Post Office Telecommunications Journal

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

Contents

Vol. 2 AUGUST, 1950 No. 4

Comment

THIS YEAR IS THE CENTENARY OF THE LAYING OF THE first submarine telegraph cable—between England and France—and to mark the occasion, an exhibition is being arranged at the Science Museum in South Kensington with the co-operation of various bodies interested in submarine cables. It is hoped that this exhibition will be opened by the Postmaster General on the centenary date, August 28th.

This first cable was a simple affair without armouring and lasted only a few hours, but it demonstrated the practicability of submarine telegraphy and opened the way to the wonderful developments which have taken place in the last 100 years. The first cable was made up of a copper conductor surrounded by insulation consisting of gutta-percha, and it is noteworthy that this kind of telegraph cable is still in use at the present day by the Post Office and other authorities. Telephony is more exacting, and although gutta-percha-insulated cables can be used for distances of a few miles, better dielectrics are necessary for longer routes. At one stage, cables having a plurality of conductors and dry paper insulation were used, and in some of these cables the conductors were loaded with inductance to reduce the loss.

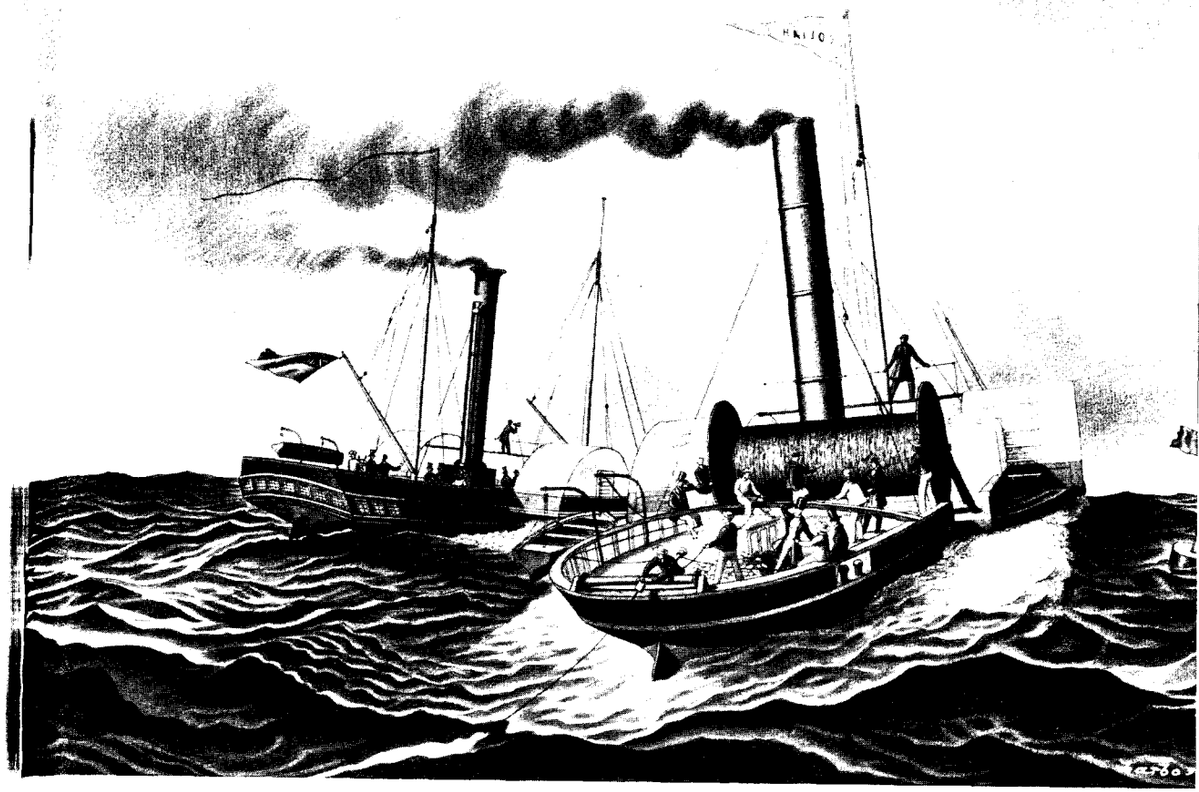
The latest practice in telephone cables, however, has been to revert to a single pair of conductors of concentric or coaxial form and to impose a plurality of circuits on this pair using carrier technique. At the same time an improved insulator of a synthetic material known as polythene has come into general use. As a

result, a recent cable between England and Belgium can carry over 200 two-way circuits on the single pair of wires.
A final development, in which the Post Office has played a pioneer role, has been the introduction of under-water amplifiers in such cables—doubling and trebling the carrying capacity at very little additional cost.

Mr. Scudamore of the Post Office and the Problems of the Submarine Cables

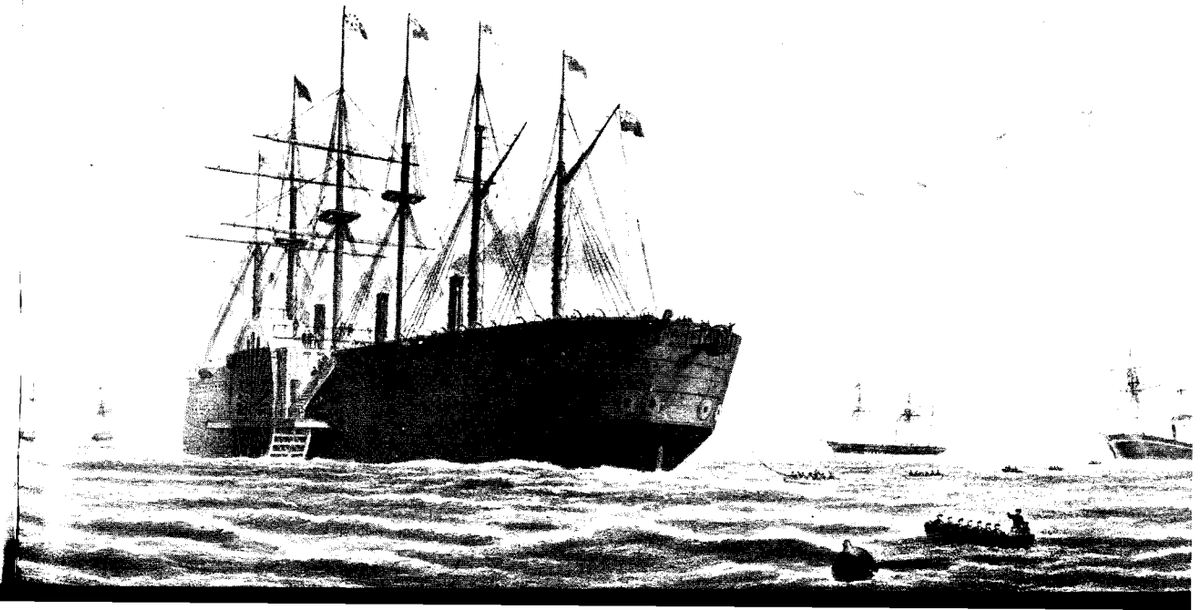
by E. C. Baker,
Post Office Librarian and Archivist

ELECTRIC TELEGRAPHS HAD NOT TOUCHED the life of the community at all widely when, in August 1850, a British company completed the manufacture of the world's first submarine telegraph cable. It was a simple affair, a single copper wire surrounded by gutta-percha to a half-inch diameter. Casual Thames-side spectators, watching it being manhandled from the Gutta-percha Company's works and coiled around a drum aboard the Steamship *Goliah*, naturally compared it with the wire-pull bells in some of their houses and imagined that signals would be made to France by jerking this cable. They predicted no very long life for it.
In this last respect they were correct. The few hours of its undersea existence on August 28, 1850, across the Channel from Dover to Cap Gris Nez as a continuous conductor of electricity were sufficient, however, to demonstrate the practicability of manufacturing and laying, in one length, twenty miles of cable—a prodigious feat with the resources then available.
Its practicability impressed an eminent railway engineer, Thomas Russell Crampton. He saw, moreover, that in the shallow waters of the English Channel gutta-percha insulation needed protection from ships' anchors and trawl-boards. He designed a cable of four copper wires, each covered with two layers of gutta-percha (to reduce the chance of air holes, which would be more likely in a single process covering). The four insulated wires he twisted together like an ordinary rope, filling interstices with tarred hemp strings and winding around an outer covering of this string at right angles. He then armoured the cable by laying ten galvanised iron wires around it helically so that it resembled a large wire rope. This was successfully laid on September 25, 1851.
The next feat to stimulate public imagination was that of spanning the Atlantic with a cable. First attempts to do this, in 1857 and 1858, were —not unexpectedly failures. Seven years passed before another attempt was made. This also failed. The fourth, in 1866, was successful. Inland telegraphy, in the meantime, developed apace and the Electric Telegraphs Act, of 1868, placed the telegraph systems of the British Isles under the Post Office. Here we can usefully recall some of the arguments adduced by the Duke of Montrose, on moving the Bill's second reading in the Lords when he told the assembled House that:—"It was proposed to place the telegraphs in the hands of the Post Office, because that Department had great advantages which no telegraph company could possess. It had agents in every town and village in the country, and persons whom it could employ at a very small cost; and, according to the arrangement that was proposed, almost every Post Office would be made into a telegraph office as



The Steamship *Goliah* laying the first submarine cable from Dover to Cap Gris Nez, August 28, 1850

Laying the Atlantic cable in 1865. The *Great Eastern* under weigh with escort



well. . . . The undertakings it was now proposed to purchase were the Electric and International, the British and Irish Magnetic, the United Kingdom, the London District (a very small concern), and the Universal Private Companies, as also Reuter's cable and privileges. In addition to these there were some railway companies which had telegraphic communication entirely in their own hands and carried on the business of telegraph companies. A great saving to the public would result from the purchase of these rights; for at present, while for a message between Manchester and London there was a certain rate, a message between Manchester and Dover would cost considerably more, a charge being made by two distinct companies. It would, therefore, be necessary to purchase the telegraphic rights of the South-Eastern, London and Brighton, Chatham and Dover, and North British Railway Companies, and also of the Caledonian Company, north of Perth. . . ." The Bill had passed the other House without a division; and he believed that Lord Stanley of Alderley, the late Postmaster General, was strongly moved in its favour, he having, indeed, moved in the matter some three years ago.*

Frank Ives Scudamore

In December, 1871, a Mr. Stead, of Mincing Lane in the City of London, printed a circular entitled "Cheap Telegraphic Communication with America" with sheets attached for the signatures of "Bankers, Merchants and Others, who believe that the acquisition of the Cable Communication between Great Britain and America by the Governments of these countries jointly, and Reduction of the Rates for Messages to One-Fourth of the existing rates, will greatly benefit Commerce, and tend to strengthen the ties of friendship between the two peoples."

He proposed that the Government should buy the three cables then working. These, he claimed, worked at half their possible capacity and at a rate of four shillings a word had annual gross receipts of £700,000. He was confident that the shareholders would be willing to sell out at a fifty per cent. profit and that the Governments would thereby, at a cost of nearly five million pounds, have a good bargain.

Frank Ives Scudamore, Second Secretary to the Post Office, who had carried out the transfer of the private telegraph companies, sent a copy of this circular to the Postmaster General, with a comment that for some time past there had been an underground agitation to induce the Government to purchase the cables connecting this country with other parts of the world. He thought it probable that the agitation would make itself visible in the coming year, and supposed Stead's circular to be a straw thrown up to ascertain the direction of the wind.

On January 26, 1872, the Council of the Society of Arts memorialised Mr. Gladstone, the Prime Minister, urging that the Government at once purchase and take over the ocean telegraphs. They submitted that the full benefit of such undertakings could only be realised to the public by administering them as part of the internal service. Among the points they made were:—

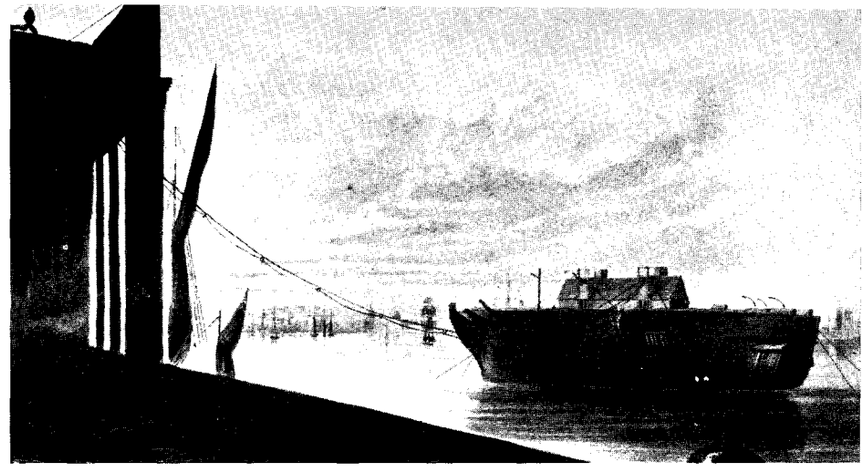
"existing conditions practically exclude the use of the telegraph for social information. As, for example, the charge of £4 10s. for the short sentence of a telegram sent to India practically excludes the use of the telegraph for the announcement of . . . marriages, deaths, and births . . ."

"existing rates for communication by submarine telegrams, by enforcing shortness, often render them dark, enigmatical, and confused."

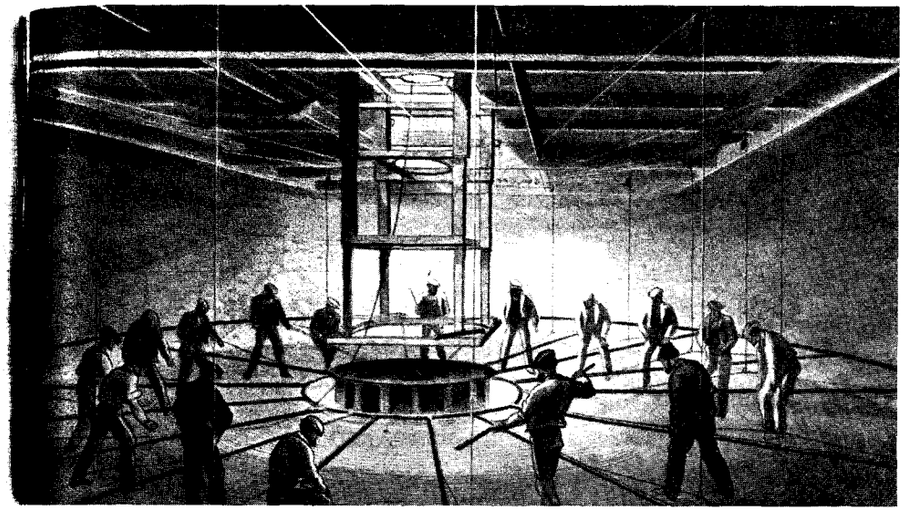
They thought that the Royal Navy might be called upon to lay and maintain cables.

They wrote again on February 23, 1872, urging that Mr. Scudamore be directed to prepare a report on the whole question to be laid before Parliament, as he had done for inland telegraphs. Mr. Gladstone replied that he had referred the correspondence to the Postmaster General, to whom the Council therefore wrote

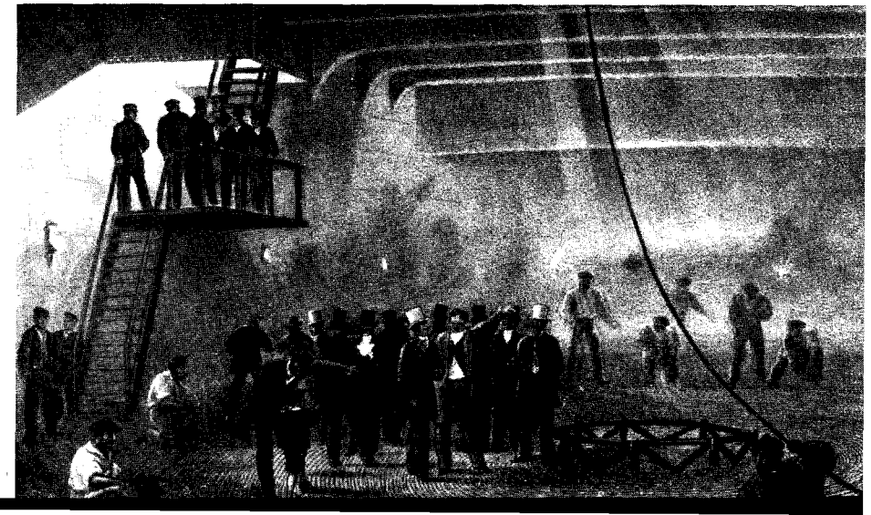
* Hansard's Debates; (Lords) July 23, 1868.



