1928.

NEW ZEALAND.

POST AND TELEGRAPH DEPARTMENT.

TELEGRAPH AND TELEPHONE ENGINEERING DEVELOPMENTS IN EUROPE AND AMERICA

(REPORT OF THE CHIEF TELEGRAPH ENGINEER ON).

Laid on the Table of the House of Representatives by Leave.

The SECRETARY, GENERAL POST OFFICE, to the Hon. the POSTMASTER-GENERAL AND MINISTER OF TELEGRAPHS.

(Memorandum.) General Post Office, Wellington, 22nd February, 1928.

I HAVE the honour to submit to the Minister the report of the Chief Telegraph Engineer (Mr. A. Gibbs) on his recent trip abroad.

The report is a most valuable one, and it is suggested that, after its contents have been made available for the information of Cabinet, the Minister approve of the report being printed for immediate use within the Department.

The Hon. the Postmaster-General and Minister of Telegraphs. G. MCNAMARA.

The CHIEF TELEGRAPH ENGINEER to the SECRETARY, GENERAL POST OFFICE.

(Memorandum.) General Post Office, Wellington, 10th February, 1928.

I BEG to submit herewith a report covering the results of my investigations into recent developments of telegraph and telephone engineering in Europe and America.

A mass of detailed information has been accumulated bearing upon engineering and allied departmental activities. As matters of this kind can more properly be dealt with in Engineering Conferences and in a series of technical bulletins that are to be prepared for circulation among officers of the Department, the accompanying report deals almost exclusively with the broader aspects of the subjects investigated, giving an outline of the trend of modern developments and their bearing upon New Zealand communication practice, present and prospective.

A. GIBBS,

The Secretary, General Post Office. Chief Telegraph Engineer.

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REPORT.

INTRODUCTORY.

In accordance with the decision of Cabinet, I left Wellington on the 4th May, 1927, with the dual object of representing New Zealand at the International Radio-telegraph Conference at Washington on the 3rd October, and of investigating *en route*, in Europe and America, the latest engineering developments of telegraph and telephone communications.

Since the visit abroad of my predecessor in 1920 no engineering representative of the Post and Telegraph Department had been engaged on such a mission. That the time was ripe for an inquiry of this nature is fully demonstrated by the fact that since that date remarkable advances have been made in the communication art, which received great impetus and intensive development on account of the extraordinary demand for electrical-signalling systems during the Great War.

Prior to leaving New Zealand a visit was paid to its principal centres with a view to making a final survey of our own practice, and of conferring with departmental Engineers and others responsible for the operation and maintenance of the telephone, telegraph, and radio plants in the several engineering districts. As a result of this survey I was afforded a final review of the operating and maintenance features of both line plant and internal equipment, and was able to prepare a complete list of subjects calling for investigation or upon which fuller information was sought. These subjects were duly classified, and in a readily available form served a useful purpose in focusing attention upon matters of primary importance to our electrical systems of communication.

Arriving in England early in June, 1927, two months were available for investigation in Great Britain and Northern Europe prior to visiting the United States and Canada and acting as the New Zealand representative at the Radio-telegraphic Conference in Washington, D.C.

While in London every assistance was rendered by the High Commissioner for New Zealand, whose office organization proved invaluable in arranging appointments with manufacturers and in facilitating my work generally.

I cannot speak too highly of the assistance rendered to me both by Government and by privately-owned telegraph and telephone administrations and corporations, and by commercial firms interested in the manufacturing side of electrical engineering. In all places visited—Great Britain, United States of America, Canada, Belgium, and Holland—high administrative and executive officers cheerfully gave me much of their time, discussing important phases of present and prospective telegraph and telephone developments and organization. In addition I was invariably permitted to work down through these undertakings and gain contact with those responsible for practical production, operation, and maintenance. Everything possible was done to enable me, in the time at my disposal, to cover as wide a field as possible. The unfailing courtesy manifested by all sections of the telegraph and telephone services with which I came in contact in these countries has left me with a great admiration for the magnanimous spirit and wide international outlook of those chiefly responsible for the world-wide development and extension of electrical communications.

My plans had to be made with a view to covering as wide a field as possible before the commencement of the International Radio-telegraph Conference. While in London it was arranged that I should attend a conference of British Empire delegates at Ottawa on the 19th September, 1927. This left me only three months in which to carry out a programme of investigation which contemplated a survey of the whole range of telegraph and telephone engineering, and for conferring with the numerous manufacturers with whom the Department carries on a large purchasing business in telegraph and telephone plant and equipment. In addition to our important interests in Great Britain, it was necessary for me to pay a brief visit to Belgium and Holland, and to spend some time in the United States of America, the home of the telephone, prior to visiting Canada in September.

The head offices of over fifty manufacturers of telegraph and telephone and general electrical plant were visited, and New Zealand business and conditions freely discussed. In addition, calls were made at forty different works engaged upon various sections of telegraph and telephone manufacture. The inspection of the many processes involved was highly illuminating, and furnished valuable knowledge regarding subjects upon which only very meagre information had hitherto been available.

This programme involved a considerable amount of travelling, and could not be covered in the time at my disposal without leaving untouched a wealth of detail, the investigation of which would have afforded me a considerable degree of satisfaction, and which would have proved a valuable asset to the Department. Under the circumstances my visits to telegraph and telephone administrations and to manufacturers and works were necessarily of a limited duration. I therefore endeavoured primarily to gain as close an acquaintance as possible with matters of broad engineering policy likely to prove of value in shaping our line of action and development, and, as opportunity afforded, spent as much time as practicable in detailed investigation of matters that appeared to be of immediate interest, or capable of early application. Due to the courtesy and assistance extended to me, a wide range of information and literature was secured on all subjects of primary importance.

TELEPHONY: AUTOMATIC AND MANUAL.

Statistical.

New Zealand holds a prominent place in the world statistics of telephones in proportion to the population. The latest figures available show the following results:—

	Telephones per 100 of Population.
United States of America	14·8
Canada	12·2
Denmark	9·2
New Zealand	9·2
Australia	6·1
United Kingdom	3·0

In the application of automatic-telephone switching methods New Zealand also holds a relatively high position. It was somewhat of a surprise to many telephone authorities to learn that our telephone system had already made such an extensive use of machine-switching methods. Of the 136,000 telephone-stations now connected with the Government system in New Zealand, 62,000 are working on the automatic system, and when present installations are completed there will be more than 68,000 automatic telephones in operation, giving a ratio of automatic telephones to the total number of stations of slightly over 50 per cent.

Rival Systems.

Our principal centres, with the exception of Christchurch, have already been converted to the "rotary" automatic system, and the latter installation is well under way. This particular type of automatic system has been manufactured to a large extent in Belgium. Apart from two small exchanges in the United Kingdom giving a very satisfactory service, its use is confined mainly to the Continent, where it is undergoing considerable extension. The system is being highly developed to meet the most exacting needs of telephone communities. In fundamental circuits and principles it is related closely to the "panel" system now being introduced by the American Telephone and Telegraph Co. for use in the largest cities of the United States of America by its associated Bell telephone companies. While the panel system has certain inherent advantages for the interconnection of networks consisting of a large number of full-sized branch exchanges, the rotary system provides at a much lower cost the same advantages for cities comparable to those found in this country. My investigation into the present state of the rotary system and its extension on the Continent enables me to state that this system, which was adopted for the four principal as well as four of our smaller centres, is fully competent to give the highest grade of automatic-telephone service to our urban communities. The same may equally be said of the somewhat smaller automatic installations which have been provided in other parts of New Zealand and which belong to what is technically known as the "step-by-step" system, which originated in the United States of America and has extended to all parts of the world.

Types of Automatic Telephone Exchange Equipment.

Several types of automatic exchange systems have now been developed. Opportunity was taken of visiting manufacturers of the same, discussing the relative merits and demerits, and obtaining the latest bulletins regarding their distinguishing features and operation. The following systems came under observation:—

Rotary system of Standard Telephones and Cables, Ltd. (late Western Electric Co.), London (works visited at Antwerp).

Step-by-step systems:—
- Automatic Electric Co., Chicago.
- Automatic Telephone Manufacturing Co., Liverpool.
- Peel Connor (General Electric Co.), Coventry.
- Siemens Bros., Woolwich, London.
- Standard Telephones and Cables, Ltd., London.

Ericsson system of the L. M. Ericsson Co., Stockholm (system inspected at Rotterdam, Holland).

Relay Automatic Telephone Co., Ltd., London.

Panel system of the Automatic Telephone and Telegraph Co., New York.

London Automatic Exchange network, consisting of a step-by-step Director system.

Telephone-manufacture in the United Kingdom.

In the United Kingdom telegraph and telephone factories have of recent years undergone considerable extension and modification. Plant has in many cases been redesigned with a view to mass production on a sound manufacturing basis. These changes have been brought about by such factors as the automatic telephoning of London, the heavy post-war demand for catching up with arrears of telephone plant, and by the rapid changes which of recent years have occurred in telegraph and telephone methods and practice, necessitating extensive alterations to plant, machinery, and previously-standardized methods.

London Automatic Exchange Network.

During my stay in London I was able to view the installation of automatic apparatus to provide for the London metropolitan network. The system adopted for London is the step-by-step system, and to adapt it to the needs of such an extensive network auxiliary apparatus known as the director system has been developed. The problem of interconnecting a number of large exchanges is a difficult one, which has been met in England and America along different lines. In the United States, as already indicated, considerable use is being made of the panel system, which has been specially designed to handle large volumes of traffic between the different branch exchanges in the network. London will be the first city of such magnitude to obtain the same results by means of the director system and the employment of step-by-step apparatus. The director apparatus, in response to the dialling of the wanted number by the subscriber, substitutes a new series of electrical impulses designed to direct the call over appropriate connecting-links to the branch exchange in which the wanted subscriber is located. Since my return to New Zealand, cable advice has been received that Holborn Automatic Exchange has been brought into operation, which means that the first important step has been taken in the conversion of the London telephone system to modern automatic methods. It may be of interest to New Zealand automatic-exchange subscribers to know that in London and all cities of similar size seven figures must be dialled, instead of five as in our principal New Zealand centres.

