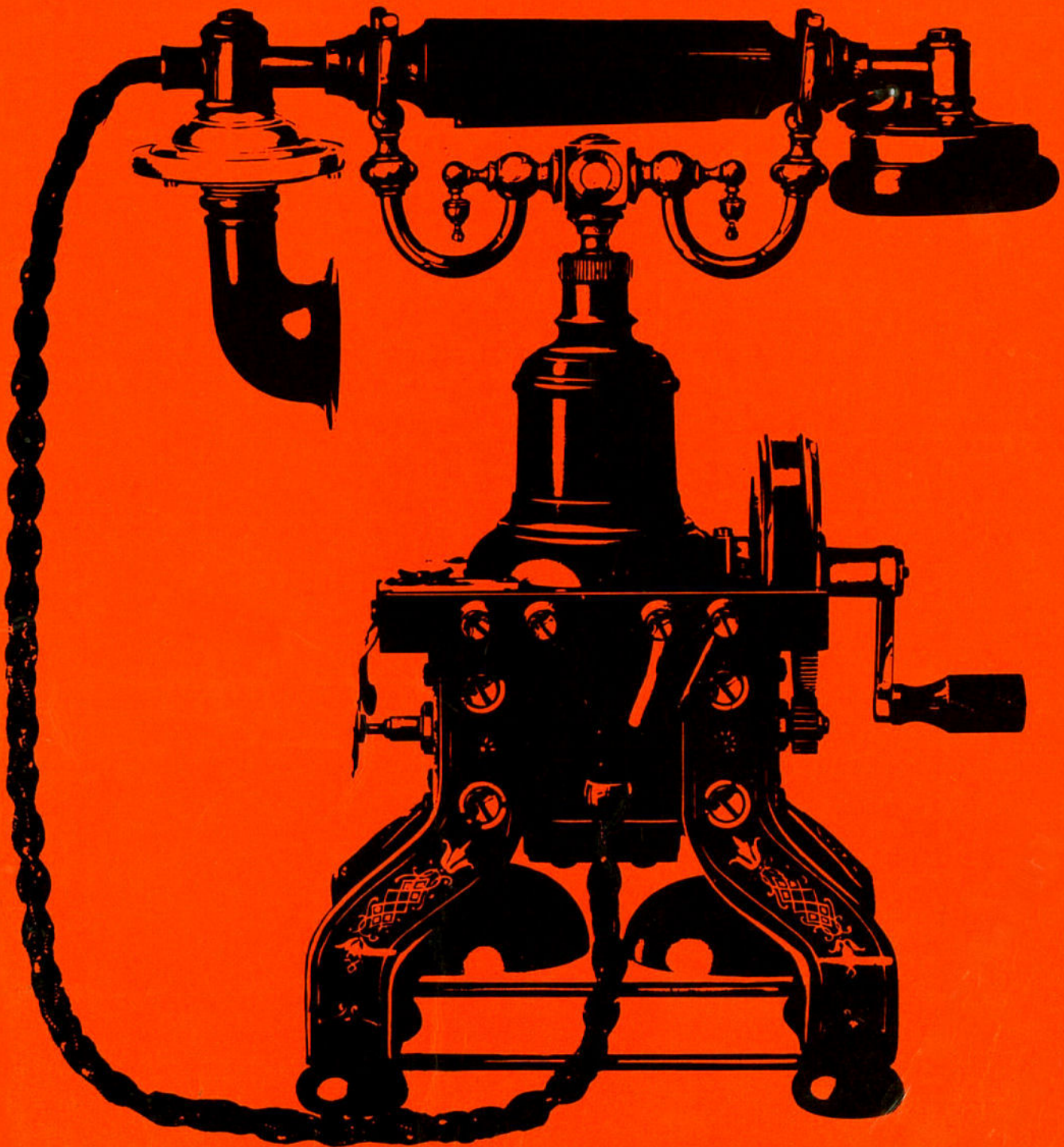
The Story of the Telephone

A Booklet for Students

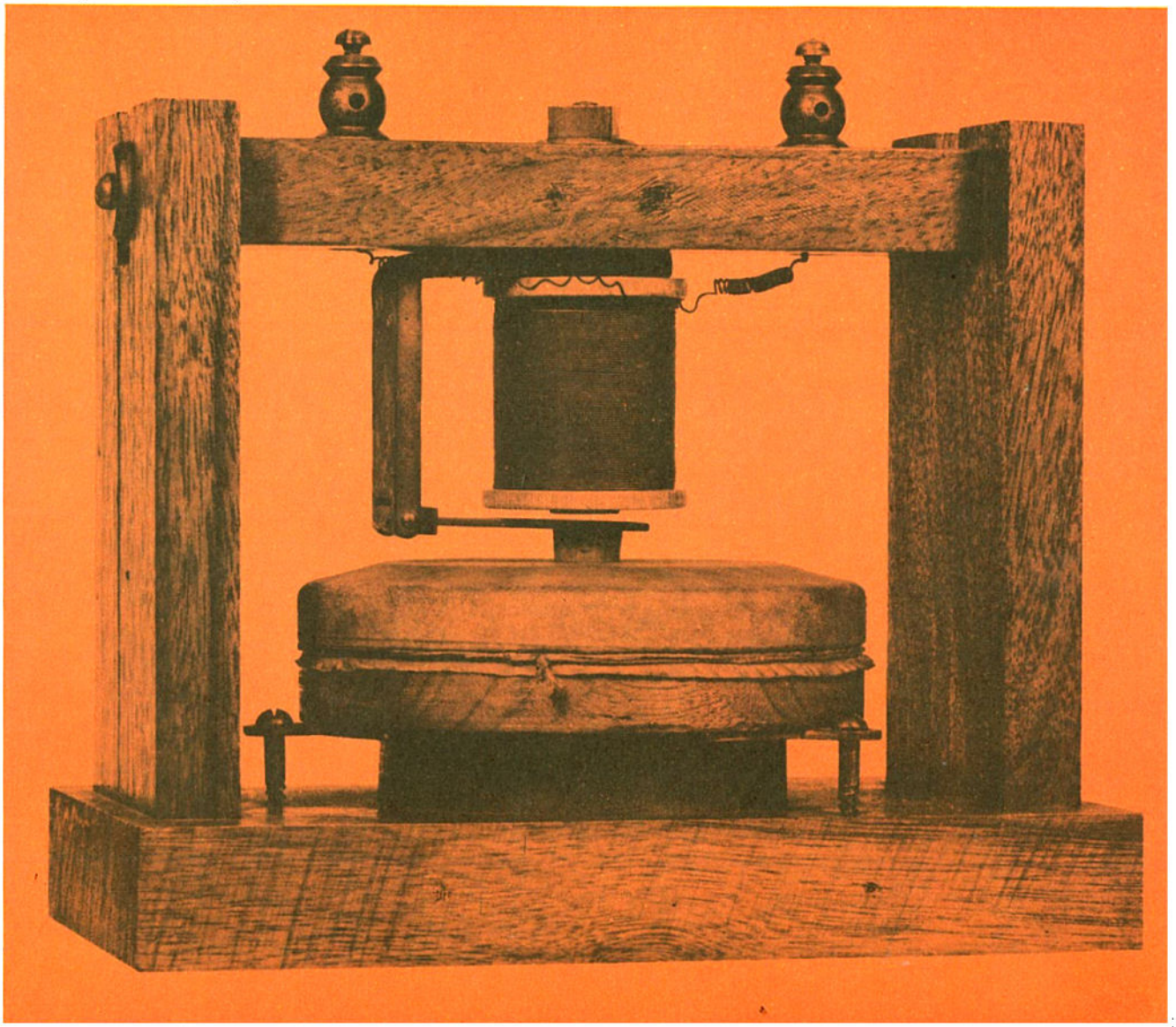


The Story of the Telephone

To-day the telephone is part of the everyday life of millions of people throughout the world. From our homes or offices we can speak to someone in the next street, or in a distant continent.

We owe this marvel of communication to a Scot, Alexander Graham Bell, who was born in Edinburgh in 1847, but who spent the greater part of his life in America. He discovered the secret of electrical transmission of speech in 1875, and made the first telephone, one year later, from pieces of clock spring and electro magnets. The possibilities of transmitting speech over distances had been explored at least 20 years earlier, but Bell's apparatus was the first practical form of telephone, the forerunner of the instrument we know to-day.

Alexander Bell's first telephone – 1875.

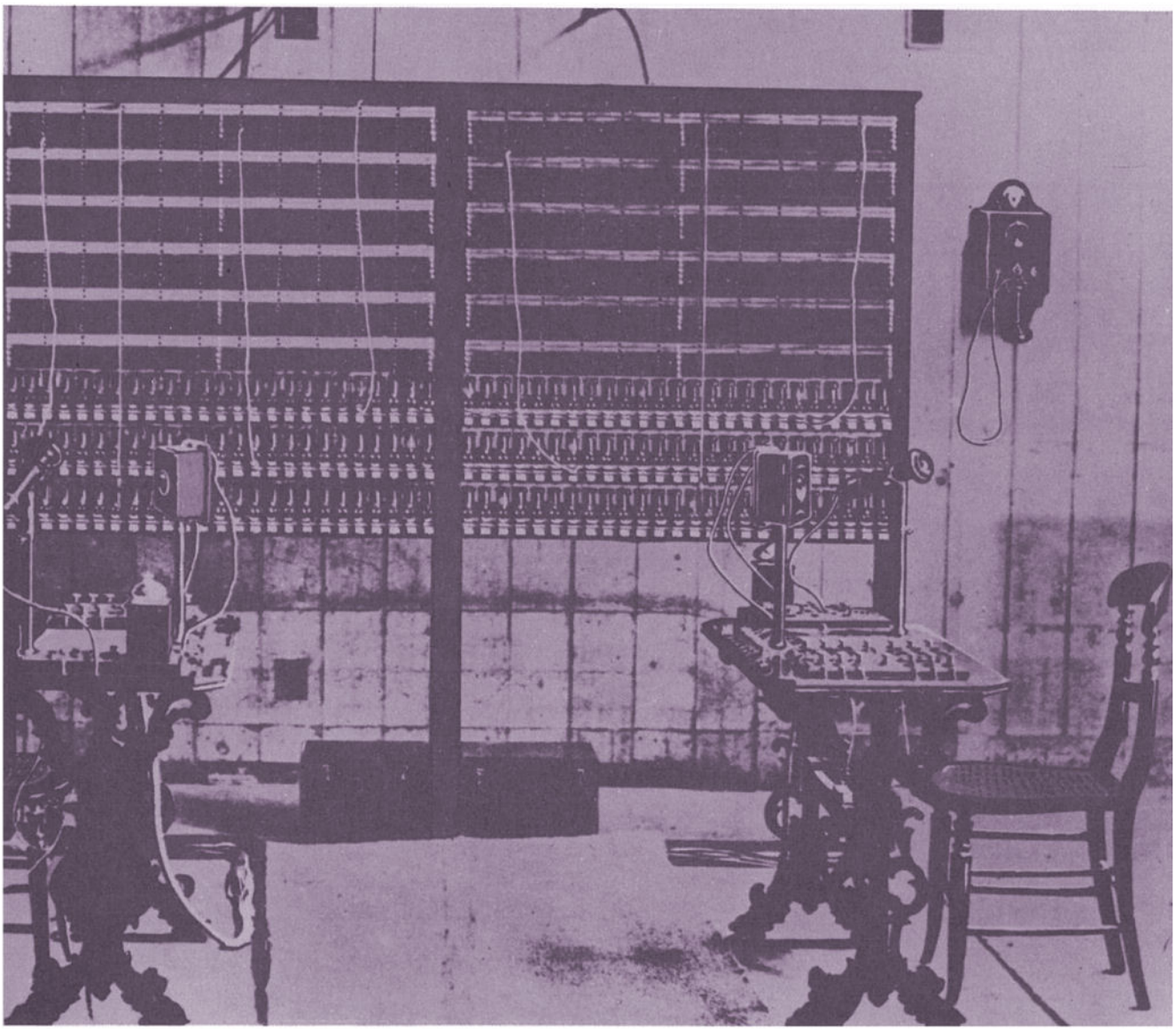


In 1878 he demonstrated this first practical telephone to Queen Victoria at Osborne in the Isle of Wight. In Great Britain there was an immediate interest in Bell's invention. The first telephone exchange in Europe was opened at 36 Coleman Street in the City of London in 1879 and the first overseas call from this country was made to Paris in 1891. The telephone system owes its development partly to the Post Office and partly to the enterprise of several private companies, they and the Post Office each operating its own service.

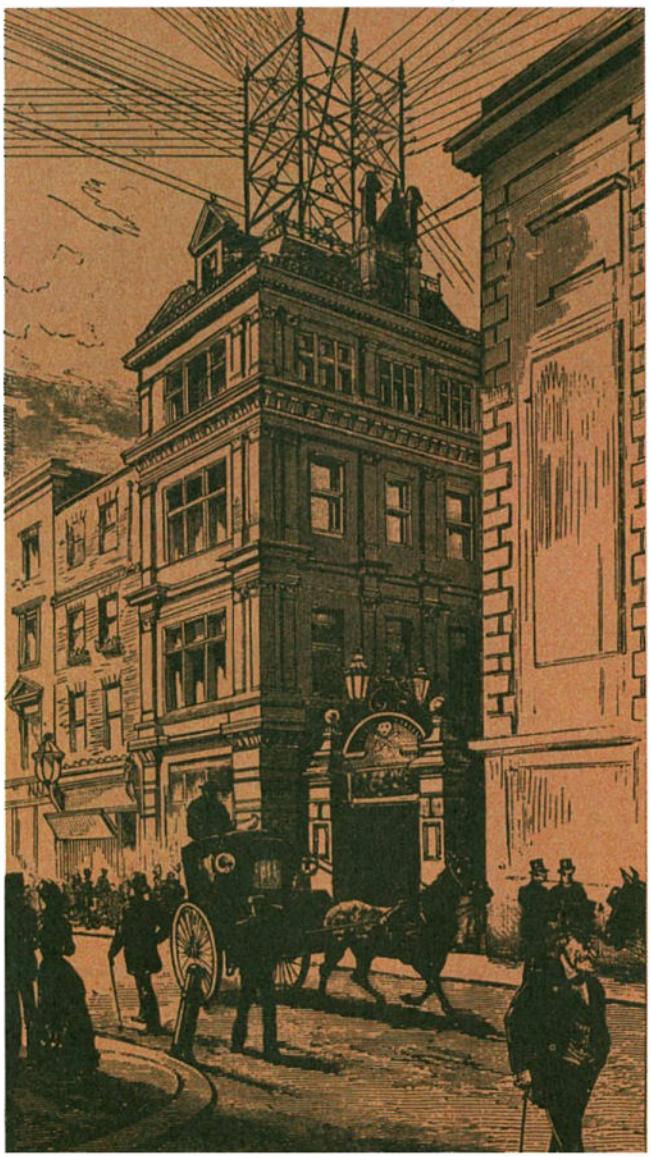
It was decided, however, that a unified system would be best, and in 1912 the Post Office acquired almost the whole of the country's telephone network. The early telephone exchanges were operated by hand but in this same year the first automatic exchange (non-director) was opened at Epsom.

At that time there were only about 700,000 working telephones in this country; the number has now grown to over 13,000,000. Since Bell made his discovery, development has been so rapid that there are now over 220,000,000 telephones throughout the world, and all but a few can be called from this country.

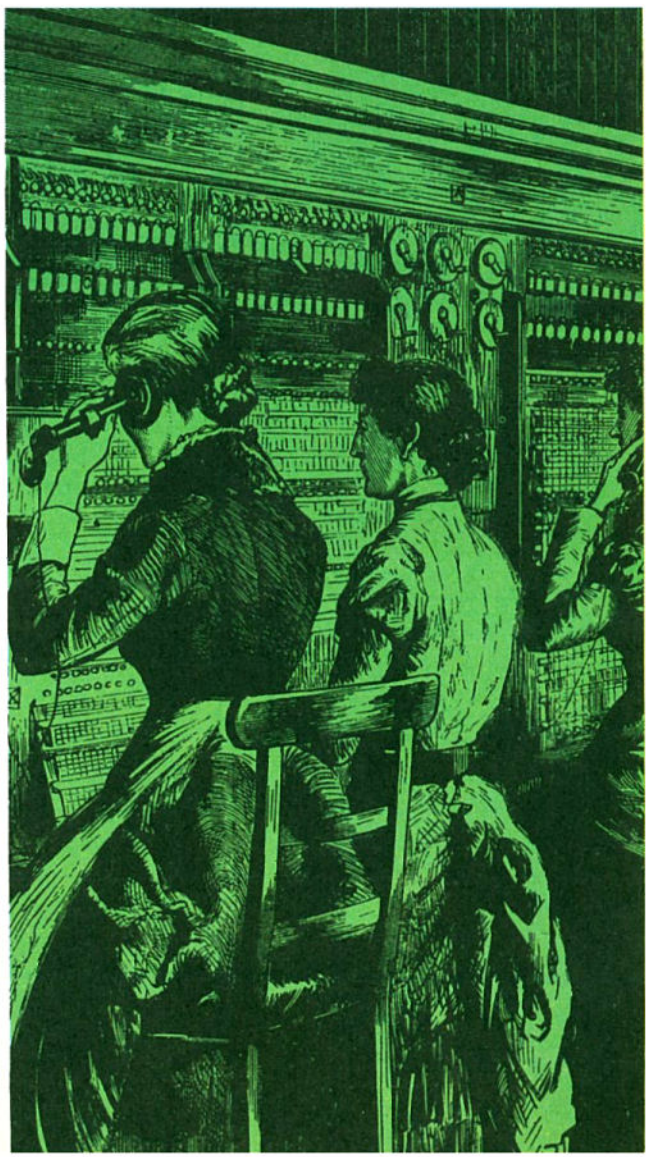
The first telephone switchboard (two panel) installed in Coleman Street, London, 1879.



The first telephone exchange in Europe at Coleman Street, London.



Eastcheap Telephone Exchange, 1883.



Telephones from 1875 . . .

1. Alexander Graham Bell's first telephone. 1875.

2. Bell's improved Telephone. Magnet has three layers. 1876.

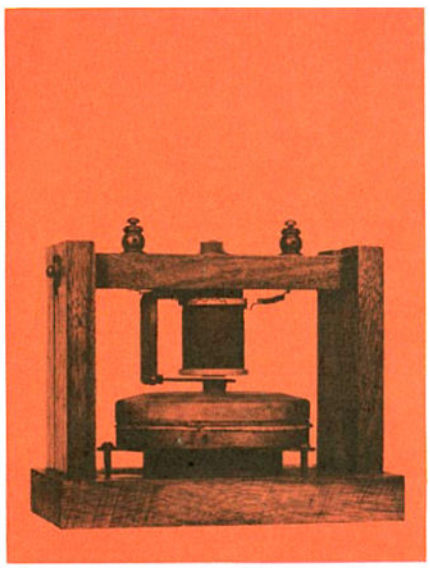
3. Dolbear Telephone Receiver. Horseshoe magnet with coils. 1876-77.

4. First Post Office Telephone. 1878.

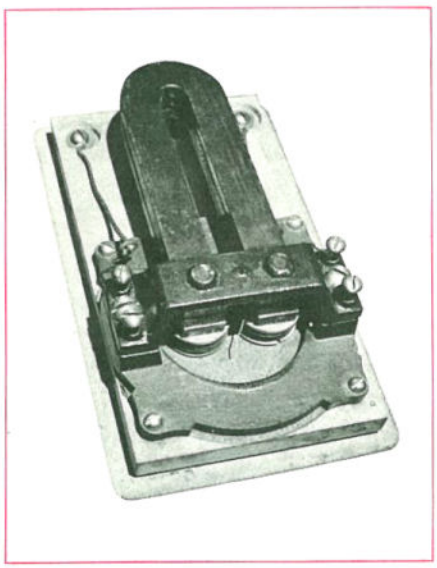
5. Hunning's Transmitter. Granular carbon model. 1878.