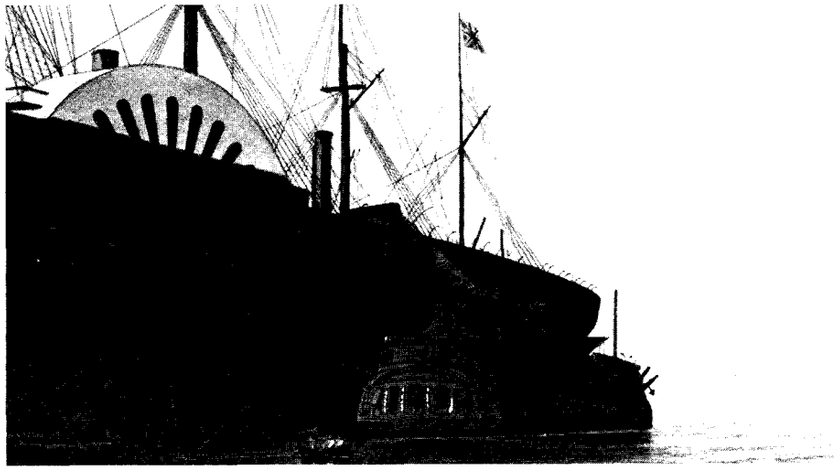
Laying the Atlantic cable in 1858. The cable passing from the works into the hulk of the *Agamemnon* lying in the Thames at Greenwich



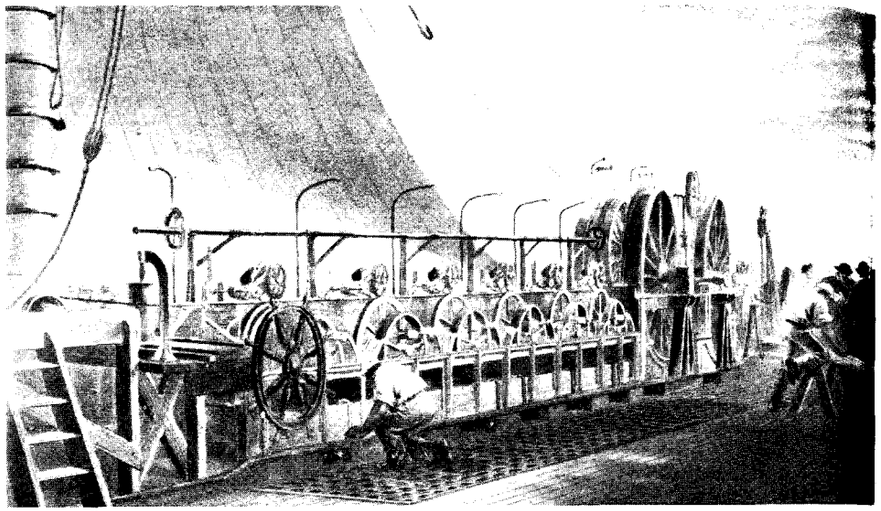
Interior of one of the large tanks on board the *Great Eastern*



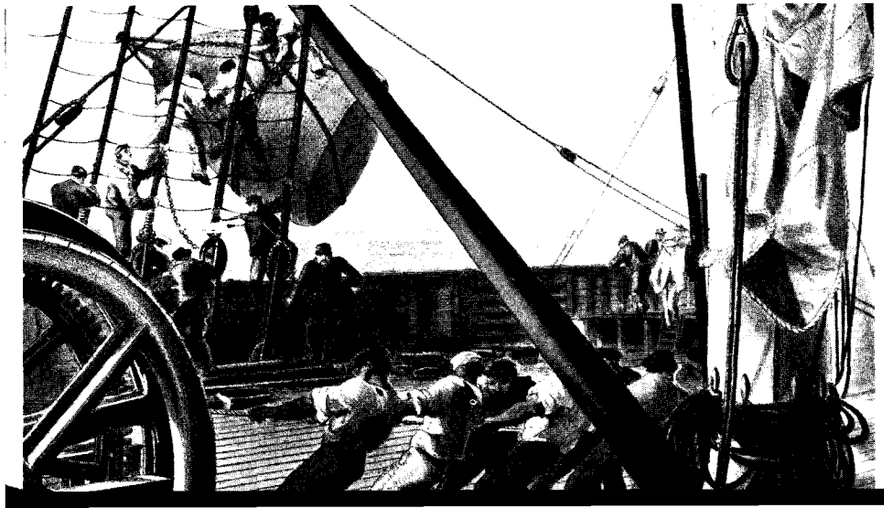
Laying the Atlantic cable in 1865. Coiling the cable into the after tank on board the *Great Eastern* at Sheerness. Visit of H.R.H. The Prince of Wales



Laying the Atlantic cable in 1865. The old frigate *Agamemnon* alongside the *Great Eastern* at Sheerness



1865. Paying-out machinery on board the *Great Eastern*



1865. On board the *Great Eastern*. Getting out one of the large buoys for launching

on March 1 reiterating their claims.

Mr. Scudamore told the Postmaster General that, in order to prepare such a report, he would obviously have to put himself into communication with the cable companies which would have an instantaneous effect on the shares of those companies.

"The ball of speculation would at once be set rolling, and would continue to roll in one direction, until the Government found itself almost committed to the purchase."

The Post Office could run the submarine cables efficiently, could reduce charges and make a profit but many of the circumstances which made the inland telegraph transfer desirable were wanting here. There had been a strong public feeling in favour of the inland telegraph purchase but there was no such feeling on the purchase of submarine telegraphs. Instead of the whole community being interested in a wide extension and low rates, as with inland telegraphs, only a narrowly limited number were interested in submarine cables. Many other countries were also involved. He suggested that the Chancellor of the Exchequer be consulted confidentially on the course to be taken. Unless the Government was at least favourably disposed on general grounds towards the scheme none of its Officials should stir.

On April 11, 1872, the Post Office informed the Society that the Government was not prepared to entertain their proposals.

In the following September, a Mr. McEwen of Lombard House in the City of London circularised the shareholders of the Amalgamated Anglo-American Telegraph Company. He referred to a rumour in the newspapers that Post Office authorities were making enquiries with a view to purchase the Atlantic Cables. He pointed out that he had started an agitation in this direction eighteen months before. He said that their stock was earning eight per cent dividend from four Atlantic cables and considered this "ought to be worth as much as ordinary railway stock" and discussed the terms on which they might sell out. An official repudiation of this rumour as altogether untrue was immediately issued to the more important newspapers.

In February, 1874, Mr. Scudamore prepared a memorandum of the subject for submission to Mr. Gladstone. After reviewing the history of the agitation, which he believed to have been set in motion by speculators in cable shares, he pointed out that although it had been going on for three years it had not travelled one inch. The agitators did not know clearly what they wanted and they had the vaguest notions of the price to be paid. They had estimated this at from five millions to fourteen millions but they were all agreed that the purchase would be a good thing for the shareholders.

It was easy for a government to control and protect a telegraph system confined to its own territory. This could not be so with systems that extended to other countries. If wars involved any of those countries, cables might be cut and income therefrom cease. With shareholders spread fairly widely throughout the world this risk was shared: if they were undertaken by one country, the risk would be taken entirely by that country's taxpayers. Only one organisation, the Society of Arts, had represented that the British Government should buy all submarine cables with landings in this country. He possessed several volumes of newspaper cuttings of leading articles in 1868, in favour of the Government purchasing inland telegraphs, but not a single article in favour of purchasing submarine cables. He went on ".....if the property of the submarine companies be bought, it should not be bought at the sole cost of the ratepayers of the United Kingdom of whom millions are very slightly interested in the workings of the submarine cables, whilst the few (capable of being reckoned by hundreds) who are interested in the working, share that interest with the natives of Foreign States".

"Let us think what the thing is which must be bought if anything be bought. It consists of the following items:—"

"(*a*). A system connecting England with the Continent, namely (1) Cables which are the joint property of the English Government and the Submarine Company between England and France, England and Belgium, England and Prussia. (2) Cables which are the property of the Great Northern and the German Union Telegraph Companies between England and Norway, England and Denmark, England and Prussia."

"(*b*). System connecting this Country with India, namely (1) The Indo-European working from London via Prussia, Russia, Persia and India. (2) The direct line working via London, Falmouth, Gibraltar, Malta, Alexandria, Suez, Bombay, with affiliations with the Mediterranean and the Peninsula."

"(*c*). The Atlantic System. (1) The original Atlantic cable working via London, Valentia and Newfoundland. (2) The French Atlantic working via London, Falmouth, Brest and St. Pierre. (To these comes a third, namely the Light Cable Company of which I have no good opinion.)"

"In connection with the foregoing there are all sorts of lines which are inextricably mixed up with the direct lines from this country. The Branch Lines in the East and West Indies are of this kind and *must* be taken into account if *any* purchase be made. . . ."

"But although, from what has been said, it would seem that the English Government would be wrong to take upon itself the entire cost, the entire working expenses, and the entire risk of a property which is certainly extra hazardous, with this additional disadvantage—that the extent of the extra hazard has not as yet been ascertained, it does not follow that a federation of nations might not undertake these costs and risks."

"Given the facts that Submarine Cables are indirectly useful to the people of Great Britain, the Continent, America, India and China, and are directly useful to influential but limited sections of the peoples of the world, why should not the acquisition and the management of the Submarine Cables be an International Undertaking? Why should not the Nations combine to buy, to work, and to protect the links which bind them together? Why should they not share the prime cost, the annual cost, and the profit? Why should they not say—these connecting chains of thought shall be sacred even during war . . ."

"I am cited as having said that there would be no difficulty in working the submarine cables if they were once purchased. Of course there would be no difficulty if they were purchased on the International plan, which is the only plan recommended by me."

"There is no difficulty now in working a composite line from London to Vienna. A little bit belongs to the English Government, another bit to the Submarine Company, another length to the French, another to the Swiss, another to the Austrian Government. Each section of the Line is maintained and yields its profit to those to whom it belongs."

"Those who would extend this management (and it is capable of almost indefinite extension) are true friends of the world and true promotees of civilisation. Those who would throw on this fat and fertile and sometimes foolish country, the entire cost of binding the nations of the world together are no friends to her or to the nations which they would connect with her."

"Lastly it would be easy to arrange a scheme in accordance with which Great Powers should be, whether for loss or profit, proprietors of the great conductors of thought and opinion from nation to nation."

"It would be easy to work the scheme when it was mounted. This would be a scheme worthy of a Statesman. But to make the British Taxpayer solely responsible for a risk and a cost which would only concern him in part, would be a cruel waste of Public money in this Country in the first instance, and a certain cause of loss of money in the future."

This memorandum was brought to the notice of Mr. Gladstone who, in the absence of general public demand, agreed that the State should do nothing to increase the value of Mr. McEwen's cable share-holdings. Nor did he pursue Mr. Scudamore's proposal that an international organisation be set up.

At the actual transfer of telegraphs to the State, in 1870, the submarine cables the Post Office had acquired were two to Holland and one to Germany, which it leased to the Submarine Telegraph Company. This company's concessions, which also included cables to France and Belgium, expired in 1889 when the several Governments concerned took over these and, in effect, thereby established international services, but by a number of mutual agreements and not in the broad sense that Mr. Scudamore had proposed.

There was an interesting development during the next year when the Minister of the French Posts, Telegraphs and Telephones, in 1890, put forward a novel idea that Paris might be connected by telephone with London. The Engineer-in-Chief of the British Post Office, Sir William Preece, proved that this was possible and designed a 4-core cable for the purpose. Messrs. Siemens Brothers of Woolwich manufactured it and in March, 1891, Her Majesty's Telegraph Ship *Monarch* laid the first telephone cable to France during a heavy snowstorm in the Channel. One of its two circuits was opened to the public on April 1. Thus, barely thirteen years after the establishment of the earliest telephone exchange in this country, the world's first submarine telephone cable was working.

By courtesy of the Staffordshire Evening Sentinel

From left to right: H. TODKILL, A.M.I.E.E., Area Engineer; D. MELVILLE, Senior Traffic Superintendent; E. A. MAYNE, B.Sc.(Eng.) A.M.I.E.E., Telephone Manager; A. H. GUPPY, Chief Clerk; E. RAWSON, Senior Sales Superintendent; E. WALSH, Secretary

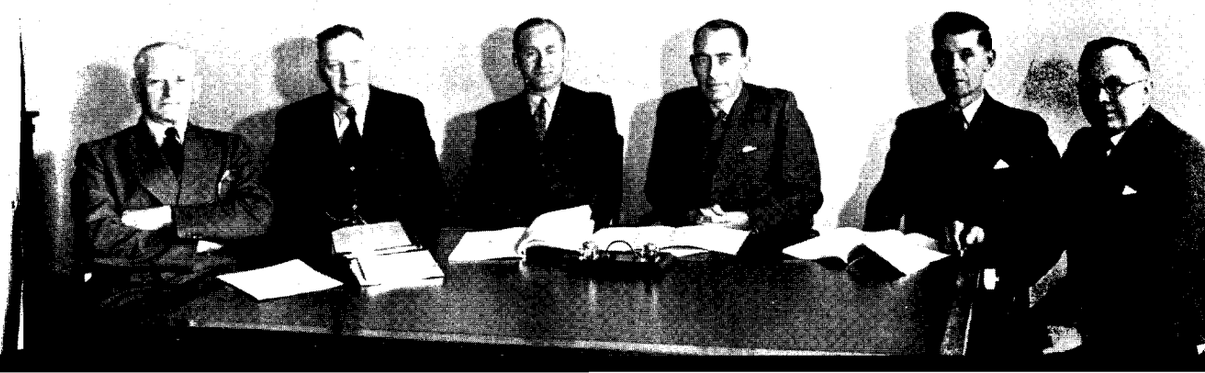
STOKE-ON-TRENT TELEPHONE AREA

Almost half the telephones in this compact Area, covering 803 square miles, are concentrated in Arnold Bennett's well known "Five Towns" in which pottery, coal, iron and steel are produced.
The Area also includes Leek, centre of the North Staffordshire silk trade; Crewe, famous railway town; and Stafford, the county town whose main industry is heavy engineering. The remainder of the Area is agricultural and in the North East, the beautiful moorland country is a favourite haunt of ramblers.
There are 74 exchanges, 60 of which are automatic, 25,883 exchange lines, 44,398 stations and a total staff of 816 including 648 engineering.

CARDIFF TELEPHONE AREA

Stretching from the estuary of the River Severn to the Brecon Beacons, the Cardiff Area covers approximately 1,600 square miles. It includes one of the richest coalfields in the United Kingdom, and the busy sea ports of Barry, Cardiff and Newport. Although steel and coal are the basic industries of this part of South Wales, Trading Estates consisting of factories in the light industry class have been established under Government auspices in several parts of the Area. In contrast, there are very large expanses of rich farming country in Monmouth, Breconshire and the Vale of Glamorgan.
There are 51 automatic and 78 manual exchanges with 40,206 exchange lines and 70,989 stations, 296,300 miles of underground and 49,150 miles of overhead wire. The total staff, excluding exchange operating staff, is 1,103 and the main preoccupation of engineering and traffic staffs now is the conversion of Cardiff Exchange to automatic working towards the end of next year.

From left to right: R. E. ANDERSON, Senior Sales Superintendent; H. S. AUSTWICK, Chief Clerk; P. E. FARREN, A.M.I.E.E., Area Engineer; D. E. KNAPMAN, B.Sc.(Eng.), M.I.E.E., Telephone Manager; E. DICKSON, A.M.I.E.E., Area Engineer; G. L. WRIGHT, Chief Traffic Superintendent



The Principles and Practice of Telecommunications Finance

by E.H.G.A. Kuhl, I.S.O.

Former Deputy Comptroller and Accountant General

Interaction of Consumption and Production

THE WHOLE PROCESS OF WEALTH production and consumption has been compared with a running wheel, one half of which is representative of Production, the other half of Consumption and furnishing the motive power of the wheel. Production being stimulated or retarded as Consumption is increased or reduced. Consumption, in this conception, sets the pace to Production, just as in the animal body the extent of the appetite determines the efforts made to satisfy it.

Or again, the process has been compared with the circle described by the flow of a stream which passes to the sea, is taken up by evaporation, deposited as rain on the uplands to again become the source of a stream flowing to the ocean.

These similes present, perhaps, too simple an illustration of the working of the industrial system in so far as they convey the impression of a certain smoothness, regularity and continuity of action which, on account of the complexity of the relations existing between innumerable industries and the lack of conscious and purposive co-operation on the part of the controllers of individual units of production, is not achieved in practice. However, even these aberrations from the regular can be paralleled in the illustrations under consideration, for the animal appetite is not always satisfied no matter how great the need, and physical phenomena operate in both short and long-term cycles. So long, therefore, as this is not overlooked these representations serve to conjure up images which, by their very simplicity, facilitate an understanding of the industrial system.

The Pivotal Position of Management

It is now possible, by leaving analogy for the concrete, to get a little closer view of the detailed working of the economic order. With the view of seeing how the latter functions, what are the factors of production and how their activity is stimulated, it will be convenient (beginning with the unit and passing on to the setting) to look first at a particular industry, say that of providing telephone service, and to illustrate its characteristic features diagrammatically (figure 1).

It is possible, even without entering upon a consideration of other industries, to generalise from the diagram and, by viewing production as a social process instead of from the view point of a particular business, to determine the factors of production not as specified items but as classes of things. Such a broad treatment would result in the following classification:—

(a) The raw materials and sources of energy supplied by nature, generally represented by "Land".

(b) Human energies which may be divided into two categories—(i) "Labour" and (ii) "Management".

(The pivotal position occupied by the Management and the inter-relationship of the activities which it has to weld into an economic synthesis are also indicated by the diagram, and thus quite clearly give an indication of what is the general nature of the problem of administrative control.)

