1907.

NEW ZEALAND.

TELEGRAPH AND TELEPHONE METHODS

(REPORT OF THE SUPERINTENDENT OF ELECTRIC LINES ON HIS TOUR TO GREAT BRITAIN AND OTHER COUNTRIES TO EXAMINE INTO).

Presented to both Houses of the General Assembly by Command of His Excellency.

REPORT.

General Post Office, Wellington, 17th October, 1907.

Memorandum for the Hon. the Minister of Telegraphs.

I HAVE the honour to submit the following report of my tour to Britain *via* Australia, also the Continent of Europe, and America, to examine into the different telegraph and telephone methods of these countries.

COMMONWEALTH.

Telegraphs.—The telegraph-offices in Sydney and Melbourne were visited. The telegraph methods are nearly identical with those of New Zealand, and do not call for any special mention.

Telephone Exchanges.—In telephone matters the position is not unlike that in New Zealand. Their best switchboards are similar to, or not so good as, those in use here.

Central-battery System.—The central-battery system is being introduced. A switchboard on this system is almost completed at Hobart, and equipments for Sydney are arriving.

Central-battery System proposed for Melbourne, &c.—It is proposed that Melbourne and the other principal cities shall be supplied with switchboards of the central-battery system, which is the highest development of telephone-switchboard practice, and where central-battery switchboards were not in use it was contemplated to replace existing boards with that system sooner or later.

SYDNEY AND MELBOURNE TELEPHONE-LINES.

Underground Work.—In Sydney the telephone-lines are placed underground in the centre of the city, starting from the basement of the Central Exchange in a tunnel, and where the tunnel ended they are continued on by the usual conduit method, but distribution is made by overhead lines. Melbourne also has some underground work. This is the only feature in Australia in which there is any improvement on our New Zealand conditions.

GREAT BRITAIN.

TELEGRAPHS.

Telegraph Methods in Britain and New Zealand similar.—In telegraph matters the same methods of working prevail in Britain as in New Zealand. The greater part of the telegraph business is done on ordinary Morse circuits, simplex, duplex, quadruplex, and Wheatstone automatic. All these methods are used in New Zealand as circumstances require.

In addition to these systems, however, the British Telegraph authorities employ two types of printing-instruments, the Hughes and the Baudot, with fair success on certain circuits to the Continent, Paris, Brussels, &c.

Baudot Printing-telegraph.—Two technical officers of the British Telegraph Department comparatively recently visited Paris to study the working of the latest improved Baudot printing-telegraph, and their report was favourable to extending its limited use in Britain under certain conditions.

The possibility of the use in New Zealand of the Baudot instrument is a question that may be worthy of consideration later on. At present there are no circuits upon which it could be advantageously used.

Murray Printing-telegraph.—The Murray telegraph printing-instrument is in use between London and Edinburgh, but is still in the experimental stage, and no definite conclusions have been arrived at whether or not it is likely to be adopted to any considerable extent.

Telegraph-wires Underground.

Telegraph-wires in Cables.—The Departmental Administration is rapidly placing all their important telegraph-wires underground. These are copper conductors of various sizes with paper insulation, and lead-covered, sixty or more wires being made up in one cable. Where there are such numbers of wires required as in Britain, the cost of placing the telegraph-wires in cables underground will, it is expected, eventually probably not be any greater than that of overhead wires, especially as the routes for pole-lines become congested. Pole-lines that are abandoned for telegraph purposes will still be used for long telephone trunk circuits.

Storm Interruptions.—The first object of placing telegraph-wires underground was partly to avoid interruptions from storms, which are not infrequent, but the pole requirements for long-distance telephone wires, which must be overhead, helped to produce the change.

The British telegraph system may be considered as second to none in the world.

New Zealand Telegraph Methods similar to British.—In New Zealand the practice and methods adopted are similar to those in Britain, much use being made of quadruplex and quadruplex repeaters and of the Wheatstone automatic system.

Return to Simpler Methods.—When more underground cables are laid in Britain for telegraph work, and plenty of conductors are available, some of these more complicated methods of working may disappear. The simpler the circuit, as a rule, the more average work can be done by an operator, and when the use of complicated apparatus reduces what may be called the output per man, it is not profitable to use such apparatus. All experienced telegraph engineers agree in this view.

Renting Long Telegraph-wires.

Rate for Renting Telegraph-wires, £4 per Mile per Annum.—There is considerable business done by the British Postal Telegraphs in renting long telegraph-wires, principally to stockbrokers. For example, a stockbroker in Glasgow rents a wire direct to his office in the Stock Exchange, London. The rate paid for the use of these wires is £4 per mile per annum. Some customers pay as much as £4,000 a year for private wires.

Line-construction.

The line-construction in England and in New Zealand is not unlike, and, indeed, in all countries any differences that exist are only in quite minor details.

Provincial Towns.

The apparatus and methods in the telegraph-offices at Manchester, Glasgow, and several other provincial towns were practically the same as those used in London.

Wireless Telegraphy.

Muirhead's System used by Army for Short Distances.—At Dr. Muirhead's factory at Elmer's End an exhibition of wireless-telegraph working was witnessed.

Dr. Muirhead's appliances are used by the army for comparatively short distances. These equipments are not of use to this Department.

The subject of wireless telegraphy is still a matter for inquiry.

Its use hitherto has been mainly confined to steamers.