Neither the director system used for London nor the panel system being used in New York and other large cities of the United States is of direct interest to New Zealand, which does not possess the large concentrations of population which exist in the older lands, and which form the most appropriate field for systems of this nature. These systems do, however, possess certain features which may ultimately prove useful in this country, and these have been noted.

Automatic Exchanges visited and compared.

Every opportunity was taken to visit exchange installations, both automatic and manual, and to compare notes with those responsible for their operation and maintenance. In this way one was able to compare the installation and operation features and maintenance costs with New Zealand results. Much useful information has been collected in this way, which, along with other matters incidentally referred to in this report, will be made the subject of special treatment for those officers who are responsible for the various phases of these systems in New Zealand. Automatic and manual switching exchanges of all kinds were inspected in England, Belgium, Holland, Canada, and the United States. On the whole, it can safely be said that in many cases the New Zealand automatic installations compare more than favourably with those seen in other countries, and it can confidently be predicted that the methods employed in installation and the care given to details by our engineers and mechanicians will reflect themselves in efficient operation, reliable service to the public, and comparatively low cost of maintenance.

Cutover Procedure.

In changing over from manual to automatic telephone-exchange operation a great deal of preliminary work has to be done on both the outside and inside plant in order to facilitate a speedy and accurate change from one system to the other. It has been of value to study the methods adopted in other countries and to compare them with our own. It has been interesting to note that in certain important features the methods adopted by our Engineers in relation to these major operations have possessed many ingenious features. Not only have they contributed towards highly satisfactory results, but, in addition, this complicated feature of the transition has been executed at a minimum of cost.

Application of Automatic-switching Methods to the Smaller Telephone Communities.

As already indicated, the larger New Zealand centres are well provided for in the matter of machine-switching telephone systems. From the automatic standpoint the outstanding telephone engineering problem in New Zealand, as in other countries visited, is to render available to the smaller communities the undoubted benefits of automatic methods. These advantages are well recognized, and are along the lines of uniformly quick and reliable service at all hours of the day or night, irrespective of holidays and other similar conditions; secrecy of conversation; quick disconnection and reconnection to another subscriber, and general high grade of service. These advantages are more fully appreciated at small exchanges where it is not economical to provide a high grade of manual service during twenty-four hours of the day.

There are already installed in small exchanges in New Zealand, consisting of only a few hundred lines, automatic switching-apparatus meeting all the above conditions, including the automatic operation of ten-party rural lines, but the difficulty has been to "prove in" this system on economic grounds. This difficulty is not peculiar to New Zealand, and was discussed frankly with me by manufacturers of such equipment, who were very pleased to be able to obtain first-hand information as to the conditions obtaining in New Zealand and the modifications considered desirable to enable automatic switching to fulfil the requirements of such situations. Certain manufacturers had already seriously addressed themselves to this problem, and a good deal of developmental work had already been done. By discussing the matter at this stage manufacturers were able to gain a clearer idea of the conditions which we desire to meet in our rural communities, and, on the other hand, I was able to obtain first-hand information as to the extent to which these demands could be met at the present stage of the art. New Zealand is in certain respects ideally situated for the extension of automatic switching into its country districts by reason of the fact that a number of strategic centres

are already equipped with automatic apparatus. These could serve as parent exchanges, and exercise the necessary supervision and maintenance over smaller equipments in surrounding districts, thereby considerably reducing the costs of operation and maintenance. Parent exchanges act as bases from which periodical inspections are made, and on which local toll lines can be concentrated and operated from a common centre, instead of being scattered throughout the district and operated from isolated points having limited hours of service.

By reason of the discussions that have taken place and of the information that has been supplied to me, we are now in a position to review such situations and to prepare specifications that have a reasonable hope of being satisfactorily met by manufacturers of this class of equipment.

Modernized Manual-exchange Equipment.

The growth of automatic methods of exchange operation has called forth new ideas and practices on the part of companies which still confine themselves to the manufacture of manual equipment. Many improvements have thereby been effected which are in the nature of simplifying operation and reducing manual staff to a minimum. Free use is made of "automatic signalling," and provision has been made for the greater employment of "team working" among telephone operators. These methods constitute a serious rival to the extension of automatic methods into smaller centres, and careful studies will have to be made in each case to determine which process will best meet the needs of our rural communities.

Automatic *versus* Manual.

The main features to be considered in viewing the above situation are the following:—

(1) The economic aspect, after making due allowance for the relative efficiencies of the different methods employed.
(2) The adaptability of such equipment to existing building-accommodation, the unsuitability of which for automatic operation in some cases causes the latter to prove unduly costly.
(3) The robustness of the automatic apparatus and freedom from such complications as would militate against remote control, testing, and maintenance by periodical visitation from a common centre.

These features have been fully discussed with manufacturers, who understand that these points will receive due consideration in the selection of equipment.

Intercommunication between Adjacent Exchanges.

A problem which I was glad of the opportunity of discussing with telephone experts of other countries is that of the conditions governing intercommunication between adjacent exchange areas. Separate exchanges within a short distance of each other and having considerable community of interest are usually given intercommunication on payment of a toll fee. In New Zealand the minimum charge for such short distances is 4d., a considerable part of which is absorbed in operating and collection expenses. The gain to the Department is small, and the imposition of a toll fee is naturally somewhat restrictive of traffic. On the other hand, a free service would have certain objections, as the increased demands on the service would unduly inflate operating-expenses and render necessary additional capital charges for outside plant and exchange switching equipment. Usually a section of the subscribers makes little use of the toll service, and is quite satisfied to pay a toll fee when and as required. A uniform increase in annual rental to cover full intercommunication with the neighbouring exchange, while favourable to the big toll-user, would press somewhat heavily on the small user. Such treatment would in reality consist in the application of the existing flat-rate rental system to the toll service. The problem is considerably simplified where both exchanges are operating upon automatic principles.

The ideal treatment would appear to be the provision of an alternative and automatic toll method, which on the one hand would charge for individual toll calls as they were made, and on the other provide full intercommunication at a fixed increase in the annual rental. The technical as well as the commercial aspects of this situation have been gone into, and the information obtained as to existing practice in other countries will be of value in determining the best course to pursue in the different situations that arise in practice.

Provision for Growth of Telephone Systems.

Another subject which vitally affects countries situated any considerable distance from telephone-factories is the extent to which provision should be made for "idle plant" in anticipation of the connection of new subscribers to the exchange system. All over the world there is an increasing demand for telephone service, and the utility of the telephone as a means of annihilating distance and of effecting economies in time and personnel is becoming universally recognized. It is the general opinion of engineers concerned with the study of such developments and the provision of plant that estimates of growth are more frequently under than over estimated, and that in a progressive community liberal provision must be made for the growth of the telephone system if demands are to be met within a reasonable period. This argument applies with all the more force to a country such as New Zealand, situated a considerable distance from the source of supplies and subject to the numerous and unfortunate delays which have arisen from time to time in connection with deliveries and shipping troubles. Definite information has been gathered with regard to the practice of other administrations in making provision for anticipated development, which will prove a useful check in connection with our own planning for future requirements.

Prospective Telephone Exchange Installations.

Several of our telephone exchanges are outgrowing their term of useful life and the capacity for which they were designed. Special attention was therefore paid to the developments now taking place in connection with such equipment, and these prospective works may now be planned with full knowledge of the best and most recent methods of meeting their specific needs.

Power Plant: Machines.

The introduction of machine switching methods both for telegraph and telephone services has resulted in the use of considerable quantities of electrical machinery to furnish the power for the electro-magnetic and signalling apparatus employed. The power plant has become a vital part of our telegraph and telephone systems, and upon its successful operation the reliability of the service given very largely depends. Power plants suitable for our purposes were discussed with electrical manufacturers, recent developments noted, and investigation made as to the extent to which reserve sets are provided to overcome emergencies due to the failure of city electrical supplies. Our practice in this respect can now be unified to a large extent, and due provision be made without the fear of unduly increasing the capital cost of the equipment.

Power Plant: Dry Batteries.

This type of power unit is largely used in telegraph and telephone practice, and to form an efficient element must invariably have a long life at a low intermittent discharge rate. Many thousands of these cells are used annually by the Department. The manufacturing processes were inspected, and arrangements made for samples of promising cells to be sent to our laboratory for test as to their suitability under New Zealand telegraph and telephone conditions. The methods adopted by the laboratories of different administrations in gauging the suitability of these cells were also noted, and the information gained under this heading will supplement that already obtained by the Department's testing section.

Power Plant: Storage Batteries.

The manufacture of storage batteries of different types was inspected, and the conditions surrounding the performance of these important units of telegraph and telephone power plants discussed with manufacturers and operating companies. The subject is one in which there are wide variations of practice among the electrical-engineering fraternity, and the opportunity of discussing with battery experts debatable practices was availed of as widely as possible.

Upon the latest practice in relation to such features as the following, and their effect upon life and output, useful data were collected: Battery design, general; plate separators; electrolyte and oil coatings; battery troubles—causes and remedies; treatment of defective cells; battery-room design; installation methods; charging methods.

With respect to the latter subject, telephone-exchange charging practice has recently undergone certain changes with the object of economizing battery-capacity and at the same time maintaining it in a condition to act at all hours as an emergency unit in the event of a temporary failure of outside power. The relative merits of the various methods, such as "off-load charge," "full and partial float," and "trickle charging," were investigated.

Air-conditioning Plant.

In order to increase the life of automatic-telephone-exchange equipment, and to reduce maintenance costs due to the harmful effect of humidity and dust, some of the more important automatic installations in this country have been provided with what is known as "full air-conditioning plants." Such systems are in operation at Auckland, Hamilton, Wellington, and Dunedin. The method employed is to convey to the switch-rooms, by ducts, air which has been washed with refrigerated water, and which is then raised to a temperature in the vicinity of 65° Fahrenheit, but having a uniform relative humidity in the region of 65 per cent. Considerable benefits have been derived from the use of such plants in situations where humidity and dust were serious considerations. The time had arrived, however, when the extension of such full air-conditioning plants to smaller exchanges of the automatic type was difficult to prove in on economic grounds, by reason of the greater ratio of air-conditioning plant cost to total investment.

