New Towns " is being created, bringing into the Area further industrial and residential development.

With the coming electrification of the railway tracks and large scale development planning in the Area, it is not unreasonable to expect a high rate of telephone expansion within the next 10 to 15 years.

Left to Right: Mr. C. J. VANN, B.Sc.(Eng.), A.M.I.E.E., Area Engineer; Mrs. M. A. BEDDOW, Secretary; Mr. D. M. GRONOW, Chief Clerk: Mr. J. L. HOWARD, B.Sc.(Eng.), A.C.G.I., A.M.I.E.E., Telephone Manager; Mr. G. B. MILLER, Senior Traffic Superintendent; Mr. A. W. GIBSON, Senior Sales Superintendent.

The International Telecommunication Union

Hugh Townshend, C.B., Assistant Secretary-General

THE AIM OF THIS ARTICLE IS TO DESCRIBE IN very broad outline and very briefly, the scope and functions of the International Telecommunication Union—what it does and how it does it.

Like most old institutions—it dates back to 1865—the I.T.U. has grown and been adapted, rather than been made—or, at least, ready-made. That is to say, it was started to meet a practical need and has been developed in various directions from time to time to meet further practical needs. These needs, one after another, began to be felt by countries operating in collaboration with each other the international communication services which the progress of technical invention made possible and the growth of international trade made necessary; the functions and structure of the I.T.U. were expanded accordingly by stages. The I.T.U. thus presents to a striking degree—in contrast to newer organizations set up to embody some more abstract ideal—the characteristics of slow growth; especially a complexity of structure and a lack of logical tidiness in the constitutional relations between its component parts, which is apt to conceal from an outside observer its relatively close adaptation to modern needs.

Perhaps the simplest way of presenting the picture is to begin with a description of the four main practical functions of the I.T.U. in the year 1953; and, taking each of these separately, to consider when and how the I.T.U. came to be entrusted with these functions, and what has been done to enable it to fulfil them. The organization can then be envisaged as a whole, and some of its characteristic features described. But it must be emphasised at the outset that the I.T.U. is an organ of voluntary international collaboration; that is to say, it exists to make possible, or to make easier than it would otherwise be, day-to-day collaboration in the specialized field of telecommunication between the independent but closely linked nations of the modern world. The I.T.U. has no other purpose or *raison d'être* than this. Whether it should, or should not, be adapted to some purpose of a different order, such as the realization in its field of some ideal of world government not yet realized on the high plane of international politics (for example, by its metamorphosis into the "Telecommunications Department" of a fully integrated international civil service), is a question not treated in this article, since the answer depends on factors external to the I.T.U. As things are, the I.T.U. may be considered, from the angle of a student of administration, as an embodiment, in the international field, of what is known in the United Kingdom as the "voluntary principle".

Sovereign members

This fact is not, I think, an accident. The I.T.U. is an organization of governments which—in the words of the Preamble to the International Telecommunication Convention—"while fully recognising the sovereign rights of each country to regulate its telecommunication", have concluded a Convention "with the object of facilitating relations between the peoples, by means of efficient telecommunication services". This objective would be quite impossible of attainment if the membership of the I.T.U. were not practically world-wide—as in fact it is; and it is extremely doubtful whether world-wide membership of the I.T.U., involving, as it does, the entering into of binding obligations by all the sovereign members, could be secured if the constitution of the Union did not afford the maximum possible scope both for action by voluntary agreement outside a minimum of formal commitments required, and for the play of discussion, persuasion and experiment, over a wide field and during considerable periods of time, as part of the inevitable process of extending or modifying such contractual commitments.

Four functions

The four main functions of the I.T.U. are, I believe, the following:

First, it produces the *international service documents* without which the day-to-day operation of international telegraph, telephone and radio services between some eighty or ninety countries would be impracticable. This is the oldest and most basic function of the I.T.U.; and the editing and publication of these documents from data furnished by the Member countries is one of the main tasks of the General Secretariat. The nature and scope of the service documents are defined in detail in the International Regulations issued and revised at intervals of some years by the Telegraph, Telephone and Radio Administrative Conferences of the Union. At these conferences, all the countries Members of the I.T.U. may be, and most in fact are, represented by specialist delegates, familiar from their daily work in their own countries with the practical needs of the time.