Wireless Signals crossing Atlantic.—When crossing the Atlantic the apparatus aboard was examined and communications from another steamer fifty or sixty miles distant were listened to. The signals were received on a telephone, and the dots and dashes could be easily read, although they were not very loud.

Method of Transmitting Daily Bulletin.—The Daily Bulletin received aboard the Atlantic steamers is sent from a shore station of either continent at 1.30 a.m. The shore station with long-distance power repeats the message four times. The ship cannot respond, not having the power. The message is repeated again once at a certain hour in the morning, and generally the Bulletin, containing 100 words news of the world, is forthcoming at breakfast-time.

There are not a great many messages tendered for transmission by passengers. On the ship referred to there was only one presented during the voyage. The charge is 8s. 4d. for so-many words, and 6d. for every additional word.

Telephone Exchanges.

British Post Office Telephones a Recent Undertaking.—The British Postal Telegraph Administration only comparatively recently entered on telephone-exchange business to any considerable extent. There was, therefore, available to that Department all the experience of the different telephone undertakings in Britain and the Continents of Europe and America to guide them, and, as was to be expected, their switchboards and general equipment represent the highest development of telephone-work known to the best telephone engineers.

After two or three years spent planning their work, operations were commenced in London.

Prior to that time the National Telephone Company practically owned the whole of the telephone-exchange business in Britain.

American Telephone Practice followed.—American practice is the model followed by the telephone administrations of Great Britain and of those countries in Europe that have, or aim at having, superior installations.

Telephone Engineers visit America.—Visits have been made from time to time by British Post Office electrical engineers and the engineers of the National Telephone Company to the United States to examine the telephone systems there, and it is the fact now that the standards of Britain and America are practically the same for the main equipments of cables, switchboards, telephones, &c.

Switchboards.

Supply of Switchboards.—The greater number of the switchboards is supplied by the Western Electric Manufacturing Company, which originated in America, and which has factories in England, France, Germany, Austria, Italy, Russia, &c.

New Exchanges.

Replacing Old Switchboards by Modern Apparatus.—In London two new exchanges, Paddington and Gerard, were seen being fitted up and equipped by the Western Electric Company with central-battery apparatus of the latest practice, to replace older types of switchboard.

Fitting-up of Switchboards.

Switchboards Abroad usually fitted by Manufacturers.—In Britain, on the Continent, in America, and even in Australia the exchange administrations are in a much better position in one respect than New Zealand, as the manufacturing company (mostly the Western Electric) not only supplied the switchboards, &c., but fitted them up with their own experts, and the administrative engineers had only to inspect the work and pass it.

Usually the manufacturing company had also maintenance to do for three months. In New Zealand we have invariably ordered the materials and have done our own fitting-up, so far successfully.

Small Sub-exchanges in Provincial Towns.

Small Sub-exchanges in Provincial Towns.—In the provincial towns of Britain there are small sub-exchanges, similar to those in New Zealand, that accommodate ten to twenty subscribers in the local post-office and a telephone cabinet in the public room of the office.

These sub-exchanges are used as ours are, mainly to enable the local subscribers to talk to their central town.

Circuits are all Metallic.—The circuits are all metallic, and the wires are run on poles overhead.

Trunk Telephone-wires.

Postal Telegraphs control Trunk Lines.—The trunk telephone-wires are very numerous in Britain, and are entirely in the hands of the Post Office exchanges or telegraph-offices.

Where the Post Office has no exchange—and they have not many yet, except small ones, outside of London—the trunk-line switchboards are controlled by the Postal Telegraph Department and accommodated in the telegraph-office buildings.

Trunk Telephone Business very large.—One instance may illustrate the enormous telephone business between large towns. Manchester has between three and four hundred trunk telephone circuits. Thirty-five of these are to Liverpool, and ten more circuits were being authorised to meet the demand arising from increased traffic.

Capacity of Trunk Circuits.

The maximum capacity of a trunk circuit for business may be put down at fifty communications during the working-day.

Quality of Speech over Long Trunk Circuits.

Speech Good on Long Circuits.—The speech over the long trunk circuits, London to Edinburgh, and between Glasgow and Belfast, was found to be fairly good, its volume, however, diminishing sensibly with the length of line, and affected very considerably where cables were in the circuit.

Delay in Getting Trunk-line Connections.

Excessive Delay on Trunk Connections.—The delays in getting the use of a speaking circuit to Manchester or Glasgow or to other large centres were very considerable, half an hour, three-quarters, or even more being common. Trunk wires seem to get filled as soon as they are provided, and it often happens customers want the same connections at the same time. It is no doubt difficult in large cities with many exchanges and junction wires to make connections as speedily as where there is only one exchange.

By Comparison, New Zealand Service Good.—The service given in New Zealand for both town and trunk connections is quite as good as any service that was met with.

Call-box System, London and Elsewhere.

Railway Platforms, &c., provided with Call-box.—The call-box system in London and elsewhere is very useful. This comprises a cabinet containing a telephone connected with exchanges, and is placed in many public places such as railway-platforms, underground-railway stairways, or wherever arrangements can be made to accommodate the cabinet. The customer enters the cabinet, rings up the exchange, and the attendant asks that the necessary pennies be dropped into the box. When she hears through the telephone that this has been done, the connection is made. The cheapest call in London is 2d.

The same system might be used in places in New Zealand with advantage.

Factories in Britain Manufacturing Telephones and Switchboard.

Principal amongst various factories for the manufacture of electrical appliances that were visited were the Western Electric Company's factory at Woolwich, and the General Electric Company's works at Birmingham and Manchester.