A study was made of the systems employed in other countries, and of the condition of telephone equipment under widely varying methods of treatment. The subject was also discussed with manufacturers with a view to seeing what modifications in design were possible in order to meet, at a lower cost than was possible for the larger installations, the less-exacting conditions found in smaller exchanges.

In taking definite measures of this kind for the treatment of the air supplied to the rooms housing its modern telephone equipment New Zealand methods have been somewhat of a pioneering character. I found that opinions as to the particular method of treatment that should be employed under different conditions were very much divided, and other administrations were interested in our installations and experience gained thereby. I am satisfied, however, that the action taken to date has been fully justified, and that with the information now available each case can be studied on its merits and a satisfactory decision reached.

Fire Precautions.

A topic of common interest was the means adopted for minimizing fire risks in connection with telegraph and telephone equipment. This subject is of more than usual importance to a country situated so remote from the great manufactories of the world. We have so far been singularly fortunate in the avoidance of serious dislocation of telegraph and telephone traffic by reason of fire losses. The latest and most approved precautions that are being adopted by other interested parties have come under review, and useful information obtained. In this minor subject, as on matters of major importance, the resources and experimental work of both Government and private telephone administrations have been made freely available to me.

Auxiliary Telephone Apparatus: P.B.X. and Interphone; Telephone Pay Stations.

The apparatus with which the subscriber is most familiar is the telephone, which is the essential unit of a telephone substation installation. With the growing complexity of modern business methods there have arisen from time to time demands for auxiliary apparatus which will give intercommunication between the various units of a business concern, and, in addition, enable communication to be obtained with the central exchange system. I find that in the matter of studying the interests of subscribers and of furnishing apparatus auxiliary to the telephone for meeting the various needs of business intercommunication New Zealand has little to learn from other countries, and, in fact, has in some respects gone much further than the older countries of the world.

There are few countries where—as is the case in New Zealand—private automatic exchanges are installed by the Telephone Department, capable of giving full automatic intercommunication between the different units of a commercial concern, and at the same time of providing full automatic communication to or from any internal extension to any subscriber connected with the central exchange system. In most cases it is imperative to employ an attendant in the commercial house to attend both to incoming and outgoing calls.

Another innovation in New Zealand has been the introduction, as a component part of the public system, of intercommunication key-boxes—commonly called "interphone sets." These provide intercommunication service by a simple process for systems up to about twenty internal lines, and also give service to the central exchange from any point. In New Zealand these interphone sets are installed by the Department where required. They are furnished with special facilities to enable the user to hold a call from the central exchange while obtaining over the interphone set information from a local source necessary to the completion of the business being discussed with the outside client. The use of an attendant is by this process limited to calls incoming from the central exchange system. Unlike the automatic private-exchange system just referred to, the interphone system does not give absolute secrecy, but apart from this feature it is a long way in advance of many of the methods being adopted by up-to-date administrations coming under my notice elsewhere. The question of furnishing secrecy for this equipment has not been lost sight of in my investigations. There are several methods whereby this additional feature could be provided, but few of them could be introduced without undesirable complications or weaknesses. The matter is, however, receiving further attention, so that the wishes of a section of our subscribers in this respect may be met if at all practicable.

The New Zealand automatic pay-station telephone (familiarly referred to as a "slot telephone"), mechanically designed by the late departmental Designing Engineer, Mr. F. Palmer, was, of its kind, as ingenious and reliable a piece of mechanism as came under my observation. By its use a full automatic pay-station service at a uniform charge of 1d. is given over the whole base-rate area of our automatic networks, and manual operating-expenses are non-existent.

Toll Operating Methods.

To some extent the connection of local toll lines to subscribers' circuits is giving place to automatic operation and registration, and within certain well-defined limits will no doubt still further reduce the manual element in telephone switching practice.

Some time was spent in observing the working of large toll offices upon which hundreds of toll lines are concentrated, and which form the long-distance "clearing-houses" for countries with a large toll network and toll-using public. In this connection I was enabled to investigate in some detail the methods of handling toll service both in the United Kingdom and the United States of America. In both countries the practice has reached a high state of development.

In the latter I found that extensive improvements in toll operating methods had recently been introduced, with results that had to some extent exceeded expectations. As in New Zealand, it had been the custom to pass all requests for toll service through a "recording operator," after which the subscriber was dismissed until such time as the toll service could be made available. At this stage an effort was made to recall him—not always with the most satisfying results. This method is being rapidly replaced by a "combined line and recording" system, whereby the subscriber gains primary contact with a toll switching operator who endeavours to give immediate service, and, failing this, in a large percentage of cases effects the connection within a few minutes, during which the subscriber "holds the line" and is ready immediately to respond when the distant station is raised. Such methods are naturally most easily and efficiently executed where the traffic justifies a group rather than a single or limited number of circuits between toll centres. They are, however, capable of assimilation into New Zealand practice at certain points, and will become more easy of application with the growth of toll traffic, and consequently toll channels, between any two centres. This change of practice has had a marked effect on the appreciation of and increased use by the public of toll facilities. The more rapid method of giving service, and the elimination of the previously irritating and disconcerting delays, have resulted in such an unexpected increase in the demand for toll calls that the system is being extended as quickly as circumstances permit. It is a remarkable testimony to the efficiency of the United States toll system that within approximately five minutes—and in many cases in a much shorter time—toll service to toll centres can be expected over a network extending from east to west over three thousand miles and embracing all States of the Union.

Auxiliary Telephone Services: Information, Time, etc., and the Relation of Broadcasting thereto.

In the most efficient telephone systems of the world it is not now the custom to give general information to subscribers over the telephone, as is done in the larger centres in New Zealand. This practice was at one time followed, but has been abandoned, for two important reasons:—

(1) That the giving of special services of the nature referred to, as well as information relating to public events, causes a diversion of the telephone facilities for which the subscriber normally pays, and a consequent degradation of its general utility. This renders it difficult for subscribers in branch exchanges to obtain the usual rapid communication with other parts of the system in cases of sickness, fire, urgent business, and similar uses. This is due to the fact that the apparatus and interconnecting junction circuits between the various parts of the networks become overloaded with the "special" calls. This condition has already been experienced in New Zealand during occasions when, for example, election results have been furnished to the public per medium of the telephone.

(2) Since the advent of radio-telephone broadcasting it is generally agreed that the broadcasting-station is the more fit and proper medium for the communication of information of general public interest. This popular medium is capable of communicating with all points in a country without causing the dislocation of other important services. It is therefore argued that those desiring to be kept posted in the progress of important events should be subscribers to the latest scientific means for the instantaneous and widespread dissemination of information of a general character.

The time has, in my opinion, arrived when due attention should be given to this aspect of telephone service.

Standards of Transmission.

Considerable attention is now being paid to the maintenance of standards of transmission and reception in connection with the transmission of speech by telephone. International standards have been set up on which substandards may be based, and the quality as well as the volume of telephone speech properly gauged. In due course we shall receive advice of the conditions under which New Zealand can be admitted to this standardization group and supplied with the necessary data and standards of reference.

Observation and Traffic Studies.

The methods whereby the service given to the public is kept under constant review were closely scrutinized and working data obtained. In all telephone organizations of note, traffic movements and observation statistics form an important part of the routine work of a highly trained section of the staff. In this respect we have a good deal to emulate in New Zealand, where, on account of the relatively low development, little has been done so far to place this phase of telephone supervision upon the efficient plane that exists in similar organizations abroad.

The traffic and commercial sections of up-to-date telephone companies are composed of specialists who are required to possess certain essential qualifications for their particular work. They make special studies of all phases of telephone development, with results that speak for themselves. Commercial engineers and assistants with suitable training relieve plant engineers to a large extent of investigations into telephone growth and prospects, and furnish reliable data upon which plant and equipment extensions may be based.

Attention to this phase of telephone organization would, I feel sure, result in many advantages in the more efficient and economical administration of the telephone service of this country.

Rates and Quality of Service.

Telephone and toll rates were investigated as closely as time permitted, and comparative data obtained, as well as information as to the basis upon which such services are made available for public use.

The ultimate effect of our New Zealand flat-rate rental system upon the calling-rate and efficiency of service furnished an important subject for investigation—particularly with the advent of a high-grade automatic service—and the information thus obtained will, it is believed, be of considerable value in guiding the policy of the Department at this stage of its development.

After reviewing the most efficient telephone systems of the world, one feels compelled to observe that the art of telephone communication is not yet finalized. The transmission of speech over long distances, both by wire and by radio, the use of thermionic repeaters and of radio-frequency methods generally, have introduced many changes into telephone technique. It will be some time before these changes become stabilized. Rapid improvements in regard to distance of transmission are possible to a progressive and financially healthy organization. It may well be expected that within a comparatively brief period international and trans-oceanic telephony will become general.

What is called "transmission quality" is also receiving an increasing amount of attention in the advanced telephone centres of the world. International standards of transmission and intercommunication are being set up, because it is realized that the day of international long-distance telephone communication is at hand.

Only by the careful and systematic development of telephonic standards may New Zealand expect to be accepted as a partner in such an international scheme. Instead of reducing rates, profits should rather be applied towards improving the standards of transmission, and hence the possible distances as well as the reliability of communication. This can be effected only by the gradual introduction of modern facilities which are at the same time more complex and more costly than those which have so far met the requirements of local and comparatively short-distance communication.

In short, it would seem more desirable to retain a scale of charges—already very favourable to New Zealand subscribers as compared with other telephone countries—which will make such development and expansion possible, than to reduce them to such a low level that the activities of the Department will be unduly hampered and future developments towards world-wide telephone communication seriously jeopardized.

Although much has been accomplished in New Zealand in the introduction of automatic telephone exchanges and the like, we are still in the chrysalis stage of long-distance-telephone development, and in many instances the quality of telephone service given falls considerably short of that maintained in the leading telephone countries of the world.