6. Blake Transmitter with separate call bell. 1879-80.

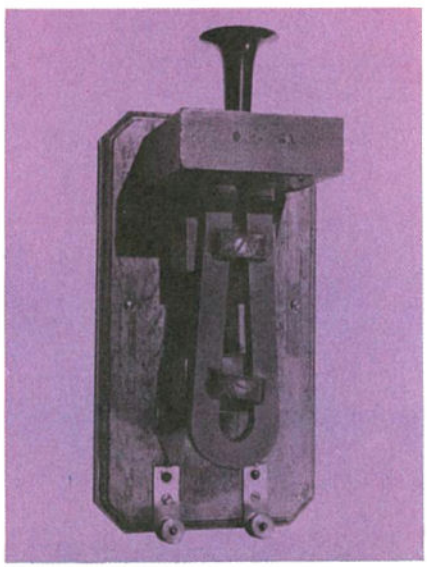
1. 1875



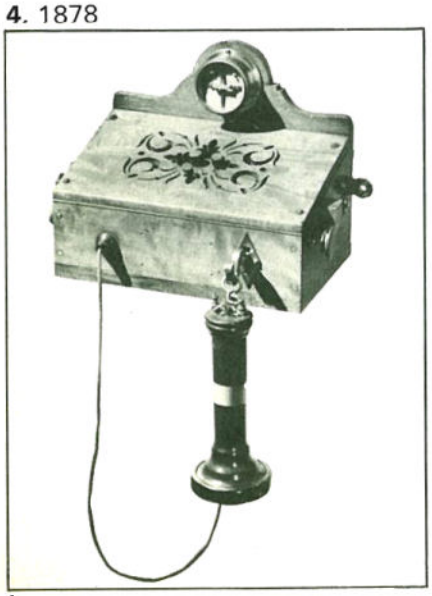
2. 1876



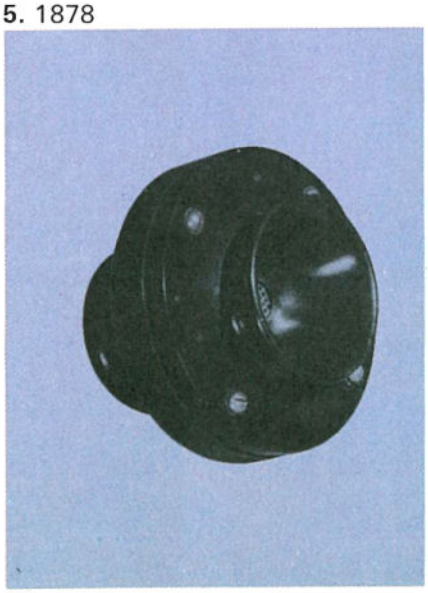
3. 1876-77



4. 1878



5. 1878



6. 1879-80

7. Edison Company's Telephone with chalk receiver. A rotating cylinder of chalk impregnated by potassium iodide amplified the received speech. 1879.

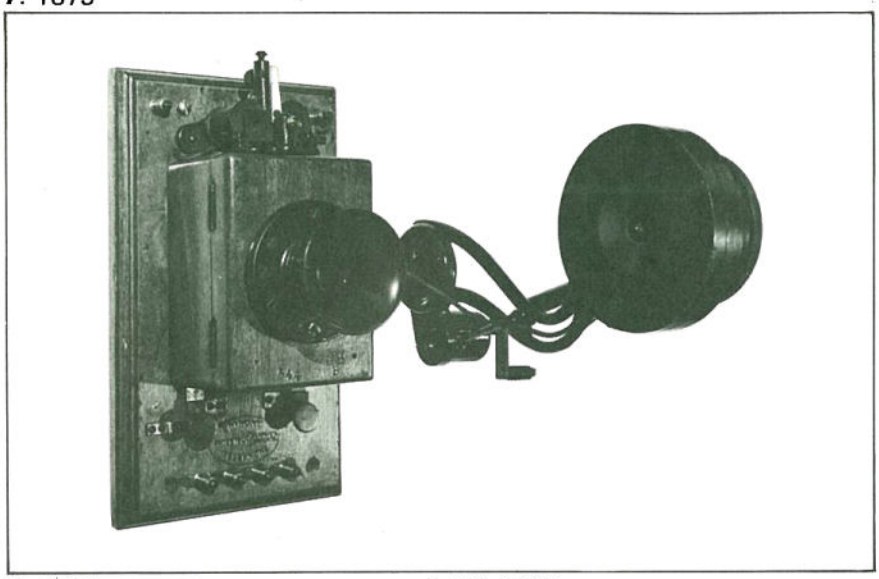
9. Granular Transmitter No. 1. Transmitter in middle box contained carbon granules. 1889.

10. Granular Transmitter No. 1 with improvements in mounting and finish. 1900.

8. Gower Bell Telephone. Receiver too heavy so tubes had to be used. About 1881.

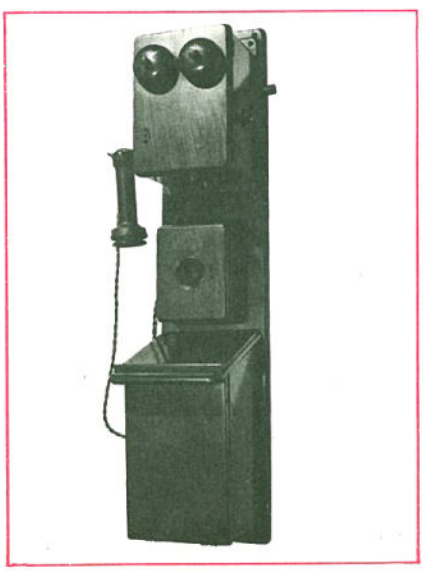
11. Ericsson Wall Telephone. Transmitter and receiver combined (hand microphone). 1900.

7. 1879

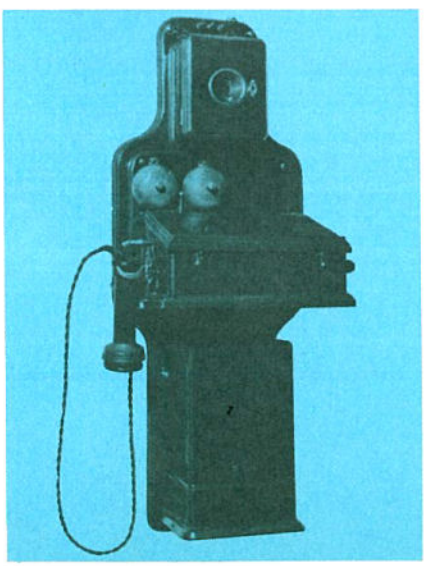


8. 1881

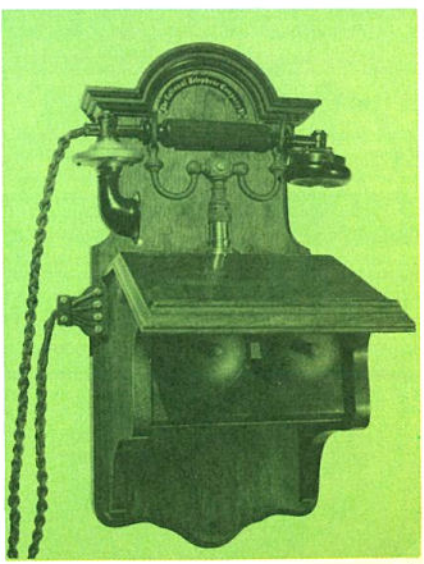
9. 1889



10. 1900



11. 1900



12. Table Telephone with hand microphone. 1900.

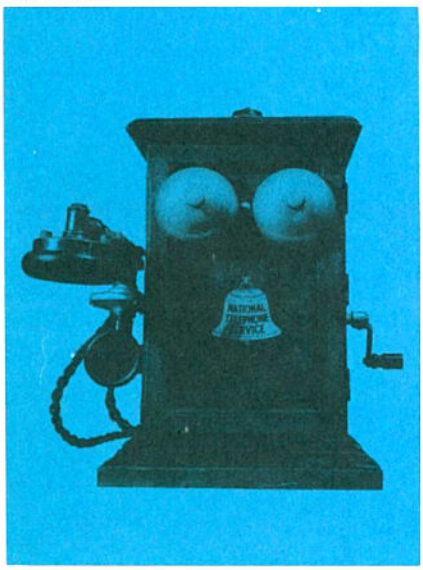
13. Magneto Telephone. 1910.

14. Western Electric Table Telephone used by Post Office. 1912.

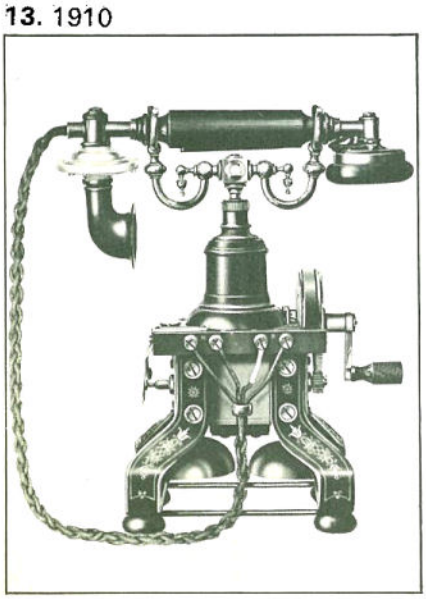
15. Pedestal Type Telephone. 1914 onwards.

16. A non-director dial hand microphone with combined bell set. 1929.

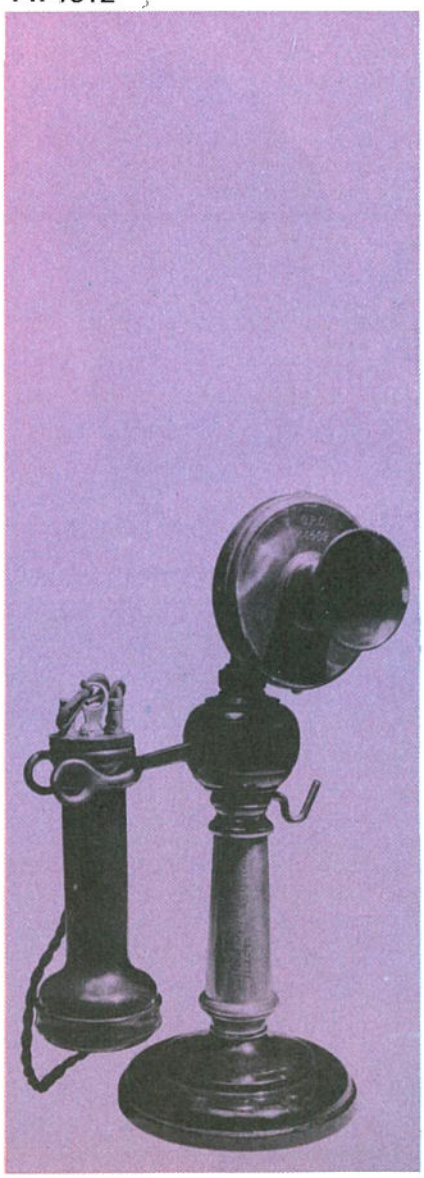
12. 1900



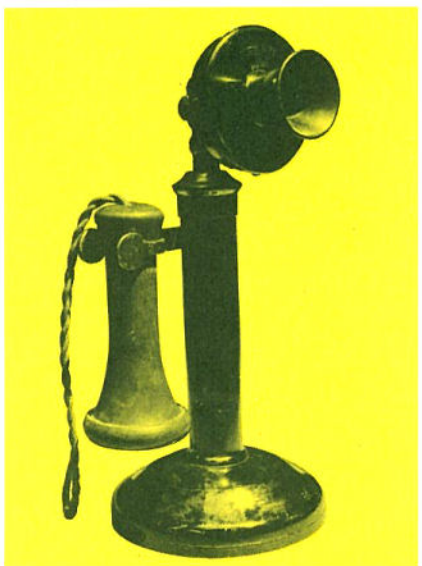
13. 1910



14. 1912



15. 1914



16. 1929

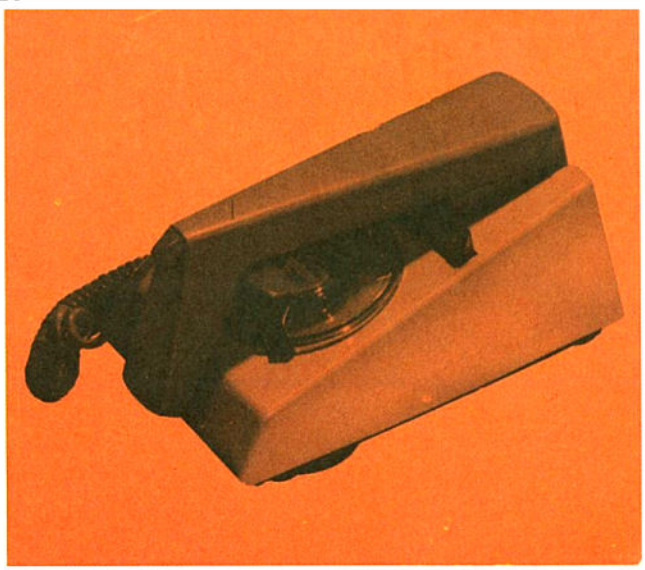
. . . to today . . .

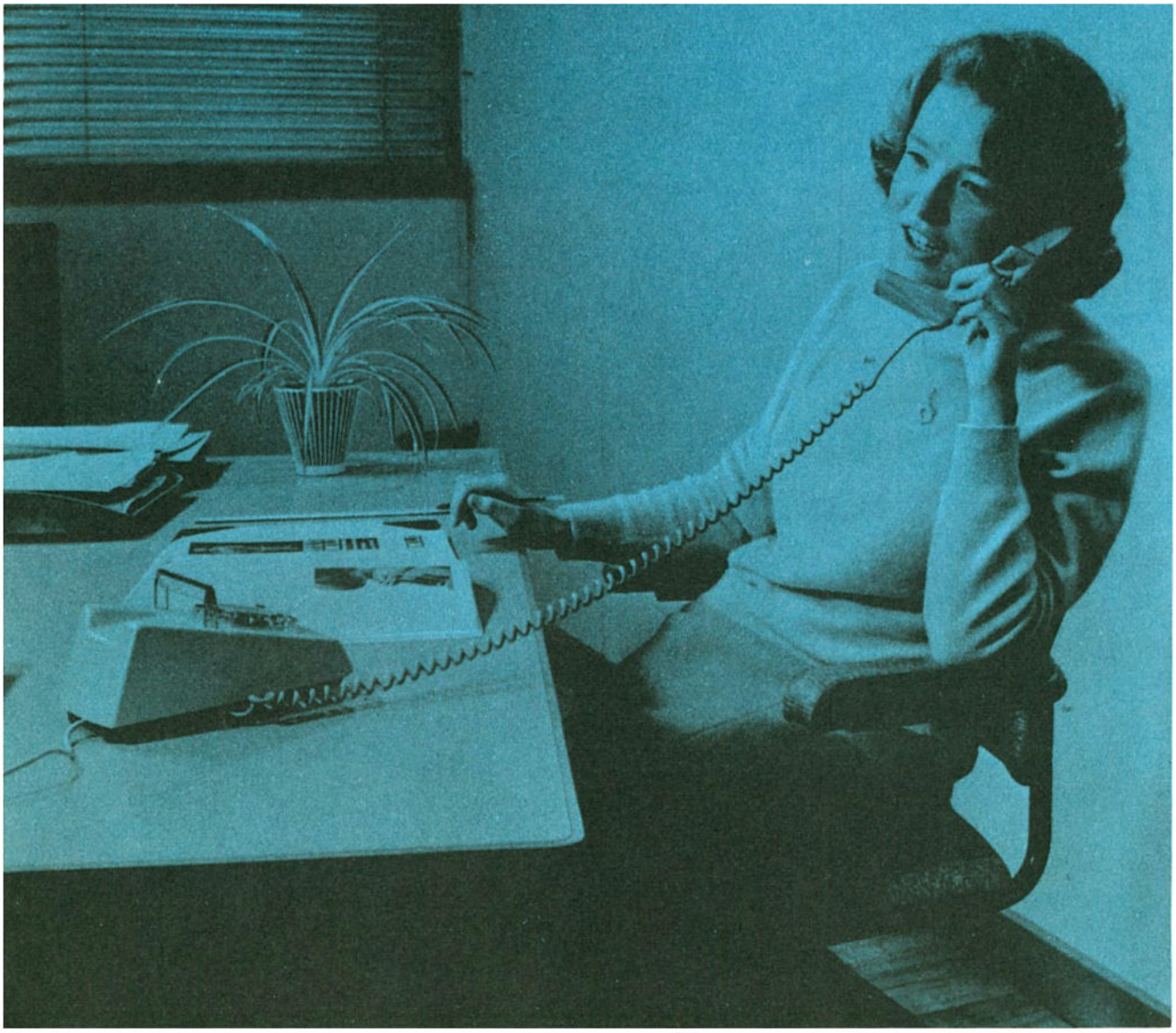
17. 1936

18.

19.

20.





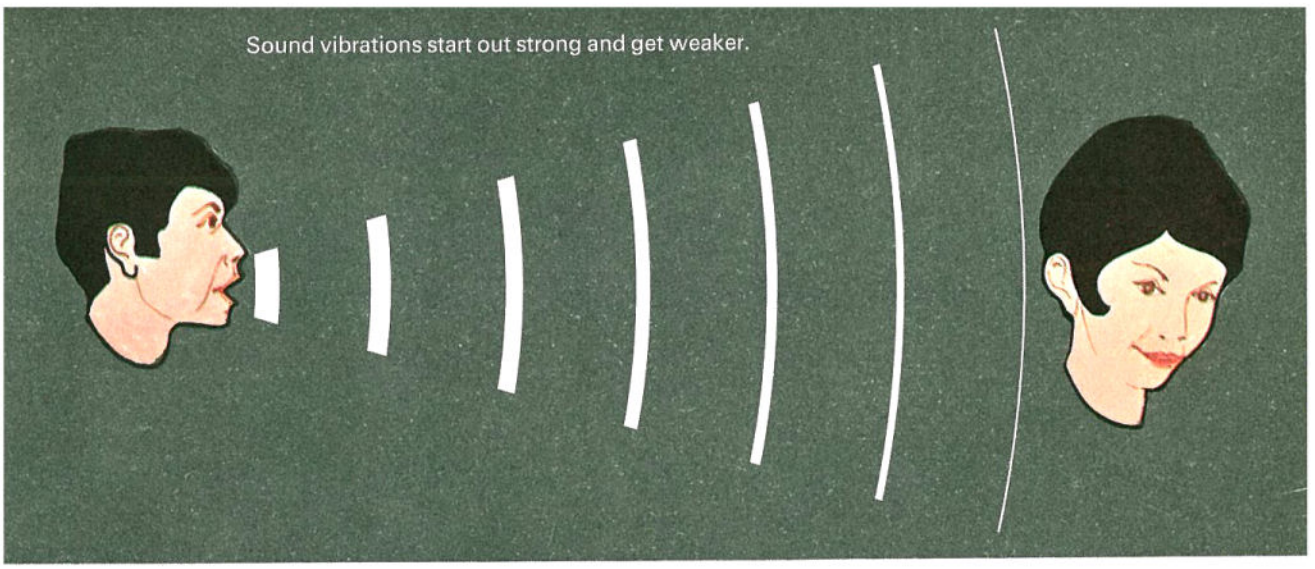
How the sound of speech travels

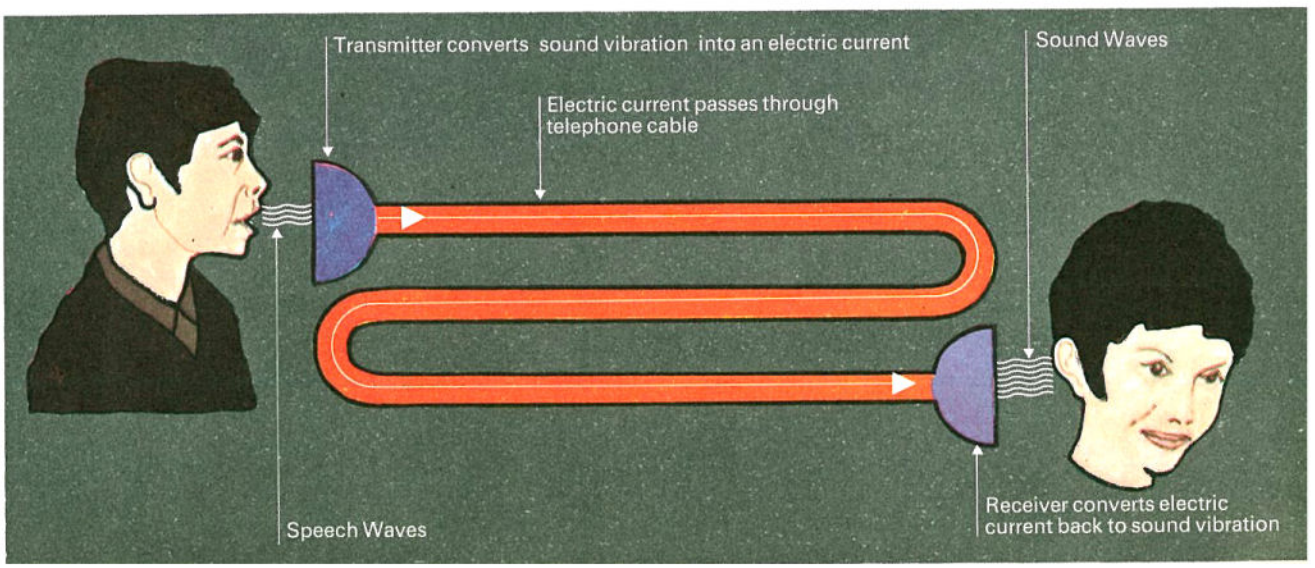
When you speak, the vibration of the vocal chords causes minute changes in air-pressure in your mouth. These changes in pressure radiate from you in waves comparable with ripples on the surface of a pond. These radiations, known as 'sound waves', make impact on the listener's ear. If the waves are strong enough, impulses are sent to the nerve centres of the brain, and your voice is heard.