Western Electric Company commands Best Patents.—The General Electric Company are now making telephones, switchboards, and accessories, and trying to get a share of that kind of business, but as they have only recently paid particular attention to these branches, they are not yet quite in a position to successfully compete with the Western Electric Company, which has generally the command of the best patents.

Experimental Departments.

The Postal Telegraphs has a special experimental department and staff in London employed trying and testing different instruments and circuits. From the results of these tests particular classes of instruments are selected and different arrangements of circuits introduced.

The National Telephone Company has also an experimental department testing telephones, transmitters, receivers, cables with different sizes of wires, and measuring telephone-currents, &c.

Practical Results from Experiments.

Very Heavy Wires do not increase Talking-efficiency.—One practical outcome of these experiments led to the saving in one year to the National Telephone Company of £80,000 by the adoption of a 9 lb. copper conductor instead of a 16 lb. conductor, and it was also determined that, in the case of overhead telephone-wires, very little increased efficiency was experienced by using a wire, say, 600 lb. to the mile, instead of a wire 400 lb. to the mile. Heavier wires than about 400 lb. to the mile have been used in England and elsewhere for trunk telephone circuits, but not in America.

Advantages of these Experiments to New Zealand.—The results of these experiments are very important, and will have a practical bearing for New Zealand in our specifications of lead-covered cable, as for many of our requirements it will be practicable to use conductors of only 12 lb. of copper to the mile instead of 16 lb. All of our requirements will not be met by this size of copper conductor, but where they can be, a not inconsiderable saving, varying with the price of copper, will be effected.

Paddington Exchange, London.—"Electrophone Section."

Subscribers connected to Theatres, &c.—An interesting feature of the new Paddington Exchange, London, is a special section called the "Electrophone section," devoted to connecting subscribers to theatres or music-halls through junction wires which are idle at night to the Gerard Exchange, that exchange being the most central for the purpose. The wires from it run to the different theatres, so that any subscriber who wishes to hear a play, an opera, or music can be connected to the particular place of amusement he asks for. Sensitive transmitters are fixed on the stages in the most suitable position to pick up in the usual way the talking, singing, or music, and this is transmitted as far as the wires extend to the telephone receiver.

The Post Office will control Telephone System throughout Britain after 1911.

Post Office provides Underground Wires for Company, charging Rental.—The British Post Office takes over all the telephones in Britain in 1911. In the meantime, however, the Post Office and the National Telephone Company may be considered as one administration as far as technical matters are concerned. The electrical engineers of both meet and adopt standards of instruments, which are mutually agreed upon, and the Post Office provides many underground wires for the National Company, charging an annual rental until the whole business is taken over by the Post Office.

Solid-back Transmitter Standard.—As an example of a standard, both Post Office and National Telegraph Company supply mainly a fixed solid-back transmitter.

Complaints and Delays.—Notwithstanding the efforts to attain high efficiency, complaints continue to be made about the telephone service, and the delays in getting the use of trunk wires.

British Post Office Exchange Rates.

The telephone-exchange rates of the British Post Office as as follow:—

Rates of Subscription at Small Towns.

I. Message-rate service: Charges for connection with an exchange within a radius of half a mile from the subscriber's premises—Annual subscription, £3, payable in advance, and, in addition, message fees of 1d. for each local call originated by the subscriber; the annual payment in respect of local messages to be at least £1 10s., also payable in advance. The minimum payment under this arrangement is thus £4 10s., for which a subscriber can make 360 calls in the year, paying 1d. for each additional call beyond 360. The subscriber is not charged for answering calls made by other subscribers.

II. Unlimited service: Annual subscription for connection with an exchange within half-a-mile radius of the subscriber's premises, together with an unlimited number of local calls, £7 10s., payable in advance.

III. Where the premises of any subscriber at the message rate or at the unlimited-service rate are beyond the prescribed radius from the exchange, the annual subscription is increased by £1 5s. for every additional quarter of a mile or fraction thereof. Where new work of an exceptionally expensive character is involved, a higher charge may be necessary.

IV. Agreements are usually for three years, and are terminable at the expiration of this term or thereafter by three months' notice.

V. The charge for use of a call office for local calls is 1d. for each three minutes' conversation.

VI. Post Office subscribers are able to use their exchange circuits for the following purposes:—

(1.) To forward messages for transmission over the public wires as telegrams:
(2.) To forward messages for delivery as express letters:
(3.) To forward messages for delivery as ordinary letters:
(4.) To call for the services of Post Office express messengers:
(5.) To receive telegrams, in place of the ordinary delivery by messenger, where, in adopting this course, no alteration in the circulation of telegrams is involved.

VII. Post Office subscribers have the right to communicate over the trunk wires with subscribers of the National Telephone Company and other licensees of the Postmaster-General in all other areas on payment of the trunk fees.

Rates of Subscription at Small Towns.—Measured Service.

I. Charge for installing a telephone on the subscriber's premises and connecting it with an exchange not more than half a mile distant—annual subscription:—

(*a.*) Five pounds, covering the right to send 480 messages during the year to offices on the same exchange, or
(*b.*) Six pounds, covering the right to send 720 messages during the year to offices on the same exchange.

Any additional messages to offices on the same exchange will be charged 1d. each.

Each call from one exchange to another in the same area is generally reckoned as two local calls.

No charge is made to a subscriber for calls received.