The full development of our toll facilities in New Zealand itself is not a simple economic problem. We are faced with the provision of telephone service between points which are not only remote but sparsely populated. Such problems can be met only by considering the communication system as a whole and by a judicious expenditure upon development.

Upon the careful studies of future expansion now being planned and the policy adopted in relation thereto will depend in a large measure the position of New Zealand in relation to the forward movements that are clearly discernible, and the quality and range of telephonic communication that will ultimately be possible. A short-sighted policy at this stage would throw back the advance of the art in this country, and seriously prejudice the sound development of what has now become a world-wide necessity.

TELEGRAPHS.

Machine Printing (General).

The telegraph, like the telephone, is becoming more and more an automatic process. This is more nearly the case in large centres of population having relatively greater traffic densities than in New Zealand. Telegraph circuits having a low load-factor are still operated manually, and in general by that portion of the staff most advanced in years and not possessing the adaptability and dexterity necessary for the newer telegraph systems.

Multiplex.

For some time machine-printing telegraphs were more appropriate in their application to heavily loaded circuits. At that stage of the evolution of the telegraph recourse was had to multiplex systems whereby a single circuit could be made to carry a greater number of messages simultaneously than was possible by manual methods. The multiplex system is still in considerable use, particularly in situations of the kind described, and is still to a certain extent augmented on press and similar circuits by what is know as "high-speed automatic telegraphy."

A multiplex machine-printing system has been in use in New Zealand for some years, forming a backbone to the telegraph system of this country, and utilized on the heavily-loaded circuits between Auckland and Invercargill, with extensions to most of the principal towns in the Dominion. By comparison with the performance of multiplex circuits elsewhere, it was pleasing to find that a high degree of accuracy was being obtained in New Zealand both in regard to the operation and the maintenance of the apparatus. Certain improvements have been made by our engineers and mechanics which called forth considerable commendation. Various systems of multiplex are in operation. These were duly inspected, and full information obtained in relation thereto, with a view to possible improvements in our over-all efficiency.

Simplex or Teletype.

Automatic telegraph methods are, however, no longer confined to the busiest circuits, as their use has been extended to less important lines by the employment of the teletype or simplex system. This is a development from and a simplification of multiplex, and is designed to operate on circuits of comparatively minor importance where multiplex methods could not be justified. Considerable attention has, during the last few years, been devoted towards perfecting its mechanism, with very satisfactory results. The system possesses many advantages, both technical and economic, over manual telegraphy, and, on account of the robustness of the latest apparatus, can now be introduced into situations where, by reason of its greater dependence on skilled attention, the multiplex could not be utilized. Notably in the United States of America the simplex system has been introduced into business houses, hotels, and the like for communication with central telegraph-offices. It is also used for intercommunication as a rival of the telephone where a written record free from the possibility of phonetic errors is more desirable than a spoken one.

Simplex apparatus is being manufactured in both England and the United States. I was therefore able to view its manufacture in both countries, and to study the conditions governing its introduction and operation. Very complete information has been furnished me regarding this rapid telegraphic evolution.

There is a large number of telegraph centres in New Zealand where such apparatus would prove a great improvement over existing manual methods, and where there are available, at associated automatic exchanges, officers well qualified to maintain the apparatus in a highly efficient condition. A study will now be made of the New Zealand telegraph system with a view to the introduction of simplex, which is well adapted to serve as a feeder to the arterial telegraph circuits of this country.

Commercial and Traffic Aspects of Telegraphy.

In the United Kingdom, as well as in New Zealand and certain other countries, the telegraphs are operated at a loss. Some time was therefore devoted to the economic side of telegraphy, and special inquiries made into the methods of operation adopted by private companies in the United States and Canada in which efficient and profitable results are consistently obtained. My investigations have shown that in the latter concerns no greater technical efficiency exists, apart from the greater use of automatic methods of operation already referred to; much greater attention is being paid to the training of staffs in efficient methods; great stress is placed upon the efficiency and organizing ability of what in New Zealand are known as traffic and executive officers; female staffs are utilized as typist-telegraphists to a greater extent than in New Zealand; and more striking methods are adopted to advertise and popularize the use of the telegraphs.

One point, however, was frankly conceded by the experts of these successful organizations—viz., that no telegraph system, however efficient, could be made to pay its way at a rate of 9d. for twelve words (including address and signature) over any part of a territory approximating one thousand miles from north to south. In this criticism I am forced to concur.

In the most successful telegraph and telephone organizations which I was able to inspect it was clear that the efficiency and economic success attained were not due to salary reductions, but rather to efficiency of organization and the creation of a commendable spirit of co-operation and friendly interest and rivalry among the various units of these extensive services.

Telegraph-offices visited.

Instructive visits were paid to the Central Telegraph Office, London, the main offices of the Western Union at New York and Chicago, and that of the Commercial and Postal Telegraphs at the latter place. In these stations large volumes of telegraph traffic are handled, and the methods adopted in these large and efficient services were noted with the greatest interest.

RADIO-TELEGRAPHS AND TELEPHONES.

General.

While in England I embraced the opportunity afforded of visiting the Rugby International Valve Transmitting-station, from which press is daily received in New Zealand, and which is the transmitting-station for the Transatlantic telephone speech having its terminus in the vicinity of New York.

At Grimsby I saw the beam transmitting-station responsible for the outward communication to Australia and India, and in the vicinity of London was courteously shown through the Continental transmitting and receiving stations of the Marconi Company. All the stations referred to above possess novel and interesting features, the inspection of which furnished clear evidence of the advances being made in the transmission and reception of radio signals to and from all parts of the globe.

In the United States visits were paid to the Rocky Point and River Head transmitting and receiving stations respectively of the Radio Corporation of America. These stations are in constant communication with all parts of Europe, Asia, and South America. Few modern developments of wireless telegraphy and telephony were missing from these giant stations, which are a striking testimony to the progress of international commercial radio signalling, and where, as in the United Kingdom, important experimental work is being carried on.

While in New York I was permitted to speak to London over the transatlantic radio-telephone service. The results were in every way satisfactory, and conversation as good as over any normal telephone toll circuit. The difficulties due to diurnal variations of signal strength and to atmospheric influences have been to a large extent combated, and are still the subject of important investigations and experiment.

A development which is of comparatively recent origin, and which has now assumed commercial importance, is the transmission of pictures of subjects or of general commercial matter by land line and by radio. The processes employed are somewhat too complex for general application at this stage, but there are great possibilities that this new phase of the communication art will ultimately revolutionize present-day methods.

International Radio-telegraph Conference, 1927.

The general effect of the recent wireless legislation of the International Radio-telegraph Conference has already been referred to in a previous report. The gathering of so many experts in the various phases of radio communication furnished a unique opportunity for obtaining information as to the practice and policy of wireless administrations in different parts of the world not visited by me.

Beacon and Direction-finding Stations.

A few miles south of New York, visits were paid to two of a chain of beacon and direction-finding stations which guard the approach to the New York harbour, and by means of which, in times of fog, navigation is carried on in a manner unknown prior to the advent of radio navigational methods. The stations visited are respectively named Seagirt and Manasquan. The actual operation of these stations was followed with interest, and data collected which will prove useful in considering the further development in New Zealand of these aids to the navigation of difficult coast-lines.

Marine Radio Installations.

This subject was discussed in its various ramifications with manufacturers and others, and every opportunity taken to view the latest developments in connection therewith.

One of the most notable advances is the successful introduction of an automatic signalling device whereby a ship's operator may automatically be warned that details of a distress signal are about to be transmitted by a ship in distress. The British Board of Trade has approved of the use of such a device, and the Radio Convention has recognized its suitability to replace the wireless watcher on board certain ships hitherto required by regulation to maintain such an officer for the interception of distress signals during the absence from duty of the ship's regular radio-telegraphist.

Another important movement is the growing use of radio-telephony on board small ships not required to engage in public correspondence with other ships or coast stations, and connected with private services of limited range. Technical and operating particulars of these installations have been obtained. Several of the larger steamers of different administrations carry radio-telephone equipment for communication with other ships and in anticipation of developments whereby telephone speech with subscribers to telephone exchanges will later be placed on a practicable basis.

The ultimate elimination of spark methods of signalling has been referred to in a separate report upon the Radio Conference.

As indicated in the latter report, New Zealand has the distinction of being the only country having "wireless-signallers" (mate-operators) in sole charge of its small-ship installations, and the success of this movement will no doubt be watched with interest by other administrations.

International Radio-telegraph Communication in relation to New Zealand.

Considerable interest was evinced in various quarters regarding the attitude of New Zealand towards long-distance radio-telegraph communication, which, by means of beam wireless and other systems, has quite recently received considerable application in other parts of the world. It was generally recognized that any development of this kind would immediately prove to be a serious competitor to the existing cable systems, in one of which the Government of New Zealand, in common with certain other Dominions and the United Kingdom, is financially interested. It was also appreciated that with a population of approximately a million and a half there could not exist sufficient traffic to keep fully employed a high-speed system of directive radio communication confined in its operations to two terminal points. Until the population, and hence the point-to-point international telegraph traffic, is considerably augmented, it is admittedly a difficult problem to demonstrate the purely economic advantages to be derived from such a system.

Experimental work is being done upon providing, in addition to telegraph channels, a radio-telephone system of communication. The progress of these experiments will be watched with interest, as the simultaneous use of both telegraph and telephone would no doubt be a factor that would play a large part in the ultimate decision regarding the establishment of an international radio-station. Further, the possibility of the successful working, at certain hours of the day, of intermediate in addition to the terminal stations would greatly enhance to this country the value of such a means of communication. It has been arranged that we shall be kept in touch with developments of this nature which may have a bearing on the future policy of the Government.

Transoceanic Speech.