(c) The material instruments used in the industrial process (machines, power plant, tools, buildings and so on) and the materials to be rearranged or changed in form, place or ownership, generally defined as Capital.

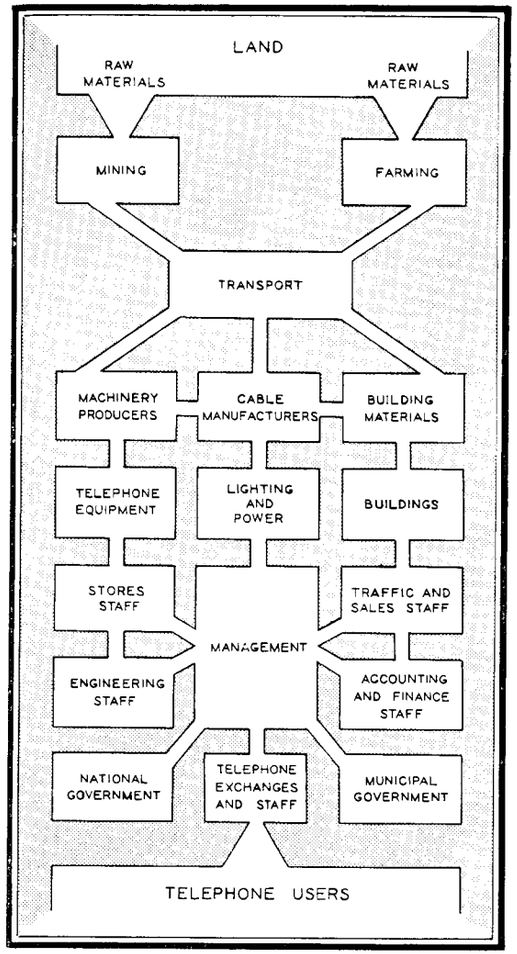


FIG. 1. PIVOTAL POSITION OF THE MANAGEMENT OF A BUSINESS SUCH AS THE TELEPHONE SERVICE

(d) Social Organisation—national and local—or "the State".

The diagram does not take account of the fact that there is no complete series of businesses entirely devoted to the provision of telephone service, but, even omitting a diagrammatic representation of the vertical and lateral series of the businesses concerned, it is still possible, without losing sight of any important feature, to give a fairly comprehensive picture of the economic system as an industrial process thus:—

Production as an Economic Process

Here is a clear representation of the fundamental features of the productive process and of the flow of consumption which is the life-blood of the economic system. On the one hand, there is a passage of goods from the extractive through the manufacturing and distributive industries to the consumers. At each stage, materials are rearranged or changed in form, place or ownership by varying combinations of Land, Labour, Management and Capital, with the State in all its manifestations exerting its required measure of activity. On the other hand, there is a flow of money in the opposite direction from the consumers to the owners of the different factors of production at each industrial stage. Money (that is, any medium of payment which is actually put into use by a person to buy what he needs for consumption or for some service of production) enters the industrial system as the universal stimulus afforded by an effective demand for commodities or services. Further, this demand is a demand for the Land, Labour, Management, Capital and State activities necessary in the different stages of production. Money, in its capacity of an instrument of demand, functions (if its powers are implemented) as a means of effecting the distribution of the industrial product. Let it be assumed that the Retailers sell goods to the value of £x daily. Out of that amount they will have to pay rent to the landlord, wages to the workers, salaries to the management, interest and depreciation in respect of the capital invested in the business, and contributions to the expenses of the State. It will be impossible to go on selling the same amount of goods daily without replenishing the stock in the shops. Hence, in addition to meeting the costs of the immediate factors of production employed by the Retailers, the latter must buy from the Wholesalers goods to replace those sold. The Wholesalers will have to meet similar direct expenses and will also, in due course, need to replenish their stocks. So the flow will continue through the various industrial stages. In this way, money, as it circulates through the system, brings the factors of production in different combinations to the points where they are needed, and thus apportions the total product of industry between the producers while these in their other capacity of consumers complete the circle. Further,

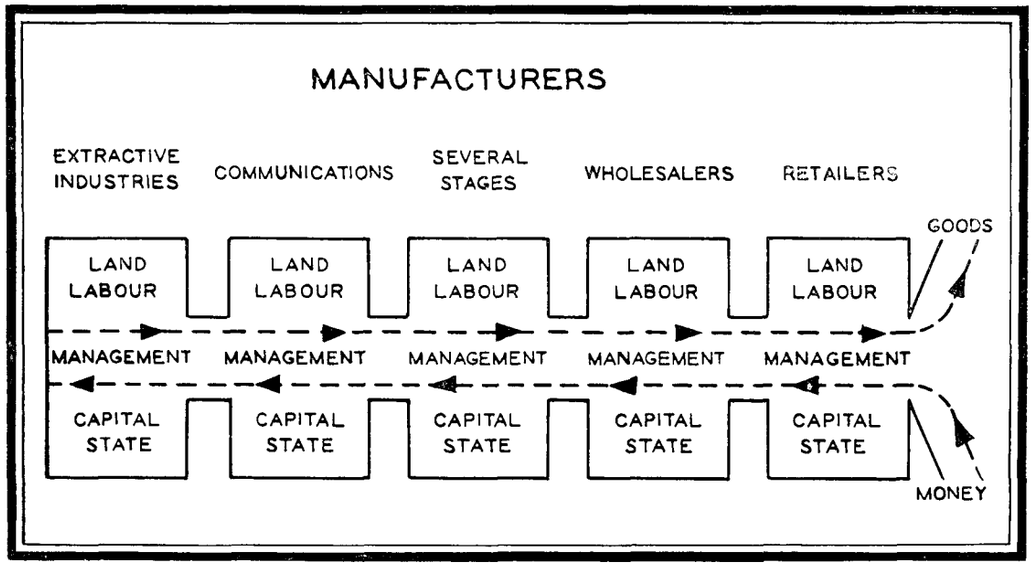


FIG. 2. PRODUCTION AS AN ECONOMIC PROCESS

though the payment may often be for goods already produced or services already performed by some factor, they are the condition and the inducement to the owners or controllers of the factors of production to apply the latter to further industrial activity.

Figure 2, therefore, conveys clearly to the mind the existence of the circular flow of money caused by the interaction of the two forces—Production and Consumption—and therefore illustrates the aptness of the parallels quoted above as descriptive of the industrial process. Although, however, these simple analogies thus succeed in expressing the fact of the existence of a relationship between the volume of production and that of effective consuming power, they already, at this point, owing to the over-simplification which we recognised at the outset, break down in detail. Thus, it is implicit in both the analogies of the wheel and that of the flow of the stream that the volume of production bears a constant ratio to the strength of the motive power: in practice, the slumps and booms of the past show that there is nothing immutable in this relationship, a proof that other factors operate of which the descriptive parallels take no account. However, if the diagrams have done nothing else, they will have shown that finance enters into every activity of a commercial or an industrial organisation, and that it is no exaggeration to say that the economic health of the latter can be measured by the financial results of its working in much the same way as the health of the human body can be gauged by the functioning of the blood stream.

The Need for Instruments of Financial Measurement

This short incursion into the field of economic theory has shown that, before a Management can decide to embark upon a production or sales programme or expand its existing activities, it is faced by the problem of how it is to finance the contemplated operations. For this purpose it will require instruments of financial measurement. Both the actual experience of the telephone service during the last 20 years and a theoretical examination of the whole process of wealth production and consumption show that what is required is, in the first instance, a co-ordinated plan which financially expresses itself in long-term budgets and forecast commercial accounts with consequent instruments which enable achievement to be measured against the plan.

Illustrations Drawn from the Field of a Private Business

There may still be some, however, who are wholly unconvinced, or who, while admitting the principle, hold the view that the machinery actually in being, and still more that contemplated in the future for the telecommunications services, is both too complicated and too restrictive. It will be useful, therefore, to consider the case of an individual who wishes to set up in business on his own and to review the problems facing him. He would have to be in possession or control of funds to purchase any necessary equipment or stock, to pay wages of any staff to be employed, to buy, or pay rent for, the required premises, indeed, to pay a series of other running expenses such as power, light, water and stationery. He would also need, for a little while, to have a surplus amount to keep him in being until a surplus of revenue over cost provides a margin for his support. In the event of the owner actually possessing the requisite funds, it would obviously be the height of folly if he started such a business without making an estimate of the costs and likely receipts. Such an estimate would represent basically a budget of expenses and receipts and further, these prospective transactions would require expression in a profit and loss statement or forecast commercial account. If this be wisdom in the event of the individual owner actually possessing the funds, it would be imperative if use of the required funds could only be obtained by means of a loan or a share subscription by the public, who could hardly be expected to provide such funds in the absence of some evidence of the soundness of the prospective venture.

Further, when the funds are obtained, steps are surely necessary which would measure achievements against the plan represented by the budget or forecast commercial account.

Now assuming that the first venture is a success and the owner intends to expand by opening branches in other centres; it is obvious that a plan is equally necessary with arrangements for measuring achievement. If the owner decides to run the business without devolving financial powers to the managers of the branches, the situation will not, in principle, be different from that when the business consists of one unit only; the only difference in practice is that the final plan will consist of an aggregation of plans prepared by the owner himself, although no doubt with the co-operation of his managers in order to obtain the benefit of their local knowledge.

If, however, the owner decides to devolve financial powers on his local representatives, he will, if he is wise, ask them to submit a plan or budget in accordance with the special accounting principles which he will lay down. When these budgets have been approved, he will expect the manager to keep within this framework unless the latter asks and receives authority to depart from it. Suppose the owner accepts a proposal from the local manager to open and equip an additional shop that would employ another five persons; he would not be prepared to let him go beyond this by opening and equipping two shops and employing ten people without further authority. He would, in fact, be expected to submit a supplementary plan or estimate.

Application of Similar Principle to Publicly-owned Business

Now what is sensible and just when an individual is the owner is none the less reasonable and just when the community is the owner. If an individual finds it difficult to finance expansion to the full limit of his desires, he has to cut his demands to suit his pocket, and a similar situation would dictate the same course in the relationship of the Post Office to the State as representing the community.

Moreover, an individual's circumstances or shortages of materials may lead him to give decisions in the direction of temporary expediency which, while not justified in ideal circumstances, are desirable in order to avoid a complete breakdown of business. If, subsequently, the financial or supply position improved, it would be right and proper to return to normal procedure. He would not be likely to refrain from doing so in order to avoid a charge of issuing contrary instructions. If the business is one of buying and selling the owner would also take steps to secure appropriate co-ordination of plan or action, and, if stores are needed for production, similar co-ordination between buying and production. In either case, if the business is subject to fluctuations in demand, changes of fashion or of technique, such estimates must be based on a foresight or estimate of such changes—trends would be an unsafe guide.

Authorities Required to Incur Post Office Expenditure

It is now necessary to look at the conditions under which the Post Office obtains its authority for the funds which it requires and see if they differ materially from and are more restrictive than, the conditions which would face an owner of a business.

The Post Office receives its authority to incur expenditure from Parliament. This authority takes two forms, (i) Loan and (ii) Vote.

(i) ***Loan.***—This authority takes the form of a Post Office and Telegraph (Money) Act which gives the Treasury power to issue funds to the Postmaster General up to a specified total sum "for developing, according to estimates approved by the Treasury, the postal, telegraphic and telephonic systems". The word "developing" gives the keynote to the type of expenditure covered by this authority, and in financial terms it consists of the amounts allocated to Capital as representing the value of any plant or equipment added to the Post Office system. The Money Act, passed early this year, gave authority for a sum of £75 million and was expected to last until the autumn of 1952. The capital estimates referred to as requiring Treasury approval form part of the annual Engineering Programme. During the course of each financial year, the amount anticipated to be required is advised to the Treasury monthly and this is advanced to the Post Office as a Loan by weekly instalments.

(ii) ***Vote.***—Authority for the remaining funds required by the Post Office is voted by Parliament annually on estimates prepared by the Post Office. These estimates, together with those of other Ministries, go to make up the Budget of the Chancellor of the Exchequer. As the funds authorised under the Post Office and Telegraph (Money) Act are a grant for development purposes, it will be appreciated that the bulk of Post Office expenditure falls under the Post Office Vote as it must cover all other day to day expenses, for example, salaries and wages of administrative, executive and operating staffs together with those engineering staffs engaged on maintenance and renewals, their travelling and subsistence costs, stores costs, conveyance and motorisation costs and expenses on rent, water, light, heating and power and so on. The original Post Office Vote amounted to nearly £167 million for 1949-50 and, in view of the magnitude of this amount, it is only natural that Parliament requires the Estimate to be divided into a number of Subheads, each covering a particular class of expenditure on the lines of the examples of expenditure already mentioned. The detailed Post Office Estimate is closely examined in the first instance by the Treasury and finally by the House of Commons, and according to the circumstances of the day, the debate on the Estimate can be either in a critical or a friendly spirit. When the House of Commons approves the Estimates, it votes the sums included in them and, in due course, the Post Office is able to draw upon its Vote through the medium of the Postmaster General's account at the Bank of England.

It is only reasonable that Parliament should require the Post Office to keep within the authorised Vote, and it is therefore essential to keep a close watch on actual expenditure and, by a system of forecasts, endeavour to anticipate whether or not there is likely to be an excess on the Vote. If, in any given financial year, the Post Office comes to the conclusion that it cannot avoid spending more than the total sum voted for that year, it has to go back to Parliament for authority to incur the probable excess. This is called asking for a Supplementary Vote and the Estimate of additional expenditure to be authorised is known as a Supplementary Estimate. The examination of the case takes up valuable Parliamentary time and the need to ask for additional money tends to throw doubt upon the efficiency of the Department's planning on which the original Estimates were based. It also offers an opportunity for general criticism of the Department in so far as the subject can be brought within the sphere of the Supplementary Estimate. The position would be worsened if the subsequent course of expenditure showed that a Supplementary Estimate had not been necessary because in fact no excess on the original estimate was incurred, since such a contingency would tend to accentuate the impression already created that there were weaknesses in the Department's estimating machinery.

At the end of the financial year, the Post Office has to prepare an Appropriation Account which compares the actual expenditure with that voted by Parliament and explains the differences which have occurred. This account is closely examined by the Public Accounts Committee

of the House of Commons, and the Director General and the Comptroller and Accountant General have to appear before the Committee to answer any questions which members of the latter may wish to raise.

Parallel with a Private Business

There is nothing in this procedure which differs in principle from that which would be followed by the owner of a business. The parallels are so obvious that they hardly need to be emphasised by repetition, and just as in the case of the relationship between the owner of a business and his local representatives, so also in the case of the Post Office the position holds good for various controlling staffs all the way down the line.

The picture of the Telecommunications Services from a financial point of view would not be complete without some idea of the make-up of the Commercial Accounts and of the factors which distinguish them from the ordinary Parliamentary Accounts which are a record of the Cash transactions effected during a particular year.

Commercial Accounts

If all expenses incurred by a business in a particular accounting period were directly related to the revenue collected in that period, the preparation of a Profit and Loss Account for that business would be simple; no difficult complications would be introduced even if allowance had to be made for debits and credits outstanding at the beginning and end of the period. Very few businesses (and the Telecommunications Services are no exception) are of such a simple type, even though all contain this simplicity in a greater or lesser degree in some of their transactions. The chief complicating factor, when present, consists in the fact that buildings and plant (with a life greater than the period for which accounts are rendered) are necessary in order to provide the goods or services which are the concern of the business.

It would be generally impracticable to pay for the acquisition of long-term assets out of revenue earned in a short period. For example, the expenditure on additional capital for the Telephone Service in 1948-49 was of the order of £23 million but the additional income was little more than £2½ million. The first objective of a Commercial Account, therefore, is to even out the incidence of expenses and thus to obtain a correct relationship of expense to revenue for the period covered by the account. The justice of this will be obvious when it is borne in mind that the £23 millions' worth of plant will continue to earn revenue for a period of something like 20 years—if this period be taken as representing the average life of the plant provided.

The way in which this process of spreading plant expenses over the life of the plant is effected can be seen by examining the relative entries in the Telephone Commercial Accounts as shown in the Income and Expenditure Account, and in the Depreciation Account.

(1) **The Telephone Income and Expenditure Account** is the account in which is shown the income and expenditure relating to the Telephone Service proper to the year.

(*a*) ***Income.***—If the Income side is considered first, it will be found that there is a substantial difference between the income shown in the Commercial Accounts and that passed through the Cash Accounts. This is largely due to the absence of cash accounting for inland Telephone Services rendered to other Government Departments. Although these services are not paid for, their value is assessed and credit is taken for them in the Commercial Accounts. In 1948-49, this credit for uncharged services was of the order of £12 million. Other differences are caused by adjustments of the debits and credits outstanding at the beginning and end of the year owing to transactions covered by subscribers' accounts in some cases overlapping two years; in other words, whereas the Cash Account shows what is received in the year the Commercial Account shows what is earned.

(*b*) ***Expenditure.***—The expenditure side of the account presents no special difficulty and little adjustment is necessary in order to relate it to the revenue proper to the year. This will be clear in respect of such day to day costs as administration, accounting, operating and maintenance. Plant charges, however, are the crux of the problem, though there are some other charges where the same problem is involved.