The service documents comprise, *inter alia*, a list of telegraph offices open for international service, the Radio Frequency Record, lists of radio stations (fixed, ship and shore, broadcasting, aeronautical and aircraft), a list of radio call signs, as well as a number of maps, statistical statements and tables of accounting rates. All these are of world-wide scope and are published in several languages. They appear at varying intervals; and are kept up-to-date, in most cases by the regular issue of supplements. Nearly all are in regular use by administrations and companies all over the world in their day-to-day work of operating telecommunication services.

Secondly, the I.T.U. conducts the *international study of technical, operating and tariff questions*. The need for such study on an international plane is to a large extent a consequence of the increasingly technical nature of telecommunication methods. Before the days of long-distance telephony and radio, a fairly wide degree of variety in technical methods was not inconsistent with the efficient functioning of an international telegraph service in which messages were forwarded successively from one office to another; and periodical international telegraph conferences sufficed to secure the necessary general agreement between countries on methods of operating the international circuits and of charging for the facilities provided for the public. For at least the last generation, however—say, since the development of the thermionic valve—telecommunication has called for a high degree of international standardization, because without it modern methods cannot be applied to telecommunication services connecting different countries. To meet these needs, the I.T.U. has developed characteristic special organs, namely, the three International Consultative[1] Committees (C.C.I.s). In the course of 30 years these "Committees"—they are not in fact committees in the ordinary sense of the word but rather special organs of the Union—have developed a characteristic structure and methods of working which are closely adapted to their special functions, and form an interesting study in themselves. (They are described briefly later in this article.) In practice, the C.C.I.s perform also a second function, at least as important, if not so basic as their primary function of standardization, namely, in constituting a forum for the exchange of ideas between the telecommunication specialists of different countries which have reached different stages of development. The C.C.I.s are essentially technical organs, and their functions are a vital part of the process, in the field of telecommunication, of the international application of scientific research.

Radio Frequencies

Thirdly, the I.T.U. effects the *international voluntary regulation of the use of radio frequencies*, to the extent that the countries of the world judge such regulation to be necessary and are willing for it to be effected by voluntary agreement between them. The need for an international "traffic policeman of the ether"—to use a characteristically English phrase, though there is nothing in the international field analogous to the legal powers conferred on traffic policemen—is comparatively recent, and the institution of a special organ of the Union, the International Frequency Registration Board (I.F.R.B.), charged with the function of arranging for the protection from interference of duly *registered* frequencies, dates back only to 1948. Before that date, radio frequencies were merely *recorded*, in accordance with the requests of countries wishing to use them, in a

[1] *"Consultative" is the authorised English version, in the titles of these bodies, of the French word "consultatif"—it means "advisory".*

service document, the "Berne List", published by the General Secretariat. The recording was effected within the framework of internationally agreed radio regulations, with the object of assuring some degree of protection to the frequencies so recorded, but without the examination by a permanent international body of the technical likelihood of interference being caused or suffered in each particular case. The Berne List has now been replaced as a service document by the "Radio Frequency Record", pending the entry into force of a complete new International Frequency List, as the basis of a system of registration of frequencies after examination. The Radio Frequency Record is published by the General Secretariat on the basis of a Master Record kept by the I.F.R.B. However, the I.F.R.B. is not yet completely through the initial stage of transition from the recording of notified radio frequencies to their registration after technical examination.

Finally, since the second world war, the I.T.U. has acquired certain new *responsibilities in connection with the Charter of the United Nations.* These responsibilities are defined in a formal agreement with the United Nations, which provides that the "United Nations recognises the International Telecommunication Union . . . as the specialized agency responsible for taking such action as may be appropriate under its basic instrument for the accomplishment of the purposes set forth therein". The most important field in which such action is at present called for is that of "Technical Assistance"; in this all the organs of the Union collaborate.