The possibility of New Zealand telephone communication with other countries by means of specially-designed submarine cables was discussed with cable-manufacturers and authorities on telephone transmission engineering. There are at present unsolved electrical and mechanical difficulties in the way of the manufacture of a submarine cable to give telephone speech over any considerable distance. For telephone speech it would be necessary to insulate such a cable with specially prepared paper, which would at any time be subject to damage by the ingress of moisture. Modern paper-insulated cables are invariably sheathed with lead, but with the depth-pressure that would be experienced lead sheathing would be mechanically impracticable. Even if such a telephone-cable were practicable, the subsequent multiplication of the available channels by modern radio-frequency methods would present still greater difficulties.

It may therefore be safely assumed that unless radical developments in transoceanic-cable design are brought to light, telephonic speech with other countries will be possible only by advances in the art of radio-telephony.

Broadcasting: Statistical.

Attached hereto is a schedule giving certain data and some unique comparisons with respect to broadcasting developments in a number of English-speaking countries, where broadcasting has undergone most rapid development. The figures should prove of value in demonstrating from various angles the position of New Zealand broadcasting in relation to other countries. To those able to analyse the same they should furnish data for much useful speculation. Such subjects, for example, as the effect of population-density and distribution, license fees, and signal intensity upon development may, within certain limits, be deduced.

Comparative Statistics relating to Radio Broadcasting.

Country.	(1.) Radio Sets in Use.	(2.) Total Population.	(3.) Radio Sets per 100 of Population.	(4.) Radio Sets per 100 of Population, based on N.Z. Development (2·7 per Cent.) and Relative Population Densities (Col. 6).	(5.) Area of Populated Territory, in Square Miles.	(6.) Population Density per Square Mile.	(7.) Radio Sets per Square Mile of Populated Territory.	(8.) Radio Sets per Square Mile based on N.Z. Development (0·4 per Cent.) and Relative Population Densities (Col. 6).	(9.) Telephones per 100 of Population.	(10.) Percentage Ratio of Radio-set Development to Telephone.	(11.) License Fee.
											£ s. d.
New Zealand ..	40,000	1,500,000	2·7	2·7	100,000	15	0·4	0·4	9·2	29·3	1 10 0
Australia ..	150,000	6,000,000	2·5	1·1	1,000,000	6	0·15	0·16	6·1	41·0	1 8 0*
Canada ..	140,000	9,000,000	1·5	1·2	1,250,000	7	0·112	0·18	12·2	12·3	0 4 2
British Isles ..	3,000,000	48,000,000	6·2	7·2	120,000	400	25·0	11·0	3·0	206·6	0 10 0
United States of America	5,500,000	114,000,000	4·8	6·8	3,026,000	38	1·8	1·1	14·8	32·4	..

Country.	Number of Broadcasting Stations.	Total Antenna Power in Watts.	Average Power in Watts per 1,000 Square Miles.	License Fee.
				£ s. d.
New Zealand	11	6,900	69·0	1 10 0
Australia	21	8,690	8·6	1 8 0*
Canada	48	21,500	17·2	0 4 2
British Isles	21	36,000	300·0	0 10 0
United States of America	700	510,000	168·0	..

* Average.

British and American Broadcasting in relation to New Zealand.

The standard of broadcasting existing in the United Kingdom has now reached a high plane, the aim being to so serve the country with broadcasting-stations of suitable power that reception will be possible to almost the entire population by means of a crystal type of receiver. The organization of broadcasting in the United Kingdom is broadly similar to what obtains in New Zealand, with the exception that the original broadcasting company, composed of various manufacturing firms, has now given place to a representative Broadcasting Commission appointed by the Government, and having full powers to carry out the policy of broadcasting in the interests of the public. All tastes are being catered for, and a high quality of service is being maintained. By use of land relay lines a considerable amount of simultaneous broadcasting is done from the different stations throughout the country. Such a scheme goes a long way to minimizing interference from radiating receivers; and, with the large revenue and the variety and high class of talent available, a very satisfactory standard of broadcasting service has been attained and is assured.

The conditions in New Zealand are relatively much more difficult. The smaller population means a smaller revenue, and has involved the necessity of a higher license fee. The larger and more-sparsely-settled area would make it a much more costly problem to furnish equivalent signal strength in all parts of the country, the configuration of which is such that only a small portion of the radiated energy is available over the land-masses of New Zealand. If anything like the same uniform standard is to be obtained it is clear that the problem must be attacked from a somewhat different angle.

In the United States the policy in relation to broadcasting is an entirely different one. Little restriction has been placed upon the growth of broadcasting-stations, and it recently became necessary to appoint a Commission to exercise a regulatory control over broadcasting-stations with a view to minimizing mutual interference. This Commission has already done good work in reducing the number of stations—until recently about seven hundred—and the interference already referred to. No fee is paid by the listener. Programmes are provided largely by commercial firms seeking the goodwill of the public by the provision of programmes of entertainment which constitute what is known as indirect advertising.

On the commercial side the British and American systems are therefore entirely opposed in principle; but, as each is providing a radio broadcasting service giving a very great measure of satisfaction to the public at large, it would appear that New Zealand could benefit by absorbing into its future policy the best and most appropriate elements of each.

As far as could be judged at this stage, it would appear that developments in the United Kingdom will be along the lines of forming a chain of high-power broadcasting-stations throughout the country, each link consisting of two stations, located remote from centres of population, and transmitting simultaneously different classes of programmes on different wave-lengths. Such a system would have many ideal features, enabling the great majority of the population to select, with equal facility, one of two different programmes from its local centre, and without the drawback of one being overpowered by the other.

Broadcasting: General.

Broadcasting-stations in the United Kingdom, the United States, and Canada were visited, and the policy and practice of broadcasting in all its aspects discussed with authorities responsible for technical design and operation and for the provision of programmes. In New York two broadcasting-stations, each of 50 kilowatts output, and embodying radically different principles of design, were seen in operation, and relevant data obtained.

At the Hague, Holland, a limited use was being made of subscribers' lines and telephones for the reception of broadcast programmes. The arrangements were such that, upon the receipt of a call from another subscriber, the telephone reverted automatically to its normal use. A special subscription was charged for this service. In the United States, electric light and power wires were also being used to some extent for a similar purpose. These developments have not yet made a great impression upon the practice of broadcast reception.

Departmental Responsibility to Broadcast Listeners in connection with Interference.

There seemed to be a unanimous opinion among administrative officers responsible for the oversight of wireless broadcasting that the primary responsibility of the governing administration is to keep the course clear for the listener to the local broadcasting-station rather than to cater for the inevitable but transitory stage of "long-distance hunting." The listener who habitually desires to reproduce a long-distance station while the local station is operating must take full advantage of the developments in the art in relation to selectivity and filtering of unwanted signals. The listener most likely to produce interference to the long-distance enthusiast is usually equipped with a receiving-set which is incapable of cutting out the neighbouring station while it is in operation, and is not likely, therefore, to invade the field of the long-distance listener during the local hours of service.

In this connection it was interesting to learn that in the early days of broadcasting a considerable demand existed in the larger cities of the United States for the observance of silent nights by the local stations. With the progress of the broadcasting art this demand has now practically ceased to exist, and listeners are largely unanimous in desiring that the local station shall give, as far as possible, a continuous service. They have outgrown the desire to chase long-distance stations with their variability and greater susceptibility to interference from static and electric light and power sources. In fact, there is in many cases little temptation to seek after distant stations under the same administration, as it not infrequently happens that the same programme is being simultaneously broadcast from all stations. It is admitted that the above arguments, while discouraging to long-distance reception, assume that everything possible should be done to create local programmes of a satisfying nature.

It will interest New Zealand listeners to know that British manufacturers are more seriously applying themselves towards the production of neutralized sets embodying radio-frequency as well as audio-frequency amplification and having a minimum of controls.

The subject of the New Zealand regulations in relation to the prohibition of the worst forms of "interfering" sets came up for frank and free discussion. When the nature of the New Zealand restrictions was fully explained and understood, I was gratified to find an almost unanimous approval of the attitude taken by the Department in this connection. I learned that many of those with whom the subject was discussed had strongly advocated a similar procedure in the early days of British broadcasting, but, due to a variety of influences that happily do not obtain in New Zealand, their ideas, although partially realized for a time, had subsequently to be abandoned. I am satisfied that we have been proceeding on sound lines in endeavouring to keep the ether as clear as practicable of unnecessary interference from "transmitting-receiving sets," and that the benefits of such action will be considerable.

A great deal of useful work has been done by the Canadian Radio Administration in detecting causes of interference to broadcast reception arising from electric light and power lines and machinery connected thereto. Properly-equipped testing-vans locate these sources of trouble, power companies and private individuals co-operating in the employment of approved remedial measures. Bulletins have also been prepared by this progressive Radio Department dealing with the various cases met with in practice.

It was the general opinion in all places visited that the elusive "howling valve" does not lend itself to equally satisfactory treatment along similar lines. The remedy undoubtedly lies in prevention rather than cure.

Quality of Broadcast Reception.

Those who are chiefly interested in high-grade reproduction of broadcast programmes are inclined to the view that the principal weaknesses of broadcasting to-day lie in the use of unsuitable receivers employing amplifying units of too limited a capacity, and badly-designed loud-speakers. The better class of manufacturers has of late been paying great attention to these features, which they claim to have satisfactorily met, with, however, a resultant high development cost and comparatively higher sales cost. It needs to be emphasized that satisfactory quality of reproduction is obtainable only by the use of properly-designed receiving-sets, amplifiers, and loud-speakers. The broadcast transmitter itself has made wonderful strides during the last few years. A well-designed transmitter properly manipulated leaves little to be desired in its ability to modulate with complete faithfulness the "carrier wave." The improvement most urgently required is in the design of the complete receiver and reproducer, and in the appreciation by the public of the fact that, while results of a kind can be obtained with the simplest of apparatus, only well-designed receivers will reproduce with a high degree of faithfulness, and with results satisfying to a musical ear, the complex sound-waves emitted from a well-designed broadcasting transmitter.

Absorption and Distortion.