(i) *Interest.*—The use of capital for the acquisition of plant can only be obtained by the payment of an interest charge or the prospect of the business being able to pay a dividend. In the

case of the Telephone Service, interest is payable at the current rate which local authorities have to pay when raising capital. The expenditure side, and therefore the telephone subscriber, however, is not charged with interest on the full prime cost of the plant, as credit is given for the interest which the balance in the Depreciation Account (standing at £139 million at the end of March, 1949) could earn if invested in a separate Fund.

(ii) *Depreciation of Plant.*—Charges on Capital are not limited to interest payments. Although Toby Shandy could declare to Corporal Trim that "nothing in this world will last for ever", George Bernard Shaw still found it necessary to instruct the Intelligent Woman on this point, and its application to economic thought and practice. In the accounting field, this factor requires that provision must be made in the Account which will make it possible, if necessary, to repay the borrowed capital which the plant represents or, in a going concern, to replace the plant at the end of its life. Living as we do in an age in which the Wellsian dreams of yesterday are becoming the reality of today, regard must be given in fixing this life to the fact that obsolescence plays a big part in reducing the useful life of plant. The annual provision in the accounts to cover the factor of depreciation is called the Depreciation provision, and it is this assessed cost which is charged as expenditure in the Income and Expenditure Account and not the actual cost of renewal.

(iii) *Pension Liability.*—This item on the expenditure side corresponds with the payments of a firm to a non-contributory Staff Pension Fund from which pensions would be paid. The actual amount paid in pensions and so on does not, therefore, appear in the accounts but is a charge on the (hypothetical) Pension Fund. The pension liability amount is based on actuarial calculations of the amount required for the purposes and aims, of course, at averaging out the charges.

(iv) *Accommodation.*—The fact that many buildings used by the telephone service either wholly or by sharing have been bought and not rented, results in the presence of a similar problem of interest and depreciation as in the case of plant. To these assessed costs are added, of course, all other expenses on items such as rents, rates, maintenance of buildings, water, light, heat and power. The charge on the expenditure side of the Account is, therefore, in the nature of a rental covering all Accommodation services.

(2) **Depreciation Account.**—It has already been mentioned that as it is generally impracticable to pay for the acquisition of long-term assets out of revenue in a short period, a charge for depreciation is calculated which has for its object a just apportionment of the capital outlay over the probable years of operation. The calculated charge, while shown as an item of expense, is also credited to a Depreciation Account. The same account is debited with the actual cost of renewals and the balance standing in the Account is expected to be representative of the value of the expired life of the plant and available for future renewals as they occur. It should be mentioned that no physical Depreciation Fund is held by the Post Office and, to this extent, the Depreciation Account represents hypothetical conditions. However, if the annual contributions to the Account be regarded in the light of premiums paid to the Treasury, on the understanding that the latter assumes all obligations to renew plant when necessary, the Account will be seen to be not divorced from reality.

It remains to consider the way in which the contributions to the Depreciation Fund are assessed. The method adopted by the Post Office is that known as the "straight-line" method. For example, assuming a given type of plant has been assigned a life of 20 years, one-twentieth of the relative capital value is set aside each year to cover depreciation. If the plant item is expected to have a residual value, the latter is deducted from the prime cost before division by the number of years of life. The fact that different items of plant have different lives is one of the reasons why there are many Classes of Work. Other reasons are that in certain cases they earmark the expenditure to the appropriate Service—Postal, Telegraph or Telephone, and in other cases they are essential for the allocation of expenditure between Vote and Loan or Renewals and Capital.

Local "Commercial" Accounts

The necessity of having Commercial Accounts, not only for the actual year of Account but also in the form of forecasts or projections into the future, may reasonably raise the question whether, if these are so useful to Post Office

Headquarters, similar information would not be desirable for local units of control. Not only is this true, but the existence of such or similar accounts would be an added advantage to Headquarters; it was, indeed, an important point of criticism on the part of the Bridgeman Committee that the instruments of financial measurement were not decentralised in the Post Office. On the Budget or Estimating side of the problem, the Post Office has gone almost the whole way in the desired direction, and the important further step of estimating for engineering stores requirements has been taken tentatively, starting with the Estimates for 1950-51.

In regard to local Commercial Accounts there are certain difficulties arising out of the character of the Telephone Services which prevent such local accounts being Commercial Profit and Loss Accounts in the full sense of the term. For example, it is not possible to find satisfactory bases for the apportionment between Regions and Areas of such items as National Headquarters Administrative Costs and settlements with Overseas Administrations for international traffic, nor can an exact allocation of revenue earned on inter-Region or inter-Area traffic be arrived at. Actually, however, it is not so important to know the actual surplus or deficit at any one point of time for a particular Area, because in any case while tariffs are largely on a basis of National uniformity, costs, owing to the physical nature of the territory, are bound to vary. What is desirable is to have information as to the trend of local telephone expenditure and revenue on as near a commercial basis as possible, which would enable the trend of results of any one Area from year to year to be judged in relation to the general trend for the country.

Two forms of Account were agreed upon before the War—a Regional Control Account and an Area Local Telephone Account. The former was actually in being in pre-war days for two or three Regions, but the war led to a suspension of their preparation. The Area Account was never brought into being for the same reason. Lack of manpower has so far prevented the development of either of these Accounts, but there is no doubt of their need, directly so where their usefulness is already recognised and, where this is not the case, their introduction will help to foster a financial outlook.

Telegraph Training from an Instructor's Point of View

by Olive L. Dando
Regional Telegraph Training Centre, Southampton

UPON THE EFFICIENT PERFORMANCE OF ONE'S job, in whatever sphere it may be, depends one's success and general well-being. It follows then that the time spent in preparing for a career is a period of vital importance.

Most tasks become easy when one knows the best way in which to perform them, and the fortunate learner is he whose training is based on quality rather than quantity and is well-balanced as to theory and practice.

This article deals with telegraph training and will no doubt conjure up in the minds of all readers employed on telegraph duties memories of their learning stage and the Instructor who taught them. The older ones will recollect early struggles with morse and sounder and perhaps the reading of rule books, while others will live again those long hours spent at a teleprinter wondering if touch-typing without error could really be achieved.

Only the more recent recruits will be able to picture telegraph training as it is today. In recent years, there have been great improvements in this branch of training to ensure that each trainee receives individual attention and instruction in all the duties expected of him in an Instrument Room.

The Course

One feels that the training scheme has been very well planned including, as it does, the following subjects:—Acceptance, Phonogram and Telephone-Telegram working, Circuit Procedure and Gumming, Circulation and Block-lettering, Delivery and Finished Check, Touch-typing and Teleprinter Operating and some simple technical instruction. Attention is given to spelling and clear speech throughout the course.

Background talks complete the syllabus which covers a wide field and entails much effort and preparation on the part of the Instructor. Experience has shown that, with forethought and the free use of appropriate visual aids, it is possible to make most of these lessons interesting so that trainees do not find the theoretical side of their training dull or irksome.

Lessons and study periods are followed by practice, under supervision, on the subject taught. Occasional visits to an Instrument Room and Switchboard Centre, and one to the local telephone exchange are included in the course and prove of great value to trainees.

It may be interesting to look at this new style of telegraph tuition through the eyes of an Instructor whose thoughts as each new class looms ahead are something like these:—

1. What will the range of ages be?
2. Will it be a mixed class?
3. Will all the ten trainees possess a natural aptitude for the work and will the average intelligence be good?
4. How many will have previous telegraph knowledge and how many will be "freshers"?

The all-important first day arrives when the above questions are answered and the Instructor prepares a plan of campaign accordingly; but let us consider these questions, even as the potter considers the clay from which he must mould his vessels.

Range of Ages

A wide range of ages (say 16—48 or so) constitutes a real headache for an Instructor. Imagine giving a lesson to ten trainees of such varying ages, and endeavouring to make it equally interesting and instructive to all! Consider the problem of keyboard training when the older trainees become discouraged to see the younger folk mastering it with such apparent ease and leaving them seemingly far behind. One cannot but pay tribute to many of these older trainees whose pluck and determination, and often greater accuracy, have "got them there" within the time limit of the course.

A mixed class receiving nstruction on the teleprinter

Instructors realise that it is not always possible to avoid such extremes of ages being brought together in one class, but one ventures to hope that this difficulty will diminish in the future. It might sometimes be better to send a trainee to a centre further from his home if the average age there is more suitable.

Mixed Classes

Few Instructors, I imagine, would take exception to a "mixed" class. The social atmosphere is usually good and a keen healthy sense of competition is often noticed. A wise Instructor will foster the latter as being a valuable aid in the making of successful trainees.

Keyboard practice in touch-typing

Teleprinter practice

Quality of Recruits

This is an all-important factor, for an Instructor can only obtain results according to the material upon which he has to work. Recruits should possess natural abilities, intelligence and a good standard in spelling (the latter so important for phonogram work). Any lowering of standards at the intake stage can mean hard extra work on the Instructor's part to help a backward trainee and, in spite of all efforts, this sometimes ends in the distressing situation of having to recommend that a trainee should be withdrawn from the course. Instructors therefore feel that careful recruitment is the pivot upon which the whole of training turns.

Previous Telegraph Knowledge

What Instructor has not heard many times from trainees with some previous experience the words "They don't do it that way in our office"? "Local Procedure" may almost be said to be the Instructor's "nightmare". Complete standardisation of procedure would be difficult to achieve, but staff in charge of Instrument Rooms could help considerably in this respect by reporting to either the Officer-in-Charge of a Training Centre, or the Telecommunications Branch, any evidence of conflicting practice brought to light by returned trainees.

Visual Aids

In common with modern educationalists the Department realises that for all forms of training, whether Telephones, Telegraphs or Counter, visual aids play a very big part in helping trainees to learn and to memorise. Charts, blank maps, blackboard diagrams and suitable Post Office posters are much in evidence in all telegraph training centres, and I understand that film strips will soon be available. "Seeing is believing" it is said. Imagine the benefit derived from seeing on the screen the correct procedure contrasted with the incorrect, illustrating for example the best posture of the

Gumming practice

Phonogram position at one of the training schools

hands for touch-typing. The various types of equipment in use in Instrument Rooms could be shown on a screen (for trainees come from all kinds of offices). How much more effective this would be than simply talking about it all! These are only some of the suggestions which could be put forward, but they will perhaps suffice to show how very useful the screen is for training purposes, and how easily it could meet the needs of Telegraph Instructors who look forward to the day when this valuable "assistant" becomes part of their equipment.

Type-Keyboard Training

Undoubtedly the hardest task of the Telegraph Instructor, or perhaps one should say the task needing the greatest amount of patience and understanding, is Type-Keyboard training. I feel sure that other Instructors welcomed the recent adjustment of the syllabus to allow three hours' typing (lessons and practice) daily up to the twelfth week instead of the former two hours daily up to the sixteenth week. Already results are showing a marked improvement.

In the early stages of training, each trainee must be constantly watched and his work very carefully checked in order to prevent the formation of bad touch-typing habits which, once acquired, cannot easily be broken. Endurance and determination are virtues very necessary in both Instructor and Instructed if the Department's standard of accuracy is to be obtained as regards uncorrected errors (one only in 80 messages).

I do not think the trainee should know the number of corrected errors permitted until well towards the end of the course. If a trainee knows he is allowed 25 then that, in many cases, becomes his standard and he is satisfied with it. Not so the Instructor, however. He feels 25 corrected errors in 80 messages is too many and hopes for better results from trainees for whom he has put forth so much effort. Indeed, I would like to see corrected errors limited to 15 in 80 messages.

What is most to be desired in touch-typing is the feeling by each trainee of confidence in his fingers, and the best way to obtain this is surely by making him type without the use of his eyes. True his typewriter keyboard is covered but he can see the result of each finger movement on the paper in front of him at the typing point, and he tends to watch it much too closely. If he were made to type from dictation with his eyes closed and then from copy with the platen covered (if some way could be found to do this) I think there would be a marked improvement in the speed and accuracy of his touch-typing.

Telegraphist operating a clear-down switch. The operator was Miss Dando's first trainee

Qualifying Tests

Writing from an Instructor's point of view the question of qualifying tests must, of necessity, come into the story. Weekly typewriting tests and, after the tenth week when training on the teleprinter is introduced, teleprinter tests are reported on the trainee's record card in the form of a graph, and on the fateful thirteenth week all results are reported to the Head Postmaster. These include a message test (40 messages in 45 minutes on the typewriter); gumming (50 messages in 45 minutes); phonograms (5,including finishing-off,in 15 minutes); and a written test in which questions are asked on acceptance and procedure generally. Final tests are, of course, similarly reported. They are much more exacting, the teleprinter test (minimum 80 messages per hour) being twice imposed, the phonogram test (8 messages, including finishing-off, in 15 minutes) also being twice imposed. The final gumming test is a minimum of 85 messages per hour, and the final written test is ranged over the whole course. The maximum length of the course is 18 weeks but trainees are passed from the 15th week onwards as soon as they achieve the final qualifying standard.

The foregoing is enough, no doubt, to show how very much more thorough the new method of Telegraph Training is than the old, when the trainee was left rather more to his own devices. The "Old Style" Instructors did a grand job and turned out many good operators, but they were not expected to be lecturers as well. This is an art in itself, for which there is a special training course; it calls for much thoughtful preparation behind the scenes.

The modern Instructor often performs much more than eight hours a day, but results bring his reward. It is a great joy to send out a well-trained telegraphist who sixteen weeks before knew not the first thing about it all.

Learning touch-typing with the aid of gramophone records

A final word about the great day in a trainee's life when, training over, he or she enters the Instrument Room to take up duty. The thought that all those telegrams are really "live" messages, is at first frightening in the extreme. Another awful thought follows—"Shall I remember it all?"

It is because of this that each returned trainee spends one week of "sitting-in" with an experienced telegraphist before taking up an effective duty. A carefully-chosen tutor can give great help to the trainee during this period and, later, with kindly encouragement from both supervisors and staff, confidence is gained and the ex-trainee begins to give evidence of the results of a sound training.

But, even now, the task is not complete. The richest ingredient has yet to be added and that is "experience".

Whilst the Training Centre can impart knowledge it cannot give experience. Time alone does that. We who teach, therefore, express the hope that supervisors and others will wait before passing judgment upon the trainee, and through him upon the Training Centres, until a reasonable amount of experience has brought to full fruition the painstaking labours of Regional Telegraph Training Instructors.

Contemporary Telephone Mechanisation Abroad and Possible Future Trends (1)

by J. A. Lawrence, A.M.I.E.E.
Engineer-in-Chief's Office

THE PROGRESSIVE MECHANISATION OF telephony has been one of the outstanding achievements of the first half of the present century although its many remarkable features are often obscured, in the public eye, by other more spectacular things.

To the layman, the novelty of automatic working has long since disappeared and the automatic telephone has become a familiar object in the daily life of all progressive countries—so familiar that it is nowadays taken for granted. To administrations, many of the problems which seemed so formidable in the early years of mechanisation have now been fully resolved and reduced to matters of routine procedure and new problems of mechanisation, such as the development of mechanised trunk working (both national and international), the planning and introduction of national numbering, and the development of electronic switching have taken their place.

While the routine business of mechanisation continues to occupy much of the effort available in the telephone industry, the attention of both administrations and manufacturers is already turning towards the solution of the new problems, some of which offer what appear to be formidable difficulties. That such difficulties will eventually be overcome is not in doubt but, as a first step towards finding solutions, it is instructive to study the development of mechanisation abroad. In this article I shall deal with local systems and in a later article with subscriber and operator dialling over longer distances.

Automatic Local Exchange Systems

All of the important telephone administrations are now committed to full mechanisation of local service, that is, ultimately manual exchanges will cease to exist for local connections. On present indications, this will (at least for the next ten years or so) be effected either wholly or principally with electro-mechanical equipment not very different in design from that commonly used at the present time. Whether or not mechanisation will ultimately be completed substantially with electro-mechanical equipment will depend upon the outcome of current research into electronic switching techniques.

Local exchanges fall roughly into three types:—
(1) Direct-driven step-by-step exchanges.
(2) Register-controlled power-driven exchanges.
(3) Marker-controlled exchanges.