In ordinary speech, air is the medium of transmission of the sound. The pressure, as the 'waves' leave your mouth, may be comparatively heavy, and the sound loud, but as the waves extend over a wider distance their force, or 'amplitude', becomes smaller, until – at no great distance from you – they become inaudible. Air is not a good medium for the transmission of sound waves over a long distance.

An electric current can be transmitted over wires to a relatively great distance without much loss. If, therefore, speech sound waves can be converted to a similarly fluctuating electric current to be later changed back again to sound, the distance over which speech can be transmitted is greatly increased. This is the principle on which the modern telephone works.

A simple telephone consists of a transmitter, which converts the sound waves to a varying electric current corresponding to them; and a receiver which changes the electric current back into sound waves of the original form.



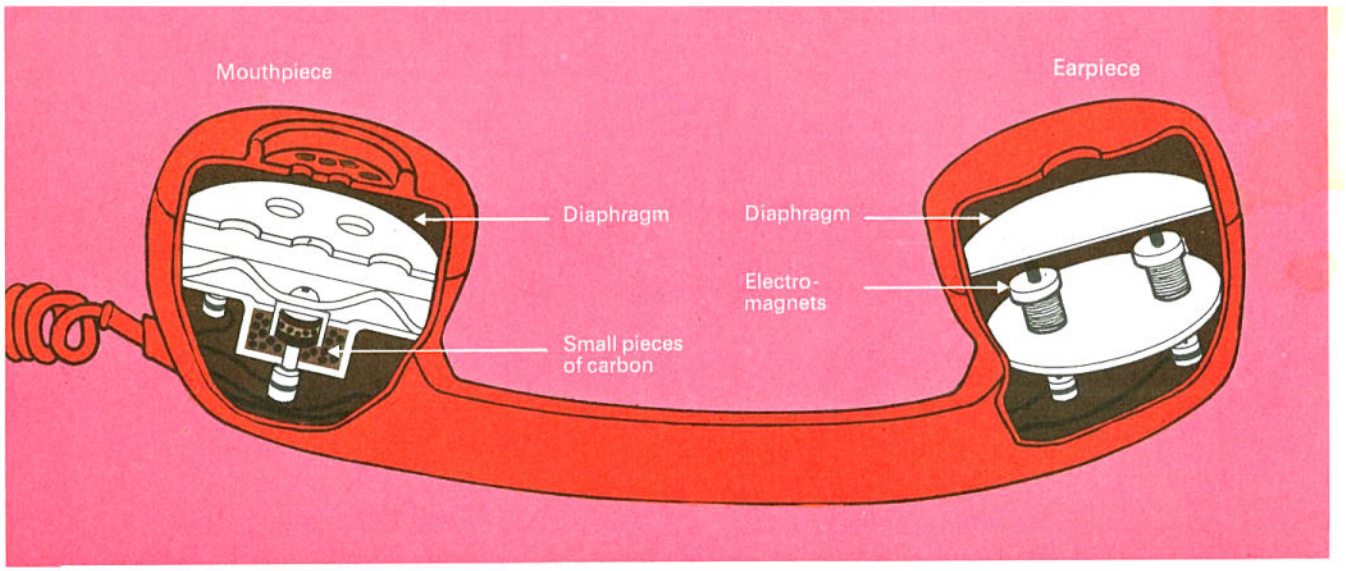


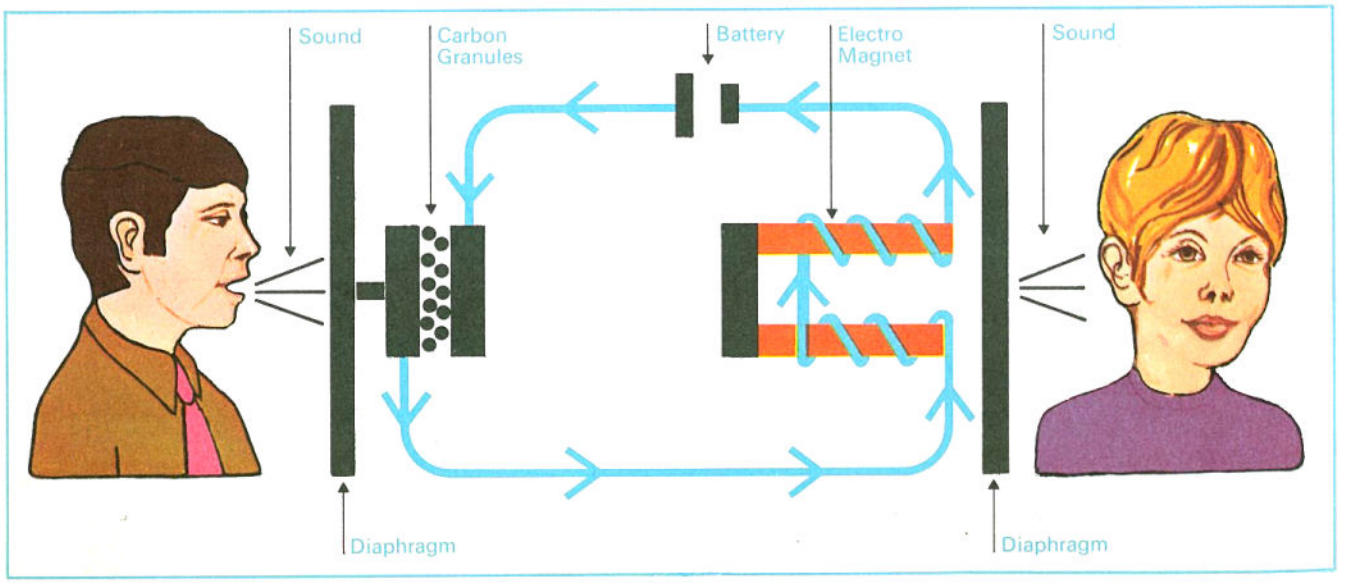
The Transmitter

The commonest form of transmitter consists of a metal diaphragm and a box containing small particles (granules) of carbon which lightly touch the centre of the diaphragm. When you speak into the mouth-piece of the transmitter this causes the diaphragm to vibrate, the vibrations causing varying pressure on the carbon granules, through which an electric current is passed. When the pressure increases, the carbon granules are pushed more closely together; the more tightly they are packed, the easier it is for an electric current to flow. When the pressure decreases the granules become more loosely packed and the electric current flows less freely. Thus the sound waves causing the diaphragm to vibrate are reproduced in the form of increases and decreases in the flow of the electric current through the transmitter. This current can be sent over a pair of wires to a distant receiver.

The Receiver

The function of the receiver is to convert the fluctuating current back into sound waves. The receiver is a metal diaphragm tightly held round the circumference and placed very close to, but not touching, the poles of a strong magnet. Round the magnet is wound a coil made of a large number of turns of fine wire. The magnet normally attracts the diaphragm with a constant pull, but when a varying current is sent through the coil this pull increases or decreases with the variation in the current. The fluctuating current from the transmitter is passed through the coil and rapid and ever-changing variations are produced in the strength of the magnet, which attracts the diaphragm in similarly varying degree, causing it to vibrate in unison with the diaphragm in the transmitter, and thus create sound waves in the surrounding air.



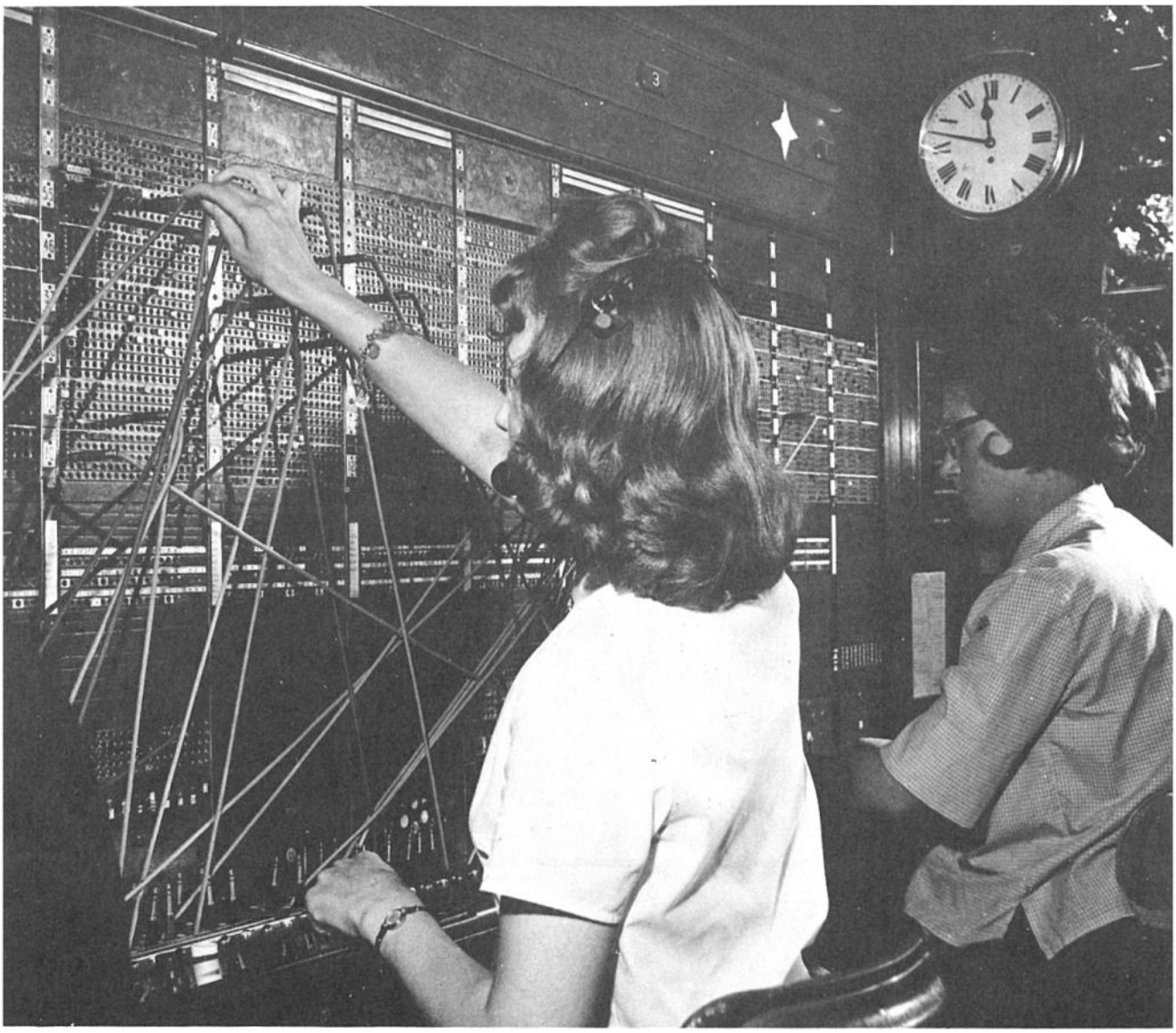


Telephone Exchanges

With Graham Bell's invention two persons could converse over a distance, each needing a transmitter and receiver in the circuit. To provide intercommunication for a number of people, however, a more practical method than direct lines from each to all the rest is needed. (By direct connexion, six people would need 15 lines; 10,000 people would need about 50 million lines.)

The problem is overcome by the use of telephone exchanges, either manually operated or automatic, where any two telephones can be connected together. In manual exchanges each connexion has to be made by the operator; at an automatic exchange the equipment does this by itself.

A Manual Telephone Exchange.



Manual Exchanges

Although there are few manual exchanges still in use, the operation of them is outlined for the benefit of readers who are still served by one. At a manual exchange the wires from the telephones end at switchboards. By means of short, flexible wires (known as 'cords' and fitted with plugs at their ends) the switchboard operator can connect any two circuits together.

When a caller lifts his receiver a switch operates and a current flows through the circuit and lights a lamp on the exchange switchboard. By inserting one of the 'cords' in the caller's line, the operator can speak to the caller, who tells her the number he wants. The operator then inserts the other end of the cord in the wanted line and operates a key to ring the wanted subscriber's bell. When this subscriber is on another manual exchange, an operator at that exchange must first be obtained. The first operator, therefore, contacts the second operator over a separate line, known as a junction' line, and tells her the wanted number. The second operator then rings this number, and the calling and called telephones are connected through the junction line by means of the cords at each exchange. When the wanted subscriber is on an automatic exchange the first operator can make direct contact with the distant telephone. When the call is finished both the receivers are replaced. When this occurs, 'clearing' signal lamps at the exchange switchboard are lit. The operator knows the call is finished and withdraws the cord, disconnecting the circuit.

The Automatic Telephone System

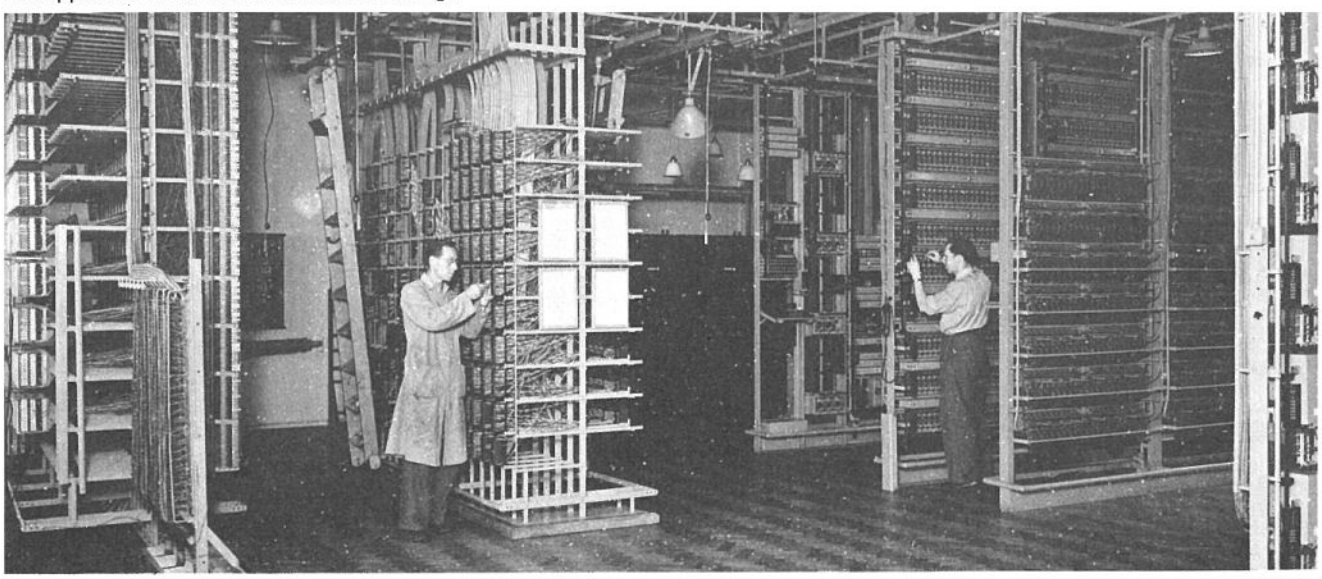
In automatic exchanges ingenious apparatus connects one subscriber's telephone with another, without the aid of an operator.

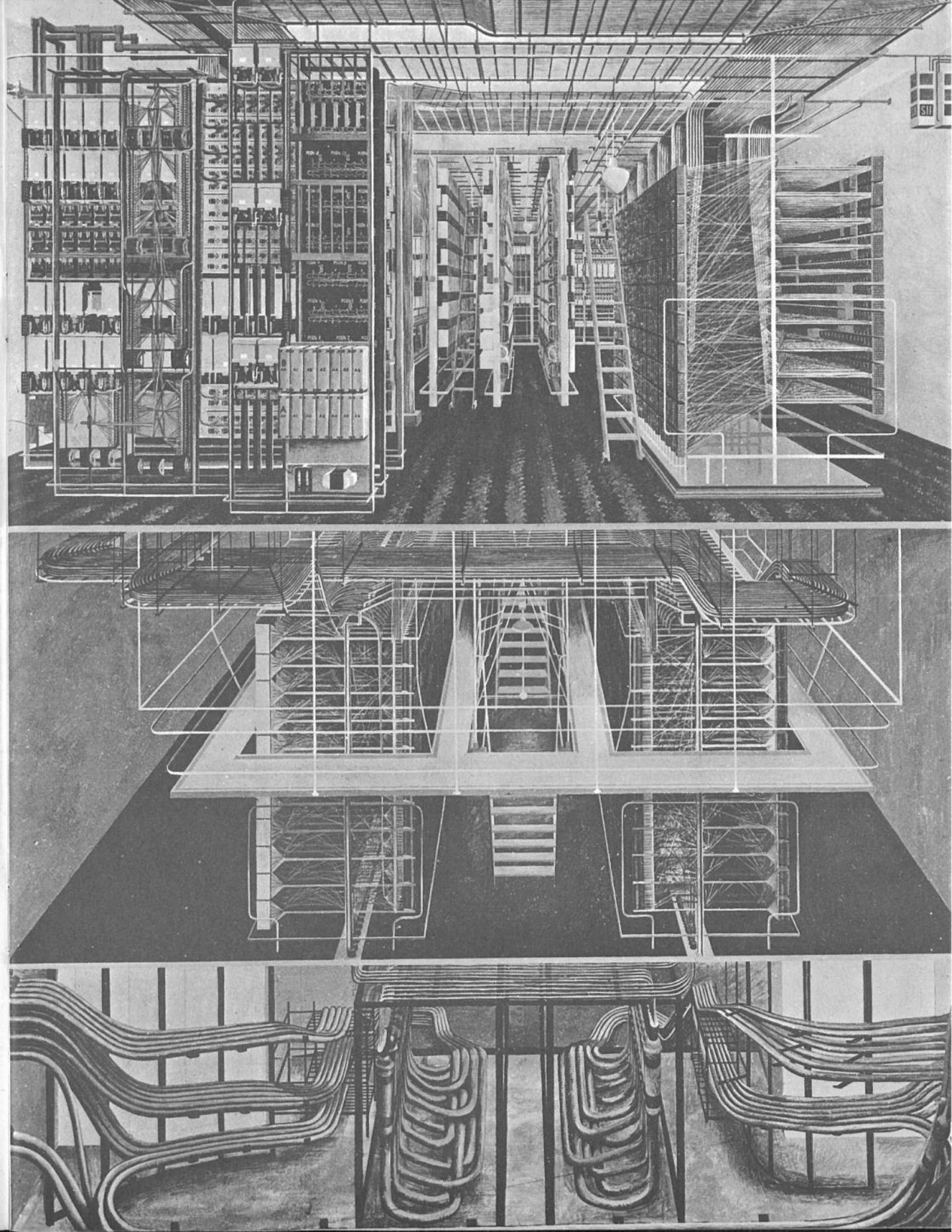
In 1914 there were less than 1,000 automatic telephones in the country: to-day there are more than 12,500,000 and the number is steadily increasing.

On an automatic exchange you can call a subscriber on the same exchange by lifting the receiver and dialling his number.

Opposite.
Sectional drawing of the interior of an automatic telephone exchange, showing (from the bottom upwards): (1) the cable chamber, with cables coming in from the street, on left and right, and going up to (2) the main distribution frames, connecting up with (3) the apparatus room.

The apparatus room of an automatic exchange.