II. Where the premises of any subscriber are more than half a mile from the exchange, the annual subscription is increased by £1 5s. for every additional quarter of a mile or fraction thereof. Where new work of an exceptionally expensive character is involved, a higher charge may be necessary.

III. Agreements are usually for three years, and are terminable at the expiration of this term or thereafter by three months' notice.

IV. The charge for the use of a call office for local calls is 2d. for each three minutes' conversation.

V. Post Office subscribers are able to use their exchange circuits for the following purposes:—

(1.) To forward messages for transmission over the public wires as telegrams:
(2.) To forward messages for delivery as express letters:
(3.) To forward messages for delivery as ordinary letters:
(4.) To call for the services of Post Office express messengers:
(5.) To receive telegrams, in place of the ordinary delivery by messenger, where, in adopting this course, no alteration in the circulation of telegrams is involved.

VI. Post Office subscribers have the right to communicate over the trunk wires with subscribers of the National Telephone Company and other licensees of the Postmaster-General in all other areas on payment of the trunk fees.

Rates for Party Lines in the Provinces.

Where two or more persons share the use of one line to an exchange, the Postmaster-General is prepared to provide the service at special rates. Such lines are called "party lines." They may be "two-party lines," where the Postmaster-General undertakes to connect the premises of only two subscribers on the one circuit; or "ten-party lines," where he reserves to himself the right to connect the premises of any number of subscribers from three to ten by means of the one line and its spurs.

The main circuit is that portion of a party line which is used in common by two or more subscribers.

The expression "spur circuit" means that portion of a party line used by one subscriber only.

The rates of subscription are:—

I. Party-line message-rate service: (*a.*) Where the length of the main circuit does not exceed the radius from the post-office covered by the minimum payment at the ordinary message rate (usually half a mile), and the spur circuits do not in each case exceed 220 yards in length, an annual subscription, payable in advance, of £2 per subscriber for a "two-party line," and of £1 10s. for a "ten-party line," exclusive of the charge for the transmission of messages.

The charge for local messages is in each case 1d. per call, with a minimum payment of £1 10s. per subscriber, also payable annually in advance.

(*b.*) Where the length of the main circuit exceeds the ordinary radius, a charge of 12s. 6d. in the case of a "two-party line," and of 10s. in the case of a "ten-party line," for each additional quarter of a mile for each subscriber using it.

(*c.*) Where the spur circuit exceeds 220 yards, a charge of 12s. 6d. for each additional 220 yards or fraction thereof, payable by the individual subscriber concerned.

II. Two-party line unlimited service: A subscription of £6 a year, payable in advance, for ordinary "two-party lines," when the length of the main circuit does not exceed half a mile and the spur circuits do not in each case exceed 220 yards in length. Excess distances in the main or spur circuits to be charged for as in the case of the message-rate subscription. The unlimited-

service subscription covers an unlimited number of local calls, but not trunk calls, which must in all cases be paid for at the usual tariff, the charge varying according to distance. There will be no unlimited-service rate for "ten-party lines."

Agreements are, as a rule, for three years, but where the work of construction is specially expensive, agreements for a longer period may be required, and some additional charge beyond the tariff charge may be necessary.

Extension lines are not provided in connection with party lines.

Special Conditions of the Service.

1. A portion of a "party line" is in every case used in common by two or more subscribers. The premises to be connected by a party line must lie in the same direction from an exchange.

2. A subscriber shall not be entitled to interrupt or otherwise interfere with the conversation of any other subscriber connected with the same party line. When one of the subscribers to a party line is speaking over the circuit, no local calls for the other subscribers can be effected.

3. But the Postmaster-General reserves to himself the right to interrupt any local conversation of a subscriber if a trunk call is received from or for any other subscriber connected with the same party line.

4. Secrecy between the several subscribers connected with a party line cannot be given.

In the County of London

the rates of subscription for exchange circuits are as follows:—

	£	s.	d.
I. Ordinary message-rate service:—			
(*a.*) Charges for connection with any exchange in the County of London within two miles of the subscriber's premises:—			
Annual subscription	5	0	0
Message fees: 1d. for each call to a subscriber on any exchange in the County of London; 2d. for each call to a subscriber on any exchange outside the County of London but within the London area.			
(*b.*) Charges for connection with any exchange outside the County of London within two miles of the subscriber's premises:—			
Annual subscription	4	0	0
Message fees: 1d. for each call to a subscriber on the same exchange; 2d. for each call to a subscriber on any other exchange in the London area.			
The minimum yearly amount payable by each subscriber for message fees is	1	10	0
II. Party-line message-rate service:—			
Annual subscriptions:—			
(*a.*) For connection with any exchange, except the Central Exchange, by means of a line used by not more than two subscribers	3	0	0
(*b.*) For connection with any exchange outside the County of London by means of a line used by more than two and not more than ten subscribers	2	0	0
Subscriptions at party-line rates cannot be accepted from subscribers on the Central Exchange, or at the lower party-line rate from subscribers on any exchange in the County of London.			
Message fees for calls originated by party-line subscribers will be the same as for calls by subscribers at the ordinary message rate, but the minimum yearly amount payable for message fees by each party-line subscriber is	3	0	0
III. Unlimited service:—			
Annual subscriptions for connection with any exchange within two miles of the subscriber's premises, together with an unlimited number of calls:—			
(*a.*) For the first line	17	0	0
(*b.*) For each additional line connecting any premises of the same subscriber with an exchange	14	0	0
IV. Call-office fee:—			
For any call from a call office to any subscriber in the London area, for each period of three minutes	0	0	2
V. Additional annual charges:—			
(*a.*) Where the premises of any subscriber at the ordinary message rate or at the limited-service rate are more than two miles from the exchange, for every additional quarter of a mile ...	1	5	0
(*b.*) Where the main circuit of a party line exceeds two miles in length, for each additional quarter of a mile, for each subscriber	0	10	0
(*c.*) Where the spur circuit of a party line exceeds 220 yards in length, for each additional quarter of a mile, for the subscriber served by the spur circuit	1	5	0