Direct-driven Step-by-step Exchanges

Step-by-step exchanges are, generally speaking, the most simple in design, and, since they can be applied economically to satisfy a wide range of local conditions, they are justly popular with a number of foreign administrations. Two basic arrangements of step-by-step equipment are shown in figure 1, the first being the familiar "non-director" arrangement and the second, the "director" arrangement. A typical modern selector is shown in figure 2. The selectors used in both arrangements are similar. In the non-director system, the selectors are controlled directly by the subscriber's dial, and the way in which the various "levels" of the selectors

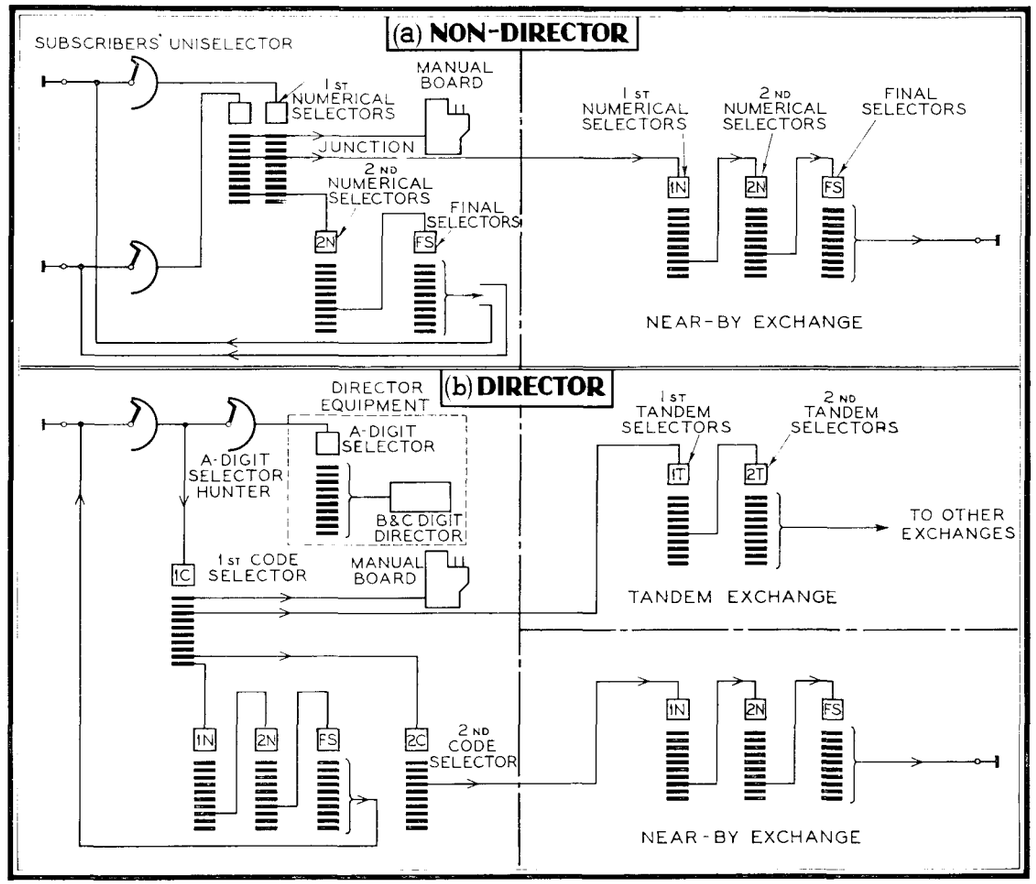


FIG. 1. DIRECT DRIVE STEP-BY-STEP WORKING USING TWO-MOTION SELECTORS: (a) SIMPLE NON-DIRECTOR WORKING; (b) DIRECTOR WORKING

are connected determines the numbers that have to be dialled to complete any given call. It follows that, if it is desired to re-arrange the network at any time, number changes may be unavoidable. In the majority of urban and city step-by-step networks, number changes can be avoided by careful planning, but in large metropolitan networks the planning problem tends to become so complex that some administrations have found it preferable to introduce the device known as the director. The director is arranged so that subscribers, instead of dialling their numbers into the actual selectors, dial instead into the director equipment. This equipment behaves as a mechanical operator and controls the movements of selectors.

The director contains the equivalent of a "routing file" and, on receiving a demand for a particular number, refers to this file to ascertain the routing of the call. It then steps the selectors as required by the routing file. This particular function of the director is known as "translation". The development of the translation principle has probably contributed more to the successful automatisation of large and complex telephone networks than any other development since the early days of automatic telephony. In the present instance, the use of

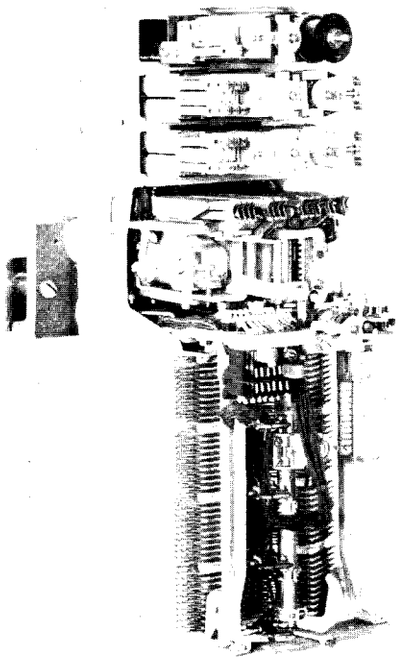


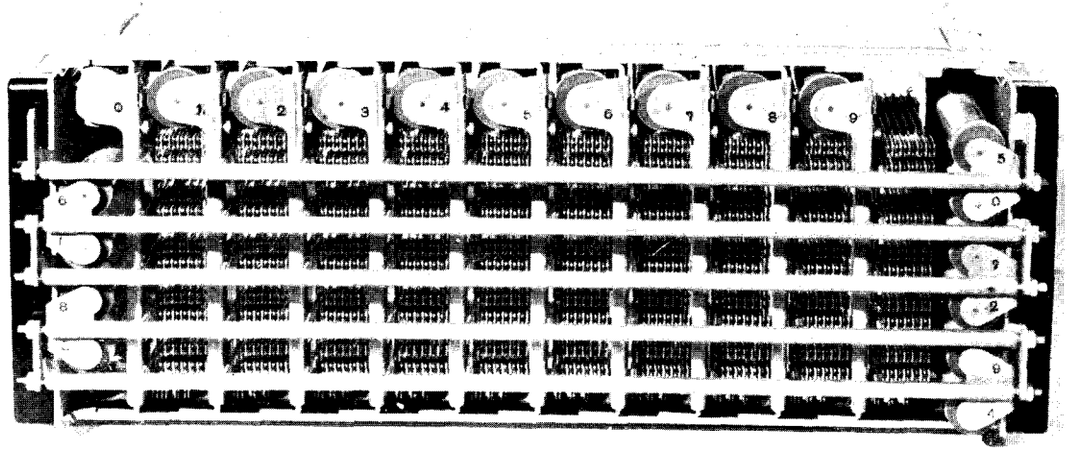
FIG. 2. A TYPICAL MODERN TWO-MOTION SELECTOR (BRITISH 2000-TYPE)

the translation principle renders the numbering scheme used for a given area independent of the lay-out of the network. As will be seen later, other systems also embody the translation principle.

Outside Britain, the director system has been used in South Africa and is scheduled for Calcutta. Elsewhere, the non-director system has been used extensively in all types of community. In Europe, Germany has the largest step-by-step network. This network is a non-director network based on Siemens and Halske selectors which are roughly similar to the British 2000-type selector. The German network may contain, ultimately, some 9000 exchanges. Six-digit, all figure, local numbering schemes are, or will be, used in the larger cities. Elsewhere the numbering schemes will normally be five-digit numbering schemes. So far, there has been no attempt to introduce director working even in the largest cities but, in attempting to extend the non-director system sufficiently to cope with long distance subscriber-dialling, the advantages of the director technique are beginning to make some impression on the German administration.

In Holland there are about 1200 exchanges, 80 per cent. of which are of the step-by-step non-director type. Prior to the war, those

FIG. 3. A TYPICAL CROSS-BAR SWITCH



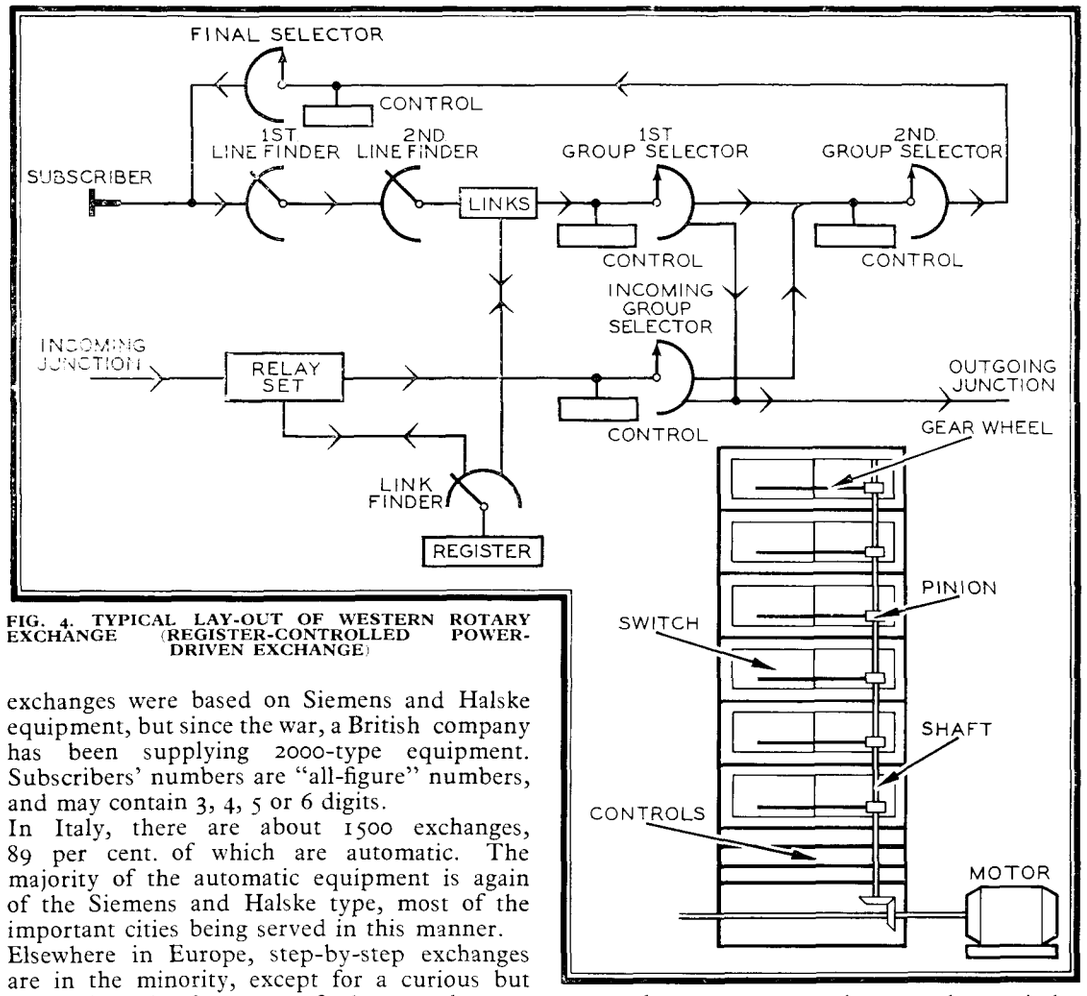


FIG. 4. TYPICAL LAY-OUT OF WESTERN ROTARY EXCHANGE (REGISTER-CONTROLLED POWER-DRIVEN EXCHANGE)

exchanges were based on Siemens and Halske equipment, but since the war, a British company has been supplying 2000-type equipment. Subscribers' numbers are "all-figure" numbers, and may contain 3, 4, 5 or 6 digits.

In Italy, there are about 1500 exchanges, 89 per cent. of which are automatic. The majority of the automatic equipment is again of the Siemens and Halske type, most of the important cities being served in this manner.

Elsewhere in Europe, step-by-step exchanges are in the minority, except for a curious but interesting development of the step-by-step principle by the Swedish Administration. In Sweden, which has about 6700 exchanges, there is a high ratio of telephones to population, but it has a small population and, because of the nature of the country, there is a big demand for rural telephones. This is illustrated by the fact that 80 per cent. of the total exchanges serve fewer than 100 lines each. To meet this demand, the Swedish Administration began to plan for large-scale rural automatisation in 1933, and by 1941, had introduced a standard rural automatic system which, although based on the cross-bar switch (figure 3) was, in fact, a step-by-step system, the cross-bar switches being arranged to respond directly to the impulses sent out by the subscriber's dial.

In North America, including Canada, step-by-step exchanges form a very important part of the automatic system, representing about 50 per cent. of the total local automatic switching plant. Until recently, the step-by-step exchanges were operated as non-director exchanges, even though many of the local numbering schemes are of the two-letter-four-figure, or two-letter-five-figure types. The selectors used are of the Strowger pre-2000-type, and the exchanges in the larger towns and cities are,

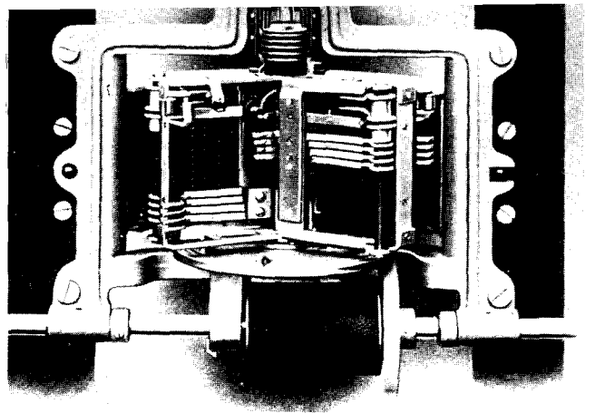


FIG. 5. A TYPICAL ROTARY SELECTOR

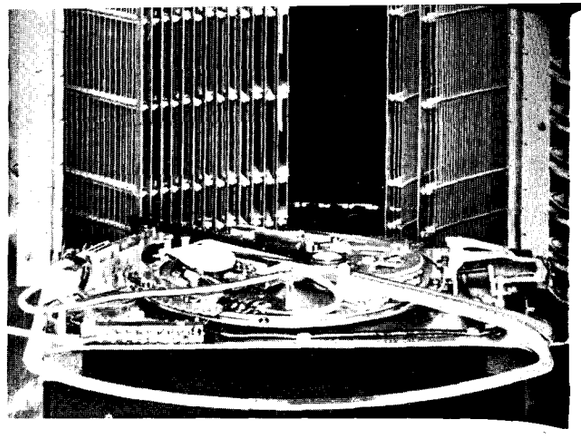


FIG. 6. A 500-LINE SELECTOR

as a general rule, larger than in comparable towns and cities in this country, that is, satellite working is the exception, preference being given to the provision of five-and-six-digit switching units. The emphasis on rural automatic working is not so great in North America as in this country and in Sweden, most of the small rural exchanges being owned and operated by very small private companies. Small rural step-by-step exchanges, generally similar to unit automatic exchanges in this country, are however used.

In the Dominions and Colonies step-by-step exchanges based on the British non-director system are an important feature of the mechanisation programmes, the British contractors being largely responsible for the manufacture of the equipment. As already mentioned, the director system has also been introduced in South Africa, and has been specified for Calcutta.

In Brazil, mechanisation is based largely on non-director step-by-step working, again on the British model, except that the large cities are served by six-figure numbering schemes based on a few very large switching units all directly interconnected. In San Paulo, for example, the present programme will lead to the ultimate provision of equipment for 180,000 lines all in one building.

Register-controlled Power-driven Exchanges

Register-controlled power-driven exchanges are, outside the United States of America and Sweden, the only effective alternatives to step-by-step exchanges. The basic arrangement is shown in figure 4, with typical selector in figure 5. There are two important systems, (i) the Western Rotary System which exists in a range of types, all incorporating the same basic principles but containing variations arranged to meet the ever-increasing demand for new facilities, and (ii) the Ericsson's 500-line Selector System, which is a particularly elegant variation of the power-driven system. A typical selector is shown in figure 6.

Power-driven selectors cannot, in their present form, be controlled directly by a subscriber's dial. The subscriber, on lifting his receiver, is connected to a device known as a register. This device is, in many ways, similar to the director already described. Its function is to "register" the requirements of a calling subscriber and control the operation of the selectors accordingly. As will be seen from figure 3, a selector is driven by a rotating shaft common to a number of similar selectors. Normally, the various selectors are disengaged from the shaft. When a register wishes to position a selector, it sends a signal to the selector which causes a clutch to engage the selector-driving gear wheel with a pinion on the rotating shaft. The selector then rotates until the clutch is subsequently released by the register.