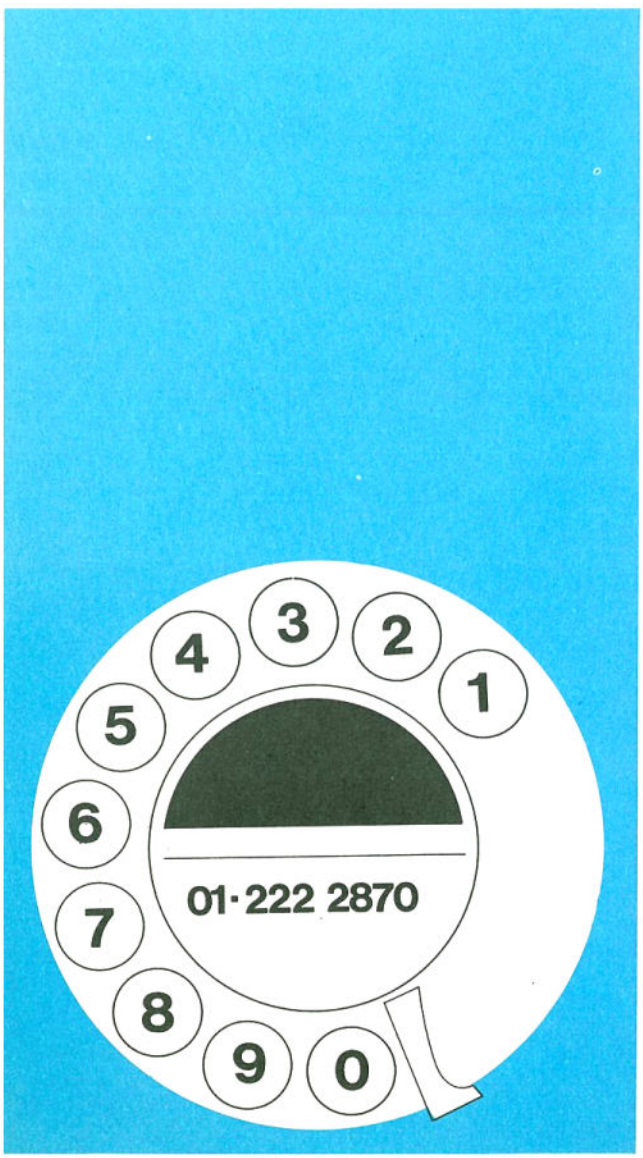
The connexion between the two telephones is completed at the exchange by automatic selectors controlled by the telephone dial.

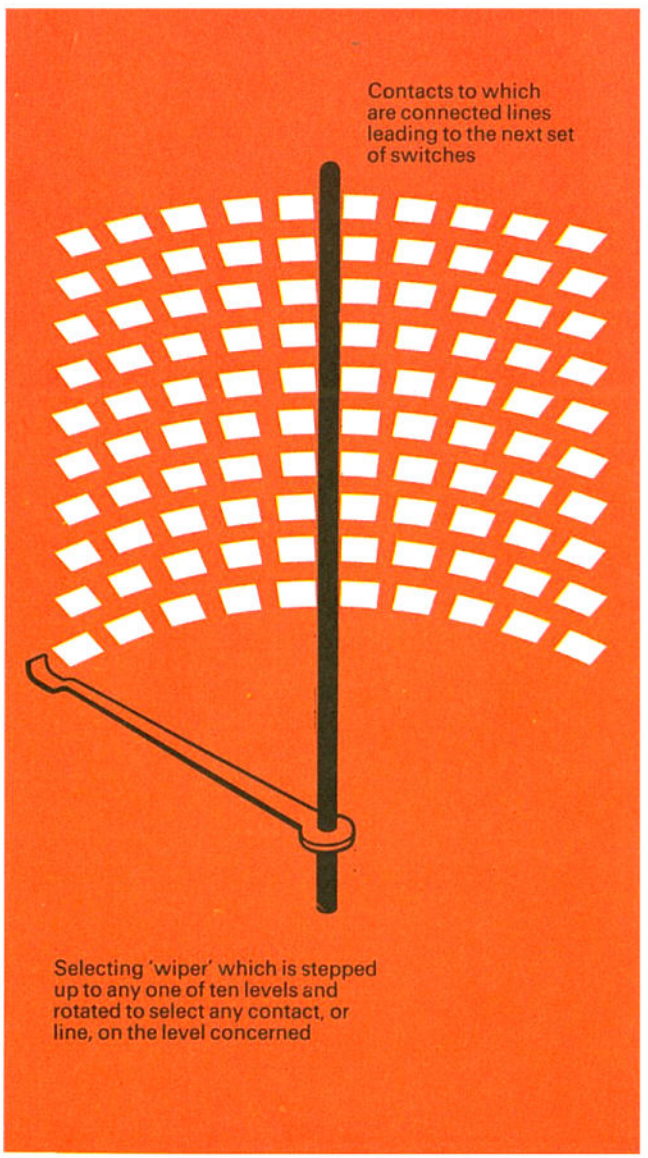
The connexion is extended from one selector to another according to the numbers dialled, until finally, when the last figure is dialled, the circuit to the called subscriber's telephone is completed. The dial, when returning to its normal position, creates current impulses corresponding to the number dialled, which travel along the circuit and operate the selectors.

The selector has a hundred contacts, arranged in rows of ten. A switch-arm (or 'wiper') moves up in steps to the row determined by the 'thousands' figure dialled (in the case of a 4-digit number), then passes round the row of contacts, stopping at the first disengaged one. This contact gives access to the next selector which, by repeating the process, accepts the 'hundreds' digit as it is dialled and then extends the connexion to the final selector. On receiving the impulses corresponding to the 'tens' digit, the switch-arm of this selector moves up to the appropriate row but does not pass along the row until the 'units' figure is dialled. When this is done, the arm moves along the row to the contact determined by the last figure dialled, thus completing the connexion to the dialled subscriber's line. The switching process is now complete and the called telephone rings automatically.

If someone you wish to telephone is on another automatic exchange within the area available at local call rate, the connexion to the distant exchange is

An All-Figure Number Telephone Dial.





made by dialling code numbers. The code numbers control switches which select a disengaged junction to the distant exchange. The wanted person's number is then dialled, the corresponding current impulses pass over the junction and operate the selectors at the distant exchange.

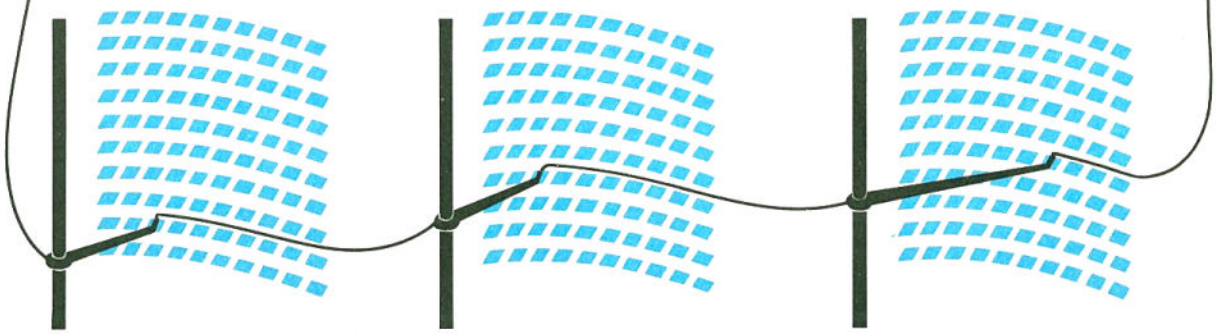
In London, Birmingham, Edinburgh, Glasgow, Liverpool and Manchester telephones have been given all-figure telephone numbers. As the term implies, these do not include an exchange name, e.g., 01-222 2870 and 051-424 2501. For calls within one of these cities you dial the last seven figures only of the number. The dial impulses are fed into an additional piece of apparatus known as the 'director', which automatically selects a free line to the wanted exchange. It then passes on the impulses of the numbers as they are dialled to operate the selectors at the distant exchange. The Post Office introduced all-figure telephone numbers in these cities (thus enabling their telephone systems to continue their rapid growth) because:

the reserve of numbers of three-letter codes, which were suitably pronounceable as exchange names, was rapidly dwindling and by using figures we can provide for further growth with sufficient codes for the rest of the century;

it enables us to deal more economically and efficiently with the increasing number of incoming and outgoing telephone calls of the cities mentioned above, by decentralising a large proportion of these calls;

The connexion is extended from one selector to another according to the numbers dialled until the circuit between the instruments is complete

The connexion between two telephones is completed by automatic selectors controlled by the telephone dial



1st digit

2nd digit

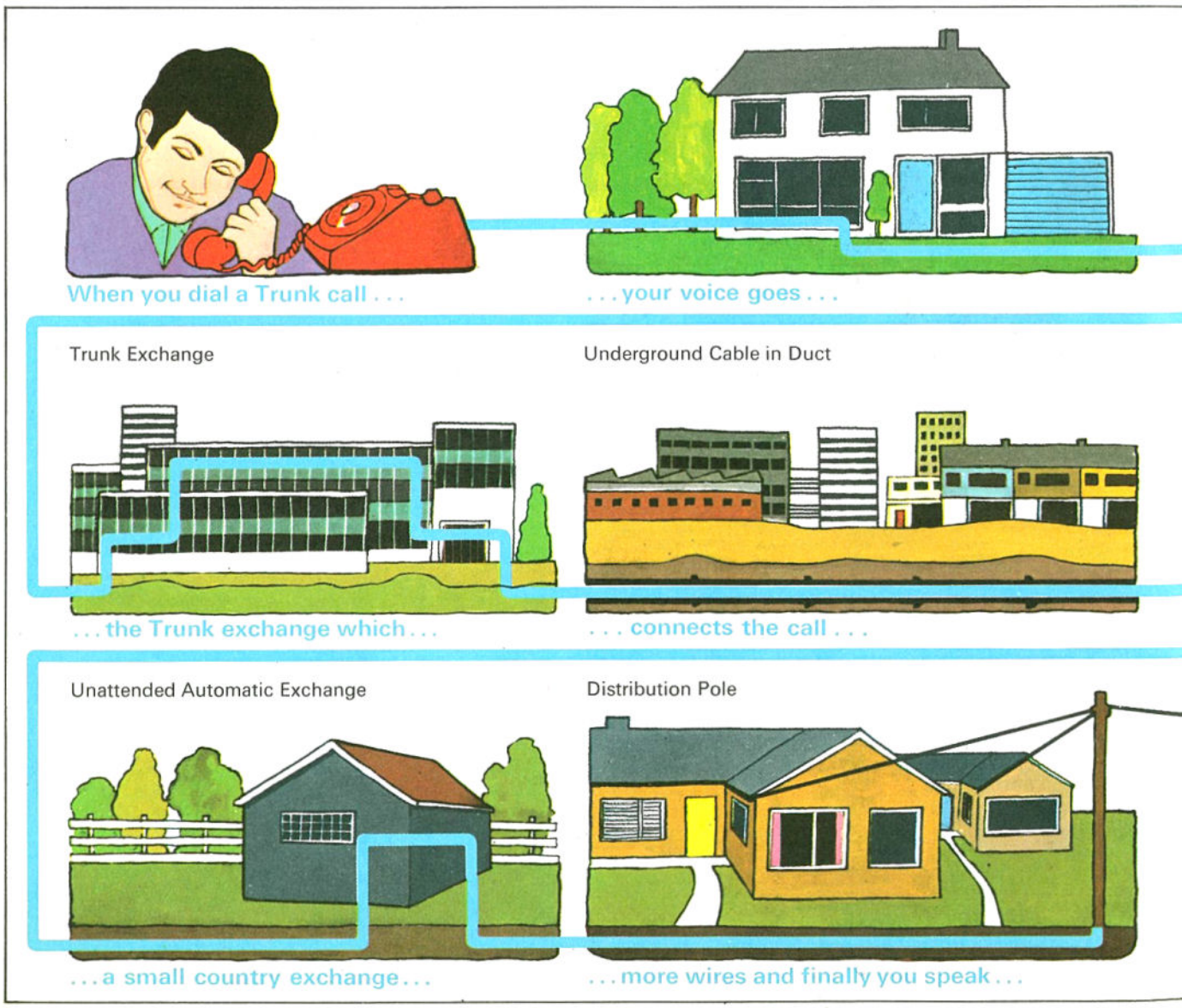
3rd and 4th digits

it allows subscribers in different countries to dial one another, as it is necessary for a common dialling system to be used. Very few countries have letters on their telephone dials, thus those overseas callers who have figures only on their dials, experience difficulty in dialling their own calls to subscribers in this country.

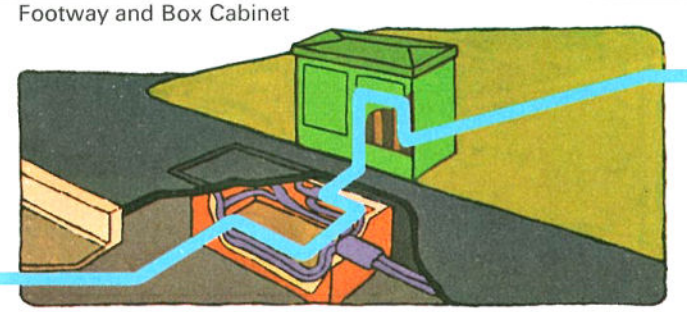
In other cities and towns you dial the number only for calls on the same exchange, and (in most cases) a local code number for nearby exchanges. For more distant exchanges, STD (Subscriber Trunk Dialling (see below)) or the assistance of an operator is necessary.

Various tones are heard while a call is being made. Details of these are given under 'Telephone Tones'.

There are special code numbers for obtaining the operator, and in practically all automatic areas 999 is dialled in emergency to obtain an operator who will connect to the required emergency service – Police, Fire Brigade, Ambulance or, in some areas, Coastguard, Mountain and Cave Rescue Services. (More information about emergency calls is given under 'Services available').

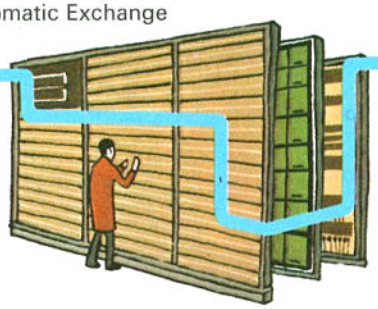


Footway and Box Cabinet



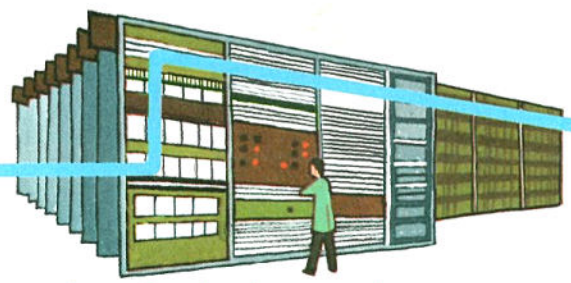
. . . along cables . . .

Local Automatic Exchange



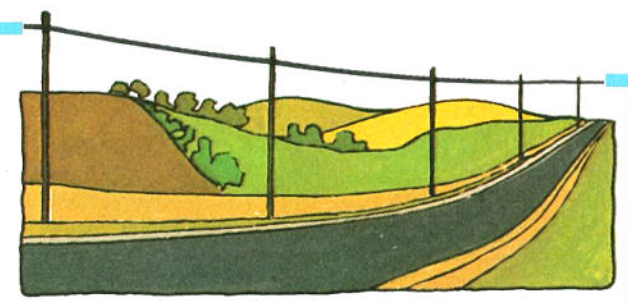
. . . to the local exchange and on to . . .

Exchange Apparatus

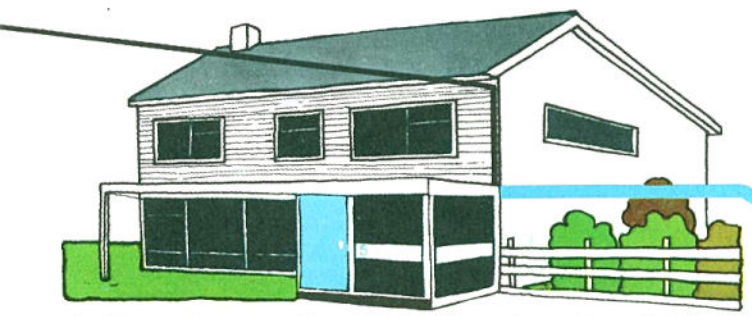


. . . through other large exchanges . . .

Overhead Pole Route



. . . over wires and perhaps . . .

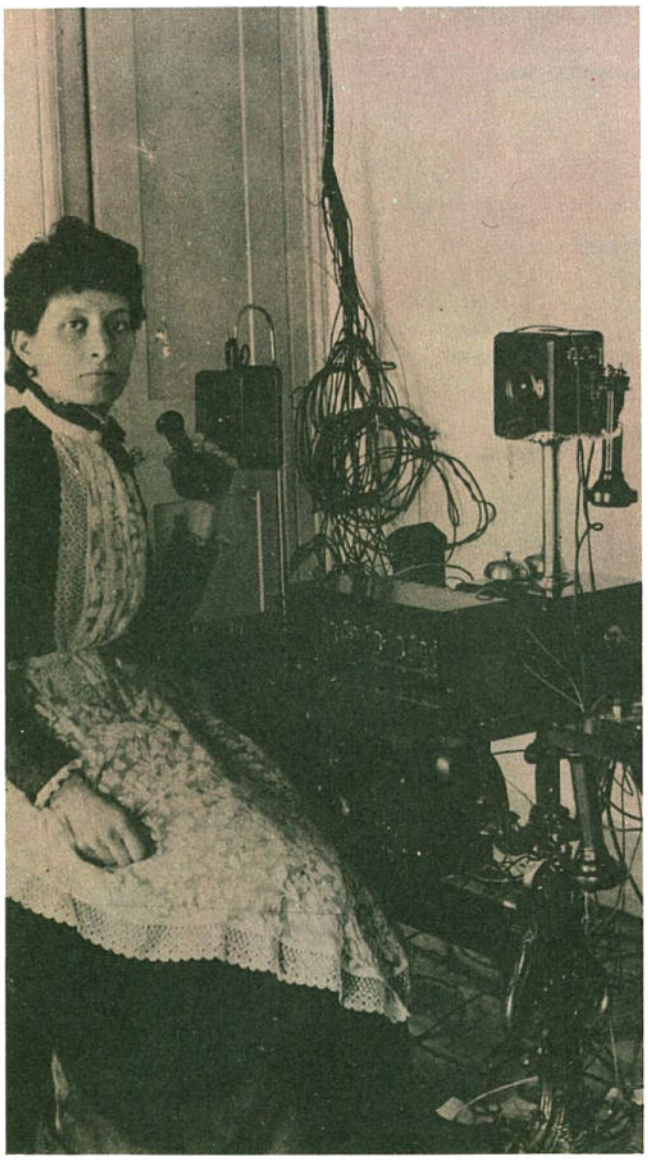


. . . to the person you have called, perhaps hundreds of miles away.

Telephone Operators and Auto manual Switchboards

Even when there is a fully automatic service there will still be some operators. Their function will continue to be to give special assistance to callers who experience difficulty in completing their calls, who make enquiries or who require special services. These operators work at automanual switchboards, the switchboards being used in conjunction with automatic exchange equipment. A more recent type of automanual board is the cordless switchboard. On this the operator manipulates switches instead of plugs and cords. One of the great advantages of this sort of switchboard is that it can be installed in office-type accommodation remote from the building which houses the automatic exchange equipment thus allowing more room for expansion for the latter.

Croydon Telephone Exchange in 1884.



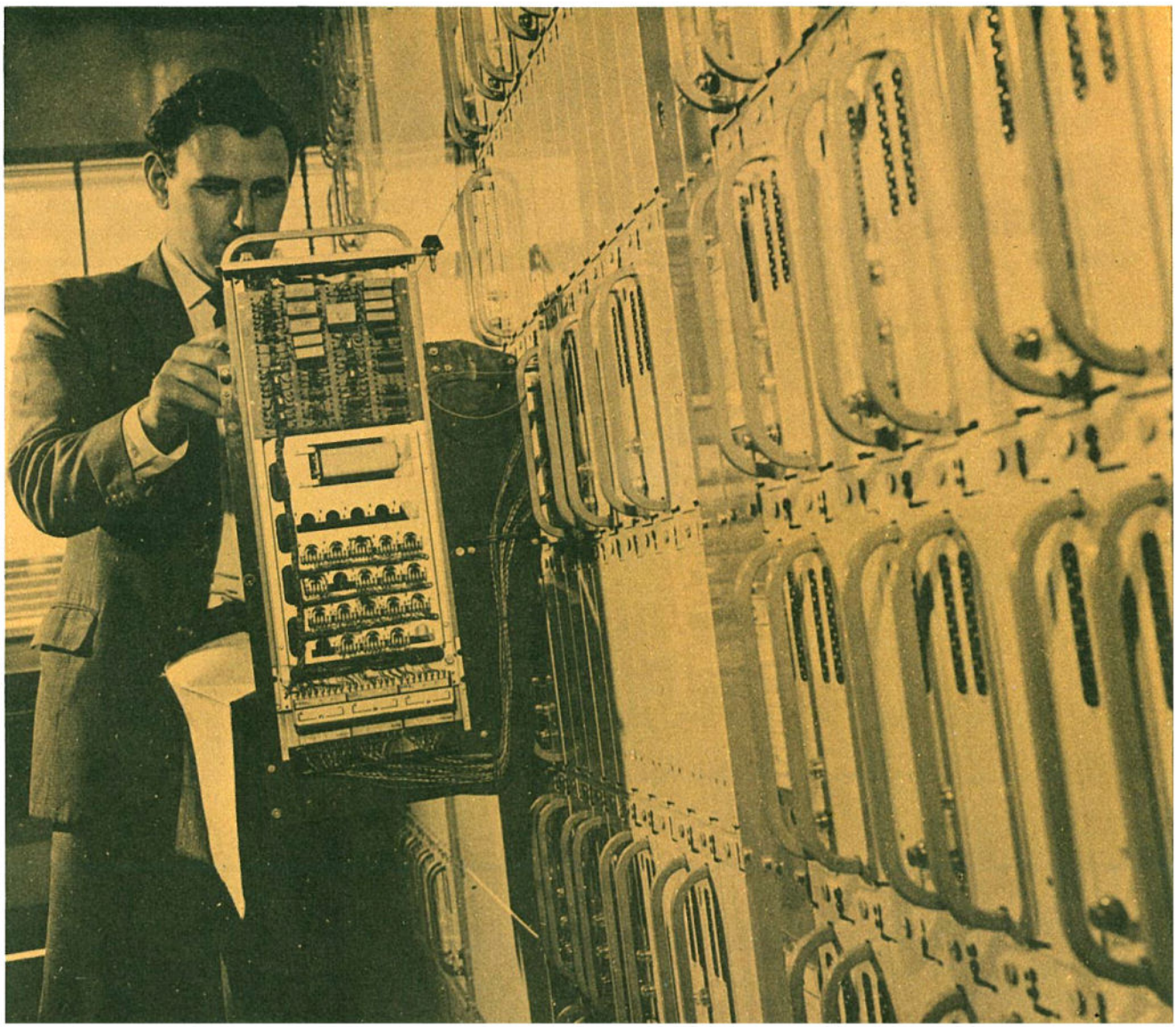
An operator using a cordless switchboard at Croydon Telephone Exchange 1970.