	£	s.	d.
(*d.*) For each extension line connecting two parts of the same premises of a subscriber, where the line is not more than 110 yards in length	1	10	0
(*e.*) For each additional 110 yards of such a line	0	10	0
(*f.*) For each extension line connecting separate premises of the same subscriber, and not more than a quarter of a mile in length...	3	10	0
(*g.*) For each additional quarter of a mile for such a line	1	5	0

The distances (except in the case of party lines) are measured in a straight line on a horizontal plane.

VI. All agreements are for one year, and are terminable thereafter by three months' notice.

VII. Post Office subscribers have the right to communicate with subscribers of the National Telephone Company in the London Exchange area at the same rates of charge as for communication with other Post Office subscribers.

NOTE.—Message fees will be charged only when subscribers' lines are connected with the lines of subscribers with whom they have asked to speak. No fees will be charged if the lines are out of order or engaged.

Where an extension line goes to a point more than two miles from the exchange with which it is connected, an agreement for five years may be required. Similarly, a five-years agreement may be required in cases where an exchange circuit is, at the request of the subscriber, connected with an exchange other than that by which the subscriber's premises would normally be served.

CONTINENT OF EUROPE.

TELEGRAPHS.

Printing-instruments on Important Circuits.—On the Continent the Hughes and Baudot printing-instruments are used for the more important circuits, the Morse system being also in general use. Quadruplex and Wheatstone automatic instruments are not used. The methods of working do not compare with those of the British Post Office.

TELEPHONE EXCHANGES.

Exchanges in Transition Stage.—A great number of the exchanges in all the countries of Europe and in other parts were found to be in a transition stage. Berlin, Vienna, Milan, and Berne are instances.

Where central-battery switchboards were not actually being fitted up, it was in contemplation to install them when any change was to be made.

Many old types of switchboards are still in use.

Telephone Equipments.—One of the most up-to-date telephone equipments on the Continent is at Brussels. It is quite new, more than amply accommodated in a fine new building, and is a good type of the accepted standard. Its capacity is for 14,400 subscribers.

A similar equipment has recently been installed at Buda-Pesth.

Charlottenburg, one of the Berlin exchanges, was another instance of a modern central-battery equipment accommodated in a new building.

The switchboards in other exchanges were of older patterns.

AUTOMATIC SYSTEM.

Only Sixty Subscribers connected.—At Berlin there was an automatic exchange arranged for 1,000 subscribers, but there were only sixty actually connected to it. Its working was not such as to compel a favourable impression of it.

A number of operations had to be performed by the subscriber, contrary to the widely accepted telephonic principle that the subscriber should be given as little to do as possible, and the mechanism was involved.

Not suited for Toll Work.—Automatic systems are not favoured by most telephone administrations on account of their complication and the trouble they give to the users. They are also not suited for carrying on the work of a trunk or toll system which is so universal

An automatic system of any of the types offering at present would not be suitable for any of our New Zealand offices.

TELEPHONE TRUNK CIRCUITS IN EUROPE.

Submarine Telephony Speech good.—On the metallic circuits, Brussels to London and Paris to London, very good speech was heard through the special cables. The circuit Brussels to London is 238 miles long with fifty-four miles of cable, and the Paris-to-London circuit is 311 miles long with twenty-three miles of cable.

High Voltage interferes with Telephones.—Switzerland, with Zurich and Berne as centres, has telephonic communication between almost every town, but the distances are all less than what is defined as long-distance speaking.

These lines, however, are subject to inductive disturbances from the high-voltage-power lines, which are numerous. As it is not improbable that there will be numerous power lines in New Zealand, it will be necessary to keep the telephone lines for long-distance working and the power lines remote from each other.

GOVERNMENT OWNERSHIP OF TELEPHONES.

Nearly all the telephone services on the Continent are owned by the respective Governments.

In Milan the telephone system was operated by a company, but it was expected that the Government would take it over any day.

The general policy, therefore, is Government ownership of telephones, the same as in England and British colonies.

Branching Multiple Switchboards.

Satisfactory Service.—The branching multiple system, which in many places is being supplanted by the central-battery switchboard, is a good system, and is in use in several of the larger exchanges in New Zealand. When metallic circuits are provided with it a very satisfactory service can be given.

Some Disadvantages.—There are, however, the disadvantages that the subscriber requires to ring up the exchange and that a local battery for speech is used at the subscriber's end, and this battery may not always be thoroughly efficient.

Central-battery System.

As the central-battery system has been so often referred to, and is the standard that is being almost universally adopted, a brief description of its principal features may be of interest.

Metallic circuits are required for satisfactory working.

There is no ringing-up by the subscriber necessary. The action of taking the telephone off the hook lights a small lamp at the exchange, which is the signal there that attention is wanted.

Current for speaking at the subscriber's end is conveyed along the subscriber's wire from the exchange, where there is a battery of accumulators that can be maintained always in a state of high efficiency These are advantages to the subscriber.