There is no doubt that the conditions governing reception are much more favourable in New Zealand than in more densely settled communities, where, in certain regions, considerable absorption and distortion are experienced. These effects are due to interference from tall buildings which have a definite relation to broadcast frequencies. There is also the advantage that in New Zealand there are comparatively fewer sources of electrical disturbance, which in some locations are a serious hindrance to broadcast reception.

Fading of Broadcasting Stations.

The peculiar fading effects experienced when listening to remote broadcasting-stations at night were discussed with specialists who have devoted much time and thought to the problem. At the present state of the art there is no practicable remedy for such evils in cases where they arise from variations in the upper atmosphere. The available means of determining definitely whether such causes are atmospheric or instrumental were inquired into, and valuable suggestions obtained. In addition, literature was supplied dealing with the most recent investigations into this perplexing phenomenon.

CARRIER CURRENT.

Application to Telegraph and Telephone Lines.

One of the most interesting developments of modern telegraph and telephone practice is that known as "carrier current," by which existing channels of communication can be multiplied without increasing the wire plant.

By the application of these principles as many as three telephone channels or ten telegraph channels may be added to an existing wire circuit. The system possesses great flexibility, and has a wide range of application to a variety of differing conditions such as are met with in a young and developing country. In brief, the method consists in the application of radio-frequency currents to land-line practice, the wires serving as a guide to the radio frequencies impressed upon them, and the latter in turn being modulated in accordance with the requirements of telegraph or telephone signalling. The high frequencies employed are thus popularly described as "carriers" of the signals, which, by means of appropriate treatment at the receiving end of the line, are reproduced in their original form.

The first application of carrier-current signalling was to aerial lines, but considerable work is now being done upon its application to specially-designed underground cables, and much practical work has already been done in this direction—notably in the United States, where this system has to date found its greatest development.

Little use has so far been made of the system in the United Kingdom, by reason of the fact that its comparatively short interurban distances, combined with the development of underground cables with intermediate repeater stations between its principal centres, rendered this system to a large extent unnecessary. In the United States, on the other hand, the comparatively large distances linked by aerial-wire lines have furnished a valuable field for the development of such methods of multiplying the usefulness of existing aerial circuits. A somewhat similar condition exists between the principal centres of population in our neighbouring Commonwealth of Australia, where already use has been made of the system between Sydney and Melbourne, and extensions are under way for increasing telephone and telegraph facilities between other centres.

Up to the present our New Zealand telephonic, toll, and telegraph needs have been well met by the existing aerial telephone circuits. The time is rapidly approaching, however, when these facilities will be overtaxed, and when recourse to the latest method of increasing the utility of existing channels of communication may prove to be a sounder economical proposition than multiplying the wire channels. The application of carrier current to a submarine telephone-cable of the type crossing Cook Strait has not so far been effected anywhere in practice. In view of developments in New Zealand, considerable attention was paid by me to such possibilities, and all available data collected that would serve to guide the Department in determining its future policy with respect to this comparatively new development.

It is unlikely that New Zealand—by reason of its much lower population density—will, for many years to come, require to follow the course adopted in the United Kingdom and elsewhere of laying long underground toll cables between its principal centres of population. It is therefore probable that the carrier-current method will shortly form a useful stepping-stone to the ultimate adoption of interurban repeatered underground-cable systems, which are no doubt an admirable means of giving telephone communication under the conditions already referred to.

The practical evolution of the carrier-current method has undergone considerable development during recent years, but inquiry showed that it has now become standardized in all essential elements of design.

A modified application of the single-channel system which I was enabled to inspect is now nearing the mass-production stage, and by reason of its lower cost will more easily " prove in " under conditions of lower traffic-density and shorter distances than would be possible with the original multi-channel system. There are two main possibilities for the application of carrier current in New Zealand: (1) By furnishing, from existing circuits, needed telephone channels of communication at a lower cost than would be possible by the erection of additional circuits; and (2) by the economic multiplication of existing channels with a view to the encouragement of traffic between points where existing rates are to some extent hampering the development of the toll service.

Power-line Carrier Current.

Although not of direct interest to this Department, data was obtained as to the latest application of " power-line carrier "—*i.e.*, the superimposing of telephone speech by radio-frequency methods on electrical-power-transmission lines. This subject was discussed with experts responsible for its development, and interesting information obtained thereupon. The relative merits of power-line carrier and wireless methods of maintaining communication between the distant points of power-transmission lines were also reviewed.

Voice-frequency Telegraphs.

A development of the " carrier " system is that known as " voice-frequency telegraphs," by means of which the frequency spectrum usually employed in the transmission of telephone conversation is divided up among a number of telegraph circuits which are able to operate simultaneously upon the same line. In the absence of underground interurban circuits between New Zealand centres little use could at present be found for such a system. There is, however, a possible field of application in connection with the submarine telegraph-cables serving as a link between the two Islands. When the capacity of these cables is reached, it is not improbable that the system could be applied to them, thus multiplying the telegraph channels available and avoiding the laying of additional submarine telegraph-cables between the Islands. Some experimental work requires to be done before it can be determined to what extent such systems can be applied to conditions of this nature, but, with the experimental and testing apparatus now being obtained, and referred to elsewhere in this report, it will be a comparatively simple matter to carry on such investigations as may pave the way for ultimate economies.

The opportunity of discussing these radio-frequency developments with Engineers responsible for their successful design and application was naturally much appreciated, and enabled me to become acquainted with many practical features which will have to be borne in mind in the application of such systems to our New Zealand conditions.

FIELD ENGINEERING.

Scope of Inquiries.

Apart from such important matters as automatic telephony, radio telegraphy and telephony, and machine-printing telegraphs, the subject on which most time was spent was that of field engineering. It is here that the methods of different countries vary most markedly, and upon which the major part of telegraph and telephone expenditure is incurred. It is therefore in this direction that there appears to be the greatest possibilities of savings by improvements in organization and practice, and by the judicious use of labour-saving construction and maintenance methods.

My investigations under this heading fall naturally into the following divisions:—

Design of outside plant systems for long-distance communication and for subscribers' distribution.

Materials used—their suitability and durability.

Methods employed, and the incidence of the latest labour-saving devices thereon.

These matters were investigated as closely as time permitted, and numerous inspections made of different types of installations—open aerial, overhead, underground and submarine cable.

Telegraph and Interurban Telephone Lines.

The system in use in New Zealand for connecting the principal centres telegraphically and telephonically consists largely of what is known as open-aerial distribution, involving the use of pole lines and bare wire. The method employed for the prevention of "cross-talk" and of power-line inductive interference is known as the "twist" system. As already referred to, the comparatively small populations that are connected by our somewhat extensive ramifications of aerial toll wires do not yet justify the use of the more costly underground-cable systems that link the larger cities of older and more densely populated countries. Knowing that in the United Kingdom some few years ago a reversion had taken place from the "twist" to the "flat transposition" system, and that this latter method had all along been the practice in the United States, it was with much interest that the rival systems were examined. The opportunity of discussing them with experts in different countries was freely availed of.

I am now satisfied that for the New Zealand conditions, which involve frequent high-tension and extra-high-tension parallelisms of considerable magnitude, the twist system now in use is our most satisfactory solution of the problem of inductive interference, and that, as practised in New Zealand, superior advantages are obtained at no greater cost in construction or maintenance than would be possible with the less flexible and—under our conditions—less efficient transposition method. By the use of the twist system combined with what is known as "phantom" working, three first-class talking-circuits are obtained from two physical telephone channels, with a result that, in its practical operation, is not being excelled in any of the countries visited. Moreover, the twist system of erecting aerial wires, when properly installed, is practically a "permanent institution," proof against any of the fluctuations or variations in adjacent telegraph or power circuits that are continually taking place; whereas the same cannot be said of other methods, which at times call for modifications to meet changing conditions.

Subscribers' Distribution.

In relation to the distribution of telephone talking circuits from the telephone exchange to the subscriber's telephone, and the various changes involved from underground to overhead cable and to final open-aerial distribution circuits, the New Zealand system is a compromise between American and British methods. By reason of the distribution of population and the considerable amount of development in sparsely-settled areas the New Zealand conditions more closely resemble those of the United States than those of Great Britain, and it was only to be expected that our distribution system should more closely approximate to the former.

Generally speaking, the final distribution system used in the United Kingdom outside the most congested points is known as "radial distribution" from underground-cable outlets, while that of the United States is by means of aerial cable and "drop wire." The different systems have received close consideration, and afford valuable data by which we shall be able to review our methods in detail. Before a final decision can be come to on many points that arise, close studies must be made by our plant-engineering officers in order to determine to what extent changes or modifications are justified. I am, however, of the opinion that although radical changes in method cannot at this stage be made in existing installations, many of the methods observed may profitably be incorporated in new exchange systems and in extensions of the old, with resulting economies.

General.

I was somewhat impressed by the fact that certain practices which have been considered to be unsuitable in this country are being successfully used with corresponding economies elsewhere. In some cases this can be accounted for by difference in climatic conditions and the availability of local supplies of material at a correspondingly reduced cost. It is not, however, improbable that, with the wealth of detailed information generously supplied me in relation to all phases of telegraph and telephone field-engineering materials and methods, processes which have been considered unsuccessful in the past may now be introduced with every confidence of success, and that a greater degree of standardization will be possible, with resulting advantages.