The amount of power-driven equipment throughout the world is roughly similar to that of step-by-step equipment, except in the U.S.A. where it is distinctly in the minority. In Europe, France has an important "Rotary" installation in Paris, where it serves a three-letter plus four-figure numbering scheme, and provides facilities almost identical to those provided by the London director system. The Belgian and Swiss networks are also basically "Rotary" networks. In Sweden, the Ericsson's 500-line selector system provides service in the majority

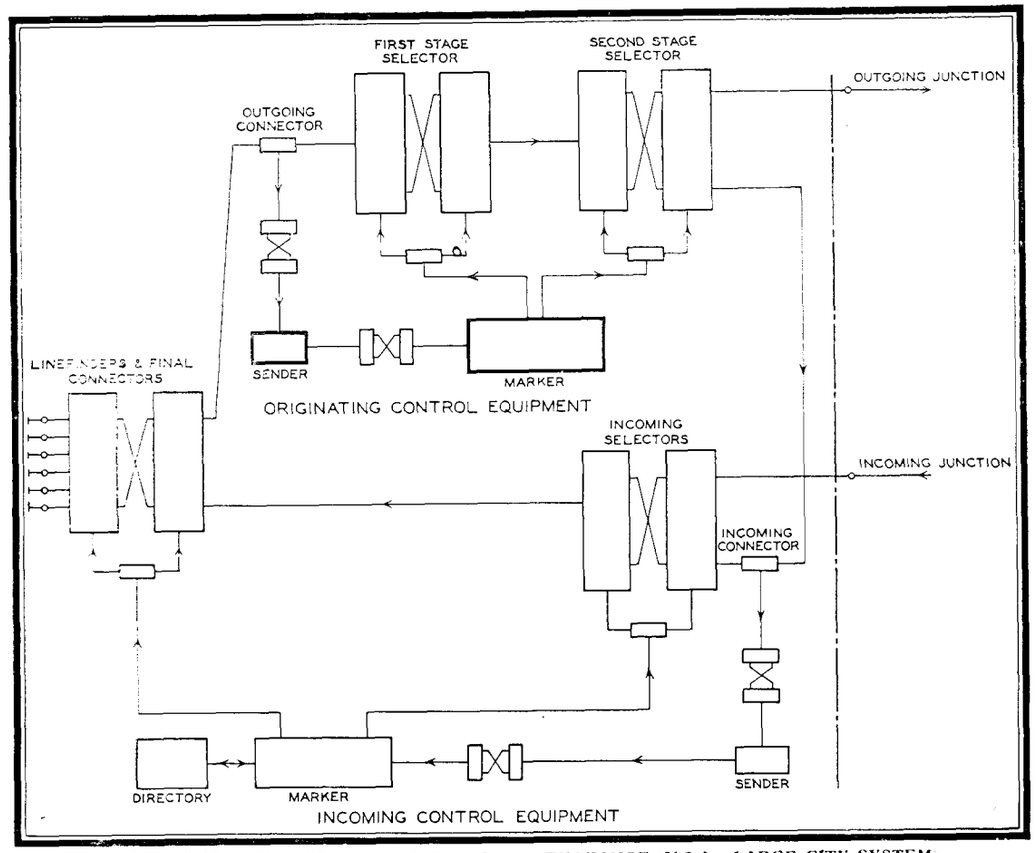


FIG. 7. A MARKER-CONTROLLED CROSS-BAR EXCHANGE (U.S.A.—LARGE CITY SYSTEM)

of the large towns and cities, and the Swedish Ericsson Company is also responsible for 500-line selector installations in countries as widely separated as Finland, Italy, New Zealand, Mexico, Persia and Turkey.

Marker-controlled Exchanges

Marker-controlled switching is, nowadays, represented only by cross-bar equipment, and in this field, the Bell system of the U.S.A. is by far the largest user. In the United States, the cross-bar system has been successfully applied to problems of switching under conditions which, in this country, would always call for director equipment. At the present time about 20 to 25 per cent. of all automatic subscribers in the U.S.A. are served by cross-bar equipment, and the proportion so served is increasing rapidly as existing, but obsolescent, exchanges are replaced and new exchanges are provided. The basic principles of the system are illustrated in figure 7.

The switches used are similar to those shewn in figure 2. The control of switching is, however, vested in a small number of devices known as markers. A subscriber, on lifting his receiver, is connected to an originating sender into which he dials the number he requires. The sender then establishes contact with an originating marker, and passes to this marker sufficient information to permit a terminating sender in the wanted exchange to be located. The

originating marker connects the calling line to the terminating sender and releases to await demands from other senders. The originating sender transfers the call to the terminating sender and releases itself for other calls. Finally, the terminating sender (in the wanted exchange) establishes contact with a terminating marker which, by reference to a mechanical directory, locates the wanted subscriber, completes the connection and releases. These operations are all effected very rapidly, the markers being taken into use for less than one second per call.

The numbering schemes served by the American cross-bar system are, in general, of the director type, using two letters plus five figures.

The Swedish Administration has also developed a marker-controlled cross-bar system which may, ultimately, be adopted in Sweden as the standard system for all exchanges serving more than 200 lines. Although the Swedish system differs in many points of detail from the American system, it is sufficient here to classify it as a variation of the same basic system. The Swedish marker-controlled cross-bar system incorporates translation facilities and could, therefore, serve "director" type numbering schemes. It is not, however, the practice to use lettered codes in Sweden, large congested areas being served by five or six-digit all-figure numbering schemes. The facilities obtained are generally similar to those obtained with the director system.

Comparison of Local Switching Systems

There are, of course, a number of variations of the three basic systems of switching depending upon the manufacturer, the local requirements and the year of manufacture. Technically, each of the three basic systems which have been described can be adapted to satisfy any local switching requirement anywhere in the world but, in practice, their respective fields of application do not entirely overlap. Thus, under rural and to some extent under semi-urban conditions, step-by-step switching, whether using two-motion selectors or cross-bar switches, tends to yield the best overall results, that is, it gives the best service and calls for the smallest annual charge. This is particularly true in Sweden and is generally true in the United States. It is also of interest to note that at least one of the Dominions has decided recently to adopt step-by-step working for rural exchanges. The preference for step-by-step switching under rural conditions is due to its great simplicity and the absence of common apparatus such as is essential in all power-driven and marker-controlled systems. Either of the latter two systems could, of course, be adapted for use in small unattended rural exchanges but, in such circumstances, the need for special safeguards to avoid exchange isolation would, in general, make the exchanges uneconomic in comparison with step-by-step equipment giving the same facilities.

For urban exchanges up to 5000 lines there seems to be little to choose between non-director step-by-step equipment and register-controlled power-driven equipment. In general, a non-director step-by-step exchange is always simpler than a corresponding power-driven register-controlled exchange, but some administrations prefer the flexibility of routing made possible by the presence of a register. For example, the use of registers permits the introduction of translations for routing and, therefore, facilitates the adoption of extensive "areas" numbering schemes which are uniform and easy to understand.

A marker-controlled cross-bar exchange is probably the most efficient kind of exchange that can be produced using only electro-mechanical techniques. Its high efficiency is, however, obtained by concentrating the traffic flow on to a small number of high-speed markers which contain a large number of fast-operating relays. For example, a busy 20,000 line exchange in New York requires only eight markers to handle all originating traffic. A single call involves the use of about 700 relays, mostly common equipment, and 1100 relay operations. The holding time of a marker is of the order of three-quarters of a second and a marker handles some 15 million calls per year. To give some meaning to these figures, it has been estimated that in a London exchange a single call would call into use about 50 relays and cause 200 relay operations. Although not directly comparable, it is also interesting to note that some London directors handle about half a million calls per year. Because of the small numbers of markers required in a cross-bar exchange, the breakdown of a marker can be very serious. It follows that the effect of marker faults on service is the least in large exchanges.

For this, and other reasons, marker-controlled cross-bar exchanges in the United States tend to be uneconomic in switching units below 5000-lines capacity. For units above 5000 lines, cross-bar exchanges can, however, compete with step-by-step and power-driven exchanges although, so far, the cross-bar system has made little headway outside Sweden and the U.S.A. The Swedish version of the marker-controlled cross-bar system is rather simpler than the American system and is claimed to be economic down to 2000 lines and worth standardising down to 200 lines.

In metropolitan areas such as those of Paris, London and New York, the large numbers of lines, high calling rates and multiplicity of exchanges call for adaptations of the three basic switching systems arranged to facilitate inter-exchange working. This has led to the use of translating equipment in all three systems. With step-by-step equipment, the translating equipment usually takes the form of a director, although other arrangements can be designed and have been used. With both power-driven equipment and cross-bar equipment, the common equipment, which is required in any event to control the action of the switches, can be and is modified to provide translation facilities. The translating equipment in all three systems is arranged to isolate the subscriber from the actual switching equipment and therefore tends to act as a mechanical operator. This "operator", by being able to "translate" a subscriber's dialled demand into routing information, permits the dialling procedure used by subscribers over a wide area to be made uniform and, at the same time, leaves the administration free to route traffic in the most economical manner. Thus, despite the diversity of types of automatic equipment and the fundamental differences in exchange design, the logical principles underlying the operations carried out by the equipment tend to be the same in similar circumstances. This similarity suggests that inter-working between differing basic types of exchange should be practicable and this has proved to be so in practice. In this connection the translation principle, referred to in describing the director system, is of great value in that, properly arranged, the requirements of one basic system of switching may, by being passed through a translator, be translated into the corresponding requirements of another basic system.

Differences in exchange systems need not, therefore, stand in the way of the development of national automatic telephone networks based on national numbering and providing for nation-wide subscriber-dialling.

In the next article I shall deal with the problems of interworking between different networks, discussing firstly the problems which arise in extending subscriber-dialling to points outside the local exchange area, and then the more general problems of national numbering and national dialling.

The International Standardisation of Television

by A. H. Mumford, O.B.E., B.Sc. (Eng.), M.I.E.E.
and J. H. H. Merriman, M.Sc., A.Inst.P., A.M.I.E.E.
Engineer-in-Chief's Office

TELEVISION BROADCASTING IN THE UNITED Kingdom is the responsibility of the British Broadcasting Corporation who have operated one transmitter on 405-line definition in the London area at Alexandra Palace since November, 1936, with the exception of the period of the war when the transmissions were closed down. A second transmitter, opened at Sutton Coldfield in December, 1949, serves an area centred on Birmingham. Other trans-

Group of delegates visiting the Dollis Hill laboratories

Mr. Esping, Chairman of the Study Group, addressing the opening meeting in London

mitters are now under construction to serve the Manchester-Leeds area, Southern Scotland, and the Bristol Channel area, whilst other stations are planned which will serve Tyneside, Southampton, Northern Ireland, Aberdeen and Plymouth. Public television broadcasting systems are, at present, operating regularly only in the United Kingdom, United States of America, France and the Union of Soviet Socialist Republics. The transmissions differ somewhat in essential technical characteristics and make-up in each of these countries. The problem of deciding which of these, or of the many other practicable standards, should be adopted by those other countries now considering the introduction of a television service is therefore difficult. Whilst it is clear that there are technical advantages to be gained from international standardisation of these essential technical characteristics, such standardisation would also make international television programme exchange a more economic possibility.

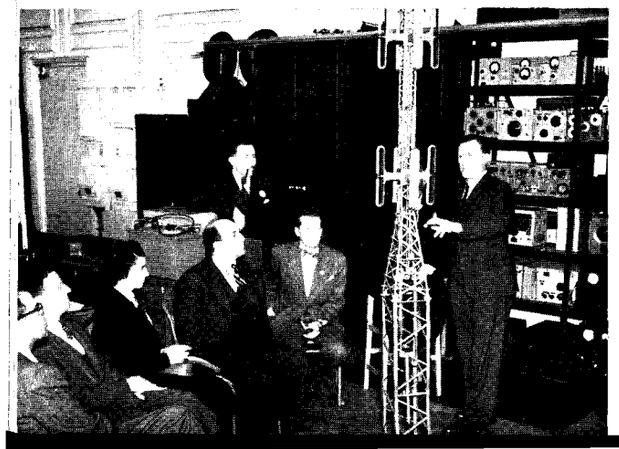
International discussions of problems associated with radio telecommunication standardisation take place under the auspices of the Comité Consultatif Internationale des Radiocommunications (C.C.I.R.) which is a body of technical experts meeting under the general regulations of the International Telecommunication Union. The work of the Committee is organised by plenary meetings at intervals of two or three years, the most recent being held in Stockholm in 1948. At the plenary meetings, the various problems to be studied are agreed and allocated to one or more of a number of study groups, each group being concerned with problems in one particular sphere of radio and conducting its work by correspondence with an international chairman.

At the Stockholm meeting in 1948, the problems of television were assigned to Study Group 11, and Mr. Erik B. Esping, Bureau Director of the Swedish Administration, was appointed Chairman. The Group was asked to make proposals on the technical factors which would assist in achieving an interchange of programmes on the widest possible scale. In view of the rapid development of television which was expected, the Group was instructed to give urgent attention to the solution of the various problems on as wide a geographical basis as possible.

From a purely scientific point of view, it is obvious that the most desirable standards would be those which would provide the viewer with a picture containing all the information capable of interpretation by the human eye. Such a standard might well be approached in a laboratory but would certainly be economically prohibitive at the present time in terms of a public television service. On the other hand, whilst entertainment of a kind can be obtained from a system providing the bare minimum of information, the undesirability of such a choice is obvious. It is not surprising, therefore, that soon after the Stockholm meeting it became apparent that a solution by interchange of correspondence would be impossible and actual meetings of the members of the study group were therefore proposed, at which the problems could be discussed and the formal report prepared for submission to the next plenary meeting due in 1951. The first of these intermediary meetings was held in Zurich in July, 1949. One of the conclusions reached was that a series of visits of inspection of the television systems working or proposed in the United States, France, the Netherlands and the United Kingdom should be made in the Spring of 1950, the visits of inspection to be followed immediately by a meeting in London for detailed discussion.

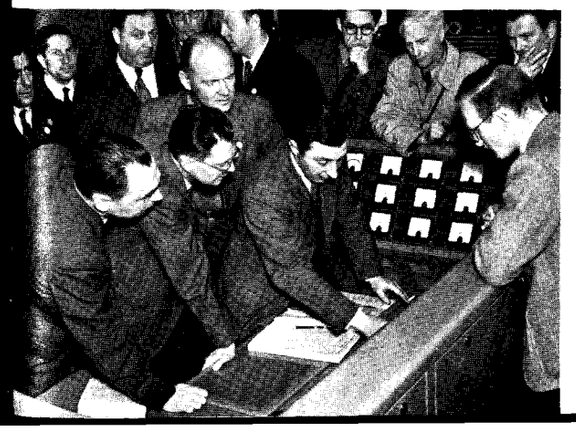
Some seventy-four delegates, from fifteen countries, took part in the tour of the United Kingdom which began in London on April 27, 1950, and was arranged jointly by the General Post Office, the British Broadcasting Corporation and the Radio Industry Council. The delegates were welcomed on arrival by Sir Archibald Gill, Assistant Director-General (Engineering) and

Demonstration to American delegates of model of Sutton Coldfield aerial system at Kingswood Warren laboratories



Group of French-speaking delegates examining a television camera in one of the studios at Alexandra Palace

Around the control table of the Sutton Coldfield television transmitter



Swiss delegates inspecting receiver assembly line at the Electrical and Musical Industries' works at Hayes

Engineer-in-Chief of the General Post Office. It was to one of his predecessors in office—Sir William Preece—that the young Marconi brought his ideas for the exploitation of radio communication and Sir Archibald recalled that it was an Englishman, Mr. A. A. Campbell-Swinton, who in a letter to "Nature" in 1908 first suggested the use of the cathode ray tube for the transmission of sight in a manner which was remarkably similar in principle to television as we know it today.

During the comprehensive series of visits, the delegates were shown the new B.B.C. television studios at Lime Grove in West London, the Alexandra Palace television station with its studios and facilities, the new transmitter at Sutton Coldfield—the most powerful in the world—with a glimpse of the radio relay system which connects it to London, and some of the work of the development laboratories of the B.B.C. at Kingswood Warren, Surrey, and of the General Post Office at Dollis Hill. At the factories of Electrical and Musical Industries, Hayes, a tour of inspection of television receiver and cathode ray tube production was followed by various technical demonstrations. At Marconi's Wireless Telegraph Co. Ltd., Chelmsford, a conversazione followed an inspection of the works. On May 5, the last day of the tour, an exhibition of British television receivers was inspected at the Dorchester Hotel, the delegates being welcomed by Mr. Oliver Lyttleton, M.P., President of the Radio Industry Council, which had arranged the exhibition. A demonstration of large screen television of the Football Association Cup Final was staged by Cinema-Television Ltd. in the Odeon Cinema, Penge, and the importance with which this demonstration was regarded can be gathered from the fact that a Saturday afternoon performance of the cinema had to be cancelled in order to accommodate the delegates.

Detailed discussions began in London on May 8 and continued until May 12, the meetings being held in the Council Chamber of the Institution of Electrical Engineers. During the course of the meetings, receptions were held at which the delegates were introduced to the Postmaster General, the Rt. Hon. Ness Edwards, M.P., and the President of the Institution of Electrical Engineers, Professor E. B. Moullin. The United Kingdom delegation consisted of representatives from the General Post Office, the B.B.C. and the Radio Industry Council, and was led by Mr. H. Faulkner, C.M.G., Deputy Engineer-in-Chief, G.P.O.