At the exchange the operator has much greater control over the connections than can be obtained under other systems.

On the keyboard in the exchange there is a small lamp associated with each cord. When a subscriber has called and has asked for another subscriber, the keyboard-lamp of the calling subscriber is darkened; his receiver being off the hook, the operator plugs into the jack of the called subscriber, and rings. The keyboard-lamp, associated with the cord used to call with, lights up and remains alight until the call is answered, which is notified to the operator by the darkening of the lamp. As long as this lamp remains alight the operator can see that the connection is incomplete, and she rings again. If after ringing several times the connection is still incomplete, as indicated by the lamp remaining alight, the plug is withdrawn from the called subscriber's jack and inserted into another jack from which "tone" signals are conveyed to the calling subscriber, signifying that the called subscriber "Does not answer." There are other "tone" signals signifying "Busy."

Subscribers soon get to know the meaning of these tone signals, and the need of conversation between operators and subscribers is reduced to a minimum.

When the conversation between two subscribers is finished each subscriber merely restores his telephone to the hook, and the keyboard-lamp of each connecting-cord glows in the exchange, which is the disconnecting signal. When only one keyboard-lamp glows the operator does not disconnect, as one of the subscribers may have placed his telephone on the hook to seek information being asked for. If either subscriber wishes to call the attention of the operator, this can be done by moving the receiver switch, thereby flashing the keyboard-lamp at the exchange; upon seeing such the operator pulls in and listens.

These are the leading features of the system as they affect the public. The advantages at the exchange are that faults disclose themselves automatically, and a high state of efficiency can be maintained.

UNITED STATES OF AMERICA.

Bell Telephone Systems.

Immense Development since Monopoly expired.—Until 1893 the Bell Telephone Company had a monopoly of telephones, which was very unsatisfactory. Since that date, when the Bell patents expired, there has been an immense development.

Without going too much into detail, the growth and magnitude of the business may be indicated by stating that in 1892 the number of telephones in the Bell system was about 220,000. Now there are between two and three millions, and the capital invested about £70,000,000 sterling.

Mileage of wire in January, 1905, was—overhead, 4,671,038 miles; underground, 1,888,760 miles.

The "Independent" Telephone Systems.

Besides the Bell system there were no less than 4,107 "independent" telephone systems, commercial and mutual, in operation, with a capital investment of about £40,000,000 sterling, and using 2,000,000 telephones in connection with 6,608 exchanges. The success of the independent companies is, to some extent, due to the cheaper rates which they offered, but it is considered to be more due, however, to the enormous demand for telephone communication, which could not be met by the existing organizations. It is impossible for the Bell companies to provide for the whole of the development required by the rapid commercial, industrial, and agricultural pursuits of the country.

Every Class of Service represented.—In the United States telephone system are to be found the largest and most perfectly equipped and organized exchanges in the world, as well as telephones worked on the roughest rural lines, often fencing-wire. The details for cities of millions or hundreds of thousands of people are different from details of equipment for cities with less than 100,000.

From a quantity of matter collected concerning American telephone practice generally, the following particulars that may be of interest are presented:—

Construction.

Underground Cables; Overhead Distribution.—In the cities cables are laid underground to points of distribution which may be in an alley-way or back street, where overhead wires come into use. This also applies to outskirts of the cities. As a rule, it may be laid down that where more than two or three hundred pairs of wires are required all telephone electrical engineers go underground, if possible, and they consider it cheaper to do so than to maintain overhead lines. The methods of distribution are similar to those used in New Zealand.

Buildings.

The big telephone companies provide in their new buildings liberally for future requirements. There is no standard design, but they all observe certain general principles in laying out their plant. To accommodate an exchange of an ultimate capacity of 10,000 subscribers a building of 150 ft. to 170 ft. long by 45 ft. wide and three stories high is provided. The top story usually accommodates the switchboard. On the second story are located the test-room, main and intermediate distributing-frames, meter-racks, relays, charging plant, and secondary cells. The ground floor can be used for accommodating the operating staff, for the engineers, and the administrative officers generally.

The cost of one exchange in New York—that in Eighteenth Street—for 10,000 lines, was—for site, £16,666; building, £39,580: total, £56,246. Average cost per line, £5 12s. 6d

Accommodation for Operating Staff.

Operators work Eight Hours daily.—The accommodation for the operating staff is always of a very simple character. A rest-room, a reading-room, a dining-room, and refreshment-rooms are always provided. A telephone-operator's work is considered very trying, especially as the day is generally of eight hours' duty, and means are afforded them of recovering from exhaustion by absolute rest or a brief interval under agreeable conditions. In many exchanges a substantial meal is provided free; in others, hot water, milk, and tea; but the management is generally disposed to give the full meal.

Schools of Instruction.

Operators well trained.—In all considerable exchanges there is a school of instruction. This applies also in a measure to England. But, as an example, Chicago may be quoted where a hundred new girls are employed every month, who all undergo tuition for a time on special switchboards fitted for the purpose before they enter on their actual duties. In the Chicago main telephone company there are over three thousand female operators, and their average stay in the service is only three years.

Maintenance and Depreciation of Telephone Plant.

Depreciation 10 per cent.—There is no general agreement as to the amount to be written off under this head; but, taking all the plant into consideration—switchboards, lines, ducts, &c.—a general average of 10 per cent. may be stated as the assumed depreciation.

Trunk Telephone Lines.

The trunk telephone circuit between New York and Chicago—960 miles—consists of two copper conductors each weighing 435 lb. to the mile.