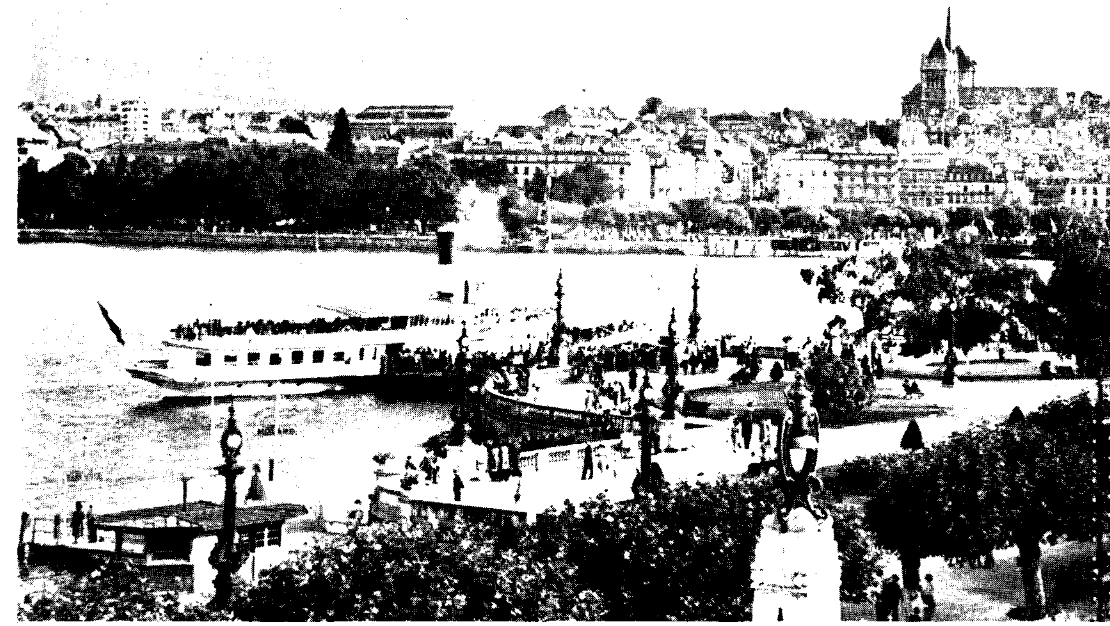
The organization which the I.T.U. has developed in order to enable it to fulfil these four functions is rather complex. First, it should be noted that the I.T.U. has been endowed, since 1947, with a central supervisory organ—the Administrative Council—which meets *annually* to survey and co-ordinate the whole working of the Union in order to ensure that it is directed to the objects laid down by, and conducted in accordance with the decisions of, the sovereign body of the Union. This sovereign body is a *quinquennial* plenipotentiary international conference, meeting to revise—subject to ratification—an *international* instrument known as the International Telecommunication Convention, which is the statute of the I.T.U. (and has the force of a Treaty), and to exercise supreme control over the whole of the structure and functions of the Union.

The *continuously operative* part of the I.T.U. is organized in five parts, the General Secretariat, the three International Consultative Committees (for telegraph, telephone and radio respectively) and the International Frequency Registration Board. Each one of these five organs has its own separate line of executive responsibility and its own characteristic type of organization. The General Secretariat is an office, under the Secretary-General who is responsible directly to the Administrative Council (which appoints him). The three C.C.I.s have each a Director,[2] a specialist international official, with a small staff known as the "specialised secretariat", who is responsible to, and appointed by, the Plenary Assembly of the C.C.I.—a triennial conference of specialist representatives of those Member countries of the Union which care to participate in the work of the C.C.I. The I.F.R.B. is a Board with 11 members—all specialized radio engineers—and a subordinate staff, responsible to the Administrative Radio Conference of the Union. This Conference does not, however, appoint the members directly, but elects 11 countries, each of which then nominates one of its nationals to become a member of the Board. The statutes of the I.T.U. provide that a member of the I.F.R.B. shall not represent the country he came from, but that he shall become an independent "custodian of an international public trust", responsible only to Members of the I.T.U. as a whole.

An important feature of the organization of the permanently functioning organs of the I.T.U. is that the Secretary-General is responsible to the Administrative Council, apart from the executive work of publishing service documents, for the general administration of the Union, and in particular for all financial and budgetary questions and for the staff administration—as distinct from the executive work—of *all* the organs of the Union. (The control of the Union's finances and the higher control of its staff administration constitute a substantial proportion of the work of the Administrative Council, which has to approve the annual budget of the Union as a whole and to approve both its Financial Regulations and its Staff Regulations.)

The four technical organs also rely on the General Secretariat, though in widely varying

[2] *Except the C.C.I.T. (telegraph), responsibility for which is provisionally vested in one of the Assistant Secretaries General, pending consideration of a proposal to fuse it with the C.C.I.F. (telephone). The C.C.I.R. has also a vice-Director, specialising in the technical aspects of broadcasting.*



A view of Geneva : seat of the Union

degrees, for the provision of common services, such as translation, typing and roneo work and supply services. Thus the five executive organs of the Union have separate executive functions and separate lines of responsibility for these functions; but there is a considerable degree of pooling in regard to ancillary services and of centralization of authority in regard to finance and staff administration.