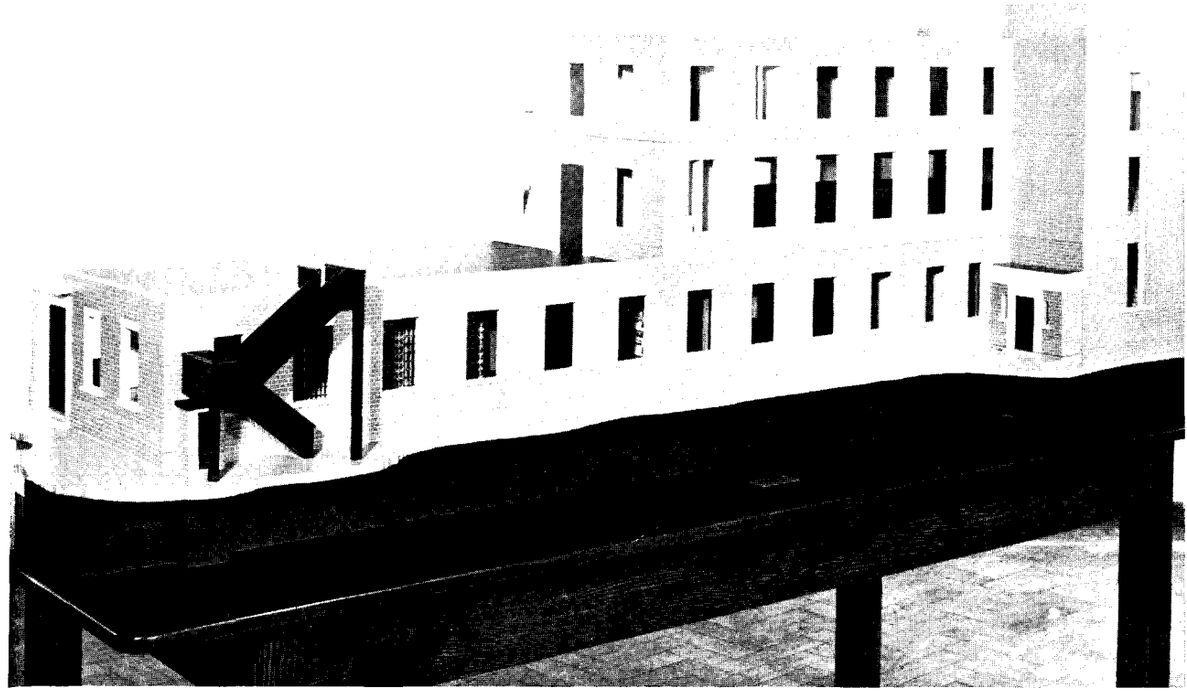
The delegation stressed that the United Kingdom standard was particularly suitable for consideration as the standard since, for systems giving a service satisfactory to the public, it has the lowest overall cost of transmission, leaving the greatest margin of income for programme production. It also allows television receivers to be sold at the lowest cost and, therefore, facilitates the penetration of television into the greatest number of homes. The continued use of the 405-line system in the United Kingdom was confirmed, having in mind the planned programme of television expansion to the provinces and the growing television audience.

It was clear, from the outset of the meeting, however, that there was likely to be considerable difference of outlook between, on the one hand, those countries in which there was already an existing established television service and in which large numbers of receivers were already in the hands of the public, and on the other hand, those countries which were considering the establishment of a service in the near future and therefore more free to consider various possible standards. As a result of this difference of outlook, unanimous agreement was possible only on those standards, the implementation of which would not be likely to adversely affect the operation of vast numbers of receivers in the hands of the viewing publics of the United Kingdom, the United States and France. International recommendations for agreement on these points are, however, of value to the exporting manufacturer in reducing the number of types of receivers to be manufactured. On the more fundamental characteristics of television transmission, such as the number of lines per picture, no recommendations for agreement upon a single standard were possible. Four standards were finally proposed; 405 lines, as used in the United Kingdom; 525 lines, as used in the United States; 625 lines, as intended to be used by Austria, Belgium, Denmark, Italy, the Netherlands, Sweden and Switzerland; and 819 lines as used in France (where there is also a public service on 450 lines at present).

Any hopes, therefore, of a widespread television exchange of live programmes must now rest upon a solution of the exceedingly complicated problems encountered when connections are

(continued on page 168)

A MODEL TELEPHONE EXCHANGE

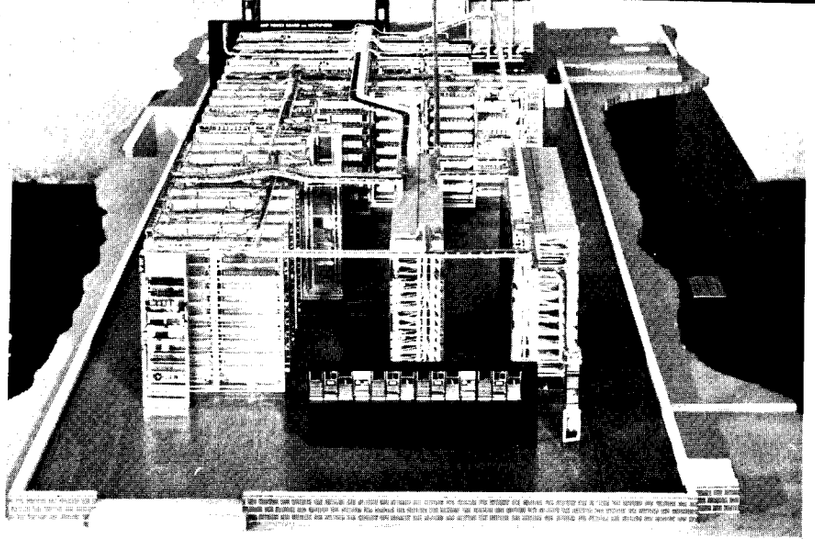


by A. E. Hammond and A. N. James Headquarters Traffic Training School

The Birth of the Idea

THE HEADQUARTERS TRAFFIC TRAINING School was opened in 1945. Its main function is to train new entrants to the Assistant Traffic Superintendent grade and several hundred students have so far passed through the School. These new entrants have come from various walks of life, many from the Post Office itself, some from other Government Departments and the remainder from outside the Civil Service. Experience has shown that many trainees who are new to the Telephone Service find some difficulty in understanding the details of automatic exchange working. The trunking of large numbers of switches and the way in which the different items of apparatus are interconnected to provide the various facilities to subscribers cannot easily be explained even with such aids as photographs and demonstration equipment. Visits to large director exchanges in Central London are, to a newcomer, rather overwhelming. A similar problem will undoubtedly arise in the training of Traffic Officers who are shortly to be recruited in considerable numbers.

This led to a decision to build a model automatic telephone exchange. As it is, to the best of our knowledge, the first of its kind, readers may be interested in some details of its planning and construction. That it serves a very useful



Apparatus Room with the Test Desk in the foreground

purpose is clear from the comments of the students taking the courses for which the model is used.

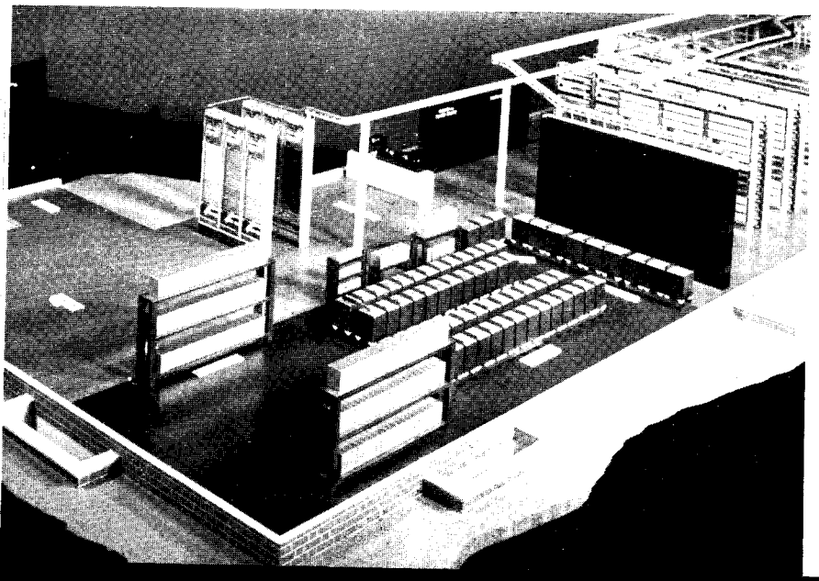
Planning the Model Exchange

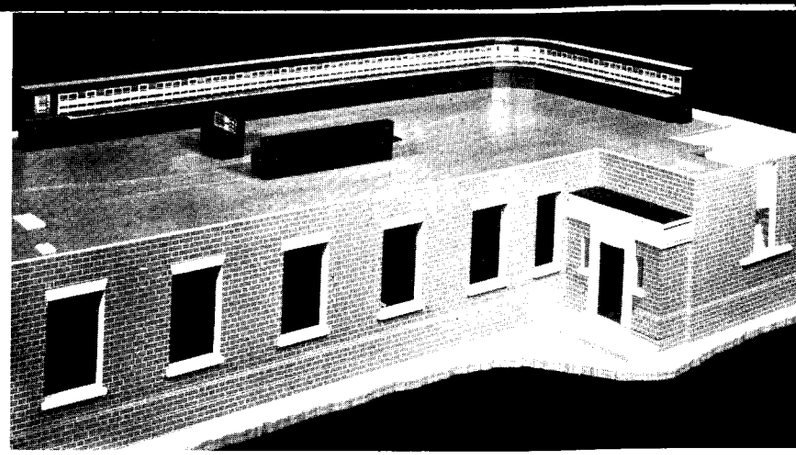
Sevenoaks exchange, in the Tunbridge Wells Area of the Home Counties Region, was chosen as a suitable example of a modern non-director automatic exchange with a manual board. In this exchange, the apparatus room, switchroom and welfare accommodation occupy the ground, first and second floors respectively. We decided that the model exchange would be a replica of Sevenoaks exchange to a scale of half-inch to one foot and that rectangular wooden blocks would represent racks and frames, with scale photographs of the actual apparatus taken in Sevenoaks exchange mounted on them. Switchboard positions were to be cut to shape and similarly treated. Cabling of some kind in the model apparatus room was considered essential in order to show the main inter-rack connections.

Construction of the Model

The constructional work was undertaken by the Factories Department. The model has been made on the "dolls' house" principle. The building was made in plywood and built in sections so that it could easily be erected and dismantled floor by floor. Interior walls and windows were constructed but doors and window glass were considered unnecessary. Ceilings and inside walls were sprayed cream in colour and the floors varnished brown. Scale-size wooden blocks, representing the racks and frames as at present provided in Sevenoaks exchange, were cut from beech. Further blocks were then cut to represent the additional equipment estimated to be required at the ultimate date (20 years after the opening of Sevenoaks exchange, that is, 1964). The base of each of these additional blocks was fitted with metal pins and corresponding sockets drilled in the floor of the apparatus room to enable the blocks to be inserted and withdrawn easily. All the blocks were sprayed battleship grey in colour and suitably engraved. A similar procedure was followed for the switchboard positions and desks, which were stained and polished. A section of the floor adjacent to the main distribution frame was made removable to give a view of the cable chamber. The main cables were made from resin core solder and the cable joints from wood! Plastic covered wire of various colours was used to represent the more important cable runs in the apparatus room. The cable racking was made from brass channel, slotted in a machine, and the "cables" fastened to it by transparent adhesive tape. The wooden apparatus racks acted as supports for the cabling racking. Most realistic scale reproductions of the batteries and ringers were made from wood.

Battery Room



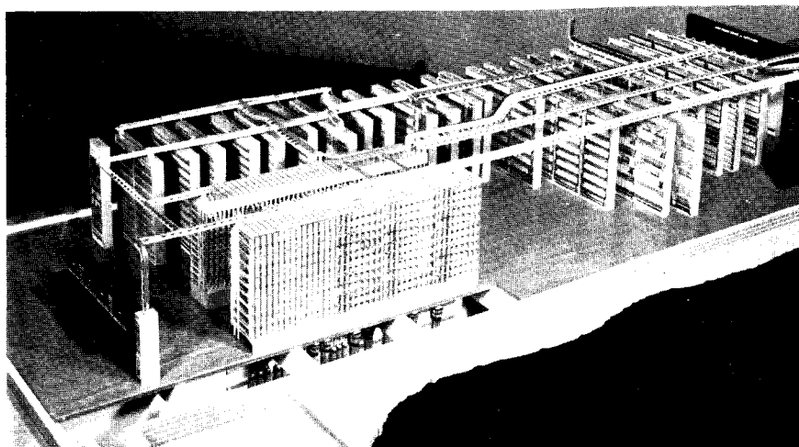


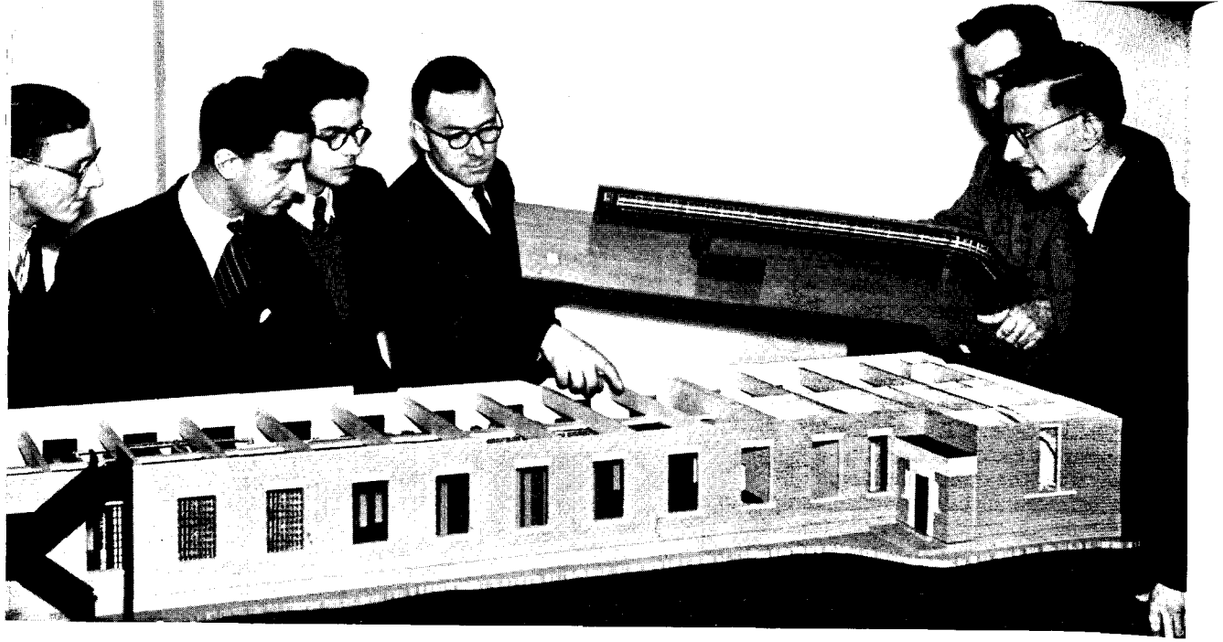
Switchroom with ultimate extension included

Photographic Work

The photographic work was carried out by the Photographic Section of the Engineering Department and here again many problems had to be solved. Photographs of the apparatus were taken in Sevenoaks exchange and then carefully reduced to the exact size of the wood blocks on which they were to be mounted. Unfortunately, it was impossible to photograph some items of equipment owing to lack of space. This difficulty was surmounted by using photographs taken in other exchanges, but it was found that some of the equipment was mounted on smaller racks than those provided at Sevenoaks. To overcome this variation in size, the print was cut at a suitable place and a piece of another print inserted to make up the height. The main and intermediate distribution frames presented particular difficulty as it was impossible to take a photograph of a complete side. However, by mounting the camera on a table just outside the building, photographs of two small sections of the line side of the main distribution frame (M.D.F.) were taken through the open windows. Sufficient prints, 44 in all, were then run off to make up the whole side; this was photographed and reduced to model size. A similar method was used to "build up" the other side of the M.D.F. and the two sides of the intermediate distribution frame (I.D.F.). The accuracy necessary in reducing the photographs to model size is best illustrated in the case of the automanual switchboard outgoing and answering multiples. The latter is arranged as a six-panel repetition and one complete appearance was photographed. 13 prints were necessary to cover the 31 positions fitted in the model exchange, and if each print had been only one-sixteenth of an inch out, an error of almost an inch (equivalent to two whole panels) would have been involved at the end of the suite. The prints were mounted on the wooden blocks by the Factories Department. After mounting, the prints were sprayed with a clear cellulose compound in order to give a protective finish. The racks, frames, switchboard positions and desks, representing the equipment fitted at the present time, were then screwed to the floors of the apparatus

Apparatus Room shewing the cable chamber





Assistant Traffic Superintendents studying the model

room and switch-room. The exterior of the building was covered with brick paper and then sprayed. It was possible to obtain the brick paper only in small sections and considerable care had to be taken to match up adjacent pieces, particularly as the paper stretched unevenly.

Use of the Model in Training

The model telephone exchange is used at several stages in the training of Assistant Traffic Superintendents and will be used also in the training of Traffic Officers. It gives the trainee a "birds-eye" view of the way in which the exchange accommodation is arranged room by room, the type of equipment provided and how the various parts of it are connected together. To demonstrate the model exchange to trainees, the roof is lifted off to expose the welfare accommodation. Name plates, describing each room, are fixed to the floor. The beams and walls of the top storey are then taken off in one piece; removal of the floor then exposes the switchroom. The beams and walls of the switchroom then lift off to give a most unusual view of switchboard positions in the open air. Removal of the switchroom floor, followed by the beams and walls of the ground floor, exposes the apparatus room with the main cabling clearly visible. The removable racks, switchboard positions and desks, already referred to in this article, enable an extension of 1000-multiple, six joint trunk positions and two monitorial positions to be effected in a few minutes!

Acknowledgements

We should like to record our thanks to the Factories Department and to the Photographic Section of the Engineering Department who carried out the work with enthusiasm and efficiency. Our thanks are also due to the Regional Director, Home Counties Region; to the Telephone Manager, Tunbridge Wells and to the Head Postmaster, Sevenoaks, for co-operation in arranging visits to Sevenoaks exchange and for making available the plans and diagrams on which the model was constructed.