No heavier conductor than this is used in America for long-distance communication.

Speech improved by using a Relay.—The introduction of a relay called an "exalter"—a recent development—into the circuit considerably improves the speech. This relay is introduced at Pittsburg about the middle of the circuit, and is estimated to increase the speaking-efficiency 30 to 40 per cent. Its presence in or absence from the circuit can be detected with ease when conversing. Speech is possible from New York to Omaha—1,500 miles—but this is not always good.

Underground Lead-covered Cables for Trunk Working.

Pupin's Loading Coils.—Underground lead-covered cables with paper-insulated conductors are being used now between New York and Philadelphia, and New York and Newhaven, each distant about ninety-six miles. The use of these underground cables for telephone purposes has been rendered possible by the invention by Pupin of coils known as "Pupin loading-coils," which are inserted at frequent intervals in each pair of wires contained in the cable. These cables contain 100 pairs of wires.

This affords some evidence of the extent of the telephone trunk business between the American cities. The overhead circuits are released for the longer distances.

The rates charged for long-distance communications are nearly double those in England. If the rates in America, however, are high, the service is good, and there is but little delay in getting connections.

Trunk Wires numerous.—Trunk wires are freely provided, and thirty communications per day, as compared with fifty in Great Britain, are considered a full load for one circuit. It follows that many of these circuits are almost idle except during two or three hours of the business day.

Future Development.

Estimating Requirements Years ahead.—One large exchange company has a telephone engineering staff studying the requirements and development that may be necessary for years ahead, and making estimates of the capital that will be required. Experience of recent years is that their estimates generally come short.

Spare Plant, Etc.

In most cases 40 to 50 per cent. of spare plant, lines, and switchboards are kept in readiness, and managers did not anticipate that any reduction could be made in this proportion.

Improved Plant generally Lessens Cost.

Improvements in the construction of underground cables, the substitution of 400 pair for smaller cables in the same ducts, the substitution of central-battery equipment which saves the cost of maintenance of batteries at the subscriber's end, and the supervisory signals on switchboards which enable an operator to attend to more subscribers—all have tended to reduce the cost of an exchange service, so in a degree defeating the well-established tendency under former conditions for the cost to increase more than proportionately with the number of subscribers. Improved plant has enabled the American telephone companies to give a more efficient service at a cheaper rate than would have been possible with the old equipments.

Great Demand for Telephones.

One striking feature of the large American cities is the buildings of twenty to twenty-four stories, having perhaps 200 to 400 separate offices with telephones in each of them. One building will have as many telephones as ten years ago would be in use in a considerable town, and with the growth of suburbs demands arise for telephones to communicate with retail tradesmen, whose business may be almost entirely conducted by means of the telephone.

As an indication of the great use made of the telephone, it may be mentioned that the Western Electric Company in Chicago paid the telephone company £150 per month for their telephone facilities.

Private Exchanges.

Facilities to get Central, but Fees are charged.—Every important hotel has a private exchange to which every bedroom is connected. This also applies to hotels in England. Some large warehouses or stores have a switchboard as large almost as that in any city in New Zealand. In Marshall Field's store in Chicago there is a branch exchange with thirteen attendants. In the same room were several cabinets for the use of customers who could be connected to the Central Exchange on payment of fees. In the halls of hotels there are also cabinets and an attendant, with a small trunk switchboard with circuits to central. For example, in a Boston hotel there were seven trunk wires connected to a small switchboard in the hall of the hotel and several cabinets for customers. The attendant collected fees, 5, 10, or 25 cents, according to the area spoken over, and this one hotel averaged some four hundred calls per day from 8 a.m. to 11 p.m. This switchboard was distinct from the hotel board connecting with the bedrooms.

Telephone Contracts.

Contracts are made with the telephone company for so-many calls in a year by commercial companies, hotels, or warehouses. It may be remarked that, while every facility is given by telephone administrations, this must be paid for at a remunerative rate.

Party Lines.

These are common in American exchanges, but in places have been discouraged as the service is not entirely satisfactory. Where the number does not exceed two on one line there is not so much objection.

Removals and Cessations.

Charges are levied for removals. There is a large proportion of withdrawals as compared with new subscribers, ranging from 20 to 36 per cent. A similar condition prevails in New Zealand in degree.

Farmers' Lines.

Prior to 1893, when the Bell patents expired, the smaller towns in America were somewhat neglected by the Bell companies. Since then many independent companies have catered for smaller towns, including farmers, at rates which in many cases did not pay. The larger companies found this reacting on their business, and they were compelled to attend to country districts at rates which barely cover expenses, but indirectly encourage exchange business in towns and cities, and toll and long-distance traffic.

Farmers' lines are erected under various conditions—by the farmers themselves in many cases, like our private-wire system in New Zealand, and in other cases by the companies. The terms of the different companies are not uniform. One system that came under notice may be referred to. The company erects a line six miles long, the line being very similar to our New Zealand lines, but two wires are provided for a metallic circuit, as there may be more than one pair of wires on any pole-line. A minimum of one subscriber is required for every mile, and the rate each is charged is $18, or £3 15s. a year. This gives free intercommunication between the subscribers on the same line, and also through the local exchange with the subscribers to it within its area. Beyond, fees are charged.

Telegraph and telephone poles of 22 ft. length cost only 65 cents, or, say, 2s. 9d. Light lines can therefore be erected cheaply. Instances are not unknown where farmers' lines have been erected, and when the poles decayed they were not replaced for want of capital. A perusal of some companies' printed reports of their business shows that farmers' lines are a branch of it.