Telephonists at an automanual switchboard.

Exchange Systems

The principles used to illustrate automatic exchange switching are those associated with the Strowger system (invented by Almon B. Strowger of Kansas City) and first patented in America in 1889. The first Public Automatic Exchange in the UK using these principles was opened at Epsom in 1912, as previously mentioned, and until recently it has been the standard system used by the Post Office. In the past year or so the Post Office has introduced, to a limited extent, the Crossbar and Electronic (Reed Relay) systems for public exchanges. These are Common Control systems whereby information concerning the call is first passed to a central control point which processes it and selects the path through the exchange that the call shall take. Connections in both systems are made by the operation of spring sets, in Crossbar by mechanical means and in Electronic (Reed Relay) by electronic devices. Both systems are much faster in operation than the Strowger system.

A Technical Officer checks the equipment at Ambergate Electronic Exchange.



Telephoning over long distances

In 1934 one of the major developments of the telephone service, 'Demand' Trunk working, was introduced. Prior to this the average time taken to connect a trunk (i.e., long distance) call was 10 minutes. Demand Trunk working enabled a trunk call to be connected while the caller waited on the line. This improvement in service was achieved by installing switchboards of a new type in Trunk exchanges, giving each operator direct access to every trunk line going out from the exchange.

Subscriber Trunk Dialling (S.T.D.)

Further developments in automatic telephony have now made it possible for most callers themselves to dial both their local and their own trunk calls. Group Routing and Charging Equipment (GRACE for short) has been designed, which connects these calls and at the same time registers the appropriate charges on the caller's meter. The equipment was introduced at Bristol in December, 1958, the first call being made by Her Majesty the Queen. Subscriber Trunk Dialling will be extended to enable 86% of our subscribers to dial trunk calls themselves by 1970.

GRACE's job is to interpret the instructions given by the caller when he dials, steer the call through the network of trunk lines to its destination, and, when the call is answered, to control the recording of the charge on the subscriber's meter.

To call someone by S.T.D. you dial a simple code before dialling his number; the code always starts with '0', which connects you to GRACE.

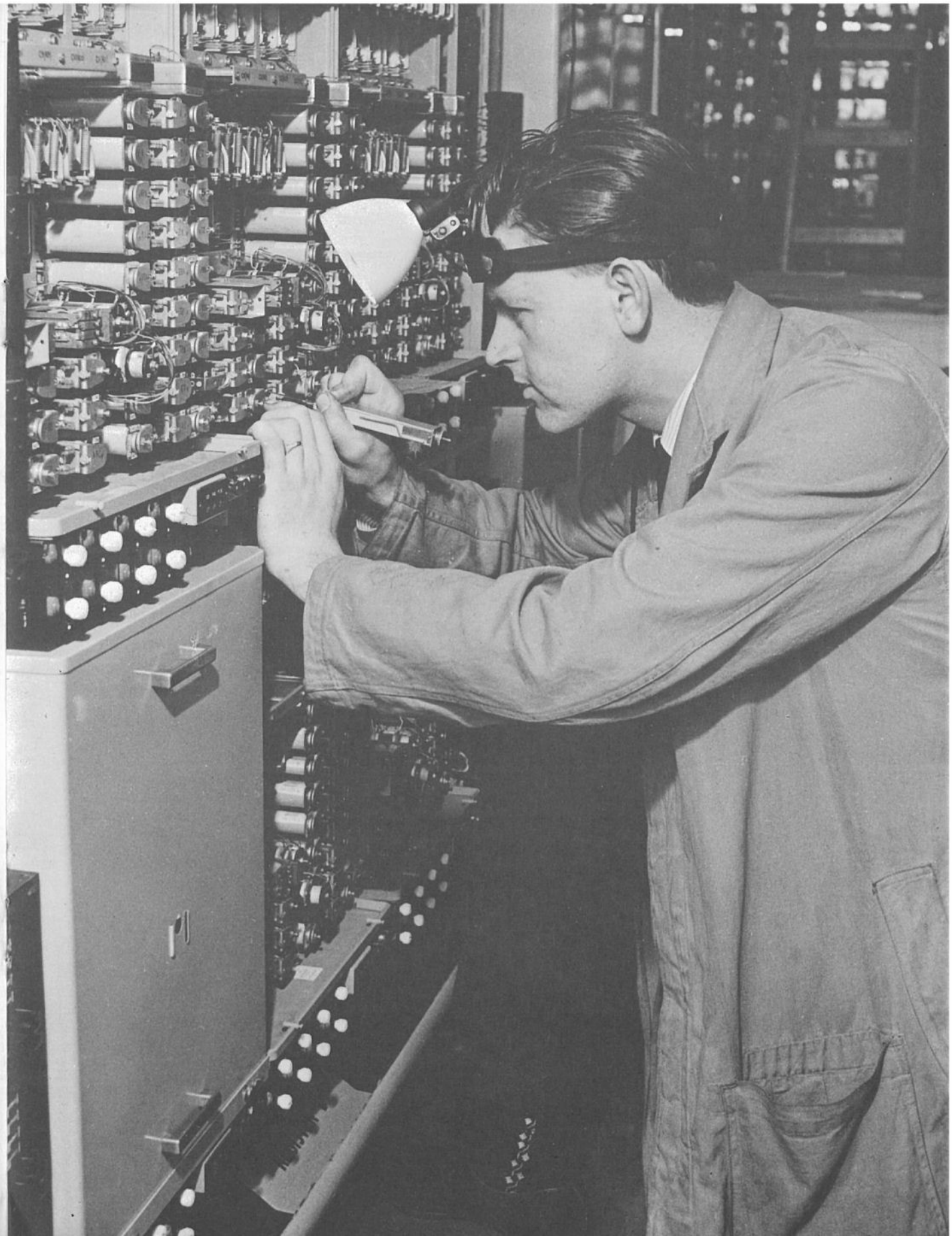
If you are served by an S.T.D. exchange and dial your own call then you use a unit method of charging which has been devised. The amount of time you buy for a unit depends upon the distance of the call, the day of the week and the time of the day at which you make the call. Cheaper rates apply to all calls you make from 6pm to 8am in the morning on weekdays and all day on Saturday. The financial advantage to you of this method, particularly when you dial trunk calls, is that you are, generally speaking, charged only for the time you actually use, whereas if you make the call via an operator, you are charged for a minimum of three minutes irrespective of whether or not you require this length of time. These concessions are given because the Post Office passes on the savings in operator costs to their subscribers. In the five years, April 1964 to March 1969, subscribers using S.T.D. paid nearly £200,000,000 less for their calls than they would have had they made their calls via operators and been charged accordingly.

Repeaters

One of the chief obstacles to development of long-distance telephony was the fact that electric currents decrease in strength as the length of wire over which they are transmitted increases. The difficulty was only partly overcome by providing very heavy wire in order to obtain good conductivity, but now, at certain points on the long-distance routes, the circuits pass through 'repeaters' which amplify the current received and send it on to the next repeater where it is again amplified. So it reaches its destination just as strong as if the distance were short.

The amplification is achieved by the thermionic valve (or more recently the transistor) which also makes radio and television possible. It is only through these that we are able to speak over great distances, not only in this country, but also across the sea to every country linked with us by submarine telephone cable or radio-telephone.

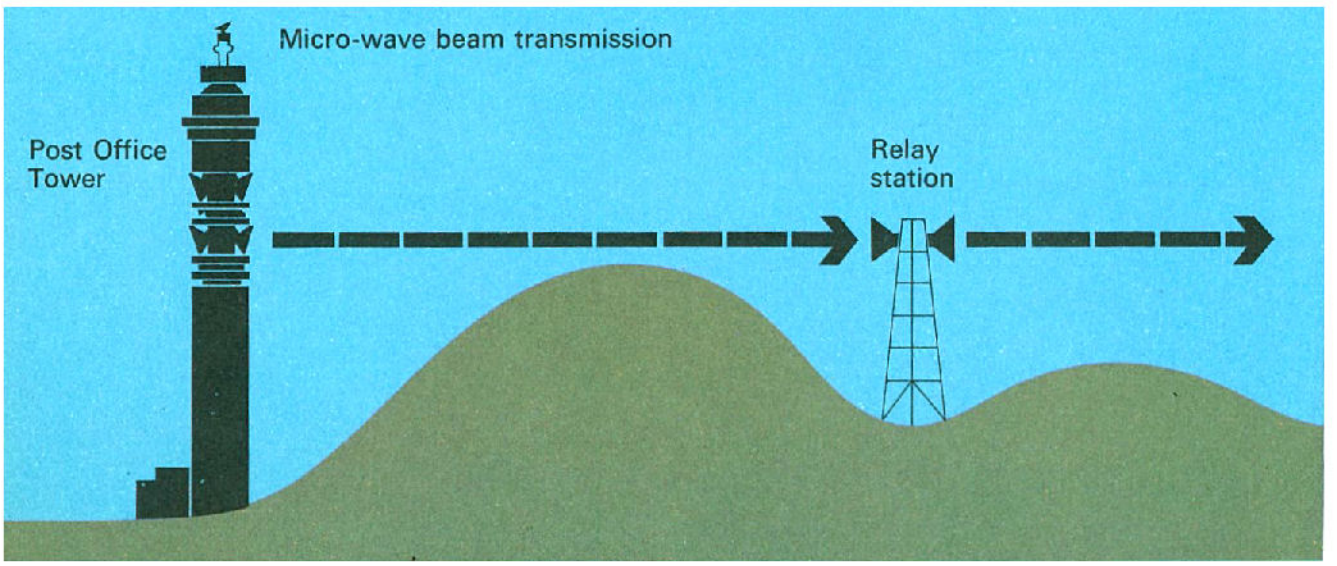
Opposite.
A technician checking adjustment on S.T.D. Register equipment.

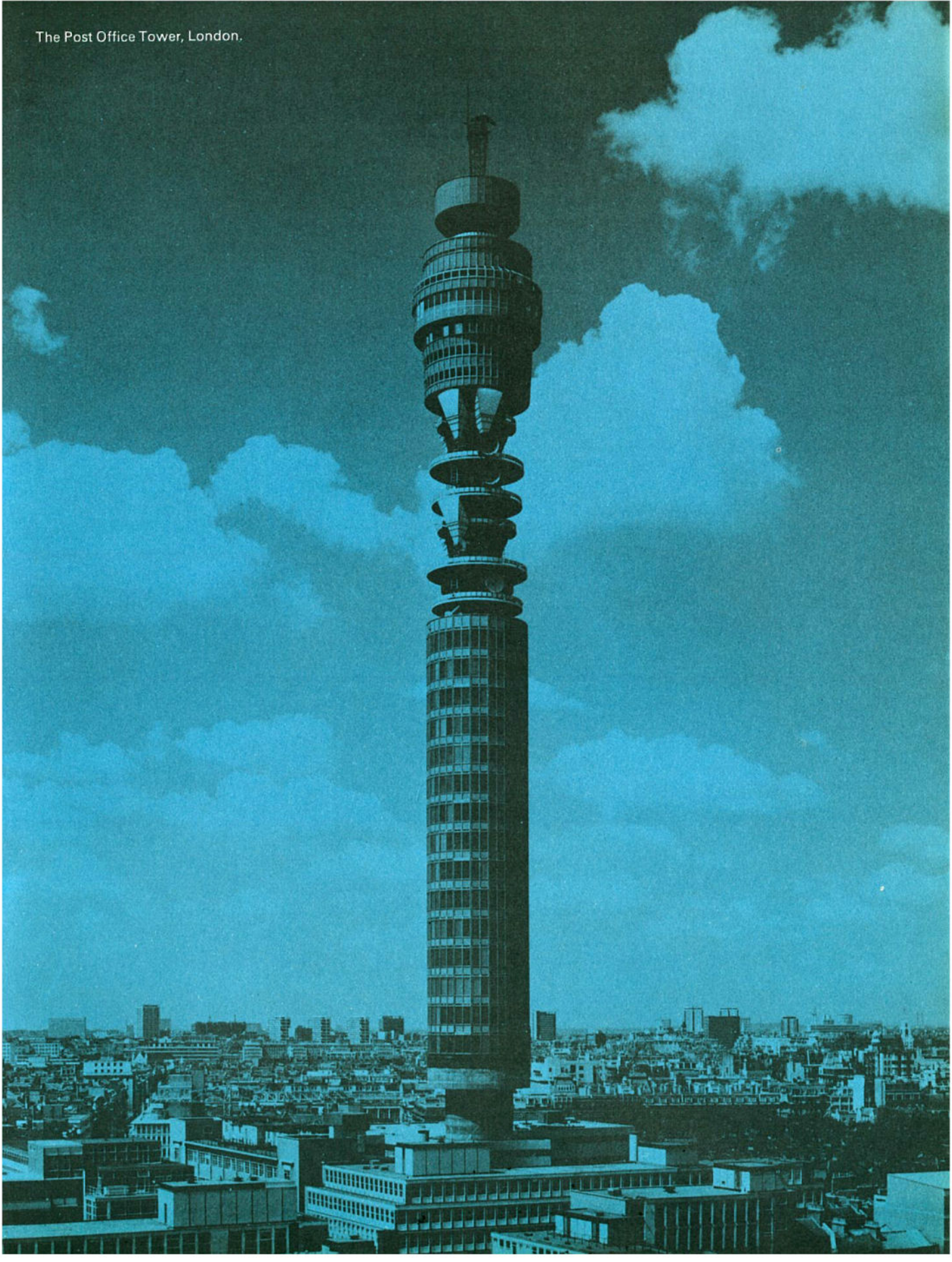


Expanding the service

We in the Post Office expect that there will be over 17,000,000 exchange connections in use in this country by the 1980s with a traffic level approaching 25,000,000,000 calls a year.

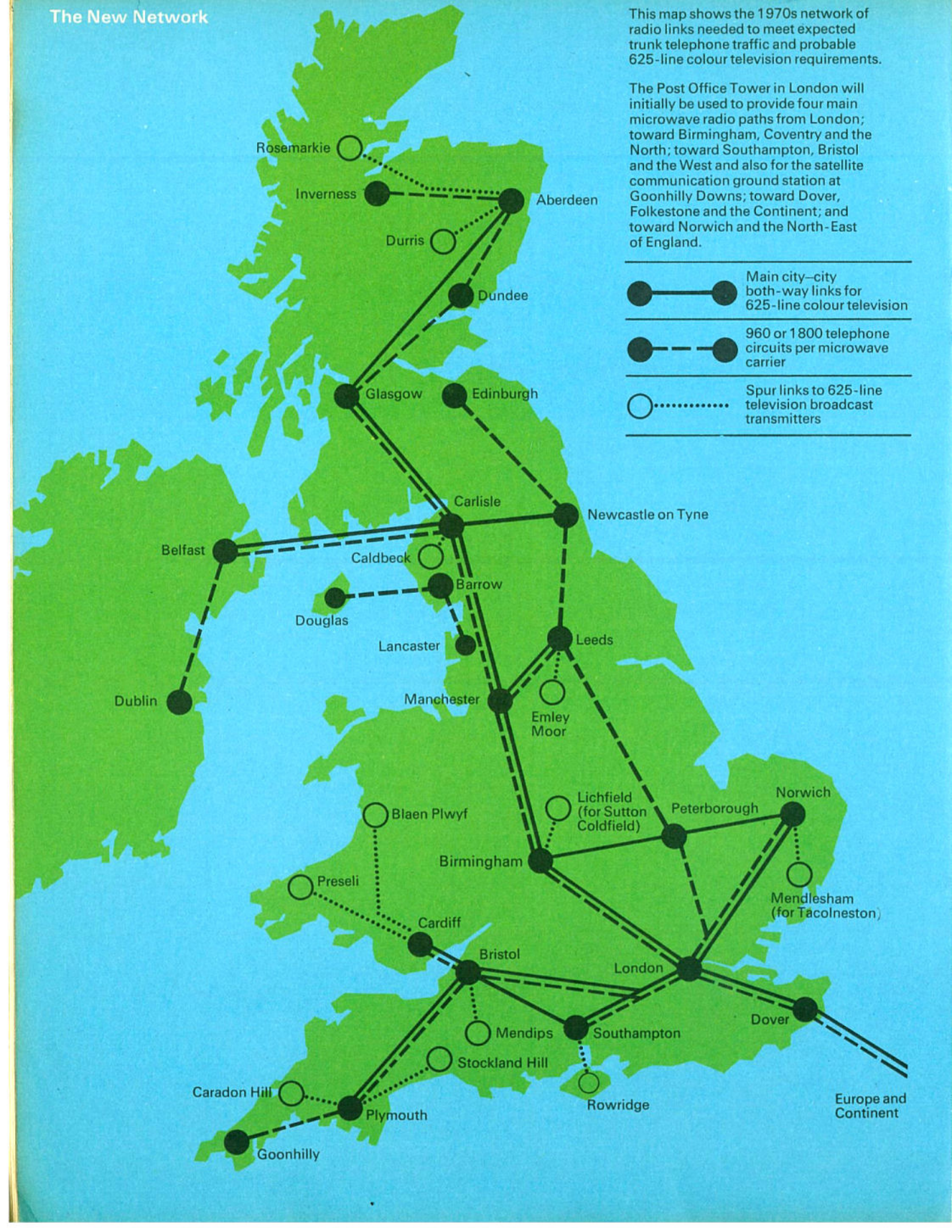
Perhaps the most important feature of our programme to cope with this expected demand is an additional 400,000 trunk circuits by the mid-1980s. Some of these circuits will be provided on existing cables by the use of P.C.M. (Pulse Code Modulation) which increases the number of simultaneous calls that can be made over a circuit from 1 to 24. Others will be provided by the extended use of co-axial cables which can carry up to 4,000 simultaneous conversations on a single pair of conductors. A great many more will be provided by the radio microwave network covering some 130 stations throughout the country. Super High Frequency radio waves are beamed between directional dish or horn-shaped aerials mounted on towers that are in visible contact one with another. The focal point of this network is the Post Office Tower near Tottenham Court Road in London. It is over 600 feet high – the highest building in the United Kingdom – to give the radio beams unimpeded paths. The dish- and horn-shaped aerials are capable of handling 150,000 simultaneous telephone calls and provide 40 television channels at the same time.





The Post Office Tower, London.