THE INTERNATIONAL STANDARDISATION OF TELEVISION *(continued from page 164)*

required between systems operating with different standards. A partial solution to these problems lies in the use of film recording technique. Whilst complete agreement on all important matters was not achieved, extremely valuable interchanges of information and ideas took place, and for probably the first time the outlines of the structure of European television began to emerge.

NOTES AND NEWS

Changes in Overseas Telegraph Services - Transferred Telephones - Telephone Instructions for Foreign Visitors - Recording of Telephone Calls - Greetings Telegrams and Cheap Trunk Calls, etc., etc.

Changes in Overseas Telegraph Services.—The new rate-structure for extra-European telegrams, as agreed at the Paris Conference of 1949, came into force on July 1, 1950. Of the five main services—urgent, ordinary, code, deferred and letter-telegrams—two are abolished, namely, code and deferred; and although there are a number of changes in detail, the general effect of the new rate-structure is one of simplification.

The charges for urgent and ordinary telegrams have been reduced by about 25 per cent. The users of code service (CDE), however, no longer have the benefit of special rates. The deferred service has been abolished and users of that service now use the ordinary full-rate service which costs them a little more, or the letter-telegram service which costs them a little less. Letter-telegram rates are slightly higher than hitherto, but there is some compensation in the fact that the minimum charge is based on 22 words instead of 25 words. The users of the Commonwealth Social Telegram service (GLT) now pay the same for 11 words as they previously paid for 13 words, but they have the advantage of being able to use an abbreviated telegraph address instead of the full postal address. The rate for Press telegrams remains the same within the Commonwealth, namely 1d. per word.

★ ★ ★

Transferred Telephones.—A person taking over a house where a telephone instrument is already installed not unnaturally feels he need only notify the Post Office that he wants to use that telephone, pay any charges required, and then start making his calls. An existing telephone subscriber who moves to another house may feel particularly aggrieved if he cannot have his service transferred to his new residence where a telephone is already available. There is, however, a large waiting list of applicants for service, comprising both intending subscribers for the first time and those who had a telephone at their previous address. While the shortage of line plant and exchange equipment continues, it is only fair that service, as it can be made available, should be given to the waiting applicant with the strongest claim even though this may entail the removal of a telephone from one house to another.

If, as is very often the case, an existing telephone is not required for an applicant with a stronger claim, service would be given to the incoming tenant without delay.

★ ★ ★

Call Office Dials.—A new type of dial designed to prevent fraudulent operation has proved successful in trials. It will be fitted in all new public call offices and on new coin box installations rented by subscribers. Dials in existing call offices will be replaced when supplies of the new type are available.

A field trial is being carried out in various parts of the country of dials on which the figures 8, 9 and O have been treated with radio-active luminous material under a protective plastic

finger plate. The dials are being fitted in a number of unlighted kiosks where the 999 facility is available.

★ ★ ★

Lighting in Telephone Kiosks.—Where the cost is reasonable, it is the practice to have kiosks lit continuously during the hours of darkness, the light being automatically switched on at dusk and off at dawn. Some 36,400 out of a total of 43,700 kiosks are so equipped. Some of the first kiosks were fitted with a floor switch which operated when they were occupied. While this practice may have resulted in a small saving of electricity, the balance of advantage is felt to rest with the continuous lighting of kiosks during the hours of darkness. This enables callers, particularly in a strange district, to find the kiosk quickly, a factor which is of much importance in cases of emergency.

★ ★ ★

Torquay Conference.—In September, a Conference of the Contracting Parties to the General Agreement on Tariffs and Trade is assembling in Torquay and is expected to last for about five months. Some 400—500 delegates representing about 50 nations will participate. The Foreign Office is responsible for the general planning and co-ordination of the conference arrangements, and the Post Office has been asked to make the necessary arrangements for all postal and telecommunications facilities. To meet telephone needs, a large private manual branch exchange is being installed in the conference building from which extensions will be provided to the conference committee rooms and to the various hotels occupied by the delegations. A considerable amount of new external cabling is also being laid and additional trunk circuits between Torquay and London will be provided.

★ ★ ★

Tracing Radio Interference.—Post Office engineers responsible for tracking down radio and television interference in the London Telecommunications Region have given lectures on this subject to the radio group of a well-known engineering firm, the junior section of a professional association, and to a public meeting of televiewers organised by a local amatuer radio society. The principal interest of the audiences has centred in the methods used for tracing interference with radio reception at home.

Interference due to domestic electrical appliances can often be traced without the assistance of a Post Office engineer and remedied by the local electrician.

★ ★ ★

British Industries Fair, 1950.—The opening of this Fair followed closely on the integration of the United Kingdom Services of Cable and Wireless Ltd. with those of the Post Office. The stands in both the Olympia and Castle Bromwich sections of the Fair were, therefore,

The G.P.O. Cable and Wireless exhibit at the British Industries Fair

designed as a joint exhibit for the Company and the Post Office. The main display comprised a standard cable receiving unit allied to a working demonstration of the automatic teleprinter switching system.

The names of associated companies and administrations abroad, and the model of the latest cable repair ship, the C. S. *Edward Wilshaw*, underlined the importance of cables in the British World Telegraph System.

In each stand a small office was set aside for handling commercial cables from buyers and stand holders.

★ ★ ★

Government Department Telephone Switchboards.—During the War, there was a big increase in the number of these switchboards staffed by Post Office telephonists, and, in November, 1949, there were some 2,500 telephonists so employed, of which 2,100 were in London. These figures have now fallen to 2,100 and 1,750 respectively. Many switchboards are still staffed by the Departments themselves, some by service or industrial personnel but others by temporary staff. As Government policy is directed toward the elimination of temporary staff on permanent work, the Post Office has been asked, and has agreed, to take on the staffing of all switchboards with two or more positions in non-industrial establishments where suitable arrangements can be made.

★ ★ ★

Telephone Breakdowns—Some Unusual Causes.—Interruption of the telephone service is generally due to bad weather conditions, but recent cases of damage caused by insects, rodents and even plant life illustrate the unpredictable problems of Post Office engineers.

A fault in a main underground cable was traced to a section where the cable passed through a four-way earthenware duct or pipe. On removal, this was found to be tightly packed with fibrous root for a distance of nearly 30 yards. Further examination revealed that a root of a nearby willow tree had entered a joint in the duct and had grown in the four cable ways.

A decayed section of an otherwise sound telegraph pole was found to be honeycombed by a large grub. In view of the unusual nature of the pest, it was submitted to expert examination and was recognised as the larva of the largest British Longhorn beetle, known to zoologists as "Prionus Coriarius".

Frequent disruption of the telephone service in a large factory was caused by rats gnawing through the internal cable always at a point where it entered a sealed pipe. It was deduced that the rats had eaten poison put down by the factory and then attempted to follow the cable in search of water.

★ ★ ★

"Chivalry is Almost Extinct Today".—Recently, a British cinema executive applied for a telephone at his home address. Owing to the difficulties of manpower and materials plus a London waiting list of 160,000, it was not possible to give him early service. He came to the General Post Office for a verbal explanation of the telephone position and, on returning to his own office, he wrote the following letter:—"Although I came away from your office a somewhat disappointed man, I would like to take the opportunity of thanking you for your courtesy and lucid explanation of the telephone fundamentals. These almost made my visit a pleasure particularly as chivalry is almost extinct today".

★ ★ ★

Telephone Instructions for Foreign Visitors.—In anticipation of the Festival of Britain, the Post Office is taking steps to extend the scheme for telephone call office instructions in foreign languages to includes notices in Czech, Danish, Dutch, Finnish, Greek, Polish, Norwegian and Swedish.

Public call office notices in German, Italian, French and Spanish, designed to instruct foreign visitors to this country in the use of the public call office and how to make various kinds of telephone calls, were introduced in July, 1949; they have proved highly successful and are much appreciated by visitors.

Foreign language instruction cards are exhibited in call offices which are frequently used by foreign visitors and a special notice is displayed on the doors. At present not more than two foreign language cards are placed in one call office.

★ ★ ★

Telephone Service with Malaya and Singapore.—Before the war, the telephone service with Malaya was routed by landline to Amsterdam and thence by the Amsterdam-Bandoeng and the Bandoeng-Kuala Lumpur radiotelephone links. It has not been practicable to reopen service by this route, and a new service has now been arranged and was opened for public business on May 22, 1950. Adverse radio propagation conditions to the Far East do not permit of a reliable direct service at all times of the year and, with a view to overcoming this difficulty, the new service is being relayed via Nairobi, Kenya. The radiotelephony terminal at the distant end is situated at Singapore and the service is extended to most of the principal places in Malaya by landline.

★ ★ ★

Telephone Service with Israel.—Telephone service was originally provided over the Anglo-Egyptian radiotelephone service to Cairo and

thence by landline to Jerusalem, but the service was suspended some two years ago. A direct service has now, however, been opened with the State of Israel, and the charge has been reduced from £3 6s. 0d. to £3 for a three-minute call.

★ ★ ★

Emergency Telephone Service—Why "999"?—Speed is the essence of the emergency telephone service. Consequently, the suggestion is frequently made to the Post Office that valuable time would be saved if, instead of the code "999", a lower code such as "111" or mixed digits such as "123" were used for the service. The choice of numbers suitable for the emergency service is limited by technical and operating considerations and also by the interests of telephone users. Experiments clearly proved that it was better to use the same digit throughout than any mixture of digits. For technical reasons, it is impossible to arrange for emergency calls on a number less than "999" to be made from a public call box without the insertion of 2d. in the coin box. Furthermore, the use of a dialling code of lower numbers would necessitate the changing of many exchange names and subscribers' numbers in all parts of the country. An additional advantage in using "999" for the emergency service is that it is easy to dial in darkness or in smoke, owing to the proximity of 9 to the fixed dial stop, by using two fingers with the dial stop as guide.

★ ★ ★

Recording of Telephone Calls.—A booklet which explains how telephone calls are recorded, and the arrangements made to ensure the correctness of subscribers' accounts, is being issued to Post Office staff whose duties bring them into contact with subscribers. Although the booklet is primarily for the instruction and use of the staff, it will also be supplied to subscribers on request.

It is felt that the information in the booklet about the mechanical aids, staff training and supervision for the correct recording of telephone calls should dispel any doubts a subscriber may have concerning the accuracy of his account.

★ ★ ★

Public Utilities Street Works Bill.—The introduction of this Bill in the House of Lords in April last was the fruition of work in a complex field that had been in progress for several years. Various other organisations as well as the Post Office are concerned in the laying of plant under public roads, and the present legislation covering the breaking up of highways codifies modern policy on a matter that has been the subject of 25 General Acts and something like 5,000 local and private Acts.

This complex problem was considered by a Committee of both Houses of Parliament which was set up under the chairmanship of Lord Carnock before the war. The Committee reported in June, 1939, but owing to the outbreak of war its recommendations could not be followed up. The present Bill is based on the findings of the Carnock Committee after further protracted negotiations with interested parties. It aims to regulate the conditions under which underground plant may be placed in the highways; the conditions governing the plant after it is in position, including the allocation of costs when its removal is necessary; the mutual protection of the various undertakings having apparatus in the same street and the general rules of routine and procedure, including the arrangements for arbitration. The Bill, if it is passed, will undoubtedly prove a blessing to those who need to concern themselves with this thorny and tortuous question.

★ ★ ★

Greetings Telegrams and Cheap Trunk Calls.—On July 12, 1950, the Postmaster General, the Rt. Hon. Ness Edwards, M.P., announced that the Greetings Telegram Service would be re-introduced in November next with a minimum charge of 2s. for 12 words. The new Greetings Telegram form will be similar in style to that in use before the war, but of a new design. There will also be a new design of decorative envelope.

He also stated that, in October, the period during which cheap trunk calls may be made will be extended. The period will be from 6 p.m. to 10.30 p.m. for calls by subscribers and from call offices.

★ ★ ★

Mr. C. O. Horn.—We welcome to membership of the Editorial Board Mr. C. O. Horn, Deputy Regional Director, London Telecommunications Region.

A vacancy existed on the Board as a result of Mr. F. J. Tickner's departure to the Treasury.

Letters to the Editor

Can the Post Office Telephone Service take further steps to meet the economic situation?

From G. Helliwell, Traffic Superintendent, Middlesbrough Telephone Area.

I should like to comment on Mr. Golothan's three suggestions for adapting arrangements in the telephone service to meet the present economic situation.

Extension of Shared Service.—To plan our cables on the basis of shared service may result in a shortage of local line plant even under shared service conditions, as development forecasts will become no more accurate when divided by two. There is, moreover, the point that in the past, the margins provided in our planning have not been adequate to meet a rapid growth in demand; and there is something to be said for having the margin that development of shared service may give when times are more normal than they are now.

Restriction of Residential Subscribers' Service.—There are several objections to this proposal.

(1) If service is to be withdrawn for 5 hours out of the 16 hours during which a subscriber normally makes calls, he could presumably claim a rebate of rental. Most of his incoming calls will be from other residential subscribers, therefore we should virtually be withdrawing all service, but we could not afford this, as we should actually be losing money by the loss of calls with no compensating equipment savings.

(2) It is conceivable that traffic would actually rise as a result of tradesmen soliciting orders by telephone.

(3) Subscribers would not secure uniform treatment. For example, a subscriber might rent his line at the business rate merely to avoid liability to have his service interrupted. Withdrawal of service might depend upon whether the subscriber's exchange were overloaded or not, or, whether (in the case of a line shared by a business and a residential subscriber) it were manual or automatic, or, if it were automatic, whether he had separate metering.

(4) If a shared service subscriber complains of absence of secrecy, he is told that this is really an advantage, as it will enable him to make a call in an emergency when the other sharing subscriber is using the line, if the latter agrees. It would therefore be desirable to exempt shared service subscribers from the restriction.

(5) If we argue that residential subscribers do not make many calls during business hours, we reduce to negligible proportions the advantage to be derived from the scheme. On the other hand, if the saving from the scheme would be appreciable we should be withdrawing a popular facility, and be inviting a demand for rebate, as mentioned under (1) above.

All these objections may have been overcome in the cases in London referred to by Mr. Golothan, and it would be interesting to hear more of them.

Differential Call Charges.—I have ascertained the ratio of afternoon busy-hour long distance calls to morning busy-hour long distance calls from the last five operating statistical records taken in this Area, with the following results:—

Date	Ratio of Afternoon to Morning
May, 1948	77 per cent.
November, 1948	78 ,, ,,
May, 1949	87 ,, ,,
November, 1949	90 ,, ,,
May, 1950	101 ,, ,,

The numbers concerned are comparatively small and, in any case, may not be representative of the country as a whole. For example, the two largest exchanges are overloaded during the morning busy-hour and this may be forcing traffic over to the afternoon. If they are representative, the only scope for diverting traffic from the morning to the afternoon is determined by the relatively short distance busy-hours, and on the May, 1950 return this ratio was 78 per cent. Much of this is timed, however, and would be affected by the differential charges, so it appears that there is comparatively little margin, in terms of valued calls, which can be made up without shifting the overall busy-hour to the afternoon.

A further increase in call charges would not be well received by industry, particularly if it could not be justified on economic grounds, but I think that a system of differential charges on the following lines might be advantageous

from both equipment and staffing points of view:—
Morning—7.0 a.m. to 12 noon, Rate 1, 4s. maximum.
Lunchtime—12 noon to 2.0 p.m., Rate 2, 3s. maximum.
Afternoon—2.0 p.m. to 6.0 p.m., Rate 1, 4s. maximum.
Evening and night—6.0 p.m. to 7.0 a.m., Rate 3, 1s. 6d. maximum.
This would tend to divert traffic to the lunch-hour period, when staff redundancy usually exists, and it might achieve some reduction in the busy-hour load.

Fifty Years' Progress in Marine Wireless.

From J. W. Clayton, Postmaster, Hatfield.

It was with considerable interest that I read the article "Fifty Years' Progress in Marine Wireless" in the May number.
I visited the exhibition at the Baltic Exchange as a result of seeing the various groups of transmitters and receivers on television, and particularly the group representing 1910-1920, as this was labelled "MPB", which most of the older operators will recognise as the call sign of the Empress of Britain. I served as Wireless Operator in this ship from 1918-1919, and it may be of interest to record the fact that, in 1919, it was possible to communicate in daylight at over 1,000 miles with the Marconi 1½ kilowatt fixed spark gap transmitter shown at the exhibition. I also recall sending 400 messages manually in four hours to Father Point (VCF), which compares with, if not excels, present day working with modern apparatus.

(Letters on subjects of general interest would be welcomed. They should be as brief as possible.)

Book Received

TELEVISION IN YOUR HOME: EVERYTHING THE POTENTIAL VIEWER NEEDS TO KNOW. By W. E. Miller, M.A.(Cantab.); published May 20, 1950 at 2s. (postage 2d.) by Iliffe & Sons, Ltd.; size 7½ 5; 64 pages and 30 diagrams.

The contents include advice on choice of set, hints on obtaining good reception, and answers to many questions which may trouble potential viewers, together with information on how programmes are received and the type of entertainment provided.

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Publication and Price. This Journal is published in November, February, May and August. Price 1 –. The annual postal subscription rate is 4 6 post free to any address at home or overseas.

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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.

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