The General Secretariat is also responsible for providing secretarial services for the international conferences which necessarily play an important part in the work of the Union. In recent years, between 1947 and 1952, the number of such conferences has probably been abnormally high, but the constitution of the Union provides for at least three large conferences, viz., the plenipotentiary conference, the telegraph and telephone administrative conferences (normally held together) and the radio administrative conference, to be held *normally* every five years; and all these have to be furnished with documents (mainly proposals by Member countries circulated before or during the conference, and minutes and reports of plenary assemblies and committees) in three languages, together with simultaneous oral interpretation (for which the Union owns its own equipment) in at least three languages. The triennial plenary assemblies of the three C.C.I.s also call, to a varying extent, on the resources of the General Secretariat for secretarial services. The General Secretariat has also to undertake the publication (in several languages) of the Final Acts of I.T.U. Conferences and of the Resolutions and decisions of the Administrative Council, and the accounting arrangements in connection with all conferences and meetings.

Last, but not least, the annual meetings of the Administrative Council require, in addition to secretarial and interpretation services, the preparation (in three languages) of working documents as the basis of discussion of the numerous items on the agenda. The majority of these working documents are drafted in the General Secretariat (others by the staff of the technical organs of the Union); all are discussed, before approval and issue to the Council, on a committee of the senior officials of all the organs. In these conditions, the "servicing" of conferences and meetings adds materially to the tasks of the General Secretariat.

The net effect of this division of responsibilities is that, of the 196 posts on the present establishment of the I.T.U., 92 are in the General Secretariat, 69 in the I.F.R.B. and 16, 2 and 17 respectively constitute the "specialised secretariats" of the C.C.I.F., the C.C.I.T. and the C.C.I.R.

In considering this organization in relation to the work it has to do, it is important to bear in mind some important respects in which both the organisation and the work itself differ from those of a national telecommunication administration.

In the first place, the *highest* authorities of all the organs of the Union, since it is an international body, are necessarily themselves international bodies, which do not operate continuously but have to work by means of conferences or meetings held at intervals. International conferences and meetings are, however, expensive and tend to be burdensome on the national representatives who have to leave their duties at home to attend them. Hence the large conferences, which alone can be fully representative in a world of 80 or more nations, can only meet at intervals of some years.

Since 1947 the need for more continuous supervision of the Union's work, particularly of its finances and staff administration, has been met as far as possible by the creation of the Administrative Council, a body which, having only 18 members, can meet annually; but even so, the administrative situation differs materially from that of a national governmental organization, which has at its head a Minister always available to give decisions of policy.

In the second place, the Union does not operate any telecommunication services; it merely co-ordinates the work of national governmental and private bodies which do.

(To be concluded)

Post Office Commercial Accounts: 1952-1953

This article presents a few salient figures, relating to the telecommunications services, from the Post Office Commercial Accounts, 1952-53.

The Accounts, which were laid before Parliament in December, can be purchased from H.M.S.O., price 2 6d., and should be studied for a complete view of Post Office profit and loss during the year.

THE TELECOMMUNICATIONS SERVICES OF THE Post Office brought in an income of £120.6 million during the financial year 1952-53 —an increase of some £10.1 million on the figure for the previous financial year. They provided 47.6 per cent. of total trading income; 5.6 per cent. arose from the telegraph services and 42.0 per cent. was derived from the telephone services.

Expenditure on the telegraph services, at £17.9 million, was £3.6 million higher than income, but the telephone services, bringing in an income of £106.3 million, realised a surplus of £3.7 million.

These are the outstanding results in the field of telecommunications revealed by the *Post Office Commercial Accounts for* 1952-53. The annual Commercial Accounts of the Post Office are, in effect, profit and loss accounts showing the financial results of the year's trading between the Post Office and its customers; they also contain statistics of business showing the quantities of mail carried and the numbers of telegrams and telephone calls handled.

Summarised, and compared with the previous year, results for 1952-53 were as follows:—

	1951-52	1952-53	Variation
All Services	£m.	£m.	£m.
Income ...	231.1	253.2	22.1
Expenditure	225.7	248.3	22.6
Surplus ...	5.4	4.9	0.5
Telegraph Services			
Income ...	13.0	14.2	1.2
Expenditure	16.4	17.8	1.4
Deficit ...	3.4	3.6	0.2
Telephone Services			
Income ...	97.4	106.3	8.9
Expenditure	93.1	102.6	9.5
Surplus ...	4.3	3.7	0.6

For the first time telephone income rose above £100 million.