The New Network



Overseas Services

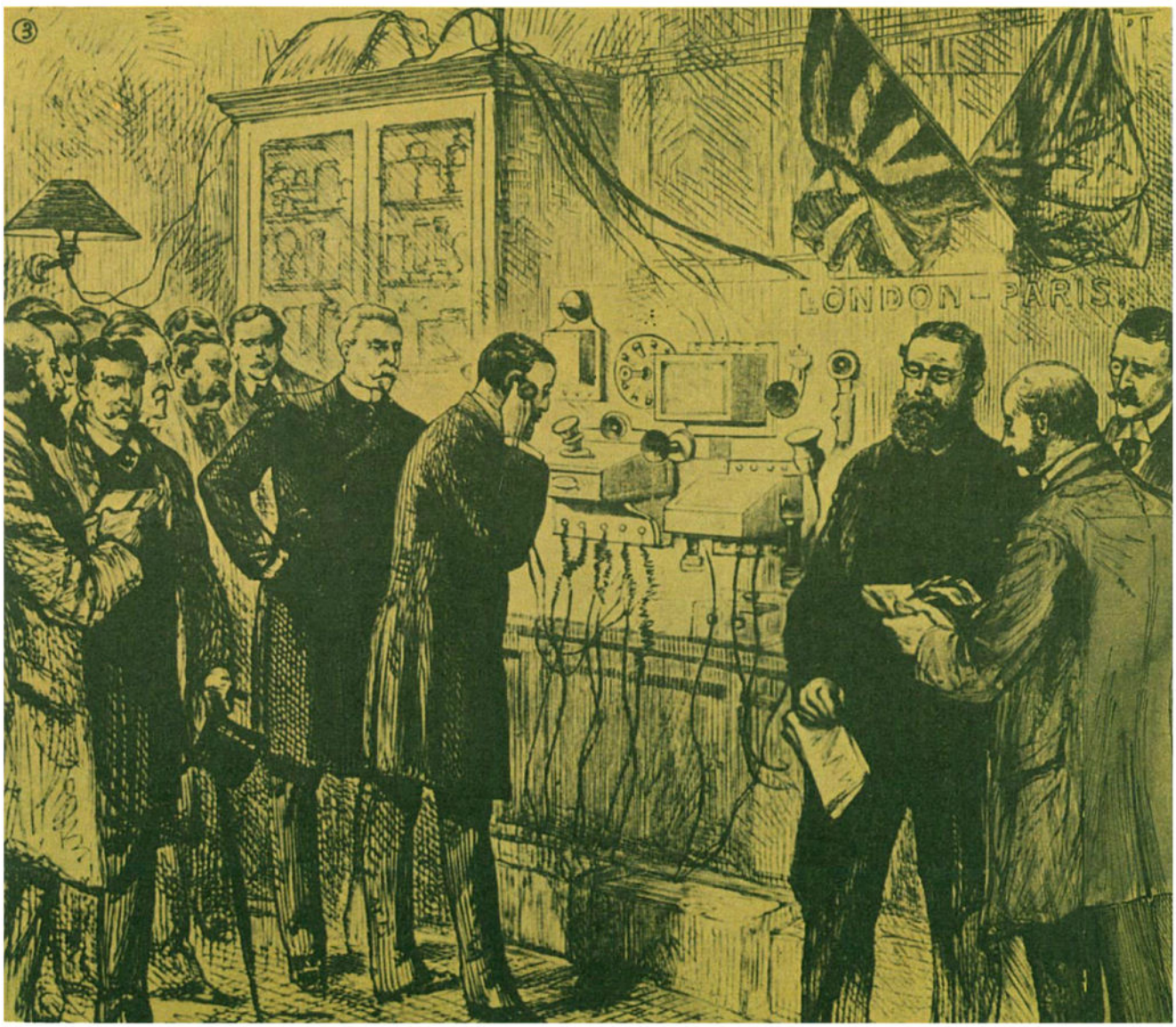
The first international submarine telephone cable was laid by H.M. Telegraph Ship 'Monarch' from St. Margaret's Bay in Kent to Sangatte in France as early as 1891. It contained only four wires enabling two simultaneous conversations to take place. There are now numerous cables, each of considerably greater capacity and every European country is in telephonic communication with Great Britain.

The laying and upkeep of these cables is costly. They are subject to destructive powers of tides, currents, rocks, ships' anchors, trawls and so on. Occasionally a fault is reported; then one of the Post Office cable ships is ordered to locate the fault and carry out repairs. The cable – which may have become deeply buried in sand – is located by delicate instruments and then dragged up by a grapnel and repaired. The Post Office has four cable ships, the latest of which is C.S. 'Alert'.

Such work, in seas which may be rough, requires, as may be imagined, much skill and patience.

The first radio-telephone service was opened in January ,1927, by means of a single long-wave radio link between this country and the U.S.A. As a result of subsequent development of short-wave techniques,

The first telephone call to Paris on 18 March, 1891. Mr. Raikes, H.M. Postmaster General, speaking to M. Roches, the French Minister of Posts and Telecommunications.

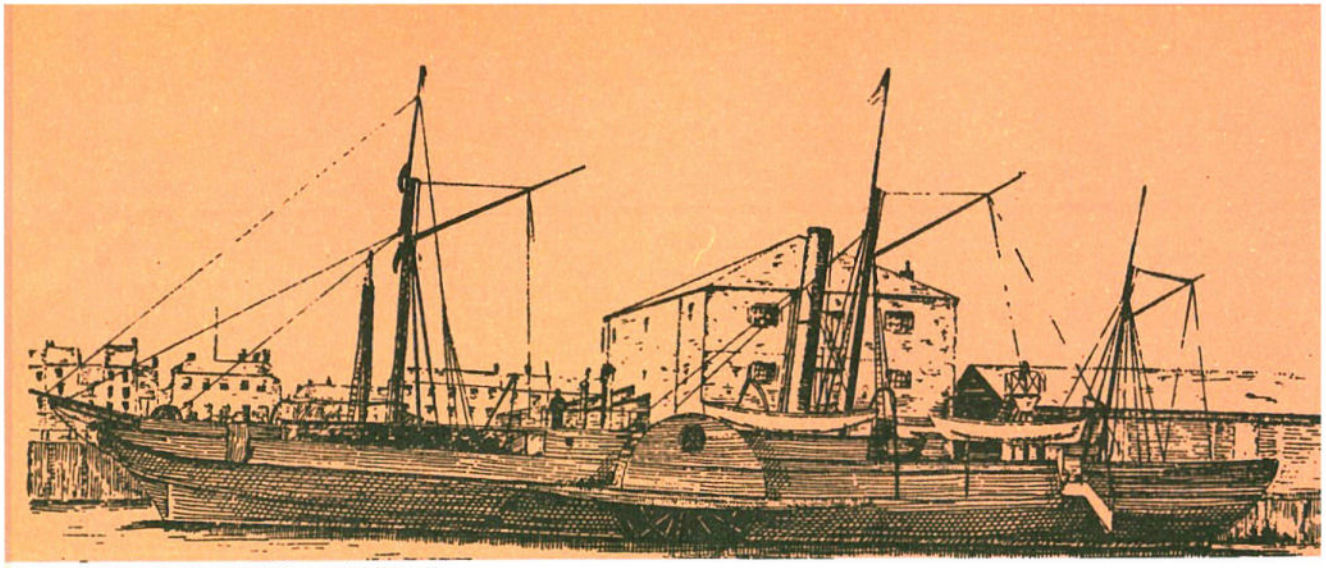


radio-telephone service is now available with most countries in the world outside Europe and with many ocean-going ships. A transmission technique comparatively recently developed by the British Post Office is know as 'Lincompex'. This greatly improves the clarity of speech transmitted by shortwave radio and is being increasingly used in telephone links with overseas countries.

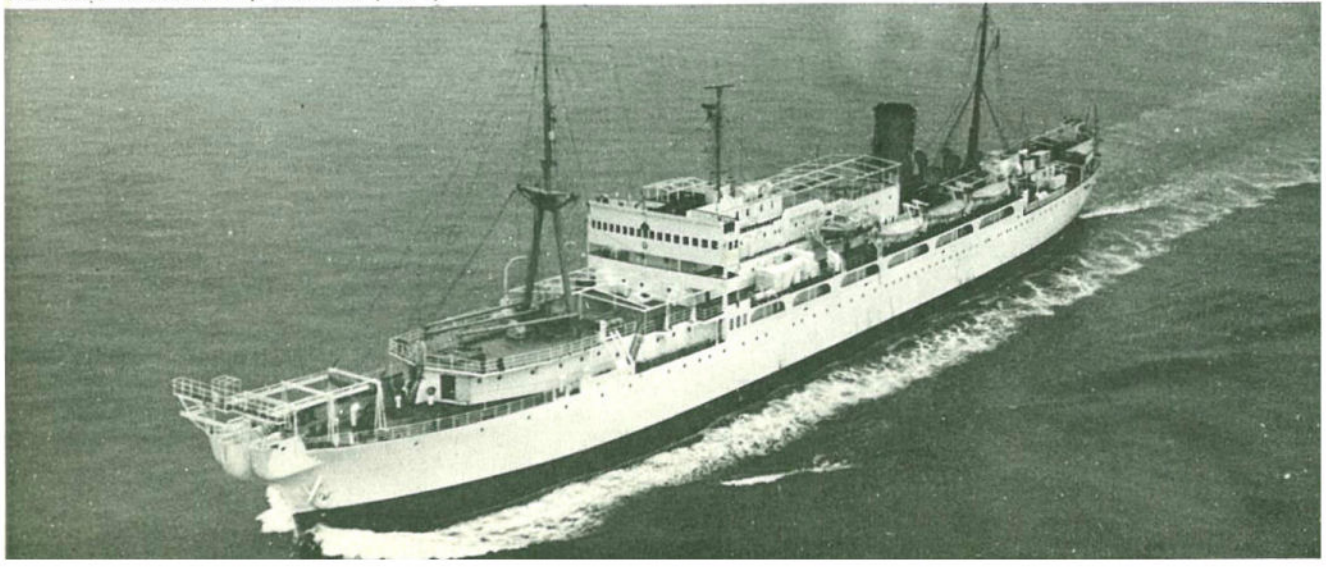
In September, 1956, the first trans-Atlantic telephone cable was completed. This proved so successful that further cables over the same route have proved necessary. There are now four telephone cables between Europe and North America, and plans for a round-the-world network began to bear fruit in December, 1963, when a cable from San Francisco to Sydney (Australia) and Wellington (New Zealand) via Hawaii and Fiji became operational. This network was extended to Commonwealth countries in south east Asia between 1965 and 1967.

The overseas services are frequently used by broadcasting and television organisations for relaying programmes and news items from abroad.

H.M. Telegraph Ship 'Monarch' (No. 1) which laid the first international telephone cable.



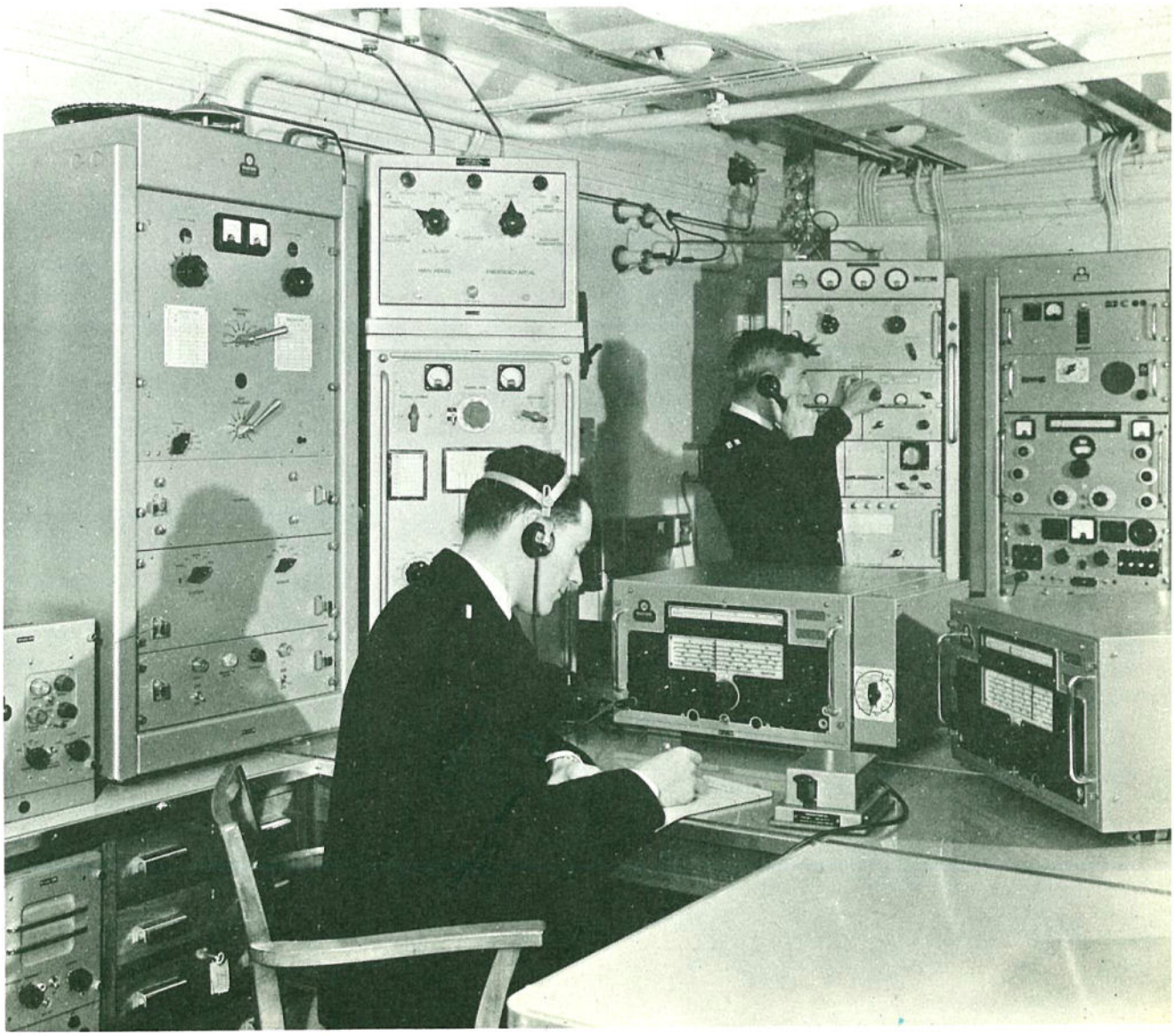
The Post Office Cable Ship 'Monarch' (No. 4)



A medium-range radio-telephone service, for communication with suitably equipped ships, is available continuously through eleven Post Office Coast Radio Stations. The Stations can communicate with ships up to a range of about 250 miles. Larger ships can be reached the world over by radio-telephone via high-powered radio stations, providing these ships are appropriately equipped.

March, 1963, saw the beginning of International Subscriber Dialling which allows callers to dial direct to most countries in western Europe. This facility is, at present, available only to subscribers in London, Birmingham, Edinburgh, Glasgow and Manchester. In 1970 London subscribers were able to dial their own calls to New York.

A ship's officer making a long-distance radio-telephone call from his ship at sea. A Marconi Marine photograph.

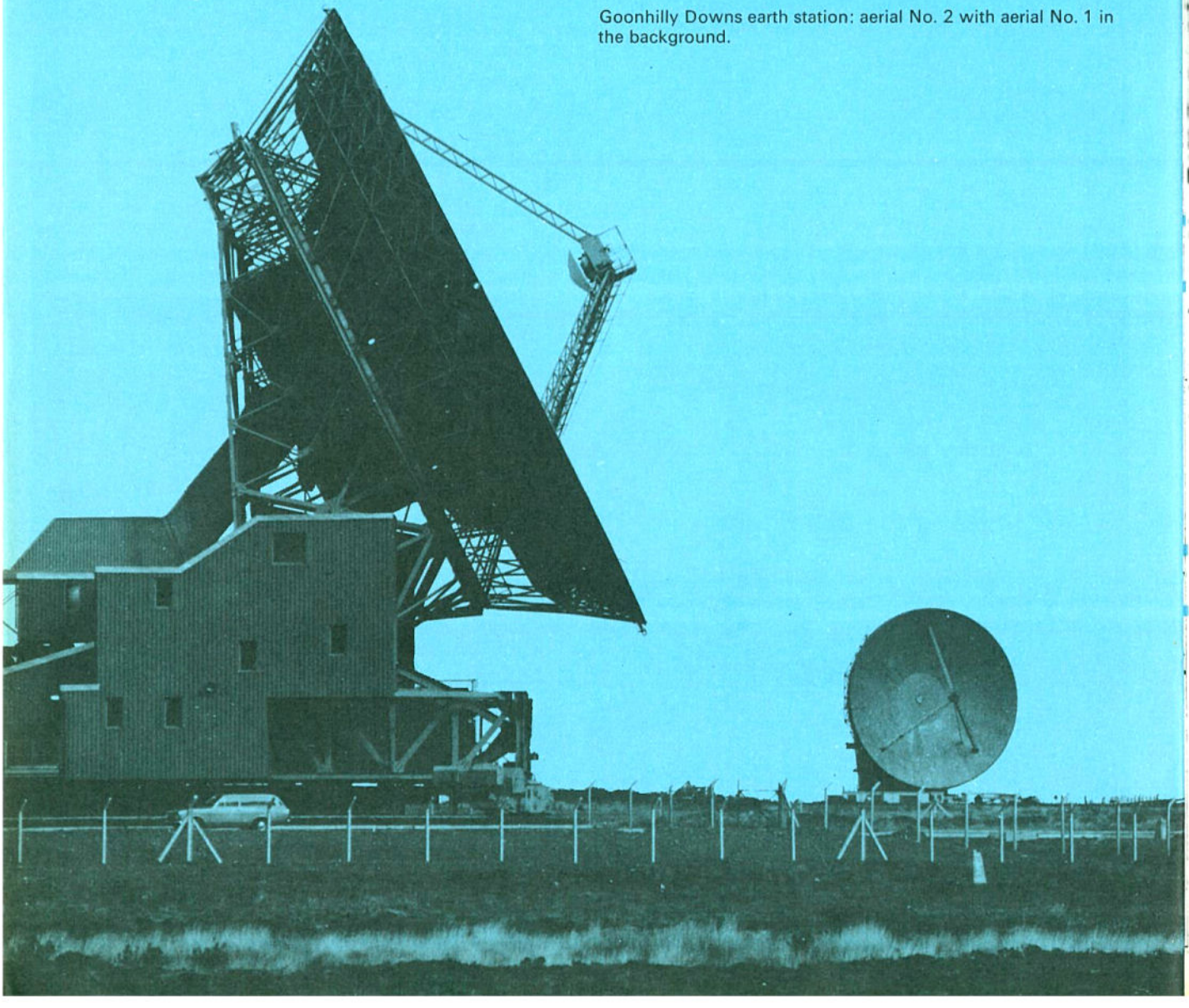


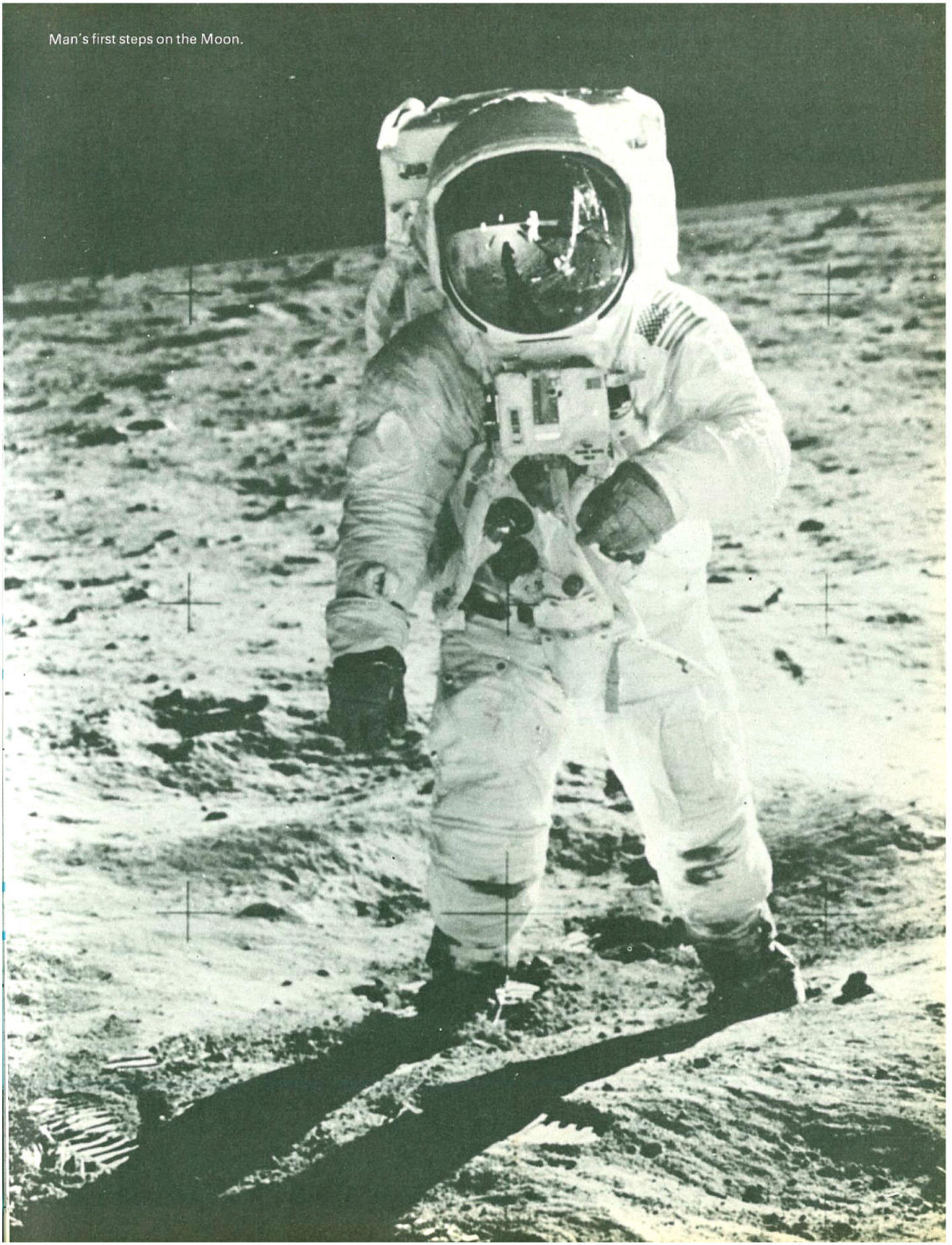
In July, 1962, the new Post Office earth station at Goonhilly Downs (designed to track satellites and, through them, transmit and receive telephone, telegraph and television signals) took part in the first trans-Atlantic television transmission made via an artificial satellite – Telstar. This and other experiments were watched by millions on their television screens. The station was later modified to take part in the inauguration of commercial satellite communications services on the North Atlantic route via the International Telecommunications Satellite Consortium's 'Early Bird' satellite launched early in 1965. Goonhilly has been regularly and very successfully in operation since then.

