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 con-
centric 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 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.

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...
Laying the Atlantic cable in 1865. The old frigate Agamenamon 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.

Laying the Atlantic cable in 1865. Paying-out machinery on board the Great Eastern at Sheerness.

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 circulated 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 landing 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 affinities with the Mediterranean and the Peninsula."

MR. SGUAMORE OF THE POST OFFICE AND THE PROBLEMS OF THE SUBMARINE CABLES

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would be no difficulty if they were purchased on the Austrian Government. Each section of the line would belong to the French, another to the Swiss, another to the Continent, America, India and China, and another length to the Submarine Company, another length to the English Government, another bit belongs to the English Government, another opposite line from London to Vienna. A little branch line 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—of 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 profits? 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 promoters 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 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 for 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 1876, 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, partly 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 Precece, 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 1st. Thus, barely thirteen years after the establishment of the earliest telephone exchange in this country, the world's first submarine telephone cable was working.
The Principles and Practice of Telecommunications Finance
by E.H.G.A. Kuhl, I.S.O.

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 into motion 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.

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 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 reprocessed or changed in form, place or ownership, generally defined as Capital.

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 a person is willing to 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 also represents the 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 ev ery day pay wages to the workers, salaries to the management, rent to the landlord, and State taxes to the State in all its manifestations exerting its powers. The extra 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, of 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 appropriates the total product of industry between the producers while these in their other capacity of consumers complete the circle. Further,
Illustrations Drawn from the Field of a Private Business

There may still be some, however, who are wholly unconvinced, or who, while admitting the view that the machinery is 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 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 that the owner intends to expand 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 happens if 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 expedients, 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.

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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 expansions in demand, changes of fashion or of technique, always interfere with this relationship, a proof that the circular flow of money is not a mechanistic plan.
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 the extent to which they differ materially from and are more restrictive than, the conditions which would face an owner of a business.

The Post Office possesses 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 required by the Post Office is voted by Parliament and explains the differences and the Estimate of additional expenditure to be incurred by the Post Office comes to the conclusion that it must cover all other day-to-day expenses, for example, salaries and wages of administrative, executive and operating staffs and those of other Ministries, go to make up the requirements by which the original Estimates were based. This is called asking for 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 on the efficiency of the Department’s planning on which the original Estimates were based. It also offers an opportunity for general criticism of the relationship between the owner of a business and the Comptroller and Accountant General and the Comptroller and Accountant General will be able to answer any questions which members of the House of Commons, and the Director General and the Comptroller and Accountant General have failed to answer before the Committee may wish to raise.

(ii) Vote.—Authority for the remaining funds required by the Post Office is voted by Parliament annually on estimates prepared by the Post Office 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.

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 Vote is carried 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.

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 result of the debate on the Estimate the Committee 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 close that they 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 the 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 Income and Expenditure Account for that business would be simple; no difficult complications would be introduced even if in any given year the business had to be treated as a going concern for the purposes of the assessment. The preparation of a balance sheet, of a loss account, and the calculation of the profit for 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 £2 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 over 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 ten years. This is a period which is 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.

(a) 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.

(b) Commercial Accounts.

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Other differences are caused by adjustments of the debts 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.

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(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 such accounts as the Depreciation Account and Telephone Services rendered to other Government Departments. Although several 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 debts 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 Accounts show the revenue for 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 maintenance, 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 acquisition of plant can only be obtained by 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 subscribers, however, is not charged with interest on the full prime cost of the plant, as credit is given for charges of interest which is an object 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.

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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.

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.

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.

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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 operator at the instrument panel. Whether the correct hand is used in operating the single or double break lever, or the correct methods of making a connection on the Counter, visual aids are of immense value in this type of training.
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 (30 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 imposed twice. The final gumming test is a minimum of 30 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 fourteenth 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 thought in 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.

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 no longer 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:

(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 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 mechanisation of large and complex telephone networks than any other development since the early days of automatic telephony. In the present instance, the use of
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 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 automaticisation 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 those of the Strowger pre-2000-type, and the exchanges in the larger towns and cities are,
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 step-by-step exchanges. 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 are, however, similar in unit automatic exchanges in this country, where they are served by six-figure numbering schemes.

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 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.

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 5, with typical selector in figure 6. 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. However, 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.

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 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, completes the connection and releases. These operations are all affected 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 suit 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, the 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 of America. In Europe, 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 the 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 small rural exchanges. 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 given the same facilities. Thus, the Swedish Administration has estimated that 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 number 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 from 500 lines up, and those in Sweden to have 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 switcher, can be 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 to be retained 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 basic 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 interworking 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 nationwide subscriber-dialling. In the next article I shall deal with the problems of interworking between different networks, the effect of 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


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-
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 II, 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
was inspected at the Dorchester Hotel, the Odeon Cinema, Penge, and the importance with 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 Assistant Traffic Superintendent grade 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.

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 attempted. 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, in 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...
First and second floors respectively. We decided and welfare accommodation occupy the ground, this exchange, the apparatus room, switchroom automatic exchange with a manual board. In the Area of the Home Counties Region, was chosen Sevenoaks exchange, in the Tunbridge Wells is used.

Students taking the courses for which the model purpose is clear from the comments of the Department. 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 necessary. 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. 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 rings were made from wood.

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 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 rings were made from wood.

Construction of the Model

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 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 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 automatic 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

Photographic Work

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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 switch-board positions to be effected in a few minutes!

Acknowledgements

We should like to record our thanks to the Factory 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.

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.

Acknowledgements

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 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.

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
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 364,000 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.

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, 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 teletypewriter switching system. The names of associated companies and administrations abroad, and the model of the latest cable repair ship, the C. S. Edward Wishes, 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.

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.

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 known engineering firm, the junior section of a university 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 usually be traced without the assistance of a Post Office engineer and remedied by the local electrician.

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. Most of these 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 staff on permanent establishment, 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.

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

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 Greek, 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 over the new route and, with the view to overcoming this difficulty, the new service is being relayed via Nairobi, Kenya. The radiotelephone 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. 6d. 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 as well as 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 of 2 digits. The new Greetings Telegram form will be similar in style to that in use before the war. He also stated that, in October, the period during which a 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 reduction in the number of calls 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.

Letters to the Editor

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

From G. Helwell, Traffic Superintendent,
Middlesex 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 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.

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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 are actually 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 provision for a metering rebate.

A further increase in call charges would not be welcome 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
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, Haslar.

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 Empire 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 1 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.

The contents include advice on choice of plans, 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.

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 included in this publication. Copyright of the contents of this Journal is reserved. Application for permission to reprint all or part of any article should be addressed to the Editor.

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