Staffs.

The large number of persons engaged in the managing, engineering, and electrical staffs was a particularly noticeable feature in American exchanges. Every part of the organization—financial management, engineering and electrical problems—receives the greatest possible consideration. The Associated Companies' principal officers frequently meet to confer with each other and to discuss the various problems that arise from time to time.

Technical Work.

Telephone Engineering intricate.—With regard to the technical side of the business, it is being recognised in the electrical world that the most difficult electrical engineering work is included in the modern telephone exchange. Many eminent electrical engineers in Europe and America with whom this subject was discussed generally conceded the correctness of that view. The American telephone engineers were mostly comparatively young men, and graduates of universities.

Operating Staffs.

Great Care exercised in engaging Operators.—As there are varying conditions in every country in the matter of pay and conditions of employment of exchange staffs, each country has to work out its own terms. In the engaging of girls for exchange work great care is exercised in regard to testing their suitability for the work as well as in regard to their respectability. The rate of pay for operators varies from $4 to $10 a week. The operators, it may be mentioned, are all female.

Girls do Night Duty.—The hours of duty in America are longer than with us, and girls generally do the night as well as the day duty.

Supervising Staff.

The supervising staff in exchanges is about one for every nine operators in the daytime, and one to every four at night.

Telephones and Population.

Percentage of Telephones to Population.—The number of telephones per hundred of population varies in the United States from about 4 to as high as 25 per cent. Boston and New York are respectively 4·8 and 4·6. The development schemes in the Eastern States are based on an ultimate expectation of ten telephones to 100 inhabitants. Our Wellington proportion of telephones to population is about 5 per cent. This is approximated in our other cities.

Systems of Charging.

There are many different rates to subscribers, flat rates and measured, with a tendency to measured. Sometimes a flat rate is applied to residence connections and not to business connections. The flat-rate system is not considered unsuitable for a city with less than 100,000 inhabitants.

Small Telephone-offices.

The many small telephone-offices so common in New Zealand, giving communication with the world to the most remote districts, seem not to have a counterpart in either Britain, the Continent of Europe, or the United States.

General Experience in Development.

With Increasing Subscribers, Improved Methods necessary.—The New Zealand experience is in keeping with that of other countries, and the changes in this country referred to below are an illustration of what is taking place abroad. The original simple switchboard served well for a limited number of subscribers. As the number of subscribers increased, rendering the use of other methods imperative, the branching multiple system was adopted, that system being the best existing at the time it was introduced.

Central-battery System for New Zealand Exchanges.—When the exchanges equipped with branching multiple switchboards—for example, Wellington—grow to the limit of their capacity, they will require to be replaced by the central-battery system, which is now being adopted universally and is superior to the branching multiple system. The Hon. the Minister of Telegraphs authorised last year equipments of central-battery switchboards for Invercargill and Timaru to replace the existing switchboards rapidly becoming unsuited because of the increase of subscribers. These new switchboards will be built on the latest developments of the most modern practice.

Telegraphs in America.

Barclay's Printing-instrument.—The Morse system is universal, and similar to our own. There is one important departure, however, by the Western Union Telegraph Company—the largest telegraph organization in the world—which calls for special mention, and that is the adoption by that company of Barclay's printing system. Barclay's instruments are being introduced into the system of that company as fast as they can be manufactured. The apparatus was seen at work, and the results were excellent. Mr. Barclay's instruments are a typewriter which punches

the tape to produce Morse characters. This tape is put through an ordinary Wheatstone transmitter, and when the signals are received at the distant end on an ordinary relay by the introduction of six local relays, the message is printed, thus saving the writing-up by operators of the messages on the received tape. The most sanguine expectations are entertained of this invention, almost to the extent that it will revolutionise telegraphy. An ordinary typewriting-girl not a telegraphist can prepare the tape for transmission, and the receiving apparatus turns out each message at the rate of 100 words a minute.

Nothing else on the technical side claims any special notice.

Bonuses for Special Work.

Bonus System has doubled the Work on some Circuits.—There is a system of bonuses in American telegraph-offices which is said to have produced good results. It is that an operator, after he has handled so-many messages in a day, gets ½d. for every additional message. This bonus is paid on New York – Chicago circuits after 280 messages have been dealt with. It is considered that by this means the companies obtain the best value out of their long and costly lines, and the operators have an incentive to do their work well and efficiently. The capacity of some of the circuits referred to has been raised from 230 to 540 messages per day.

Typewriting Telegrams.

Telegrams are invariably typed in the large telegraph-offices by the receiving operators. One company pays each operator $5—equal to £1—a month to provide and keep his own typewriting-machine. This can be recommended for New Zealand.

SUMMARY.

To summarise what may be of immediate practical bearing on New Zealand development from the foregoing, it is recommended—

Telegraphs.

1. To endeavour to get Mr. Barclay's apparatus, and, if found up to expectations, extend the use of it to our long lines, more especially our cables.
2. To encourage the use of typewriters for receiving messages.

Telephone Exchanges.

1. That wherever our number of lines exceeds 300 pairs the cables should be placed underground.
2. That as the present multiple switchboards at the four principal cities become full they be replaced by common battery equipment; steps being taken to have the new switchboards erected by the time the old ones have no more room for more subscribers.
3. That metallic circuits be gradually provided at all exchanges, the larger ones first.

J. K. Logan.

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