TELEGRAPH SERVICE

The year 1952-53 showed a general decline in telegraph business, both on inland and overseas services.

The total number of inland telegrams (including Government, Railway Pass and Press messages) handled fell from 38.6 million to 36.4 million. The public sent only 28.4 million ordinary inland telegrams, compared with 31.1 million in the previous year, but greetings telegrams rose from 5.6 million to 6.1 million. The number of overseas telegrams handled fell from 21.3 million to 20.0 million. As a small offset telex calls increased from 317,000 to 508,000.

Of the increase of £1.2 million in income from the telegraph services, £0.6 million arose from changes in Post Office tariffs made in 1951-52 and 1952-53, the balance arising from an increase in the Post Office net traffic revenue from the international telegraph services (the Department sharing in the yield of increased tariffs imposed by Cable and Wireless Ltd., overseas), and in the use of private wires.

Pay awards

Of the increase of £1.4 million in expenditure on the telegraph services, pay awards (and their effect on pension liability) accounted for £1 million; of this, £0.8 million was in respect of the full year effect of awards made in 1951-52. The remaining £0.4 million of the increase in expenditure was due mainly to increases in the cost of material, interest charges and provision for depreciation.

The total operating expenditure of the telegraph services was equivalent to 121.9 per cent. of total income compared with 122.5 per cent. in the previous year. The operating loss, which in 1951-52 was £2.9 million, rose to £3.1 million in 1952-53. After providing for interest on plant, this loss was increased to £3.6 million.

TELEPHONE SERVICE

It will be recalled that, during August, 1953, the 6,000,000th telephone was installed in the United Kingdom. The Commercial Accounts show that the number of telephone stations installed by March 31, was 5,927,000, a net increase of 212,000 during the year. Between March 31 and August, therefore, there was a net increase of 73,000 stations and later reports bring the figure up to 96,000 for the first two quarters of 1953.

During the financial year 1952-53, the waiting list for telephones had been reduced by 55,000. By September 30, 1953, it had been further reduced by 43,400.

There was, however, a decline in the number of inland local calls from 3,230 million in 1951-52 to 3,165 million in 1952-53, but this was partially counteracted by an increase from 262 million to 264 million in inland trunk calls.

More overseas calls

On the other hand, there was an increase in the use of the overseas telephone service, the total calls rising (comparing the two years) from 3,024,000 to 3,062,000.

Tariff changes accounted for all but £1 million of the £8.9 million increase in income from the telephone services.

Pay awards (and their effect on pension liability) accounted for £4.1 million of the £9.5 million increase in expenditure: £3.5 million of the £4.1 million was due to the full effect of pay awards announced during the previous year. The remainder of the increase in expenditure, £5.4 million, arose —as in the case of telegraphs—mainly from increases in the cost of materials, interest charges and provision for depreciation.

The total operating expenditure of the telephone service is shown at 85.5 per cent. of total income. The operating profit rose from £15.0 million to £15.5 million, which, after provision for interest on plant, produced the final telephone surplus of £3.7 million.

Ambulance Radio.—It is reported that the installation of two-way radio in Hertfordshire ambulances has saved time, miles and money. Radio ambulances have been re-directed while in transit on over 4,000 occasions and these diversions have saved 52,627 miles and 1,722 hours running time.

NOTES AND NEWS

Royal Signals Institution.—A Royal Signals Institution has been formed and membership is open to all officers or ex-officers of the Royal Signals Corps (regular, or auxiliary and temporary commissions in the British or other Commonwealth forces), and to officers of the W.R.A.C. (or A.T.S.) who have served, or are serving, with the Corps.

Broadly speaking the Institution has been formed to further the cultural activities of the Corps and it is hoped to publish the first issue of the *Royal Signals Journal* to all members of the Institution early this year.

The subscription for officers of auxiliary forces, retired officers and ex-officers, is 15s. a year. Application for membership should be made to Lt.-Col. N. G. Newell, Hon. Secretary, Ministry of Supply, Room 419, Castlewood House, 77/91, New Oxford Street, London, W.C.1.