A second large steerable aerial to supplement the existing one was completed in 1969 and Goonhilly can now operate with satellites over both the Atlantic and Indian Oceans providing direct telephone and television communications between this country and the majority of countries in the world.

Television broadcasts by satellite are now commonplace. A notable example was the transmission to the U.K. in July, 1969, of the Apollo 11 moon landing. Because the Atlantic satellite (INTELSAT III) had recently failed, these pictures had to be transmitted by satellite across the Pacific to Japan and then onwards via the Indian Ocean satellite to Goonhilly. Goonhilly was thus the earth terminal for Europe for the television coverage for this historic landing.

Goonhilly Downs earth station: aerial No. 2 with aerial No. 1 in the background.





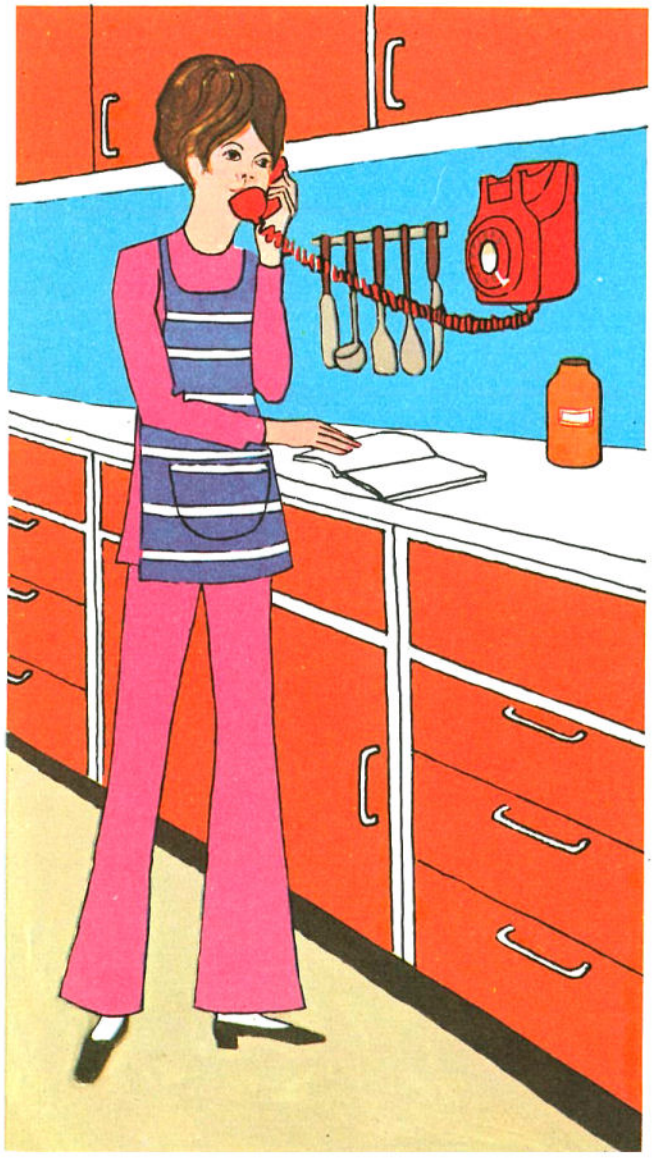
Man's first steps on the Moon.

Services available

The possession of a telephone offers you many services additional to your ability to speak to people in most parts of the world. You can obtain the time at any hour of the day or night, or arrange for the exchange to ring you every morning at a fixed time. You can hear a recorded local weather forecast by calling the Post Office Weather Service in many towns or obtain a more detailed forecast for any part of the country from your nearest Meteorological Office. Other recorded services, available in many towns, are the cricket test match score, motoring information (including details of road weather and traffic conditions) and recipe services. In addition, there is a 'Teletourist' service in London and Edinburgh giving details of the day's events of interest in these towns. The London announcements are given in English, French, German, Italian and Spanish. The recorded Financial Times Share Index Service is also available in London. The telephone numbers for all these services where available are shown in telephone directories.

An essential Post Office service is, of course, the one which exists to connect you to the emergency services – fire, police, ambulance, and; in some areas, Coastguard, Mountain and Cave Rescue.
From most telephones such calls can be made by dialling 999. In some cases 100 or 0 has to be dialled instead. Instructions on how to make an emergency call are given on the dial label of the telephone you are using.

Getting a recipe from the Recipe Service.



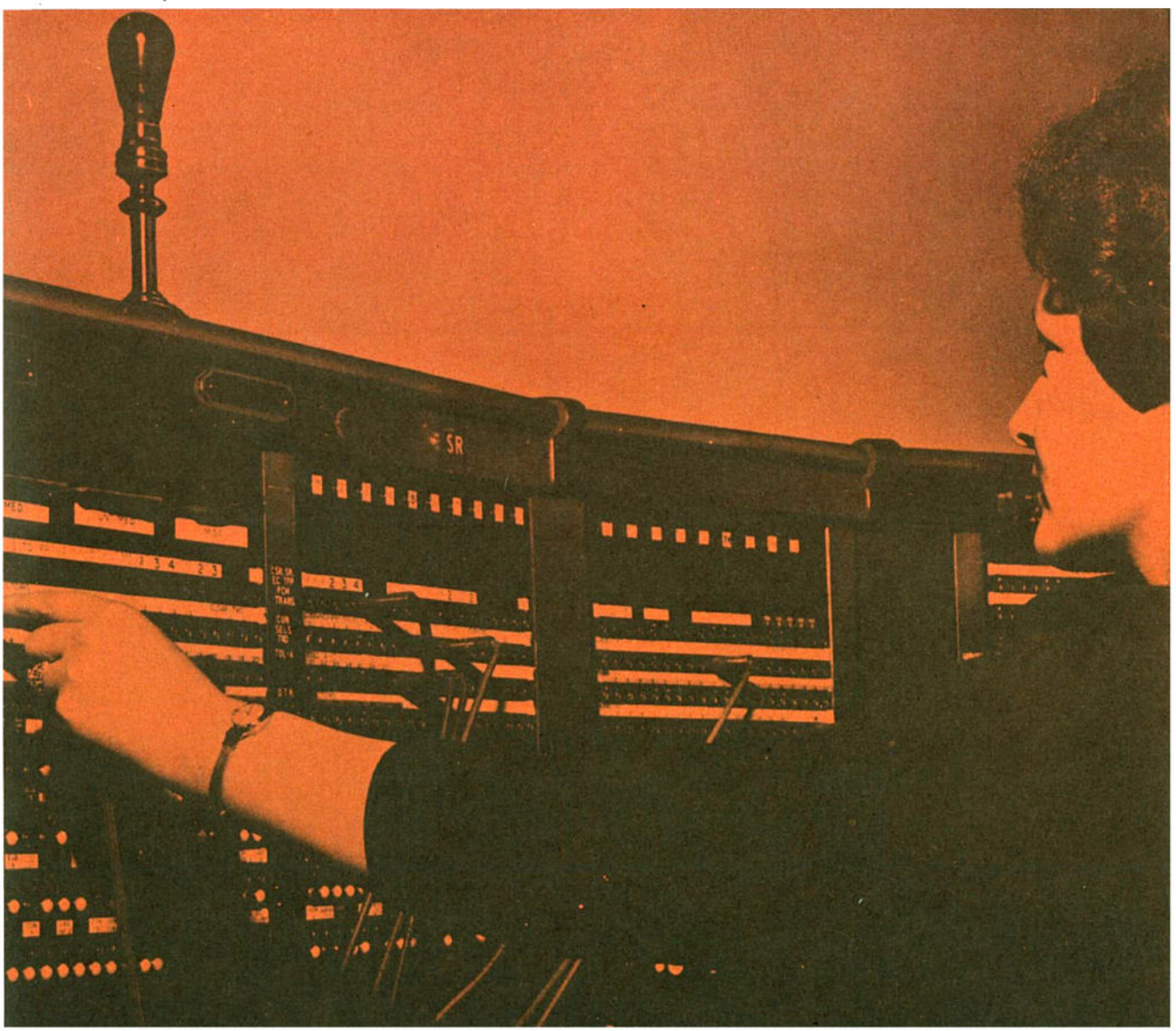
Firemen answering an emergency call.

All emergency calls are answered immediately by a Post Office operator who will want to know the service you require and your telephone number (in case for some reason you are unable to continue the call). When the Emergency Authority answers, you will be asked to give all the necessary information such as the location where aid is required. Emergency calls are free of charge.

If you need to contact these services for non-emergency purposes, telephone them in the normal way – their numbers are listed in local directories.

Many other services are, of course, available and you can get details of these by looking in the Post Office Guide.

A red alarm lamp flashes and a buzzer sounds when a '999' call is received in the telephone exchange.



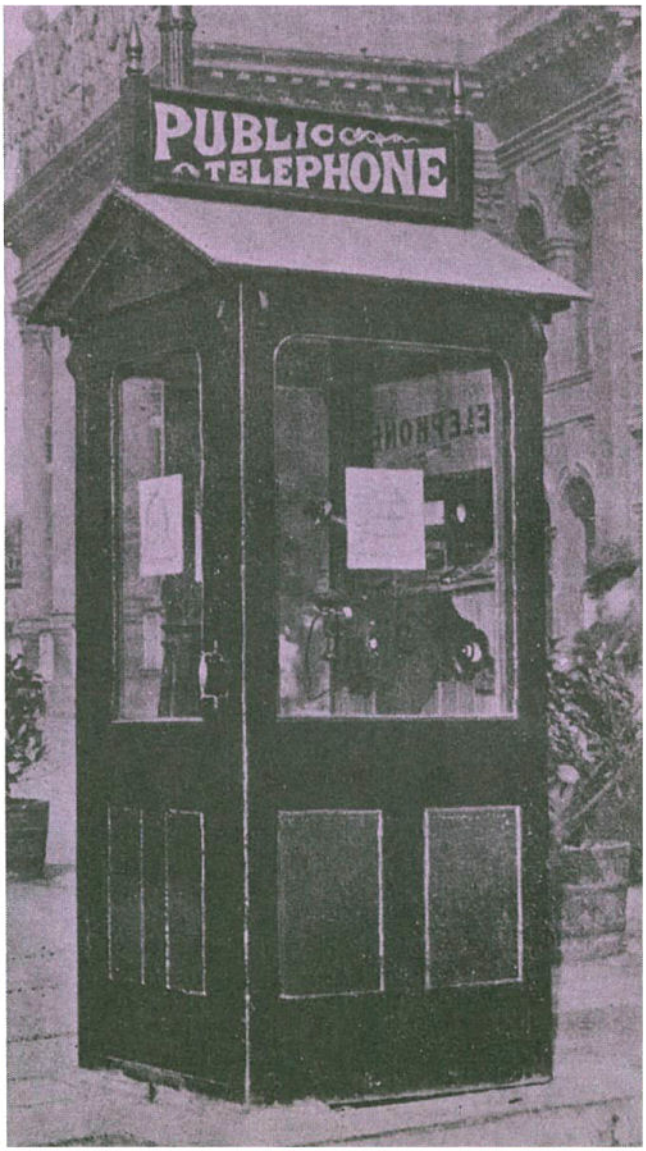
Call Offices

Most of the earliest public call offices in this country were installed in shops. Call offices appeared on the public highway, in a variety of shapes and colours, in the early 1900s. The Post Office's first standard design was introduced in 1921 and designated Kiosk No. 1.

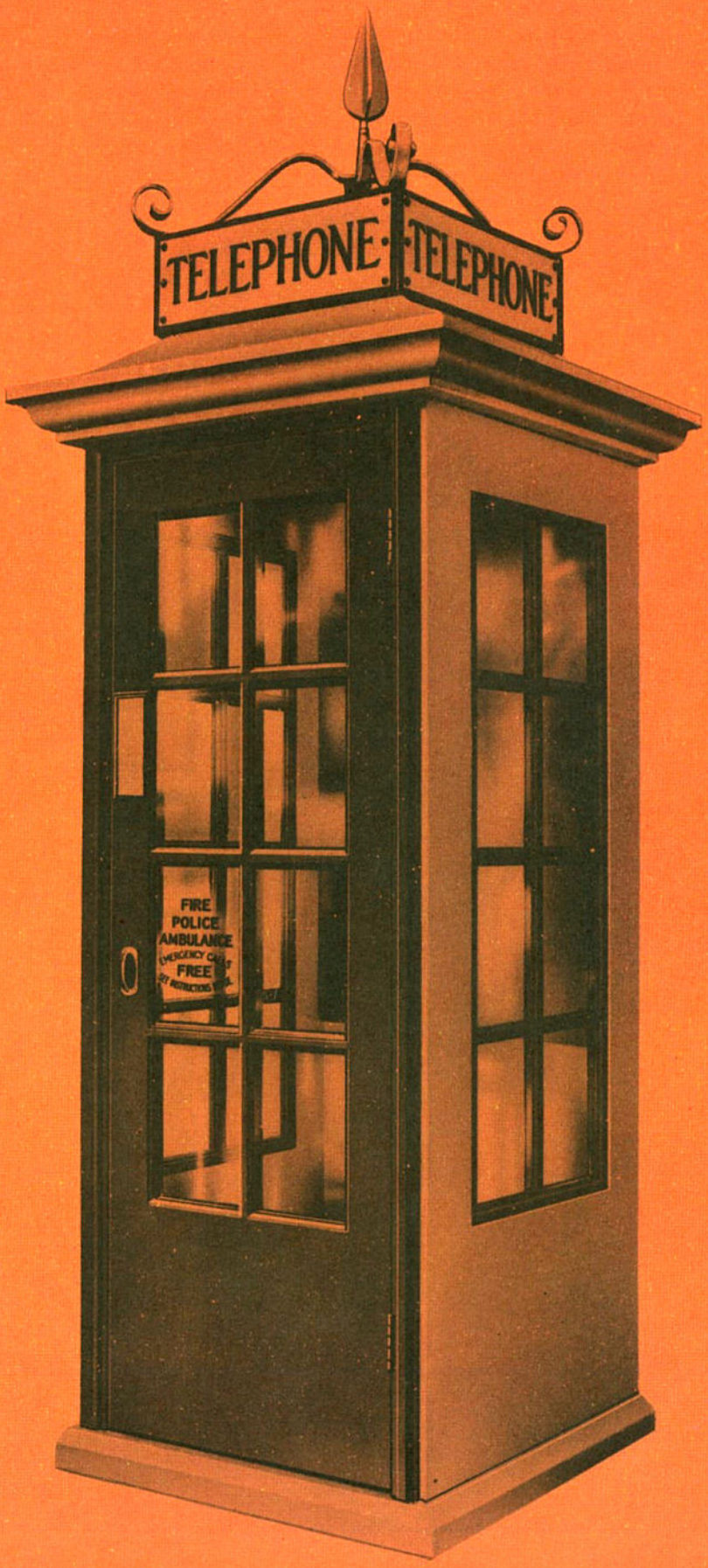
Now there are over 75,000 public call offices, most of them in the streets. You can use them for local and trunk calls, transferred charge calls and inland and overseas telegrams. You insert coins in the coin box to effect payment but no charge is made for emergency calls for Police, Fire Brigade, Ambulance, Coastguard, Cave or Mountain Rescue Services. All the necessary information about using the call office is given on notices near the telephone.

1908.

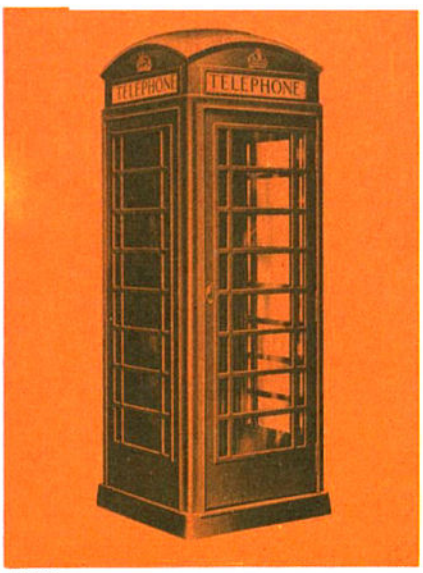
1908.



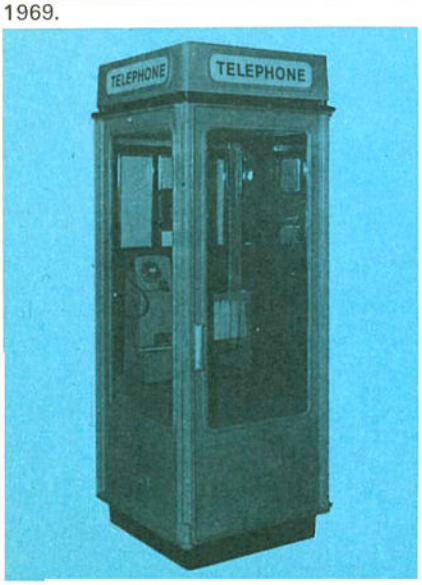
Kiosk No 1. 1921.



1936.



1969.



Telephoning from the latest type of call office.

Future Developments

Several interesting new facilities are in the course of experiment or development. One of these is the Videophone. Associated with the telephone instrument is a small TV screen on which you will be able to see the person to whom you are speaking on the telephone.

Another idea is to provide each subscriber with a multi-circuit lead-in consisting of a pair of wires for the telephone and a co-axial cable. This will not only bring television and radio programmes to your house but, by the use of coding arrangements, be able to pass back to central recording points information about your domestic gas and electricity consumption.

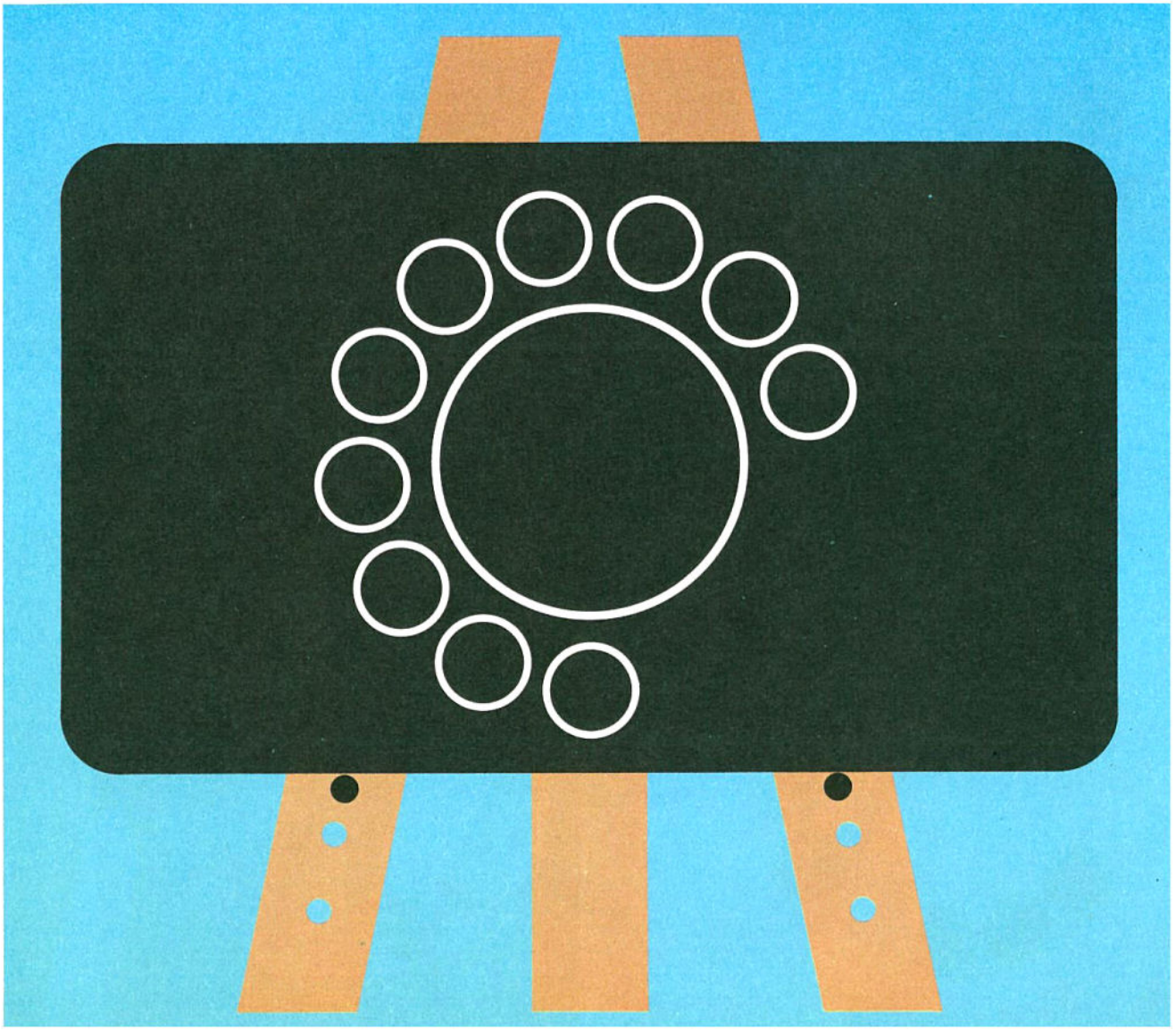
Videophone.