Among the more important subjects coming under this heading which were investigated are the following:—

Design and reinforcement of pole structures, and methods adopted for preserving the same from decay:

Joint use of telegraph, telephone, and power poles; conditions governing same, and experience obtained therein:

Labour-saving devices used in construction and maintenance of telegraph and telephone lines (this subject has undergone considerable development, and devices are now available which are applicable, in part at least, to New Zealand conditions, and which should result in reducing the cost of works in situations where such machines can be applied):

Tools and equipment used in construction and maintenance works:

Design of toll-line systems with a view to ultimate application of radio-frequency methods for increasing the number of channels available:

Power-line crossings: methods found most suitable for avoidance of physical contact between power and telegraph and telephone wires, with resulting damage to the latter:
Methods adopted for jointing line-wires, and for ensuring non-deterioration of electrical conductivity in the same:
Methods used for the provision of field testing-points in isolated sections of line:
Class of wire used for lines of varying distances, and experience in connection with the maintenance and life of same:
Insulators: manufacture of same, and methods used in determining relative efficiency and durability:
Installation practice *re* subscribers' telephones, and maintenance of same:
Conditions surrounding erection and regulation of private lines:
Materials used and general practice in connection with the installation of overhead and underground telephone-cable:
Types of cables used in subways and in situations exposed to abnormal risks of power contact, inductive interference, &c.:
Cable-repair methods and desiccation methods:
Practices found most useful in location of faults in overhead, underground, and submarine cables, and the latest testing procedure for the detection of incipient troubles:
Relative merits of different systems of cable-distribution:
Testing and jointing of telephone-cables, and field testing-apparatus generally:
Cable-entrances to telephone exchanges:
Methods adopted for preventing electrolysis in lead-sheathed telephone-cables:
Use of improved devices for the suspension of overhead aerial lead-covered cable:
Loading of cables, and relation to subsequent employment of telephone repeaters and carrier-current methods:
Types of submarine telephone-cables most useful for New Zealand situations such as estuaries, river-crossings, &c.:
Latest practices in connection with the telephone wiring of buildings and groups of buildings:
Different types of ducts for use in connection with underground cables, and relative merits and demerits of same:
Organization of field-work:
Systems devised for checking of engineering output in connection with field-works:
Systems for checking faults in telephone systems and furnishing comparative analyses of same:
Methods adopted by large administrations for recording and planning overhead and underground circuits for reference:
Transport of linemen and materials.

In all the above-mentioned subjects I was given the utmost assistance and information, both oral and printed, by manufacturers, telegraph and telephone administrations and corporations, and in many cases was accompanied on visits of inspection to typical plants illustrating the various features under discussion.

PROTECTION OF TELEGRAPH AND TELEPHONE PLANT FROM ELECTRIC POWER AND LIGHTNING.

A subject of continual concern to telegraph and telephone Engineers is that of the degree of protection which should be provided against damage to plant and equipment caused by the effects of lightning or electrical-power circuits, precautions against which must be taken in the design of telegraph and telephone plant and in its subsequent maintenance. The practice in this respect was known to vary greatly in different parts of the world. I was not surprised to find that it had not yet become standardized, and that differences of opinion were held by telephone Engineers upon various matters connected therewith. In this respect the personal investigations made by me will be of great value, and will enable us to attack the problems arising under this heading with a full knowledge of the motives underlying the varying procedure of different countries.

Protection units are provided in telephone exchanges, in subscribers' premises, and at certain points in the outside plant, notably where open aerial wires junction with overhead or underground cables.

My discussions elicited that New Zealand is regarded by some authorities as overprotected, but it was generally agreed that such a condition is preferable to underprotection, particularly in a country so remotely situated as New Zealand from the world's telephone factories and supplies. Full data were collected as to the practice in England and America. In certain matters such as protection there is a danger of effecting economies at the risk of interruption of service, and danger to life and property. It has to be remembered that in many parts of New Zealand lightning disturbances are experienced in a more or less violent form, and that over practically the whole of this country electric light and power circuits are run both overhead and underground, with corresponding danger of contact and injury to plant, equipment, and person. The view has generally been held by New Zealand Telegraph Engineers that these considerations should weigh even more heavily with a Government Department than possibly with a private company, and that in a country so remote from supplies no unnecessary risks should be taken which would tend to reduce the reliability of the telephone service to the community. The cost of protection is, after all, but a small percentage of the total cost of plant and equipment. We have already experienced the partial annihilation of telephone

plant from such causes, and have realized the difficulties that would arise in replacing the same within a reasonable time from our limited resources of spare equipment. The question is also one of maintenance as well as capital cost. With regard to the former, it is believed that with the information now available maintenance costs due to lightning interruptions can be reduced by the employment of recently developed apparatus which came under my notice.

Sufficient data have now been collected to enable an intelligent revision of our protection methods to be carried out, and economies effected in installation wherever such a practice does not entail risks which at this distance from the telegraph and telephone sources of supply it would be undesirable to take.

BUILDINGS.

Many opportunities were afforded me of inspecting the accommodation provided for the housing of modern telephone and telegraph plant, and of discussing with those responsible for the same the various details of design which directly affect the efficient operation and extension of such equipment.

Typical plans have been obtained which have been designed with a view to economizing space, providing for extension, and giving a proper relation to those sections of the plant which are to be closely related in operation and maintenance.

Due attention was paid during these visits of inspection to such questions as prevention of fire, illumination, ventilation, cable-entrances, and such general features as tend towards the ideal maintenance and operation of equipment with the least loss of effective effort.

In countries where telephone practice is highly developed it is usually the case to provide in the one building accommodation for engineering, traffic, and commercial departments, in addition to the actual housing of the equipment, thus concentrating all the closely related interests. This method has some undoubted advantages, and has been followed as far as practicable in the recently-erected Stout Street (Wellington) Telephone Exchange building, where, in addition to the automatic telephone exchange and its toll switchboards and power plants, the Public Accounts and Contract Department and the District Telegraph Engineer's organization are also accommodated.

The leading organization of the United States has a large staff engaged upon all matters pertaining to the design of telephone-exchange buildings. They regard the matter of such importance that they hold periodical conferences of central-office and equipment Engineers from all parts of the United States, so that buildings shall be designed with due regard to all the interests involved and no factor of importance overlooked. One of the latest and most impressive telephone buildings is that of the New York Telephone Co. in West Street, New York, which is one of many telephone buildings serving that city and suburbs. Due to the courtesy of the company's architect, I was shown over this building in detail. It is at present utilized mainly as the headquarters of the administrative staff of the company. This building is a striking monument to the development of the telephone in modern cities. It has thirty-six stories, is 498 ft. high, covers an area of 28 acres, and has space enough for six thousand workers in addition to six central automatic exchanges capable of serving 120,000 telephones. An inspection of its numerous appointments impressed me with the need for careful planning for the needs of ultimate telephone development.

ORGANIZATION.

Causes contributing towards Variations in Telephone Density.

In view of the fact that the telephone density differs to such a great extent in different countries of the world, it was of interest to observe the varying conditions surrounding its development, and the general attitude of the public towards the telephone as a public utility.

In certain countries where a low telephone density existed it was found that the administration was at times hampered by a shortage of funds with which to carry on an organized system of development and extension. In a growing system such as that of telephone communication such a condition is a serious drawback to the economic planning of and provision for annual growth, inevitably leading to greater cost in the provision of service than is the case where plans can be made well ahead of requirements, and systematic additions made to plant and equipment at the ideal time. Under such restricted conditions the service is not made attractive to the public, which, on account of the belated provision of facilities and the low state of development, becomes more or less indifferent to its advantages.

On the other hand, in highly developed telephone countries it was clear that the extension of telephone facilities was planned for long periods ahead, and adequate funds made available for the economical carrying-out of a programme of works spreading over a period of years. In such countries the telephone administrations aim at giving the highest grade of service possible, and at making the telephone indispensable to the public. Large sums of money are spent on the extension of toll lines and in the giving of a prompt and immediate service over the same. The satisfactory service which results has the effect of promoting greater demands for such facilities. It is only natural under these conditions that the attitude of the public should be highly appreciative, and the utility of the telephone in the saving of time and effort fully realized. Direct contact by telephone is regarded as the nearest approach to the " personal touch " which is so largely in evidence in modern business methods. Where the motto of the telephone company is that every call is an urgent one, and facilities are provided in accordance with this view, the public apparently come to rely upon the telephone, and to regard it as an indispensable adjunct of business and social life; whereas the provision of a poor telephone service causes the public rather to tolerate than to appreciate the telephone service at its true worth.

Research Work.

A very interesting commentary upon the rapid growth in the higher phases of telegraph and telephone technique was furnished by the large amount of experimentation being done upon the adaptation of scientific discoveries to practical use and operation. Special departments are constantly engaged on such work with a view to improvements in methods and reduction in cost. This was impressed upon me by viewing the research and development sections of the British Post Office and of the American Telegraph and Telephone Co., as well as by visits to national physical and technological institutions.

Staff Training: Engineering and Technical.

In addition to the expenditure upon research and development work referred to in the above paragraph, it was of interest to observe that some of the administrations referred to organize instructional schools and refresher courses for engineering and skilled workers generally, in anticipation of the introduction of new and complex methods of communication.

It was interesting to learn that the British Government permitted engineering representatives from other countries to take full advantage of the experience and information obtainable from their telegraph and telephone laboratories and educational institutions. Students of communication engineering are constantly arriving from practically all European and Asiatic countries and from British dominions. Considerable regret was expressed that New Zealand was not sharing in these advantages. I was assured by the authorities of the British Post Office that they would be delighted to do all in their power to place the full benefits of these institutions at the disposal of any New Zealand Post and Telegraph Engineer having the necessary time to make a detailed study of the problems there dealt with.

In view of the rapid developments now taking place in the higher phases of telegraph and telephone work, considerable benefits would be derived by taking as full advantage as possible of such an organization, the cost of which would be more than offset by the first-hand knowledge of developments which must shortly be introduced if our telegraph, telephone, and radio services are to keep pace with those of other countries. In addition to the actual training received, such an officer would be given free access to the accumulated and detailed data in all branches of telegraph and telephone activity, from which much practical and useful information would be gleaned.

In contrast with the serious efforts made by telegraph and telephone administrations abroad to keep their engineering officers abreast of modern developments and consequent changes in practice, our own methods do not appear favourably by comparison. It cannot be expected that we should emulate the larger administrations in spending equivalent sums of money in the promotion of such objects, but there are obvious directions in which our policy is capable of considerable improvement both in the interests of officers and of the work entrusted to them. A survey of the telegraph and telephone methods of other bodies permits the practice in this respect to be viewed in a truer perspective. It is quite natural that in a rapidly developing country our engineer-technicians should in the past have been called upon to spread their energies over too wide a field. In addition, the growing routine work connected with the engineering division of the Department, and the heavy demands consequently made upon its limited personnel, have made it a matter of considerable personal sacrifice for our Engineers to keep closely in touch with the rapid developments taking place outside the sphere in which they have been immediately engaged. This condition is likely to continue, and to be accentuated as later and still more complex developments are introduced.