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Swansea Telephone Exchange Jubilee.—Early in November the Swansea telephone service attained its jubilee, the first exchange having been opened on November 5, 1903. It was housed in the exchange building in Pier Street and was controlled by a Committee of 12 aldermen and councillors of the Swansea Corporation. The original scheme provided for 750 lines.

Ultimately the Swansea Corporation Exchange was absorbed into the National Telephone Company's system which, in turn, was taken over completely by the Post Office in 1911.

The wall-type telephone, with a side handle for ringing on and off, was the instrument in use in 1903. Today the service is automatic with the hand-microphone telephone, the speaking clock, and the "999" emergency call. The number of telephones in the Area now approaches 15,000.

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Mysterious Interference.—Following the case of television interference reported from Cardiff which, after extensive tests, was tracked to the 42-inch pendulum of a non-electric clock (just a quarter of the wavelength of the Cardiff transmitter) came the "barking dog mystery" from Coventry. This came to light when residents complained and, although private investigations had been made locally, no explanation was found and the interference continued.

Then an inspector working out of doors with a portable interference tracing set heard a dog barking over his earphones. Following this up he found the dog shut up in a shed, barking furiously. But how did the noise get on the radio?

A detailed search found an electric pump motor from which the earth line to the motor had broken away and was lying loosely across it. The loose contact functioned as a microphone which picked up nearby sounds and transmitted them to local sets through a power line which ran overhead. The interference ceased when the earth line was properly connected.

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Water Calling.—Waterworks engineers will soon be able to ring up remote reservoirs—and the reservoirs will answer. A new float-operated instrument has been perfected which, when called up on the Post Office telephone system, will report the water level by high-pitched buzzes for the feet and low-pitched for the inches.

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New Television Links.—In connection with the Post Office and Telegraph Money Bill which seeks to provide £125,000,000 for capital development, it was stated that £650,000 might well be spent over the next two years on television links. Radio links to Aberdeen and to the Isle of Wight will cost £130,000 and £75,000 respectively, while £44,000 is to be spent on another link between Alexandra and Crystal Palaces.

There is also £55,000 for a cross-Channel link, as the B.B.C. hope to pick up programmes increasingly from Europe. Provision is also made for a radio link to East Anglia, although the station is not yet approved.

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The author of "The Shouting Telephone", which was published in the November edition of the *Journal*, wishes to acknowledge gratefully the original suggestion for the article and the reference to the *Wireless World* made by Mr. C. F. Thomas, N.W. Telephone Area, London.

Book Review

PRINCIPLES OF ELECTRONICS. By L. T. Agger, B. E. Macmillan & Co., Ltd. 340 pp. 18s. 0d.

Electronics as a separate subject has not yet appeared in the syllabuses of more than a few of the examining bodies who cater for telecommunications and electrical engineering students, but its universal appearance cannot be long delayed, and a book concentrating on this subject is very welcome.

The author at the outset defines his interpretation of Electronics as "the branch of electrical science which deals with conduction through a vacuum or gas" and his treatment of this aspect is adequate and clearly set out.

An introduction on atomic structure and a chapter on electron dynamics are followed by a complete treatment of the phenomena of emission, rectification, amplification, oscillation, modulation and photo-electric effects for both hard and gas filled valves, and for cathode ray tubes. The diagrams, shorn of all non-essential matter, are simple and straightforward and the explanatory text commendably concise.

Sufficient mathematical treatment and proofs of the various processes are included, and these will be understood without difficulty by students of A.M.I.E.E. or ordinary degree standard. The symbols used by the author are orthodox, and a list of these precedes the text. There is also a useful paragraph on the M.K.S. (metre-kilogramme-second) system of units, but the reader needing further information on this or other subject is given no references to assist him.

Students will, however, have no difficulty in checking their acquired knowledge by working out the comprehensive set of problems at the end of each chapter. Answers to these problems are appended.

No book which suffers even the ordinary delays of publication can expect to be up-to-date on so rapidly developing a subject as Electronics, and no treatment is given of the theory of semi-conductors and the corresponding practical applications, for example, transistors. The author's definition certainly excludes these from present consideration, but there is no doubt that any future work on Electronics must completely cover the recognized field.

N.V.K

Publication and Price. This Journal is published in November, February, May and August. Price 1/6. The annual postal subscription rate is 6/6 post free to any address at home or overseas.

Contributions. The Editorial Board will be glad to consider articles of general interest within the telecommunication 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."

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