Improving your Telephone Techniques

You may be a student learning about the telephone system in the course of general studies on the history, growth and development of communications. Or perhaps a commercial student taking 'Office Practice' lessons. But whether your particular interest in the telephone is for vocational, academic or mainly social reasons, you will find it necessary to familiarise yourself with the same simple, basic procedures if you want to achieve maximum effectiveness when you use it. Some of you do, of course, use the telephone frequently. Nevertheless even you may benefit from some of our general suggestions and explanations as to where you can get information about, and how you can gain extra proficiency in, telephoning. If, on the other hand, you are one of those students who are unused to the telephone and consequently feel a little nervous when you have to make or take a call, do not worry. Your diffidence will soon disappear when you get more experience and gain confidence as a result of constant practice.

The Post Office Guide gives full details about the telephone services that are available and the front pages of your telephone directory and dialling instruction booklet give you information on how to use the telephone, etc. The dial label of the telephone you are using will tell you how to contact the operator and the emergency services: Police, Fire and Ambulance. Lesser known emergency services that are available in certain areas are Coastguard, Mountain and Cave Rescue. Instructions on how to make a call from that particular telephone are displayed in every call office.

Emergency calls are free of charge.



The thing to bear in mind when using any telephone is that sometimes slightly different procedures have to be adopted depending on the area in which you are at the time. Commerce class teachers can obtain copies of a student's leaflet 'Using the Telephone' (Tele Ed 4) free of charge from one of our Regional Public Relations Officers by writing to the local Telephone Manager. Visits of school parties to telephone exchanges can be arranged also by writing to the latter.

The following are some of the most important aspects on which you might concentrate if you wish to improve your telephone techniques.

Tracing Telephone Numbers

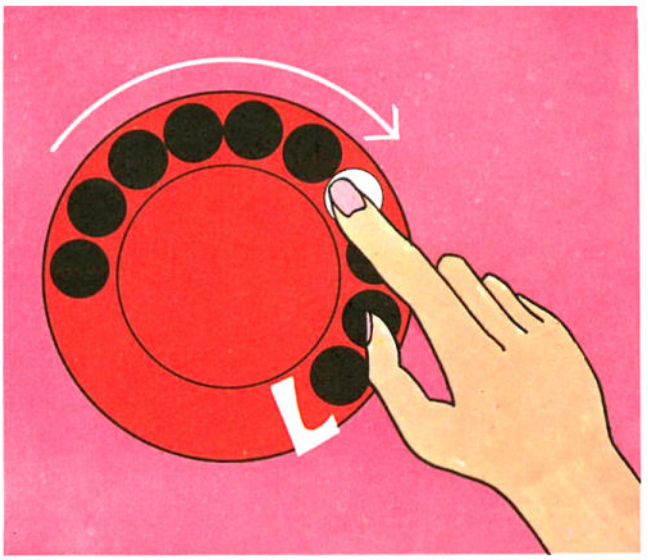
If you familiarise yourself with the types of entries and where to find them in directories, you will learn that this is well worth the time you expend in terms of time which could be lost later on. Try looking up double-barrelled surnames or those prefixed 'M', 'Mc', 'Mac' or 'St.'; railways, hospitals, libraries, schools; your favourite discotheque or boutique. Getting into the habit of recording the numbers you call most frequently will also speed up your telephone calls.

Tracing telephone numbers.

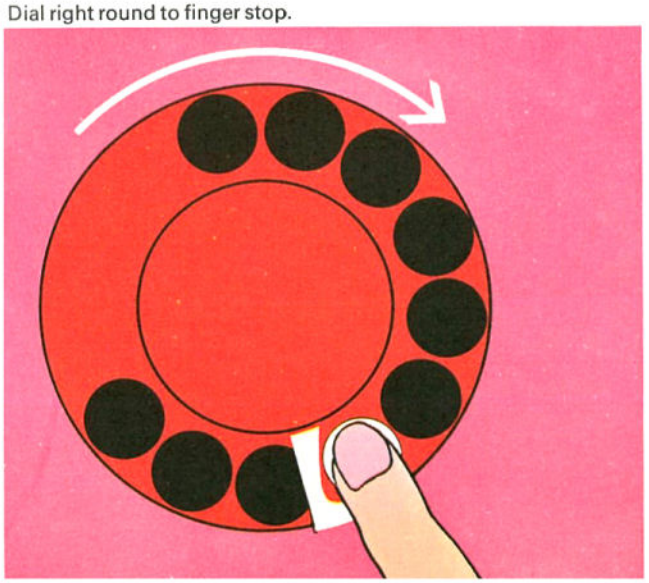
Dialling

We do not have to explain why it is important to dial numbers carefully. When you dial, take the dial right round to the finger stop and let it return freely for each digit. After you have dialled the number you require you will have to give the exchange equipment time to connect the call.

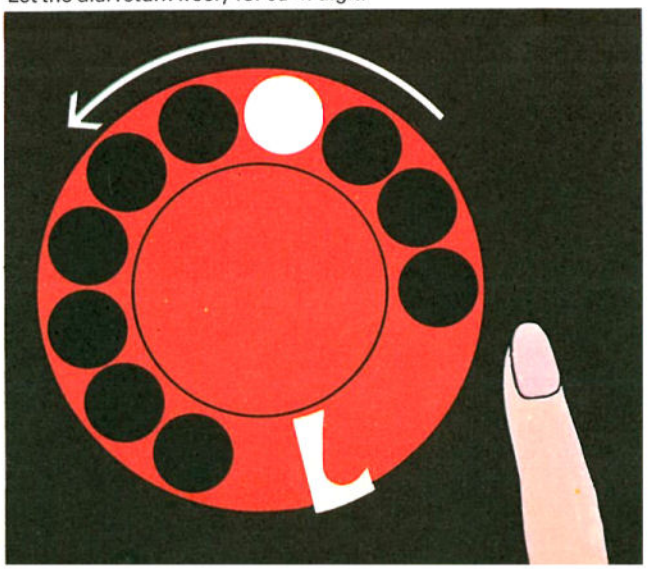
Dial the number carefully.



Dial right round to finger stop.



Let the dial return freely for each digit.



Telephone tones

These tones are very simple ones and you can soon learn to recognise them. They are:

Dialling tone – a continuous purring sound, which means the equipment is ready for you to dial. If you dial before you hear this tone you may get a wrong number.

Ringing tone – 'burr-burr', repeated regularly, which means your called number is being rung. Allow a reasonable time for an answer; if there is no reply, replace the receiver and try again later.

Engaged tone – a single high-pitched note repeated at regular intervals. This usually means the number you are calling is in use, but it can also mean that the exchange equipment is busy. In either case, replace the receiver and try again in about five minutes.

Number unobtainable tone – a continuous high-pitched note. This tells you that the number you have called is out of service, or spare. If you hear this tone, replace your receiver, check that you are dialling the correct dialling code and number and then call again. If you again hear the tone, call the Post Office operator and explain what has happened.

Pay tone – high pitched rapid pips. You are being called from a Pay-on-answer coin box. The caller must insert money in order to stop Pay tone and speak to you. Give the caller time to put his money in the box. Deal with the call as speedily as possible in case the caller runs out of change.

'Lines-engaged' announcement. On some STD calls you may hear an announcement 'Lines from . . . are engaged, please try later'. This is self-explanatory.

One of our telephone operators will demonstrate these tones for you free of charge.

Speech on the Telephone

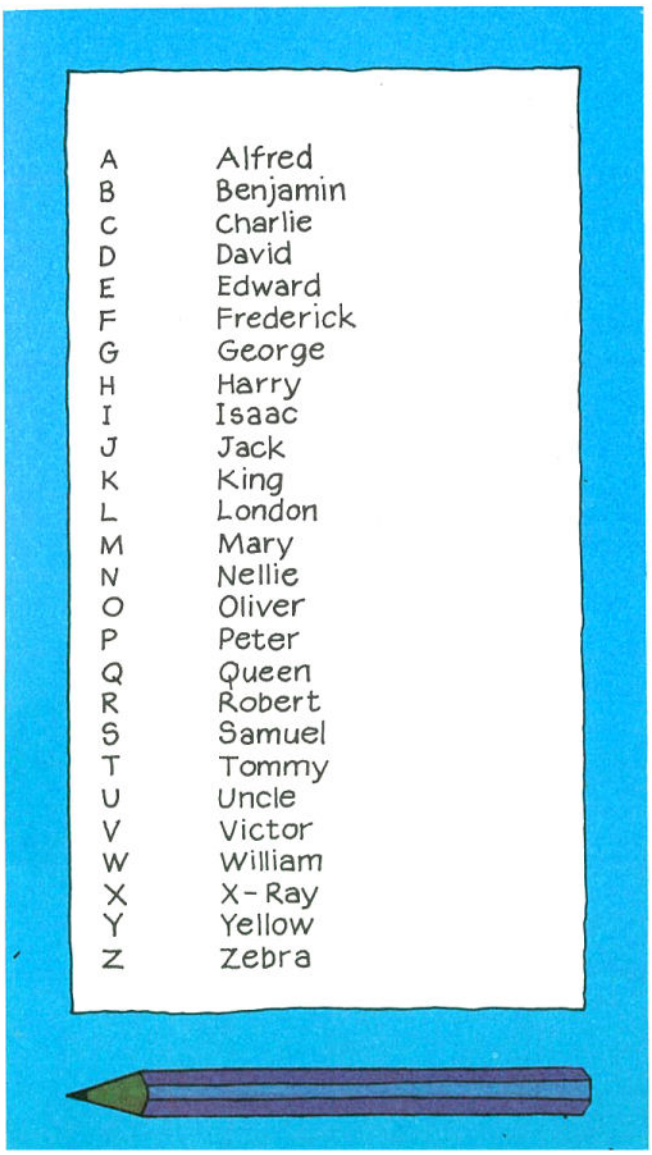
If you experience difficulty in making yourself understood on the telephone, try the following: check that you are speaking directly and clearly into the mouthpiece of your telephone; change the pitch of your voice and speak rather more slowly; and try not to be tempted to speak loudly because this can result in distortion.

If you quote numbers say 'fife' for 'five' as this can be confused with 'nine'. Say 'oh' not 'nought' for this can sound like 'eight'.

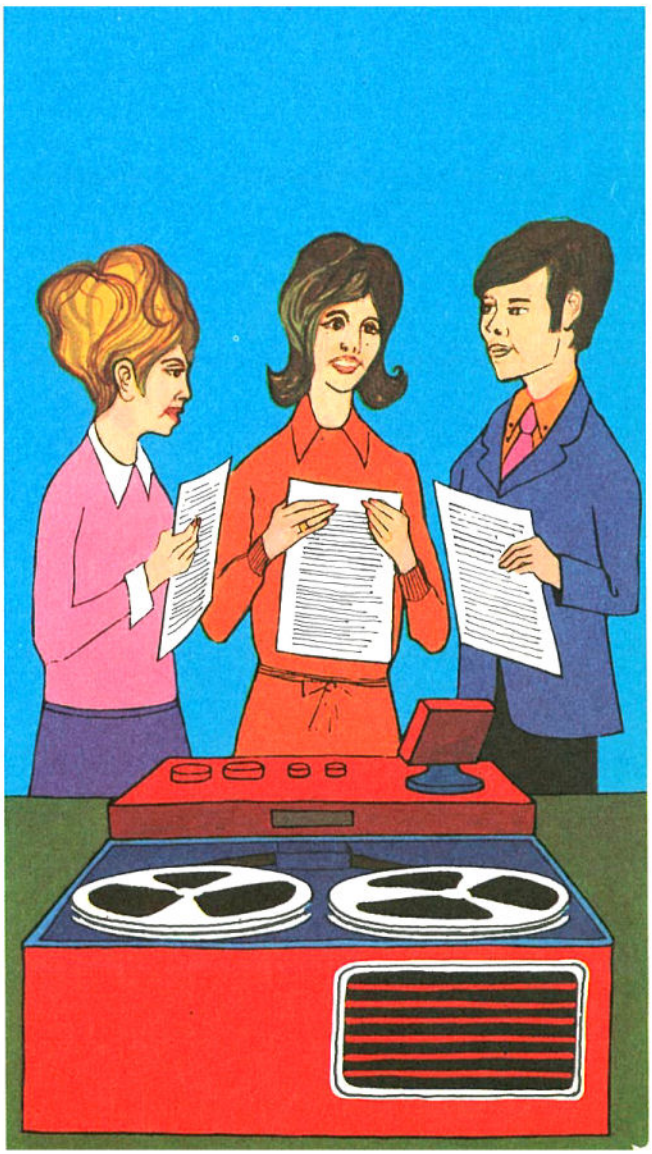
If you wish to spell out a word, make use of this phonetic alphabet:

You cannot, of course, rely on gestures to put across your meaning or attitude when speaking on the telephone. This being so, you will have to ensure that what you say, and the way in which you say it, conveys to your listener precisely what you mean. Smiling when you speak will go a long way in making your voice sound pleasant on the line.

The telephone alphabet.



Practising on the tape recorder.



Showing courtesy to your telephone callers

Discourtesy on the telephone is mostly the result of lack of thought. Any form of unnecessary delay is a type of discourtesy. You can take steps to avoid this by:

always keeping a pad and pencil near your telephone to enable you to take down notes, thus not wasting your caller's time while you search for something on which to write;

answering your telephone promptly;

announcing your identity and telephone number, not just saying 'hello' when you answer;

offering to ring your caller back if you have to supply him with information that will take you some time to get.

Replacing your Receiver

Replacing the receiver carefully in its proper position will ensure that you can receive other calls. If you are cut off on an incoming call, replace your receiver and wait for the other person to call you.

The Post Office Telecommunications Service is constantly trying to improve the telephone service but it needs your co-operation in following the foregoing simple principles when you telephone.

Other Post Office Schools items
Post Office wall charts suitable for general use with this booklet are Post Office Tower (Sch PP3) and Post Office Overseas Telecommunications Services (Tele Ed 2); for office practice students, the leaflet 'Using the Telephone', (Tele Ed 4) is available. Other items are in course of preparation. (See end of book for details on how to obtain these items). These publications are free of charge and are available to teachers only.

Further Reading

Title	Author	Publishers	Date
The History of the Telephone in the UK.	Baldwin, F. G. C.	Chapman & Hall Ltd.	1938
Voice Across the Sea. The Story of Deep Sea Cable Laying 1858-1958.	Clark, A. C.	F. Muller Ltd.	1966
Your Telephone and How it Works.	Sneider, Herman and Nina	Brockhampton Press Ltd.	1961
From Semaphore to Satellite	Michaelis, Dr. A. R.	*International Telecommunication Union, Geneva	1965
The Post Office: From Carrier Pigeon to Confravision	Martin, Nancy	J. M. Dent & Sons Ltd.	1969

*Obtainable from the Secretary General, International Telecommunication Union, Place des Nations, 1211 Geneva 20.

Visiting your Telephone Exchange
If you are 14 years of age or older and you wish to visit your local telephone exchange, please contact your local Telephone Manager.

Definitions of some of the Terms in Common Use in the Telephone Service

All Figure Numbers (AFN).
A telephone number which does not include an exchange name. The exchange name is replaced by figures which include the STD code. For example, ELGar 0721 becomes 01-965 0721, the figures before the hyphen being the STD code and those after it being the local number

Auto-Manual Exchange.
A switchboard associated with one or more automatic exchanges for the purpose of handling those calls which are not dialled direct by the people on the automatic exchanges concerned.

Business Subscriber.
A person whose telephone is installed on premises used solely or mainly for business.

Call Office.
A telephone generally accessible to the public on the highway, in Post Offices or on private property, from which one may make calls by payment of the required fee through a coin box, or to an attendant.

Charging Group.
A group of exchanges having a common local call area and the same call-charge point.

Director Exchange.
An automatic exchange in a 'Director area'. Here dial impulses are fed into an additional piece of apparatus known as the 'director' which automatically selects a free line to the wanted exchange. There are director exchanges in six areas in the United Kingdom: London, Edinburgh, Birmingham, Glasgow, Liverpool and Manchester.

Exchange Connexion.
Each connecting path over which a person gains access to his local exchange is an exchange connexion. Part of it may be common to two subscribers. A shared service line is two connexions.

Exchange Station.
Each telephone instrument which can be connected with a public exchange is an exchange station. Where someone has a private branch exchange, each telephone at an extension point is an exchange station.

International Subscriber Dialling (ISD).
A system whereby subscribers with STD (q.v.) facilities can themselves dial certain overseas countries without the assistance of an operator.

Lincompex System.
In the Lincompex system (*Lin*ked *Com*pressor and *Ex*pander) a compressor raises all the syllables of speech, to a constant high level for transmission over the radio circuit. At the receiving end, the speech is restored to its original form by means of a variable-gain expander, controlled by means of a frequency-modulated (f.m.) tone transmitted with the speech. The system almost completely eliminates radio noise and fading and gives a circuit which is the equal of cables and satellites.

Local Automatic Exchange.
A local exchange where certain telephone calls can be dialled direct by a caller without the intervention of an operator.

Local Call.
A call between subscribers who are situated in the same or adjacent charging groups. (In certain places where neighbouring charging groups are separated by natural features, e.g. estuaries, they have been classed as 'non-adjacent' for the purpose of the call tariff.)

Local Exchange.
A public exchange through which private and call office users can be connected with each other and with people on other public exchanges.

Local Manual Exchange.
A local exchange where all telephone calls are handled by telephone operators.

Private Branch Exchange (PBX).
An exchange (manual or automatic) installed at a subscriber's premises for the purpose of connecting calls from extension telephones to other extensions, and to or from other exchanges (public or private.)

Pulse Code Modulation
With Pulse Code Modulation, the size of the electrical output (which determines the volume) from the speaker's microphone is measured at regular intervals of time. The results are coded using uniform, rectangular, on/off pulses for sending over a junction to the distant exchange. By using very fast pulses (1.5 million per second) up to 24 separate conversations may, in turn, share the same pair of wires. Decoding equipment at the receiving end translates the pulses back to speech form.

Residential Subscriber.
A person whose telephone is installed in his private residence and is used solely or mainly for social as distinct from business calls.

Shared Service Subscriber.
Someone who shares a line to the exchange with another subscriber. He has a separate telephone instrument and telephone number.

Subscriber Trunk Dialling (STD).
A system providing for trunk calls to be obtained by callers themselves by dialling, thus without the intervention of an operator.

Telephone Cabinet.
A structure, similar to a Telephone Kiosk (q.v.), not on the public highway but located under cover in post offices, at railway stations, etc.

Telephone Exchange.
A public telephone centre through which calls are connected.

Telephone Kiosk. A special structure on the highway, containing a public coin-box telephone, and usually accessible to callers at all times of the day or night.

Telephone Subscriber. A person who rents a Post Office telephone connected with a Post Office telephone exchange either directly or through a Private Branch Exchange. (One subscriber may have two or more telephones with different numbers and at more than one address.)

Trunk Call.
A call between people situated in charging groups that are not adjacent.

Trunk Exchange.
An exchange (manual or automatic) at which trunk calls only are handled or switched.

Unit Automatic Exchange (UAX).
A small automatic exchange (usually with 800 exchange connexions or less) built up of standard units.

Teachers who would like to know more about Post Office publications for schools should write to their local Telephone Managers or Head Postmasters respectively for telecommunications and postal material.

Post Office Telecommunications

Designed by Brian Denyer ARCA MSIA

Printed by the Upton Printing Group

Tele Ed 3