Specialization.

Only of recent years has any attempt at specialization been made, and that only when the urgent demands for some complex phase of the telegraph and telephone art has rendered it unavoidable. It is clear that a broad policy of specialization is now necessary if plans are to be laid for the future and the best and most efficient results obtained from the apparatus available.

Understudies.

Consistent with the above, the policy of releasing telegraph and telephone Engineers from routine work which can be efficiently performed by others of lesser training and qualifications can safely be extended. I found that in the most efficient telegraph and telephone organizations, where a real impression has been made on the art and practice of communication, professional workers were given every possible assistance so that their energies might as far as possible be concentrated upon engineering and technical considerations. The remarkable results achieved proved the wisdom of such a course.

Under "Obversation and Traffic Studies" I have referred to the assistance rendered to plant and equipment Engineers elsewhere by competent traffic sections. In New Zealand, traffic and development studies requiring a degree of engineering knowledge and training have necessarily been carried out by our own Engineering Division in addition to their plant and equipment duties. Nominally, however, traffic matters have been the function of another division of the service.

The time has in my judgment arrived when a readjustment of this important section of our work on modern lines would give much-needed relief to plant and equipment Engineers and be fraught with much benefit from an economic standpoint.

Engineering Conferences.

Engineering conferences have occasionally been held by our Department, and a considerable amount of good has resulted therefrom. At such conferences technical matters of all descriptions and proposed modifications can be fully discussed, and the results of research into the field of communi-

cation suitably outlined. The need for such conferences becomes greater as the work becomes more highly specialized. Considerable attention is paid to this aspect of things by the organizations already referred to, where it is recognized that a complex art having many overlapping phases cannot function to the best advantage unless the overlapping sections are dovetailed together by practical co-operation and a mutual understanding of the activities of other related workers. A greater all-round efficiency ensues where such means are adopted, and as a result works are executed with a greater regard to the best practice and experience.

Decentralization.

In our New Zealand Engineering Division a good deal has already been done towards the avoidance of overcentralization of authority with a view to facilitating the smooth running and conduct of works requiring a considerable measure of local supervision and initiative. From observation and discussions *re* similar engineering organizations abroad, where large works are efficiently executed, the importance of a judicious decentralization of administrative responsibility was very evident. Decentralization, or functional delegation of executive authority, becomes at a certain stage of development a paramount necessity if the demands of a rapidly expanding electro-mechanical enterprise are to be promptly and efficiently met. The main point to be safeguarded under such a scheme of organization is to ensure that the officers to whom such authority is delegated are fully competent to exercise the same. For the successful execution of such a scheme it is obvious that provision must be made for unification of the broad lines of policy and procedure, and for suitable consultation and conference on matters that involve any essential modification of the principles and policy laid down. It is claimed by privately-conducted communication systems that much of their success in the development of the telephone business as compared with that achieved by certain Government-controlled organizations is due to a liberal recognition of such principles, no less than to the standardization of tried and tested methods and practices.

Staff Conditions.

Information was obtained as widely as possible of the conditions of employment and remuneration pertaining to officers engaged in all phases of engineering and associated works, enabling suitable comparisons to be made with the conditions obtaining in our service.

Recruiting of Telegraph and Telephone Engineers and Technicians.

A comparison of the British, American, and New Zealand practices with respect to the recruiting of Engineers was the subject of a useful and profitable study. The subject is one that has given considerable thought and concern to large administrations faced with big developments requiring professional supervision of a highly specialized character. The general practice has been to enlist the services of degree men from Universities, who are then placed in different sections of the organization and become more or less specialized in some phases of electrical communication engineering.

The New Zealand practice differs fundamentally from that generally in force elsewhere, and consists in taking lads with Engineering Preliminary qualifications, appointing them as Engineering Cadets, and giving them facilities for the acquirement of University degrees, during which period useful work is done and experience gained in different sections of telegraph and telephone engineering. The system is working out well in practice, and was very favourably commented upon by administrations and corporations with whom the subject was discussed. It has the advantage that engineering-work and theoretical study synchronize and are to a large extent mutually helpful. By the time degree work is finished, a splendid foundation—both theoretical and practical—has been laid for the more serious study of telegraph and telephone engineering problems. I am more than ever satisfied that the principle is a sound one, and that the Department is already reaping and will continue to derive a maximum benefit from the system adopted.

Special attention was also paid to the recruiting of skilled workers, which are the backbone of any electrical organization. The subject was discussed in all its bearings with organizing Engineers responsible for the execution of telegraph and telephone construction and maintenance works. The general aim, it was found, was to provide and maintain an adequate permanent staff of skilled workers, rather than be faced with the losses and interruptions of service which inevitably result from the casual employment of unskilled workers with insufficient knowledge of and training in the various processes involved.

Standardization.

It was not surprising to find that considerable divergences of practice existed in different countries, and, in fact, in different parts of the same country. In this respect my visit has emphasized the great advantage of personal inspection and discussion, and has shown how unsafe it is to accept isolated printed references to telephone or telegraph development as indicative of standard practice. In some cases these differences were found to exist even in various parts of the same organization. Inquiry, however, frequently disclosed that differences of the latter kind could be accounted for by considerations such as the non-availability of certain classes of material or apparatus at the time of the installation, by the existence of special conditions of a local nature, and by the fact that large organizations with standardized practices nevertheless permit reasonable scope to the individuality and initiative of executive officers so long as fundamental principles are not violated. In this way helpful experimentation, within due limits, is encouraged, and fruitful ideas are given an opportunity of proving their adaptability or otherwise.

LABORATORY.

One of the most neglected features of our Engineering Division has been the equipment of our departmental laboratory with suitable testing and electrical-research apparatus. This matter was fully recognized prior to my visit abroad, and it was agreed that I should select and purchase what apparatus was most needed. Upon my arrival in London this was made one of my first duties. In this matter I was rendered invaluable assistance by the well-equipped Research Department of the British Post Office, whose resources in equipment and personnel were freely placed at my disposal. It was thus possible to select approved apparatus which had stood the test of use similar to that which will be undertaken by our own laboratory, and which could be relied upon to furnish suitable standards of reference in fields which we had not previously explored. This selection of apparatus involved a good deal of detailed inquiry and investigation, and absorbed about one-fifth of the total time available in the United Kingdom. I feel, however, that the time was well spent, and that this work alone would fully have justified my visit. An arm of our service that is becoming vitally important to development along modern lines will now be in a much more favourable position to contribute its due share to the investigation of problems which frequently call for urgent treatment, and the solution of which is necessary to the efficient carrying-on of a complex communication system. We have officers well qualified both by education and experience to carry out these duties successfully, but their efforts have been largely nullified by the absence of suitable apparatus. In all administrations having responsibilities commensurable with our own I found that great attention was being paid to this branch of the service. With a capital investment of £7,500,000 in telegraph and telephone plant and equipment, and with annual accretions to the value of approximately £850,000, it is obvious that economies in methods and materials cannot be effected without proper laboratory investigations into the principles and processes involved. With the availability of such testing-apparatus due attention must now be paid to personnel and accommodation so that the full benefits of this branch may be realized.

PLANT ACCOUNTING.

The statutory requirements as to the keeping of a departmental balance-sheet and Profit and Loss Account have of recent years resulted in the institution by the accountancy section of the Department of a comprehensive and carefully-designed system of plant accounts whereby costs may be duly assigned to the various works in progress—both internal and external. The application of such an accounting system to field-works scattered over remote parts of a developing country presents certain inherent difficulties compared with a system of workshops or factory accounts. It was interesting to find that these difficulties had been experienced by other administrations, and that serious efforts had been made towards simplifying as far as possible the amount of accounting-work to be done by the field staff, and at the same time retaining all the necessary elements for an accurate accounting system. The time was very opportune for comparing methods and for collecting data regarding the same from telegraph and telephone administrations and telephone companies. This information will enable our responsible officers to study the question from fresh angles.

The ultimate result will, I hope, be along the lines of enabling field staffs to concentrate to a greater extent upon the work in which they have had special training without sacrificing essential details necessary to adequate accounting, and will assist in the effort to keep the cost of field accounting systems in close approximation to their actual worth.

CONCLUSION.

One of the outstanding advantages of my visit is the fact that I was able to get into touch with experimental work which had not yet reached the commercial production stage, but which may have an important bearing upon future departmental practice. This work does not reach the publicity stage until a much later date. In the light of these probable developments, engineering practice can now be carried on with a better realization of changes that may eventuate. Unnecessary expenditure can thus be avoided by reason of an enlightened anticipation of requirements, and by the design of works to fit in with these ultimate and inevitable departures from existing methods and standards.

Definite information is now available—and in certain respects unexpected conclusions already reached—as to practices which in some cases were considered unsuitable for this country and in other cases were the subject of a converse opinion.

A clearer idea has been obtained of the organization and practice of telegraph and telephone engineering work in other countries, and the reasons for failures together with the factors contributing towards success more clearly understood.

What is even, in my judgment, more important than the foregoing is the fact that cordial relations have been established with leaders of telegraph and telephone engineering developments in all countries visited, and a personal understanding of New Zealand conditions communicated to manufacturers to whom the Department looks for the best possible service in the supply of its plant and equipment.

I have already referred to the unfailing assistance rendered to me in all directions. This happy condition was, I felt, due largely to the fact that New Zealand held a high place in the estimation of older countries. It was clear that this esteem was largely due to the high standard of commercial and political morality which has characterized its undertakings, and to the lasting and dignified impression created by its representatives at the Great War.

On all hands a genuine interest was manifested in the prospects and potentialities of this Dominion, and, in addition to the more specific duties of a telegraph and telephone Engineer, it afforded me much pleasure to be able to furnish information in many quarters as to the general conditions and attractions of my native country.

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Chief Telegraph Engineer.

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